

INSTRUCT-SKILLMIX: A POWERFUL PIPELINE FOR LLM INSTRUCTION TUNING

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ABSTRACT

We introduce INSTRUCT-SKILLMIX¹, an automated approach for creating diverse, high quality SFT data for instruction-following. The pipeline involves two stages, each leveraging an existing powerful LLM: (1) *Skill extraction*: uses the LLM to extract core “skills” for instruction-following by directly prompting the model. This is inspired by “LLM metacognition” of Didolkar et al. (2024); (2) *Data generation*: uses the powerful LLM to generate (instruction, response) data that exhibit a randomly chosen pair of these skills. Here, the use of random skill combinations promotes diversity and difficulty. The estimated cost of creating the dataset is under \$600.

Vanilla SFT (i.e., no PPO, DPO, or RL methods) on data generated from INSTRUCT-SKILLMIX leads to strong gains on instruction following benchmarks such as AlpacaEval 2.0, MT-Bench, and WildBench. With just 4K examples, LLaMA-3-8B-Base achieves 42.76% length-controlled win rate on AlpacaEval 2.0, a level similar to frontier models like Claude 3 Opus and LLaMA-3.1-405B-Instruct.

Ablation studies also suggest plausible reasons for why creating open instruction-tuning datasets via naive crowd-sourcing has proved difficult. In our dataset, adding 20% low quality answers (“shirkers”) causes a noticeable degradation in performance.

The INSTRUCT-SKILLMIX pipeline seems flexible and adaptable to other settings.

1 INTRODUCTION

Instruction tuning (sometimes also called *imitation learning*) is the first step in converting a base LLM trained on next-word prediction into a helpful and interactive agent. Whereas early versions of instruction tuning involved supervised fine-tuning (SFT) on traditional NLP question-answer datasets (Wei et al., 2022), nowadays, the SFT data is collected at high cost from skilled human annotators. We will use the term “instruction tuning” to refer solely to supervised fine-tuning (SFT) on such Q&A pairs — and not to reinforcement-learning methods such as PPO/DPO/RLHF (Schulman et al., 2017; Rafailov et al., 2023) etc., which usually follow SFT in the pipeline.

Human-generated data is expensive (e.g., even the tiny model Instruct-GPT was estimated to require 20K human hours OpenAI (2022)), which has motivated the creation of open-domain alternatives. ShareGPT (Chiang et al., 2023) contains conversations collected from a model-hosting website, whereas OpenAssistant (Köpf et al., 2023) and Dolly (Conover et al., 2023) contain crowd-sourced human data. Another intriguing method, popularized by Self-Instruct (Wang et al., 2023b) (and its variants, e.g., Alpaca (Taori et al., 2023)) leverages synthetic datasets. Here, a strong LLM is prompted using a small set of human-created examples to generate a large number of (query, answer) examples on a variety of topics.

Open evaluations of instruction-following ability have also sprung up. The popular AlpacaEval 2.0 (Dubois et al., 2023; 2024) is based upon curated queries from various sources. In such evaluations, a model’s response to a provided query is compared against a strong reference model’s response, and the model is ranked based upon its *win rate* — the percentage of queries for which the model

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¹Source code can be found at <https://github.com/princeton-pli/Instruct-SkillMix>.

produces a better answer than the reference model, as judged by a powerful LLM. Rankings on AlpacaEval and related benchmarks like WildBench broadly align with the human rankings of a model’s performance (Dubois et al., 2024; Lin et al., 2024).

1.1 SURPRISING DIFFICULTY OF INSTRUCTION TUNING

A persistent puzzle in this field is that SFT on the above public datasets does *not* yield good performance on the evaluations. It was initially suspected this is due to a lack of diversity in the training data. But, efforts to produce more diverse synthetic data — e.g., UltraChat (Ding et al., 2023), a synthetic dataset of 1.5M multi-turn conversations created via meticulously tracking lexical and topical diversity as well as coherence — did not significantly improve performance.

Another hypothesis places the blame on the uneven quality of open datasets — which are usually a hodge-podge of collected queries (e.g., Dolly (Conover et al., 2023)) — whereas proprietary datasets are produced to careful specifications using strict quality-control. One finding that supports this hypothesis is that SFT on the 1K Q&A pairs in Alpaca-52K with the longest responses, outperforms SFT on all 52K pairs (Zhao et al., 2024). In other words, the 51K other data-points are redundant, or even interfere with the “signal” present in the best 1K examples. This finding has inspired “less is more” approaches — including an extreme one based upon just a judicious set of in-context examples (Lin et al., 2023) to provide a surprisingly reasonable level of instruction tuning and alignment — but they did not significantly improve the performance either.

Some have cautioned against hopes for a miracle out of instruction tuning. Gudibande et al. (2023) suggest, based upon careful experiments, that basic capabilities of the LLM arise from pre-training and its massive training corpus. Most deficiencies left after pre-training will not be fixable by, say, a million SFT examples. While this perspective feels broadly correct, it does not quite explain why open efforts to instruction tune Mistral-7B-Base-v0.2 fail to match the performance of its proprietary *Instruct* counterpart, which has only undergone SFT.

The above difficulties have lately lowered interest level in instruction tuning, with many researchers now turning to RL-based methods (e.g., PPO, DPO), which have been used in recent open-source projects to greatly improve proprietary chat models (Meng et al., 2024), which had already trained on expensive human data.

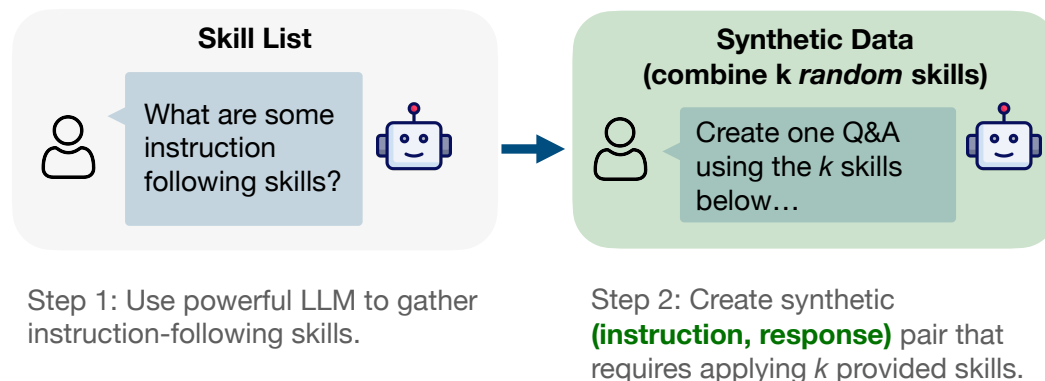


Figure 1: **Sketch of INSTRUCT-SKILLMIX pipeline.** See Figures 2a and 2b for more details on two different implementations of INSTRUCT-SKILLMIX.

1.2 OUR CONTRIBUTIONS

We describe a more efficient and effective approach for creating synthetic instruction tuning datasets. Past open efforts invested significant human effort in ensuring *high coverage* of topics and scenarios to sufficiently equip the LLM for scenarios it might encounter at deployment time. We take a subtly different tack. Accepting that pre-training is the dominant source of the LLM’s “inner knowledge,” we focus on merely teaching the LLM to draw upon that inner knowledge and present it nicely during conversations.

The key idea is to use a strong LLM as a teacher. The recent discovery of *LLM Metacognition* (Didolkar et al., 2024) suggests that frontier models have significant capability to “think about thinking,” which in humans is referred to as *metacognition* (Flavell, 1979). Specifically, it was shown that given a task dataset, frontier LLMs can help assemble a list of named “skills” needed to solve that task. This requires no human involvement apart from an automated interaction with an LLM².

The first phase (“*Skill Extraction*”) of our pipeline INSTRUCT-SKILLMIX uses this idea and a frontier LLM to identify a list of “basic skills” needed for instruction-following. Unlike Didolkar et al. (2024), which extracts skills from existing SFT datasets, we instead identify skills by directly prompting a strong LLM. (We also tried extracting skills using examples from Alpaca and Ultrachat, and it works quite well, but noticeably worse than our main method.) See Section 2.1.

The second phase of our pipeline, *Data Generation*, uses the list of extracted skills to produce synthetic query-response examples. Here, we repeatedly draw a random pair of skills from the list and prompt the powerful LLM to produce a suitable query that tests those two skills, and to also produce a good response to the query. This generation is inspired by the SKILLMIX evaluation (Yu et al., 2024) for LLMs’ compositional generalization, which also uses a predetermined list of skills. Hence we call our method INSTRUCT-SKILLMIX. See Section 2.2

Using merely 2K to 4K such Q&A examples, vanilla SFT allows popular small base models (Mistral-7B-Base-v0.2, LLaMA-3-8B-Base, and Gemma-2-9B-Base) to match or surpass some apex models on AlpacaEval 2.0, such as the original GPT-4, LLaMA-3.1-405B-Instruct and Claude 3 Opus (Table 1). The estimated cost of creating this 4K dataset using the GPT-4 API is under 600 US dollars.

We stress that although reminiscent of prior efforts using synthetic data such as UltraChat, our pipeline is fully automated with no human design elements (e.g., choice of topics, lexicon etc.). The only human involvement involves the short prompts used for skill extraction and question generation, which we adapted from the math setting of Didolkar et al. (2024). While our pipeline currently focuses on simple instruction-following, the method seems extensible in future to safety/alignment, as well as domain-specific Q&A.

2 INSTRUCT-SKILLMIX

This section describes our methodology for extracting skills from powerful LLMs³ and how to use these extracted skills to create a diverse, high quality dataset. A simplified version of our pipeline and prompts are depicted in Figures 1 and 2. Section 3 reports the evaluation results when finetuning on this dataset.

2.1 SKILL EXTRACTION PROCEDURE

The method involves an automated interaction with a frontier LLM (GPT-4-Turbo). We ask the frontier LLM to first generate a list of topics that arise in instruction-following. For each topic returned by the LLM, we further prompt it to generate a list of skills that are needed to answer typical queries on that topic. Additionally, we ask the LLM to create a list of query types (e.g., “Information Seeking”) that might arise in that topic. See Appendix L.4 for details about the prompts used, and Appendix K.2 for the list of all extracted skills. Since this method relies solely upon the LLM’s inner meta-knowledge, this method should extend easily to other types of instruction-following.

An Earlier Attempt: Our initial attempt to extract skills leveraged existing instruction tuning datasets, which is a more direct analog of the method in Didolkar et al. (2024). However, we suspected this to be sub-optimal due to known limitations of past instruction tuning datasets. We therefore designed the method described above, and found it superior. It also has scientific benefit of being independent of existing datasets like Alpaca and Ultrachat. However, the dataset from the initial method, called INSTRUCT-SKILLMIX-SEED-DATASET-DEPENDENT (INSTRUCT-SKILLMIX-D;

²Skill lists generated by different frontier models are related but not isomorphic. Skills generated by one model are comprehensible to other models. See Didolkar et al. (2024) for such experiments.

³We use GPT-4-Turbo for our main experiments (2024-04-09 checkpoint unless specified otherwise). See Appendix B for results when using Claude 3.5 Sonnet (2024-06-20).

Table 1: **Evaluation results of *base* models supervised-finetuned on INSTRUCT-SKILLMIX versus the proprietary *instruct* versions and other proprietary models.** For our models, we report the results for best checkpoint selected using held-out queries. For other models(*), we report the published numbers available on publicly available leaderboards. “# Data” refers to the number of (instruction, response) pairs in the training data. See Table 9 for a more detailed view, including comparisons to past open datasets.

Model	# Data	AlpacaEval2.0 LC WR(%)	WildBench WB-Reward _∞ ^{gpt4t}
LLaMA-3-8B			
Ours	4K	42.76	-36.91
*LLaMA-3-8B-Instruct	-	22.90	-46.30
Mistral-7B-v0.2			
Ours	4K	36.70	-29.25
SFT on Alpaca-52K	52K	8.64	-80.47
*Mistral-7B-Instruct-v0.2	-	17.10	-54.70
Gemma-2-9B			
Ours	2K	36.18	-37.83
Gemma-2-9B-Instruct	-	37.21	-28.78
*Other Proprietary Models			
LLaMA-3.1-405B-Instruct	-	39.30	-
Mistral Large	-	32.70	-46.40
Claude 3 Opus	-	40.50	-21.20
Claude 3 Sonnet	-	34.90	-30.30
GPT-4-Omni (2024-05-13)	-	57.50	+1.70
GPT-4 (2023-03-14)	-	35.30	-

see Appendix A) is still very useful for ablations that pinpoint ways in which our skill-based pipeline improves on past synthetic datasets for instruction-following (see Tables 2, 3, 4, and 5).

2.2 DATA GENERATION

Inspired by the recent SKILLMIX evaluation (Yu et al., 2024), we generate instruction-following examples by randomly picking k skills as well as a random query type. The frontier LLM is prompted to create Q&A pairs that illustrate these k skills and the query type. We refer to the resulting dataset as INSTRUCT-SKILLMIX. For example, INSTRUCT-SKILLMIX($k=2$)-1K refers to 1,000 examples of data created from random combinations of $k = 2$ skills. See Appendix L.3 and L.5 for the details about the prompts used for data generation.

See Appendix A for more details, and an estimate of the low cost of INSTRUCT-SKILLMIX pipeline.

Where does diversity come from? The first source of diversity is the skill labels. A skill label represents some part of the frontier LLM’s meta-knowledge of human behavior and needs, which it observed in its vast training set or during instruction tuning. Replacing a concrete Q&A example with a skill label converts it into a pointer to a region in the frontier LLM’s meta-knowledge, which the model can then freely draw upon to create new examples. The second source of diversity is the use of random k -tuples of skills when generating new examples. The motivation here is that, in most cases, distinct tuples will lead to very distinct flavor of examples.

For instance, the skill pair (critical thinking and communication, literature and language skills) leads to the following instruction

I’m a high school English teacher aiming to develop a curriculum unit for my 11th-grade class, focusing on American literature. I want this unit to go beyond just reading and understanding the texts. Specifically, I’m looking to enhance my students’ critical thinking and communication skills through engaging activities related to the literature. Can you suggest detailed ways to incorporate these skills, ideally with concrete examples and expected learning outcomes?

whereas the skill pair (critical thinking and communication, skill in virtual and system design) leads to

As an IT manager, I am overseeing the development of a virtual workspace to enhance communication and efficiency among remote teams. This workspace must support multimedia content, including video conferencing and live document editing. What are the critical steps I should take in its design and implementation, balancing technical robustness with ease of use? Could you provide specific technologies to consider and any potential obstacles?

Even though the two skill pairs share a common skill, they lead to rather distinct Q&A pairs, involving creative and nuanced situations with subtle moving parts. Since the number of k -tuples scales as $\binom{N}{k}$, where N is the number of skills, using pairs of skills foster a lot of diversity — e.g., 125,000 possibilities with $N = 500, k = 2$. The pipeline in our experiments mainly uses $k = 2$, but generating answers to these queries will certainly end up using many other unnamed skills as well, and thus serve as a rich source for learning how to follow instructions.

3 EXPERIMENTS

3.1 EXPERIMENTAL SETUP

SFT on INSTRUCT-SKILLMIX(k). We finetune LLaMA-3-8B-Base, Mistral-7B-Base-v0.2, Gemma-2-9B-Base, LLaMA-2-7B-Base, and LLaMA-2-13B-Base on a varying number of examples from INSTRUCT-SKILLMIX-D(k) and INSTRUCT-SKILLMIX(k). We train for multiple epochs and select the best checkpoint by performance on 100 held-out questions. Similar to Ouyang et al. (2022); Zhou et al. (2023), we observe that using cross-entropy loss on a validation set does not lead to the best checkpoint. See Appendix E.2 for a more detailed discussion of the checkpoint selection procedure. As a baseline, we also finetune on different subsets of Alpaca-52K, including the 1K or 5K examples with the longest completions. For further training details (e.g., hyperparameters), see Appendix E.1.

Evaluation. We evaluate our models on popular instruction following benchmarks: AlpacaEval 2.0 (Dubois et al., 2024), MT-Bench (Zheng et al., 2023), and WildBench (Lin et al., 2024). For AlpacaEval, we report the length-controlled win rate (LC WR) of the responses of our model against a reference response, which corrects for the length bias of the judge model. For MT-Bench, we report the average score of the responses of our model graded by a judge model. For WildBench, we report the WB-Reward (weighted win-rate) of the response of our model against one reference response when graded by a judge model. For further evaluation details, see Appendix D. See Table 11 in Appendix C for evaluations on additional benchmarks.

3.2 MAIN RESULTS

For the main results of the paper, we report the evaluation results when models are finetuned on INSTRUCT-SKILLMIX in Table 1, and summarize our findings below. For a more detailed version of Table 1, see Table 9. For additional ablations, see Appendix F. For evaluations on other LLM benchmarks, see Table 11.

INSTRUCT-SKILLMIX achieves SOTA performance amongst SFT models. LLaMA-3-8B-Base finetuned on 4K examples from INSTRUCT-SKILLMIX(k=2) yields LC win rate of 42.76% on AlpacaEval 2.0. This score is higher than Claude 3 Opus, LLaMA-3.1-405B-Instruct, and GPT-4 (2023-03-14). Mistral-7B-Base-v0.2 finetuned on the same data achieves -29.25 on WildBench, which outperforms Claude 3 Sonnet and Mistral Large. Gemma-2-9B-Base finetuned on 2K examples from INSTRUCT-SKILLMIX(k=2) gets a score of 8.12 on MT-Bench, which is better than GPT-3.5-Turbo (2023-03-01). To best of our knowledge, these scores are higher than any base model that has *only* undergone supervised instruction finetuning (i.e., no RLHF, DPO, PPO, or variants).

Early saturation. Performance from our method rises rapidly, reaching unprecedented levels with 1K examples. Unfortunately, improvements stop already with 4K examples. This turns out to be a consequence of its high efficiency at inducing good instruction-following. Specifically, with 4K

examples, the win-rate against GPT-4 approaches 50% on *heldout* queries from our pipeline, and thus overfitting sets in.

Observed limitations. The open benchmarks used in this study have known limitations, related to the insufficient number of under-specified or ambiguous queries, and no testing of long-form generations such as multi-page essays. Our current pipeline shares some of these limitations. Fixing this seems very doable via suitable modification to our INSTRUCT-SKILLMIX pipeline, but this is left for future work. This aligns with the observation in Bai et al. (2024) that a model’s effective generation length seems to be limited by the typical length of examples seen during SFT, and is exacerbated by the relative scarcity of long-form samples in the SFT data. This underscores the critical influence of training data composition on a model’s post-fine-tuning capabilities, and would be interesting to investigate in future work.

4 ABLATION STUDY

Whereas pretraining is the source of an LLM’s basic capabilities (Gudibande et al., 2023), the sole goal of instruction tuning is to impart skills, such as answer-structuring, empathy, helpfulness, etc.

Vanilla SFT on Q&A data generated by a teacher LLM is akin to *imitation learning*. Our ablation studies below help understand the contribution of different elements to the effectiveness of imitation learning method using INSTRUCT-SKILLMIX Q&A. The main finding is that the source of largest improvement is the skill extraction step.

4.1 BENEFITS OF SKILL EXTRACTION (WITH MIXING TURNED OFF)

To highlight the benefits of our skill-based method versus current synthetic approaches, we use the pioneering Alpaca dataset, whose responses are rewritten by GPT-4 (2023-03-14) (Peng et al., 2023). The fairest comparison here would be with our INSTRUCT-SKILLMIX-D(k=1) data, where the underlying skills were derived from a random sample of *Alpaca-52K*, and each of our datapoints uses one of those extracted skills. All results below involve finetuning Mistral-7B-Base-v0.2 on different subsets of the Alpaca-52K dataset: (1) *Alpaca-1K Longest*: 1,000 examples with the longest responses (Zhao et al., 2024); (2) *Alpaca-5K Longest*: 5,000 examples with the longest responses; (3) *Alpaca-5K Random*: 5,200 randomly sampled examples from which we extracted our skills; and (4) *Alpaca-52K*: the full 52,002 examples.

Table 2: **Evaluation results of Mistral-7B-Base-v0.2 finetuned on INSTRUCT-SKILLMIX-D vs. on Alpaca-52K.** Note that skills extracted from Alpaca-5K Random were used to create the INSTRUCT-SKILLMIX-D datasets.

SFT Dataset	# Data	AlpacaEval 2.0 LC WR (%)	MT-Bench	WildBench WB-Reward $_{\infty}^{\text{gpt4t}}$
INSTRUCT-SKILLMIX-D(k=2)	4K	29.77	7.17	-39.06
INSTRUCT-SKILLMIX-D(k=1)	1K	27.04	7.22	-46.83
Alpaca-1K Longest	1K	10.09	6.88	-63.38
Alpaca-5K Longest	5K	8.92	6.90	-62.55
Alpaca-5K Random	5K	11.10	6.86	-74.41
Alpaca-52K Full	52K	8.64	6.45	-80.47

As shown in Table 2, finetuning on 1,000 examples with the longest completions from Alpaca-52K yields 10.09% LC win rate on AlpacaEval 2.0. On the other hand, finetuning on only 1K examples of INSTRUCT-SKILLMIX-D(k=1) yields 27.04% LC win rate. Note that since the skills in INSTRUCT-SKILLMIX-D are mostly derived from Alpaca-52K, the observed improvements in the win rate are indicative of the improved quality of INSTRUCT-SKILLMIX-D queries.

4.2 MIXING SKILLS HELPS, BUT NOT AS MUCH AS SKILL EXTRACTION

In Table 3, models finetuned on INSTRUCT-SKILLMIX-D(k=2) data marginally outperform models SFT on INSTRUCT-SKILLMIX-D(k=1) on AlpacaEval and WildBench, whereas performance on

MT-bench is about the same. The marginal improvements from increasing k are less noticeable for INSTRUCT-SKILLMIX.

Table 3: **Evaluation results of Mistral-7B-Base-v0.2 SFT on INSTRUCT-SKILLMIX where $k=1$ vs. $k=2$.** In each entry, we report **INSTRUCT-SKILLMIX-D/INSTRUCT-SKILLMIX**

Model	# Data	AlpacaEval 2.0		MT-Bench	WildBench
		WR(%)	LC WR(%)		WB-Reward $_{\infty}^{\text{pt4t}}$
SFT on INSTRUCT-SKILLMIX($k=2$)					
Mistral-7B-Base-v0.2	1K	33.87/42.48	27.48/38.34	6.92/7.33	-41.46/-30.65
	2K	37.05/40.83	31.57/36.18	7.04/7.20	-43.46/-31.92
	4K	35.08/40.74	29.77/36.70	7.17/7.16	-39.06/-29.25
SFT on INSTRUCT-SKILLMIX($k=1$)					
Mistral-7B-Base-v0.2	1K	30.06/41.75	27.04/38.34	7.22/7.49	-46.83/-30.95
	2K	35.07/-	31.66/-	7.39/-	-46.97/-
	4K	33.57/-	28.85/-	7.13/-	-44.43/-

4.3 QUALITY OF QUERIES (AND SKILLS) MATTERS

The effectiveness of this approach depends on the quality of the queries used in the fine-tuning process, where high-quality queries enable the frontier LLM teacher to provide richer instruction to the student model undergoing instruction tuning. This relationship between the quality of queries and the skills being imparted is supported by two key observations. First, the frontier LLM proves to be a more effective teacher when the skill list being used was also entirely generated using its help (as opposed to giving it skills derived from existing datasets).⁴ Across all model types, dataset size, and the evaluation benchmark, we generally see an improvement when finetuning on INSTRUCT-SKILLMIX compared to INSTRUCT-SKILLMIX-D (see Table 9 for more details). Second, incorporating these sub-optimal skills from existing datasets as a part of “teaching” (e.g., with INSTRUCT-SKILLMIX-D) is still more effective than using an equal number of random (or even the longest) examples from Alpaca-52K when responses are also by the same frontier LLM. These findings suggest that the quality of the queries (and the skills used to create those queries) drives how well data generated by the frontier LLM is able to impart its skills on the model undergoing instruction tuning.

4.4 EFFECT OF TEACHER AND GRADER

SFT performance derives from the model used to generate Q&A data, which plays the *teacher* role in imitation learning. The student’s performance is evaluated by the grader model. The main results reported in this paper used GPT-4-Turbo as the teacher, and some checkpoint of GPT-4 or GPT-4-Turbo as the grader.

Effect of the teacher Many SFT efforts in 2023 used earlier versions of GPT-4 or GPT-3.5, which were weaker than GPT-4-Turbo. To pin-point the effect of this change, we try doing a head-to-head comparison once we fix the teacher. The responses in Alpaca-1K Longest are written by GPT-4 (2023-03-14), whereas INSTRUCT-SKILLMIX data is generated by GPT-4-Turbo. Thus, we use GPT-4-Turbo to regenerate answers to Alpaca-1K Longest (Zhao et al., 2024), and we also use GPT-4 (2023-03-14) to regenerate INSTRUCT-SKILLMIX-D.

Table 4 compares the performance of Mistral-7B-Base-v0.2 when finetuned on the two datasets using the two versions of GPT-4. For each fixed data generator model, the INSTRUCT-SKILLMIX dataset leads to a better performance. Furthermore, replacing GPT-4 with the stronger GPT-4-Turbo in data generation makes INSTRUCT-SKILLMIX pull even further ahead of Alpaca-1K Longest, which highlights that our pipeline is better positioned than Alpaca dataset to elicit better supervision from a more powerful LLM teacher.

⁴We also observed improved performance when the teacher model generated data based on its own set of skills, rather than using skills extracted by a different teacher model, further highlighting the advantages of leveraging the teacher model’s metacognitive capabilities during dataset creation (see Appendix B.3).

Table 4: **Evaluation results of Mistral-7B-Base-v0.2 finetuned on INSTRUCT-SKILLMIX-D vs. Alpaca-1K Longest generated from two different versions of GPT-4.** For a fixed data generator model, SFT Mistral-7B-Base-v0.2 on INSTRUCT-SKILLMIX-D outperforms SFT on Alpaca-1K Longest.

Model for Data Generation	Dataset	AlpacaEval 2.0		MT-Bench
		WR(%)	LC WR(%)	
GPT-4 (2023-03-14)	Alpaca-1K Longest	12.75	10.09	6.83
	INSTRUCT-SKILLMIX-D-1K	13.29	15.01	7.10
GPT-4-Turbo (2024-04-09)	Alpaca-1K Longest	35.23	19.62	6.99
	INSTRUCT-SKILLMIX-D-1K	33.87	27.48	6.92

Effect of choice of grader We use GPT-4-Turbo to generate data and AlpacaEval 2.0 uses GPT-4 for grading, creating a scenario where both the teacher model and grader model are from the same family. This raises the question of whether model family overlap leads to a potential grading bias and inflated scores. To quantify this effect, we used Claude 3 Opus as the grader for AlpacaEval 2.0. Table 5 shows that although Claude is a more generous grader across the board, it generally preserves the relative rankings among the models. Importantly, it exhibits even stronger preference for our student models’ generations than does GPT-4.

Table 5: **Evaluation results when using two different graders for AlpacaEval 2.0.** Relative ranking of evaluated models are generally preserved when using different graders. Here, ISM-D refers to INSTRUCT-SKILLMIX-D.

Model	Grader: GPT-4 (2023-11-06)		Grader: Claude 3 Opus	
	WR(%)	LC WR(%)	WR(%)	LC WR(%)
Mistral-7B-Base-v0.2 SFT on ISM-D-1K	33.87	27.48	50.56	38.50
Mistral-7B-Base-v0.2 SFT on ISM-D-2K	37.05	31.57	48.94	38.29
Mistral-7B-Base-v0.2 SFT on ISM-D-4K	35.08	29.77	52.55	44.16
(Reference Model) LLaMA-3-70B-Instruct	33.20	34.40	39.68	42.33
(Reference Model) Mistral-7B-Instruct-v0.2	14.70	17.10	15.16	18.89
(Reference Model) LLaMA-2-70B-Chat	13.90	14.70	16.67	17.85

5 EFFECT OF LOW QUALITY DATA

Our fully synthetic pipeline produces a large number of high-quality questions and answers that look impressive but also (for want of a better word) “robotic.” Data sourced from human workers shows greater variation, and one begins to wonder if that additional diversity could be beneficial. We tried interventions such as generating 20% using a different prompt — e.g., require a shorter answer, or a poor quality answer. In a human pipeline, this variation would be expected. We can think of this as “data from shirkers,” and one would expect a fair bit of it in naive crowdsourcing. (In corporate settings it would be mitigated via quality control measures.) See Appendix I for an example of a poor quality response.

We replace 20% of the responses in INSTRUCT-SKILLMIX(k=2)-2K with short responses (“respond in one paragraph”) to create BREV-INSTRUCT-SKILLMIX(k=2)-2K. Finetuning Mistral-7B-Base-v0.2 on BREV-INSTRUCT-SKILLMIX-D was surprising: brevity constraint on just 20% of data almost halved the average response length on AlpacaEval, from 2817 to 1746 characters. LC win rate dropped from 31.57% to 23.93%.

We alternatively replace 20% of the responses in the same datasets with responses that are still long but have poor quality (i.e., deliberately sloppy and unhelpful) to create JUNK-INSTRUCT-SKILLMIX(k=2)-2K. Mistral-7B-Base-v0.2 finetuned on the JUNK-INSTRUCT-SKILLMIX-D yields less than 1% win rate on AlpacaEval and 5.01 on MT-Bench.

Lower-quality data harms performance. As shown in Table 6, replacing just 20% of the data with poor quality responses harms performance. For INSTRUCT-SKILLMIX-D, the harm is super-proportionate. These observation may help explain why creating open-domain instruction tuning data has proved so difficult via naive crowd-sourcing.

Table 6: **Evaluation results of models finetuned on low quality INSTRUCT-SKILLMIX.** Replacing just 20% of the dataset with low quality data has a super-proportionate harm on the model performance. Amount of harm greatly differs between the two versions of the pipeline.

Model	# Data	AlpacaEval 2.0		MT-Bench	WildBench
		LC WR(%)	Avg Len		WB-Reward $_{\infty}^{\text{gpt4t}}$
SFT on INSTRUCT-SKILLMIX-D(k=2)					
Mistral-7B-Base-v0.2	2K	31.57	2817	7.04	-43.46
	2K (Brevity 20%)	23.93	1746	6.69	-49.85
	2K (Junk 20%)	0.77	1104	5.01	-47.50
SFT on INSTRUCT-SKILLMIX(k=2)					
Mistral-7B-Base-v0.2	2K	36.18	2936	7.20	-31.92
	2K (Brevity 20%)	31.61	2336	7.32	-32.27
	2K (Junk 20%)	24.60	2435	6.90	-47.50

High-quality data’s protective effect. While adding some low-quality data to INSTRUCT-SKILLMIX already causes a noticeable performance drop, doing the same to INSTRUCT-SKILLMIX-D is catastrophic. This suggests that INSTRUCT-SKILLMIX is more robust to “shirkers,” corroborating our previous observations in Table 9 of the superior performance of INSTRUCT-SKILLMIX over INSTRUCT-SKILLMIX-D. This finding suggests that higher quality data can somewhat protect against negative effects of “shirkers,” which needs further study.

6 RELATED WORK

Prior works observe improvements from instruction finetuning on *fewer*, but *higher quality* data generated by humans (Zhou et al., 2023; Touvron et al., 2023). However, efforts to curate high quality data from humans are quite expensive, and licensing can become complicated. This has led to an increase in the popularity of semi-automated and less expensive approaches.

Selecting high quality data. Synthetic data creation has become a predominant approach for curating instruction tuning datasets, especially in the academic realm (Wang et al., 2023b; Dubois et al., 2023; Xu et al., 2024; Gunasekar et al., 2023). These synthetic datasets are generally created by providing in-context examples to a powerful LLM to produce the synthetic data, followed by some post-filtering (Wang et al., 2023b). Recent efforts have also focused on data selection strategies for high quality subsets of the original dataset, which lead to performance gains (Tunstall et al., 2023; Chen et al., 2024; Liu et al., 2024; Zhao et al., 2024). Notably, Zhao et al. (2024) show that finetuning on just the 1K longest completions from Alpaca-52K outperforms finetuning on the entire Alpaca-52K dataset. Whereas the data selection methods just described focus on *general-purpose* instruction tuning, Xia et al. (2024) explore an optimizer-aware data selection strategy for *targeted* instruction tuning.

Encouraging data diversity. Common approaches to elicit diversity in datasets include mixing multiple datasets (Wang et al., 2022; Longpre et al., 2023; Wang et al., 2023a), as well as rewriting the data in multiple ways and changing formatting (Allen-Zhu and Li, 2024; Honovich et al., 2023). The Self-Instruct framework (Wang et al., 2023b) and variants such as Alpaca-52K (Dubois et al., 2023) encourage diversity by identifying similar pairs using ROUGE-L similarity. Other approaches to ensure diversity impose constraints on the topic in order to enhance wide coverage (Ding et al., 2023; Xu et al., 2024), or require synthetic data to use a random subset of words or concepts chosen from some vocabulary (Eldan and Li, 2023; Gunasekar et al., 2023; Li et al., 2024). The latter approach is also suggested by recent work that provides a mathematical model for emergence via LLM scaling (Arora and Goyal, 2023) and used in the evaluation setting in Yu et al. (2024).

AlpacaEval. AlpacaEval (Li et al., 2023; Dubois et al., 2024) is a popular evaluation for assessing instruction-following capabilities of LLMs. The tested model provides answers 805 carefully curated instructions, and its answers are compared against reference outputs of a designated baseline model. For each instruction, another evaluator LLM outputs a preference between the two responses (output

of the model being evaluated vs. reference output by the baseline mode). The primary evaluation metric is the *win rate*, which represents the expected probability that the grader model favors the response generated by the evaluated model over the response produced by the baseline model. Given that a raw win rate shows bias towards longer responses, AlpacaEval 2.0 (Dubois et al., 2024) introduces the *length-corrected (LC) win rate* as a proxy for what the raw win rate would be if the evaluated model’s response lengths and baseline model’s response lengths matched.

WildBench. WildBench (Lin et al., 2024) is another benchmark for assessing the instruction following capabilities of LLMs. Unlike the AlpacaEval instructions, 50% of which are only “information seeking” type questions, the instructions for WildBench cover a more diverse distribution of task categories, including coding and creative writing. Whereas the grading in AlpacaEval is more liberal (since there is no penalty for poor responses), the grading in WildBench is more finegrained: a model answer is compared against a reference answer, but is graded on a scale of (1) win by a big margin, (2) win by a small margin, (3) tie, (4) lose by a small margin, and (5) lose by a big margin. This ensures that models that output bad answers to certain types of questions are penalized.

RL-inspired approaches. Since we do not use RL, we defer discussion of these approaches to Appendix G.

7 CONCLUSION

While one would have certainly expected the cost factor as well as scaling ability to ultimately favor synthetic data, the surprising finding in this paper is that, when done well, synthetic data can be much more *effective* than human data for instruction tuning. Our INSTRUCT-SKILLMIX pipeline, uses the recent discovery of LLM Metacognition (Didolkar et al., 2024) to extract skills using a powerful LLM and then leverages an LLM to create quality instruction data using random pairs of those skills.

Vanilla SFT of base models on just 1K to 4K examples from our pipeline outperforms the proprietary *instruct* versions of the same model, as well as older and larger instruction tuning efforts like Vicuna and Ultrachat that used orders of magnitude more datapoints. The performance also approaches those of frontier models, which trained on expensive human data as well as with RL techniques. Unfortunately, our method saturates at 4K examples, when win-rate on heldout queries approaches 50%.

Ablation studies in Section 4.4 rule out potential confounding factors, such as the use of a strong teacher, or bias due to teacher and grader belonging to the same family. These ablations reinforce that the improvement is primarily due to the uniformly high quality of examples produced by our skill-based pipeline. Each example contains a query with nontrivial scenarios and lots of moving parts, which improve imitation learning.

Section 5 offers a preliminary exploration of pitfalls of naive collection of instruction tuning data. In particular, the presence of some lower quality data noticeably harms the model’s performance. This insight should be more rigorously investigated, including via new theory. The experiment also suggests that our less preferred INSTRUCT-SKILLMIX-D method (which involves extracting skills from an existing dataset) is more susceptible to such bad data than our preferred INSTRUCT-SKILLMIX.

One potential benefit of INSTRUCT-SKILLMIX-D may be that it gives some insights into an efficient method for dataset distillation (Wang et al., 2020) for text datasets, which has not yet proved possible.

Finally, it should be noted that our results look stronger on paper than they actually are. Open evaluations such as AlpacaEval 2.0 have blind spots, especially the fact that win rate of even 50% against a frontier model still allows unacceptably high frequency of unsuitable responses in a deployment setting. The new WildBench evaluation does test for more corner cases. We hope that INSTRUCT-SKILLMIX ideas can also leverage LLM metacognition to create a better evaluation.

Although our SFT data does not address safety and alignment, our skill-based ideas may be useful there. A related next step would be to leverage our ideas of skill extraction to improve RL-based methods (whether for instruction-following or alignment). We hope to address these in future work.

8 REPRODUCIBILITY STATEMENT

We provide the full lists of extracted skills, topics, and query types in Appendix K. We provide the set of prompts used to generate the data from these lists in Appendix L.3 and L.3. We provide the set of training hyperparameters in Appendix E.1. We discuss the details of the checkpoint selection method in Appendix E.2. We provide the details of evaluation settings in Appendix D.

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A INSTRUCT-SKILLMIX PIPELINE (MORE DETAILS)

A.1 INSTRUCT-SKILLMIX-D AND INSTRUCT-SKILLMIX PIPELINES

Method 1: Leveraging existing instruction datasets. Even though existing instruction-following datasets may not induce good chat capability via vanilla SFT, these datasets still exhibit (possibly in an uneven fashion) some “skills” needed by the model. Thus, we adapt the methodology presented in Didolkar et al. (2024) and use GPT-4-Turbo to extract instruction-following skills from random samples of existing instruction and alignment datasets (5,200 samples from Alpaca-52K and 1,000 samples from UltraChat). We then use GPT-4-Turbo to cluster similar skills into broader categories, forming our final list of instruction-following skills. See Appendix K.1 for the list of all extracted skills and Appendix L.1 and L.2 for details about the prompts used for skill extraction.

Method 2: Directly prompting a powerful LLM. While Method 1 works surprisingly well, it generated unease about possibly relying on existing seed datasets of uneven quality, and thus potentially inheriting their limitations and biases. Therefore we also tried an alternative pipeline that solely relies on the powerful LLM’s ideas about list of skills it leverages for instruction-tuning.

We will refer to the datasets generated from the seed-dataset dependent and the seed-dataset agnostic versions as INSTRUCT-SKILLMIX-SEED-DATASET-DEPENDENT and INSTRUCT-SKILLMIX-SEED-DATASET-AGNOSTIC, respectively. Unless stated otherwise, INSTRUCT-SKILLMIX refers to the INSTRUCT-SKILLMIX-SEED-DATASET-AGNOSTIC data.

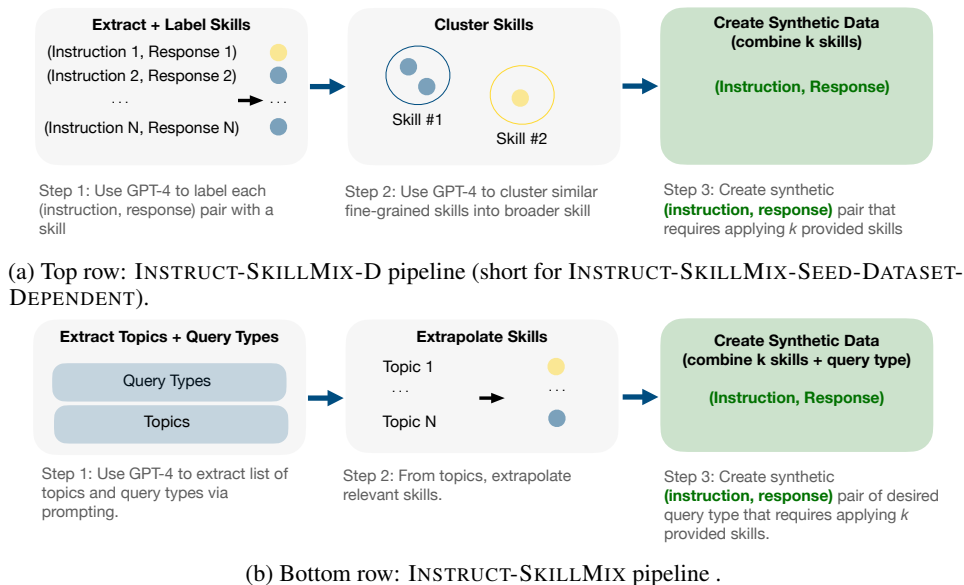


Figure 2: **Two variants of the INSTRUCT-SKILLMIX pipeline.** INSTRUCT-SKILLMIX(k) involves two steps: (1) skill extraction using similar ideas as Didolkar et al. (2024); (2) data generation from random k -tuples of skills.

A.2 DATASET CURATION COSTS

Generating synthetic data using the INSTRUCT-SKILLMIX pipeline is more cost effective compared to using human annotators. To extract the skill clusters for INSTRUCT-SKILLMIX-D, it costs less than \$120 to extract and cluster skills from 6,200 examples from various existing datasets. For INSTRUCT-SKILLMIX, extracting skills via direct prompting costs under \$5. Additionally, producing 4,000 examples of INSTRUCT-SKILLMIX($k=2$) data costs under \$570.

B INSTRUCT-SKILLMIX WITH A DIFFERENT TEACHER MODEL

We apply INSTRUCT-SKILLMIX with Claude-3.5-Sonnet (2024-06-20) as the teacher model and replicate some of the experiments from the main paper. See Tables 7, 8 for the results. We report the results for best checkpoint selected using held-out queries.

B.1 INSTRUCT-SKILLMIX IS APPLICABLE WITH ANY STRONG TEACHER MODEL

We observe that Claude-3.5-Sonnet is also able to generate a meaningful list of query types, topics, and fine-grained skills. See Appendix K.3 for the full list. When compared to the list generated by GPT-4-Turbo (Appendix K.2), we see that Claude-3.5-Sonnet generates a very similar list of query types (e.g., “Information-seeking” and “Help-seeking” are the first two entries generated from both models), but the description and example queries from each query type are more terse. On the other hand, the topics and skills generated by Claude-3.5-Sonnet are more fine-grained and specific than those of GPT-4-Turbo.

Claude-3.5-Sonnet is also able to generate (instruction, response) pairs from randomly selected pair of skills and a random choice of query type. Upon manual inspection, we observe that the data generated by Claude-3.5-Sonnet is slightly less illustrative than the INSTRUCT-SKILLMIX data generated by GPT-4-Turbo.

B.2 INSTRUCT-SKILLMIX OUTPERFORMS OTHER METHODS

Once we fix the teacher model as Claude-3.5-Sonnet, the conclusion remains the same from the main paper: INSTRUCT-SKILLMIX outperforms regenerating responses to existing datasets. See Table 7.

Table 7: **Evaluation results on AlpacaEval 2.0 and MT-Bench.** “# Data” refers to the number of (instruction, response) pairs in the training data.

Dataset	# Data	AlpacaEval 2.0		MT-Bench
		WR(%)	LC WR(%)	
SFT Mistral-7B-Base-v0.2 on data generated by Claude-3.5-Sonnet (2024-06-20)				
INSTRUCT-SKILLMIX(k=2)	1K	25.74	25.54	6.88
Alpaca-52K	Long 1K	22.10	19.12	7.13
ShareGPT	Random 1K	21.00	19.77	7.06

B.3 EXTRACTING SKILLS WITH ONE TEACHER AND GENERATING WITH ANOTHER

We ask Claude-3.5-Sonnet to generate INSTRUCT-SKILLMIX(k=2)-1K from the query types and skills generated by GPT-4-Turbo, and vice versa. For any fixed choice of teacher model, performance is slightly better when it generates INSTRUCT-SKILLMIX(k=2) data from the query types and skills it extracted. See Table 8.

Table 8: **Evaluation results on AlpacaEval 2.0 and MT-Bench.**

Data Generated by	Skills From	AlpacaEval 2.0		MT-Bench
		WR(%)	LC WR(%)	
SFT Mistral-7B-Base-v0.2 on INSTRUCT-SKILLMIX(k=2)-1K				
GPT-4-Turbo	GPT-4-Turbo	41.97	38.48	7.33
	Claude-3.5-Sonnet	43.22	31.98	7.20
Claude-3.5-Sonnet	GPT-4-Turbo	21.32	23.91	6.87
	Claude-3.5-Sonnet	25.74	25.54	6.88

C FULL EVALUATION RESULTS (MORE DETAILED)

Tables 9, 10 contain the full evaluation results on instruction following benchmarks, including the ones in Table 1. Table 11 contains the full evaluation results on other popular LLM benchmarks.

For our models, we report the results for best checkpoint selected using held-out queries. For other models(*), we report the published numbers available on publicly available leaderboards.

Table 9: **Evaluation results on AlpacaEval 2.0, MT-Bench, and WildBench.** “# Data” refers to the number of (instruction, response) pairs in the training data. In each relevant entry, we report **INSTRUCT-SKILLMIX-D/INSTRUCT-SKILLMIX**.

Model	# Data	AlpacaEval 2.0		MT-Bench	WildBench WB-Reward _∞ ^{gpt4t}
		WR(%)	LC WR(%)		
SFT on INSTRUCT-SKILLMIX(k=2)					
LLaMA-3-8B-Base	1K	27.83/27.48	23.41/27.83	6.85/7.15	-48.58/-41.46
	2K	31.19/35.73	29.16/36.51	6.85/7.18	-45.70/-42.52
	4K	30.05/ 44.63	28.59/ 42.76	7.05/7.09	-51.76/-36.91
Mistral-7B-Base-v0.2	1K	33.87/42.48	27.48/38.34	6.92/7.33	-41.46/-30.65
	2K	37.05/40.83	31.57/36.18	7.04/7.20	-43.46/-31.92
	4K	35.08/40.74	29.77/36.70	7.17/7.16	-39.06/ -29.25
Gemma-2-9B-Base	1K	31.36/36.80	34.80/39.58	7.81/7.99	-53.17/-37.16
	2K	34.28/39.30	42.09/36.18	7.80/ 8.12	-52.05/-37.83
	4K	33.64/37.97	35.87/40.05	7.88/7.69	-56.05/-38.23
LLaMA-2-7B-Base	1K	8.94/14.00	10.20/13.81	4.38/4.59	-77.98/-72.36
	2K	7.24/14.95	10.75/15.76	4.44/4.67	-80.71/-75.15
	4K	6.90/12.50	9.63/13.94	4.50/4.31	-81.12/-76.27
LLaMA-2-13B-Base	1K	17.34/22.54	18.06/22.69	6.40/6.71	-64.42/-55.22
	2K	16.95/19.67	17.76/22.75	6.29/6.73	-67.58/-58.40
	4K	15.79/20.70	17.08/23.05	6.44/6.29	-69.48/-62.55
SFT on INSTRUCT-SKILLMIX(k=1)					
Mistral-7B-Base-v0.2	1K	30.06/41.75	27.04/38.34	7.22/7.49	-46.83/-30.95
	2K	35.07/-	31.66/-	7.39/-	-46.97/-
	4K	33.57/-	28.85/-	7.13/-	-44.43/-
SFT Mistral-7B-Base-v0.2 on Other Datasets (response generated by GPT-4 (2023-03-14))					
Alpaca-52K	Long 1K	12.75	10.09	6.88	-63.38
	Long 5K	13.01	8.92	6.90	-62.55
	Random 5K	8.70	11.10	6.86	-74.41
	Full 52K	7.47	8.64	6.45	-80.47
SFT Mistral-7B-Base-v0.2 on Other Datasets (response generated by GPT-4-Turbo (2024-04-09))					
Alpaca-52K	Long 1K	35.23	19.62	6.99	-43.26
	Random 1K	20.85	23.48	6.93	-55.42
ShareGPT	Random 1K	30.06	26.01	7.19	-
Ultrachat	Random 1K	37.10	25.64	7.39	-

Table 10: **Evaluation results on AlpacaEval 2.0, MT-Bench, and WildBench (continued).** “# Data” refers to the number of (instruction, response) pairs in the training data.

Model	# Data	AlpacaEval 2.0		MT-Bench	WildBench
		WR(%)	LC WR(%)		WB-Reward _∞ ^{gpt4t}
*Existing Models (not trained by us)					
LLaMA-3.1-405B-Instruct	-	39.10	39.30	-	-
Mistral Large	-	21.40	32.70	-	-46.40
Claude 3 Opus	-	29.10	40.50	-	-21.20
Claude 3 Sonnet	-	25.60	34.90	-	-30.30
GPT-4-Omni (2024-05-13)	-	51.30	57.50	-	+1.70
GPT-4 (2023-03-14)	-	22.10	35.30	8.96	-
LLaMA-2-70B Chat	-	13.90	14.70	6.86	-53.40
UltraLM 13B V2.0	1.5M	7.50	9.90	-	-
Vicuna 13B v1.5	> 1M	7.00	11.70	6.57	-
LLaMA-3-8B-Instruct	-	22.60	22.90	-	-46.30
Mistral-7B-Instruct-v0.2	-	14.70	17.10	7.60	-54.70
Gemma-2-9B-Instruct	-	21.49	37.21	-	-28.78
Zephyr 7B Beta	-	11.00	13.20	-	-
Claude 2.0	-	17.20	28.20	8.06	-
Gemini Pro	-	18.20	24.40	-	-
GPT-3.5-Turbo (06/13)	-	14.10	22.70	8.39	-
GPT-4 (2023-06-13)	-	15.80	30.20	9.18	-

Table 11: Evaluation results on MMLU, TruthfulQA, GSM8K, ARC Challenge, Winogrande, PIQA.

Model	MMLU	TrQA	GSM	ARC-C	Winogrande	PIQA
LLaMA-3-8B Models						
INSTRUCT-SKILLMIX-D-1K	62.09	34.88	52.54	53.92	74.51	79.76
INSTRUCT-SKILLMIX-D-2K	62.09	37.33	52.77	53.75	75.06	79.54
INSTRUCT-SKILLMIX-D-4K	62.28	32.19	50.42	52.73	73.09	79.22
INSTRUCT-SKILLMIX-1K	62.33	37.09	51.25	52.39	74.19	79.92
INSTRUCT-SKILLMIX-2K	62.18	35.25	52.39	52.39	74.66	79.05
INSTRUCT-SKILLMIX-4K	61.72	34.15	51.10	52.22	73.72	79.27
LLaMA-3-8B-Instruct	63.84	36.23	76.12	52.99	72.06	78.62
LLaMA-3-8B-Base	62.06	27.05	49.96	50.43	72.85	79.71
Mistral 7B v0.2 Models						
INSTRUCT-SKILLMIX-D-1K	58.97	26.19	36.01	51.02	73.64	81.18
INSTRUCT-SKILLMIX-D-2K	58.67	25.95	36.32	50.60	73.56	81.01
INSTRUCT-SKILLMIX-D-4K	58.38	26.68	36.54	50.00	73.56	81.45
INSTRUCT-SKILLMIX-1K	59.24	27.05	35.10	52.47	73.48	81.23
INSTRUCT-SKILLMIX-2K	58.90	25.83	33.66	52.99	73.88	81.66
INSTRUCT-SKILLMIX-4K	58.49	26.68	31.77	52.13	73.72	81.12
INSTRUCT-SKILLMIX-D(k=1)-1K	59.02	26.56	34.27	50.34	72.77	81.07
INSTRUCT-SKILLMIX-D(k=1)-2K	58.90	25.83	33.66	52.99	73.88	81.66
INSTRUCT-SKILLMIX-D(k=1)-4K	58.94	26.56	33.97	51.11	73.56	81.45
INSTRUCT-SKILLMIX(k=1)-1K	59.07	26.44	35.86	51.71	74.11	81.45
Alpaca-1K Longest	58.72	27.29	35.18	51.88	72.93	81.01
Mistral-7B-Instruct-v0.2	58.70	52.51	43.67	54.35	72.38	80.41
Mistral-7B-Base-v0.2	58.59	28.27	37.98	48.81	71.67	80.30
Gemma-2-9B Models						
INSTRUCT-SKILLMIX-D-1K	69.16	30.60	70.96	62.54	74.74	81.23
INSTRUCT-SKILLMIX-D-2K	69.26	30.72	70.81	63.23	74.59	81.28
INSTRUCT-SKILLMIX-D-4K	69.39	30.11	71.72	63.14	74.66	81.66
INSTRUCT-SKILLMIX-1K	69.49	31.21	70.74	62.80	73.95	81.83
INSTRUCT-SKILLMIX-2K	69.64	32.56	71.04	63.82	74.59	81.66
INSTRUCT-SKILLMIX-4K	69.36	31.58	71.27	63.74	74.27	81.72
Gemma-2-9B-Instruct	71.61	42.96	79.08	63.40	76.32	81.18
Gemma-2-9B-Base	68.58	30.11	67.10	61.60	74.11	81.45
LLaMA-2-7B Models						
INSTRUCT-SKILLMIX-D-1K	41.04	34.39	11.83	46.93	70.01	78.07
INSTRUCT-SKILLMIX-D-2K	41.84	31.21	17.51	47.10	69.53	78.45
INSTRUCT-SKILLMIX-D-4K	43.00	30.84	15.24	47.01	69.38	78.24
INSTRUCT-SKILLMIX-1K	41.45	34.39	14.78	48.38	69.61	78.35
INSTRUCT-SKILLMIX-2K	43.17	33.41	15.92	47.78	70.01	78.51
INSTRUCT-SKILLMIX-4K	42.56	32.80	14.63	47.70	68.67	78.02
LLaMA-2-7B-Chat	46.39	30.35	21.76	43.86	66.69	76.44
LLaMA-2-7B-Base	40.76	25.21	12.36	43.52	69.46	77.97
LLaMA-2-13B Models						
INSTRUCT-SKILLMIX-D-1K	51.25	30.72	28.51	51.02	72.38	79.16
INSTRUCT-SKILLMIX-D-2K	51.03	30.84	28.73	50.85	72.30	79.43
INSTRUCT-SKILLMIX-D-4K	51.05	29.50	28.58	51.19	71.82	80.03
INSTRUCT-SKILLMIX-1K	50.68	30.11	27.45	50.60	72.61	79.92
INSTRUCT-SKILLMIX-2K	51.67	30.35	29.19	50.17	72.06	79.98
INSTRUCT-SKILLMIX-4K	51.47	30.60	30.86	50.94	71.67	80.41
LLaMA-2-13B-Chat	53.25	27.91	34.80	46.42	71.03	77.69
LLaMA-2-13B-Base	50.48	25.70	22.74	48.81	72.06	79.27

D EVALUATION DETAILS

To evaluate our models on the AlpacaEval 2.0, we followed the instructions in https://github.com/tatsu-lab/alpaca_eval (Dubois et al., 2024). The reference model and judge model are both GPT-4-Turbo (2023-11-06).

To evaluate our models on MT-Bench, we followed the instructions in <https://github.com/lm-sys/FastChat> (Zheng et al., 2023). The reference model and judge model are both GPT-4 (2023-06-13).

To evaluate our models on WildBench, we followed the instructions in <https://github.com/allenai/WildBench> (Lin et al., 2024). The reference model and judge model are both GPT-4-Turbo (2024-04-09), and we used no length penalty ($K = \infty$). This corresponds to $\text{WB-Reward}_{\infty}^{\text{gpt4t}}$ in their notation.

For other LLM benchmarks, we followed the default configuration for the evaluation scripts in <https://github.com/EleutherAI/lm-evaluation-harness> (Gao et al., 2023). We report the exact-match accuracy for GSM8K and the MC1 score for TruthfulQA.

E TRAINING DETAILS

E.1 HYPERPARAMETERS

In Table 12, we include the hyperparameters use in our experiments. We finetune each model using the AdamW optimizer. For every run, we use a learning rate schedule with a linear warmup of 0.03 and cosine decay to zero. For all experiments, we finetune for 15 epochs and store the checkpoint after each epoch, with the exception of the full Alpaca-52K dataset on which we only finetune for 3 epochs.

We use the torchtune package (torchtune maintainers and contributors, 2024) to train all models, except for the Gemma models, which were trained with the MAMmoTH package (Yue et al., 2023). Note that the default hyperparameters not specified here might be different in each of the packages.

Training a 7B model on 15 epochs of 1000 examples from INSTRUCT-SKILLMIX takes approximately 15 minutes on 4 H100 GPUs via PyTorch FSDP (Zhao et al., 2023).

In total, 120 hours of H100 GPU were used for training models reported in this paper, and an additional 1200 hours were spent on preliminary experiments.

Table 12: **Hyperparameters used for SFT.**

Model	LR	Batch Size
LLaMA-3-8B-Base	2e-5	64, 128
Mistral-7B-Base-v0.2	2e-6	64
Gemma-2-9B-Base	1e-6	64
LLaMA-2-7B-Base	2e-5	64
LLaMA-2-13B-Base	2e-5	64

E.2 CHECKPOINT SELECTION

As discussed in prior works (Ouyang et al., 2022; Xia et al., 2024; Zhou et al., 2023), minimizing validation loss does not always correspond to improved generation quality. Thus, we select checkpoints based on generation quality on held-out data, as used in some prior work (Zhou et al., 2023). In particular, we use length-controlled win rate on held-out as the selection metric.

We randomly choose 100 held-out examples from our dataset. After each epoch, we generate responses to the held-out instructions using the model checkpoint. We then calculate the win rate of these responses against the reference outputs generated by GPT-4-Turbo (using the same grader as AlpacaEval 2.0). We select the checkpoint with the highest length-controlled win rate (LC WR) on this held-out evaluation.

Since the held-out dataset contains only 100 examples, the costs associated with evaluating win rates on the held-out dataset are relatively low. Across all 15 epochs, the total number of API calls made is just under twice the number needed to evaluate the selected checkpoint on 805 AlpacaEval examples.

In Table 13, we report the LC WR and WR on our validation dataset and on AlpacaEval 2.0 for all 15 checkpoints when training Mistral-7B-Base-v0.2 on INSTRUCT-SKILLMIX-D-4K.

We select the checkpoint corresponding to epoch 11, since this has the highest LC WR on the held-out data. Note that (1) the corresponding LC WR on AlpacaEval (29.77%) is fairly close to the best LC WR (30.84%); and, (2) the corresponding WR on AlpacaEval (35.08%) is the best WR.

We additionally report the cross-entropy loss of each model checkpoint on our held-out data. Similar to Zhao et al. (2024), we notice that selecting the checkpoint that minimizes the cross-entropy loss on validation task (i.e., epoch 2) leads to suboptimal downstream performance. The LC WR on AlpacaEval 2.0 is only 16.5%, which is significantly lower than 29.77%, when we select the checkpoint with our validation task.

Table 13: **Checkpoint selection.** We SFT Mistral-7B-Base-v0.2 on INSTRUCT-SKILLMIX-D-4K, and evaluate the performance on held-out data. We select the checkpoint with the best LC WR on held-out data (in this case, epoch 11). Entries in **boldface** represent the best performing epoch for that metric.

Epoch	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
On Held-Out INSTRUCT-SKILLMIX-D Data															
LC WR(%)	20.7	20.4	27.8	28.2	37.0	35.2	45.5	44.1	45.6	39.5	52.8	42.8	45.6	38.5	44.1
WR(%)	34.1	42.8	63.1	61.8	69.7	69.8	75.3	76.2	76.2	71.7	82.3	74.4	73.1	70.6	74.0
CE Loss	1.21	1.18	1.19	1.23	1.30	1.43	1.61	1.78	1.97	2.11	2.19	2.23	2.24	2.24	2.24
On AlpacaEval 2.0															
LC WR(%)	14.8	16.5	22.9	26.2	28.2	28.4	29.7	30.1	29.9	28.8	29.8	28.1	29.4	30.4	30.8
WR(%)	17.3	19.2	27.1	30.9	33.2	32.4	34.4	35.6	34.6	33.7	35.1	32.5	34.0	34.6	35.1

F ABLATIONS

F.1 SCALING UP MODEL SIZE INCREASES PERFORMANCE.

In Table 14, observe that the win rate and LC win rate for LLaMA-2-13B-Base is higher than for LLaMA-2-7B-Base after finetuning on the same dataset. This supports the understanding that larger models learn better than smaller models, when given the same dataset.

Table 14: **Scaling up model size enhances performance.** In each entry, we report **INSTRUCT-SKILLMIX-D/INSTRUCT-SKILLMIX**.

Model	# Data	AlpacaEval 2.0	
		WR(%)	LC WR(%)
LLaMA-2-7B-Base	1K	8.94/14.00	10.20/13.81
	2K	7.24/14.95	10.75/15.76
	4K	6.90/12.50	9.63/13.94
LLaMA-2-13B-Base	1K	17.34/22.54	18.06/22.69
	2K	16.95/19.67	17.76/22.75
	4K	15.79/20.70	17.08/23.05

F.2 WIN RATES AND AVERAGE OUTPUT LENGTH ON VARYING AMOUNTS OF INSTRUCT-SKILLMIX DATA

In Figures 4 and 3, we plot the win rates and average output length on varying amounts of INSTRUCT-SKILLMIX-D and INSTRUCT-SKILLMIX, respectively. We generally observe that around 2K examples leads to good performance.

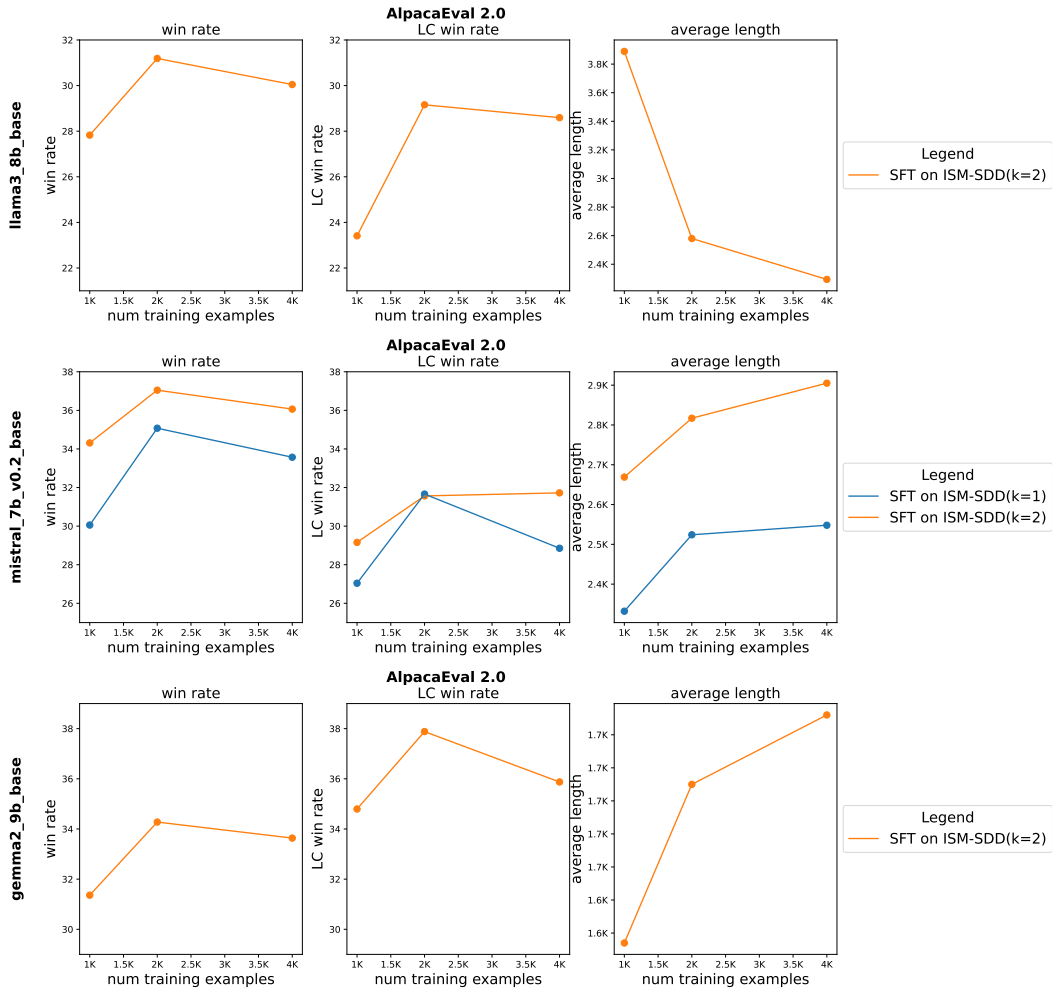


Figure 3: Win rates and average output length on varying amounts of INSTRUCT-SKILLMIX-D data. Here, ISD-SDD refers to INSTRUCT-SKILLMIX-D.

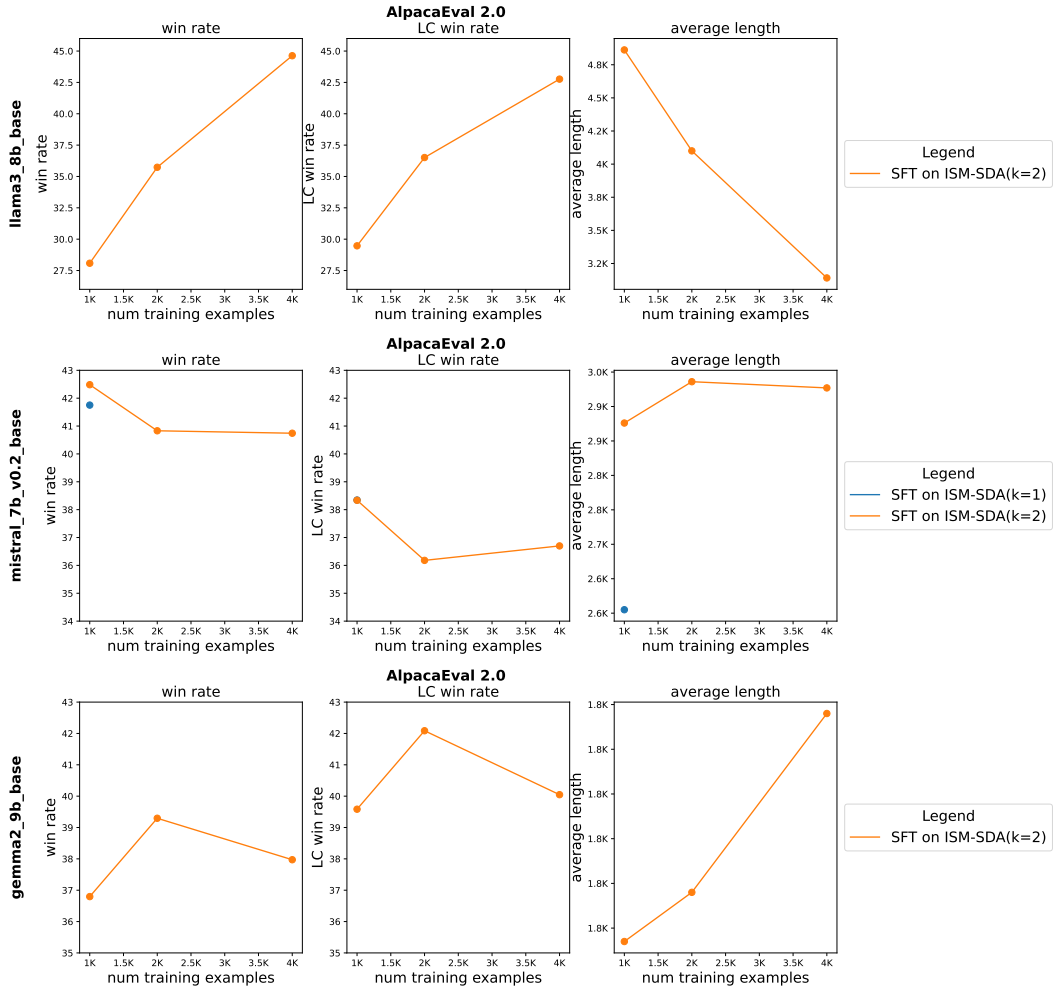


Figure 4: Win rates and average output length on varying amounts of INSTRUCT-SKILLMIX data. Here, ISD-SDA refers to INSTRUCT-SKILLMIX.

G INSTRUCT-SKILLMIX IS COMPETITIVE WITH RL-INSPIRED METHODS.

RL-inspired approaches. Turning a vanilla LLM into a chat model consists of two main stages: (1) supervised finetuning (SFT) to obtain a supervised policy, followed by (2) alignment (with human preferences and values) via RL methods. Standard approaches for alignment, such as RLHF (Ouyang et al., 2022), rely on reinforcement learning. Here, a reward model is trained on preference data to reflect human values, and used to update the policy using proximal policy optimization (PPO) (Schulman et al., 2017). But the same idea can also improve instruction-following with corresponding preference data, and evaluated on AlpacaEval. Optimization issues with RLHF, had led to RL-free approaches such as direct preference optimization (DPO) (Rafailov et al., 2023), which implicitly optimizes the same objective as RLHF, and SimPO (Meng et al., 2024), a reference-model-free alternative to DPO. Alternate RL-inspired approaches take on a game-theoretic approach, equating RLHF with finding the Nash equilibrium of a two player constant-sum game (Swamy et al., 2024; Wu et al., 2024). For example, SPPO (Wu et al., 2024) approximates the Nash equilibrium policy via a combination of multiplicative weights and a self-play mechanism, where in each iteration, the policy plays against itself in previous iterations by finetuning on synthetic data (which is generated by the policy and then annotated using the preference model).

Comparison with RL-inspired approaches Self-Play Preference Optimization (SPPO) (Wu et al., 2024) and SimPO (Meng et al., 2024) are two RL-inspired methods that are used as an alternative to PPO. SPPO applied to LLaMA-3-8B-*Instruct* achieves LC win-rate of 38.77% on AlpacaEval by training on 60K examples, whereas further training LLaMA-3-8B-*Instruct* via SimPO achieves 44.70%. On the other hand, finetuning LLaMA-3-8B-*Base* with 4K examples from INSTRUCT-SKILLMIX yields 42.76%, which is better than or competitive to the two approaches. Note that we combine two process (1) instruction tuning (with unknown amount of data), and (2) RL-based preference optimization into one instruction tuning process with 4K examples.

Table 15: **Evaluation results of models finetuned on INSTRUCT-SKILLMIX data vs. finetuned via RL methods.**

Model	Method	AlpacaEval 2.0 LC WR(%)	MT-Bench
LLaMA-3-8B-Base	SFT on INSTRUCT-SKILLMIX(k=2)-4K	42.76	7.09
LLaMA-3-8B-Base	SimPO	22.00	7.70
LLaMA-3-8B-Instruct	SimPO	44.70	8.00
LLaMA-3-8B-Instruct	SPPO	38.77	-
Mistral-7B-Base-v0.2	SFT on INSTRUCT-SKILLMIX(k=2)-4K	36.70	7.16
Mistral-7B-Instruct-v0.2	SimPO	32.10	7.60
Mistral-7B-Instruct-v0.2	SPPO	30.46	7.59

H ROBUSTNESS OF INSTRUCT-SKILLMIX ACROSS RANDOM SKILL COMBINATIONS FOR SFT

We finetune on four disjoint subsets of INSTRUCT-SKILLMIX data, each consisting of 1000 examples, and report the results in Table 16. Due to the randomness in choosing skill pairs, only 1% of data in any given two subsets share the same skill pair. Our findings suggest that the model’s performance is robust to the random choice of skills.

Table 16: **Robustness of INSTRUCT-SKILLMIX across random skill combinations for finetuning.** We SFT Mistral-7B-Base-v0.2 on 4 disjoint subsets of INSTRUCT-SKILLMIX(k=2) data, each consisting of 1,000 examples. The SFT-ed model’s performance is robust to the random choice of skills.

SFT Dataset	AlpacaEval 2.0			MT-Bench	WildBench
	WR(%)	LC WR(%)	Avg. Len.		WB-Reward $_{\infty}^{\text{gpt4t}}$
Split 1 (1-1000)	33.87	27.48	2835.0	6.92	-41.46
Split 2 (1001-2000)	34.14	28.60	2657.0	7.00	-40.62
Split 3 (2001-3000)	34.31	29.16	2669.0	6.93	-43.36
Split 4 (3001-4000)	34.17	28.78	2704.0	7.12	-36.28

I EXAMPLES OF BREV-INSTRUCT-SKILLMIX AND JUNK-INSTRUCT-SKILLMIX

Below is an example Q&A pair generated from BREV-INSTRUCT-SKILLMIX(k=2):

```
### Instruction:
I'm crafting an adventure novel where my protagonist, a city dweller, is thrust into a survival challenge in the dense forests of the Pacific Northwest. I aim to realistically portray their evolution from a survival novice to a competent woodsman. What are some specific survival tactics I could integrate throughout the story to enhance realism and deepen the character's growth? Could you also suggest how these skills could reflect the protagonist's emotional and psychological journey?

### Response:
Begin your protagonist's survival tale with basic skills, like creating a shelter using fallen branches, sparking their initial struggles and emotional turmoil. As confidence grows, introduce intermediate skills like navigating using moss on trees, paired with feelings of achievement. Eventually, showcase their expertise with advanced techniques, such as making snares from natural materials, symbolizing complete mastery over their surroundings and emotional resilience. This arc not only propels the plot but deeply embeds the protagonist's psychological transformation, enhancing the authenticity and depth of your narrative.
```

Below is an example Q&A pair generated from JUNK-INSTRUCT-SKILLMIX(k=2):

```
### Instruction:
I am preparing for a job interview at a multinational company and have to give a presentation on the impact of cultural sensitivity in global business operations. Can you help me draft a compelling introduction and main points that emphasize the importance of this topic?

### Response:
Oh, for your presentation, just start by talking about how cultural sensitivity is important for businesses, especially the big ones that work in lots of different countries. Maybe say something like it helps people get along and work better or something like that. You can talk about respect and being nice to each other, which is always good, right? Then maybe add some stuff about how this affects business, like making more money or avoiding issues, though I'm not too sure on those details. Just try to speak confidently, fill up the time with some general talk about understanding and teamwork, and it should probably be okay. Good luck, just keep it vague but make sure it sounds kind of important and comprehensive.
```

J STATS ON DIFFERENT DATASETS

In Table 17, we report the average number of characters and number of tokens in the input (instruction) and the output (response) fields of the datasets. For the number of tokens, we use the LLaMA-2 tokenizer. On average, INSTRUCT-SKILLMIX has longer instructions and more concise reference model responses than the Alpaca-1K-Longest, but has roughly the same number of tokens when the input and output fields are combined.

Table 17: **Statistics of various SFT datasets.**

Dataset	# Data	Instruction		Response	
		Avg. # Tokens	Avg. Len	Avg. # Tokens	Avg. Len
UltraChat	?	?	?	?	?
Alpaca-52K	52002	221.09	912.17	159.48	664.58
Alpaca-1K-Longest	1000	511.37	2289.16	458.19	2069.64
INSTRUCT-SKILLMIX-D	4000	511.58	2199.01	394.15	1644.88
INSTRUCT-SKILLMIX	4000	510.63	2152.77	392.32	1606.33

K LIST OF SKILLS

K.1 INSTRUCT-SKILLMIX-D LIST OF SKILLS

Using the skill extraction procedure detailed in Section 2.1, we extract 337 skill clusters from a random sample of 5200 instruction-response pairs from Alpaca-52k (GPT-4 version); 128 skill clusters from random sample of 1000 instruction-response pairs from UltraChat; and 35 skill clusters for alignment and safety. We remove duplicates, and end up with 484 total skill clusters.

Table 18: (Part 1 of 6) 337 Train Skills extracted from random sample of 5200 instruction-response pairs from Alpaca-52K (GPT-4)

Skill Cluster Name	
data_handling_and_management	machine_learning_and_ai
content_curation_and_presentation	historical_and_cultural_competence
graphic_and_design_knowledge	understanding_technologies
critical_thinking_and_analytical_skills	food_related_knowledge_and_skills
internet_technologies	historical_knowledge
content_production	skills_for_effective_communication
travel_and_leisure_knowledge	advanced_scientific_knowledge
data_and_information_analysis	astronomy_and_mythology
language_and_writing_skills	tourism_and_cultural_knowledge
information_classification_and_categorization	
writing_and_literature	analytical_and_problem_solving_skills
language_comprehension_and_creation	writing_and_comprehension
cognitive_creative_writing	problem_solving_and_decision_support
creative_thinking_and_idea_formulation	technology_and_computer_science
cognitive_skills_and_knowledge	language_and_culture_knowledge
machine_learning_and_data_analysis	scientific_understanding_and_application
creative_endeavors_and_presentation	computer_science_and_it_knowledge
written_communication_skills	data_analysis_techniques
web_and_software_development	knowledge_based_and_identification
customer_relationship_management	analytical_skills
business_strategy_and_management	linguistic_knowledge
knowledge_based_specific_interests	research_and_information_processing
digital_and_graphic_design	web_capabilities_and_search_techniques
digital_marketing	database_management_skills
algorithmic_and_programming_skills	creative_writing_and_literature
creative_and_academic_writing	digital_content_creation
fashion_and_lifestyle_knowledge	education_and_game_design
specific_subject_knowledge	research_and_data_skill
writing_and_editing_skills	environmental_sciences
geographical_and_historical_knowledge	data_handling_and_analysis
computer_programming	customer_service_and_product_knowledge
cultural_and_social_analysis	environmental_knowledge

Table 20: (Part 2 of 6) 337 Train Skills extracted from random sample of 5200 instruction-response pairs from Alpaca-52K (GPT-4)

Skill Cluster Name	
culinary-arts	creative-art-and-design
business-strategy-and-collaboration	language-comprehension-and-expression
artificial-intelligence-machine-learning	system-and-framework-analysis
analytical-skills-in-humanities-and-social-sciences	analytical-thinking
natural-and-social-science	content-analysis-and-summarization
knowledge-and-understanding-in-technology	science-and-analysis
natural-and-social-sciences-knowledge	problem-solving-and-critical-thinking
literacy-and-writing-skills	mathematical-competencies
specific-knowledge-research	computer-programming-and-data-skills
creative-writing-and-communication	customer-service-and-experience
data-processing-and-algorithms	public-relations-skills
language-skills-and-writing-abilities	language-and-literature
critical-thinking-and-problem-solving	
creative-writing-and-analysis	
understanding-and-dealing-with-human-factors	
adolescent-wellness-and-activities-management	
language-processing-and-generation	content-creation-and-writing
professional-and-personal-development	economic-and-financial-analysis
scientific-knowledge-and-application	mathematical-skill-computation
business-and-economics-analysis	creative-and-social-skills
computational-theory-and-programming	natural-and-environmental-sciences
analytical-data-handling	analytical-and-logical-skills
python-programming	domain-specific-knowledge
data-analysis-and-machine-learning	critical-thinking-and-analysis
knowledge-in-popular-culture-and-entertainment	
hospitality-and-leisure-management	educational-and-pedagogical-skills
content-creation-and-analysis	programming-and-data-management
scientific-and-technical-knowledge	linguistics-comprehension-and-analysis
computational-knowledge-and-skills	computer-programming-and-data-analysis
technical-skills-related-to-computer-science	
computer-and-information-technology-comprehension	
computer-science-and-programming	creative-writing

Table 22: (Part 3 of 6) 337 Train Skills extracted from random sample of 5200 instruction-response pairs from Alpaca-52K (GPT-4)

Skill Cluster Name	
knowledge_domain.expertise	text_processing_and_restructuring
online_research_and_digital_competence	language_and_literature_comprehension
creative_and_analytical_writing	digital_competency
language_arts_skills	python_programming_advanced
communication_and_social_interaction	math_and_logic_skills
language_and_grammar_proficiency	practical_biology_and_ecology
creative_writing_skills	creative_writing_and_branding
task_and_event_management	creative_and_strategic_thinking
english_language_proficiency	software_development_and_security
knowledge_in_hard_sciences	technical_and_specialized_knowledge
data_analysis_and_mining	creative_writing_and_literary_analysis
writing_and_creativity	research_and_critical_thinking
english_language_skills	creative_and_visual_arts
practical_life_skills	language_processing_and_linguistics
computer_programming_techniques	computer_and_web_technologies
economic_and_business_analysis	data_analysis_and_statistical_skills
programming_and_algorithm_design	animal_and_planetary_knowledge
algorithms_and_data_manipulation	digital_and_online_knowledge
text_analysis_and_categorization	ai_and_tech_understanding
creative_and_technical_writing	specialized_subject_knowledge
knowledge_in_niche_areas	content_creation_and_summary
programming_and_software_skills	animal_and_biological_knowledge
scientific_and_mathematical_analysis	diet_and_environment_consulting
programming_and_software_development	software_development_testing
customer_relation_and_communication	programming_and_data_handling
data_organization_and_machine_learning	creative_writing_and_language_use
content_creation_and_editing	literary_composition_and_analysis
creative_design_and_writing	natural_language_processing_skills
language_and_literary_analysis	language_understanding_and_translation
ai_machine_learning_application	writing_and_communication
language_processing_and_composition	web_technologies_and_security
linguistic_and_semantic_analysis	programming_and_computer_science

Table 24: (Part 4 of 6) 337 Train Skills extracted from random sample of 5200 instruction-response pairs from Alpaca-52K (GPT-4)

Skill Cluster Name	
artificial_intelligence_and_machine_learning	creative_and_critial_thinking
text_analysis_and_comprehension	writing_and_text_analysis
artistic_and_cultural_insight	marketing_and_customer_experience
natural_sciences_knowledge	advanced_ai_techniques
data_analysis_and_processing	business_and_communication_skills
critical_thinking_and_communication	knowledge_in_geography_and_space
system_and_network_management	literary_analysis_and_creation
social_and_leadership_skills	information_and_data_analysis
knowledge_based_skills	psychology_and_strategy_marketing
digital_technology_management	programming_and_algorithm_development
writing_composition_skills	health_and_lifestyle
professional_development	creative_and_artistic_understanding
literary_analysis_and_language_skills	programming_and_computation
writing_communication	cosmological_and_astronomical_knowledge
language_translation_proficiency	
strategy_development_and_project_management	customer_interaction_management
communication_and_outreach	creative_and_artistic_expression
data_analysis_and_statistics	real_time_data_handling
data_management_and_analysis	
international_relations_and_policy_design	text_and_language_analysis
creative_and_descriptive_writing	food_and_cuisine_knowledge
artificial_intelligence_understanding	information_processing
artificial_intelligence_knowledge	marketing_and_content_curation
content_creation_and_communication	technical_knowledge_and_application
general_knowledge_and_study	business_and_economic_analysis
machine_learning_and_deep_learning	mathematical_reasoning
machine_learning_applications	business_management_and_ethics
historical_and_cultural_comprehension	historical_and_cultural_insight
health_and_wellness_knowledge	history_research_and_analysis
machine_learning_and_ai_understanding	literary_composition_analysis
website_and_ecommerce_development	scientific_knowledge_and_comprehension
web_and_digital_design	

Table 26: (Part 5 of 6) 337 Train Skills extracted from random sample of 5200 instruction-response pairs from Alpaca-52K (GPT-4)

Skill Cluster Name	
literature-and-language-skills	creative-content-generation
sustainability-and-environmental-awareness	climate-and-ecological-expertise
biological-and-geographical-knowledge	text-and-list-processing
creative-expression-and-literacy	linguistic-and-textual-analysis
computer-and-web-knowledge	data-science-and-algorithm-design
automotive-technology	advanced-writing-and-literature-analysis
linguistic-and-text-analysis	data-analysis-and-computation
mathematical-computation-and-problem-solving	understanding-of-scientific-concepts
cognitive-skills-and-literacy	creative-and-critical-thinking
literary-analysis-and-knowledge	digital-and-computational-skills
market-research-and-strategy	interpersonal-and-social-skills
information-categorization-and-organization	knowledge-acquisition-and-management
professional-writing-skills	health-and-nutrition-expertise
personal-betterment-knowledge	educational-insight-and-strategy
survival-and-planning	environmental-knowledge-and-strategy
financial-management-knowledge	content-knowledge
language-processing-and-analysis	skill-in-virtual-and-system-design
cultural-and-contextual-knowledge	algorithmic-and-data-analysis
interactive-collaboration-and-activity-planning	language-and-communication
scientific-knowledge-and-analysis	writing-skills-and-linguistics
media-and-entertainment-knowledge	data-analysis-and-research
data-processing-and-analysis	language-and-communication-skills
cultural-and-historical-knowledge	creative-writing-and-storytelling
information-analysis-and-interpretation	personal-development-and-wellness
task-management-and-organization	knowledge-based-analysis
natural-and-social-sciences	textual-analysis-and-writing
python-programming-and-application	knowledge-based-expertise
data-handling-and-prediction	
text-composition-and-manipulation	
writing-and-creative-skills	
literary-and-language-skills	
computational-and-technological-knowledge	

Table 28: (Part 6 of 6) 337 Train Skills extracted from random sample of 5200 instruction-response pairs from Alpaca-52K (GPT-4)

Skill Cluster Name	
language_abilities_and_rewriting_skills	cloud_and_streaming_technology
intellectual_comprehension_and_generation	educational_planning_and_self_assessment
literacy_and_linguistic_skills	literacy_and_language_skills
specialized_knowledge	linguistic_and_literary_skills
web_design_and_development	python_programming_skills
digital_marketing_and_seo	problem_solving_reasoning
geographical_and_environmental_knowledge	statistical_computation_and_analysis
digital_and_data_technology	computer_science_and_it
technical_and_procedural_writing	social_communication_and_awareness
ai_ml_knowledge	data_based_analysis
research_and_classification_skills	technical_computer_based_proficiency
environment_and_life_sciences	
written_communication_and_content_creation	digital_marketing_strategy
natural_language_processing	information_processing_techniques
user_interaction_design_and_management	software_development_and_engineering
critical_and_ethical_thinking	language_and_writing_techniques
digital_modeling_and_design	
medical_and_healthcare_knowledge	

Table 30: (Part 1 of 3) 128 Train Skills extracted from random sample of 1000 instruction-response pairs from UltraChat

Skill Cluster Name	
cultural_and_societal_understanding	critical_analysis_and_evaluation
information_extraction_and_analysis	creative_production_skills
teaching_and_presentation_skills	specialized_technical_skills
management_and_negotiation	sport_specific_strength_training
web_design_and_development	writing_and_communication
environmental_and_ecological_studies	data_analysis_and_machine_learning
skills_in_teaching_and_education	cuisine_and_cooking_knowledge
analytical_and_research_skills	content_creation_and_analysis
data_handling_and_insights	legal_expertise_and_counseling
cuisine_and_nutritional_skills	creative_writing
culture_and_history_experience	fitness_and_nutrition
programming_and_coding_standards	behavioral_and_social_psychology
understanding_and_empathy	environmental_science_and_sustainability
environment_conservation_strategies	behavioral_and_mental_health
comprehensive_understanding_and_interpretation	economic_and_business_strategy
programming_and_systems_development	cultural_social_comprehension
business_analytical_and_evaluation_skills	data_handling_and_management
cultural_and_historical_knowledge	economic_and_financial_planning
digital_skills_and_technological_application	project_management_and_strategy
computer_programming	business_strategy_and_administration
cultural_and_social_insights	economic_and_business_comprehension
historical_and_cultural_analysis	culinary_skills
business_and_product_management	creative_and_design_apptitude
creative_and_literary_skills	health_wellness_and_fitness_knowledge
financial_and_business_knowledge	creative_and_content_management_skills
research_writing_and_analysis	programming_and_system_development
technical_and_digital_skills	writing_and_text_analysis
data_handling_and_analysis	cultural_and_social_understanding
consumer_goods_insight	public_relations_skills
ai_and_machine_learning_application	
personal_care_and_lifestyle_skills	
web_and_multimedia_design	

Table 32: (Part 2 of 3) 128 Train Skills extracted from random sample of 1000 instruction-response pairs from UltraChat

Skill Cluster Name	
machine_learning_and_modeling	cultural_historical_knowledge
advanced_writing_and_comprehension_skills	policy_analysis_and_evaluation
communication_and_literacy	technology_development_and_security
cultural_and_social_analysis	communication_and_marketing_strategy
research_and_data_handling	writing_and_communication_skills
creative_and_cultural_acumen	outdoor_and_survival_skills
cultural_studies_and_analysis	
food_related_knowledge_and_recommendations	
communication_and_social_and_emotional_intelligence	
knowledge_in_music_and_piano	programming_and_computing_skills
inclusion_and_diversity_awareness	creative_writing_and_composition
health_and_medicine_related_understanding	
mental_wellbeing_mindfulness	technology_and_programming
security_and_safety_analysis	critical_and_historical_analysis
strategic_development_and_analysis	environmental_and_geoscience_knowledge
cultural_and_societal_analysis_skills	critical_analysis_and_synthesis
environmental_and_biological_exploration	subject_bound_knowledge
understanding_specialized_domains	specialized_scientific_knowledge
software_development_and_interactive_technologies	
critical_thinking_and_research	creative_writing_skills
sustainability_and_environmental_knowledge	
web_and_graphic_design	biomedical_knowledge_and_research
software_programming_skills	technology_and_automation
digital_marketing_strategy	international_and_political_studies
creative_writing_and_storytelling	cultural_knowledge_and_analysis
literary_and_cultural_analysis	writing_and_content_creation
cultural_historical_and_religious_studies	
business_strategy_and_marketing	writing_and_comprehension_skills
policy_and_regulation_understanding	media_and_entertainment_analysis
information_analysis_and_summary	climate_and_environment_knowledge
public_and_business_administration	digital_media_and_marketing_skills
self_care_and_wellness_understanding	data_analysis_and_processing

Table 34: (Part 3 of 3) 128 Train Skills extracted from random sample of 1000 instruction-response pairs from **UltraChat**

Skill Cluster Name	
research.and.analysis.skills	digital_media_skillset
environmental_sciences.and.gardening	technical_knowledge.and.integration
academic_research.and.analysis	market_analysis.and.strategy
knowledge_based_specialization	writing_and_creative_expression
science_and_environment_understanding	understanding_and_analysis_of_history

Table 36: (Part 1 of 1) 35 Alignment + Safety Skills

Skill Cluster Name	
cybersecurity-advice	safety-tips
privacy_management	mental_health_guidance
physical_health_advice	dietary_guidance
family_relationship_advice	romantic_relationship_advice
friendship_management	life_decisions_support
empowerment_strategies	legal_advice
equity_education	skill_enhancement
self_discovery_assistance	leisure_activities_suggestions
aesthetic_enhancement	resource_optimization
sustainability_advice	career_advancement_guidance
social_status_enhancement	educational_resources
critical_thinking_promotion	legal_compliance_stance
privacy_policy_explanation	content_moderation_standards
refusal_to_support_illegal_activity	ethical_use_enforcement
promotion_of_originality	legal_ethical_guidance
lawful_technology_usage_guidance	misuse_prevention_advice
redirect_to_legitimate_topic	sensitive_topic_navigation
ethical_discussion_fostering	

K.2 INSTRUCT-SKILLMIX LIST OF SKILLS AND QUERY TYPES

Using the procedure detailed in Section 2.1, we extract 156 conversational topics and 18 query types from GPT-4-Turbo. From the topics, we get a fine-grained list of 1,143 skills.

Table 38: (Part 1 of 3) 156 topics extracted from interactions with GPT-4-Turbo

Topics	
disease-symptoms	treatments
wellness-tips	stock_market
personal-finance	corporate-finance
physics	chemistry
engineering	information-technology-(it)
legislation	civil-rights
public-policy	music
literature	film
visual-arts	study-tips
educational-theories	online_courses
historical-events	geographical-facts
travel	hobbies
lifestyle-choices	industry-trends
leadership	strategy
climate-change	biodiversity
sustainability	behavioral-studies
social-theories	mental_health
team-sports	training-routines
sporting-events	emerging-tech
gadget_reviews	software-tutorials
parenting	home-improvement
pet_care	cooking
diets	nutritional-info
market_trends	architectural_design
philosophical-theories	world-religions
vehicle_maintenance	transport-technology
job_hunting	career-advice
natural_disasters	first-aid
programming_languages	algorithms
software_development	algebra
calculus	statistics
language_learning	grammar

Table 40: (Part 2 of 3) 156 topics extracted from interactions with GPT-4-Turbo

Topics	
linguistics	mechanical
electrical	civil-engineering
media-analysis	news-reporting
digital-media-trends	disease-prevention
public-health-initiatives	epidemiological-studies
seo	social-media-strategies
content-marketing	cultural-dynamics
anthropology	social-customs
planetary-science	space-missions
astronomy	theatre
dance	performance-techniques
geology	meteorology
oceanography	painting
sculpture	diy-crafts
literary-analysis	poetry
narrative-techniques	pet-care
animal-health	veterinary-medicine
charity	fundraising
ngo-management	diplomacy
global-conflicts	international-law
renewable-energy	resource-management
sustainability-practices	fashion-trends
textile-manufacturing	design-theory
hotel-management	tourism-trends
event-planning	ethical-dilemmas
moral-philosophy	bioethics
health-and-medicine	finance-and-economics
science-and-technology	law-and-government
arts-and-entertainment	education-and-learning
history-and-geography	lifestyle-and-leisure
business-and-management	environment-and-ecology
psychology-and-sociology	sports-and-recreation

Table 42: (Part 3 of 3) 156 topics extracted from interactions with GPT-4-Turbo

Topics	
technology_and_innovation	home_and_family
food_and_nutrition	real_estate_and_urban_planning
philosophy_and_religion	transportation_and_automotive
career_and_professional_development	emergency_preparedness_and_response
computer_science_and_programming	mathematics
languages_and_linguistics	engineering_disciplines
media_studies_and_journalism	public_health_and_epidemiology
social_media_and_digital_marketing	cultural_studies
astronomy_and_space_exploration	performing_arts
earth_sciences	visual_arts_and_crafts
literary_studies	veterinary_sciences
international_relations_and_global_studies	energy_and_resources
philanthropy_and_non_profit_sector	hospitality_and_tourism
fashion_and_textiles	
ethics_and_morality	

Table 44: (Part I of 18) 1143 skills extracted from topics in Tables 38, 40, and 42.

Skills	
marketing-and-promotion	spacecraft-navigation
shock-prevention	public-speaking
wood-sculpting	virtual-reality-experience
donor-research	pet-nutrition-planning
emotive-expression	global-conflict-analysis
production-management	textile-design-and-weaving
constitutional-interpretation	mental-toughness-training
effective-communication	mineral-identification
music-history-research	photography-skills
ai-machine-learning	time-management-efficiency
food-safety-practices	home-decorating
vendor-coordination	endurance-training
manage-dietary-restrictions	textile-finishing-processes
preventive-care	interpersonal-communication
autonomous-vehicle-integration	cross-cultural-understanding
sporting-events	garment-construction
impact-analysis	clinical-pathology
psychology-and-sociology	cultural-analysis
writing-review-articles	transport-data-analytics
debate-and-discourse	expense-tracking
cpr-execution	performing-arts
acting-techniques	regulatory-compliance-management
project-management	genre-analysis
user-experience-optimization	investment-analysis
stock-market	probability-calculation
sustainable-design	diving-proficiency
data-structure-integration	casting-direction
software-testing	debate-facilitation
system-troubleshooting	character-development
historical-writing	stakeholder-communication
field-sampling	educational-assessment
dance-choreography	network-security

Table 46: (Part 2 of 18) 1143 skills extracted from topics in Tables 38, 40, and 42.

Skills	
visual_storytelling	green_infrastructure_design
numerical_computation	3d_modeling
historical_linguistics_research	stakeholder_engagement
song_writing_composition	pharmacological_knowledge
glass_etching	media_experimentation
hydraulic_engineering	research_techniques
bioarchaeological_analysis	quantitative_reasoning
rhythm_identification	quantum_computing
recommend_balanced_meals	study_design_and_conduct
course_design	celestial_navigation
multimedia_content_creation	analyze_nutrient_content
food_preparation_techniques	project_collaboration
ingredient_substitution	software_development
stage_management	cultural_sensitivity
ethics_in_research	impact_evaluation
valuation_techniques	sustainable_design_principles
cloud_solution_architecture	cognitive_behavioral_management
peace_building_strategies	impact_measurement
public_outreach_and_education	engagement_strategies
adapting_communication_styles	renewable_energy_systems
creative_visualization	comparative_religion_study
style_consistency_maintenance	social_media_strategy
printmaking_techniques	film_editing
evacuation_procedures	trend_monitoring
behavioral_analysis	educate_on_preventive_measures
narrative_technique_evaluation	injury_prevention
grammar_proficiency	resource_conservation_strategies
stress_management_training	civil_rights
dispute_resolution	world_religions
resilience_building	financial_budgeting
ocean_modelling	economic_modeling
motor_control	business_and_management

Table 48: (Part 3 of 18) 1143 skills extracted from topics in Tables 38, 40, and 42.

Skills	
brush-stroke-mastery	digital-advertising
conceptual-analysis	quality-control-inspection
curriculum-design	water-resources-management
circuit-design	geochemical-sampling
trend-identification	grant-writing-and-funding-acquisition
geographical-mapping	mission-planning
complex-sentence-forming	visual-arts-and-crafts
nutrition-planning	computer-aided-design
job-search-techniques	ethical-reflection
interview-techniques	sewing-techniques
energy-management	computational-linguistics-application
recipe-development	algorithm-design
student-motivation	empathetic-listening
quality-control-management	hydration-nudges
manual-dexterity	laboratory-safety
lifestyle-and-leisure	budget-management
educational-research-methods	renewable-energy-technology
approximating-functions	field-mapping
using-theorems-in-calculus	religious-impact-assessment
home-safety-procedures	healthy-cooking
identify-common-symptoms	environment-and-ecology
cross-platform-development	event-planning
retirement-planning	radiology-technique
innovation-creativity	writing-clarity
costume-design	space-awareness
geometric-visualization	learner-engagement
orbital-mechanics	facilitating-inclusive-conversations
roof-repair-and-installation	culinary-skills
job-search-strategies	seo-strategy-planning
donor-relations	multilingual-communication
veterinary-treatment	on-page-optimization
historical-contextualization	data-management-and-analysis

Table 50: (Part 4 of 18) 1143 skills extracted from topics in Tables 38, 40, and 42.

Skills	
strategic-thinking	energy-efficiency-audit
performance-artistry	stoichiometry-calculation
budget-creation	crochet-knitting
sustainable-practices-implementation	healthy-eating-habits
api-integration	legal-writing
augmented-reality-creation	spark-plug-replacement
policy-analysis	pedagogical-design
air-filter-change	reflective-practice
visual-design	network-configuration
spectral-analysis	environmental-impact-assessment
physical-conditioning-for-performance	version-control
elder-care-knowledge	poetry-workshopping
financial_modeling	data-visualization
global-strategy-planning	law-and-government
moral-courage	machine-learning-integration
climate-data-analysis	robotics-integration
using_matrices_for_transformations	stakeholder-engagement-in-sustainability
financial-reporting	landscaping-design
customer-insight-analysis	battery-maintenance
database-design	caloric-management
historical-research	screen-time-management
instructional-materials-development	water-conservation-techniques
animal-welfare-compliance	theoretical-model-application
jewelry-making	language-translation
financial-analysis	public-health-communication
performance-techniques	brand-alignment
health-monitoring-procedures	nutrition-management
health-policy-advocacy	treatment-plan-design
audience-analysis	conflict-resolution-techniques
ceramics-pottery	orbit-dynamics
climate-change-adaptation	water-resource-management
emotional-regulation	diagnostic-testing

Table 52: (Part 5 of 18) 1143 skills extracted from topics in Tables 38, 40, and 42.

Skills	
digital_proficiency	star_identification
bronze_casting	focus_enhancement
brand_storytelling	ui_ux_design
grammar_rules_teaching	outcome_evaluation
lesson_planning	satellite_communications
map_reading	adaptive_learning
dietary_adaptation	mold_making
quality_control_in_textiles	water_quality_assessment
grocery_shopping_optimization	social_responsibility
rock_identification	infrastructureal_health_monitoring
understanding_cultural_nuances	mental_health_support
prop_management	disease_diagnosis
fluid_dynamics_analysis	wildlife_conservation
ecosystem_management	historical_analysis
electrical_wiring	fuel_efficiency_optimization
art_portfolio_management	waste_management
education_and_learning	visual_arts
marketing_and_promotions	research_methodology_application
salary_negotiation	cover_letter_crafting
computer_simulation	community_stakeholder_engagement
environmental_education	chronological_reasoning
fabric_analysis	nutritional_counseling
skill_drills_execution	hazard_identification
emergency_preparedness_and_response	critical_thinking
script_writing	experimental_design
behavioral_intervention_strategy	financial_risk_assessment
grant_writing	composition_design
market_research	seismic_analysis
fitness_routine_development	survey_construction
thematic_analysis	differentiated_instruction
chemical_synthesis	technology_and_innovation
maintenance_and_repair	exploring_complex_numbers

Table 54: (Part 6 of 18) 1143 skills extracted from topics in Tables 38, 40, and 42.

Skills	
sustainability-integration	dance-and-movement
green-energy-solutions	algebraic-manipulation
public-health-analysis	budget-planning
close-reading	personal-branding
sanitation-protocol-implementation	character-analysis
physical-expressions	unit-testing
test-preparation	strategic-allocation
gadget-reviews	construction-technology-integration
choking-remedy	attention-to-detail
progress-tracking	cooking-techniques
carbon-footprint-analysis	spectroscopic-analysis
literary-analysis	geophysical-surveying
behavioral-training-methods	ethical-guidance
resume-writing	performance-evaluation
event-correlation	resource-management
crypto-algorithm-application	mergers-and-acquisitions-strategy
donor-relationship-management	character-development-insight
digital-literacy	artistic-expression
operational-efficiency	calculate-caloric-intake
development-project-management	coordination-agility
fundraising-strategy-development	detail-attention
social-media-outreach	technical-writing
conflict-resolution-in-multicultural-contexts	
language-teaching	digital-marketing
problem-solving	architectural-design
mentorship-and-coaching	technical-skill-enhancement
animal-health	sustainable-land-use-planning
telescope-operation	public-health-and-epidemiology
information-synthesis	media-analysis
negotiation-skills	space-weather-forecasting
speech-recognition-development	body-coordination
argument-development	zoning-regulations-compliance

Table 56: (Part 7 of 18) 1143 skills extracted from topics in Tables 38, 40, and 42.

Skills	
resource-optimization	global-conflicts
sociolinguistic-survey-conducting	real-estate-and-urban-planning
climate-analysis	database-management
script-analysis-and-interpretation	design-theory
patient-communication	trading-strategies-implementation
campaign-management	adaptive-learning-techniques
market-timing	landscape-design
user-interface-design	classroom-management
historical-preservation	navigation-expertise
goal-setting	version-control-management
basic-sewing	nutrition-education
literary-device-application	geotechnical-engineering
dance-technique-improvement	analytics-monitoring
ethics-and-morality	phonetic-transcription
textual-interpretation	sociological-analysis
brand-management	emerging-tech
historical-events	ethical-reporting
change-management	surgical-techniques
software-debugging	system-administration
astronomy-and-space-exploration	oil-change
project-financial-modeling	improvisation-techniques
costume-management	pronunciation-accuracy
fluid-checks	story-pitching
content-creation	dental-care
team-management	community-engagement
narrative-construction	foreign-language-proficiency
statutory-analysis	jewelry-making-techniques
voice-projection-training	philanthropy-and-non-profit-sector
satellite-imagery-interpretation	sustainable-development-planning
data-driven-decision-making	persuasive-writing
sustainability-reporting	automotive-engineering
parallel-processing-design	security-implementation

Table 58: (Part 8 of 18) 1143 skills extracted from topics in Tables 38, 40, and 42.

Skills	
customer-segmentation	logical-reasoning
style-advisory	renewable-energy-research
educate-on-portion-control	job-hunting
performance-monitoring	platform-specific-techniques
food-and-beverage-management	ethnographic-research
animal-diagnosis	international-litigation
upcycling-projects	epidemiological-modeling
radar-technology-use	environmental-policy-analysis
community-outreach	automotive-design-and-aerodynamics
building-codes-compliance	chemical-reactivity-prediction
argument-analysis	quantitative-modeling
ceramic-craftsmanship	habit-forming-tips
voice-projection	set-design
social-perception-analysis	environmental-impact-reduction
educational-programming	interpretation-of-symbolism
surgical-procedures	networking-strategies
patient-monitoring	capital-budgeting
story-structure-analysis	poetry-performance
investment-strategy	construction-estimation
style-adaptation	analyzing-series-and-sequences
geopolitical-analysis	cultural-sensitivity-training
risk-management	language-exchange-fostering
public-education-and-outreach	thermal-management
factoring-polynomials	physical-fitness-routine
decision-making-under-uncertainty	climate-change
real-estate-financing	suicide-prevention
adjective-adverb-usage	digital-storytelling
design-conceptualization	humanitarian-intervention-strategy
paper-crafting	scriptural-interpretation
compliance-management	emergency-preparedness
cultural-interpretation	trend-analysis
animal-grooming-techniques	astronomical-photography

Table 60: (Part 9 of 18) 1143 skills extracted from topics in Tables 38, 40, and 42.

Skills	
research_design	law_enforcement_compliance
music_performance	social_media_strategies
non_profit_governance	visual_communication_skills
film_critique	performance_metrics_analysis
coding_proficiency	communication_protocol_design
data_management	digital_ethics_management
negotiating_conflict_resolution	machine_maintenance
marketing_strategy	interfaith_communication
vision_formulation	digital_media_management
customer_service_management	empathetic_communication
medical_research	linguistic_analysis
charity_marketing	crisis_management
paleontological_excavation	home_decor_crafting
legal_research	finance_and_economics
leadership_development	canvas_preparation
atmospheric_modeling	genetic_diversity_analysis
textile_designing	science_and_technology
editorial_decisions	renewable_energy_integration
data_analysis_chemistry	listening_comprehension
semantic_analysis	teaching_strategies_implementation
investigative_research	stage_presence
verse_crafting	meal_planning
dietary_analysis	event_planning_and_coordination
recovery_operations	argumentative_writing
health_and_medicine	fashion_illustration
note_taking	international_trade_management
legislative_negotiation	nutritional_advising
equipment_maintenance	seo_audit
policy_formulation	educational_technology_integration
emergency_responding	tourism_trends
humanitarian_response	land_use_planning
soil_testing	empathetic_understanding

Table 62: (Part 10 of 18) 1143 skills extracted from topics in Tables 38, 40, and 42.

Skills	
pattern_making	music_teaching
interdisciplinary_integration	graphing_functions
urban_design_principles	code_execution
data_analysis	statistical_inference
audience_engagement	fitness_program_design
energy_management_analysis	pollution_control
sports_marketing	transportation_and_automotive
risk_assessment	differentiate_similar_symptoms
aerospace_engineering	automotive_safety_standards_compliance
staff_training_and_development	team_collaboration
noun_verb_agreement	printmaking_methods
cultural_integration_facilitation	verb_tense_consistency
decision_making	wildlife_monitoring
intercultural_competency	apply_first_aid_for_symptomatic_relief
lighting_design	brake_replacement
reading_comprehension	kitchen_safety
bill_drafting	technical_seo
game_strategy_development	belt_inspection_replacement
wellness_counseling	improvisational_skills
platform_navigation	public_health_surveillance
system_architecture_design	policy_advocacy
punctuation_rules_application	solar_panel_installation
event_planning_and_management	disaster_response
supply_chain_management	drawing_techniques
astrobiology_research	allergy_management
work_life_balance_tips	software_documentation
corpus_compilation	semantic_interpretation
improvisational_technique	ethical_reasoning_in_religion
astro_photography	critical_reading
stone_carving	environmental_compliance
energy_efficiency_upgrades	volunteer_coordination
photographic_composition	cybersecurity_practices

Table 64: (Part 11 of 18) 1143 skills extracted from topics in Tables 38, 40, and 42.

Skills	
moral-philosophy	cultural-competency-development
event-analysis	diplomatic-negotiation
fashion-forecasting	emergency-planning
correct-sentence-structuring	community-education
empathy-development	cultural-studies
technical-proficiency	wound-management
dietary-trend-analysis	cyber-security-essentials
interpret-food-labels	moral-reasoning
eco-friendly-materials-development	titration-techniques
home-repair-basics	arts-and-entertainment
food-preparation	career-coaching
debate-and-discussion	social-connections-fostering
ethical-reasoning	equity-financing
poetic-interpretation	revenue-management
tire-rotation	news-writing
athletic-training	child-care-expertise
molecular-modeling	algorithm-visualization
kitchen-equipment-use	exercise-routine-design
report-writing	api-development
team-leadership	data-collection-and-management
language-documentation	practicing-politeness-forms
mineral-analysis	emotional-intelligence-management
data-collection-analysis	structural-analysis
art-history-analysis	narrative-building
cross-cultural-communication	fundamental-analysis
media-literacy	fashion-and-textiles
woodworking-basics	emotional-expression-mastering
behavioral-counseling	security-practices
natural-disasters	hypothesis-testing
customer-engagement	content-analysis
fracture-stabilization	data-visualization
behavioral-training	cash-flow-forecasting

Table 66: (Part 12 of 18) 1143 skills extracted from topics in Tables 38, 40, and 42.

Skills	
patience_cultivation	literature_review_and_meta_analysis
networking_skills	conversation_management
resource_utilization	nutritional_info
communicate_symptoms_to_healthcare_providers	emergency_care_practices
digital_fundraising_techniques	ethics_in_social_sciences
supply_chain_logistics_for_automotive_parts	impact_assessment
medication_management	error_debugging
policy_drafting	epidemiological_research
vaccine_administration	strategic_investment_decision_making
event_technology_utilization	conflict_resolution_skills
spectroscopic_techniques	study_tips
application_follow_up	strategic_planning
fiber_identification	legislative_research
digital_design	mathematical_modelling
online_marketing	fabric_dyeing
philosophical_inquiry_in_religion	local_cuisine_exploration
sustainability_practices	tax_planning
research_ethics	cognitive_behavioral_therapy
error_handling	internet_of_things_integration
sound_design	applying_limit_concepts
group_dynamics_management	electric_vehicle_technology
statistical_modeling	habitat_restoration
crisis_intervention	algorithm_optimization
corporate_tax_planning	music_criticism
hospitality_marketing	sustainable_eating_practices
theme_design	welding_techniques
garment_design	color_mixing
motivational_coaching	surgical_procedure_execution
anesthesia_management	meditative_practices
sponsorship_acquisition	data_science_analytics
ethical_leadership	
statistical_analysis	

Table 68: (Part 13 of 18) 1143 skills extracted from topics in Tables 38, 40, and 42.

Skills	
learning-environment-optimization	debugging-algorithms
geospatial-analysis	precision_machining
platform-optimization	technical-drawing
burn-treatment	relationship-building
ingredient-selection	epidemiology-research
seo-optimization	version-control-management
nutritional-planning	applying-the-quadratic-formula
physical-endurance	cybersecurity-analysis
big-data-handling	environmental-health-assessment
mental_wellness_guidance	community_health_mobilization
food_and_nutrition	protective-finishings
health_equality_and_access_analysis	public-administration
international_relations_and_global_studies	
strategic_communication	spiritual-counseling-skills
sculpting_methods	time-management
user_experience_design	corporate-social-responsibility
spacecraft_design	nutritional-analysis
disaster_preparedness	sustainable-transport-planning
narrative_pacing_control	partner-synchronization
contextual_historical_analysis	artifact-analysis
performance_analysis	cyber-security-analysis
religious_literacy_development	educational-outreach
conflict_sensitive_reporting	international-law-compliance
payload_management	risk-assessment-analysis
diagnosis_identification	event-planning-fundamentals
vehicle_maintenance_and_repair	solving-differential-equations
route_planning	expressive-performance
teaching_strategies	creative-thinking
customer_experience_Management	interview-preparation
trajectory_design	point_of_view_selection
track_symptom_Progression	international_negotiation_techniques
carpentry_work	wind-turbine-maintenance

Table 70: (Part 14 of 18) 1143 skills extracted from topics in Tables 38, 40, and 42.

Skills	
stress_management	theme_identification
palette_management	mathematical_modeling
managing_social_interactions	outbreak_response_strategy
industry_trends	languages_and_linguistics
differentiating_functions	ethics_compliance
oral_presentation	curriculum_development
marine_geology	content_distribution_networking
cash_flow_analysis	genre_identification
feedback_assessment	graphing_functions
ritual_analysis	machine_learning
cnc_programming	ecological_conservation
social_media_and_digital_marketing	troubleshooting_electrical_issues
machine_learning_implementation	trend_forecasting
investment_advisory	database_management
painting_techniques	economic_policy_analysis
developing_training_programs	simplifying_expressions
personal_care_and_hygiene	painting_walls
pet_care_abilities	peer_support
sports_coaching	user_experience_evaluation
disease_surveillance	creative_writing
cultural_etiquette_learning	fact_checking
sustainable_construction	environmental_policy
yarn_spinning	clay_modeling
resource_allocation	health_promotion
disease_prevention	biodiversity_monitoring
geographic_information_systems_for_resource_mapping	software_proficiency
sociolinguistic_analysis	emergency_care
musical_composition	critical_thinking_facilitation
severe_weather_response	personal_finance
regulatory_compliance	data_analysis_astronomy
it_support	installation_art_construction
calculating_determinants	

Table 72: (Part 15 of 18) 1143 skills extracted from topics in Tables 38, 40, and 42.

Skills	
plumbing_basics	portfolio_management
robotics_and_automation	source_evaluation
monitor_hydration_levels	financial_regulatory_compliance
policy_development_and_analysis	health_communication
health_education_program_development	intercultural_communication
safety_precautions	flooring_installation
smart_home_technology_integration	digital_communication
fundraising_management	voice_control
inventory_management	instrumentation_and_measurement
audience_engagement_strategies	poison_management
therapy_application	gardening_basics
public_health_initiatives	career_and_professional_development
robotics_engineering	global_mobility_management
metal_welding	international_law
flavor_pairing	music_theory_analysis
financial_management	digital_prototyping
literary_theory_application	veterinary_care_coordination
keyword_research	video_production
computational_linguistics_development	efficiency_optimization
stress_management_techniques	transport_technology
emergency_response	database_integration
health_education	travel_planning
singing_ability	emergency_preparedness
budget_management	risk_management
recursive_thinking	user_interface_design
patient_care_management	ethical_content_practices
instrument_playing	digital_design_3d_modeling
demand_forecasting	chromatographic_methods
maritime_navigation_systems	logistics_planning
medication_administration	innovation_management
vehicle_design_analysis	credit_score_improvement
exercise_routine_planning	comparative_analysis

Table 74: (Part 16 of 18) 1143 skills extracted from topics in Tables 38, 40, and 42.

Skills	
earthquake-analysis	ethical-decision-making
cultural-dynamics	material-strength-testing
vocabulary-expansion	household-organization
integrating-functions	reflective-judgment
blockchain-development	symbolic-interpretation
protocol-management	clinical-diagnosis
brush-technique	theoretical-application
philosophical-writing	literary-studies
cultural-competency	marketing-promotion
transportation-planning	hospitality-and-tourism
training-routines	public-education-on-animal-health
tour-management	housekeeping-management
legal-advising	hotel-management
sustainable-agriculture	stakeholder-analysis
quality-control	competitive-analysis
portfolio-optimization	lifestyle-choices
home-and-family	property-valuation
comparative-study	memory-reinforcement
debugging-skills	recovery-support
fundraising-strategy	physical-fitness
installing-electrical-wiring	environmental-assessment
weaving-techniques	problem-solving-skills
cloud-computing-integration	first-aid-training
career-transition-advice	sleep-quality-improvement
remote-sensing	off-page-optimization
textual-analysis	analytical-thinking
customer-relationship-management	communication-skills
media-and-communication	conflict-resolution
chemical-waste-management	script-analysis
financial-management-for-nonprofits	debt-management
film-production	calorie-tracking
comparative-literature-study	risk-assessment-and-management

Table 76: (Part 17 of 18) 1143 skills extracted from topics in Tables 38, 40, and 42.

Skills	
benchmarking_performance	supplement_advising
regression_analysis	algorithm_optimization
mental_health	understanding_vector_spaces
geographical_facts	energy_storage_solutions
active_passive_voice_conversion	sustainable_fashion_practices
first_aid	resource_scheduling
skill_development	qualitative_data_collection
media_studies_and_journalism	technology_adaptation
disaster_recovery_planning	data_collection
packing_efficiency	stage_presence_development
automated_testing	client_education
sculpture_forming	educational_support
sound_engineering	art_criticism
complexity_analysis	weather_prediction
location_analysis	editing_and_proofreading
integrity_cultivation	sports_journalism
team_communication	planetary_science
setting_description	cloud_computing
curatorial_practices	pattern_recognition
api_design	design_research_methods
interpret_symptom_severity	student_assessment_analysis
climate_modeling	geothermal_systems_design
textile_design	conservation_strategy_planning
instrument_proficiency	energy_efficiency_techniques
geographic_information_systems	technical_analysis
observing_etiquette_rules	interior_designing
stratigraphic_correlation	grammar_error_identification
waste_reduction_strategies	advocacy_strategy_development
pedagogical_content_knowledge	debt_financing
pet_safety_precautions	health_education_development
scientific_writing	philosophy_and_religion
speaking_fluency	quantitative_decision_making

Table 78: (Part 18 of 18) 1143 skills extracted from topics in Tables 38, 40, and 42.

Skills	
crisis-communication	team-building
application-security	solar-panel-installation
traffic-management-systems	market-analysis
electrical-safety-inspection	species-identification
emotional-intelligence	energy-and-resources
technical-problem-solving	fashion-trends
poetic-analysis	stakeholder-negotiation
patina-application	link-building
food-presentation	healthy-eating-advice
solving-linear-equations	history-and-geography
cultural-adaptation-strategies	trip-planning
agile-methodologies	negotiation-tactics
digital-art-design	social-media-marketing
mindfulness-techniques	planetary-geology
security-risk-assessment	code-optimization
technology-integration	fashion-branding
career-planning	literary-criticism
data-driven-strategy	public-transport-planning
dialogue-crafting	home-budget-management
digital-music-production	risk-factor-identification
reservation-handling	vaccination-schedule-management
creative-problem-solving	social-media-ads-creation
user-experience-evaluation	sleep-improvement-strategies
coding-and-debugging	client-communication
legislative-drafting	color-theory-application
sustainability-planning	human-resources-management
sustainable-agriculture-practices	literary-critique
active-listening	syntax-analysis
theme-exploration	choreography-design
epidemic-outbreak-investigation	autonomous-vehicle-navigation

Table 80: (Part 1 of 5) 18 Query/Task Types extracted from interactions with GPT-4-Turbo.

Query Type	Description
Information-Seeking	This includes any query where the user is looking to find out facts, data, explanations, or learn about a topic.
Help-Seeking	Queries where the user needs assistance in solving a problem or performing an action. This could be technical support, troubleshooting, or guidance on personal issues.
Instructional	Queries that specifically request detailed, step-by-step instructions or procedural guidance. This category is designed to assist users in understanding and executing tasks by breaking them down into sequential, manageable steps. Whether it's a practical day-to-day task, a complex technical procedure, or a creative process, the AI provides a clear, methodical approach to accomplishing specific objectives.
Conversational	These are queries where the user is possibly looking for engagement more than specific information or tasks. This can include small talk or generative interactions aimed at entertainment or companionship.

Table 82: (Part 2 of 5) 18 Query/Task Types extracted from interactions with GPT-4-Turbo.

Query Type	Description
Narrative	Queries where the user is interested in hearing stories, experiences, or detailed accounts of events. These can be historical, personal, or fictional.
Planning	Queries that assist in planning or organizing activities, events, or projects.
Situational	Queries related to specific situations or scenarios that the user is facing, asking for tailored advice or solutions.
Interpretative	Queries that ask for interpretation of texts, artworks, or other cultural artifacts.
Decision-Making	Queries that assist the user in making decisions by evaluating options, risks, and benefits.
Task Execution	Queries where the user delegates the completion of a specific task or action to the AI. This involves the AI taking on roles that might require decision-making, processing, or interacting with other systems to achieve the desired outcome.

Table 84: (Part 3 of 5) 18 Query/Task Types extracted from interactions with GPT-4-Turbo.

Query Type	Description
Digital Communication Design and Strategy	Queries focused on designing and strategizing content for optimal communication across digital platforms. This includes creating engaging designs and coherent strategies for websites, blogs, podcasts, emails, and digital essays.
Code Generation	Queries where users directly ask for guidance on implementing specific functions, features, or algorithms in a particular programming language. These queries explicitly request code snippets, examples, or step-by-step instructions on how to implement the desired functionality.
Fact-Seeking	Queries where the user is looking for specific, factual information or data points. These queries are often straightforward and can be answered with a concise response. The focus is on providing accurate, reliable information from trustworthy sources.
Comparative	These queries involve comparing different items, ideas, or scenarios. Users often seek assistance in making decisions or understanding differences.

Table 86: (Part 4 of 5) 18 Query/Task Types extracted from interactions with GPT-4-Turbo.

Query Type	Description
Interpretive Explanation	Queries in which the user seeks a detailed explanation or interpretation of a provided text snippet. This could include literary analysis, code explanation, or any form of textual dissection. The AI acts as an analytical tool to help users understand complex passages, technical descriptions, or conceptual writings.
Error Detection	Queries where the user seeks assistance in finding and diagnosing errors or bugs in provided materials. This could include syntactical errors in code, grammatical mistakes in written text, or inconsistencies in data sets. The AI acts as a diagnostic tool to help pinpoint and suggest corrections for these issues.
Feedback-Seeking	Queries where users are looking for feedback on their ideas, creations, or opinions. This can be particularly relevant in educational, artistic, or professional contexts.

Table 88: (Part 5 of 5) 18 Query/Task Types extracted from interactions with GPT-4-Turbo.

Query Type	Description
Clarification-Seeking	<p>These queries aim to clarify confusion or get more detailed information about a previously mentioned or understood topic. Users might need further explanation or a more refined understanding of a complex issue.</p>

K.3 INSTRUCT-SKILLMIX LIST OF SKILLS AND QUERY TYPES (CLAUDE-3.5-SONNET)

Using the procedure detailed in Section 2.1, we extract 138 conversational topics and 13 query types from Claude-3.5-Sonnet. From the topics, we get a fine-grained list of 3,266 skills.

Table 90: (Part 1 of 3) 138 topics extracted from interactions with Claude-3.5-Sonnet

Topics	
computer.science.and.technology	software.development.practices
data.analysis.methods	network.security.systems
computer.infrastructure.management	emerging.technology.trends
health.and.medicine	medical.treatment.methods
public.health.management	mental.health.treatment
fitness.training.methods	emergency.medical.response
business.and.economics	financial.management.systems
business.strategy.planning	marketing.campaign.management
business.operations.management	economic.market.analysis
science.and.engineering	physical.science.research
biological.science.research	engineering.design.methods
earth.science.research	space.exploration.technology
education.and.academia	educational.teaching.methods
academic.research.methods	subject.specific.tutoring
learning.strategy.development	academic.writing.techniques
arts.and.culture	visual.arts.creation
theatrical.performance.arts	literary.arts.analysis
musical.arts.production	digital.media.creation
society.and.humanities	psychological.behavior.analysis
philosophical.theory.analysis	religious.studies.analysis
historical.event.analysis	cultural.pattern.analysis
law.and.government	legal.system.analysis
public.policy.development	international.relationships.management
civil.rights.legislation	government.system.analysis
environment.and.resources	climate.change.analysis
energy.system.management	sustainability.practices.development
environmental.conservation.methods	natural.resource.management
lifestyle.and.personal	nutrition.planning.methods
family.life.management	travel.planning.strategies
career.development.planning	personal.finance.management
professional.services	hospitality.service.management
urban.development.planning	business.consulting.practices

Table 92: (Part 2 of 3) 138 topics extracted from interactions with Claude-3.5-Sonnet

Topics	
journalism_content_production	nonprofit_organization_management
industry_and_manufacturing	manufacturing_process_optimization
quality_control_systems	supply_chain_optimization
industrial_product_design	industrial_automation_systems
sports_and_recreation	team_sports_techniques
individual_sports_training	athletic_coaching_methods
sports_science_analysis	recreational_activity_planning
transportation_and_logistics	automotive_system_engineering
aviation_system_management	maritime_transport_operations
public_transit_planning	logistics_system_optimization
military_and_defense	military_strategy_development
defense_technology_systems	military_history_analysis
security_system_planning	military_intelligence_operations
language_and_communication	linguistics_theory_analysis
language_translation_methods	language_acquisition_techniques
technical_documentation_writing	public_speaking_techniques
fashion_and_design	fashion_design_methods
interior_space_design	industrial_product_design
textile_production_methods	fashion_accessory_design
agriculture_and_food_production	agricultural_farming_methods
food_processing_techniques	livestock_management_systems
agricultural_technology_systems	food_safety_management
entertainment_and_media	film_production_techniques
video_game_development	digital_content_creation
social_media_management	multimedia_content_production
construction_and_infrastructure	building_construction_methods
construction_project_management	materials_engineering_analysis
construction_safety_standards	infrastructure_development_planning
mathematics_and_statistics	pure_mathematics_theory
applied_mathematics_methods	statistical_analysis_techniques
mathematical_model_development	mathematical_optimization_methods
professional_skills	leadership_development_methods

Table 94: (Part 3 of 3) 138 topics extracted from interactions with Claude-3.5-Sonnet

Topics	
project_management_techniques	negotiation_strategy_development
time_management_techniques	business_communication_methods
digital_technologies	artificial_intelligence_development
blockchain_system_development	iot_device_management
extended_reality_development	cloud_computing_systems

Table 96: (Part I of 52) 3266 skills extracted from topics in Tables 90, 92, and 94.

Skills	
science-and-engineering	scientific_method_application
data_analysis_and_interpretation	experimental_design
hypothesis_formulation	technical_writing
laboratory_techniques	problem_solving
critical_thinking	mathematical_modeling
statistical_analysis	research_methodology
project_management	computer_aided_design
programming_and_coding	systems_thinking
error_analysis	technical_drawing
instrument_calibration	safety_protocol_implementation
literature_review	peer_review_process
grant_writing	interdisciplinary_collaboration
data_visualization	scientific_communication
prototype_development	quality_control_and_assurance
risk_assessment	ethical_decision_making
sustainability_analysis	industrial_product_design
conceptual_sketching	3d_modeling
prototyping_techniques	material_selection
ergonomic_analysis	design_for_manufacturing
computer_aided_design	user_interface_design
design_thinking_process	product_lifecycle_management
sustainability_assessment	design_research_methods
design_for_assembly	rendering_and_visualization
design_for_maintenance	human_factors_engineering
design_patent_research	design_for_recyclability
rapid_prototyping	design_critique_facilitation
design_for_disassembly	design_for_mass_production
design_for_customization	design_for_modularity
design_for_serviceability	computer_science_and_technology
programming_languages	algorithm_design
data_structures	software_development
database_management	network_administration

Table 98: (Part 2 of 52) 3266 skills extracted from topics in Tables 90, 92, and 94.

Skills	
cybersecurity-implementation	web-development
mobile-app-development	cloud-computing
artificial-intelligence	machine-learning
data-analysis	system-architecture
version-control	debugging-and-troubleshooting
operating-system-management	hardware-configuration
user-interface-design	agile-methodologies
devops-practices	api-integration
big-data-processing	blockchain-development
iot-implementation	virtual-reality-development
quantum-computing	natural-language-processing
computer-vision	parallel-computing
transportation-and-logistics	route-optimization
inventory-management	supply-chain-planning
freight-forwarding	warehouse-operations
fleet-management	demand-forecasting
customs-clearance	shipment-tracking
load-planning	transportation-mode-selection
reverse-logistics-handling	cold-chain-management
last-mile-delivery-coordination	cross-docking-operations
intermodal-transportation-planning	risk-assessment-and-mitigation
cargo-insurance-management	sustainable-logistics-implementation
logistics-network-design	transportation-cost-analysis
packaging-optimization	carrier-selection-and-negotiation
logistics-performance-measurement	international-trade-compliance
travel-planning-strategies	research-destination-options
compare-transportation-methods	create-travel-itinerary
budget-trip-expenses	book-accommodations
plan-activities-and-attractions	organize-travel-documents
pack-efficiently	navigate-foreign-languages
manage-travel-logistics	research-local-customs-and-etiquette
identify-travel-insurance-needs	optimize-reward-points-and-miles

Table 100: (Part 3 of 52) 3266 skills extracted from topics in Tables 90, 92, and 94.

Skills	
plan_for_emergencies	coordinate_group_travel
research_visa_requirements	compare_currency_exchange_options
create_backup_plans	research_local_cuisine_options
plan_for_health_and_safety_precautions	professional_services
client_relationship_management	project_planning_and_execution
business_analysis	strategic_consulting
financial_modeling	risk_assessment_and_mitigation
contract_negotiation	proposal_writing
stakeholder_communication	process_optimization
change_management	quality_assurance
data_analysis_and_interpretation	market_research
presentation_skills	time_management
problem_solving	team_leadership
conflict_resolution	regulatory_compliance
industry_specific_expertise	technical_writing
resource_allocation	performance_metrics_tracking
client_needs_assessment	fashion_and_design
color_theory_application	pattern_making
fabric_selection	garment_construction
trend_forecasting	fashion_illustration
textile_design	draping_techniques
digital_design_software_use	fashion_styling
sustainable_design_practices	fashion_marketing
collection_development	fashion_photography
accessory_design	costume_design
fashion_history_analysis	fashion_show_production
brand_identity_creation	fashion_writing
visual_merchandising	fashion_buying
fashion_cad_modeling	upcycling_techniques
fashion_business_management	mental_health_treatment
assess_mental_health_status	diagnose_mental_disorders
develop_treatment_plans	conduct_psychotherapy_sessions

Table 102: (Part 4 of 52) 3266 skills extracted from topics in Tables 90, 92, and 94.

Skills	
prescribe-psychiatric-medications	monitor-patient-progress
provide-crisis-intervention	implement-cognitive-behavioral-therapy
practice-active-listening	apply-mindfulness-techniques
facilitate-group-therapy-sessions	perform-psychological-assessments
utilize-motivational-interviewing	manage-patient-records
collaborate-with-healthcare-professionals	apply-trauma-informed-care
educate-patients-and-families	implement-relapse-prevention-strategies
conduct-risk-assessments	business-consulting-practices
practice-cultural-competence	problem-solving
strategic-planning	financial-modeling
data-analysis	process-optimization
market-research	project-management
change-management	risk-assessment
stakeholder-communication	organizational-design
performance-measurement	cost-benefit-analysis
business-process-reengineering	client-relationship-management
industry-benchmarking	negotiation-techniques
presentation-skills	business-case-development
swot-analysis	scenario-planning
trend-forecasting	value-chain-analysis
competitive-intelligence-gathering	psychological-behavior-analysis
digital-transformation-strategy	conduct-behavioral-interviews
observe-nonverbal-cues	interpret-psychological-assessments
analyze-cognitive-patterns	identify-emotional-triggers
apply-behavioral-theories	design-behavior-modification-plans
evaluate-social-interactions	interpret-psychometric-data
analyze-environmental-influences	assess-mental-health-status
recognize-personality-traits	analyze-group-dynamics
implement-cognitive-behavioral-techniques	assess-developmental-milestones
conduct-functional-behavior-analysis	analyze-decision-making-processes
interpret-body-language	
identify-behavioral-reinforcers	

Table 104: (Part 5 of 52) 3266 skills extracted from topics in Tables 90, 92, and 94.

Skills	
evaluate_cultural_influences_on_behavior	film_production_techniques
camera_operation	lighting_setup
sound_recording	script_writing
storyboard_creation	set_design
costume_design	makeup_application
special_effects_implementation	video_editing
color_grading	sound_mixing
location_scouting	prop_management
cinematography_planning	shot_composition
actor_directing	production_scheduling
budget_management	green_screen_filming
motion_capture_techniques	aerial_drone_filming
post_production_workflow	foley_sound_creation
digital_compositing	philosophical_theory_analysis
critical_thinking	logical_reasoning
argument_evaluation	conceptual_analysis
comparative_analysis	historical_contextualization
ethical_reasoning	metaphysical_inquiry
epistemological_assessment	textual_interpretation
thought_experiment_creation	philosophical_writing
dialectical_reasoning	premise_identification
fallacy_detection	sylllogism_construction
ontological_categorization	phenomenological_description
hermeneutical_analysis	axiological_evaluation
paradigm_shift_recognition	philosophical_system_mapping
cross_cultural_philosophy_comparison	philosophical_jargon_translation
philosophical_debate_moderation	maritime_transport_operations
navigate_vessels	operate_ship_systems
manage_cargo_loading_unloading	plan_voyage_routes
interpret_weather_patterns	implement_maritime_safety_protocols
conduct_vessel_maintenance	manage_crew_operations
handle_maritime_emergencies	comply_with_maritime_regulations

Table 106: (Part 6 of 52) 3266 skills extracted from topics in Tables 90, 92, and 94.

Skills	
operate_communication_equipment	manage_fuel_consumption
perform_risk_assessments	coordinate_port_operations
execute_docking_procedures	monitor_vessel_performance
implement_environmental_protection_measures	operate_navigation_instruments
manage_maritime_documentation	agricultural_technology_systems
conduct_maritime_security_checks	analyze_soil_composition_data
operate_precision_farming_equipment	manage_irrigation_automation
implement_crop_monitoring_systems	program_farm_management_software
interpret_satellite_imagery_for_crop_health	design_hydroponics_systems
calibrate_agricultural_sensors	integrate_iiot_devices_in_agriculture
troubleshoot_smart_farming_devices	develop_predictive_crop_yield_models
optimize_greenhouse_climate_control	implement_vertical_farming_techniques
maintain_automated_harvesting_machinery	manage_livestock_monitoring_systems
configure_gps_guided_tractors	
analyze_agricultural_drone_data	
optimize_precision_fertilizer_application	
implement_blockchain_for_supply_chain_tracking	
design_automated_pest_control_systems	mathematical_model_development
problem_formulation	data_collection_and_analysis
variable_identification	assumption_making
equation_derivation	parameter_estimation
model_simplification	dimensional_analysis
numerical_methods_implementation	simulation_design
sensitivity_analysis	model_validation
error_analysis	optimization_techniques
statistical_inference	computer_programming
data_visualization	literature_review
interdisciplinary_collaboration	technical_writing
model_documentation	uncertainty_quantification
model_calibration	scenario_analysis
model_comparison	fitness_training_methods
design_workout_programs	perform_strength_exercises

Table 108: (Part 7 of 52) 3266 skills extracted from topics in Tables 90, 92, and 94.

Skills	
execute_cardiovascular_routines	demonstrate_proper_form
adjust_training_intensity	monitor_heart_rate
track_fitness_progress	implement_periodization_techniques
teach_flexibility_exercises	apply_plyometric_training
conduct_fitness_assessments	utilize_resistance_bands
operate_gym_equipment	practice_interval_training
modify_exercises_for_injuries	incorporate_bodyweight_exercises
explain_nutrition_principles	lead_group_fitness_classes
provide_motivational_coaching	analyze_movement_patterns
society_and_humanities	critical_thinking
cultural_analysis	ethical_reasoning
historical_research	social_theory_application
qualitative_data_analysis	cross_cultural_communication
philosophical_argumentation	literary_interpretation
anthropological_fieldwork	sociological_observation
political_system_analysis	comparative_religion_study
art_history_interpretation	psychological_assessment
demographic_trend_analysis	human_rights_advocacy
social_policy_evaluation	archival_research
oral_history_collection	ethnographic_writing
conflict_resolution	gender_studies_application
media_literacy	linguistic_analysis
military_and_defense	tactical_planning
weapon_handling	combat_strategy
threat_assessment	military_intelligence_analysis
logistics_management	battlefield_communication
physical_fitness_training	leadership_and_command
crisis_management	cyber_warfare_operations
military_law_interpretation	reconnaissance_and_surveillance
emergency_medical_response	military_equipment_maintenance
aerial_combat_maneuvering	naval_navigation
counter_terrorism_tactics	military_diplomacy

Table 110: (Part 8 of 52) 3266 skills extracted from topics in Tables 90, 92, and 94.

Skills	
psychological_warfare_techniques	military_budget_allocation
defense_policy_formulation	military_recruitment_and_training
military_technology_development	military_history_analysis
financial_management_systems	budget_planning_and_forecasting
financial_data_analysis	risk_assessment_and_management
cash_flow_monitoring	financial_reporting_and_compliance
investment_portfolio_management	cost_control_and_optimization
financial_software_implementation	audit_preparation_and_coordination
accounts_payable_and_receivable_management	
financial_performance_metrics_tracking	financial_statement_preparation
tax_planning_and_compliance	capital_structure_optimization
financial_process_automation	financial_modeling_and_scenario_analysis
internal_control_implementation	financial_decision_support
treasury_management	financial_system_integration
leadership_development_methods	active_listening
effective_communication	strategic_thinking
decision_making	conflict_resolution
team_building	emotional_intelligence
goal_setting	performance_evaluation
coaching_and_mentoring	change_management
time_management	problem_solving
motivating_others	critical_thinking
ethical_decision_making	public_speaking
stress_management	vision_casting
cross_cultural_communication	feedback_delivery
organizational_skills	historical_event_analysis
source_evaluation	chronological_ordering
cause_and_effect_analysis	contextual_interpretation
comparative_analysis	bias_identification
primary_source_examination	secondary_source_interpretation
historical_data_visualization	cross_cultural_comparison
historiographical_analysis	historical_argument_construction

Table 112: (Part 9 of 52) 3266 skills extracted from topics in Tables 90, 92, and 94.

Skills	
evidence_based_reasoning	historical_narrative_creation
interdisciplinary_connection_making	long_term_impact_assessment
historical_trend_identification	critical_thinking_application
historical_methodology_implementation	historical_perspective_taking
medical_treatment_methods	diagnose_medical_conditions
develop_treatment_plans	administer_medications
perform_surgical_procedures	interpret_medical_test_results
monitor_patient_vital_signs	provide_emergency_medical_care
manage_chronic_diseases	prescribe_appropriate_medications
conduct_physical_examinations	apply_wound_care_techniques
implement_pain_management_strategies	perform_non_invasive_procedures
educate_patients_on_treatment_options	coordinate_multidisciplinary_care
assess_treatment_effectiveness	adjust_treatment_plans_as_needed
utilize_medical_imaging_technologies	apply_infection_control_measures
perform_cardiopulmonary_resuscitation	engineering_design_methods
problem_definition	requirements_analysis
concept_generation	design_iteration
prototype_development	feasibility_assessment
technical_drawing	computer_aided_design
design_for_manufacturability	failure_mode_analysis
design_optimization	systems_thinking
project_management	design_documentation
stakeholder_communication	cost_estimation
risk_assessment	sustainability_analysis
ergonomic_design	design_validation_testing
material_selection	design_for_assembly
quality_control_implementation	design_review_facilitation
reverse_engineering	visual_arts_creation
color_theory_application	perspective_drawing
composition_arrangement	brush_technique_mastery
digital_painting_proficiency	sketching_and_ideation
texture_creation	light_and_shadow_rendering

Table 114: (Part 10 of 52) 3266 skills extracted from topics in Tables 90, 92, and 94.

Skills	
anatomy_understanding	mixed_media_integration
art_history_interpretation	visual_storytelling
abstract_concept_visualization	proportion_and_scale_management
negative_space_utilization	color_palette_selection
gesture_drawing	digital_software_navigation
art_material_knowledge	stylization_and_abstraction
visual_balance_creation	symbolism_incorporation
emotional_expression_through_art	art_critique_and_analysis
creative_problem_solving	industrial_automation_systems
plc_programming	hmi_design
scada_system_configuration	industrial_network_setup
motion_control_implementation	robot_programming
sensor_integration	data_acquisition_system_design
process_control_optimization	safety_system_implementation
machine_vision_integration	industrial_iiot_implementation
predictive_maintenance_planning	energy_management_system_design
automated_quality_control_setup	distributed_control_system_configuration
fieldbus_protocol_implementation	opc_ua_integration
industrial_cybersecurity_implementation	digital_twin_development
automated_material_handling_system_design	
industrial_cloud_computing_implementation	
machine_learning_for_process_optimization	
industrial_database_management	industrial_edge_computing_setup
public_transit_planning	route_optimization
demand_forecasting	traffic_flow_analysis
infrastructure_assessment	budget_management
stakeholder_engagement	environmental_impact_evaluation
accessibility_planning	data_visualization
transit_scheduling	fare_system_design
multimodal_integration	land_use_analysis
population_density_mapping	transit_oriented_development_planning
ridership_analysis	service_frequency_optimization

Table 116: (Part 11 of 52) 3266 skills extracted from topics in Tables 90, 92, and 94.

Skills	
transit_technology_evaluation	public_outreach_coordination
transit_policy_development	recreational_activity_planning
activity_research_and_discovery	budget_allocation_and_management
time_management_and_scheduling	risk_assessment_and_mitigation
group_dynamics_management	equipment_selection_and_preparation
location_scouting_and_evaluation	weather_forecasting_interpretation
transportation_logistics_coordination	emergency_response_planning
dietary_requirements_accommodation	accessibility_needs_assessment
permit_and_reservation_acquisition	team_building_exercise_design
environmental_impact_minimization	cultural_sensitivity_awareness
first_aid_and_safety_protocol_implementation	
activity_customization_for_diverse_groups	
post_activity_evaluation_and_feedback_collection	time_management_techniques
conflict_resolution_and_mediation	create_to_do_lists
prioritize_tasks	use_time_blocking
set_smart_goals	delegate_responsibilities
implement_pomodoro_technique	practice_effective_scheduling
eliminate_distractions	conduct_time_audits
utilize_productivity_tools	manage_email_efficiently
apply_eisenhower_matrix	batch_similar_tasks
learn_to_say_no	use_calendar_effectively
identify_peak_productivity_hours	minimize_multitasking
break_large_projects_into_smaller_tasks	practice_mindfulness_and_focus
set_deadlines_and_stick_to_them	epidemiological_data_analysis
public_health_management	disease_surveillance_implementation
health_policy_development	health_program_planning
community_health_assessment	health_communication_strategy
resource_allocation_optimization	health_equity_promotion
outbreak_response_coordination	health_information_system_management
public_health_research_design	health_budget_management
health_workforce_development	health_education_program_design
health_risk_assessment	

Table 118: (Part 12 of 52) 3266 skills extracted from topics in Tables 90, 92, and 94.

Skills	
environmental_health_monitoring	health_emergency_preparedness
health_data_visualization	health_impact_evaluation
cross_sector_collaboration_facilitation	health_legislation_interpretation
population_health_trend_analysis	health_technology_assessment
public_health_ethics_application	global_health_diplomacy
marketing_campaign_management	campaign_strategy_development
target_audience_identification	market_research_analysis
budget_planning_and_allocation	creative_content_creation
channel_selection_and_optimization	campaign_performance_tracking
data_driven_decision_making	a_b_testing_implementation
customer_segmentation_techniques	marketing_automation_tool_usage
roi_calculation_and_analysis	cross_channel_campaign_coordination
campaign_timeline_management	stakeholder_communication_and_reporting
brand_messaging_consistency	social_media_campaign_execution
email_marketing_campaign_design	conversion_rate_optimization
campaign_kpi_setting_and_monitoring	competitor_analysis_and_benchmarking
crisis_management_in_campaigns	influencer_partnership_management
campaign_compliance_and_legal_review	post_campaign_analysis_and_reporting
quality_control_systems	statistical_process_control
root_cause_analysis	data_collection_and_analysis
quality_management_software_operation	process_mapping
failure_mode_and_effects_analysis	design_of_experiments
lean_six_sigma_implementation	quality_auditing
corrective_action_planning	measurement_system_analysis
control_chart_interpretation	supplier_quality_management
risk_assessment_and_mitigation	continuous_improvement_facilitation
quality_documentation_management	product_inspection_techniques
nonconformity_identification_and_reporting	customer_feedback_analysis
quality_cost_analysis	strategic_planning
nonprofit_organization_management	volunteer_management
fundraising_and_grant_writing	board_governance
financial_management_for_nonprofits	

Table 120: (Part 13 of 52) 3266 skills extracted from topics in Tables 90, 92, and 94.

Skills	
program.development.and.evaluation	donor.relationship.and.stewardship
nonprofit.marketing.and.communications	legal.compliance.and.risk.management
community.outreach.and.engagement	nonprofit.leadership.and.decision.making
performance.measurement.and.impact.assessment	
resource.allocation.and.budgeting	stakeholder.relationship.management
nonprofit.technology.implementation	ethical.decision.making.in.nonprofits
conflict.resolution.and.negotiation	nonprofit.human.resources.management
project.management.for.nonprofits	advocacy.and.policy.influence
sports.and.recreation	physical.fitness.training
team.coordination	strategic.game.planning
equipment.maintenance	injury.prevention.techniques
sports.rules.interpretation	athletic.performance.analysis
nutrition.management.for.athletes	sports.psychology.application
coaching.and.mentoring	sports.event.organization
outdoor.survival.skills	sports.facility.management
sports.medicines.first.aid	sports.broadcasting.and.commentary
sports.data.analysis	recreational.activity.planning
sports.equipment.selection	sports.officiating.and.refereeing
sports.marketing.and.promotion	natural.resource.management
ecosystem.assessment	resource.inventory.management
conservation.planning	sustainable.harvesting.techniques
environmental.impact.analysis	habitat.restoration
wildlife.population.monitoring	water.quality.management
soil.conservations.practices	forest.management.planning
fisheries.stock.assessment	land.use.planning
biodiversity.monitoring	climate.change.adaptation.strategies
invasive.species.control	watershed.management
environmental.policy.development	resource.allocation.optimization
stakeholder.engagement	gis.mapping.and.analysis
remote.sensing.interpretation	ecological.modeling
conflict.resolution.in.resource.management	
environmental.law.compliance	sustainable.tourism.planning

Table 122: (Part 14 of 52) 3266 skills extracted from topics in Tables 90, 92, and 94.

Skills	
economic_market_analysis	data_collection_and_management
statistical_analysis	econometric_modeling
trend_identification	market_segmentation
competitive_landscape_assessment	demand_forecasting
supply_chain_analysis	pricing_strategy_development
risk_assessment_and_mitigation	financial_ratio_analysis
macroeconomic_indicator_interpretation	industry_specific_knowledge_application
market_entry_strategy_formulation	consumer_behavior_analysis
data_visualization_and_reporting	scenario_planning_and_simulation
regulatory_impact_assessment	swot_analysis_execution
market_opportunity_identification	investment_potential_evaluation
economic_policy_analysis	market_size_estimation
growth_rate_calculation	market_share_analysis
business_operations_management	process_optimization
supply_chain_management	inventory_control
quality_assurance	resource_allocation
performance_measurement	project_management
risk_assessment	lean_manufacturing
capacity_planning	demand_forecasting
workflow_analysis	cost_reduction_strategies
continuous_improvement	data_driven_decision_making
stakeholder_management	operational_budgeting
change_management	time_management
team_leadership	strategic_planning
problem_solving	vendor_relationship_management
logistics_coordination	productivity_analysis
musical_arts_production	audio_engineering
music_composition	sound_design
digital_audio_workstation_operation	mixing_and_mastering
instrument_performance	vocal_recording
music_theory_application	arrangement_and_orchestration
live_sound_reinforcement	music_production_software_proficiency

Table 124: (Part 15 of 52) 3266 skills extracted from topics in Tables 90, 92, and 94.

Skills	
midi-programming	sample-creation-and-manipulation
acoustic-treatment-implementation	music-business-management
collaborative-project-coordination	music-copyright-understanding
studio-equipment-maintenance	audio-signal-processing
music-marketing-and-promotion	livestock-management-systems
animal-health-monitoring	feed-management-optimization
breeding-program-implementation	herd-productivity-analysis
disease-prevention-protocols	pasture-rotation-planning
livestock-record-keeping	environmental-impact-assessment
waste-management-implementation	genetic-improvement-strategies
animal-welfare-compliance	market-trend-analysis
livestock-transportation-logistics	biosecurity-measures-implementation
nutrition-plan-development	automated-milking-system-operation
livestock-facility-design	animal-behavior-assessment
sustainable-farming-practices-integration	
livestock-product-quality-control	project-management-techniques
create-project-charter	define-project-scope
develop-work-breakdown-structure	estimate-project-costs
create-project-schedule	identify-project-risks
manage-stakeholder-expectations	allocate-resources-effectively
monitor-project-progress	implement-change-control-processes
conduct-project-meetings	perform-critical-path-analysis
use-project-management-software	apply-agile-methodologies
create-gantt-charts	manage-project-budget
resolve-project-conflicts	perform-earned-value-analysis
conduct-project-post-mortems	implement-quality-control-measures
statistical-analysis-techniques	data-cleaning
descriptive-statistics-calculation	hypothesis-testing
correlation-analysis	regression-modeling
variance-analysis	probability-distribution-identification
sampling-technique-selection	outlier-detection
data-visualization	confidence-interval-calculation

Table 126: (Part 16 of 52) 3266 skills extracted from topics in Tables 90, 92, and 94.

Skills	
statistical-software-usage	experimental-design
multivariate-analysis	time-series-analysis
factor-analysis	cluster-analysis
power-analysis	nonparametric-test-application
bayesian-inference	meta-analysis
principal-component-analysis	survival-analysis
statistical-report-writing	data-interpretation
construction-and-infrastructure	structural-design
project-management	blueprint-reading
cost-estimation	site-surveying
material-selection	safety-protocol-implementation
heavy-equipment-operation	concrete-pouring-and-finishing
welding-and-metalwork	plumbing-installation
electrical-wiring	hvac-system-installation
building-code-compliance	sustainable-design-implementation
risk-assessment-and-mitigation	quality-control-inspection
soil-analysis	foundation-laying
scaffolding-assembly	load-calculation
drainage-system-design	traffic-flow-analysis
bridge-engineering	tunnel-construction
road-paving	environmental-impact-assessment
waste-management-planning	urban-planning
seismic-retrofitting	fashion-design-methods
sketching-garment-designs	creating_moodboards
pattern-making	draping-fabric
textile-selection	color-theory-application
trend-forecasting	garment-construction
digital-design-software-use	fashion-illustration
technical-flat-drawing	fabric-manipulation-techniques
silhouette-development	collection-planning
fashion-history-analysis	sustainable-design-practices
garment-fitting-and-alteration	fashion-marketing-integration

Table 128: (Part 17 of 52) 3266 skills extracted from topics in Tables 90, 92, and 94.

Skills	
accessory_design	fashion_show_production
building_construction_methods	structural_design_analysis
blueprint_reading_interpretation	material_selection_optimization
construction_site_management	safety_protocol_implementation
cost_estimation_budgeting	project_scheduling_coordination
foundation_laying_techniques	framing_and_roofing_execution
plumbing_system_installation	electrical_wiring_implementation
hvac_system_integration	concrete_pouring_finishing
masonry_techniques_application	carpentry_skills_utilization
welding_and_metalwork_execution	insulation_installation_methods
drywall_installation_finishing	painting_and_coating_application
sustainable_building_practices_implementation	quality_control_inspection
building_code_compliance_assessment	waste_management_recycling
construction_equipment_operation	applied_mathematics_methods
building_information_modeling_bim	differential_equation_solving
numerical_analysis	statistical_modeling
optimization_techniques	data_analysis_and_interpretation
linear_algebra_application	computational_geometry
mathematical_modeling	probability_theory_implementation
graph_theory_application	complex_analysis_techniques
discrete_mathematics_utilization	stochastic_process_modeling
fourier_analysis_application	algorithm_design_and_analysis
matrix_computation	dynamical_systems_analysis
mathematical_software_usage	cryptography_implementation
operations_research_techniques	finite_element_analysis
signal_processing_methods	machine_learning_algorithm_development
time_series_analysis	iot_device_management
game_theory_application	monitor_device_health
configure_iiot_devices	manage_device_lifecycle
update_firmware_remotely	analyze_device_data
implement_security_protocols	optimize_power_consumption
troubleshoot_connectivity_issues	

Table 130: (Part 18 of 52) 3266 skills extracted from topics in Tables 90, 92, and 94.

Skills	
scale-iot-infrastructure	integrate-iot-platforms
manage-device-inventory	implement-over-the-air-updates
configure-device-authentication	monitor-network-performance
manage-device-groups	implement_data_encryption
create-device-dashboards	automate-device-onboarding
manage-device-permissions	analyze-device-logs
implement-edge-computing	optimize-data-transmission
manage-device-alerts	implement-device-diagnostics
ensure-regulatory-compliance	climate-change-analysis
data-collection-and-management	statistical-analysis
climate-modeling	greenhouse-gas-inventory-assessment
remote-sensing-interpretation	time-series-analysis
geospatial-data-analysis	scientific-report-writing
policy-impact-assessment	carbon-footprint-calculation
climate-scenario-development	adaptation-strategy-formulation
mitigation-measure-evaluation	interdisciplinary-collaboration
data-visualization	uncertainty-analysis
peer-reviewed-literature-synthesis	climate-risk-assessment
stakeholder-engagement	environmental-impact-assessment
renewable-energy-potential-analysis	ecosystem-vulnerability-assessment
climate-finance-analysis	sustainable-development-goal-alignment
climate-communication-and-outreach	government-system-analysis
comparative-government-analysis	political-structure-evaluation
policy-impact-assessment	legislative-process-mapping
electoral-system-comparison	constitutional-interpretation
bureaucratic-efficiency-measurement	power-distribution-analysis
governance-model-classification	political-ideology-identification
intergovernmental-relations-assessment	public-administration-evaluation
democratic-index-calculation	government-transparency-measurement
checks-and-balances-examination	federalism-vs-centralism-analysis
political-party-system-evaluation	government-budget-analysis
public-policy-formulation	civic-engagement-assessment

Table 132: (Part 19 of 52) 3266 skills extracted from topics in Tables 90, 92, and 94.

Skills	
government-accountability_measurement	political_risk_analysis
regime_type_classification	government_reform_strategy_development
international_governance_comparison	fashion_accessory_design
trend_analysis	sketching_techniques
color_theory_application	material_selection
3d_modeling_for_accessories	prototype_creation
computer_aided_design	market_research
brand_identity_development	sustainable_design_practices
manufacturing_process_understanding	quality_control_assessment
cost_estimation	presentation_skills
client_communication	fashion_history_knowledge
ergonomic_design_principles	textile_manipulation
pattern_making	digital_rendering
fashion_forecasting	technical_specification_writing
sourcing_materials	production_timeline_management
collaborative_design_skills	aviation_system_management
air_traffic_control_coordination	flight_scheduling_optimization
aircraft_maintenance_planning	runway_capacity_management
aviation_safety_protocol_implementation	fuel_efficiency_analysis
crew_resource_management	airport_operations_oversight
aviation_regulatory_compliance	emergency_response_coordination
passenger_flow_optimization	baggage_handling_system_management
aviation_weather_interpretation	aircraft_fleet_management
aviation_data_analysis	airspace_design_and_planning
aviation_security_implementation	ground_handling_operations_management
aviation_environmental_impact_assessment	aviation_technology_integration
construction_project_management	project_planning_and_scheduling
budget_estimation_and_cost_control	risk_assessment_and_mitigation
resource_allocation_and_management	contract_negotiation_and_administration
quality_assurance_and_control	stakeholder_communication_and_management
safety_protocol_implementation	change_order_management
progress_monitoring_and_reporting	subcontractor_coordination

Table 134: (Part 20 of 52) 3266 skills extracted from topics in Tables 90, 92, and 94.

Skills	
building_code_compliance	construction_document_interpretation
value_engineering	conflict_resolution
procurement_and_logistics_management	environmental_impact_assessment
site_selection_and_analysis	construction_technology_implementation
team_leadership_and_motivation	nutrition_planning_methods
assess_nutritional_needs	calculate_caloric_requirements
create_balanced_meal_plans	analyze_macro_nutrient_ratios
design_personalized_diet_plans	evaluate_food_quality_and_sources
interpret_nutrition_labels	track_daily_nutrient_intake
adjust_meal_plans_for_dietary_restrictions	optimize_meal_timing_for_performance
incorporate_supplements_into_diet_plans	educate_clients_on_nutrition_basics
plan_hydration_strategies	adapt_plans_for_different_life_stages
monitor_body_composition_changes	manage_weight_loss_or_gain_programs
integrate_cultural_food_preferences	develop_sports_nutrition_strategies
address_nutrient_deficiencies	digital_media_creation
create_budget_friendly_meal_plans	graphic_design
video_editing	motion_graphics_creation
audio_production	animation_techniques
3d_modeling	photo_manipulation
color_grading	storyboard_creation
typography_design	digital_illustration
social_media_content_optimization	video_compositing
user_interface_design	digital_photography
sound_design	virtual_reality_content_creation
web_design	live_streaming_management
augmented_reality_development	interactive_media_design
digital_storytelling	digital_painting
data_visualization	sustainability_practices_development
video_compression_techniques	resource_efficiency_analysis
environmental_impact_assessment	
sustainable_design_principles_application	
lifecycle_assessment_implementation	waste_reduction_strategy_development

Table 136: (Part 21 of 52) 3266 skills extracted from topics in Tables 90, 92, and 94.

Skills	
renewable_energy_integration	carbon_footprint_calculation
green_supply_chain_management	sustainability_reporting_and_disclosure
stakeholder_engagement_facilitation	circular_economy_model_implementation
sustainable_materials_selection	water_conservation_planning
energy_audit_conducting	biodiversity_impact_mitigation
sustainable_agriculture_practices_implementation	
corporate_social_responsibility_program_development	
green_building_design_and_certification	sustainable_transportation_planning
eco_labeling_and_certification_management	
logistics_system_optimization	supply_chain_analysis
inventory_management	route_optimization
demand_forecasting	warehouse_layout_design
transportation_mode_selection	order_fulfillment_process_improvement
reverse_logistics_management	data_driven_decision_making
cost_benefit_analysis	lean_logistics_implementation
cross_docking_optimization	last_mile_delivery_planning
fleet_management	logistics_network_design
risk_assessment_and_mitigation	performance_metrics_development
logistics_software_implementation	sustainability_integration
vendor_relationship_management	capacity_planning
customs_and_compliance_management	real_time_tracking_implementation
logistics_process_automation	multi_modal_transportation_planning
software_development_practices	version_control_management
code_review_execution	agile_methodology_implementation
test_driven_development	continuous_integration_setup
code_refactoring	design_pattern_application
software_architecture_planning	technical_documentation_writing
debugging_and_troubleshooting	performance_optimization
security_best_practices_implementation	code_quality_assessment
requirements_gathering_and_analysis	sprint_planning_and_execution
pair_programming_facilitation	code_commenting_and_self_documentation
database_design_and_optimization	api_development_and_integration

Table 138: (Part 22 of 52) 3266 skills extracted from topics in Tables 90, 92, and 94.

Skills	
devops_practices_implementation	code_versioning_and_release_management
code_modularity_and_reusability_improvement	cross_platform_development
unit_testing_implementation	education_and_academia
scalability_planning_and_implementation	research_methodology
critical_thinking	data_analysis
academic_writing	classroom_management
literature_review	student_assessment
curriculum_development	grant_writing
peer_review	teaching_methods
public_speaking	academic_advising
educational_technology_integration	statistical_analysis
scholarly_publishing	thesis_development
experiment_design	interdisciplinary_collaboration
citation_management	learning_theories_application
academic_integrity_enforcement	instructional_design
educational_policy_analysis	family_life_management
academic_program_evaluation	household_budgeting
meal_planning_and_preparation	time_management
conflict_resolution	stress_management
effective_communication	home_organization
child_rearing_techniques	family_activity_coordination
work_life_balance_maintenance	household_chore_delegation
emergency_preparedness	health_and_wellness_promotion
relationship_nurturing	educational_support
financial_planning	technology_management_in_home
family_tradition_cultivation	energy_conservation_practices
family_meeting_facilitation	content_strategy_development
digital_content_creation	search_engine_optimization
writing_for_digital_platforms	video_production_and_editing
social_media_management	podcast_creation_and_hosting
graphic_design_for_digital_media	email_marketing_campaign_creation
web_content_management	

Table 142: (Part 24 of 52) 3266 skills extracted from topics in Tables 90, 92, and 94.

Skills	
content_creation	audience_engagement
social_listening	analytics_interpretation
trend_identification	crisis_management
community_building	hashtag_strategy
influencer_collaboration	paid_advertising_management
brand_voice_development	visual_content_design
scheduling_and_automation	cross_platform_integration
customer_service_handling	performance_reporting
campaign_planning	user_generated_content_curation
social_media_policy_development	competitor_analysis
lifestyle_and_personal	time_management
stress_reduction	personal_finance_planning
healthy_meal_preparation	effective_communication
goal_setting_and_achievement	mindfulness_practice
work_life_balance_maintenance	self_care_routines
habit_formation_and_breaking	decluttering_and_organization
relationship_building	conflict_resolution
personal_style_development	fitness_program_design
sleep_optimization	emotional_intelligence_cultivation
productivity_enhancement	public_speaking
personal_branding	networking_and_social_skills
decision_making	creative_problem_solving
meditation_and_relaxation_techniques	sustainable_living_practices
law_and_government	legal_research
policy_analysis	legislative_drafting
constitutional_interpretation	regulatory_compliance
case_law_application	legal_writing
courtroom_advocacy	negotiation_and_mediation
public_speaking	government_budgeting
diplomatic_relations	parliamentary_procedure
election_management	public_policy_implementation
administrative_law_application	ethics_and_integrity_management

Table 144: (Part 25 of 52) 3266 skills extracted from topics in Tables 90, 92, and 94.

Skills	
crisis_management	intergovernmental_coordination
civic_engagement_facilitation	human_rights_protection
legislative_process_navigation	judicial_decision_making
law_enforcement_administration	international_treaty_negotiation
journalism_content_production	research_and_fact_checking
interview_techniques	news_writing
storytelling_and_narrative_structure	copy_editing
headline_crafting	source_verification
data_journalism	multimedia_content_creation
ethical_reporting	news_judgment
headline_management	social_media_reporting
investigative_journalism_techniques	content_curation
news_analysis	feature_writing
breaking_news_coverage	cross_platform_adaptation
audience_engagement	search_engine_optimization
fact_based_storytelling	news_literacy
visual_storytelling	language_translation_methods
analyze_source_text	identify_linguistic_patterns
apply_grammar_rules	use_translation_software
research_cultural_context	maintain_translation_memory
implement_machine_learning_algorithms	evaluate_translation_quality
adapt_idiomatic_expressions	manage_terminology_databases
utilize_computer_assisted_translation_tools	
perform_localization	conduct_parallel_text_analysis
apply_natural_language_processing	interpret_source_language_nuances
implement_statistical_machine_translation	
optimize_neural_machine_translation	develop_custom_translation_algorithms
perform_post_editing_machine_translations	
integrate_translation_apis	hospitality_service_management
customer_service_excellence	conflict_resolution
reservation_management	front_desk_operations
housekeeping_coordination	food_and_beverage_service

Table 146: (Part 26 of 52) 3266 skills extracted from topics in Tables 90, 92, and 94.

Skills	
event_planning_and_execution	revenue_management
inventory_control	staff_training_and_development
guest_satisfaction_monitoring	crisis_management
cultural_sensitivity	upselling_techniques
complaint_handling	time_management
team_leadership	health_and_safety_compliance
financial_budgeting	marketing_and_promotion
quality_assurance_implementation	sustainability_practices
technology_systems_operation	multi_tasking
problem_solving	international_relations_management
diplomatic_negotiation	cross_cultural_communication
geopolitical_analysis	conflict_resolution
treaty_drafting	multilateral_cooperation
foreign_policy_formulation	international_law_interpretation
economic_sanctions_management	global_crisis_management
international_organization_coordination	public_diplomacy_execution
foreign_aid_administration	international_trade_facilitation
global_security_assessment	international_mediation
protocol_management	foreign_language_proficiency
international_project_management	global_risk_assessment
international_public_speaking	diplomatic_etiquette_application
international_event_planning	global_alliance_building
international_media_relations	agricultural_farming_methods
soil_preparation_techniques	crop_rotation_planning
irrigation_system_management	pest_control_implementation
fertilizer_application_methods	harvest_timing_optimization
seed_selection_and_planting	sustainable_farming_practices
farm_equipment_operation	weather_pattern_analysis
organic_farming_techniques	greenhouse_management
hydroponics_system_setup	crop_disease_identification
soil_nutrient_analysis	water_conservation_methods
precision_agriculture_implementation	livestock_integration_planning

Table 148: (Part 27 of 52) 3266 skills extracted from topics in Tables 90, 92, and 94.

Skills	
composting-and-soil-amendment	farm_data_management_and_analysis
crop_yield_forecasting	agricultural_drone_operation
vertical_farming_techniques	agroforestry_implementation
post_harvest_handling_and_storage	food_safety_management
hazard_analysis_critical_control_point_implementation	
sanitation_standard_operating_procedures_development	
food_safety_risk_assessment	food_allergen_management
temperature_control_monitoring	food_safety_audit_conducting
microbial_contamination_prevention	food_recall_protocol_execution
personal_hygiene_training	food_safety_legislation_compliance
food_storage_best_practices_implementation	
cross_contamination_prevention	food_safety_documentation_management
food_safety_culture_promotion	food_traceability_system_implementation
pest_control_management	food_safety_equipment_maintenance
food_safety_incident_investigation	food_safety_training_program_development
food_safety_data_analysis_and_reporting	religious_studies_analysis
comparative_religion_analysis	sacred_text_interpretation
religious_symbolism_decoding	theological_concept_explanation
religious_history_contextualization	ritual_practice_examination
religious_demographics_assessment	interfaith_dialogue_facilitation
religious_ethics_evaluation	myth_and_folklore_analysis
religious_art_interpretation	spiritual_experience_categorization
religious_sociology_application	religious_philosophy_critique
religious_conflict_resolution	religious_terminology_clarification
religious_anthropology_research	religious_psychology_assessment
religious_law_interpretation	religious_syncretism_identification
blockchain_system_development	smart_contract_programming
distributed_ledger_design	consensus_mechanism_implementation
cryptography_application	blockchain_architecture_planning
decentralized_application_development	network_protocol_optimization
blockchain_security_auditing	scalability_solution_implementation
token_economics_modeling	interoperability_protocol_design

Table 150: (Part 28 of 52) 3266 skills extracted from topics in Tables 90, 92, and 94.

Skills	
blockchain-governance-system-development	data-structure-optimization
peer-to-peer-network-management	blockchain-performance-tuning
transaction-validation-algorithm-design	blockchain-api-development
digital-signature-implementation	blockchain-testing-and-debugging
blockchain-integration-with-existing-systems	
business-strategy-planning	market-analysis
competitive-intelligence-gathering	swot-analysis-creation
goal-setting-and-prioritization	financial-forecasting
risk-assessment-and-mitigation	resource-allocation-optimization
stakeholder-management	strategic-decision-making
business-model-innovation	scenario-planning
kpi-development-and-tracking	change-management-implementation
strategic-partnership-development	long-term-vision-creation
value-chain-analysis	portfolio-management
blue-ocean-strategy-formulation	balanced-scorecard-implementation
strategic-communication	theatrical-performance-arts
stage-presence	vocal-projection
character-development	script-analysis
movement-and-physicality	emotional-expression
memorization-techniques	timing-and-pacing
ensemble-collaboration	costume-management
prop-handling	stage-combat
accent-and-dialect-mastery	makeup-application
set-design-understanding	lighting-cue-awareness
audience-engagement	backstage-etiquette
warm-up-routines	voice-modulation
blocking-and-staging	quick-change-techniques
audition-preparation	rehearsal-discipline
energy-system-management	power-grid-optimization
renewable-energy-integration	load-forecasting
demand-response-management	energy-storage-planning
smart_meter_data_analysis	microgrid-design-and-control

Table 152: (Part 29 of 52) 3266 skills extracted from topics in Tables 90, 92, and 94.

Skills	
energy_efficiency_assessment	power_quality_monitoring
fault_detection_and_diagnosis	peak_load_management
energy_market_analysis	transmission_loss_reduction
voltage_regulation	distributed_generation_management
energy_policy_implementation	carbon_footprint_calculation
energy_auditing	power_system_stability_analysis
energy_cost_optimization	learning_strategy_development
metacognitive_awareness	goal_setting_and_planning
time_management	note_taking_techniques
active_reading_strategies	information_organization
memory_enhancement_techniques	critical_thinking_application
self_assessment_and_reflection	learning_style_identification
resource_evaluation_and_selection	study_environment_optimization
test_taking_strategies	stress_management_for_learning
motivation_maintenance	attention_and_focus_improvement
collaborative_learning_facilitation	technology_integration_for_learning
continuous_improvement_mindset_cultivation	cloud_computing_systems
feedback_interpretation_and_application	manage_virtual_machines
deploy_cloud_infrastructure	optimize_cloud_resource_allocation
implement_cloud_security_measures	configure_load_balancing
design_scalable_architectures	automate_cloud_deployments
implement_disaster_recovery_plans	manage_cloud_storage_solutions
monitor_cloud_performance	orchestrate_microservices
implement_containerization_technologies	optimize_cloud_costs
configure_cloud_networking	manage_multi_cloud_environments
implement_serverless_computing	implement_cloud_data_backup_strategies
integrate_cloud_services	optimize_cloud_application_performance
configure_cloud_identity_management	biomechanical_movement_analysis
sports_science_analysis	performance_metrics_evaluation
physiological_data_interpretation	nutrition_plan_development
injury_risk_assessment	recovery_strategy_optimization
training_program_design	

Table 154: (Part 30 of 52) 3266 skills extracted from topics in Tables 90, 92, and 94.

Skills		
sports_equipment_analysis	athlete_monitoring_techniques	statistical_data_analysis
sports_psychology_implementation	fatigue_management_assessment	exercise_physiology_application
periodization_planning	sports_technology_integration	motion_capture_data_interpretation
research_methodology_application	operate_spinning_machinery	sports_specific_testing_protocols
perform_fabric_dyeing	maintain_textile_equipment	strength_and_conditioning_programming
analyze_fabric_properties	operate_knitting_machines	performance_enhancement_strategies
troubleshoot_production_issues	handle_raw_materials	textile_production_methods
implement_sustainable_production_practices	operate_computerized_embroidery_machines	set_up_weaving_looms
conduct_textile_testing	apply_textile_coating_techniques	execute_screen_printing
effective_communication	problem_solving	implement_quality_control_measures
teamwork_collaboration	conflict_resolution	design_textile_patterns
project_management	emotional_intelligence	apply_fabric_finishing_techniques
presentation_skills	stress_management	optimize_production_efficiency
strategic_planning	data_analysis	manage_textile_inventory
digital_literacy	self_motivation	perform_fabric_cutting_operations
professional_etiquette	research_methodology	operate_nonwoven_fabric_machinery
		professional_skills
		time_management
		critical_thinking
		leadership_ability
		adaptability_flexibility
		decision_making
		networking_relationship_building
		negotiation_skills
		active_listening
		creative_thinking
		cultural_awareness
		customer_service
		organizational_skills
		academic_writing_techniques
		critical_thinking

Table 156: (Part 31 of 52) 3266 skills extracted from topics in Tables 90, 92, and 94.

Skills	
thesis_statement_formulation	argument_construction
literature_review_synthesis	citation_management
academic_tone_maintenance	paragraph_structuring
evidence_evaluation	logical_flow_creation
abstract_writing	proofreading_and_editing
plagiarism_avoidance	academic_vocabulary_usage
data_analysis_interpretation	scholarly_source_identification
outline_development	peer_review_participation
revision_process_management	academic_style_guide_adherence
food_processing_techniques	apply_heat_treatment
implement_food_preservation_methods	operate_food_processing_equipment
maintain_food_safety_standards	perform_quality_control_checks
execute_batch_processing	manage_ingredient_inventory
optimize_production_efficiency	apply_fermentation_techniques
implement_packaging_solutions	conduct_sensory_evaluation
analyze_nutritional_content	develop_new_food_products
troubleshoot_processing_issues	apply_food_chemistry_principles
manage_waste_reduction_strategies	implement_food_traceability_systems
operate_automated_processing_lines	apply_food_microbiology_knowledge
conduct_self_life_testing	career_development_planning
self_assessment	goal_setting
career_research	resume_writing
interview_preparation	personal_branding
time_management	skill_gap_analysis
professional_development_planning	decision_making
adaptability_and_flexibility	continuous_learning
mentorship_seeking	work_life_balance_management
career_path_mapping	industry_trend_analysis
leadership_development	communication_skills_enhancement
negotiation_skills	conflict_resolution
stress_management	financial_planning_for_career_growth
personal_swot_analysis	professional_etiquette

Table 158: (Part 32 of 52) 3266 skills extracted from topics in Tables 90, 92, and 94.

Skills	
legal-system-analysis	legal-research-and-analysis
case-law-interpretation	statutory-interpretation
legal-writing-and-drafting	comparative-law-analysis
legal-precedent-application	legal-argument-construction
legal-system-evaluation	judicial-decision-analysis
legal-policy-assessment	legal-ethics-application
legal-reform-proposal-development	legal-data-visualization
legal-risk-assessment	legal-process-mapping
legal-trend-forecasting	legal-system-efficiency-evaluation
cross-jurisdictional-analysis	legal-technology-integration
legal-stakeholder-analysis	personal-finance-management
create-budget	track-expenses
set-financial-goals	manage-debt
build-emergency-fund	invest-wisely
understand-compound-interest	optimize-tax-strategies
negotiate-salary	analyze-financial-statements
calculate-net-worth	improve-credit-score
plan-for-retirement	diversify-investment-portfolio
research-financial-products	automate-bill-payments
balance-checkbook	compare-insurance-policies
reduce-unnecessary-expenses	maximize-employee-benefits
create-passive-income-streams	understand-mortgage-options
manage-risk-tolerance	read-financial-news
use-budgeting-software	video-game-development
game-design	level-creation
character-modeling	texture-mapping
animation-rigging	scripting-and-programming
game-engine-proficiency	sound-design
narrative-writing	user-interface-design
playtesting-and-debugging	performance-optimization
version-control-management	asset-pipeline-development
shader-programming	artificial-intelligence-implementation

Table 160: (Part 33 of 52) 3266 skills extracted from topics in Tables 90, 92, and 94.

Skills	
multiplayer_networking	game_balancing
project_management	quality_assurance_testing
health_and_medicine	diagnose_medical_conditions
perform_physical_examinations	interpret_lab_results
administer_medications	conduct_surgical_procedures
develop_treatment_plans	monitor_patient_vital_signs
provide_emergency_medical_care	analyze_medical_imaging
counsel_patients_on_health_issues	maintain_patient_records
sterilize_medical_equipment	perform_cpr_and_first_aid
prescribe_appropriate_medications	conduct_medical_research
educate_patients_on_preventive_care	manage_chronic_diseases
perform_health_risk_assessments	interpret_ecg_readings
administer_vaccinations	assist_in_childbirth
conduct_mental_health_evaluations	perform_physical_therapy_exercises
analyze_nutritional_needs	operate_medical_devices
infrastructure_development_planning	urban_planning
project_management	environmental_impact_assessment
cost_benefit_analysis	stakeholder_engagement
resource_allocation	risk_assessment_and_mitigation
land_use_planning	transportation_network_design
utility_systems_planning	data_analysis_and_interpretation
geographic_information_system_usage	regulatory_compliance_management
sustainable_design_implementation	budget_forecasting
public_private_partnership_facilitation	infrastructure_lifecycle_management
demographic_trend_analysis	economic_feasibility_studies
climate_resilience_planning	community_needs_assessment
interdisciplinary_collaboration	long_term_strategic_planning
construction_phasing_and_sequencing	infrastructure_capacity_modeling
defense_technology_systems	radar_system_operation
electronic_warfare_management	cybersecurity_implementation
missile_guidance_programming	satellite_communication_coordination
unmanned_vehicle_piloting	cryptogeography_application

Table 162: (Part 34 of 52) 3266 skills extracted from topics in Tables 90, 92, and 94.

Skills	
battlefield_network_administration	weapons_system_integration
threat_detection_analysis	command_and_control_optimization
sensor_fusion_implementation	ballistic_missile_defense_operation
electromagnetic_spectrum_management	combat_simulation_modeling
data_link_system_configuration	stealth_technology_application
directed_energy_weapon_operation	artificial_intelligence_integration
quantum_computing_utilization	mathematics_and_statistics
perform_statistical_analysis	solve_complex_equations
apply_probability_theory	interpret_data_visualizations
conduct_hypothesis_testing	design_experimental_studies
use_mathematical_modeling	calculate_descriptive_statistics
implement_regression_analysis	apply_linear_algebra
perform_multivariate_analysis	use_calculus_for_optimization
conduct_time_series_analysis	apply_bayesian_inference
perform_numerical_simulations	use_matrix_operations
apply_differential_equations	conduct_cluster_analysis
implement_machine_learning_algorithms	perform_data_cleaning_and_preprocessing
use_statistical_software_packages	apply_game_theory
conduct_monte_carlo_simulations	interpret_confidence_intervals
perform_factor_analysis	physical_science_research
experimental_design	data_collection
statistical_analysis	laboratory_techniques
scientific_writing	literature_review
hypothesis_formulation	data_visualization
instrument_calibration	error_analysis
peer_review_process	grant_proposal_writing
research_ethics_compliance	scientific_presentation
collaborative_research	computational_modeling
sample_preparation	safety_protocol_implementation
data_management	critical_thinking
problem_solving	equipment_troubleshooting
scientific_method_application	interdisciplinary_communication

Table 164: (Part 35 of 52) 3266 skills extracted from topics in Tables 90, 92, and 94.

Skills	
research.project.management	construction.safety.standards
risk.assessment.and.hazard.identification	safety.plan.development
personal.protective.equipment.selection	fall.protection.system.implementation
osha.regulation.compliance	heavy.machinery.operation.safety
scaffolding.safety.inspection	emergency.response.planning
confined.space.entry.procedures	accident.investigation.and.reporting
safety.training.program.design	hazardous.material.handling
workplace.ergonomics.assessment	electrical.safety.management
fire.prevention.and.protection	noise.level.monitoring.and.control
first.aid.and.cpr.administration	tool.and.equipment.safety.inspection
safety.signage.implementation	environment.and.resources
site.security.management	environmental.impact.assessment
sustainable.resource.management	renewable.energy.implementation
waste.reduction.and.recycling	ecosystem.restoration
water.conservaion.techniques	green.building.design
carbon.footprint.calculation	natural.disaster.mitigation
environmental.policy.analysis	air.quality.monitoring
biodiversity.conservaion	environmental.data.analysis
soil.contamination.remediation	climate.change.adaptation.planning
sustainable.agriculture.practices	ecological.footprint.assessment
environmental.education.and.outreach	sustainable.transportation.planning
environmental.risk.management	rocket.propulsion.design
space.exploration.technology	orbital.mechanics.calculation
spacecraft.systems.engineering	space.navigaion.programming
mission.planning.and.analysis	space.suit.engineering
life.support.systems.development	satellite.communication.implementation
zero.gravity.adaptation.training	interplanetary.trajectory.planning
space.debris.tracking.and.mitigation	extraterrestrial.resource.utilization
space.habitat.construction	space.robotics.programming
radiation.shielding.design	space.telescope.operation
thermal.control.systems.management	space.weather.forecasting
microgravity.experiment.design	

Table 166: (Part 36 of 52) 3266 skills extracted from topics in Tables 90, 92, and 94.

Skills	
launch_vehicle_integration	data_analYSIS_methods
data_cleaning	statistical_analysis
data_visualization	hypothesis_testing
regression_analysis	time_series_analysis
cluster_analysis	principal_component_analysis
exploratory_data_analysis	predictive_modeling
data_interpretation	feature_selection
outlier_detection	correlation_analysis
data_transformation	dimensionality_reduction
text_mining	sentiment_analysis
machine_learning_application	data_sampling_techniques
data_normalization	multivariate_analysis
bayesian_analysis	data_imputation
experimental_design	public_speaking_techniques
deliver_clear_message	engage_audience
structure_speech_effectively	use_body_language
manage_stage_presence	control_vocal_tone_and_pitch
handle_q_and_a_sessions	incorporate_storytelling
utilize_visual_aids	adapt_to_different_audiences
manage_speech_timing	overcome_stage_fright
use_rhetorical_devices	improvise_and_think_on_feet
research_and_prepare_content	create_memorable_openings_and_closings
use_humor_appropriately	maintain_eye_contact
project_confidence	handle_technical_difficulties
multimedia_content_production	video_editing
audio_mixing	graphic_design
storyboard_creation	script_writing
camera_operation	lighting_setup
sound_recording	color_grading
motion_graphics_creation	3d_modeling
animation_techniques	special_effects_implementation
live_streaming_management	content_management_system_operation

Table 168: (Part 37 of 52) 3266 skills extracted from topics in Tables 90, 92, and 94.

Skills	
social_media_optimization	digital_asset_management
video_compression_techniques	interactive_media_development
user_experience_design	project_management
copyright_law_understanding	audience_analysis
content_strategy_development	cross_platform_adaptation
negotiation_strategy_development	active_listening
conflict_resolution	emotional_intelligence
persuasive_communication	strategic_planning
stakeholder_analysis	problem_solving
critical_thinking	data_analysis
goal_setting	rapport_building
body_language_interpretation	cultural_awareness
power_dynamics_understanding	win_win_solution_creation
concession_management	deadline_pressure_handling
alternative_option_generation	risk_assessment
value_creation_identification	negotiation_style_adaptation
information_gathering	patience_and_timing_management
assertiveness_balancing	ethical_decision_making
extended_reality_development	3d_modeling_and_design
virtual_environment_creation	augmented_reality_programming
motion_tracking_implementation	spatial_audio_integration
user_interface_design_for_xr	real_time_rendering_optimization
haptic_feedback_integration	gesture_recognition_development
immersive_storytelling_techniques	xr_hardware_integration
cross_platform_xr_development	shader_programming_for_xr
performance_optimization_for_xr	xr_interaction_design
volumetric_capture_and_processing	photogrammetry_for_xr_assets
xr_content_creation	mixed_reality_application_development
xr_user_experience_design	spatial_computing_implementation
xr_networking_and_multiplayer_development	xr_prototyping_and_rapid_development
computer_vision_for_xr	team_sports_techniques
xr_testing_and_quality_assurance	

Table 170: (Part 38 of 52) 3266 skills extracted from topics in Tables 90, 92, and 94.

Skills	
execute-passing-techniques	implement-defensive-formations
apply-offensive-strategies	perform-ball-handling-drills
coordinate-team-movements	analyze-opponent-tactics
communicate-effectively-on-field	maintain-proper-positions
execute-set-plays	adapt-to-game-situations
perform-physical-conditioning	practice-teamwork-exercises
develop-spatial-awareness	master-sport-specific-rules
execute-feinting-maneuvers	implement-zonal-marking
perform-tactical-substitutions	utilize-equipment-effectively
execute-scoring-techniques	practice-injury-prevention-methods
entertainment-and-media	content-creation
script-writing	video-editing
audio-production	social-media-management
digital-marketing	public-speaking
graphic-design	live-streaming
podcast-hosting	music-composition
voice-over-narration	special-effects-creation
audience-engagement	brand-development
media-analysis	trend-forecasting
content-curation	event-planning
interview-conducting	news-reporting
sound-design	media-law-compliance
emerging-technology-trends	analyze-market-trends
evaluate-technological-feasibility	predict-future-innovations
assess-societal-impact	identify-disruptive-technologies
develop-adoption-strategies	conduct-technology-forecasting
perform-competitive-analysis	create-technology-roadmaps
evaluate-ethical-implications	assess-scalability-potential
integrate-emerging-technologies	manage-innovation-portfolios
analyze-patent-landscapes	develop-proof-of-concepts
assess-cybersecurity-risks	evaluate-regulatory-compliance
facilitate-cross-disciplinary-collaboration	

Table 172: (Part 39 of 52) 3266 skills extracted from topics in Tables 90, 92, and 94.

Skills	
conduct_technology_due_diligence	communicate_complex_technical_concepts
security_system_planning	risk_assessment
threat_analysis	vulnerability_identification
security_policy_development	access_control_design
surveillance_system_planning	emergency_response_planning
budget_allocation	security_technology_evaluation
perimeter_security_design	personnel_security_management
data_protection_strategy	security_audit_conducting
compliance_regulation_interpretation	security_awareness_training
incident_response_planning	security_equipment_selection
physical_security_layout_design	cybersecurity_integration
security_staff_coordination	business_communication_methods
write_professional_emails	deliver_effective_presentations
conduct_productive_meetings	active_listening
negotiate_business_deals	create_persuasive_proposals
manage_conflict_resolution	facilitate_group_discussions
craft_clear_business_reports	develop_interpersonal_relationships
use_nonverbal_communication	adapt_communication_style
give_constructive_feedback	practice_cross_cultural_communication
utilize_digital_communication_tools	create_effective_visual_aids
implement_internal_communication_strategies	
master_public_speaking	write_concise_business_memos
employ_active_questioning_techniques	subject_specific_tutoring
assess_student_knowledge	identify_learning_gaps
create_personalized_lesson_plans	explain_complex_concepts_simply
adapt_teaching_methods	provide_constructive_feedback
track_student_progress	use_subject_specific_resources
motivate_and_engage_students	manage_tutoring_time_effectively
address_individual_learning_styles	develop_practice_exercises
implement_assessment_techniques	build_student_confidence
foster_critical_thinking_skills	utilize_educational_technology
communicate_effectively_with_students	set_achievable_learning_goals

Table 174: (Part 40 of 52) 3266 skills extracted from topics in Tables 90, 92, and 94.

Skills	
provide-study-strategies	create-supportive-learning-environment
urban-development-planning	zoning-regulation-analysis
land-use-planning	demographic-trend-forecasting
infrastructure-needs-assessment	environmental-impact-evaluation
public-transportation-planning	sustainable-design-implementation
community-engagement-facilitation	urban-growth-modeling
historic-preservation-integration	affordable-housing-strategy-development
traffic-flow-optimization	green-space-allocation
economic-development-planning	urban-revitalization-strategy-creation
smart-city-technology-integration	urban-resilience-planning
mixed-use-development-design	walkability-assessment
urban-density-management	earth-science-research
conduct-field-surveys	analyze-geological-samples
operate-remote-sensing-equipment	interpret-satellite-imagery
model-climate-systems	perform-geochemical-analysis
collect-sediment-cores	analyze-seismic-data
map-geological-formations	measure-atmospheric-composition
conduct-hydrological-assessments	analyze-ice-core-samples
operate-ground-penetrating-radar	perform-radiometric-dating
analyze-ocean-current-patterns	monitor-volcanic-activity
conduct-soil-analysis	interpret-paleoclimate-data
use-geographic-information-systems	analyze-rock-formations
conduct-environmental-impact-assessments	operate-mass-spectrometers
analyze-tree-ring-data	model-plate-tectonics
conduct-geophysical-surveys	literary-arts-analysis
close-reading	critical-thinking
textual-interpretation	literary-device-identification
character-analysis	plot-structure-analysis
theme-extraction	symbolism-recognition
narrative-perspective-analysis	genre-classification
historical-context-evaluation	comparative-literature-analysis
stylistic-analysis	rhetorical-device-recognition

Table 176: (Part 41 of 52) 3266 skills extracted from topics in Tables 90, 92, and 94.

Skills	
intertextuality_identification	cultural_context_interpretation
literary_theory_application	authorial_intent_analysis
figurative_language_interpretation	literary_movement_categorization
literary_criticism_writing	research_methodology
citation_and_referencing	literary_period_identification
literary_adaptation_analysis	business_and_economics
financial_analysis	market_research
strategic_planning	risk_management
project_management	data_interpretation
budget_forecasting	investment_portfolio_management
supply_chain_optimization	cost_benefit_analysis
business_valuation	economic_modeling
negotiation_and_deal_making	financial_statement_preparation
business_process_improvement	competitive_analysis
pricing_strategy_development	business_plan_writing
economic_policy_analysis	mergers_and_acquisitions_planning
international_trade_management	business_ethics_implementation
entrepreneurship_and_innovation	organizational_leadership
marketing_strategy_development	civil_rights_legislation
analyze_historical_context	interpret_legal_documents
research_case_law	draft_policy_proposals
advocate_for_equality	identify_discrimination_patterns
communicate_complex_ideas	build_coalitions
negotiate_legislative_compromises	assess_societal_impact
organize_grassroots_movements	debate_constitutional_issues
implement_compliance_measures	evaluate_policy_effectiveness
mediate_conflicts	conduct_public_hearings
analyze_voting_patterns	litigate_civil_rights_cases
educate_public_on_rights	investigate_rights_violations
technical_documentation_writing	information_gathering
audience_analysis	content_organization
clear_writing	technical_jargon_translation

Table 178: (Part 42 of 52) 3266 skills extracted from topics in Tables 90, 92, and 94.

Skills	
document_structuring	style_guide_adherence
version_control_management	collaborative_editing
proofreading_and_editing	visual_aid_creation
metadata_tagging	accessibility_implementation
user_testing_coordination	feedback_incorporation
technical_research	software_tool_proficiency
api_documentation	troubleshooting_guide_creation
localization_preparation	cross_referencing
index_creation	glossary_compilation
template_design	document_formatting
revision_tracking	stakeholder_communication
project_management	deadline_adherence
quality_assurance_testing	public_policy_development
policy_analysis	stakeholder_engagement
data_interpretation	legislative_drafting
impact_assessment	cost_benefit_analysis
problem_identification	research_methodology
policy_evaluation	strategic_planning
public_speaking	negotiation_and_consensus_building
budget_allocation	project_management
regulatory_framework_design	policy_implementation_planning
cross_sector_collaboration	evidence_based_decision_making
risk_assessment	policy_communication
conflict_resolution	performance_measurement
scenario_planning	ethical_reasoning
political_landscape_analysis	digital_technologies
web_development	mobile_app_creation
data_analysis	cloud_computing_management
cybersecurity_implementation	network_administration
database_management	software_engineering
ui_ux_design	digital_marketing
search_engine_optimization	social_media_management

Table 180: (Part 43 of 52) 3266 skills extracted from topics in Tables 90, 92, and 94.

Skills	
content_management_system_usage	artificial_intelligence_programming
machine_learning_implementation	blockchain_development
internet_of_things_integration	virtual_reality_development
augmented_reality_creation	data_visualization
digital_project_management	it_support_and_troubleshooting
api_integration	version_control_system_usage
responsive_web_design	network_security_systems
implement_firewalls	configure_intrusion_detection_systems
perform_vulnerability_assessments	manage_access_control_lists
deploy_virtual_private_networks	monitor_network_traffic
conduct_penetration_testing	implement_encryption_protocols
manage_security_information_and_event_management	
perform_log_analysis	configure_network_segmentation
implement_multi_factor_authentication	conduct_security_audits
patch_management_and_updates	design_secure_network_architectures
implement_data_loss_prevention_strategies	
manage_security_policies	respond_to_security_incidents
perform_malware_analysis	implement_secure_wireless_networks
configure_network_security_appliances	conduct_risk_assessments
implement_endpoint_protection_solutions	manage_security_compliance
perform_threat_hunting	academic_research_methods
literature_review_conducting	research_question_formulation
hypothesis_development	experimental_design_planning
data_collection_methods_selection	survey_design_and_implementation
interview_technique_application	statistical_analysis_performing
qualitative_data_analysis	research_ethics_compliance
academic_writing_and_citation	peer_review_process_navigation
research_proposal_drafting	grant_application_writing
data_visualization_creation	research_methodology_selection
sampling_technique_application	validity_and_reliability_assessment
research_software_utilization	meta_analysis_conducting
systematic_review_performing	research_presentation_skills

Table 182: (Part 44 of 52) 3266 skills extracted from topics in Tables 90, 92, and 94.

Skills	
academic-publication-process-understanding	research-time-management
interdisciplinary-research-collaboration	lesson-planning
educational-teaching-methods	student-assessment
classroom-management	curriculum-development
differentiated-instruction	student-engagement-techniques
educational-technology-integration	inquiry-based-learning-facilitation
formative-feedback-provision	project-based-learning-design
collaborative-learning-implementation	learning-styles-accommodation
adaptive-teaching-strategies	critical-thinking-promotion
behavior-management	educational-data-analysis
active-listening-and-communication	multicultural-teaching-approaches
inclusive-education-practices	peer-tutoring-facilitation
student-motivation-techniques	blended-learning-design
flipped-classroom-implementation	educational-game-design
problem-based-learning-facilitation	create-personalized-training-plan
individual-sports-training	optimize-nutrition-intake
analyze-performance-metrics	implement-recovery-strategies
developmental-toughness	set-realistic-goals
improve-technique-efficiency	prevent-sports-injuries
manage-training-intensity	track-progress-systematically
enhance-flexibility-and-mobility	
adapt-training-to-environmental-conditions	balance-strength-and-endurance-training
utilize-sports-specific-equipment	maintain-proper-form-and-posture
incorporate-cross-training-methods	manage-pre-competition-anxiety
develop-sport-specific-skills	analyze-and-improve-biomechanics
optimize-sleep-patterns	training-program-design
athletic-coaching-methods	injury-prevention-techniques
performance-analysis	communication-with-athletes
athlete-motivation-strategies	sport-specific-technique-instruction
goal-setting-and-planning	nutrition-guidance
strength-and-conditioning-programming	psychological-preparation
team-building-exercises	

Table 184: (Part 45 of 52) 3266 skills extracted from topics in Tables 90, 92, and 94.

Skills	
recovery_and_regeneration_methods	biomechanical_analysis
video_analysis_and_feedback	periodization_planning
competition_strategy_development	leadership_skill_development
stress_management_techniques	athlete_assessment_and_evaluation
sports_ethics_and_fair_play_promotion	interior_space_design
spatial_planning	color_theory_application
furniture_arrangement	lighting_design
material_selection	ergonomic_design
3d_modeling_and_visualization	sustainable_design_implementation
budget_management	client_communication
trend_analysis	space_optimization
architectural_drawing_interpretation	textile_and_fabric_selection
accessory_styling	project_management
building_code_compliance	historical_style_adaptation
universal_design_implementation	acoustics_management
mood_board_creation	scale_and_proportion_balancing
computer_aided_design_software_proficiency	presentation_skills
vendor_and_contractor_coordination	analyze_linguistic_structures
linguistics_theory_analysis	apply_phonological_rules
compare_language_typologies	evaluate_syntactic_theories
identify_morphological_patterns	assess_pragmatic_contexts
interpret_semantic_relationships	examine_historical_language_changes
conduct_discourse_analysis	design_linguistic_experiments
formulate_linguistic_hypotheses	apply_computational_linguistics_methods
analyze_corpus_data	synthesize_cross_linguistic_data
critique_linguistic_theories	investigate_sociolinguistic_variations
explain_language_acquisition_processes	analyze_phonetic_transcriptions
apply_psycholinguistic_principles	materials_engineering_analysis
evaluate_language_universals	microstructure_analysis
material_property_characterization	stress_strain_curve_interpretation
failure_mode_identification	scanning_electron_microscopy
x_ray_diffraction_analysis	

Table 186: (Part 46 of 52) 3266 skills extracted from topics in Tables 90, 92, and 94.

Skills	
thermal-analysis-techniques	mechanical-testing-procedures
corrosion-resistance-evaluation	composite-material-design
phase-diagram-interpretation	material-selection-optimization
finite-element-analysis	fracture-mechanics-assessment
non-destructive-testing-methods	surface-treatment-analysis
polymer-degradation-assessment	crystallography-interpretation
fatigue-life-prediction	material-performance-modeling
military-intelligence-operations	information-gathering
data-analysis	threat-assessment
covert-surveillance	signal-interception
cryptography-and-decryption	geospatial-intelligence-interpretation
human-intelligence-collection	counterintelligence-operations
strategic-planning	risk-mitigation
source-cultivation	pattern-recognition
report-writing	operational-security-maintenance
cyber-intelligence-gathering	foreign-language-proficiency
cultural-awareness	tactical-decision-making
intelligence-briefing-delivery	asset-management
electronic-warfare-techniques	open-source-intelligence-analysis
imagery-interpretation	network-analysis
industry-and-manufacturing	production-line-optimization
quality-control-management	supply-chain-coordination
lean-manufacturing-implementation	industrial-safety-compliance
inventory-management	process-automation-design
equipment-maintenance-scheduling	resource-allocation-planning
product-lifecycle-management	industrial-waste-reduction
manufacturing-cost-analysis	production-capacity-planning
assembly-line-balancing	industrial-ergonomics-application
just-in-time-inventory-control	factory-layout-design
material-requirements-planning	statistical-process-control
industrial-robotics-programming	emergency-medical-response
assess-patient-condition	perform-cpr

Table 188: (Part 47 of 52) 3266 skills extracted from topics in Tables 90, 92, and 94.

Skills	
control_bleeding	administer_first_aid
use_automated_external_defibrillator	manage_airway_obstruction
treat_shock	immobilize_fractures
handle_burn_injuries	recognize_stroke_symptoms
manage_cardiac_emergencies	administer_emergency_medications
triage_multiple_casualties	communicate_with_emergency_services
operate_emergency_vehicles	use_personal_protective_equipment
perform_basic_life_support	manage_environmental_emergencies
handle_hazardous_materials_exposure	provide_emotional_support_to_patients
supply_chain_optimization	demand_forecasting
inventory_management	route_optimization
warehouse_layout_design	supplier_relationship_management
logistics_network_planning	risk_assessment_and_mitigation
data_analysis_and_visualization	lean_manufacturing_implementation
just_in_time_inventory_control	reverse_logistics_management
supply_chain_modeling	cost_benefit_analysis
performance_metrics_tracking	process_improvement_techniques
negotiation_and_contract_management	sustainability_assessment
quality_control_implementation	transportation_mode_selection
supply_chain_software_utilization	blockchain_integration_for_transparency
cross_functional_team_coordination	global_trade_compliance_management
supply_chain_resilience_planning	last_mile_delivery_optimization
manufacturing_process_optimization	production_line_analysis
lean_manufacturing_implementation	quality_control_management
supply_chain_optimization	inventory_management
process_flow_mapping	statistical_process_control
root_cause_analysis	six_sigma_methodology_application
equipment_efficiency_assessment	waste_reduction_techniques
production_scheduling_optimization	bottleneck_identification_and_resolution
continuous_improvement_facilitation	data_driven_decision_making
automation_integration	ergonomic_workplace_design
cost_benefit_analysis	resource_allocation_optimization

Table 190: (Part 48 of 52) 3266 skills extracted from topics in Tables 90, 92, and 94.

Skills	
performance_metrics.development	predictive_maintenance_planning
value_stream_mapping	cycle_time_reduction
change_management_implementation	cross_functional_team_leadership
language_and_communication	active_listening
public_speaking	written_communication
nonverbal_communication	cross_cultural_communication
persuasive_writing	conflict_resolution
empathetic_communication	technical_writing
proofreading_and_editing	foreign_language_proficiency
translation_and_interpretation	body_language_interpretation
effective_questioning	presentation_skills
speech_writing	tone_and_voice_modulation
audience_analysis	interpersonal_communication
facilitation_skills	business_writing
social_media_communication	emotional_intelligence
pure_mathematics.theory	abstract_reasoning
logical_deduction	theorem_proving
mathematical_modeling	formal_proof_construction
axiom_formulation	mathematical_notation_usage
set_theory_application	number_theory_analysis
topology_conceptualization	algebraic_structure_manipulation
mathematical_induction_application	complex_analysis_techniques
group_theory_implementation	differential_geometry_interpretation
category_theory_application	measure_theory_utilization
functional_analysis_implementation	combinatorics_problem_solving
graph_theory_application	mathematical_logic_reasoning
abstract_algebra_manipulation	real_analysis_techniques
mathematical_proof_writing	mathematical_conjecture_formulation
cultural_pattern_analysis	observe_cultural_behaviors
identify_cultural_symbols	analyze_social_structures
interpret_cultural_rituals	compare_cross_cultural_practices
document_ethnographic_data	conduct_qualitative_interviews

Table 192: (Part 49 of 52) 3266 skills extracted from topics in Tables 90, 92, and 94.

Skills	
<p> apply-anthropological-theories map-cultural-networks interpret-nonverbal-communication examine-historical-contexts identify-cultural-trends interpret-cultural-narratives apply-cultural-relativism formulate-optimization-problems implement-nonlinear-optimization-algorithms use-gradient-descent-methods analyze-convex-optimization-problems utilize-dynamic-programming-approaches develop-multi-objective-optimization-models perform-sensitivity-analysis use-quadratic-programming-techniques solve-network-optimization-problems develop-particle-swarm-optimization-algorithms utilize-simulated-annealing-techniques implement-branch-and-bound-algorithms tactical-analysis resource-allocation logistics-planning scenario-modeling communication-coordination force-deployment-optimization psychological-warfare-planning geopolitical-assessment contingency-planning strategic-forecasting cyber-warfare-strategy diplomatic-negotiation morale-management </p>	<p> recognize-cultural-biases analyze-linguistic-patterns assess-cultural-values synthesize-cultural-information analyze-material-culture evaluate-cultural-adaptation mathematical-optimization-methods apply-linear-programming-techniques solve-constrained-optimization-problems apply-integer-programming-techniques implement-metaheuristic-algorithms apply-stochastic-optimization-methods implement-genetic-algorithms apply-interior-point-methods perform-lagrangian-relaxation military-strategy-development threat-assessment terrain-evaluation intelligence-gathering risk-management decision-making-under-pressure technology-integration historical-battle-analysis alliance-building war-game-simulation operational-planning asymmetric-warfare-tactics supply-chain-management military-history-analysis </p>

Table 194: (Part 50 of 52) 3266 skills extracted from topics in Tables 90, 92, and 94.

Skills	
analyze_battle_tactics	evaluate_strategic_decisions
interpret_historical_documents	compare_military_technologies
assess_logistical_challenges	identify_key_military_leaders
analyze_geopolitical_influences	reconstruct_historical_battles
evaluate_military_intelligence_operations	
analyze_war_economics	interpret_military_maps
assess_cultural_impacts_on_warfare	compare_military_doctrines
analyze_military_organizational_structures	
evaluate_weapons_effectiveness	interpret_military_communications
assess_psychological_warfare_techniques	analyze_military_alliances
evaluate_military_training_methods	interpret_military_symbolism
language_acquisition_techniques	active_listening_practice
vocabulary_memorization	grammar_pattern_recognition
pronunciation_improvement	reading_comprehension_enhancement
writing_proficiency_development	conversation_practice_engagement
language_immersion_implementation	mnemonic_device_utilization
spaced_repetition_application	language_learning_app_navigation
accent_reduction_techniques	idiomatic_expression_mastery
translation_exercise_completion	language_exchange_participation
audio_visual_material_utilization	self_assessment_conducting
goal_setting_and_tracking	cultural_context_understanding
metacognitive_strategy_application	artificial_intelligence_development
machine_learning_implementation	neural_network_design
data_preprocessing	feature_engineering
model_evaluation_and_validation	natural_language_processing
computer_vision_development	reinforcement_learning_application
deep_learning_framework_usage	algorithm_optimization
data_visualization	ethical_ai_implementation
ai_research_methodology	ai_project_management
ai_system_integration	ai_performance_tuning
ai_model_deployment	ai_explainability_techniques
ai_security_implementation	ai_hardware_optimization

Table 196: (Part 51 of 52) 3266 skills extracted from topics in Tables 90, 92, and 94.

Skills	
ai-software-development	ai-testing-and-quality-assurance
ai-documentation-and-reporting	ai-data-collection-and-annotation
ai-model-versioning-and-tracking	automotive-system-engineering
vehicle-architecture-design	powertrain-integration
electrical-system-optimization	chassis-dynamics-analysis
automotive-safety-engineering	thermal-management-design
vehicle-diagnostics-implementation	automotive-software-development
vehicle-network-communication	noise-vibration-harshness-mitigation
fuel-efficiency-optimization	emissions-control-system-design
vehicle-performance-testing	automotive-materials-selection
ergonomics-and-human-factors-integration	vehicle-aerodynamics-optimization
automotive-manufacturing-process-design	vehicle-durability-testing
automotive-systems-integration	autonomous-driving-system-development
automotive-cybersecurity-implementation	vehicle-weight-reduction-strategies
automotive-sensor-integration	vehicle-simulation-and-modeling
automotive-quality-control-management	agriculture-and-food-production
crop-rotation-planning	soil-nutrient-management
irrigation-system-design	pest-identification-and-control
harvest-timing-optimization	food-safety-protocol-implementation
sustainable-farming-practices	livestock-health-monitoring
farm-equipment-operation	greenhouse-management
organic-certification-compliance	crop-yield-forecasting
food-processing-techniques	agricultural-data-analysis
farm-financial-planning	seed-selection-and-breeding
precision-agriculture-implementation	post-harvest-handling
vertical-farming-techniques	aquaponics-system-management
farm-to-table-logistics	agricultural-waste-management
climate-adaptive-farming	agritourism-program-development
food-preservation-methods	computer-infrastructure-management
network-configuration	server-administration
data-center-management	virtualization-implementation
cloud-infrastructure-deployment	system-monitoring

Table 198: (Part 52 of 52) 3266 skills extracted from topics in Tables 90, 92, and 94.

Skills	
performance-optimization	disaster-recovery-planning
backup-and-restoration	security-policy-enforcement
patch-management	capacity-planning
load-balancing-configuration	storage-management
hardware-troubleshooting	software-deployment
infrastructure-documentation	vendor-management
cost-optimization	compliance-management
automation-scripting	remote-access-configuration
power-management	cable-management
inventory-tracking	change-management-implementation
service-level-agreement-monitoring	incident-response-coordination
infrastructure-scalability-planning	lifecycle-management
biological-science-research	experimental-design
data-analysis	laboratory-techniques
scientific-writing	literature-review
cell-culture	dna-sequencing
pcr-amplification	protein-purification
bioinformatics-analysis	statistical-modeling
grant-writing	research-ethics-compliance
scientific-presentation	sample-preparation
animal-handling	molecular-cloning
western-blotting	flow-cytometry
gene-expression-analysis	hypothesis-formulation
data-visualization	lab-safety-protocols
scientific-collaboration	

Table 200: (Part 1 of 2) 13 Query/Task Types extracted from interactions with Claude-3.5-Sonnet

Query Type	Description
Information-seeking	Queries aimed at acquiring factual knowledge or understanding about a specific topic
Help/Problem-solving	Queries seeking assistance with specific issues or challenges that need resolution
Verification/Validation	Queries asking to check the accuracy, correctness, or appropriateness of something
Opinion/Recommendation	Queries seeking subjective advice or suggestions based on preferences or criteria
Clarification	Queries asking for explanation of concepts, terms, or distinctions between related things
Exploratory/Learning	Open-ended queries driven by curiosity without a specific information target
Creative/Generative	Queries requesting the creation of new content or ideas

Table 202: (Part 2 of 2) 13 Query/Task Types extracted from interactions with Claude-3.5-Sonnet

Query Type	Description
Analysis	Queries asking for detailed examination or evaluation of content, data, or situations
Social/Emotional	Queries seeking conversation, emotional support, or human-like interaction
Hypothetical/Scenario Analysis	Queries exploring potential outcomes or consequences of theoretical situations
Comparative	Queries seeking evaluation of differences and similarities between options
Procedural/How-to	Queries seeking step-by-step instructions or methodical guidance
Planning/Strategy	Queries seeking structured approaches to achieve specific goals

L SKILL EXTRACTION PROMPTS

L.1 PROMPT FOR SKILL EXTRACTION (INSTRUCT-SKILLMIX-D)

```
Consider the following question. Label this question with a skill that would be required to solve the question. Basically, you should be able to use the skill as a dictionary key in python. The skill name should be lower case letters only. The skill name should be very descriptive and you may use multiple words to describe the skills required in the question. If you do use multiple words per question, then join them by an underscore. {text}
Your answer should be as follows:
<name of the skill>, reason: <reason for the skill>
```

L.2 PROMPT FOR SEMANTIC CLUSTERING (INSTRUCT-SKILLMIX-D)

```
Given the list of skills required to solve various questions, your task is to categorize these skills into descriptive and specific groups. Each category should not only capture the essence of the skills it includes but also reflect clear, distinct areas of expertise or application. Use terminology that is precise and specific to the tasks those skills accomplish. Categories should be narrow enough to provide meaningful insight into the specialization they represent. Format category names in lowercase, joining multiple words with underscores.
For each category you create, provide a comprehensive rationale explaining:
- Why these particular skills are grouped together.
- How the category name specifically reflects the specialization and distinctiveness of the skills.

### Skills List:
{skills-joined-str}

### Examples:
- Category name: `web.development`
- Included skills: html.css.design, javascript.interactivity, web.performance.optimization
- Rationale: This category focuses specifically on the skills required to build and optimize web interfaces, distinguishing it from broader software development.

- Category name: `machine.learning.techniques`
- Included skills: machine.learning.model.creation, understanding.algorithmic.fairness, machine.learning.application.in.finance
- Rationale: These skills are grouped under 'machine.learning.techniques' because they directly relate to the development and application of machine learning models, emphasizing specific use cases and ethical considerations, which are distinct from general programming skills.

Please ensure your category names are informative, specific, and reflective of the skills grouped under them. This will aid in their practical utility and clarity.
```

L.3 PROMPT FOR CREATING SYNTHETIC DATA (INSTRUCT-SKILLMIX-D)

Prompt 1

I am creating a dataset of engaging human-AI interactions that demonstrate the capabilities and value of AI models across diverse skills. Please help me generate high-quality examples for this dataset.

I will first give you a set of {num.skills} skills that are valuable to humans.

Next, you would create a query that a human might plausibly ask whose answer involves using those {num.skills} skills.

For this query you will generate a good length answer using your best helpfulness and wisdom. Please try to avoid generic sound queries and answers. People often have concrete problems and would give important details. The answer should also give some concrete details and examples, but not get verbose.

Before I give you the set of {num.skills} skills, I will provide some examples involving 2 skills.

Example 1:

Skills: self_reflection_skills, linguistics

Instruction: I often find myself in conflicts at work due to miscommunication and differing perspectives. How can I improve my conflict resolution skills by incorporating self-reflection and effective communication techniques into my daily interactions with colleagues?

Response: To enhance your conflict resolution skills in the workplace, integrate these self-reflection and linguistic strategies into your daily routine:

Self-Reflection Techniques:

End-of-Day Review: Spend 10 minutes reflecting on interactions, noting successes and areas for improvement. For example, I successfully de-escalated a tense situation with a client by actively listening to their concerns and finding a mutually beneficial solution."

Conflict Log: Record details of conflicts, your responses, and outcomes in a dedicated journal. Analyze patterns monthly to identify growth opportunities. For instance, I noticed I tend to become defensive when criticized. I will practice pause and respond techniques to improve my reactions."

Linguistic Techniques:

Empathy Statements: Use phrases that demonstrate understanding and validate others' perspectives, such as I can see why you feel that way or That must be challenging for you. In a recent meeting, saying I understand your frustration with the project timeline helped a coworker feel heard and open to finding a solution together.

Reflective Listening: Paraphrase the other person's key points before responding to ensure clarity and show you're listening. For example, So, what I'm hearing is that you're concerned about the budget allocation. Let's discuss some options to address that."

Integration into Routine:

Weekly Practice Sessions: Dedicate an hour each week to role-play conflict scenarios with a trusted colleague, focusing on applying self-reflection insights and linguistic techniques. Provide each other with constructive feedback for continuous improvement.

Real-Time Application: When a conflict arises, take a moment to mentally review your phrase bank and select an appropriate response. After the interaction, briefly reflect on what worked well and what could be improved next time.

By consistently practicing these strategies, you'll build stronger habits and enhance your overall conflict resolution skills in the workplace.

Example 2:

Skills: psychological_understanding, data_handling_and_analysis

Instruction: I recently started working as a data analyst for a meal kit delivery service. We've noticed a significant increase (20%) in customer churn over the past quarter. How can I leverage data analysis and psychological principles to identify the root causes of churn and develop targeted strategies to improve customer retention?

Response: To address the 20% increase in customer churn for your meal kit service, employ a combination of data analysis and psychological insights:

Data Analysis:

Customer Segmentation: Analyze churn rates by customer segments such as age, location, and dietary preferences. For example, if you find that vegetarian customers have a higher churn rate, you can focus on improving vegetarian meal options.

Churn Timing Analysis: Identify common timeframes when churn occurs, such as after the first month or after specific promotions end. If churn spikes after the first month, consider implementing a more robust onboarding process or extending promotional offers.

Psychological Insights:

Exit Surveys: Conduct exit surveys to gather direct feedback from churning customers. Include open-ended questions to uncover deeper insights. For instance, What was the primary reason for canceling your subscription? and What could we have done better to keep you as a customer?"

Customer Journey Mapping: Map out the customer journey to identify pain points and opportunities for improvement. Apply psychological principles like the Peak-End Rule to prioritize the most impactful moments. Focus on creating a positive onboarding experience and ensuring a satisfying last interaction before cancellation.

Actionable Strategies:

Personalized Retention Campaigns: Develop targeted email campaigns for at-risk segments, addressing their specific concerns. For example, send vegetarian customers an email highlighting new plant-based recipes and offering a discount on their next box.

Flexible Subscription Options: Introduce more flexible subscription plans, such as the ability to skip weeks or customize delivery frequency. This addresses the psychological need for autonomy and control, reducing the likelihood of churn.

By leveraging data-driven insights and psychological principles, you can create a targeted approach to reduce churn and improve customer satisfaction in your meal kit service.

Example 3:

Skills: food.related.knowledge.and.skills, internet.technologies

Instruction: I'm a food truck owner looking to expand my online presence and attract more customers. I want to create a website that allows customers to customize their meals, track my truck's real-time location, and place orders for pickup. What web technologies should I consider to build a user-friendly and feature-rich website for my food truck business?

Response: To create a robust and interactive food truck website with meal customization and real-time location tracking, consider the following web technologies:

Front-End:

React: Use React, a popular JavaScript library, for building a dynamic and responsive user interface. React's component-based architecture allows for easy management of real-time updates, such as displaying the current location of the food truck.

HTML5 Geolocation API: Leverage the HTML5 Geolocation API to capture the user's location (with their permission) and display nearby food truck locations on an interactive map.

Leaflet or Google Maps: Integrate Leaflet, an open-source mapping library, or Google Maps to display food truck locations and enable users to get directions. Customize the map markers to show additional information like menu items or special offers.

Back-End:

Node.js and Express: Use Node.js, a server-side JavaScript runtime, and the Express web application framework to handle server-side logic and API routing. Node.js's non-blocking I/O model is well-suited for real-time applications like location tracking.

WebSocket: Implement WebSocket communication to enable real-time updates between the server and the client. When a food truck's location changes, the server can push the updated coordinates to connected clients, ensuring users always see the most current location.

Firestore Realtime Database: Store and sync food truck location data in real-time using Firestore Realtime Database. This NoSQL cloud database allows for efficient storage and retrieval of location data, enabling seamless real-time updates across multiple devices.

User Experience:

Progressive Web App (PWA): Develop the website as a PWA to provide a native app-like experience. PWAs offer features like offline accessibility, push notifications, and home screen installation, enhancing user engagement and convenience.

Responsive Design: Ensure the website is fully responsive and optimized for various screen sizes, particularly mobile devices. Use CSS media queries and flexible layouts to create a seamless experience across desktops, tablets, and smartphones.

Accessibility: Follow web accessibility guidelines (WCAG) to ensure the website is usable by people with disabilities. Implement proper headings, alt text for images, and keyboard navigation to create an inclusive user experience.

By combining these web technologies, you can create a feature-rich and user-friendly food truck website that offers meal customization and real-time location tracking, providing a seamless experience for your customers.

Example 4:

Skills: algorithmic.and.programming.skills, digital.marketing

Instruction: As a software engineer, I've developed a sophisticated recommendation engine that I believe could greatly benefit e-commerce businesses. I want to showcase my work through a technical blog post and live demo to attract potential clients and demonstrate the value of my solution. How can I structure my blog post and demo to effectively highlight the technical aspects and business benefits of my recommendation engine?

Response: To effectively showcase your recommendation engine and attract potential e-commerce clients, structure your technical blog post and live demo as follows:

Blog Post Structure:

Attention-Grabbing Introduction: Start with a compelling hook that highlights the value of personalized recommendations in e-commerce. Use statistics or real-world examples to demonstrate the impact on sales and customer satisfaction.

Problem Statement: Clearly define the challenges e-commerce businesses face in providing relevant product recommendations at scale. Discuss common pain points like data sparsity, cold-start problems, and real-time updates.

Technical Deep Dive: Explain the core components of your recommendation engine, such as collaborative filtering, content-based filtering, or hybrid approaches. Use diagrams and code snippets to illustrate your architecture and key algorithms. Highlight any innovative techniques you've employed, such as deep learning or reinforcement learning.

Performance Metrics: Present quantitative results that showcase the effectiveness of your recommendation engine. Include metrics like precision, recall, F1 score, and mean average precision. Compare your results to industry benchmarks or popular open-source recommendation libraries to demonstrate your engine's superiority.

Scalability and Efficiency: Discuss how your recommendation engine handles large-scale

data and real-time updates. Explain your strategies for efficient data processing, such as parallel computing or incremental updates. Provide performance benchmarks to highlight the speed and scalability of your solution.

Live Demo: E-commerce Store Integration: Create a mock e-commerce store that seamlessly integrates your recommendation engine. Showcase personalized product recommendations based on user interactions, such as viewed items, purchases, or ratings.

Real-Time Recommendations: Demonstrate how your engine adapts in real-time as users navigate the store. For example, show how the recommendations update dynamically based on the user's browsing history or cart contents.

Explanations and Transparency: Provide clear explanations for each recommendation, such as Customers who bought this item also bought... or Recommended based on your recent searches. This transparency builds trust and helps users understand the relevance of the recommendations.

A/B Testing: Implement an A/B testing feature that allows potential clients to compare the performance of your recommendation engine against a default or random recommendation system. Visualize the results through metrics like click-through rates or conversion rates to highlight the tangible benefits of your solution.

Promotion and Engagement:

Targeted Social Media Ads: Create compelling social media ads that highlight the key features and benefits of your recommendation engine. Target decision-makers in the e-commerce industry, such as marketers, product managers, and CTOs. Use eye-catching visuals and clear calls-to-action to drive traffic to your blog post and live demo.

LinkedIn Thought Leadership: Share your blog post on LinkedIn and engage in discussions related to e-commerce personalization. Participate in relevant groups and forums to establish yourself as a thought leader in the field. Offer valuable insights and answer questions to build trust and credibility with potential clients.

Webinars and Workshops: Host webinars or workshops that provide a hands-on experience with your recommendation engine. Walk participants through the setup process and demonstrate how to integrate your solution into their existing e-commerce platforms. Offer Q&A sessions to address specific concerns and showcase your expertise.

By structuring your technical blog post and live demo in this manner, you can effectively showcase the capabilities and benefits of your recommendation engine. Combine this with targeted digital marketing techniques to reach and engage potential e-commerce clients, ultimately driving interest and adoption of your solution. Example 5:

Skills: geographical.and.historical.knowledge, analytical.thinking

Instruction: I'm a history enthusiast planning a two-week trip to Eastern Europe with my family. We're particularly interested in exploring medieval architecture and learning about the region's experiences during the Cold War era. How can I create an itinerary that combines visits to historical sites, museums, and cultural experiences to gain a deeper understanding of Eastern Europe's past and present?

Response: Here's a curated itinerary for a historically rich two-week trip through Eastern Europe, focusing on medieval and Cold War sites:

Week 1: Poland and Czech Republic

Krakow (3 days):

Wawel Castle: Explore this 14th-century castle complex, which served as the residence of Polish kings. Marvel at the Gothic and Renaissance architecture, and visit the Dragon's Den, a legendary cave beneath the castle.

Oskar Schindler's Factory Museum: Learn about the Holocaust and Oskar Schindler's efforts to save Jewish workers during World War II. The museum offers a immersive experience, recreating the wartime atmosphere of Krakow.

Nova Huta: Take a guided tour of this planned socialist city, built during the Cold War era. Visit the iconic Lord's Ark Church, which became a symbol of resistance against the communist regime.

Warsaw (2 days):

Old Town: Stroll through the meticulously reconstructed Old Town, which was destroyed during World War II. Visit the Market Square, the Warsaw Barbican, and St. John's Cathedral to admire the Gothic and Renaissance architecture.

Warsaw Uprising Museum: Discover the story of the 1944 Warsaw Uprising, a major resistance operation against Nazi occupation. The museum features interactive exhibits, original artifacts, and a 3D movie that brings history to life.

Palace of Culture and Science: Explore this imposing Stalinist-era skyscraper, which remains the tallest building in Poland. Take an elevator to the observation deck for panoramic views of Warsaw.

Prague (2 days):

Prague Castle: Visit the world's largest ancient castle complex, dating back to the 9th century. Explore the Gothic St. Vitus Cathedral, the Romanesque St. George's Basilica, and the Golden Lane, a picturesque row of colorful houses.

Charles Bridge: Walk across this iconic 14th-century stone bridge, lined with baroque statues. Enjoy street musicians and artists, and take in the stunning views of the Vltava River and the Old Town.

Nuclear Bunker Tour: Experience the chilling reality of the Cold War by visiting a former Soviet nuclear bunker. Learn about the strategies and technology employed during this tense period in history.

Week 2: Hungary and Romania

Budapest (3 days):

Buda Castle: Discover this 13th-century castle, which has been rebuilt and expanded over the centuries. Visit the Hungarian National Gallery, the Budapest History Museum, and the Matthias Church, known for its colorful tiled roof.

House of Terror Museum: Explore this powerful museum dedicated to the victims of the fascist and communist regimes in Hungary. The exhibits are housed in the former headquarters of the Arrow Cross Party and the communist secret police.
Memento Park: Visit this open-air museum showcasing monumental statues from the Soviet era. Learn about the propaganda and ideology behind these imposing sculptures.
Bucharest (2 days):
Palace of Parliament: Tour the world's largest civilian building, constructed during the communist era under the rule of Nicolae Ceaușescu.

Marvel at the opulent interiors and learn about the controversial history of this massive structure.
Old Town: Explore the charming streets of Bucharest's Old Town, lined with historical buildings, churches, and cafes. Visit the ruins of the Old Princely Court, which served as the residence of Wallachian princes.
Revolution Square: Pay tribute to the heroes of the 1989 Romanian Revolution at this significant square. See the Memorial of Rebirth, which honors those who lost their lives fighting against the communist regime.
Travel Tips:
Book guided tours with knowledgeable local guides to gain deeper insights into the historical context and personal stories behind each site.
Stay in centrally located accommodation to minimize travel time and maximize your exploration of each city.
Use public transportation or ride-sharing services to navigate within cities, as parking can be challenging and expensive in historical areas.
By following this itinerary, you'll embark on a fascinating journey through Eastern Europe's medieval and Cold War past, gaining a profound appreciation for the region's rich history and resilience.

Now, it is your turn! Given the guidelines and examples above, please create a query that a human might plausibly ask whose answer involves using all skills below:
Skills: {skills_str}

Prompt 2

Thanks! It looks like the response may have been cut off. Please rewrite the entire response, making sure it fits within the length constraint. No need to include verbose or extraneous information. Thanks!

Prompt 3

Pretend you are the human asking the question, and make a list of weaknesses and strengths of the response. Currently the response looks a bit generic. Perhaps it could benefit from some concrete examples and details.

Prompt 4

Now, please refine your instruction and response (keep the strong parts and work on the weak parts).

Prompt 5

It looks like the improved response may have been cut off. Please rewrite the entire improved response, making sure it fits within the length constraint. No need to include verbose or extraneous information. Thanks again!

L.4 PROMPT FOR EXTRAPOLATING SKILLS (INSTRUCT-SKILLMIX)

First, consider the following definitions:
- Knowledge: A set of information, facts, descriptions, and theories acquired through education or experience.
- Topic: A subset of Knowledge that focuses on a particular area or subject.
- Skill: A function that transforms Knowledge into actions or performances that achieve specific outcomes.
Now, for the topic of topic, please provide me with multiple skills (in snake case) that could be relevant to the topic.

L.5 PROMPT FOR CREATING SYNTHETIC DATA (INSTRUCT-SKILLMIX)

Prompt 1

I am creating a dataset of engaging human-AI interactions that demonstrate the capabilities and value of AI models across diverse skills. Please help me generate high-quality examples for this dataset.

I will first give you a set of {num.skills} skills that are valuable to humans.

Next, you would create a query that a human might plausibly ask whose answer involves using those {num.skills} skills.

For this query you will generate a good length answer using your best helpfulness and wisdom. Please try to avoid generic sound queries and answers. The answer should also give some concrete details and examples, but not get verbose.

Before I give you the set of {num.skills} skills, I will provide some examples involving 2 skills.

Example 1:

Task Type: Information-Seeking

Skills: psychologicalunderstanding, data.handling.and.analysis

Instruction: What are the primary psychological theories that explain the impact of social media on adolescent self-esteem, and what evidence supports these theories? Additionally, what statistical techniques have been used in the literature to dissect these relationships, and how do these techniques help in understanding the nuances of psychological data?

Response: The impact of social media on adolescent self-esteem is a widely studied topic within psychology. Various theories and statistical techniques are employed to understand and measure these effects. Below, I'll outline some of the primary theories, the supporting evidence, and the statistical techniques used in this research.

Response: The impact of social media on adolescent self-esteem is a widely studied topic within psychology. Various theories and statistical techniques are employed to understand and measure these effects. Below, I'll outline some of the primary theories, the supporting evidence, and the statistical techniques used in this research.

****Psychological Theories and Evidence****

Social Comparison Theory: Adolescents often assess their worth by comparing themselves with peers on social media. A study by Vogel et al. (2014) found that Facebook usage was associated with negative self-perceptions when users compared themselves to others they perceived as better off. This suggests a direct correlation between the frequency of social media use and increased feelings of inferiority.

Self-Presentation Theory: Adolescents feel pressure to present themselves in an idealized way on platforms like Instagram and Snapchat. Research by Chou and Edge (2012) highlights that the need for positive feedback and fear of negative evaluations can lead to cycles of anxiety and lowered self-esteem when these expectations are not met.

Media Richness Theory: Different types of social media platforms impact self-esteem differently. A study by Sherman et al. (2016) compared text-based versus image-based platforms, finding that image-based platforms (like Instagram) can exacerbate body image concerns and anxiety more than text-based platforms due to the intense focus on physical appearance.

Statistical Techniques and Applications

Regression Analysis: Used extensively to quantify the relationship between social media usage and self-esteem. For instance, studies might control for variables like age, gender, and socioeconomic status to isolate the effect of social media usage.

Structural Equation Modeling (SEM): SEM enables researchers to construct a comprehensive model of how different factors like peer influence, media consumption, and personal traits interact to affect self-esteem. An example is Kross et al.'s (2013) study, which modeled the pathways through which social media affects mood and self-esteem over time.

Longitudinal Studies and Growth Curve Modeling: These techniques provide insights into how self-esteem trajectories change over time with social media use. For instance, longitudinal research might track self-esteem changes from early to late adolescence, revealing critical periods where impacts are most pronounced.

Mediation and Moderation Analyses: These are crucial for exploring underlying mechanisms and boundary conditions. For example, studies might explore how the negative impact of social media on self-esteem can be mediated by social support or moderated by individual resilience.

****Contradictory Evidence****

While many studies suggest a negative impact of social media on self-esteem, some

research offers a different perspective. For instance, Valkenburg et al. (2006) found that online interactions can enhance well-being by providing social support and a platform for self-expression. These findings suggest that the impact of social media on self-esteem is not universally negative and can vary based on usage patterns and individual differences.

****Practical Implications****

Understanding these dynamics is crucial for developing targeted interventions. For instance, educational programs that teach critical media literacy can help adolescents navigate social media healthily. Moreover, knowing which aspects of social media use trigger negative self-comparisons can guide the development of features that promote positive interaction and reduce the emphasis on appearance.

Example 2:

```
### Task Type: Help-Seeking
### Skills: self-reflection-skills, linguistics
### Instruction: I often find myself in conflicts at work due to miscommunication and differing perspectives. How can I improve my conflict resolution skills by incorporating self-reflection and effective communication techniques into my daily interactions with colleagues?
### Response: To enhance your conflict resolution skills in the workplace, integrate these self-reflection and linguistic strategies into your daily routine:
Self-Reflection Techniques:
End-of-Day Review: Spend 10 minutes reflecting on interactions, noting successes and areas for improvement. For example, "I successfully de-escalated a tense situation with a client by actively listening to their concerns and finding a mutually beneficial solution."
Conflict Log: Record details of conflicts, your responses, and outcomes in a dedicated journal. Analyze patterns monthly to identify growth opportunities. For instance, "I noticed I tend to become defensive when criticized. I will practice pause and respond techniques to improve my reactions."
Linguistic Techniques:
Empathy Statements: Use phrases that demonstrate understanding and validate others' perspectives, such as "I can see why you feel that way" or "That must be challenging for you." In a recent meeting, saying "I understand your frustration with the project timeline" helped a coworker feel heard and open to finding a solution together.
Reflective Listening: Paraphrase the other person's key points before responding to ensure clarity and show you're listening. For example, "So, what I'm hearing is that you're concerned about the budget allocation. Let's discuss some options to address that."
Integration into Routine:
Weekly Practice Sessions: Dedicate an hour each week to role-play conflict scenarios with a trusted colleague, focusing on applying self-reflection insights and linguistic techniques. Provide each other with constructive feedback for continuous improvement.
Real-Time Application: When a conflict arises, take a moment to mentally review your phrase bank and select an appropriate response. After the interaction, briefly reflect on what worked well and what could be improved next time.
By consistently practicing these strategies, you'll build stronger habits and enhance your overall conflict resolution skills in the workplace.
```

Example 3:

```
### Task Type: Information-Seeking
### Skills: geographical-and-historical-knowledge, analytical-thinking
### Instruction: What were the major geopolitical changes in Europe following World War II, and how have these changes influenced current European political boundaries?
### Response: **Major Geopolitical Changes in Europe After World War II**

1. Division of Germany: The division of Germany into East and West Germany in 1949 was a critical symbol of the Cold War's onset. This division, marked physically by the Berlin Wall from 1961, lasted until the reunification in 1990 and significantly influenced European political dynamics.

2. Creation of the Iron Curtain: Winston Churchill's term, the Iron Curtain, described the ideological and physical boundary separating the Soviet-controlled Eastern Bloc and the Western democracies. This division dictated political alignments and conflicts during the Cold War, influencing policies and international relations.

3. Decolonization: Following the war, European powers like Britain and France began a significant process of decolonization. This period saw the independence of nations such as India in 1947 and the rapid decolonization of Africa in the 1960s, marking a major shift in global dynamics and European foreign policies.

4. Formation of the European Union (EU): The EU's origins lie in the European Coal and Steel Community in 1951, evolving into the European Economic Community by 1957. These alliances, expanding to include more countries over the decades, aimed to foster economic cooperation and prevent further wars in Europe, influencing both economic and political policies within the continent.

5. NATO and the Warsaw Pact: The establishment of NATO in 1949 by Western countries
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was a strategic move for collective security against the Soviet threat. The Soviet response, the Warsaw Pact in 1955, defined the military alliances in Europe, solidifying the East-West divide.

****Influence on Current European Political Boundaries****

1. German Reunification: The fall of the Berlin Wall in 1989 and the subsequent reunification of East and West Germany in 1990 reshaped Germany's role in Europe, altering both its internal and external political boundaries.
2. EU Expansion: The EU's expansion has included many former Eastern Bloc countries, fundamentally changing the political landscape of Europe. The Schengen Agreement, implemented in 1995, minimized the importance of national boundaries within the EU, promoting free movement and economic integration.
3. Breakup of Yugoslavia and the Soviet Union: The disintegration of Yugoslavia into seven successor states throughout the 1990s and the Soviet Union into 15 independent countries in 1991 dramatically redrew political boundaries. These events, rooted in ethnic tensions and political upheavals, continue to influence regional stability and alignments.

****Case Studies: Key Treaties and Shifts in Alliances****

1. Treaty of Paris (1951): This treaty established the European Coal and Steel Community, a foundational step towards European integration. It set precedents for future economic policies and cooperative frameworks within Europe, promoting peace and economic stability across former wartime adversaries.
2. Impact of NATO and the Warsaw Pact on Poland: Poland's transition from a Warsaw Pact member to a NATO member in 1999 exemplifies the dramatic shift in military and political alliances. This change significantly influenced Poland's foreign and security policies, reflecting broader geopolitical shifts in Eastern Europe post-Cold War.

Now, it is your turn! Given the guidelines and examples above, please create a query that aligns with the following task type:
{query.type}

Include specific text snippets when they are essential to analyze and validate your query effectively. Make sure that the query is one that a human might plausibly ask whose answer involves using all skills below:
Task Type: {query.str}
Skills: {skills.str}

Prompt 2

Thanks! It looks like the response may have been cut off. Please rewrite the entire response, making sure it fits within the length constraint. No need to include verbose or extraneous information. Thanks!

Prompt 3

Pretend you are the human asking the question, and make a list of weaknesses and strengths of the response. Currently the response looks a bit generic. Perhaps it could benefit from some concrete examples and details.

Prompt 4

Now, please refine your instruction and response (keep the strong parts and work on the weak parts).

Prompt 5

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M COMPARISON OF RESPONSES

In this section, we show side-by-side comparisons of responses from various models to the following instruction from AlpacaEval.

I'm trying to teach myself to have nicer handwriting. Can you help?

Observe that responses produced by models finetuned on INSTRUCT-SKILLMIX tend to include concrete examples (whereas responses produced by the other models do not always).

Response by LLaMA-3-8B-Base SFT on INSTRUCT-SKILLMIX(k=2)-4K

Absolutely! Improving your handwriting involves both technique and practice. Here's a concise guide to help you achieve nicer handwriting:

1. Posture and Grip:

- **Posture:** Sit upright with your paper at a 45-degree angle to reduce arm and hand movement, which helps prevent smudging.
- **Grip:** Use a relaxed, comfortable grip with your pen or pencil resting lightly in your fingers. This promotes smoother movement and reduces pressure on the paper.

2. Pen Lifts:

- **When to Lift:** Between words and sentences to create clear breaks, especially in cursive.
- **Purpose:** Pen lifts help maintain the integrity of each letter, preventing them from blending together and enhancing readability.

3. Slant and Direction:

- **Natural Slant:** Write with a natural slant that's comfortable for your hand, typically a slight upward slope helps legibility.
- **Direction:** Write continuously without lifting your pen too much, maintaining a fluid motion can enhance the flow and elegance of your handwriting.

4. Pressure and Speed:

- **Pressure:** Apply consistent pressure, avoiding excessive force which can cause fatigue and messy handwriting.
- **Speed:** Write at a comfortable pace that allows your handwriting to remain clear and legible.

5. Regular Practice:

- **Routine:** Set aside time daily for handwriting practice, such as 10 minutes a day writing sentences or paragraphs.
- **Variety:** Mix practice sessions with both structured exercises focusing on specific letters and free writing to maintain fluidity.

6. Paper and Tools:

- **Paper Choice:** Use smooth, medium-weight paper that allows for control without too much slip.
- **Tool Variety:** Experiment with different writing tools|pens, pencils, markers|to find which provides the best feel and outcome for your handwriting.

7. Evaluation and Adjustment:

- **Self-Review:** Regularly assess your handwriting samples to note improvements and areas needing more work.
- **Feedback:** Ask for feedback from others or enroll in a calligraphy class to gain insights from experienced instructors.

By focusing on these specific elements and committing to regular practice, your handwriting will improve. Remember, small, consistent efforts can lead to significant improvements over time.

This response is concise yet informative, providing specific, actionable advice for each step of the handwriting improvement process. It also includes practical tips and suggestions for maintaining motivation and evaluating progress, making it a comprehensive guide for anyone looking to refine their handwriting.

Response by Mistral-7B-Base-v0.2 SFT on INSTRUCT-SKILLMIX(k=2)-4K

Improving your handwriting is a rewarding skill to develop and can be both therapeutic and practical. Here's a structured guide with specific techniques and exercises to help you achieve elegant, legible handwriting:

****Step 1: Posture and Setup****

- ****Posture****: Sit with a straight spine and relax your shoulders to prevent tension.
- ****Light****: Use a desk lamp for adequate lighting.
- ****Paper and Pen****: Use smooth, lined paper and a pen grip that feels comfortable, such as a Pilot G2 or a Pentel EnerGel.

****Step 2: Warm-up and Mindfulness****

- ****Warm-up****: Write the alphabet three times to warm up muscles.
- ****Breathing****: Inhale for four counts, exhale for four counts; repeat until calm. This helps reduce writing tension.

****Step 3: Basic Strokes****

- Practice basic strokes: the upward stroke (v), downward stroke (∩), and circular stroke (o).

****Step 4: Letter Formation****

- ****Uppercase Letters****: Form each letter slowly, tracing them with a stencil for accuracy.
- ****Lowercase Letters****: Practice looping 'l' and crossing 't'.

****Step 5: Word Practice****

- Write simple sentences like "The quick brown fox jumps over the lazy dog." Focus on each word.

****Step 6: Cursive Writing****

- Start with connected uppercase letters, then move to fluid cursive lowercase.
- Try online tutorials for modeled cursive formation.

****Step 7: Pressure and Speed****

- Practice on a tablet to see pressure applied; aim for consistent pressure.
- Slow down; writing fast increases errors.

****Step 8: Style Inspirations****

- Explore calligraphy styles online, imitating specific fonts like Script or Gothic.

****Step 9: Regular Practice****

- Write a journal entry daily, focusing on quality, not quantity.

****Step 10: Challenges and Variety****

- Weekly challenges like writing with your non-dominant hand or different tools.
- Experiment with bullet journaling for creativity.

****Step 11: Track Progress****

- Monthly before-and-after writing samples.
- Ask for feedback from a calligraphy expert or mentor.

****Step 12: Enjoy the Process****

- Listen to calming music or an audiobook to enjoy the time writing.

****Additional Tips****

1. ****Muscle Training****: Use hand exercise tools or write with silverware for grip strength.
2. ****Mindfulness****: Meditate before writing to enhance focus.
3. ****Rewards****: Treat yourself after achieving goals, like a new pen for milestones.

This guide not only sharpens your handwriting but also promotes mindfulness and creativity, offering both functional and mental benefits. Enjoy the journey to better handwriting!

Response by the Reference Model (GPT-4-Turbo 2023-11-06)

Certainly! Improving your handwriting involves patience, practice, and attention to technique. Here are some tips to help you develop nicer handwriting:

- 1. **Understand Your Current Style**:** Before you can improve your handwriting, you need to understand where you're starting from. Write a paragraph and analyze it to see where you could make improvements. Look for consistent slant, letter size, spacing, and legibility.
- 2. **Choose the Right Tools**:** Use a pen or pencil that feels comfortable in your hand. The right tool can make a significant difference in your writing. Some people find that using a fountain pen improves their writing because it encourages a more relaxed grip and has a smoother ink flow.
- 3. **Practice Basic Strokes**:** Before focusing on letters, practice basic strokes. This includes straight lines, curves, and circles. These are the building blocks of letters, and getting comfortable with these will make your letters more consistent.
- 4. **Slow Down**:** Speed can lead to sloppy writing. By slowing down, you can focus on the shape of each letter and ensure that you're writing them correctly.
- 5. **Maintain Proper Posture and Grip**:** Sit up straight and hold your pen or pencil with a relaxed grip. Don't hold it too tightly, as this can make your handwriting appear more jagged and can also cause your hand to tire out more quickly.
- 6. **Form Letters Correctly**:** Start and end each letter in the right spot to ensure consistency and flow. Practice writing each letter of the alphabet, focusing on the ones that give you the most trouble.
- 7. **Practice Consistent Letter Size and Spacing**:** Consistency is key to neat handwriting. Work on keeping all of your letters the same size and your words evenly spaced. You could use lined paper as a guide.
- 8. **Use Handwriting Worksheets**:** You can find handwriting practice worksheets online for both print and cursive writing. These worksheets can guide you through the proper strokes and help you practice consistency.
- 9. **Copy Neat Writing**:** Find a sample of handwriting you admire and try to copy it. This can help you develop a sense of the style you're aiming for.
- 10. **Write Often**:** Like any skill, handwriting improves with regular practice. Find reasons to write by hand every day, whether it's journaling, writing letters, or making to-do lists.
- 11. **Analyze and Adjust**:** Regularly look back at your handwriting to see where you've improved and what still needs work. Make adjustments as needed.
- 12. **Be Patient and Persistent**:** Don't get discouraged if progress is slow. Handwriting improvement takes time and dedication. Remember, the goal of improving your handwriting is to make it more legible and aesthetically pleasing, but it should also be comfortable for you to write. There's no one "correct" style of handwriting, so focus on developing a style that works for you."

Response by UltraLM 13B

Sure, I'd be happy to help! Here are some tips to improve your handwriting:

1. **Practice regularly:** The more you practice, the better your handwriting will become. Set aside some time every day to practice writing letters, words, and sentences.
2. **Start with the basics:** Begin by learning the basic strokes of each letter, such as circles, lines, and curves. Then practice writing each letter in isolation before moving on to words and sentences.
3. **Use the right tools:** Make sure you have the right supplies, such as a good-quality pen or pencil, lined paper, and an eraser. Using the right tools can make a big difference in the quality of your handwriting.
4. **Watch your posture:** Good posture is essential for good handwriting. Sit up straight with your feet flat on the floor and your arms and wrists relaxed.
5. **Relax your grip:** Hold your pen or pencil lightly and avoid gripping it too tightly. This will help you write more smoothly and legibly.
6. **Take breaks:** It's important to take breaks while practicing to avoid fatigue and strain. Take a break every 20-30 minutes and stretch your hands and wrists.

Remember, improving your handwriting takes time and practice, so be patient with yourself. Keep practicing and soon you'll have beautiful handwriting!

Response by Mistral-7B-Base-v0.2 SFT on Alpaca-52K

Sure! Here are some tips that can help you improve your handwriting:

1. Practice regularly: The more you practice, the better your handwriting will become. Set aside some time each day to write out letters, words, and sentences to improve your handwriting.
 2. Use the right tools: Make sure you have a good pen or pencil that flows smoothly and is comfortable to write with. A good quality pen or pencil can make a big difference in the quality of your writing.
 3. Keep your posture in mind: Sit up straight and hold your pen or pencil correctly, with your arm and wrist relaxed. This will help you write more smoothly and avoid cramping.
 4. Take your time: Don't rush your writing. Take your time to form each letter and make sure it's legible.
 5. Use proper grip: Hold your pen or pencil correctly, with your fingers and thumb supporting it, and your index finger and middle finger guiding it.
 6. Keep your letters consistent: Make sure your letters are the same size and have the same slant. This will make your writing look more uniform.
 7. Practice proper letter formation: Make sure your letters are formed correctly, with the right strokes and curves. You can find examples of proper letter formation online or in a handwriting guidebook.
 8. Keep your handwriting neat: Keep your writing neat and tidy, with even spacing between words and lines.
 9. Practice cursive writing: Cursive writing can help improve your handwriting by making your letters more connected and flowing.
 10. Experiment with different styles: Try different styles of handwriting to find one that suits you. There are many styles to choose from, such as print, cursive, and italic.
 11. Use guides: You can use a ruler or a grid to help you keep your writing straight and even.
 12. Get feedback: Ask a friend or teacher to give you feedback on your writing and see where you can improve.
 13. Keep it simple: Avoid overly decorative or complicated writing, as it can be hard to read.
 14. Keep it legible: Make sure your writing is easy to read, even if it's not perfect.
 15. Be patient: Improving your handwriting takes time and practice, so be patient with yourself and keep practicing.
- Remember, everyone's handwriting is unique, so don't be too hard on yourself if it doesn't look exactly like someone else's. Just keep practicing and you'll see improvement over time.

Response by Mistral-7B-Base-v0.2 SFT on Alpaca-1K Longest

Sure! Here are some tips that may help you improve your handwriting:

1. **Practice regularly:** Like any skill, improving your handwriting takes practice. Set aside some time each day to write out words, sentences or even whole passages to develop fluency and consistency in your strokes.
2. **Use the correct tools:** Make sure you have a pen or pencil that feels comfortable in your hand and that you sharpen it regularly to ensure a fine point. Also, use paper that is not too smooth or too rough, as this can affect the quality of your strokes.
3. **Posture:** Sit up straight and keep your writing surface at a comfortable height to avoid straining your hands, wrists, or arms. Your writing instrument should be held in a relaxed grip, not too tightly.
4. **Start with proper formation:** Make sure you form each letter correctly from the beginning strokes. This means starting with the upward and downward strokes of the letter at the right angle, and sizing them appropriately.
5. **Don't rush:** Take your time and write slowly and deliberately, focusing on the movement of your hand and the pressure you apply to the paper.
6. **Keep it simple:** Avoid overly ornate or fancy writing, as this can be hard to read and may slow you down. Stick to basic, uniform strokes and practice until they become second nature.
7. **Don't lift your pen:** Lifting your pen off the paper to change direction can cause inconsistencies in your writing. Practice making smooth, fluid transitions between strokes without lifting your pen.
8. **Practice Cursive:** Cursive writing can help improve the flow and connectedness of your letters, making your handwriting look neater. Practice connecting the letters in words and phrases.
9. **Pay attention to spacing:** Make sure there is enough space between words and letters for legibility.
10. **Keep it clean:** A neat, uncluttered workspace can help you focus on your writing. Keep your desk free of clutter and sharpen your pencils regularly to avoid smudges.
11. **Experiment:** Try different styles and techniques until you find one that feels natural and looks good to you. Don't be afraid to mix and match until you find what works best for you.
12. **Don't give up:** Improving your handwriting takes time and patience, so don't get discouraged if you don't see results immediately. Keep practicing and you will eventually see an improvement.

Remember, handwriting is a personal expression, so find a balance between what looks nice and what comes naturally to you. With practice, you can develop a neat and legible handwriting that reflects your personality.