From KMMLU-REDUX to PRO: A Professional Korean Benchmark Suite for LLM Evaluation

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Abstract

The development of Large Language Models (LLMs) requires robust benchmarks that encompass not only academic domains but also industrial fields to effectively evaluate their applicability in real-world scenarios. In this paper, we introduce two Korean expert-level benchmarks. **KMMLU-REDUX**, reconstructed from the existing KMMLU (Son et al., 2024a), consists of questions from the Korean National Technical Qualification exams, with critical errors removed to enhance reliability. **KMMLU-PRO** is based on Korean National Professional Licensure exams to reflect professional knowledge in Korea. Our experiments demonstrate that these benchmarks comprehensively represent industrial knowledge in Korea.

1 Introduction

As LLMs continue to achieve strong performance across a wide range of subjects (OpenAI et al., 2024b; Deepmind, 2024; DeepSeek-AI et al., 2025a; Research et al., 2025), the demand for comprehensive benchmarks has grown. MMLU (Hendrycks et al., 2021) is widely used for its broad coverage of general knowledge from elementary to college level. However, its publicly available online problems has raised concerns about reliability and potential data contamination (Gema et al., 2025; Vendrow et al., 2025; Zhao et al., 2024).

We identify similar issues in KMMLU (Son et al., 2024a), a widely used benchmark for evaluating Korean expert-level knowledge. The dataset was constructed by crawling websites that provide questions from various exams. We observe noisy samples, including problems that explicitly reveal the answer or non-existent reference, which can mislead performance evaluation. Additionally, we find evidence of contamination between the train and test splits, as well as with common web corpus such as FineWeb2 (Penedo et al., 2024).

Instead of collecting data from online sources directly, recent challenging benchmarks (Srivastava et al., 2023; Rein et al., 2024; Phan et al., 2025; Kazemi et al., 2025; Team et al., 2025b) have been constructed through problems and answers authored by human expert. Although this approach ensures high-quality, contamination-free benchmarks, it is costly to construct and maintain. The high construction cost hinders regular updates (White et al., 2025; Jain et al., 2025), leaving the benchmarks vulnerable to deprecation and potential contamination. Furthermore, existing benchmarks focus primarily on academic knowledge and evaluate models using a single overall score. They often overlook the practical applicability of models in industrial or professional contexts, specifically whether the models meet the standards for real-world professional certification.

We introduce two benchmarks to address the limitations above and reflect real-world professional knowledge. First, **KMMLU-REDUX**, a refined subset of KMMLU with 2,587 problems, is built through rigorous manual examination by authors to reduce errors and contamination within KMMLU. Furthermore, while the KMMLU contains problems from wide range of exams, even with high-school level, KMMLU-REDUX only selects Korean National Technical Qualification (KNTQ) exams as sources of the benchmark. The exams require applicants to have either a bachelor's degree or at least nine years experience in industrial field, thus making the benchmark more challenging.

Second, we build **KMMLU-PRO**, a new challenging benchmark, which consists of 2,822 problems from acquisition exams for Korean National Professional Licensure (KNPL), representing highly specialized professions in Korea. We include 14 professions from diverse domains. Unlike KMMLU that crawls websites, we collect data directly from the official source of each license. After that, human annotators manually examine it to

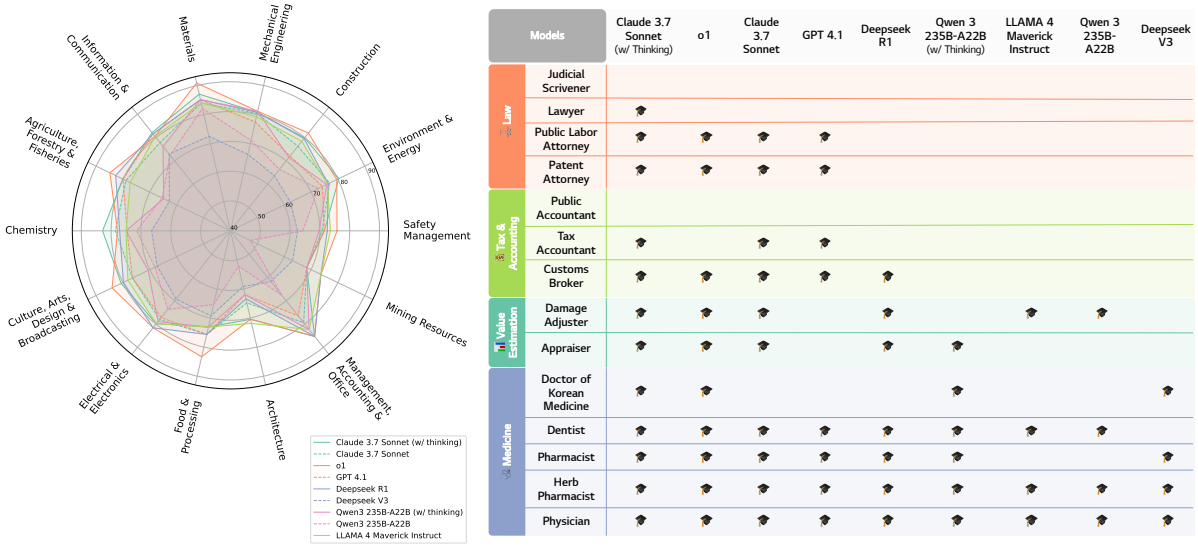

Figure 1: Model performance across industry domains on KMMLU-Redux (**left**) and profession acquisition status with 🎓 on KMMLU-Pro (**right**).

avoid noises. KMMLU-Pro only includes exams held in the most recent year and would be updated annually with the latest exam to maintain long-term reliability and prevent contamination.

We conduct extensive evaluations of various LLMs on the two benchmarks. Our benchmarks, based on real-world exams, enable aligned analysis with industrial and professional qualifications, effectively revealing the practical strengths of each model. As shown in Figure 1, KMMLU-Pro assesses which professional license a model is capable of obtaining, while KMMLU-Redux evaluates the breadth of industrial knowledge. The results show that several state-of-the-art models perform strongly in the medicine domain, passing most licenses, yet nearly fail in law-related licenses.

Moreover, we observe the significant performance gaps between our datasets and merely translated datasets like MMMLU (OpenAI, 2024), especially in domains such as laws, where in-depth knowledge of specific countries is required (see Section 6.1). We argue that these findings underscore the practicality of our benchmarks for assessing the capabilities of models in professional fields within Korea.

To summarize, our contributions are as follows:

- We improve the previous benchmark, KMMLU, to construct the refined and compact version of the benchmark, **KMMLU-Redux**, by correcting various errors.
- We introduce **KMMLU-Pro**, a new benchmark designed to evaluate high-level professional knowledge in Korea. By imitating real-world license acquisition systems, KMMLU-Pro assesses the industrial practicality across various professions in Korea.
- We comprehensively analyze the results of two benchmarks, highlighting the importance of benchmarks specialized in Korea-specific professional knowledge.

2 KMMLU-Redux

We first revisit KMMLU (Son et al., 2024a) to examine its quality. Building on these insights, we construct KMMLU-Redux, a cleaned and compact version of the KMMLU. We carefully denoise against the KMMLU and increase difficulty.

2.1 Revisiting KMMLU

KMMLU plays a significant role in the NLP community as a de facto standard for evaluating LLMs on Korea-specific expert knowledge (Yoo et al., 2024; Research et al., 2024; Team et al., 2025a). The dataset was constructed by crawling websites[1] where various exam questions are uploaded by people online, spanning from high school to professional qualification exams. Upon closer inspection, we identify several noises and limitations, which can be categorized into three types: 1) duplication issues, 2) dataset errors, and 3) contamination.

Duplication Issue As the KMMLU crawls problems from hundreds of exams in Korea, we observe

[1] https://www.kinz.kr/

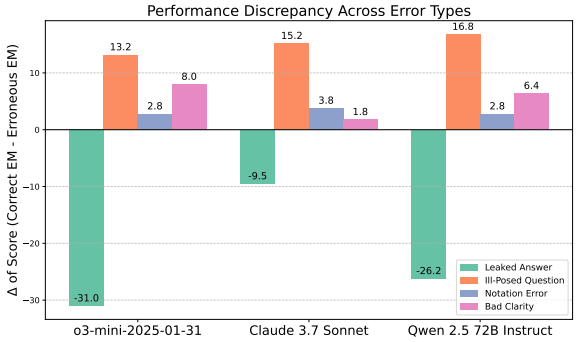

Figure 2: Performance differences in LLMs on the erroneous versus correct dataset. Leaked answer errors tend to overestimate model capabilities, while three other error types hinder LLMs to correctly predict true answers.

multiple duplicated questions across related exams. Notably, duplicated samples occur not only within the test set but also between the training and test sets. Using the Longest Common Sequence (LCS) algorithm to investigate overlaps, we could find 5.36% duplication within the test set and a 5.46% contamination between train and test set.

Dataset Errors Following Gema et al. (2025), we investigate the extent to which various error types appear in the KMMLU test set and their potential impact on LLM performance. We identify four representative error types: leaked answers, ill-posed questions, poor clarity, and notation errors. We then annotate the entire test set using GPT-4o[2] (OpenAI et al., 2024a). In total, we find that 7.66% of the data contains one of the errors mentioned above. We describe the details of the investigation of dataset errors in Appendix A.

In Figure 2, we observe significant discrepancies in the LLM's performance between erroneous and correct samples. Notably, the performance of instances with leaked answers drops significantly when the LLMs are assessed on the clean dataset. Conversely, all models' scores increase on ill-posed questions, underscoring their inability to identify the correct answer for poorly formulated questions.

Contamination The KMMLU was primarily sourced online, making them highly susceptible to contamination from web-crawled training corpora. When applying n-gram contamination detection (Lambert et al., 2025; Grattafiori et al., 2024) to the Korean subset of FineWeb2 (Penedo et al., 2024) and the KMMLU dataset, 1.88% of the data were flagged as contaminated.

[2]gpt-4o-2024-11-20

2.2 Dataset Construction

KMMLU consists of approximately $35k$ examples, making evaluation resource-intensive. To reduce this burden, we first restrict the scope to a subset of high-difficulty exams (Section 2.2.1). Furthermore, to ensure the reliability of the benchmark, we manually conduct a thorough examination of the dataset to eliminate errors (Section 2.2.2).

2.2.1 Filtering Non-Challenging Problems

Since KMMLU includes a variety of exams in Korea, spanning from high school to professional certification exams, we filter out the easier exams to build a more challenging benchmark. Specifically, we choose Korean National Technical Qualification (KNTQ) exams, which are primarily designed to assess practical technical competencies required in industrial field. The qualifications require applicants to have either a bachelor's degree or at least nine years of professional experience. We adopt a collection of 100 KNTQ exams across the 14 domains in total. We only include the most recent exam for each qualification, thereby avoiding outdated knowledge being evaluated[3].

To further discriminate simple problems, we leverage the performances of LLMs on the data (Wang et al., 2024; Zellers et al., 2019; Lee et al., 2023). By employing seven smaller LLMs[4], we mark a data as *easy* if four or more models correctly predict its answer. Through this process, we remove 38.6% of the dataset.

2.2.2 Denoising

To remove noises, we follow the processes described in Section 2.1. Specifically, we first manually review the dataset to minimize errors. Next, we perform decontamination to prevent potential data leakage from pre-training corpora. Additionally, we detect inner duplication and against the training and test sets in KMMLU, thus finally remove all duplicates.

[3]We have compiled a list of all KNTQs exams alongside their most recent exam dates in Appendix B. Our aim is to make these available to LLM researchers and developers to help prevent data contamination.

[4]Llama 3.2 3B (Meta, 2024c), Qwen 2.5 3B (Qwen et al., 2025), Gemma 3 4B IT (Team, 2025a), Kanana Nano 2.1B Instruct (Team et al., 2025a), EXAONE 3.5 2.4B (Research et al., 2024), DeepSeek-R1-Distill-Qwen-1.5B (DeepSeek-AI et al., 2025a) EXAONE Deep 2.4B (Research et al., 2025), and Ko-R1-7B-v2.1 (OneLineAI).

Domain	Names of KNPLs	U.S. Equivalent	# of Instances
Law	Certified Judicial Scrivener	Paralegal, Legal Document Assistant, or Notary Public (no direct equivalent)	198
	Lawyer (Kim et al., 2024b)	Attorney-at-Law	150
	Certified Public Labor Attorney	Labor & Employment Lawyer (requires J.D. and bar admission; no separate certification in the U.S.)	239
	Certified Patent Attorney	Patent Attorney (JD + USPTO registration required)	109
Tax & Accounting	Certified Public Accountant (CPA)	Certified Public Accountant (CPA) – Exact Equivalent	208
	Certified Tax Accountant	Enrolled Agent (IRS) or CPA with Tax Specialization	238
	Certified Customs Broker	U.S. Customs Broker (licensed by U.S. Customs and Border Protection - CBP)	159
Value Estimation	Certified Damage Adjuster (CDA)	Claims Adjuster / Insurance Adjuster (state-licensed)	120
	Certified Appraiser	Certified Real Estate Appraiser (licensed at the state level)	196
Medicine	Doctor of Korean Medicine	Licensed Acupuncturist (L.Ac.) or Doctor of Acupuncture and Oriental Medicine (D.A.O.M.)	288
	Dentist (Kweon et al., 2024)	Doctor of Dental Surgery (D.D.S.) / Doctor of Dental Medicine (D.M.D.)	252
	Pharmacist (Kweon et al., 2024)	Doctor of Pharmacy (Pharm.D.)	271
	Herb Pharmacist	Herbalist (non-licensed or CAM-certified depending on state)	244
	Physician (Kweon et al., 2024)	Medical Doctor (M.D./D.O.)	150
	Total		**2822**

Table 1: The list of National Professional Licenses (NPLs) used for KMMLU-PRO and their corresponding statistics. The names of NPLs are translated from those in Korea and we also report equivalent licences in U.S. We use KorMedMCQA (Kweon et al., 2024) for three licenses in the Medical category, and KBL (Kim et al., 2024b) for the bar exam of lawyer.

2.2.3 Final Statistics

For KMMLU-REDUX, we have collected 2,587 problems from 100 KNTQ exams. Among these, 596 problems are from exams that require over nine years of professional experience to acquire the qualification. To categorize the dataset into 14 domains, we follow the Korean Standard Industrial Classification (KSIC) published by Statistics Korea[5] as the qualification system is primarily designed to align with industrial fields. Figure 6 in Appendix B illustrates the distribution of domain of KMMLU-REDUX.

3 KMMLU-PRO

A major challenge in building benchmarks from online sources is data contamination (Zhao et al., 2024; Jain et al., 2025; Roberts et al., 2024). While some studies address this by having experts manually create problems (Srivastava et al., 2023; Rein et al., 2024; Phan et al., 2025; Kazemi et al., 2025; Team et al., 2025b), this approach is costly and time-consuming. As an alternative, recent work explores periodic releases of fresh subsets. (White et al., 2025; Jain et al., 2025).

Motivated by these approaches, we focus on the Korean National Professional Licensure (KNPL) exams. These are high-stakes exams administered annually that pose a significant challenge. Unlike benchmarks crafted by a small set of experts (Rein et al., 2024; Phan et al., 2025), our approach leverages the well-established curricula of professional licensing systems, designed to assess real-world professional knowledge.

3.1 Korean National Professional Licensures

We choose KNPL exams for main source of KMMLU-PRO. KNPL exams target high-level professionals, such as lawyers, accountants, or physicians, requiring advanced knowledge, critical reasoning, and ethical judgment. Among them, we select 14 KNPLs representing highly specialized and regulated professions in Korea (See Table 1 for the list of KNPLs and their equivalent licensure in U.S.). These licenses are legally mandated credentials required to practice in their respective domains. As such, they serve as institutionalized gateways to high-status occupations with significant entry barriers. Our evaluation simulates real-world assessment standards by incorporating official exam pass criteria, aligning model performance with human standards.

3.2 Dataset Collection and Annotation

In Korea, the government releases and manages the questions for KNPL acquisition exams. We directly download the PDF files from the government's websites for each license and use GPT-4o (OpenAI et al., 2024a) for OCR parsing. As our dataset sources from the official PDFs, we can enhance the quality of the dataset, avoiding potential errors when collecting from online text (Team et al., 2025b). Since GPT-4o has difficulty handling tables and low-resolution PDFs, we employ human annotators to review parsed questions. When a problem contains an image, the annotators convert it into text that conveys the same meaning of the image, if possible[6]. Notably, our process remains relatively

[5] https://www.kostat.go.kr/

[6] For further details, please see Appendix C

cost-efficient as it requires human annotators solely for error reviewing tasks, not full annotation.

We follow previous works, releasing a new set of questions periodically (White et al., 2025; Jain et al., 2025). Since the exams are conducted annually, we commit to collect and release questions from the exams held just before the current year.

3.3 Decontamination

We also adopt the same process outlined in Section 2.2.2 to ensure KMMLU-PRO is free from contamination. When conducting n-gram match between KMMLU-PRO, FineWeb2, and the training and validation sets of KMMLU, we did not find any contaminated examples. As a result, we can retain all 2,822 data points in the KMMLU-PRO, maintaining its contamination-free integrity.

4 Experiments

We select a diverse set of baseline models varying in size, multilingual capability, and reasoning ability. By default, we apply a zero-shot Chain-of-Thought (CoT) (Wei et al., 2022) prompt written in Korean. However, we observe that some models perform worse when prompted in Korean. For those models, we report results using the English prompt instead[7]. Our evaluation implementation is based on OpenAI's simple-evals repository[8]. We use greedy decoding for non-reasoning models, while for reasoning models, we follow the settings in DeepSeek-AI et al. (2025a); Research et al. (2025) , using a temerature of 0.6 and top-p (Holtzman et al., 2020) of 0.95. For more details, see Appendix D.

Metrics In addition to accuracy, our primary evaluation metric, we also report the number of licenses each LLM obtains in KMMLU-PRO. To better align with human evaluation standards, our procedure is desgined to mirror the official license acquisition criteria. However, for licenses that rely heavily on image-based questions, full replication is not possible. See Appendix D.3 for details.

5 Results

5.1 Main Results

Table 2 presents the overall performance on KMMLU-REDUX and KMMLU-PRO. The o1 model achieves the highest average accuracy (79.55), followed by Claude 3.7 with Thinking (78.49). Among open-weight models, DeepSeek's R1 even outperforms many closed models. Models equipped with reasoning capabilities consistently perform better than their non-reasoning models, such as the Qwen3 series.

Beyond accuracy, we evaluate each model's ability to obtain professional licenses under the official passing criteria for KMMLU-PRO. Specifically, in most licenses, a model must score at least 40% in each subject and achieve an overall average of 60% to pass. Claude 3.7 with Thinking obtains 12 out of 14 KNPL licenses, the highest among all evaluated models. In contrast, although the o1 model achieves higher accuracy, it qualifies for fewer licenses than Claude 3.7 with Thinking. This highlights the importance of balanced competence across subjects, as required in real-world certification exams.

5.2 Performance Across Industrial Domains in KMMLU-REDUX

Through KMMLU-REDUX, we assess the technical competencies of models across diverse industrial fields. As shown in Figure 1 (left), models with reasoning capabilities consistently outperform their non-reasoning counterparts across all domains. The improvement is particularly notable in Agriculture, Food & Processing, and Architecture. Despite these gains, all models continue to struggle in domains such as Mining Resources and Architecture, highlighting persistent challenges in underrepresented or highly specialized fields. The full results for all models across 14 domains are presented in Appendix E.3.

5.3 Professional License Acquisition Status on KMMLU-PRO

We provide a breakdown of the KMMLU-PRO results by analyzing which licenses are most frequently obtained by LLMs. Figure 1 (right) shows the pass rates of LLMs across 14 KNPLs. While many models obtain licenses in the medicine domain, most fail in Law and Tax & Accounting, with only DeepSeek R1 passing the Customs Broker exam among open-weight models. Notably, no models pass the Judicial Scrivener or Public Accountant exams. This trend becomes even more evident in the full results across a broader range of LLMs; the only licenses that relatively smaller models (<20B) are able to pass are in the medicine domain (see Table 8 in Appendix E.4).

Moreover, many LLMs fail to obtain licenses

[7]For further details, please see Section 6.3.

[8]https://github.com/openai/simple-evals

	KMMLU-Redux	KMMLU-Pro		
	Acc	Acc	# of passed KNPLs	Avg. Acc (micro)
Open-weight Models				
Aya Expanse 32B (Dang et al., 2024)	33.05	31.26	0/14	32.12
Gemma 3 12B IT (Team, 2025a)	46.70	45.82	2/14	46.24
Phi-4 (14B) (Abdin et al., 2024)	49.75	45.32	1/14	47.44
EXAONE 3.5 32B Instruct (Research et al., 2024)	49.40	46.71	2/14	48.00
Mistral Small 3.1 Instruct (24B) (Mistral, 2025)	52.92	49.49	3/14	51.13
Gemma 3 27B IT (Team, 2025a)	54.04	51.03	2/14	52.47
Llama 3.3 70B Instruct (Meta, 2024a)	56.17	53.24	3/14	54.64
Qwen3-14B (Yang et al., 2025)	57.25	53.02	3/14	55.04
EXAONE Deep 32B (Research et al., 2025)	58.33	52.33	1/14	55.20
Qwen3-30B-A3B (Yang et al., 2025)	58.41	52.33	3/14	55.24
C4AI Command A (111B) (Cohere, 2025)	62.93	57.48	3/14	60.07
Qwen3-32B (Yang et al., 2025)	64.98	58.86	3/14	61.79
Llama-4-Scout-17B-16E-Instruct (Meta, 2025)	67.49	58.14	4/14	62.61
Qwen3-30B-A3B (w/ thinking) (Yang et al., 2025)	65.25	60.52	3/14	62.78
Qwen3-14B (w/ thinking) (Yang et al., 2025)	65.71	60.18	2/14	62.82
DeepSeek V3 (671B) (DeepSeek-AI et al., 2025b)	65.64	60.77	4/14	63.10
Qwen3-32B (w/ thinking) (Yang et al., 2025)	68.77	61.14	3/14	64.79
QwQ 32B (Team, 2025b)	67.34	63.94	5/14	65.57
Qwen3-235B-A22B (Yang et al., 2025)	69.54	62.12	4/14	65.67
Qwen3-235B-A22B (w/ thinking) (Yang et al., 2025)	74.49	68.22	6/14	71.22
Llama-4-Maverick-17B-128E-Instruct (Meta, 2025)	77.58	68.10	4/14	72.63
DeepSeek R1 (671B) (DeepSeek-AI et al., 2025a)	78.51	71.33	7/14	74.76
Closed Models				
GPT-4.1 mini (2025-04-14) (OpenAI, 2025a)	67.03	62.18	4/14	64.50
o3-mini (2025-01-31) (OpenAI, 2025c)	67.84	62.05	3/14	64.82
Grok-3-mini-beta (xAI, 2025)	71.47	65.08	5/14	68.14
Grok-3-beta (xAI, 2025)	72.90	68.37	7/14	70.54
o4-mini (2025-04-16) (OpenAI, 2025b)	75.80	69.65	6/14	72.59
GPT-4.1 (2025-04-14) (OpenAI, 2025a)	75.86	72.99	10/14	74.36
Claude 3.7 Sonnet (Anthropic, 2025)	76.88	74.52	10/14	75.65
o3 (OpenAI, 2025b)	79.92	73.60	9/14	76.62
Claude 3.7 Sonnet (w/ thinking) (Anthropic, 2025)	79.36	77.70	12/14	78.49
o1 (OpenAI et al., 2024b)	81.14	78.09	10/14	79.55

Table 2: The main evaluation results of KMMLU-REDUX and KMMLU-PRO benchmarks on various LLMs. The gray-shaded models stand for reasoning models. The results of models with size < 10B are presented in Table 6 in Appendix E.2.

even when scoring above 60%; for example, o3-mini, Qwen3-235B-A22B, and Llama-4-Maverick score over 85% on the Pharmacist exam but still fail to qualify due to not meeting the threshold of law-related subject in the exam. These cases highlight the difficulty of acquiring region-specific domain knowledge, particularly in legal subjects governed by Korean law.

6 Analysis

6.1 The Importance of Locally Adapted Benchmarks

To highlight the importance of evaluation grounded in local context (Plaza et al., 2024; Singh et al., 2025), we compare category-level performance between benchmarks translated from English and KMMLU-PRO. Specifically, we focus on subjects related to law, accounting, and medicine, [9] selecting relevant subjects from the Korean subset of MMMLU (OpenAI, 2024), as well as KMMLU-PRO.

As shown in Figure 3, the performance gap is relatively small in categories such as medicine, where domain knowledge is largely consistent across countries and cultures. In contrast, categories such as law, where substantial differences in content are expected, show a significantly larger gap. This sug-

[9] {*professional_law*, *jurisprudence*, *international_law*} for Law. {*professional_accounting*} for Accounting. {*professional_medicine*, *clinical_knowledge*, *college_medicine*, *medical_genetics*, *anatomy*} for Medicine.

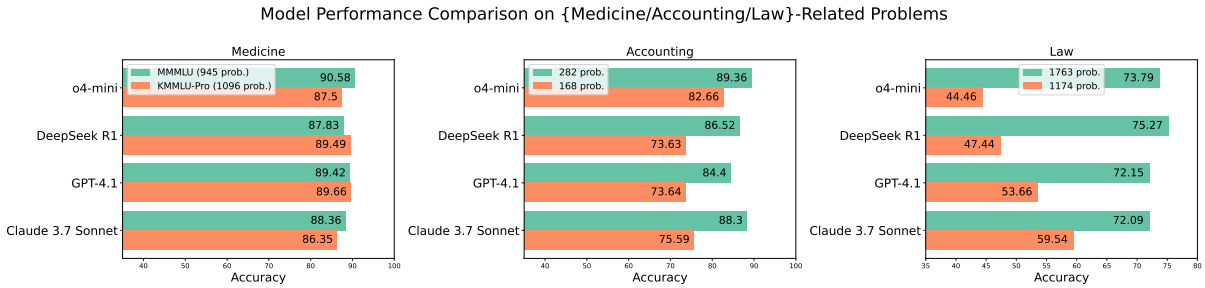

Figure 3: Performance of four LLMs on {Medical**(left)**, Accounting**(center)**, Law**(right)**}-relevant subsets from the MMMLU (Korean) (OpenAI, 2024) and KMMLU-Pro. While the discrepancies in scores are narrow in the medicine domain, they are wider in law-related problems, emphasizing the need for datasets that reflecting real professional knowledge in Korea.

gests that MMMLU, which relies on direct translation of law questions based on U.S. standards, cannot adequately represent knowledge of Korean law. These findings highlight the importance of our dataset, which reflects authentic professional knowledge specific to the Korean context.

6.2 Impact of Reasoning Budget

Recent studies have shown that increasing reasoning efforts can enhance model performance (Muennighoff et al., 2025; Anthropic, 2025; Qwen et al., 2025). To examine how reasoning *budget* affects performance on individual licenses in KMMLU-Pro, we conduct an experiment varying the number of tokens allocated to the reasoning path. We adopt Qwen3-32B (Yang et al., 2025) and Claude 3.7 Sonnet (Anthropic, 2025), for each budget $b \in B$, we generate $n = 4$ for Qwen3 and $n = 2$ for Claude.

As shown in Figure 4, we observe a positive correlation between the reasoning budget and the overall score of KMMLU-Pro for both models. However, this trend does not hold uniformly across all licenses. For example, we observe little to no improvement on the Judicial Scrivener and Herb Pharmacist licenses for both models, indicating that increased reasoning budget does not result in performance gains for certain licenses.

6.3 Impact of Prompt Language

Prompt language can significantly influence model behavior, raising concerns about consistency in multilingual settings (Wang et al., 2025; Zhang et al., 2025; Lai and Nissim, 2024). Since all exam questions in our datasets are written in Korean, using Korean prompts is a natural choice. However, we observe that some models perform worse when prompted in Korean. Table 3 presents the performance difference between English and Korean prompts. The Llama-4 model series exhibits the most substantial drop in performance, while closed models such as Grok-3-mini-beta and o4-mini show minimal change.

	KMMLU-Redux			KMMLU-Pro		
	English	Korean	*diff* (%)	English	Korean	*diff* (%)
Qwen3-32B (w/ thinking)	68.77	69.08	+0.5%	61.14	60.66	-0.8%
o4-mini (2025-04-16)	75.80	76.17	+0.5%	69.65	69.10	-0.8%
Qwen3-235B-A22B (w/ thinking)	74.49	75.11	+0.8%	68.22	66.98	-1.8%
Grok-3-mini-beta	71.47	70.85	-0.9%	65.08	64.89	-0.3%
Qwen3-14B (w/ thinking)	65.71	65.40	-0.5%	60.18	59.48	-1.2%
EXAONE Deep 32B	58.33	56.17	-3.7%	52.33	52.19	-0.3%
DeepSeek R1 (671B)	78.51	75.38	-4.0%	71.33	70.62	-1.0%
QwQ 32B	67.34	62.66	-6.9%	63.94	59.95	-6.2%
EXAONE Deep 7.8B	44.99	40.82	-9.3%	41.53	38.98	-6.1%
Llama-4-Maverick-17B-128E-Instruct	77.58	72.52	-7.0%	68.10	57.15	-16.1%
Llama-4-Scout-17B-16E-Instruct	67.49	45.03	-33.3%	58.14	28.74	-50.6%

Table 3: Comparison results between English and Korean prompts of models whose main results are evaluated on English prompts. The *diff* values are the relative difference in scores between two prompts. The specific prompts used are detailed in Appendix D.1.

7 Related Works

Reliability Issues of Benchmarks Recent works (Gema et al., 2025; Vendrow et al., 2025) have raised concerns about the reliability of LLM benchmarks due to dataset noise and contamination. MMLU-Redux (Gema et al., 2025) improved evaluation quality through systematic human reannotation, while GSM8K-Platinum (Vendrow et al., 2025) refined arithmetic benchmarks via automated and manual error detection. MMLU-CF (Zhao et al., 2024) prevents both unintentional and malicious contamination via sourcing diverse domains and question rewriting. LiveBench (White et al., 2025) and LiveCodeBench (Jain et al., 2025) adopted dynamic evaluation protocols with temporal cutoffs to prevent future leakage.

Professional Benchmark With the rapid advancement of LLMs, more challenging benchmarks have become essential. GPQA (Rein et al., 2024) and SuperGPQA (Team et al., 2025b) assess graduate-level knowledge; MMLU-Pro (Wang

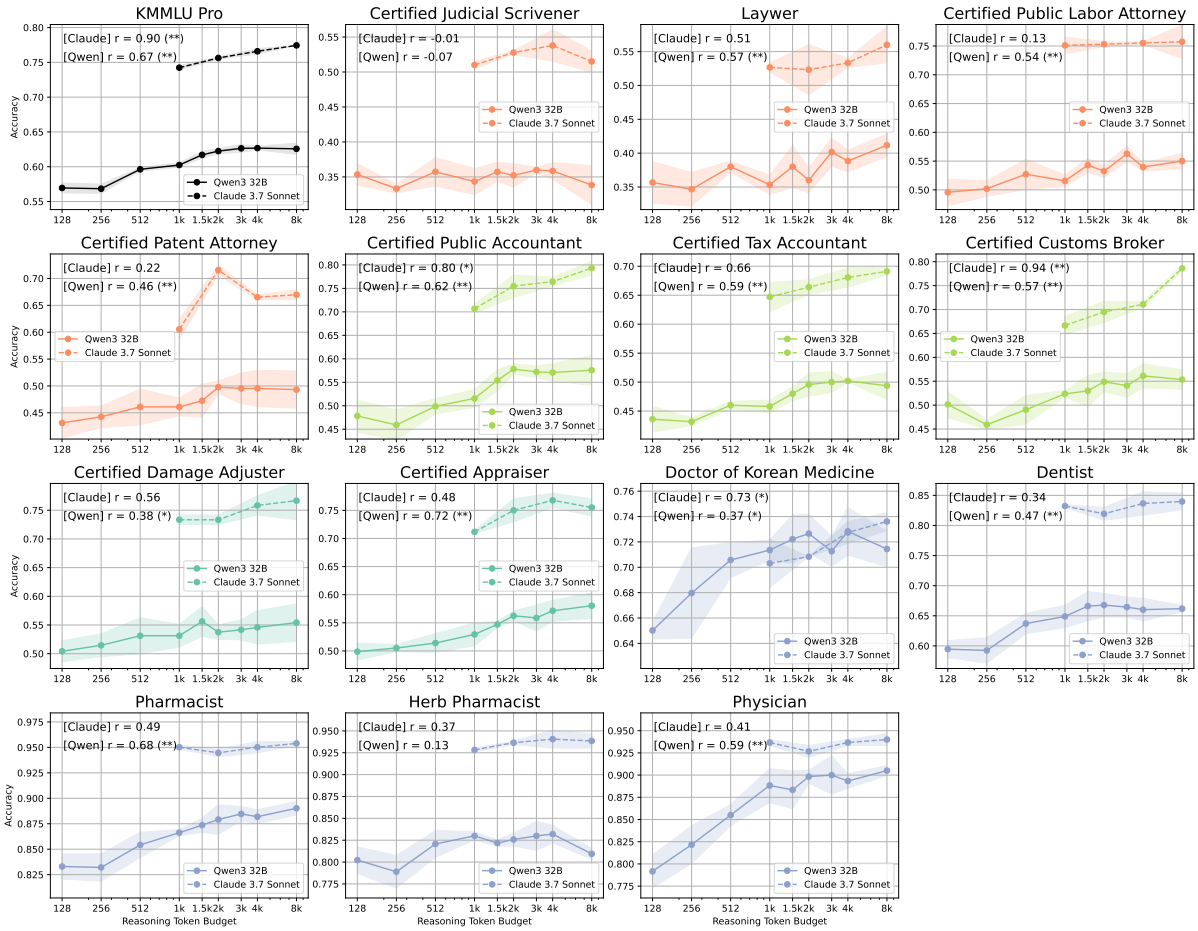

Figure 4: Reasoning budget results of Qwen3-32B and Claude 3.7 Sonnet on KMMLU-PRO. r indicates the Pearson Correlation coefficient value between the reasoning token budget and the accuracy. The responses are sampled multiple times for each thinking budget setting; $n = 4$ and $n = 2$, respectively, for Qwen and Claude.

et al., 2024) extends MMLU by increasing the share of college-level questions and expanding answer choices. Humanity's Last Exam (Phan et al., 2025) introduces a frontier benchmark composed of manually authored, research-level questions.

Korean Benchmark While prior benchmarks focus primarily on English, recent efforts have produced Korean-specific evaluations (Son et al., 2024b; Kim et al., 2024a). Some rely on translated datasets (Park et al., 2024; Kim et al., 2025; OpenAI, 2024; Singh et al., 2024), often with human post-editing, but these lack regional context, institutional norms, and domain-specific fluency. In contrast, native Korean benchmarks such as KMMLU (Son et al., 2024a), KorMedMCQA (Kweon et al., 2024), and KBL (Kim et al., 2024b) address cultural and linguistic specificity. However, KMMLU (Son et al., 2024a) suffers from quality issues, including leaked answers, and KorMedMCQA (Kweon et al., 2024) and KBL (Kim et al., 2024b) are limited to narrow domains.

In this work, we introduce KMMLU-REDUX and KMMLU-PRO, two contamination-free, industry grade benchmarks, providing a practical assessment of LLM capabilities in Korean industries.

8 Conclusion

We present two benchmarks constructed from real-world professional licensing exams, designed to reflect industrial domain knowledge and practical application standards. To ensure reliability, we identify and eliminate various sources of errors. Through extensive experiments, we evaluate the professional knowledge capabilities of LLMs across a wide range of domains. Our analysis further identifies key factors that influence performance, including region-specific knowledge, reasoning budget, and prompt language. We hope this work provides a foundation for more rigorous evaluation and continued advancement of real-world competence in language models.

Limitations

Our benchmarks are limited to text-only and multiple-choice questions for text-only LLMs. It restricts its coverage of real-world licensure exams. Many real-word professional qualification exams include non-textual modalities or require constructed responses such as essay. Our benchmark cannot fully assess all aspects of professional competence or reasoning required in such exams. Expanding to multimodal inputs and open-ended question formats is an important direction for future work.

Ethical Statements

All data used in our benchmarks are either publicly available or collected from official licensing materials released by government or professional institutions. For quality control, we hired human annotators to review parsed questions from PDF; they were compensated over the mininum wage in Korea. Our benchmarks would be released under CC-BY-NC-ND 4.0 license.

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A Details of KMMLU-Redux Errors

A.1 Error Statistics

We define a set of error types based on recurring issues observed during our analysis of the KMMLU. Then, we find out the number of data instances per each error type as shown in Table 4. To identify leaked answer cases, we apply rule-based filtering using string-overlap heuristics. For other error types, including notation errors, bad clarity, and ill-posed questions, we leverage GPT-4o to assist in annotation. Also, we provide the prompt used for annotation in Figure 5.

- **Ill-posed Question** : The question lacks critical references or contextual information.
- **Leaked Answer** : The ground truth is explicitly stated within the question itself.
- **Notation Error** : Errors in mathematical expressions or chemical equations.
- **Bad Clarity** : The data itself is unclear and contains grammatical errors.

Error Type	# of Questions (Ratio)
Ill-posed Question	512 (1.46 %)
Leaked Answer	42 (0.11%)
Notation Error	846 (2.42%)
Bad Clarity	1284 (3.67%)

Table 4: Statistics of the error types

A.2 Example of Error Types

Table 10 provides examples of the error types in 2.2 identified in KMMLU. Each example illustrates a specific issue that affects benchmark reliability.

B Korean National Technical Qualification List of KMMLU-Redux

Table 9 presents the list of Korean National Technical Qualifications (KNTQs) included in our benchmark along with their corresponding official exam dates. To facilitate analysis, we categorize the 100 NTQs into Korean Standard Industrial Classification (KSIC) where mapping to the exam (see Figure 6). This categorization enables structured evaluation across diverse domains and better reflects the real-world industrial fields.

GPT-4o Error Annotation Prompt

You are a helpful assistant that annotates error types in questions.
- Ill-posed question stands for which question miss the critical reference information to solve the question (such as table, formular, image, etc.).
- Notation correct stands for which question has correct math and chemical notation. Criteria of correctness whether the notation is impact to solve the question. (e.g. m2 is incorrect, but $m\hat{2}$ is correct. 센티미터 is correct.)
- Grammar correct stands for which question has correct grammar and spelling. Criteria of correctness whether the notation is impact to understand the question. (e.g. 상 담 기 법 보 다 는 상 담 자 의 인 간 적 자 질 과 진 솔 한 태 도 를 중 시 한 다 . is grammatically incorrect due to spacing error.)

Please check the following question whether it has error types.
Check ill-posed question True/False.
Check notation correct True/False.
Check grammar correct True/False.
Then, if there is any error, please explain the reason.

Question
{{*question*}}

Figure 5: The prompt is used for error type annotation. Each sample is annotated as an error if the respective field returns True. The 'Grammar Correct' field is used to detect 'Bad Clarity' cases.

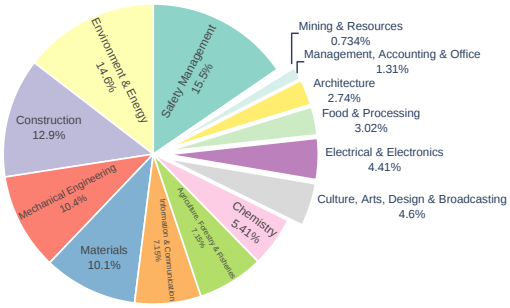

Figure 6: Domain distribution of problems in KMMLU-REDUX. The total size of the dataset is 2,587.

C Details of KMMLU-PRO Annotation

C.1 Annotation Pipeline

We first conduct OCR parsing with GPT-4o on PDF files of KNPL acquisition exams. With the parsed data, the main tasks for human annotators are: 1) reviewing parsing errors, 2) converting tables into latex format, and 3) converting images into text which conveys same meaning. If it is impossible to convert an image into text, we remove it. For the cases where multiple answers are allowed, commonly due to the ambiguity of question itself, we discard them.

As we leverage the official PDF files managed and controlled by the government, we can guarantee the correctness of answer label. This help us to save costs because we do not need experts for annotations nor the answer relabeling to avoid risk of data from online (Gema et al., 2025; Team et al., 2025b). Before annotation, we explained the context of benchmark construction about the Korean professional license exams to human annotators. We present annotation instructions in Fig 7.

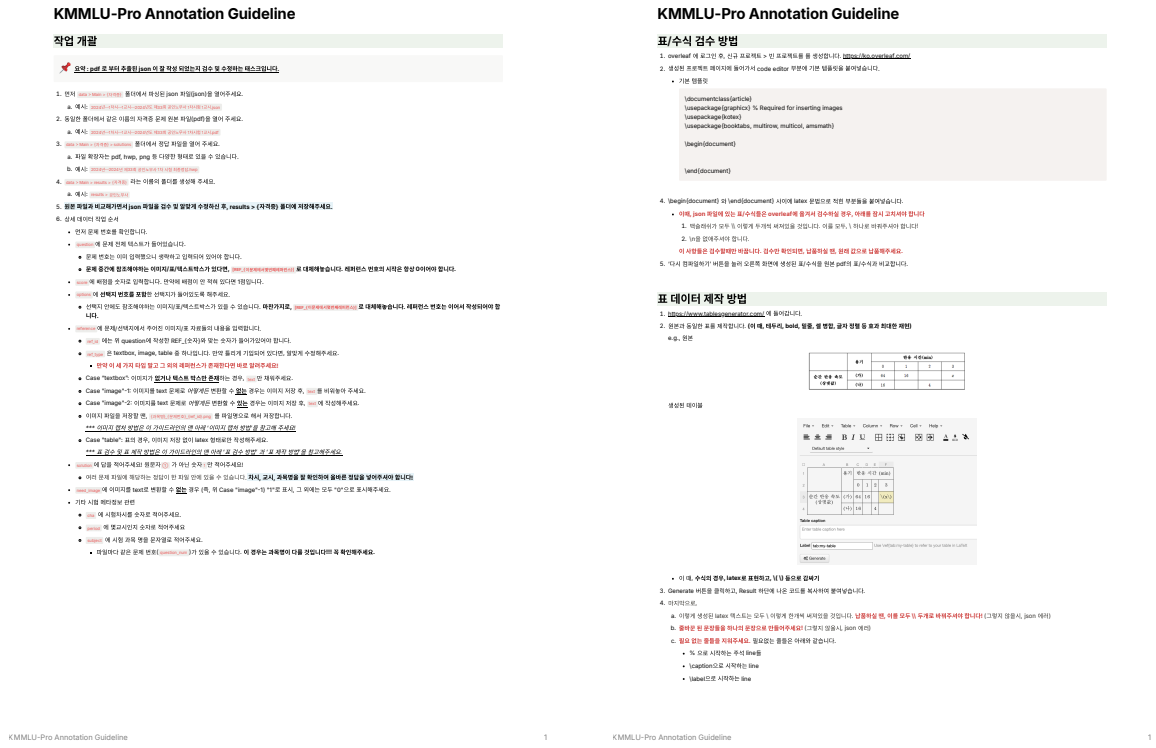

Figure 7: Excerpt from the annotation guidelines for converting PDF documents into structured text. We carefully instruct LaTeX table formatting.

Category	Demographics	Counts
Gender	Female	23
	Male	-
Age	20s	13
	30s	8
	40s	2
Academic background	Bachelor's degrees	20
	Master's degrees	3

Table 5: Demographics of the human annotators for KMMLU-Pro.

C.2 Annotators Demographics

The detailed demographics of annotators are presented in Table 5. The average hourly wage is 8.83 U.S. dollars, which is higher than the legal minimum wage at the time of hiring in South Korea.

D Evaluation Setup

D.1 Evaluation Prompts

The figure 8 and figure 9 present the prompt for the evaluation written in English and Korean, respectively. For the English prompt, we use the regex expression of `r"(?i)Answer[^A-E]*:[^A-E]*([A-E])"`. For the Korean prompt, we use `r"정답[^A-E]*:[^A-E]*([A-E])"`. The regex expressions for the flexible parsing are `r"Answer[^A-E]*([A-E])|([A-E])\)"` and `r"정답[^A-E]*([A-E])|([A-E])\)"`, respectively.

D.2 Inference Engines

Excluding closed models, the main inference engine we use is SGLang (Zheng et al., 2024). However, for the Gemma 3 series and Mistral Small 3.1 Instruct models, we adopt vLLM (Kwon et al., 2023) due to their incompatibility with SGLang at the time of the paper writing. Evaluating open-sourced models was conducted over four days using sixteen NVIDIA A100 GPUs. For closed models, we accessed them via API calls, which incurred a total cost of approximately 4,000 USD.

D.3 License Acquisition Criteria for KMMLU-Pro

We follow the official scoring criteria used for each license examination. All licensing exams in KMMLU-Pro are composed of multiple subjects. Candidates are typically required to score at least 40% in every subject and achieve an average score of at least 60%, except for the cases of the Certified

English Prompt

Answer the following multiple choice question. The last line of your response should be of the following format: 'Answer: $LETTER' (without quotes) where LETTER is one of ABCD. Think step by step before answering.

{{*question*}}

A) {{*option A*}}
B) {{*option B*}}
C) {{*option C*}}
D) {{*option D*}}

Figure 8: The English prompt used for evaluating LLMs on our KMMLU-REDUX and KMMLU-PRO. This prompt is exactly same with the prompt used for Multiple-Choices Question Answering (MCQA) in OpenAI's simple-evals repository. The number of options is adjusted for each problems.

Korean Prompt

다음 문제에 대해 정답을 고르세요. 당신의 최종 정답은 ABCD 중 하나이고, "정답:" 뒤에 와야 합니다. 정답을 고르기 전에 차근차근 생각하고 추론하세요.

{{*question*}}

A) {{*option A*}}
B) {{*option B*}}
C) {{*option C*}}
D) {{*option D*}}

Figure 9: The Korean prompt used for evaluating LLMs on our KMMLU-REDUX and KMMLU-PRO. This prompt is translated version of the English prompt. The number of options is adjusted for each problems.

Judicial Scrivener and the Lawyer. For the Certified Judicial Scrivener exam, candidates need only score at least 40% in each subject, with no requirement regarding the average. The Lawyer license exam uses a relative grading system where only a certain proportion of top-scoring candidates pass. The usual cut-off point is approximately 54.22 (900 out of 1660), which we use as the passing threshold.

It is also important to note that our evaluation benchmark is text-based, not multi-modal. Therefore, we exclude questions that include images. In addition, candidates often need to go through multiple exam stages to obtain a license, with the later stages, such as the second or third, containing descriptive questions. However, since we only collect multiple-choice questions, the descriptive problems are excluded. Lastly, we exclude questions with multiple answers introduced by the ambiguity of the question.

E Detailed Results

E.1 KMMLU vs KMMLU-REDUX

Figure 10 illustrates the performance of LLMs on KMMLU and KMMLU-REDUX. The LLMs' performances on KMMLU-REDUX is lower than on KMMLU, due to our filtration process which aims to retain only challenging problems from KMMLU (see Section 2.2.1). Despite this decrease, there is a near-perfect monotonic association between the results, with a Spearman's rank correlation coefficient (ρ) of 0.995, suggesting they are highly correlated.

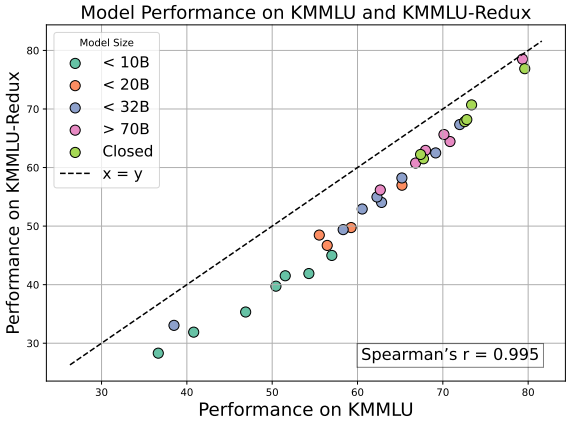

Figure 10: Performance of LLMs on KMMLU and KMMLU-REDUX. A high ρ value indicates a strong correlation between the results of the two benchmarks.

E.2 The Results for Smaller (<10B) Models

The Table 6 presents the results of KMMLU-PRO and KMMLU-REDUX for smaller (<10B) models. Since many of the *tiny* models in this table were used to construct KMMLU-REDUX through adversarial filtration, their KMMLU-REDUX scores are biased. Nevertheless, as shown by the results for larger models, models equipped with dense reasoning capabilities usually outperform their counterparts without reasoning (e.g., Qwen3-8B with and without "thinking").

E.3 Breakdown of Results of KMMLU-REDUX

The Table 7 presents the breakdown results for 14 categories in KMMLU-REDUX across various LLMs.

E.4 Breakdown of Results of KMMLU-PRO

The Table 8 shows the breakdown results for all NPLs in KMMLU-PRO across various LLMs. While the models relatively easily pass licensing in the medicine domain, they struggle in the Law and Tax&Accounting domains.

	KMMLU-Redux	KMMLU-Pro		
	Acc	Acc	# of passed KNPLs	Avg. Acc (micro)
DeepSeek-R1-Distill-Qwen-1.5B (DeepSeek-AI et al., 2025a)	21.30⋆	20.55	0/14	20.91
Llama 3.2 3B Instruct (Meta, 2024c)	17.59⋆	25.53	0/14	21.73
Gemma 3 4B IT (Team, 2025a)	25.09⋆	32.86	0/14	29.14
Qwen 2.5 3B Instruct (Qwen et al., 2025)	24.74⋆	33.27	0/14	29.19
Qwen3-1.7B (Yang et al., 2025)	28.99	30.42	0/14	29.74
Kanana Nano 2.1B Instruct (Team et al., 2025a)	27.25⋆	32.60	0/14	30.04
Aya Expanse 8B (Dang et al., 2024)	28.30	31.65	0/14	30.05
EXAONE Deep 2.4B (Research et al., 2025)	28.84⋆	32.08	0/14	30.53
EXAONE 3.5 2.4B Instruct (Research et al., 2024)	27.72⋆	34.49	0/14	31.25
HyperCLOVAX-SEED-Text-Instruct-1.5B (naver hyperclovax, 2025)	33.94	30.13	0/14	31.95
Llama 3.1 8B Instruct (Meta, 2024b)	31.89	33.81	0/14	32.89
Qwen3-1.7B (w/ thinking) (Yang et al., 2025)	37.80	38.27	1/14	38.05
Ko-R1-7B-v2.1 (OneLineAI)	41.94	38.70	1/14	40.25
EXAONE 3.5 7.8B Instruct (Research et al., 2024)	41.90	41.71	0/14	41.80
EXAONE Deep 7.8B (Research et al., 2025)	44.99	41.53	0/14	43.18
Qwen3-8B (Yang et al., 2025)	49.25	46.92	1/14	48.03
Qwen3-8B (w/ thinking) (Yang et al., 2025)	58.79	55.27	3/14	56.95

Table 6: The main evaluation results of KMMLU-REDUX and KMMLU-PRO benchmarks on smaller (< 10B) LLMs. The gray-shaded models are the dense-reasoning models. The KMMLU-REDUX scores with ⋆ are biased as these models are used for the dataset filtration (Section 2.2.1).

Domain		*Safety Management*	*Environment & Energy*	*Construction*	*Mechanical Engineering*	*Materials*	*Information & Communication*	*Agriculture, Forestry & Fisheries*	*Chemistry*	*Culture, Arts, Design & Broadcasting*	*Electrical & Electronics*	*Food & Processing*	*Architecture*	*Management, Accounting & Office*	*Mining & Resources*	*Avg.*
Opensourced Models																
< 5B	DeepSeek-R1-Distill-Qwen-1.5B	20.50	17.77	24.32	20.00	24.43	26.49	17.84	20.71	19.33	20.18	15.38	18.31	20.59	31.58	21.30*
	Llama 3.2 3B Instruct	13.00	12.20	13.81	14.81	11.07	15.68	16.76	11.43	17.65	7.89	16.67	11.27	5.88	15.79	17.59*
	Qwen 2.5 3B Instruct	16.50	17.24	15.32	17.41	15.27	20.54	18.38	11.43	26.05	16.67	11.54	15.49	14.71	10.53	24.74*
	Gemma 3 4B IT	23.00	23.87	22.52	25.56	20.23	28.65	32.43	25.71	21.01	27.19	21.79	21.13	14.71	10.53	25.09*
	Kanana Nano 2.1B Instruct	24.75	27.32	25.83	26.67	29.77	22.16	26.49	23.57	25.21	28.07	28.21	28.17	26.47	10.53	27.25*
	EXAONE 3.5 2.4B Instruct	26.75	26.79	22.22	28.15	29.39	28.65	29.19	32.86	31.93	28.95	23.08	33.80	26.47	31.58	27.72*
	EXAONE Deep 2.4B	27.50	30.77	23.72	28.52	32.06	30.27	22.16	40.00	25.21	34.21	25.64	18.31	17.65	15.79	28.84*
	Qwen3-1.7B	30.50	27.06	27.93	36.67	32.82	29.73	23.24	30.00	23.53	28.95	25.64	23.94	20.59	15.79	28.99
	HyperCLOVAX-SEED-Text-Instruct-1.5B	28.00	25.99	30.93	32.59	33.21	29.19	32.97	22.86	35.29	28.07	32.05	32.39	17.65	26.32	33.94
	Qwen3-1.7B (w/ thinking)	37.25	35.54	33.03	39.63	40.08	41.62	36.76	40.71	35.29	46.49	42.31	29.58	41.18	42.11	37.80
< 10B	Aya Expanse 8B	25.00	20.42	23.72	21.11	24.05	29.19	29.19	21.43	23.53	22.81	20.51	30.99	26.47	21.05	28.30
	Llama 3.1 8B Instruct	30.50	25.99	23.12	28.15	30.53	33.51	32.97	22.14	35.29	24.56	29.49	26.76	29.41	31.58	31.89
	EXAONE 3.5 7.8B Instruct	41.75	37.40	41.14	44.81	42.37	48.11	41.62	40.00	47.06	42.11	38.46	46.48	38.24	21.05	41.90
	Ko-R1-7B-v2.10	42.50	37.93	39.94	41.48	38.55	50.81	37.30	52.14	49.58	50.00	33.33	33.80	50.00	36.84	41.94
	EXAONE Deep 7.8B	40.75	45.09	40.54	49.26	46.56	51.35	31.89	57.14	42.02	55.26	47.44	39.44	44.12	26.32	44.99
	Qwen3-8B	47.00	48.01	43.84	49.63	56.11	56.22	41.62	58.57	47.06	60.53	46.15	43.66	50.00	31.58	49.25
	Qwen3-8B (w/ thinking)	55.75	57.82	53.15	67.78	64.89	62.16	45.95	65.71	57.14	66.67	56.41	53.52	58.82	63.16	58.79
< 20B	Gemma 3 12B IT	44.50	42.18	46.25	44.81	46.95	50.81	51.35	50.71	57.98	48.25	46.15	39.44	50.00	42.11	46.70
	Phi-4 (14B)	48.50	47.75	48.05	52.59	49.62	52.43	44.86	58.57	54.62	56.14	50.00	36.62	52.94	36.84	49.75
	Qwen3-14B	52.75	55.70	51.95	63.33	61.45	65.95	47.57	61.43	57.98	67.54	52.56	59.15	61.76	47.37	57.25
	Qwen3-14B (w/ thinking)	64.50	66.58	60.36	70.00	72.90	68.65	54.05	73.57	63.87	75.44	51.28	57.75	70.59	68.42	65.71
< 32B	Aya Expanse 32B	30.50	32.10	27.03	38.15	35.50	39.46	37.84	28.57	33.61	35.09	32.05	35.21	26.47	21.05	33.05
	EXAONE 3.5 32B Instruct	46.75	45.89	46.25	46.30	55.34	54.05	55.14	47.14	57.98	50.00	50.00	50.70	55.88	31.58	49.40
	Mistral Small 3.1 Instruct (24B)	45.00	50.40	51.95	55.93	59.54	58.38	51.35	58.57	56.30	58.77	47.44	52.11	58.82	31.58	52.92
	Gemma 3 27B IT	49.50	51.19	47.45	57.41	58.02	62.70	49.73	60.71	59.66	62.28	56.41	47.89	67.65	31.58	54.04
	EXAONE Deep 32B	53.25	62.07	53.75	66.30	59.54	67.03	53.51	62.86	57.14	60.53	56.41	45.07	58.82	21.05	58.33
	Qwen3-30B-A3B	54.25	57.56	54.65	58.52	64.50	61.08	51.89	65.00	62.18	68.42	58.97	56.34	58.82	52.63	58.41
	Qwen3-32B	59.50	64.19	60.66	68.52	72.52	69.19	58.38	68.57	74.79	72.81	58.97	53.52	70.59	63.16	64.98
	Qwen3-30B-A3B (w/ thinking)	63.00	64.19	62.46	69.63	70.23	69.19	56.76	69.29	68.91	72.81	53.85	56.34	70.59	68.42	65.25
	QwQ 32B	61.25	67.64	68.17	71.11	74.05	72.97	58.38	71.43	72.27	71.05	53.85	56.34	79.41	52.63	67.34
	Qwen3-32B (w/ thinking)	64.50	68.97	66.97	74.07	75.57	70.81	62.70	74.29	68.91	72.81	64.10	53.52	73.53	57.89	68.77
> 70B	Llama 3.3 70B Instruct	52.25	54.11	52.85	62.59	59.92	64.32	52.43	50.71	60.50	60.53	55.13	53.52	64.71	36.84	56.17
	C4AI Command A (111B)	56.75	66.58	63.06	63.33	64.89	67.57	62.16	60.71	68.91	64.04	62.82	59.15	55.88	47.37	62.93
	DeepSeek V3 (671B)	62.50	62.33	63.66	66.30	72.52	72.97	62.70	66.43	67.23	69.30	69.23	59.15	61.76	63.16	65.64
	Llama-4-Scout-17B-16E-Instruct	64.00	67.64	65.77	69.63	77.10	71.35	61.08	69.29	66.39	71.93	62.82	57.75	64.71	57.89	67.49
	Qwen3-235B-A22B	64.25	72.68	66.37	71.11	82.06	72.43	65.41	71.43	68.07	73.68	65.38	52.11	67.65	47.37	69.54
	Qwen3-235B-A22B (w/ thinking)	69.75	75.86	71.47	81.11	85.11	76.22	64.86	75.00	70.59	78.95	73.08	61.97	82.35	68.42	74.49
	Llama-4-Maverick-17B-128E-Instruct	73.50	76.13	78.38	79.26	83.97	80.54	77.30	75.00	78.15	79.82	73.08	71.83	82.35	73.68	77.58
	DeepSeek R1 (671B)	72.50	76.39	79.58	80.74	85.11	81.62	82.70	77.14	79.83	81.58	75.64	63.38	85.29	73.68	78.51
Closed Models																
	GPT-4.1 mini (2024-04-14)	61.00	64.99	63.66	69.26	74.81	72.43	63.78	73.57	70.59	66.67	75.64	56.34	73.53	57.89	67.03
	o3-mini (2025-01-31)	63.75	66.05	63.96	72.96	73.66	75.14	63.78	69.29	72.27	75.44	66.67	46.48	76.47	57.89	67.84
	Grok-3-mini-beta	69.75	69.76	69.07	73.33	83.97	77.30	65.95	70.71	68.07	73.68	61.54	59.15	76.47	73.68	71.47
	Grok-3-beta	70.00	70.56	68.47	76.30	83.97	76.76	69.19	75.71	74.79	69.30	70.51	71.83	73.53	57.89	72.90
	o4-mini (2025-04-16)	67.75	73.74	76.28	78.52	82.06	81.08	76.76	78.57	80.67	79.82	71.79	61.97	79.41	78.95	75.80
	GPT-4.1	71.50	74.27	72.07	77.41	85.11	81.62	80.00	74.65	76.47	77.19	75.64	61.97	76.47	68.42	75.86
	Claude 3.7 Sonnet	70.75	76.92	76.28	80.37	83.97	77.84	78.92	78.57	76.47	78.07	75.64	64.79	79.41	68.42	76.88
	Claude 3.7 Sonnet (w/ thinking)	71.50	80.37	79.88	80.74	87.02	82.16	80.00	82.86	80.67	79.82	73.08	70.42	85.29	68.42	79.36
	o3	77.75	78.25	77.78	80.37	85.50	78.92	83.24	78.17	84.03	85.09	82.05	66.20	85.29	78.95	79.92
	o1	75.75	79.58	81.98	81.11	90.84	80.54	84.86	77.86	84.03	81.58	83.33	70.42	85.29	73.68	81.14

Table 7: The break down results for 14 categories in KMMLU-REDUX. The gray-shaded models are the dense-reasoning models. The scores with ⋆ are biased as these models are used for the dataset filtration (Section 2.2.1).

Domain		Law				Tax & Accounting			Value Estimation		Medical						
	Names of KNPLs	*Judicial Scrivener*	*Lawyer*	*Public Labor Attorney*	*Patent Attorney*	*Public Accountant (CPA)*	*Tax Accountant*	*Customs Broker*	*Damage Adjuster (CDA)*	*Appraiser*	*Doctor of Korean Medicine*	*Dentist*	*Pharmacist*	*Herb Pharmacist*	*Physician*	*Avg.*	*# of passed NPLs*
Opensourced Models																	
< 5B	DeepSeek-R1-Distill-Qwen-1.5B	15.66	13.33	24.27	25.69	23.56	18.07	18.24	20.00	21.94	20.49	18.49	23.25	23.77	18.67	20.55	0/14
	Llama 3.2 3B Instruct	27.27	24.67	25.94	20.18	16.35	23.95	23.9	23.33	19.39	23.26	26.45	36.53	30.74	28.67	25.53	0/14
	HyperCLOVAX-SEED-Text-Instruct-1.5B	24.24	24.67	30.13	26.61	25.48	29.83	30.19	41.67	25.00	30.90	27.31	36.16	35.66	33.33	30.13	0/14
	Qwen3-1.7B	19.19	20.67	30.96	32.11	21.63	21.01	23.9	30.0	29.08	30.56	30.32	46.49	46.72	33.33	30.42	0/14
	EXAONE Deep 2.4B	16.67	21.33	31.38	36.70	25.00	23.53	32.08	37.50	30.61	30.21	29.25	52.77	44.67	32.00	32.08	0/14
	Kanana Nano 2.1B Instruct	19.19	24.67	30.13	22.02	23.08	26.47	26.42	28.33	26.53	42.01	31.61	52.40	44.67	38.67	32.60	0/14
	Gemma 3 4B IT	23.23	26.67	32.22	26.61	27.4	26.47	27.67	29.17	23.47	37.15	36.56	49.08	43.03	36.00	32.86	0/14
	Qwen 2.5 3B Instruct	20.20	25.33	35.15	24.77	21.63	23.11	30.19	35.00	27.04	37.85	35.05	47.97	52.46	34.67	33.27	0/14
	EXAONE 3.5 2.4B Instruct	28.28	24.67	32.22	28.44	33.17	21.43	27.67	35.00	31.63	36.81	35.91	53.14	43.44	38.67	34.49	0/14
	Qwen3-1.7B (w/ thinking)	25.25	25.33	31.8	34.86	25.48	25.63	29.56	34.17	36.22	44.79	38.06	**61.99**	59.43	44.67	38.27	1/14
< 10B	Aya Expanse 8B	20.20	20.00	30.54	22.02	23.56	18.49	37.11	33.33	22.45	36.11	29.25	50.18	46.31	42.00	31.65	0/14
	Llama 3.1 8B Instruct	28.28	21.33	30.96	23.85	21.15	23.53	33.33	33.33	26.02	35.42	33.76	54.61	50.82	42.00	33.81	0/14
	Ko-R1-7B-v2.1	40.59	28.85	38.33	39.8	35.22	33.94	26.47	29.86	42.21	29.29	48.67	46.24	**64.21**	30.67	38.70	1/14
	EXAONE Deep 7.8B	26.26	28.00	38.91	42.20	35.10	31.09	38.99	39.17	40.31	42.36	44.73	64.94	53.69	52.67	41.53	0/14
	EXAONE 3.5 7.8B Instruct	28.79	28.00	38.49	35.78	32.21	31.09	37.74	40.00	33.16	44.10	43.44	67.53	56.56	50.67	41.71	0/14
	Qwen3-8B	29.29	34.0	46.03	35.78	33.17	35.71	34.59	43.33	40.82	50.69	46.02	71.96	**73.36**	59.33	46.92	1/14
	Qwen3-8B (w/ thinking)	27.78	36.0	49.37	41.28	48.08	44.12	49.69	50.83	53.06	61.81	54.19	**83.03**	**76.23**	**75.33**	55.27	3/14
< 20B	Phi-4 (14B)	33.33	34.00	41.00	36.70	37.50	37.82	42.77	44.17	43.37	45.49	41.29	**72.69**	57.38	51.33	45.32	1/14
	Gemma 3 12B IT	28.79	23.33	40.59	39.45	34.62	34.87	42.14	39.17	35.71	52.08	49.46	71.59	**62.30**	**68.00**	45.82	2/14
	Qwen3-14B	32.83	30.67	39.75	47.71	48.56	38.24	42.14	49.17	50.00	57.64	55.91	**81.18**	**75.0**	**75.33**	53.02	3/14
	Qwen3-14B (w/ thinking)	30.81	36.67	48.95	47.71	58.65	51.26	52.2	47.50	54.59	65.28	61.94	**87.82**	**80.74**	**82.67**	59.48	3/14
< 32B	Aya Expanse 32B	24.75	18.67	24.27	32.11	20.67	21.01	27.67	34.17	23.98	32.64	31.83	53.14	45.49	38.67	31.26	0/14
	EXAONE 3.5 32B Instruct	33.33	26.67	43.10	38.53	34.62	32.35	42.77	52.50	41.33	48.96	49.89	70.11	**61.89**	**66.00**	46.71	2/14
	Mistral Small 3.1 Instruct (24B)	27.27	33.33	43.51	39.45	39.90	38.66	42.77	47.50	41.33	52.08	49.89	**79.34**	**68.03**	**72.00**	49.49	3/14
	Gemma 3 27B IT	29.80	31.33	44.35	33.94	38.46	43.28	40.88	43.33	44.39	52.08	58.49	81.18	**73.36**	**72.67**	51.03	2/14
	Qwen3-30B-A3B	31.31	26.00	47.28	35.78	45.19	35.71	44.03	49.17	47.96	56.60	53.98	**83.03**	**77.87**	**72.00**	52.33	3/14
	EXAONE Deep 32B	30.30	36.00	48.54	46.79	45.67	39.92	46.54	55.00	48.98	53.47	52.26	78.97	65.98	**72.67**	52.33	1/14
	Qwen3-32B	33.33	35.33	53.14	43.12	57.69	45.80	53.46	53.33	48.98	61.46	60.86	**85.24**	**84.84**	**84.00**	58.86	3/14
	Qwen3-30B-A3B (w/ thinking)	35.35	37.33	50.21	45.87	57.21	50.0	48.43	54.17	54.08	70.49	59.78	**88.19**	**84.43**	**84.67**	60.52	3/14
	Qwen3-32B (w/ thinking)	33.33	34.67	55.23	43.12	55.29	47.06	54.09	57.50	55.61	70.14	**66.88**	87.08	**81.56**	**88.67**	61.14	3/14
	QwQ 32B	35.35	39.33	55.65	44.04	60.58	55.04	57.23	56.67	**64.29**	71.53	**66.24**	**88.93**	**84.43**	**88.67**	63.94	5/14
> 70B	Llama 3.3 70B Instruct	32.83	41.33	46.44	42.20	42.31	38.66	49.69	54.17	43.37	51.39	56.77	**85.98**	**71.72**	**74.00**	53.24	3/14
	C4AI Command A (111B)	41.92	34.00	51.46	49.54	45.67	45.80	46.54	54.17	52.04	61.46	57.63	**83.39**	**79.10**	**80.67**	57.48	3/14
	Llama-4-Scout-17B-16E-Instruct	35.86	34.00	53.14	50.46	47.12	43.70	47.80	54.17	47.45	61.46	**68.17**	**81.92**	**85.25**	**82.67**	58.14	4/14
	DeepSeek V3 (671B)	38.89	36.00	56.49	48.62	50.00	42.44	47.80	52.50	53.06	**71.53**	64.95	**87.82**	**87.70**	**84.67**	60.77	4/14
	Qwen3-235B-A22B	38.38	39.33	54.81	45.87	55.77	49.58	52.83	**60.0**	57.65	64.24	**70.97**	86.72	**86.07**	**84.67**	62.12	4/14
	Llama-4-Maverick-17B-128E-Instruct	38.38	41.33	62.34	55.96	61.06	56.72	56.60	**69.17**	66.84	75.00	**76.34**	89.67	**90.98**	**90.67**	68.10	4/14
	Qwen3-235B-A22B (w/ thinking)	43.43	42.67	56.90	57.80	69.23	61.76	61.64	59.17	**62.76**	**71.88**	**77.42**	**89.67**	**89.34**	**88.00**	68.22	6/14
	DeepSeek R1 (671B)	45.45	38.00	61.51	57.80	66.83	60.50	**69.18**	**68.33**	**64.80**	79.51	**81.29**	**92.99**	**94.67**	**92.67**	71.33	7/14
Closed Models																	
	GPT-4.1 mini (2024-04-14)	38.38	32.00	56.90	56.88	54.81	48.32	50.31	50.00	55.10	67.36	**72.47**	**90.77**	**81.97**	**90.00**	62.18	4/14
	o3-mini (2025-01-31)	38.38	38.67	51.46	47.71	60.10	47.06	50.31	52.50	57.65	64.24	**76.56**	88.93	**80.33**	**91.33**	62.05	3/14
	Grok-3-mini-beta	37.37	34.67	57.74	48.62	67.79	49.58	**65.41**	54.17	64.80	66.32	**73.98**	**91.14**	**84.84**	**90.0**	65.08	5/14
	Grok-3-beta	42.42	41.33	59.00	55.96	63.94	57.98	**62.89**	**61.67**	**66.84**	70.49	**77.85**	**89.30**	**91.80**	**94.67**	68.37	7/14
	o4-mini (2025-04-16)	37.37	46.0	62.34	49.54	69.23	55.04	**66.67**	59.17	**67.35**	76.74	**82.15**	**93.36**	**89.75**	**92.0**	69.65	6/14
	GPT-4.1	47.47	50.00	**66.95**	**63.30**	66.83	**59.24**	**67.30**	**66.67**	**68.37**	80.21	**82.80**	**94.10**	**92.62**	**94.67**	72.99	10/14
	o3	45.96	41.33	71.13	57.80	73.56	**61.76**	**70.44**	**65.83**	**71.94**	**77.43**	**87.96**	**92.99**	**91.39**	**94.67**	73.60	9/14
	Claude 3.7 Sonnet	55.56	53.33	**73.22**	**63.30**	68.27	**64.29**	**67.92**	**77.50**	**73.47**	70.83	**81.51**	**94.46**	**92.21**	**93.33**	74.52	10/14
	Claude 3.7 Sonnet (w/ thinking)	50.00	**56.00**	**77.41**	**74.31**	78.85	**70.17**	**75.47**	**70.00**	**81.12**	**76.39**	**84.09**	**93.36**	**93.03**	**92.67**	77.70	12/14
	o1	54.55	49.33	**71.55**	**65.14**	75.48	67.23	**76.73**	**78.33**	**78.06**	**83.33**	**88.39**	**94.10**	**95.49**	**96.67**	78.09	10/14

Table 8: The break down results for all KNPLs in KMMLU-PRO. The gray-shaded models are the dense-reasoning models. The **blue** scores indicate that the LLM obtain the license. The details for the pass criteria of each license are described in Appendix D.3.

Year	Tests
2005	Master Craftsman Construction Equipment Maintenance, Master Craftsman Building General Work, Master Craftsman Precious Metal Processing, Master Craftsman Confectionary Making, Master Craftsman Casting, Master Craftsman Sheet-Metal & Boiler Making
2008	Master Craftsman Architectural Carpentering, Master Craftsman Surface Treatment
2010	Master Craftsman Railway Vehicles Maintenance
2014	Master Craftsman Welding
2016	Master Craftsman Steel Making
2017	Master Craftsman Metal Material, Master Craftman Metal Mould, Master Craftsman Cook
2018	Master Craftsman Gas, Master Craftsman Machinery Maintenance, Master Craftsman Plumbing, Master Craftsman Rolling, Master Craftsman Energy Management, Master Craftsman Hazardous Material, Master Craftsman Motor Vehicles Maintenance, Master Craftsman Electricity, Master Craftman Electronics, Master Craftsman Iron Making
2020	Engineer Radio Electronic Communication, Engineer Floral Design
2021	Engineer Construction Equipment, Engineer Machinery Design, Engineer Agricultural Health and Safety, Engineer Leak Nondestructive Testing, Engineer Radiation Nondestructive Testing, Engineer Biology Classification—Animal, Engineer Aquaculture, Engineer Visual Communication Design, Engineer Eddy Current Nondestructive Testing, Engineer Welding, Engineer Biomedical, Engineer Magnetic Nondestructive Testing, Engineer Electric Railway, Engineer Computer, Engineer Concrete, Engineer Explosives Handling
2022	Engineer Gas, Engineer Construction Safety, Engineer Construction Material Testing, Engineer Architecture, Engineer Building Facilities, Engineer Air-Conditioning Refrigerating Machinery, Engineer Transportation, Engineer Metal, Engineer Meteorology, Engineer Air Pollution Environmental, Engineer Urban Planning, Engineer Bioprocess, Engineer Forest, Engineer Industrial Safety, Engineer Industrial Hygiene Management, Engineer Plant Maintenance, Engineer Fire Protection System—Mechanical, Engineer Fire Protection System—Electrical, Engineer Noise & Vibration, Engineer Water Pollution Environmental, Engineer Elevator, Engineer Plant Protection, Engineer Food Processing Safety, New and Renewable Energy Equipment (Photovoltaic) Engineer, Engineer Interior Architecture, Engineer Energy Management, Engineer Greenhouse Gas Management, Engineer Organic Agriculture, Engineer Ergonomics, Engineer General Machinery, Engineer Motor Vehicles Maintenance, Engineer in Nature Environment and Ecological Restoration, Engineer Electric Work, Engineer Electricity, Engineer Computer System Application, Engineer Electronics, Engineer Information Processing, Engineer Landscape Architecture, Engineer Seeds, Engineer Cadastral Surveying, Engineer Railroad Signal Apparatus, Engineer Ultrasonic Nondestructive Testing, Engineer Livestock, Engineer Surveying Geo-Spatial Information, Engineer Penetrante Nondestructive Testing, Engineer Colorist, Engineer Civil Engineering, Engineer Soil Environment, Master Craftsman Telecommunication Apparatus, Engineer Wastes Treatment, Engineer Quality Management, Engineer Ocean Environment, Engineer Chemical Industry, Fire Investigation & Evaluation Engineer, Engineer Chemical Analysis
2023	Engineer Radio Telecommunication Equipment, Engineer Broadcasting Communication, Engineer Information Communication

Table 9: Redux Years and National Qualification Test Additions

Error Type	Examples
Ill-posed Question	Category: Political science and sociology A, B에 대한 설명으로 옳은 것만을 <보기>에서 고르면? *What is the correct explanation about A, B in <Reference>?*
Leaked Answer	Category: Ecology 산복수로에서 쌓기공작물의 높이가 3m이고, 수로깊이가 1m일 때 수로받이의 근사적 길이는? (문제 오류로 현재 복원중입니다. 보기 내용을 아시는 분들께서는 오류 신고를 통하여 보기 작성 부탁 드립니다. 정답은 3번입니다.) *What is the approximate length of the culvert if the pile is 3 meters high and the channel is 1 meter deep? (This is currently being restored due to a question error. If you know the referebce, please report the error. The correct answer is 3.)*
Notation Error	Category: Math 다항식 x2017-1을 x2-x로 나누었을 때의 나머지를 R(x)라 할 때, R(2017)의 값은? *If the remainder of the polynomial x2017-1 divided by x2-x is called R(x), what is the value of R(2017)?*
Bad Clarity	Category: Education 정신분석 상담과 행동주의 상담의 공통점에 해당하는 것은? A. 상담과정에서 과거 경험보다 미래 경험을 중시한 다 . B. 상 담 기 법 보 다 는 상 담 자 의 인 간 적 자 질 과 진 솔 한 태 도 를 중 시 한 다 . C. 인간의 행동을 인과적 관계로 해석하는 결정론적 관점을 가진 다 . D. 비합리적 신념을 인식하고 수정하는 논박 과정을 중시한 다 . *Which is a common feature of psychoanalytic counseling and behavioral counseling?* *A. Emphasizes future experiences over past experiences in the counseling process.* *B. Prioritizes the counselor's human qualities and sincerity over counseling techniques.* *C. Interprets human behavior through a deterministic perspective based on causal relationships.* *D. Focuses on the disputation process to recognize and modify irrational beliefs.*

Table 10: Examples of error types in KMMLU. Each example demonstrates a specific issue that impacts the reliability of the benchmark. Gray text represents translation of the examples in English