

436 A Database categories

437 In the main manuscript, we described, at a high-level, the contents of the various benchmark databases
438 (Turath Standard, Art, and UNESCO), and outlined the number of image categories that each contains.
439 In this section, we list all the image categories that appear in each of the benchmark databases. Please
440 keep in mind that many of the category names are romanized versions of the original Arabic text, and
441 thus may not be fully comprehensible to non-Arabic speakers.

442 A.1 Turath Standard (micro)

443 aish el-saraya, ahaggar national park, ain ghazal, ajwa dates, al-quwaysimah-jordan, aleppo souk,
444 aleppo-syria, alexandria coastline, alexandria-egypt, algiers-algeria, amman-jordan, ancient jerusalem
445 market, arabic mamoul food, ariana-governorate-tunisia, ayyala folk dance, babaghanoush, bamia,
446 barhi dates, batna,-algeria-algeria, beirut-lebanon, besarah, bint al sahn, cairo-egypt, camel riding,
447 casablanca-morocco, cave church egypt, chorba, couscous, damascus-syria, daraa-syria, dead sea, jor-
448 dan, deir-ez-zor-syria, desert horse riding dubai, djelfa-algeria, dune bashing, eggah, egypt basbousa
449 food, egypt's black desert, el mate, eliyahu hanavi synagogue, emirate-of-abu-dhabi-the-united-arab-
450 emirates, emirate-of-fujairah-the-united-arab-emirates, emirate-of-sharjah-the-united-arab-emirates,
451 erbil citadel, essaouira market, essaouira, morocco, falafel, farasan islands, saudi arabia, farinata,
452 fasolada, fatteh, fattoush, fesikh, feteer-meshaltet, figuig, freekeh, ful-medames, galayet-bandora,
453 gebel barkal, giza-egypt, gouraya national park, algeria, grape leaves food, green-beans, halloumi-
454 cheese, hama-syria, haneeth, harees, harira, hawawshi, hininy, hummus, ichkeul lake and national
455 park, tunisia, idrisid-dynasty-morocco, iraqi traditional dress, irbid-jordan, jabal qara caves, jeita
456 grotto, lebanon, jordanian mansaf food, jordanian traditional dress, jounieh-lebanon, kabab, kabsa,
457 kairouan-governorate-tunisia, kamounia, karak chai, kebab, kemençe instrument, khoshaf, kibbeh,
458 kofta, layali lubnan, lebanon hummus food, luqaimat, mabroom dates, markook-shrek, marrakesh-
459 safi-morocco, medjool dates, merguez, merzouga desert, mesfouf, mohammad al-amin mosque,
460 mohammed-ben-abdallah-morocco, moroccan couscous food, moussaka, msemen, mt. sinai, egypt,
461 mulukhiyah, musandam fjords, oman, musandam oman, mutabbal, méchoui, Nile river, egypt, oasis
462 du sud marocain biosphere reserve, old mosque of shali fortress, olives, omani traditional dress,
463 oran-algeria, palestine keffiyeh, palestine kunafa food, palestinian maqluba food, port-said-egypt,
464 qamar al deen drink, qualah iraq mountains, quzi, rabbi dates, red sea coast, rub' al khali, ara-
465 bian peninsula, russeifa-jordan, sabu-jaddi rock art sites, safawi dates, sahlab drink, saint hilarion
466 monastery, sandboarding, saudi kabsa food, saudi sambousek food, sayer dates, sfax-governorate-
467 tunisia, shishbarak, shubra-el-kheima-egypt, sidon-lebanon, socotra island, yemen, souk al hamidiyah,
468 sousse-governorate-tunisia, sudan traditional dress, sukkary dates, syria kibbeh food, syria qatayef
469 food, syrian ice cream food, tabbouleh, tanbur instrument, tanger-tetouan-al-hoceima-morocco, tarim
470 palace yemen, the church of the annunciation, tinghir oasis, morocco, torta-de-gazpacho, tripoli,-
471 lebanon-lebanon, tunis-governorate-tunisia, tyre,-lebanon-lebanon, wadi mathendous rock art, wadi
472 rum, jordan, wadi wurayah biosphere reserve, waw an namus, libya, zahidi dates, zarqa-jordan, zil
473 instrument, acacus mountains, algeria fashion men, algeria fashion women, algiers algeria night, am-
474 man jordan night, arab zaatar, arabic coffee, arabic tea, archery sport, atlas cedar biosphere reserves,
475 awamat sweets, ayran drink, baalbek-images, barazik, beirut lebanon night, buzuq-images, cashew
476 fingers, chrea national park algeria, constantine algeria, cracs-images, dabke dancing, damascus
477 syria night, dana biosphere reserve, derbeke-images, desert palm tree, djurdjura national park, egypt
478 dancing, egyptian folk dance, falcon hunting arab gulf, fez morocco night, ghraybeh, giza egypt
479 night, grand mosque qatar, hama syria night, hisham-s palace, jabal al rihane biosphere reserve, jabal
480 moussa biosphere reserve, jarash jordan, jellab drink, jet skiing dubai beach, karkadeh drink, khan
481 khalil egypt, khartoum night, kleicha dessert, kol w shkor, kumma hats, lebanon old houses, libya
482 fashion women, madain-images, marakkesh souq, marrakech morocco night, mauritania fashion
483 men, mauritania fashion women, mauritania fishing, mbesses, meroe-images, mizmar, morrocan
484 traditional dress, muscat capital, muscat oman night, muttrah souk, nay-images, old souk jeddah,
485 oman fashion men, oman fashion women, omani halwa, oud-images, palmyra-images, petra-images,
486 qanoon-images, rabat capital, ras muhammad national park, rawshe-images, rebab, red sea diving,
487 riyadh capital, sanaa yemen night, santur instrument, saudi champagne, saudi male sandals, saudi old
488 houses, saudi shemagh, shamadan dance, shangeet-images, sheikh zayed mosque, shouf biosphere
489 reserve, subhah beads, sudan capital, syria old houses, table-images, tamina dessert, testour mosque,
490 timgad-images, traditional fez hat, tripoli lebanon night, tunisian dancing, ula-images, umm ali

491 dessert, ummayad mosque, ummayad-images, volubilis-images, yemen fashion men, yemen fashion
492 women, yemeni old houses,

493 A.2 Turath Art

494 abdalla-omari-art, abdallah-akar-art, abdallah-benanteur-art, abdallah-murad-art, abdel-hadi-el-
495 gazzar-art, abdel-kader-guermaz-art, abdel-qader-hassan-art, abdelkader-benchamma-art, abdelkebir-
496 rabi-art, abderrahim-iqbi-art, Abdul-hay-mosallam-zarara-art, abdul-qader-al-raï-art, abdul-qadir-al-
497 obaidi-art, abdul-qadir-al-rassam-art, abdul-raheem-salem-art, abdul-rahim-sharif-art, abdul-rahman-
498 al-maaini-art, abdul-rahman-mowakket-art, abdul-rida-bager-art, abdulhalim-radwi-art, abdullah-al-
499 muharraqi-art, abdullah-al-qassar-art, abdulnasser-gharem-art, achraf-touloub-art, adam-henein-art,
500 adel-abdessemed-art, adel-abidin-art, adel-al-khalaf-art, adel-dauood-art, adel-el-siwi-art, adham-
501 wanly-art, adonis-ali-ahmed-said-esber-art, afaf-zurayk-art, afifa-alelby-art, ahmad-durak-sibai-art,
502 ahmad-moualla-art, ahmad-nawash-art, ahmad-shibrain-art, ahmed-alsoudani-art, ahmed-askalany-
503 art, ahmed-baqer-art, ahmed-ben-driss-el-yacoubi-art, ahmed-cherkaoui-art, ahmed-kassem-art,
504 ahmed-mater-art, ahmed-morsi-art, ahmed-moustafa-art, ahmed-neshaat-al-zuaby-art, akram-halabi-
505 art, akram-zaatari-art, ala-younis-art, ali-al-abdan-art, ali-al-jabri-art, ali-al-tajer-art, ali-cherri-art,
506 ali-ferzat-art, ali-hassan-art, ali-mokawas-syria-art, ali-omar-ermes-art, ali-rafei-art, ali-talib-art,
507 amar-dawood-art, amer-al-obaidi-art, ammar-abd-rabbo-art, ammar-abo-bakr-art, ammar-al-attar-art,
508 amr-nazeer-art, andre-elbaz-art, armen-agop-art, asaad-arabi-art, asim-abu-shakra-art, asma-fayoumi-
509 art, atef-maattallah-art, athar-jaber-art, atta-sabri-art, aula-al-ayoubi-art, aya-tarek-art, ayad-al-nimar-
510 art, ayad-alkadhi-art, ayoub-hussein-art, baghdad-benas-art, basel-uraiqat-art, bashar-alhroub-art,
511 basim-magdy-art, bassel-safadi-art, bassem-dahdouh-art, batoul-shimi-art, bibi-zogbe-art, boushra-
512 al-mutawakel-art, camille-zakharia-art, chafic-abboud-art, chant-avedissian-art, chaouki-choukini-
513 art, charbel-joseph-h-boutros-art, clea-badaro-art, dana-al-jouder-art, deirrieh-fakhoury-art, dia-
514 azzawi-art, diana-al-hadid-syria-art, djamel-tatah-art, djamila-bent-mohamed-art, driss-ouadahi-
515 art, ebtisam-abdulaziz-art, effat-naghi-art, el-seed-art, elias-zayat-art, emmanuel-guiragossian-art,
516 emmanuel-nassar-art, ervand-demerdjian-art, essa-grayeb-art, etel-adnan-art, ezequiel-baroukh-
517 art, fadi-al-hamwi-art, fadia-haddad-art, fahr-el-nissa-zeid-art, faik-hassan-art, faisal-laibi-sahi-art,
518 farah-al-qasimi-art, farah-behbehani-art, faraj-abbo-al-numan-art, fares-cachoux-art, farid-belkahia-
519 art, farida-el-gazzar-art, fateh-al-moudarres-art, fatema-al-mazrouie-art, fathi-afifi-art, fathi-hassan-
520 art, faycal-baghriche-art, fouad-bellamine-art, fouad-elkoury-art, gazbia-sirry-art, gcc-collective-
521 art, george-bahgory-art, george-hanna-sabbagh-art, ghada-amer-art, ghadeer-saeed-art, ghassan-
522 ghaib-art, ghassan-kanafani-art, gouider-triki-art, habib-srouer-art, hadjithomas-joreige-art, hafidh-
523 aldroubi-art, haidar-al-mehrab-art, halim-al-karim-art, halim-karibebine-art, hamdan-al-shamsi-
524 art, hamed-abdalla-art, hamed-ewais-art, hamed-nada-art, hamza-bounoua-art, hanaa-mallallah-
525 art, hani-alqam-art, hani-zurob-art, hanoos-hanoos-art, hassan-el-glaoui-art, hassan-massoudy-art,
526 hassan-meer-art, hassan-sharif-art, hatim-elmekki-art, hayv-kahraman-art, hazem-al-zubi-art, hazem-
527 harb-art, hazem-mahdy-art, hedi-turki-art, helen-khal-art, hessa-al-joker-art, hind-nasser-art, hind-
528 zulfa-art, huda-lutfi-art, huguette-caland-art, hussein-fawzi-art, hussein-madi-art, hussein-sharif-
529 art, hussein-shariffe-art, ibi-ibrahim-art, ibrahim-el-salahi-art, ibrahim-ismail-art, iman-issa-art,
530 inaya-fanis-hodeib-art, inji-efflatoun-art, ismael-al-khaïd-art, ismail-al-rifai-art, ismail-fattah-art,
531 ismail-samson-art, ismail-shammout-art, issa-saqer-al-khalaf-art, issam-al-said-art, jaber-al-azmeh-
532 art, jabra-ibrahim-jabra-art, jafar-islam-art, jaffar-al-oraibi-art, jamil-hamoudi-art, jananne-al-ani-art,
533 jassim-zaini-art, jawad-al-malhi-art, jeffar-khalidi-art, jewad-selim-art, jilali-gharbaoui-art, jorge-
534 tacla-art, juliana-seraphim-art, jumana-el-husseini-art, jumana-manna-art, kader-attia-art, kadhim-
535 hayder-art, kamal-boullata-art, kamala-ibrahim-ishaq-art, kamel-el-telmesani-art, kamel-moghani-art,
536 kareem-lotfy-art, kareem-risan-art, kevork-mourad-art, khadeir-al-shakarji-art, khalidoun-shishakly-
537 art, khaled-al-jader-art, khaled-hafez-art, khaled-hourani-art, khaled-jarrar-art, khaled-zaki-art,
538 khalid-al-jallaf-art, khalid-albahi-art, khalid-farhan-art, khalid-mezaina-art, khalifa-al-qattan-art,
539 khalil-gibran-art, khazaal-awad-qaffas-art, kholoud-al-sharafi-art, khouzaima-alwani-art, laila-shawa-
540 art, lamia-joreige-art, lamya-gargash-art, lara-baladi-art, larissa-sansour-art, lateefa-bint-maktoum-
541 art, lawrence-abu-hamdan-art, layan-shawabkeh-art, layla-al-attar-art, layla-juma-art, leila-nseir-
542 art, lorna-selim-art, louay-kayyali-art, lulwah-al-hamoud-art, madiha-umar-art, maha-maamoun-
543 art, mahmoud-abboud-fahmy-art, mahmoud-bin-radwan-art, mahmoud-hammad-art, mahmoud-
544 obaidi-art, mahmoud-sabri-art, mahmoud-said-art, maitha-demithan-art, maliheh-afnan-art, maliheh-
545 afnan-palestine-art, malika-agueznay-art, mamdouh-ammam-art, mamdouh-kashlan-art, manal-al-
546 dawayan-art, marguerite-nakhla-art, mariam-abdel-aleem-art, marwa-adel-art, marwa-arsanios-art,
547 maysa-mohammed-art, maysaloun-faraj-art, mazen-ismail-al-ashkar-art, mejri-thameur-art, menhat-

548 helmy-art, michael-rakowitz-art, michel-basbous-art, miloud-labeid-art, moataz-nasr-art, modhir-
 549 ahmed-art, mohamad-fahmy-ganzeer-art, mohamad-said-baalbaki-art, mohamed-abou-el-naga-art,
 550 mohamed-ben-allal-art, mohamed-chebaa-art, mohammed-abla-art, mohammed-ahmed-ibrahim-art,
 551 mohammed-al-kouh-art, mohammed-al-mazrouie-art, mohammed-al-qassab-art, mohammed-farea-
 552 art, mohammed-hamidi-art, mohammed-ismail-art, mohammed-issiakhem-art, mohammed-kacimi-
 553 art, mohammed-kazem-art, mohammed-khadda-art, mohammed-mandi-art, mohammed-masri-art,
 554 mohammed-melehi-art, mohammed-naghi-art, mohammed-omar-khalil-art, mohammed-sabry-art,
 555 mohssin-harraki-art, mona-hatoum-art, mona-saudi-art, moosa-al-halyan-art, mounirah-mosly-art,
 556 moza-al-suwaidi-art, muhanna-durra-art, munira-al-kazi-art, mustafa-al-hallaj-art, nabil-nahas-art,
 557 nabil-safwat-art, nadia-ayari-art, nadia-kaabi-linke-art, nadia-saikali-art, nadim-raef-art, naim-ismail-
 558 art, najat-maki-art, najla-al-saleem-art, nasser-al-yousif-art, nazar-yahya-art, naziha-selim-art, nazir-
 559 ismail-art, nazir-nabaa-art, nedim-kufi-art, nejib-belkhoja-art, nermine-hammam-art, nidhal-chamekh-
 560 art, nja-mahdaoui-art, noor-al-suwaidi-art, noor-bahjat-art, nouri-al-rawi-art, obaid-suroor-art, omar-
 561 al-rashid-art, omar-el-nagdi-art, omar-hamdi-art, omar-khairy-art, omar-onsi-art, paul-guiragossian-
 562 art, raafat-ishak-art, rachid-koraichi-art, rafa-al-nasiri-art, rafic-charaf-art, ragheb-ayad-art, rajiha-
 563 qudsi-art, ramses-younan-art, rashid-al-oraifi-art, rawya-ahmed-malik-art, reda-abdelrahman-art,
 564 reem-al-faisal-art, reem-al-ghaith-art, rim-al-jundi-art, saad-ben-cheffaj-art, saad-el-khadem-art,
 565 saadi-al-kaabi-art, sadik-alfraji-art, safia-farhat-art, safwan-dahoul-art, salah-abdel-kerim-art, salah-
 566 taher-art, salama-safadi-art, saleh-al-jumaie-art, saliba-douaihy-art, salman-abbas-art, salman-al-
 567 basri-art, saloua-raouda-choucair-art, sama-al-shaibi-art, sami-mohammed-art, samia-halaby-art,
 568 samir-rafi-art, samir-sayegh-art, samira-badran-art, seif-wanly-art, seta-manoukian-art, shaaban-zaki-
 569 art, shada-safadi-art, shadi-alzaqzouq-art, shadi-habib-allah-art, shakir-hassan-al-said-art, sharif-
 570 waked-art, shawki-youssef-art, simone-fattal-art, sinan-hussein-art, sophia-al-maria-art, steve-sabella-
 571 art, suad-al-attar-art, sueraya-shaheen-art, suha-shoman-art, sulafa-hijazi-art, suleiman-mansour-art,
 572 susan-hefuna-art, tagreed-darghouth-art, tahia-halim-art, talal-moualla-art, tammam-al-akhal-art,
 573 tammam-azzam-art, tarek-al-ghoussein-art, tawfik-al-alousi-art, tayseer-barakat-art, taysir-batniji-
 574 art, thuraya-al-baq sami-art, ufemia-rizk-art, van-leo-art, vera-tamari-art, wael-darwish-art, walead-
 575 beshty-art, walid-al-shami-art, walid-ebeid-art, walid-raad-art, walid-siti-art, waseem-marzouki-
 576 art, wassef-boutros-ghali-art, wijdan-ali-art, yasser-dweik-art, yasser-rostom-art, yousef-ahmed-art,
 577 youssef-kamel-art, youssef-nabil-art, yto-barrada-art, yvette-achkar-art, zena-al-khalil-art, zena-assi-
 578 art, zhivago-duncan-art, ziad-antar-art, ziad-dalloul-art, zineb-sedira-art, zoulikha-bouabdellah-art,

579 **A.3 Turath UNESCO**

580 abu-mena-unesco-site, aflaj-irrigation-systems-of-oman-unesco-site, ahwar-of-southern-iraq-unesco-
 581 site, al-ahsa-oasis-unesco-site, al-ain-unesco-site, al-balad,-jeddah-unesco-site, al-maghtas-unesco-
 582 site, al-zubarah-unesco-site, amphitheatre-of-el-jem-unesco-site, ancient-city-of-bosra-unesco-
 583 site, ancient-city-of-damascus-unesco-site, ancient-ksour-of-ouadane,-chingueti,-tichitt-and-oualata-
 584 unesco-site, anjar,-lebanon-unesco-site, archaeological-site-of-carthage-unesco-site, archaeological-
 585 sites-of-bat,-al-khutm-and-al-ayn-unesco-site, assur-unesco-site, baalbek-unesco-site, babylon-
 586 unesco-site, bahla-fort-unesco-site, bahrain-pearling-trail-unesco-site, battir-unesco-site, beni-
 587 hammad-fort-unesco-site, byblos-unesco-site, casbah-of-algiers-unesco-site, cedars-of-god-unesco-
 588 site, church-of-the-nativity-unesco-site, citadel-of-arbil-unesco-site, citadel-of-salah-ed-din-unesco-
 589 site, cyrene,-libya-unesco-site, dead-cities-unesco-site, dilmun-burial-mounds-unesco-site, diriyah-
 590 unesco-site, djémila-unesco-site, dougga-unesco-site, el-jadida-unesco-site, essaouira-unesco-site,
 591 fes-el-bali-unesco-site, frankincense-trail-unesco-site, gebel-barkal-and-the-sites-of-the-napatan-
 592 region-unesco-site, ghadames-unesco-site, giza-pyramid-complex-unesco-site, hatra-unesco-site,
 593 hebron-unesco-site, ichkeul-national-park-unesco-site, islamic-cairo-unesco-site, kadisha-valley-
 594 unesco-site, kairouan-unesco-site, kerkouane-unesco-site, krak-des-chevaliers-unesco-site, ksar-of-
 595 ait-ben-haddou-unesco-site, leptis-magna-unesco-site, medina-of-marrakesh-unesco-site, medina-of-
 596 sousse-unesco-site, medina-of-tunis-unesco-site, meknes-unesco-site, meroë-unesco-site, necropolis-
 597 of-kerkouane-unesco-site, nubian-monuments-from-abu-simbel-to-philae-unesco-site, old-city-of-
 598 aleppo-unesco-site, petra-unesco-site, qalhat-unesco-site, qasr-amra-unesco-site, rabat-unesco-
 599 site, rock-art-sites-of-tadrart-acacus-unesco-site, sabratha-unesco-site, samarra-unesco-site, shibam-
 600 unesco-site, site-of-palmyra-unesco-site, theban-necropolis-unesco-site, thebes,-egypt-unesco-site,
 601 timgad-unesco-site, tipaza-unesco-site, tyre,-lebanon-unesco-site, tétouan-unesco-site, umm-ar-rasas-
 602 unesco-site, volubilis-unesco-site, wadi-al-hitan-unesco-site, wadi-rum-unesco-site, zabīd-unesco-
 603 site,

B Implementation details

To allow for the reproducibility of our image classification experiments, we outline, in Table 3, the implementation details of those experiments. We use TensorFlow [29] for all experiments and during hyperparameter optimization, we experimented with learning rates in the range $lr \in [1e^{-4} - 1e^{-3}]$. We did not implement any data augmentation strategy during training, such as random cropping, rotations, etc. All images were reshaped to 224×224 before being fed to a network. For all experiments, and to mitigate over-fitting, we implemented an early stopping criterion based on the loss incurred on the validation set with a patience value of 5 epochs. For evaluation purposes, we extracted and exploited the parameters that coincided with the minimum loss incurred on the validation set. The experiments leveraged the GPU resources on Google Colab and, depending on the benchmark database, each epoch of training and evaluation on the validation set was 30 – 200s in duration.

Table 3: **Implementation details of the image classification experiments conducted on the benchmark databases.** LR and BS refer to the learning rate and batch-size respectively. Macro and micro refer to the granularity of the category labels used during training and evaluation.

Benchmark	Optimizer	Loss	LR	BS
Turath Standard (<i>macro</i>)	Adam	Cross-entropy	$1e^{-3}$	64
Turath Standard (<i>micro</i>)	Adam	Cross-entropy	$1e^{-4}$	64
Turath Art	Adam	Cross-entropy	$1e^{-4}$	64
Turath UNESCO	Adam	Cross-entropy	$1e^{-4}$	64

C Limitations of networks pre-trained on ImageNet

In the main manuscript, we made the case for the limitations of networks pre-trained on ImageNet. We did so by deploying an EfficientNet on image samples from the Turath database and comparing the Top-5 predictions to the ground-truth label. In this section, we extend those findings to other neural architectures, including MobileNetV2 and ResNet50. We randomly sample 9 images from the Turath database, perform a forward pass through the network, and present the Top-5 predictions and corresponding confidence levels in Figs 7a and 7b.

We find that, regardless of the neural architecture, networks pre-trained on ImageNet are unable to correctly predict the micro-level category of image samples from the Turath database. For example, in Fig. 7a, we see that MobileNetV2 misclassifies Cyrene, an ancient Greek city in present-day Libya, as a cliff. Similarly, it misclassifies Gebel Barkal, pyramids in present-day Sudan, as a megalith. In Fig. 7b, we see that ResNet50 confidently misclassifies a scene from Damascus, Syria, as a monastery and confuses Kibbeh, a traditional Arab food item, for a stone wall.

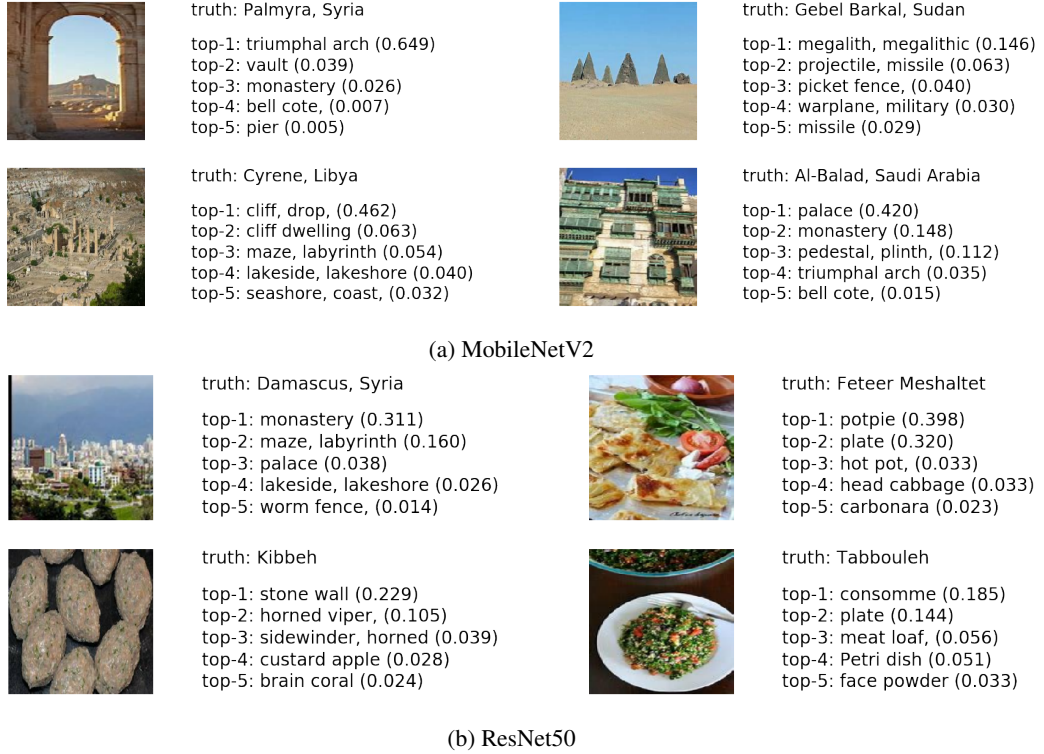


Figure 7: Top-5 predictions (and confidence) made by networks pre-trained on ImageNet and directly deployed on image samples from the Turath Standard benchmark. We also present the ground-truth *micro* category of each of the image samples. Most of the predictions are incorrect, lack the finer resolution of our micro categories, and do not have a cultural emphasis.