6.819 / 6.869: Advances in Computer Vision

Project Overview

Project Website:

http://6.869.csail.mit.edu/fa15/project.html

Aude Oliva

Projects (40%)

Three Project Options

1) Summary of final project proposal (5%): 1 page (template) due Tuesday Nov 10 on stellar
   - Each person submits a file, but it can be the same within a team
2) Research component of final project (30%, template) and final presentation (5%).
   - Presentation (2-5 minutes each): Dec 3 (challenge), Dec 8 (projects)
   - Everybody in 6.868 presents.

Summary of Project Proposal

- The same proposal can be submitted by all the team members (put the name of your teammates when submitting to stellar).
- The project proposal should be one page maximum this template:
- **What is the problem/question** that you will be investigating?
- **What are the most relevant readings**? (2-4 papers)
- **What data will you use?**
- **What method or algorithm will you use? For challenge/deep network: what changes do you plan to do?**

- **How will you evaluate your results?**

  Qualitatively, what kind of results do you expect (e.g. plots or figures)

  Quantitatively, what kind of analysis will you use to evaluate and/or compare your results (e.g. what performance metrics or statistical tests)?

Project : A survey (individual)
<u>only for 6.819</u>

- Select a topic (e.g. texture synthesis, face recognition, saliency models, computational neuroscience models of object recognition, machine learning techniques for vision, etc).
- Select 10-12 papers: **Project template to submit on stellar is the title of your survey and the reference list of 10-12 papers**
- Write a 2500 words survey article (a survey template will be given).
- You can opt for that option and change from a coding project to the survey, at any moment before Thanksgiving.
- Question: contact Aude (oliva@mit.edu)

Project: Your own project
2-4 people

- **Applications/Models.** If you have access to a specific large image dataset (e.g. biology, engineering, physics, neuroscience) and a categorization task, you can apply models to this problem.
- From what you learn in class, you can choose a topic/question and propose an approach/model (including questions related to neuroscience).
- Submit also the proposal to stellar

Project: Mini Places Challenge

Goal: **Build the best classifier you can for scenes**

Introduction

The goal of this challenge is to identify the scene category depicted in a photograph. The data for this task comes from the Places2 dataset which contains 10+ million images belonging to 400+ unique scene categories. Specifically, the challenge data will be divided into 8.1M images for training, 20k images for validation and 381k images for testing coming from 401 scene categories. Note that there is a non-uniform distribution of images per category for training, ranging from 4,000 to 30,000, mimicking a more natural frequency of occurrence of the scene.

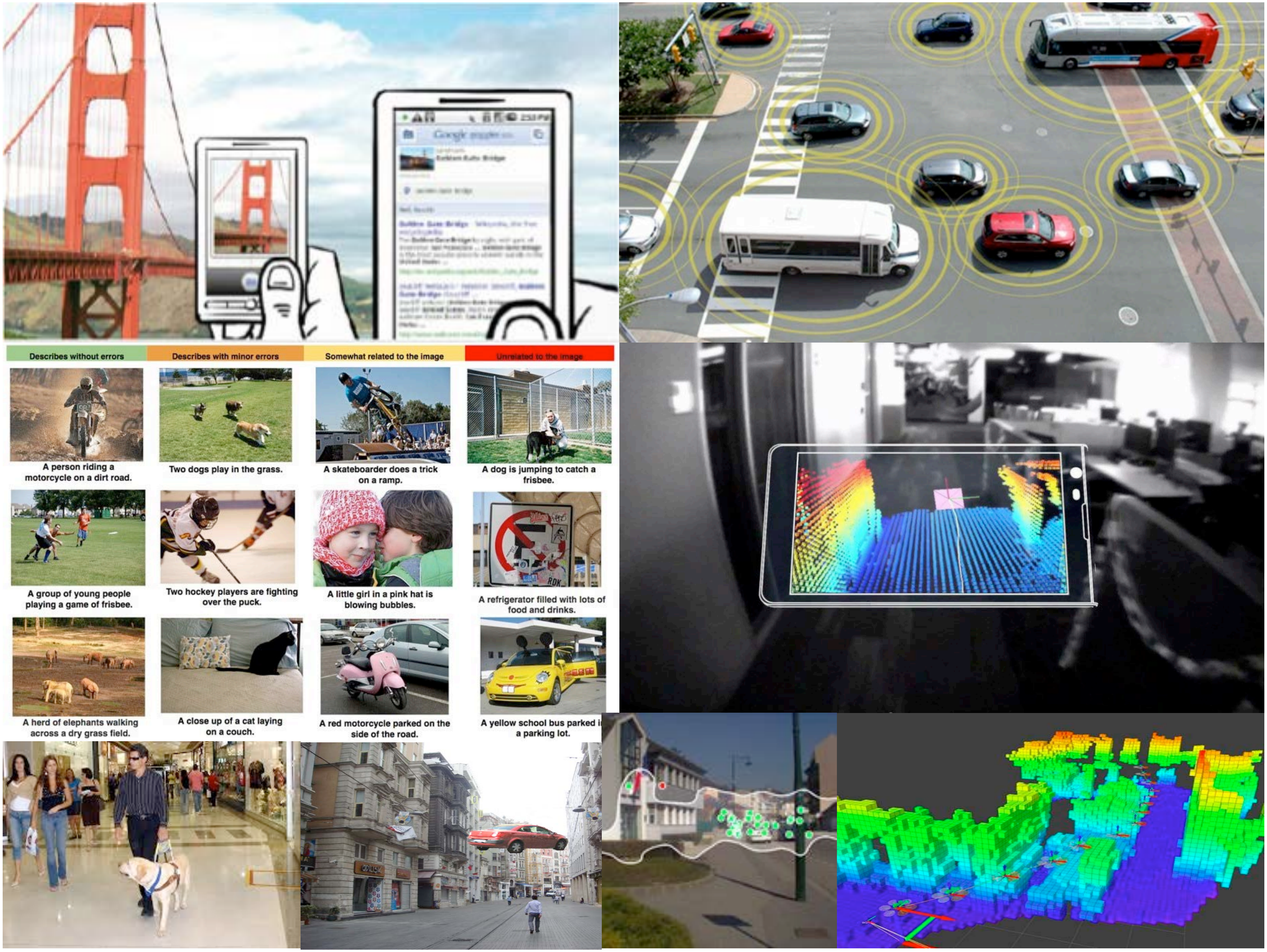
For each image, algorithms will produce a list of at most 5 scene categories in descending order of confidence. The quality of a labeling will be evaluated based on the label that best matches the ground truth label for the image. The idea is to allow an algorithm to identify multiple scene categories in an image given that many environments have multi-labels (e.g. a bar can also be a restaurant) and that humans often describe a place using different words (e.g. forest path, forest, woods).

Dates

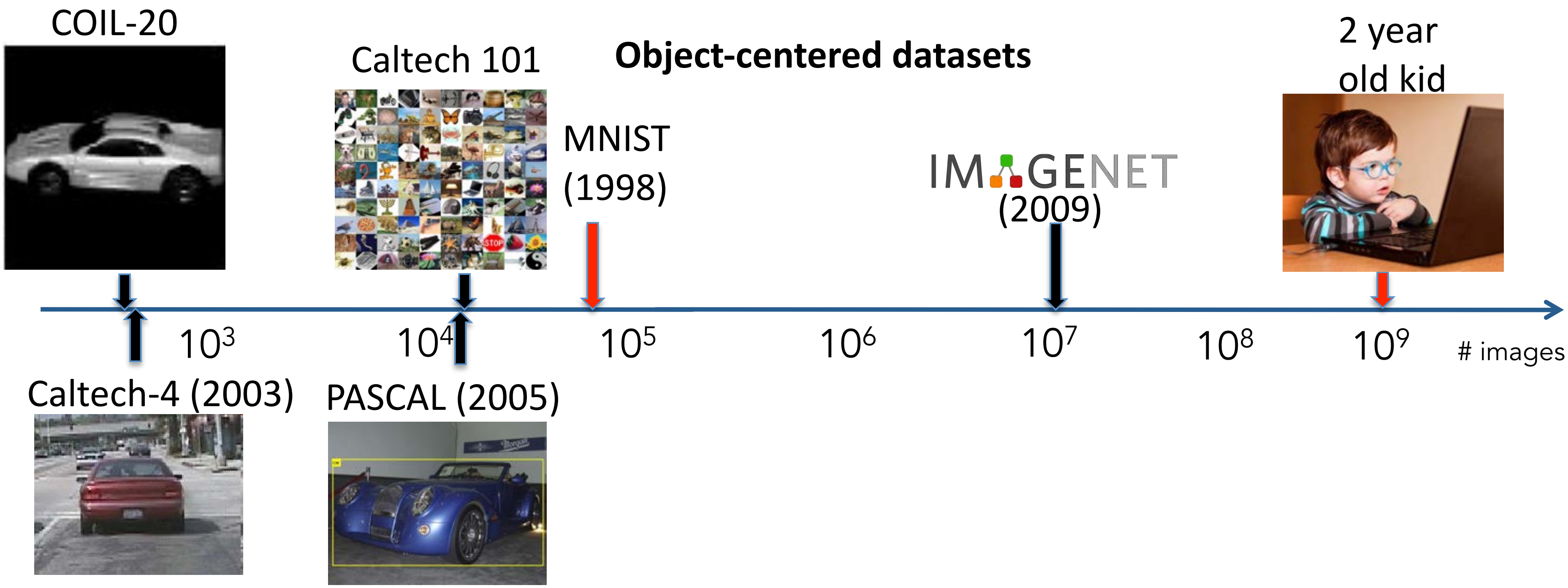
- **August 15, 2015**: Development kit, data, and evaluation software made available
- **November 13, 2015, 5pm PST**: Submission deadline
- **December 10, 2015**: Challenge results released
- **December 17, 2015**: Winner(s) presents at ICCV 2015 Workshop

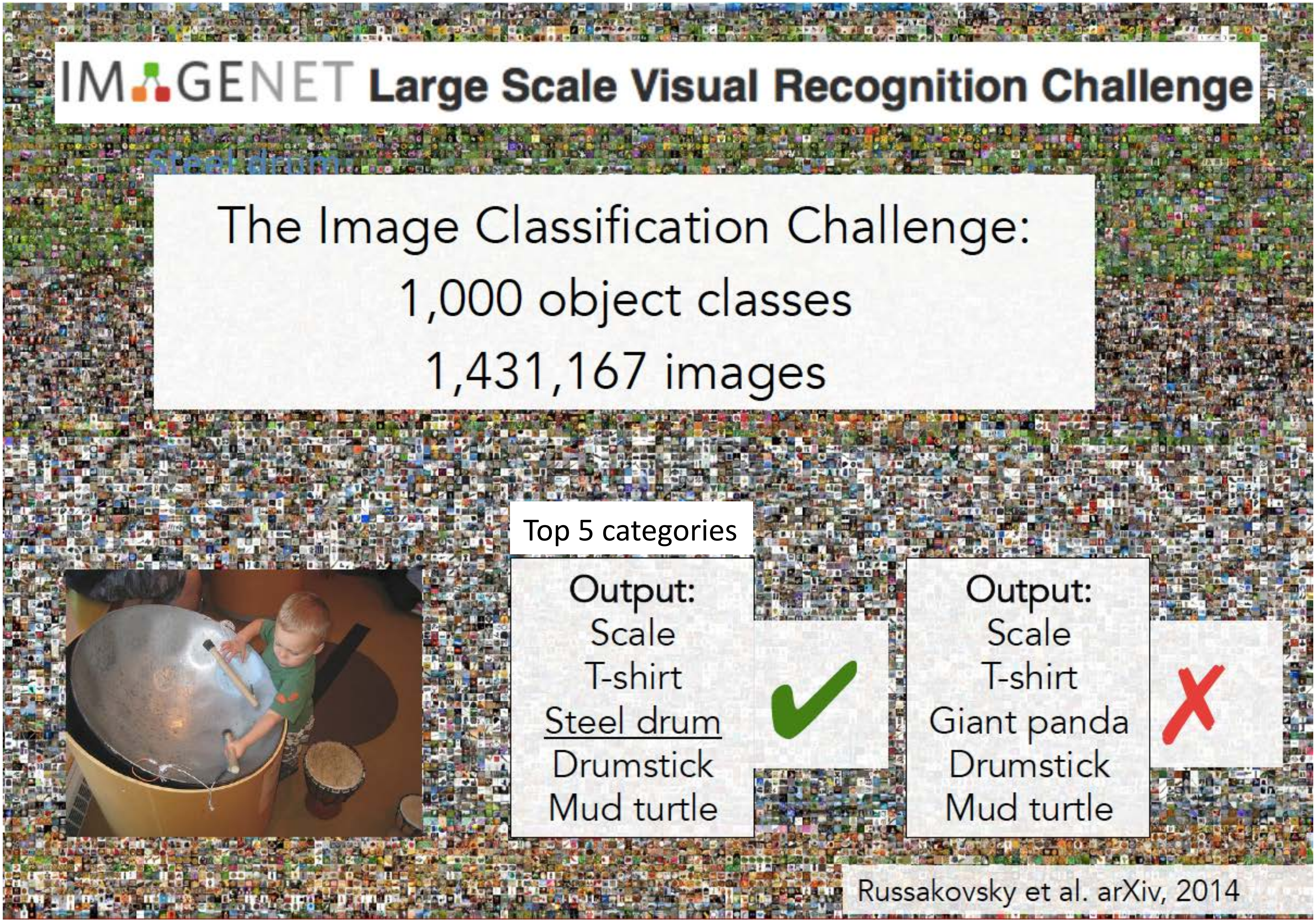
Organizers

- Aditya Khosla
- Bolei Zhou
- Agata Lapedriza
- Antonio Torralba
- Aude Oliva


Describes without errors
Describes with minor errors
Somewhat related to the image
Unrelated to the image
A person riding a motorcycle on a dirt road.
Two dogs play in the grass.
A skateboarder does a trick on a ramp.
A dog is jumping to catch a frisbee.
A group of young people playing a game of frisbee.
Two hockey players are fighting over the puck.
A little girl in a pink hat is blowing bubbles.
A refrigerator filled with lots of food and drinks.
A herd of elephants walking across a dry grass field.
A close up of a cat laying on a couch.
A red motorcycle parked on the side of the road.
A yellow school bus parked i
a parking lot.

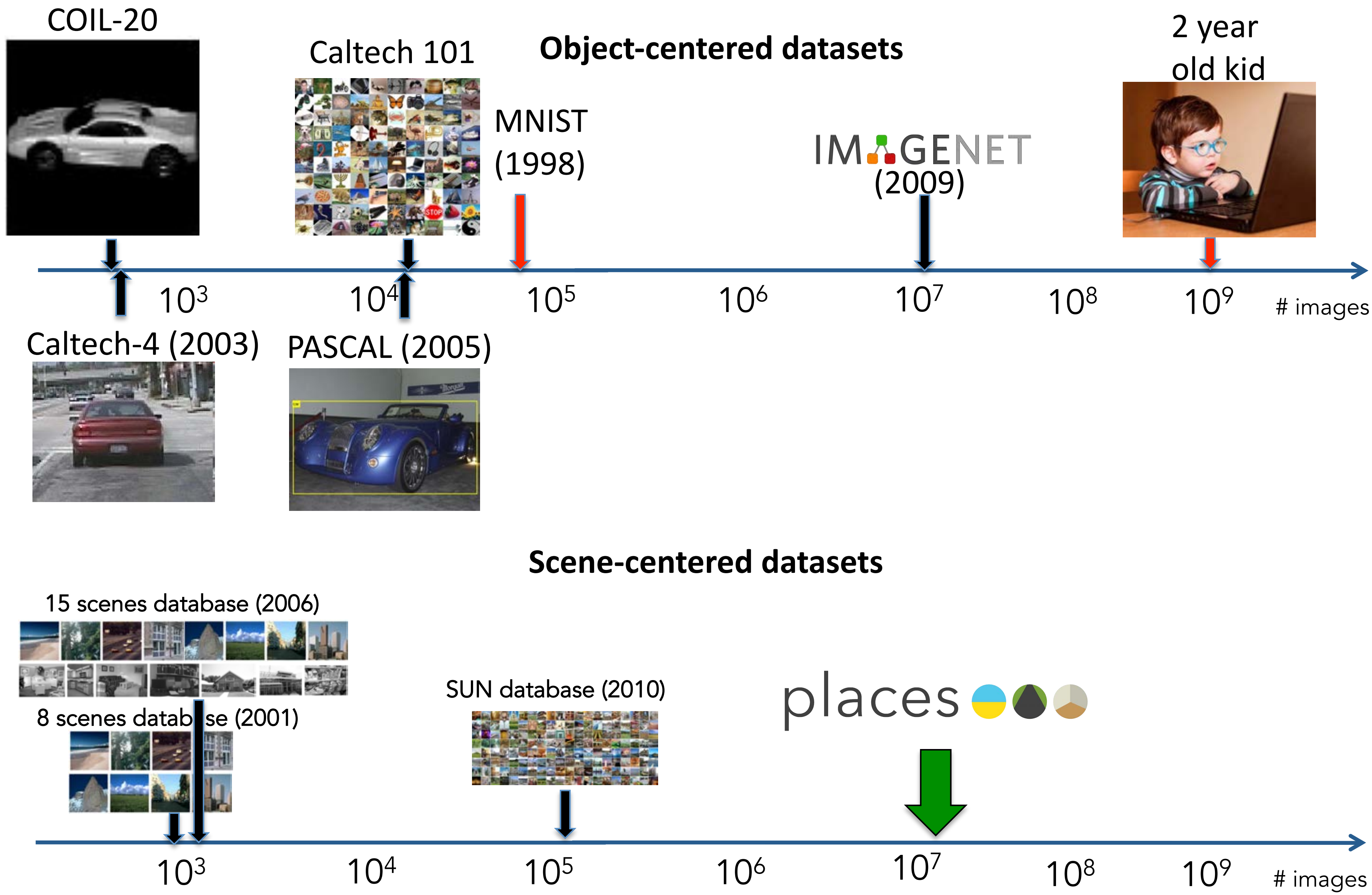
The evolution of vision databases

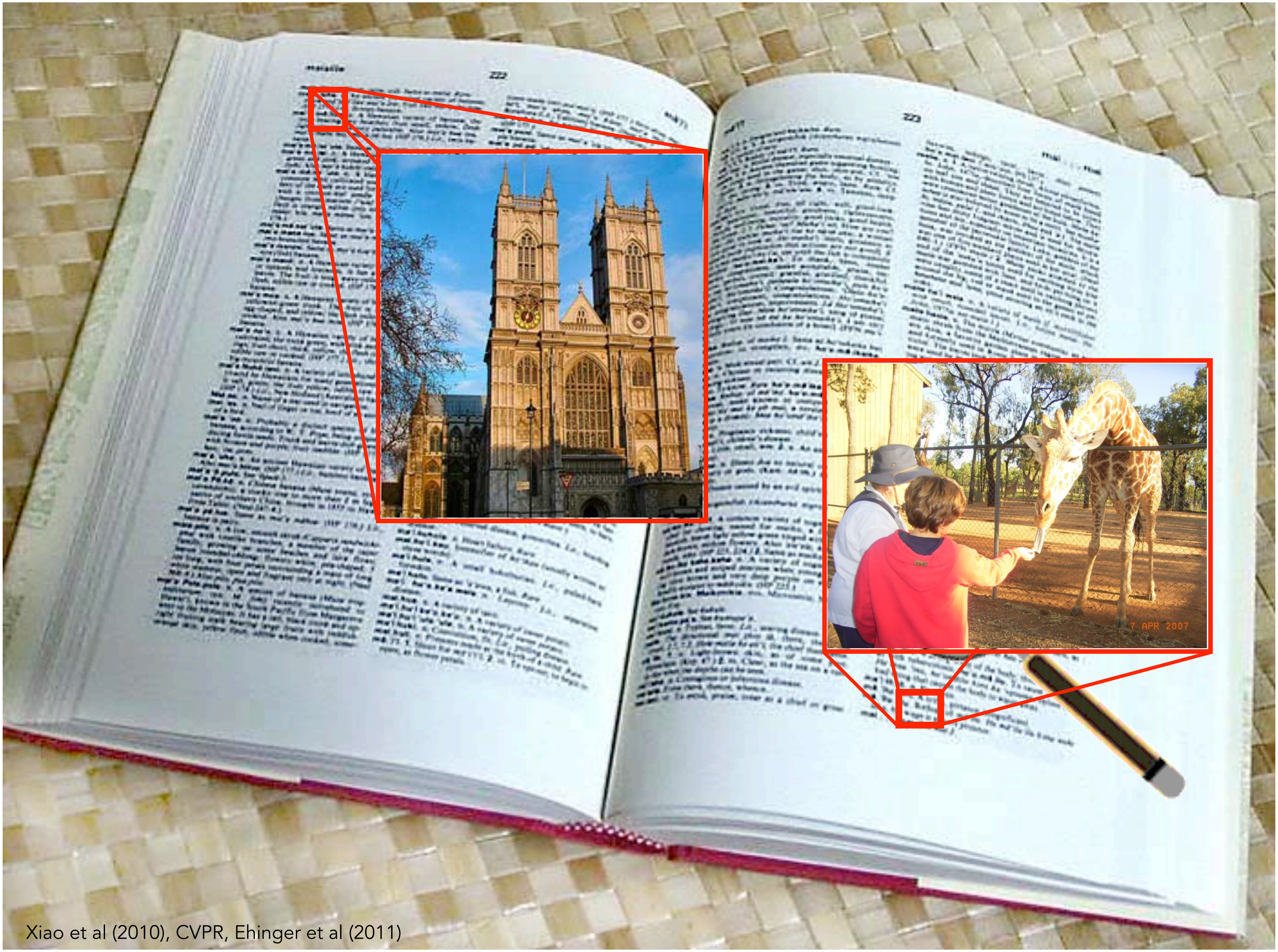




Slide from Fei-Fei Li & Andrej Karpathy

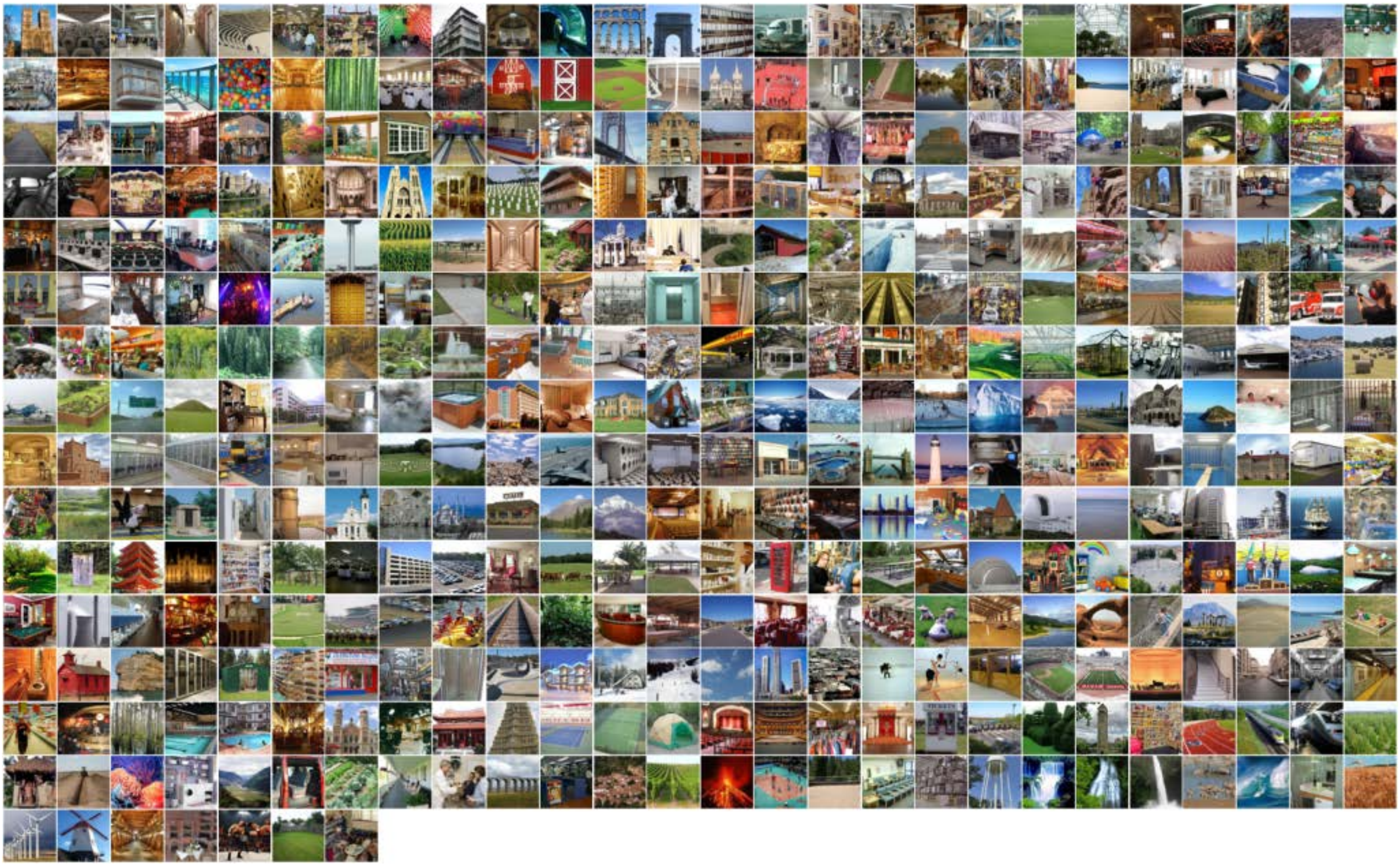
The evolution of vision databases





Xiao et al (2010), CVPR, Ehinger et al (2011)

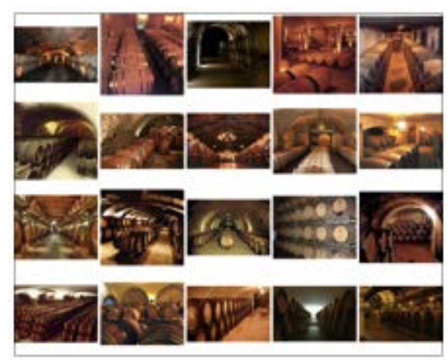
SUN dataset: 900 Scene Categories & 130,000 images



SUN dataset: Entry-level category labels

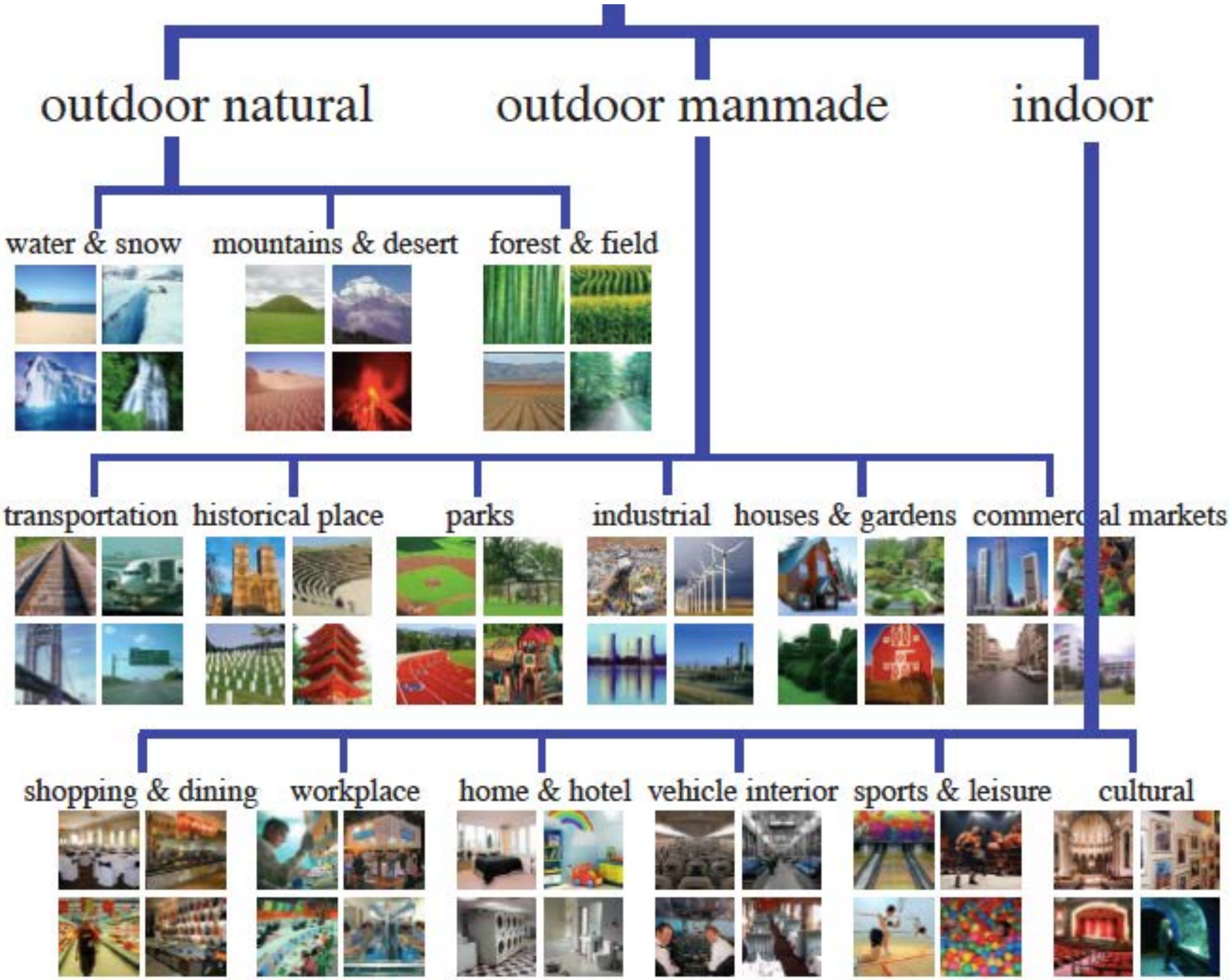
Ballroom

Car interior - backseat

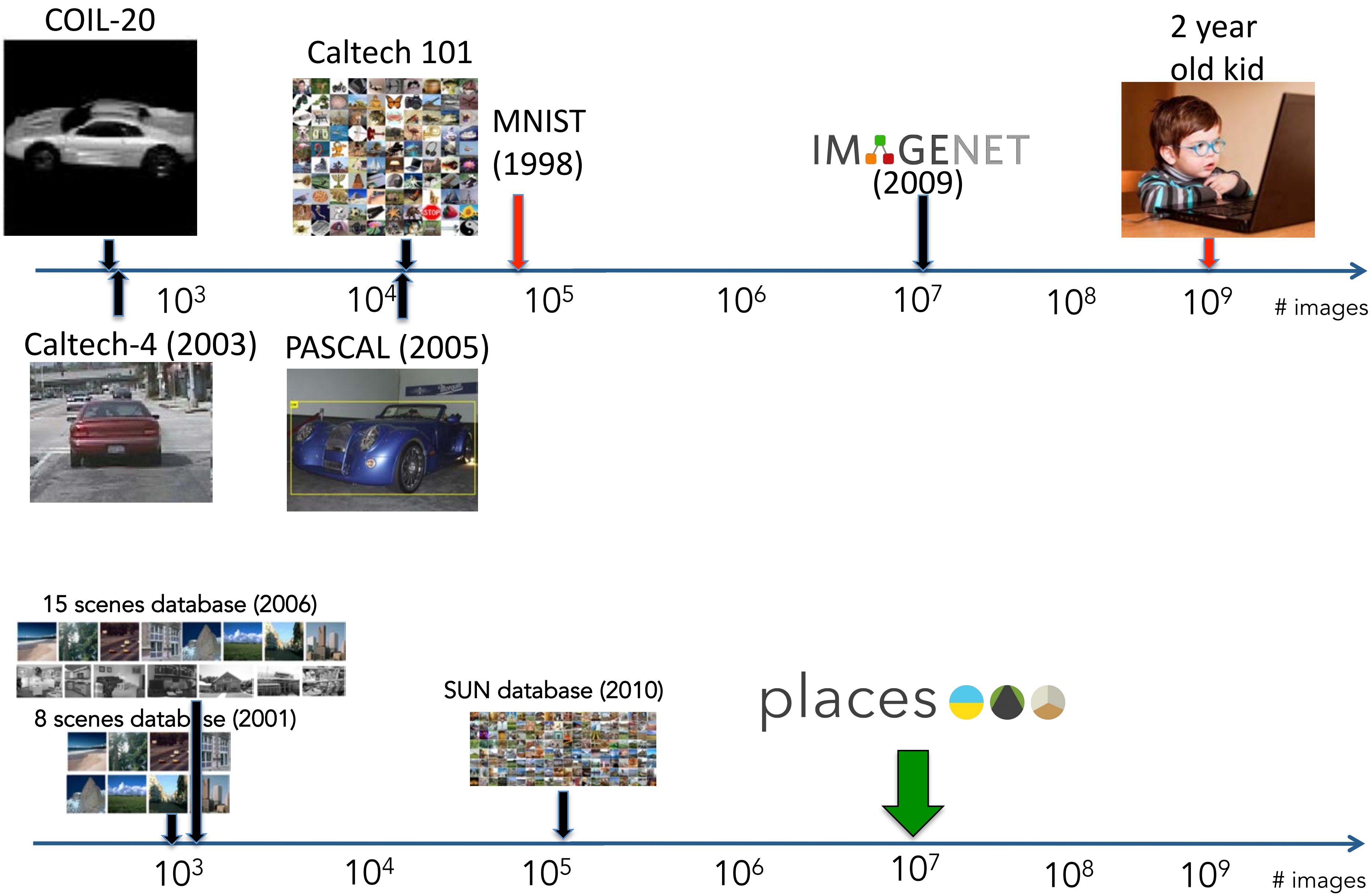


Wine cellar

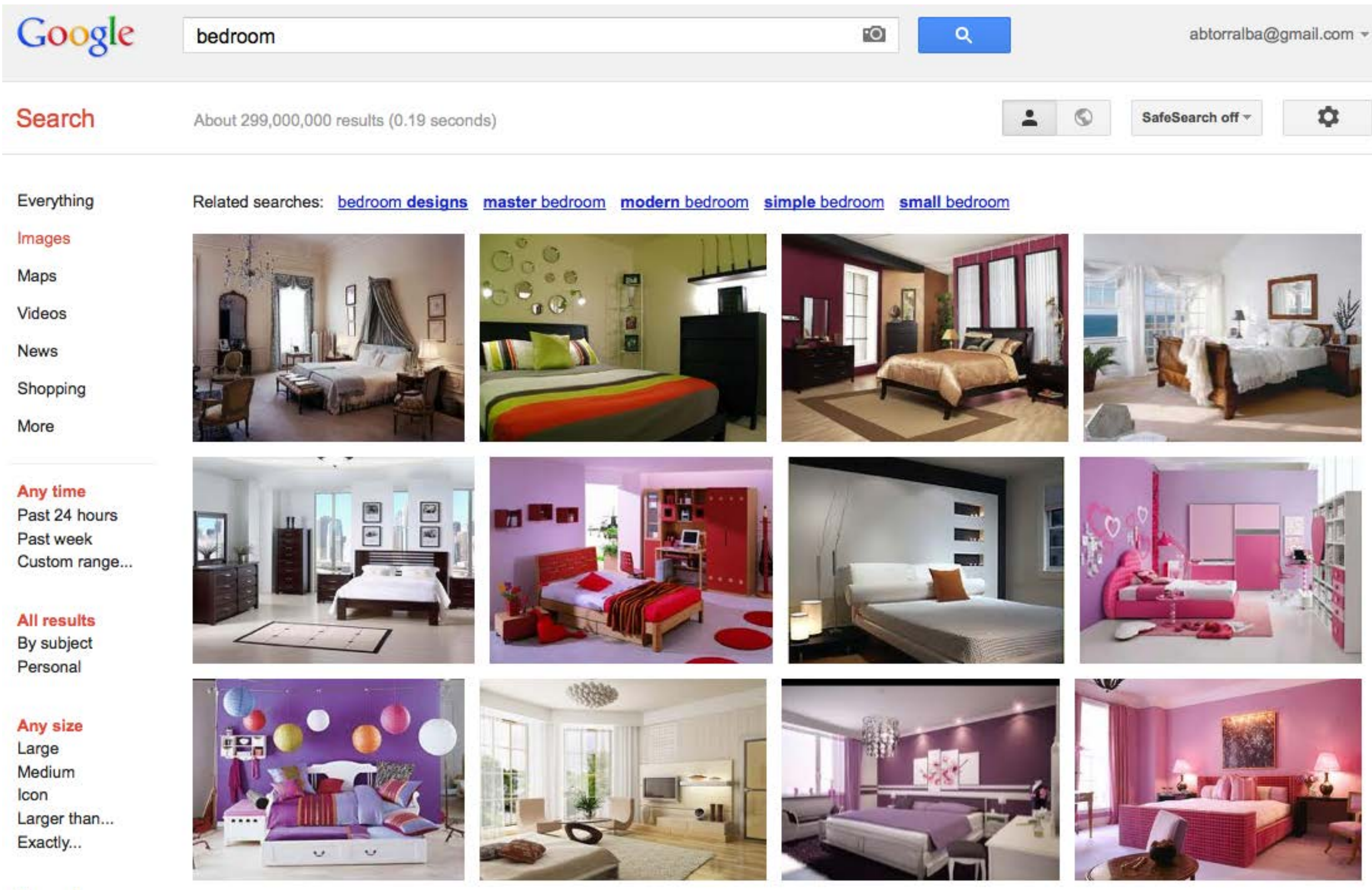
SUN dataset: Hierarchical organization

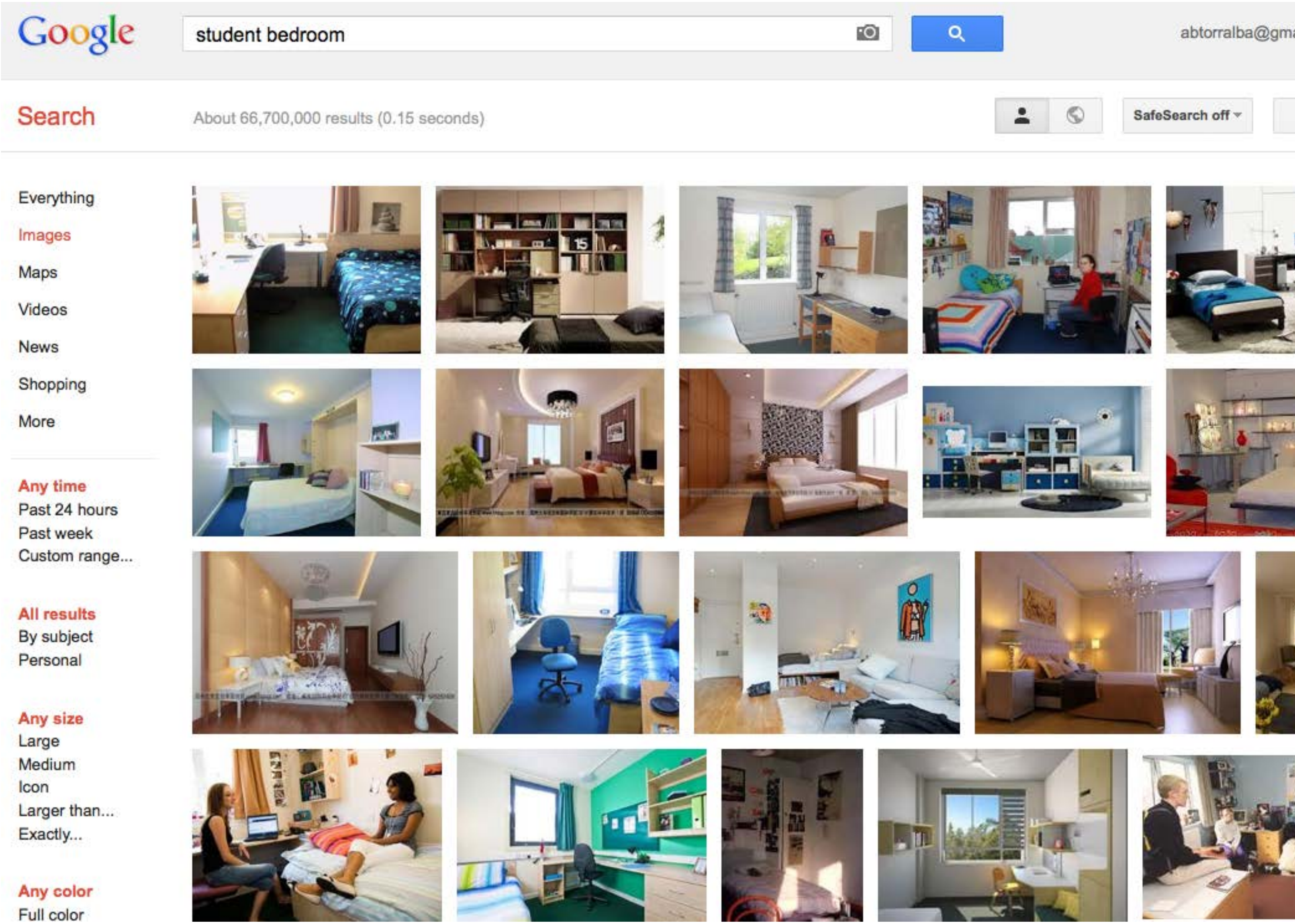


The evolution of scene and object centered databases




Computation with millions of pictures of
places, scenes, environments –
Where you and objects are
Start with 60 million images

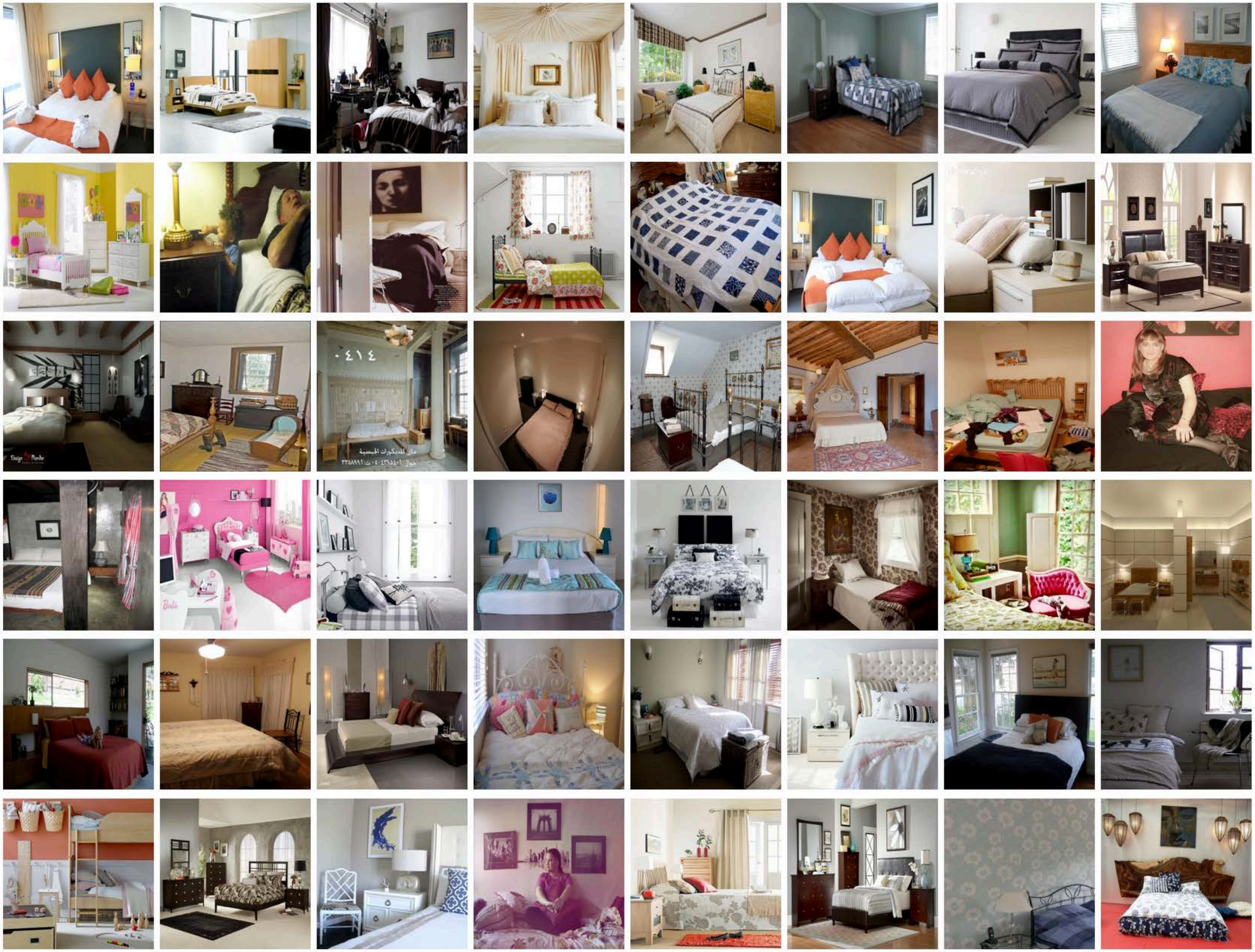

bedroom
abtorralba@gmail.com
Search
About 299,000,000 results (0.19 seconds)
SafeSearch off
Everything
Images
Maps
Videos
News
Shopping
More
Any time
Past 24 hours
Past week
Custom range...
All results
By subject
Personal
Any size
Large
Medium
Icon
Larger than...
Exactly...
Related searches: bedroom designs master bedroom modern bedroom simple bedroom small bedroom


Google
student bedroom
abtorralba@gm
Search
About 66,700,000 results (0.15 seconds)
SafeSearch off
Everything
Images
Maps
Videos
News
Shopping
More
Any time
Past 24 hours
Past week
Custom range...
All results
By subject
Personal
Any size
Large
Medium
Icon
Larger than...
Exactly...
Any color
Full color

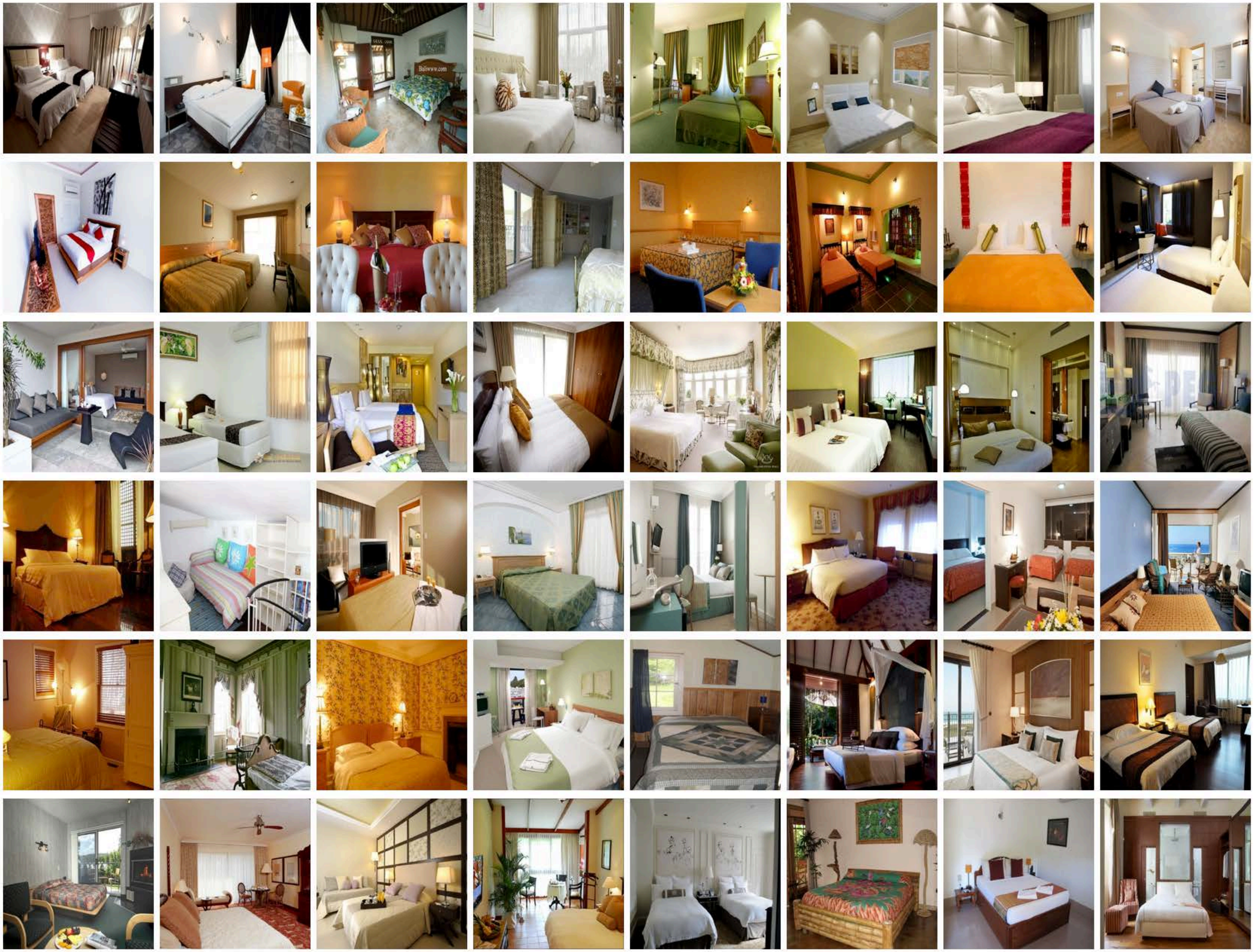
Improving diversity

abandoned, acceptable, accessible, additional, adjacent, advertised, affordable, air-conditioned, alternative, american, amusing, ancient, antique, appealing, appropriate, architectural, asian, astonishing, astounding, attractive, austere, authentic, available, average, awesome, beautiful, beguiling, beloved, best, better, better-known, big, bigger, biggest, bizarre, black, black-and-white, bland, boring, breezy, brick-built, bright, brighter, brightest, brilliant, broken, busiest, business-like, bustling, busy, central, centralized, certain, changed, changing, charming, cheap, cheaper, cheapest, cheerful, cheerless, cheery, cherished, chilling, chilly, civilized, classic, classical, clean, cleaner, clear, clearer, clinical, closer, closest, closing, cloudy, coastal, cold, coldest, colourful, comfortable, comforting, comfortless, comfy, common, comparable, comparative, competitive, complementary, complete, complex, complicated, concealed, conceivable, confined, considerable, contemporary, cool, coolest, cosmopolitan, cost-effective, cosy, cozy, cream-white, creative, crowded, cultivated, cultural, current, damp, dangerous, dark, darkened, darker, darkest, decorative, delightful, designated, designed, desirable, desired, desolate, desolated, different, difficult, dilapidated, dim, dimly-lit, dingy, dirty, disadvantageous, disorderly, do-it-yourself, domestic, double, double-fronted, double-length, downtown, drab, dreadful, driest, dry, dual, dull, duller, dullest, dusty, early, economic, economical, elegant, embarrassing, empty, enormous, especial, european, everyday, exciting, exemplary, exotic, exterior, external, extraordinary, extravagant, familiar, famous, fancy, fantastic, far-away, fascinating, fashionable, fashioned, favourable, fictional, fictitious, filmed, filthy, fine, foggy, foreign, formal, fractured, friendly, frightening, frightful, frosty, frozen, frustrating, full, funny, furnished, fuzzy, gaudy, ghastly, ghostly, glamorous, glassy, glazed, glittering, gloomy, glorious, glossy, godlike, gold-plated, good, gorgeous, graceful, gracious, grand, gray, great, greatest, green, greener, grey, grisly, gruesome, habitable, habitual, handy, happy, harmonious, harrowing, harsh, hazardous, healthful, healthy, heart-breaking, heart-rending, heavy, hideous, hiding, higgledy-piggledy, high, hilarious, historic, historical, holiest, home, horizontal, hospitable, hostile, hot, huge, humid, idyllic, illegal, imaginary, immaculate, immense, imminent, immortal, impassable, impassioned, impersonal, important, impossible, impressive, improbable, improper, inauspicious, inconceivable, inconvenient, incredible, independent, individual, indoor, industrial, ineffable, inexpensive, informal, inhabited, inhospitable, initial, innovatory, innumerable, insecure, insignificant, inspiring, integrated, intentional, interesting, intermediate, internal, international, intimidating, intriguing, inviting, irrational, irregular, isolated, joint, joyful, key, known, large, large-scale, largest, less-favored, lesser, licensed, lifeless, light, limited, little, little-frequented, little-known, lively, living, local, lofty, logical, lone, long, long-awaited, long-forgotten, long-inhabited, long-netting, long-stays, long-term, lost, lousy, lovely, low, low-ceilinged, low-cost, low-energy, lower, lucky, luxury, magical, magnificent, main, majestic, major, marginal, marine, marvellous, massive, masterful, maximum, mean, meaningless, mechanised, medieval, mediocre, medium-sized, melancholy, memorable, messy, middle, middle-order, mighty, miniature, minor, miserable, missing, misty, mixed, modern, moist, mouldy, mountainous, moving, muddy, multi-functional, multiple, mundane, murky, musty, muted, mysterious, mysterious-looking, mystic, mystical, mythic, naff, named, nameless, narrow, national, native, natural, naturalistic, nearby, neat, necessary, neglected, neighboring, new, nice, night-time, nineteenth-century, noisy, nondescript, normal, northern, notable, notorious, numerous, odd, odorous, official, old, only, open, open-air, operatic, orderly, ordinary, organic, original, ornamental, out-of-homes, out-of-the-way, outdoor, outlying, outside, outstanding, over-crowded, overgrown, overwhelming, paid, painful, painted, palatial, pastoral, peaceful, peculiar, perfect, periodic, peripheral, permanent, permitted, personal, petty, pictorial, picturesque, pitiful, placid, plain, planted, pleasant, pleasing, poisonous, poor, popular, populated, populous, positive, possible, post-war, posterior, postmodern, potential, powerful, practical, pre-arranged, pre-eminent, precise, predictable, present, present-day, preserved, pretty, previous, pricey, primal, prior, private, privileged, probable, professional, profitable, promising, proven, public, pure, queer, quiet, rainy, rare, real, realistic, reasonable, rebuilt, recent, recognized, recommended, reconstructed, recreated, recurring, red, red-brick, redundant, refused, regional, regular, related, relative, relaxing, relevant, reliable, religious, remaining, remarkable, remote, rented, representative, reputable, required, reserved, residential, respectable, respected, restful, restless, restricted, retail, rich, ridiculous, right, rigid, river-crossing, rocky, romantic, rural, sacred, sad, safe, salubrious, satisfying, scary, scattered, scenic, scientific, secondary, secret, secured, selected, senior, separated, serious, sexy, shiny, shocking, shoddy, short-term, significant, silent, silly, similar, simple, single, sizable, slack, small, smelly, smoke-free, smoking, snowy, sobering, soft, solid, sombre, soothing, sophisticated, sorrowful, sound-filled, southern, spare, spatial, special, specialized, spectacular, sporting, stable, standard, static, steady, stifling, strange, stressful, striking, stunning, stupendous, stupid, stylish, successful, sufficient, sunny, super, superb, superior, surrealistic, suspicious, symbolic, teenage, terrible, terrific, theoretical, thrilling, thriving, tidier, tight, tiny, tough, tragic, unattractive, unbelievable, uncertain, unchanging, uncharted, uncivilized, uncomfortable, unconventional, underground, underwater, undisturbed, uneven, unexpected, unfamiliar, unforgettable, unfriendly, unhappy, unhealthy, unimportant, unknown, unnatural, unnecessary, unparalleled, unpleasant, unsafe, unseemly, unsuitable, unusual, upmarket, urban, vague, valuable, varied, various, vertical, very, vibrant, virtual, visual, vital, vivid, voluntary, vulgar, vulnerable, wacky, waiting, warm, wealthy, weeping, weird, weird-looking, well-assured, well-defended, well-designed, well-hidden, well-insulated, well-known, well-lit, well-loved, well-ordered, well-organized, well-secured, well-sheltered, well-used, wet, white, whole, wicked, wide, widespread, wild, windy, wintering, wonderful, wondrous, wooded, wordless, working, worldly, worldwide, worst, worthwhile, worthy, wretched, wrong, young, yucky,

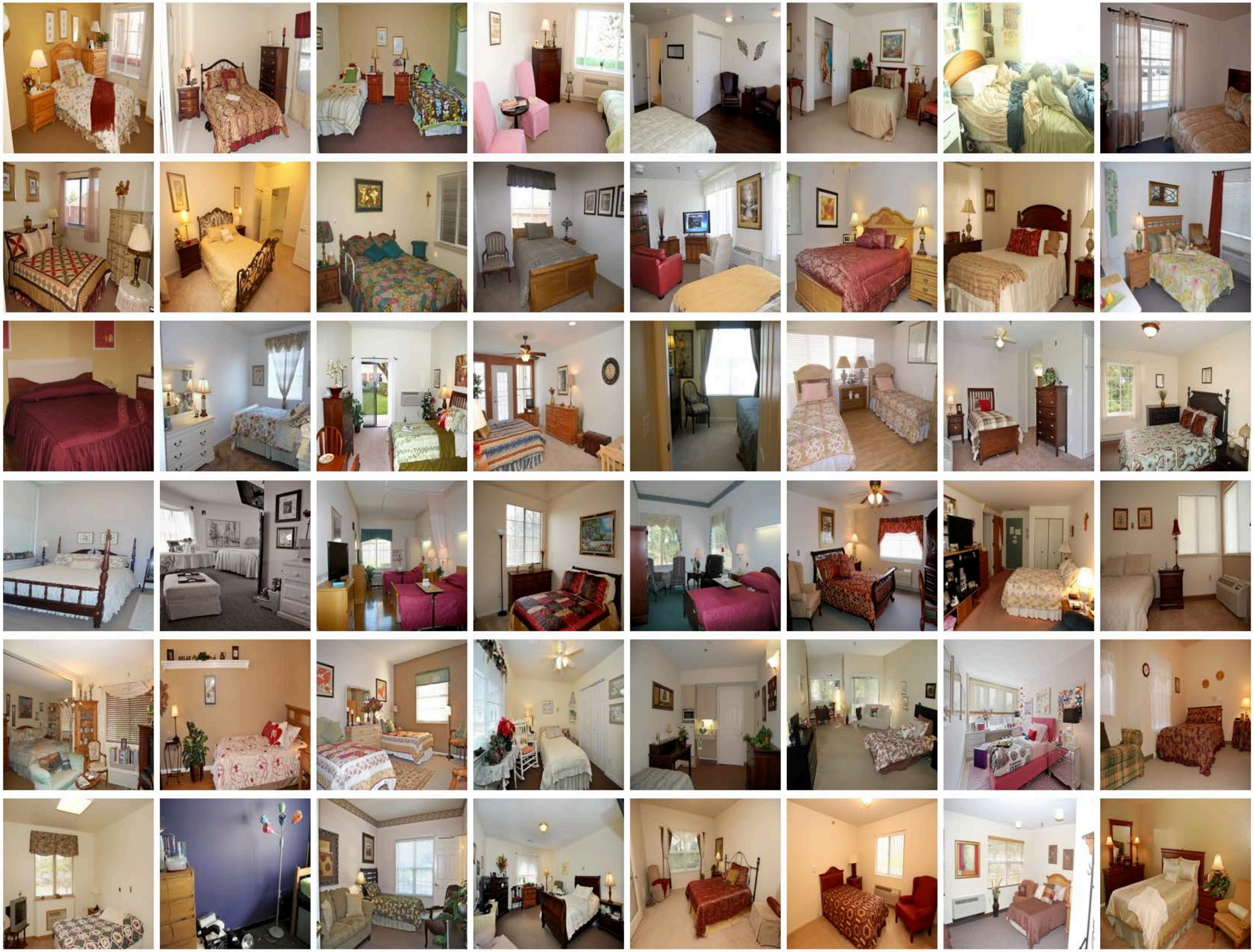
simple bedroom:476



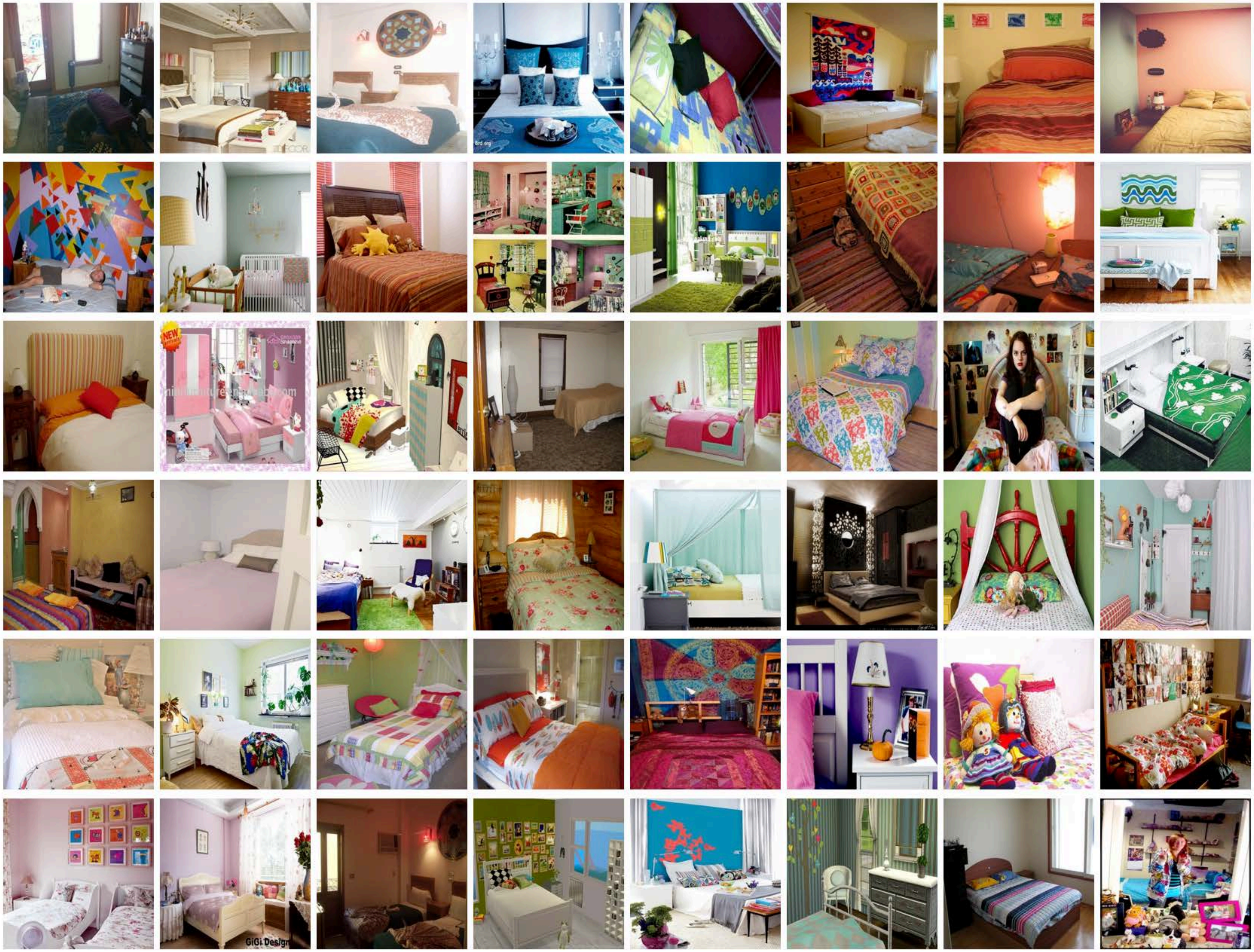
superior bedroom:423



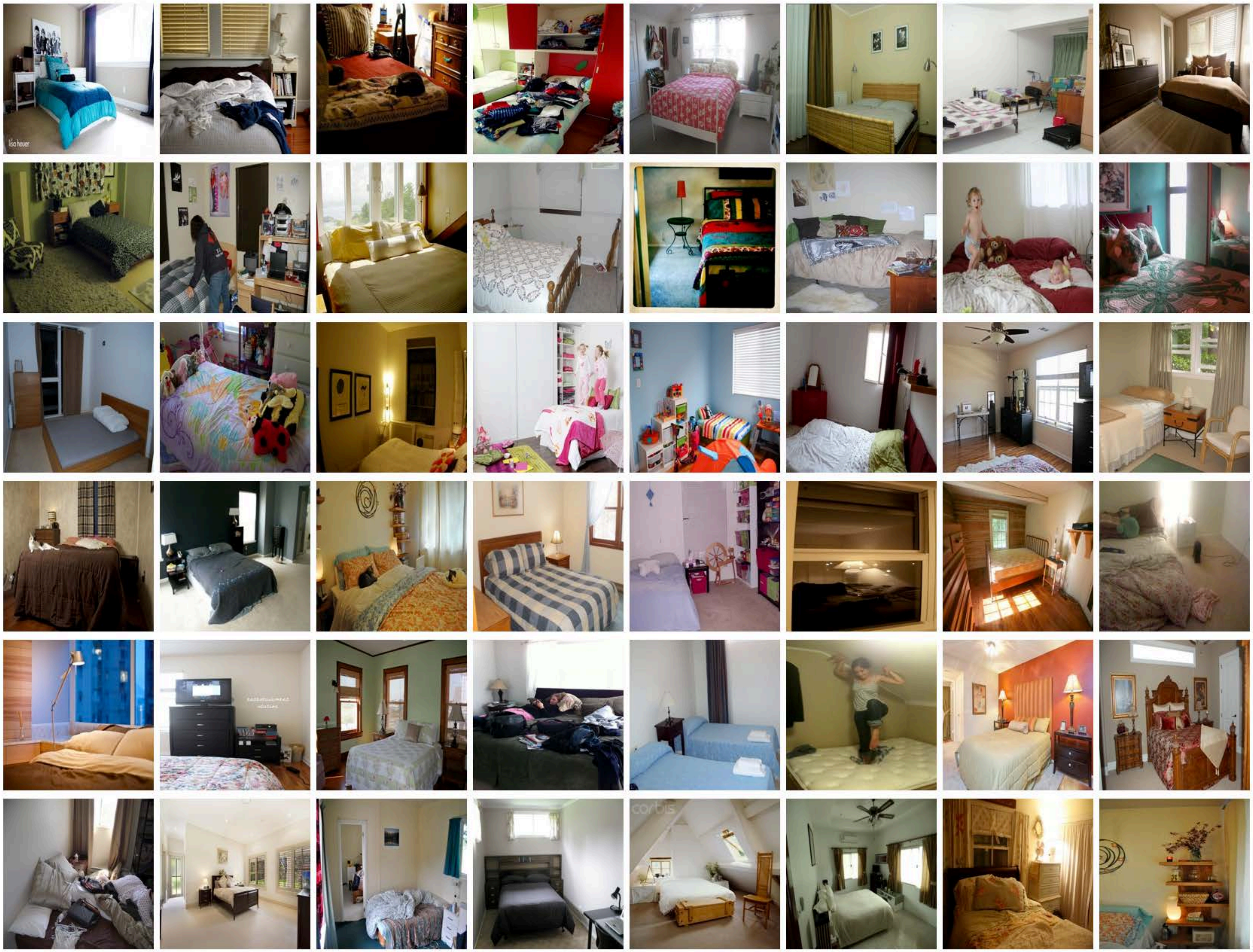
senior bedroom:319



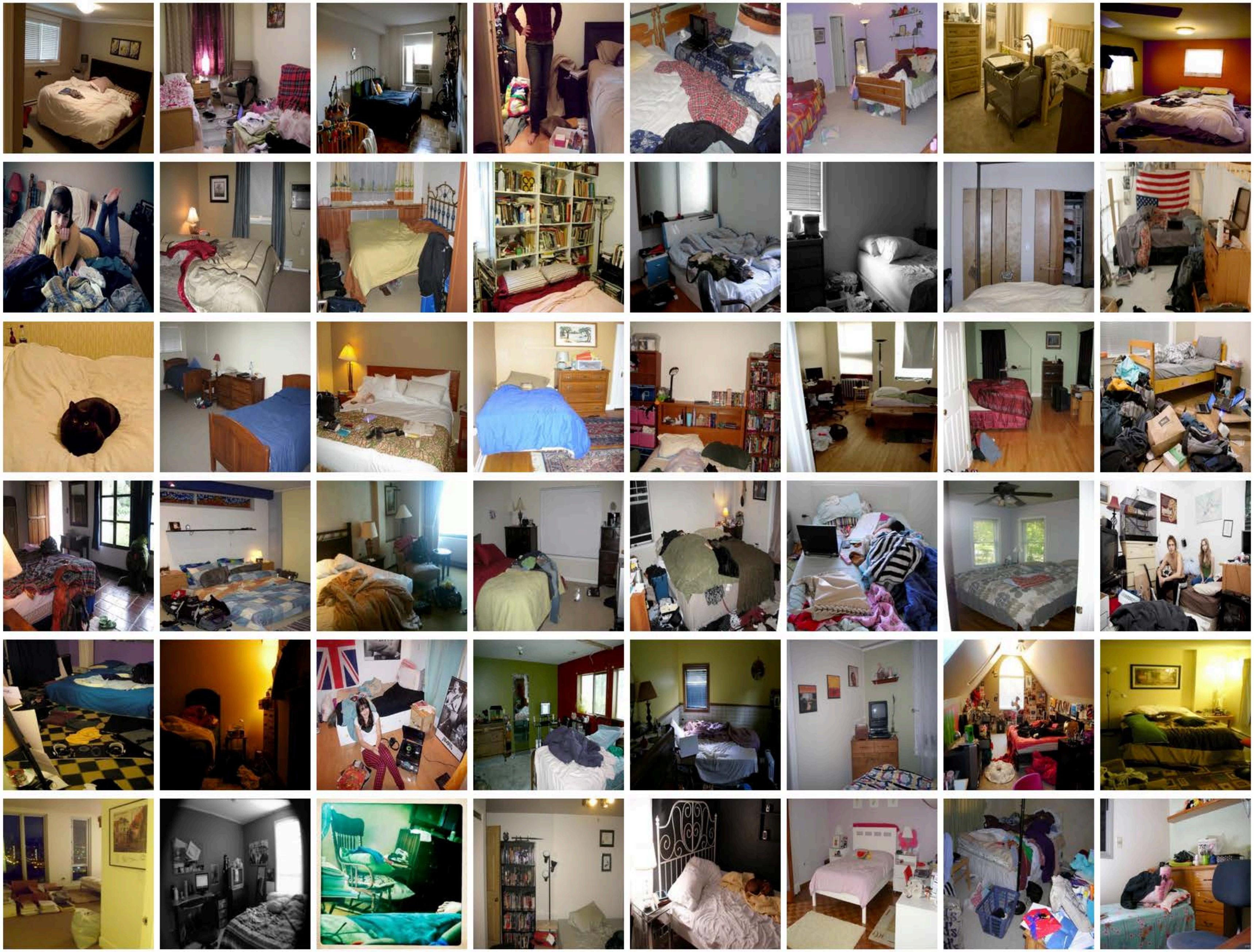
colourful bedroom:209



cleaner bedroom:205



messy bedroom:808



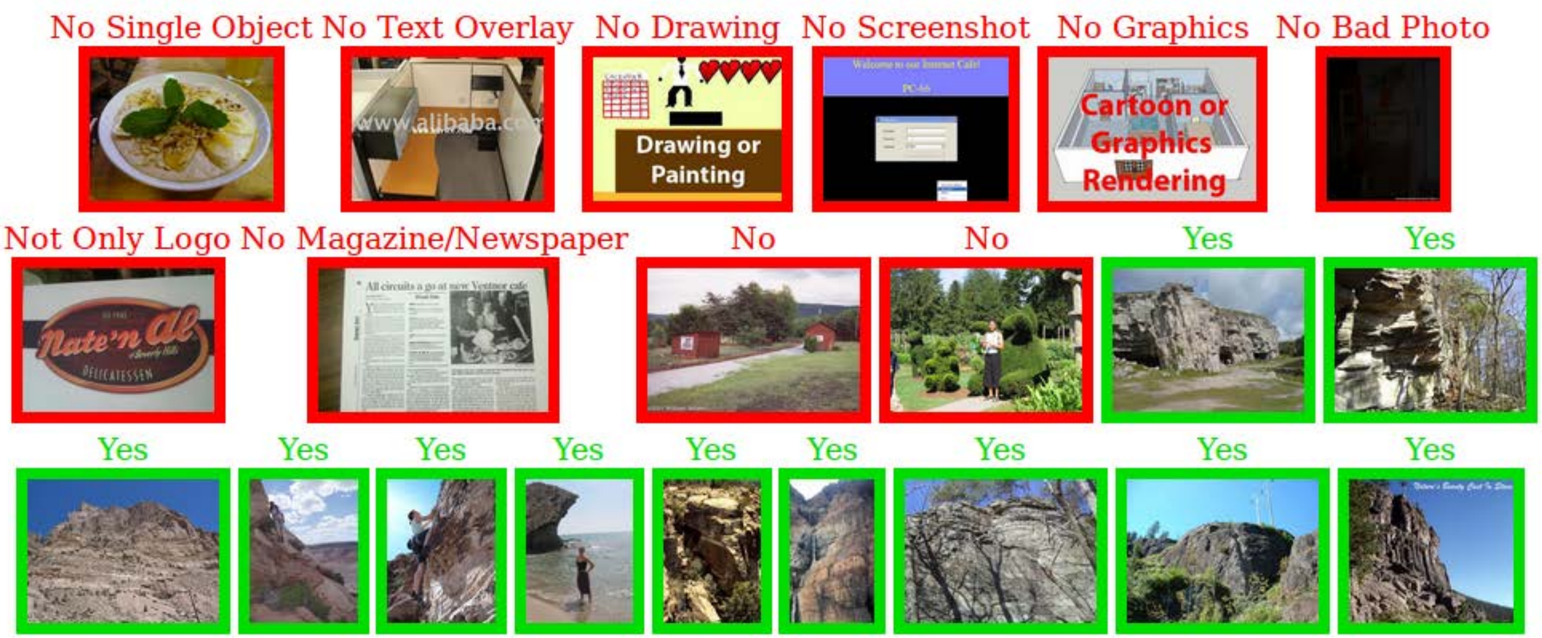
Start

Is this a cliff scene?

Definition: a high, steep or overhanging face of rock.

Task

For each of the **810** images, answer yes or no to the above question. Only answer **Yes** to **real photos**. Always answer **No** to **cartoon**, **drawing**, **CG rendering**, or real photos with a **large text overlay** on the photo. Here are some examples:



Amazon Mechanical Turk:
Single Image Classification

Amazon Mechanical Turk:

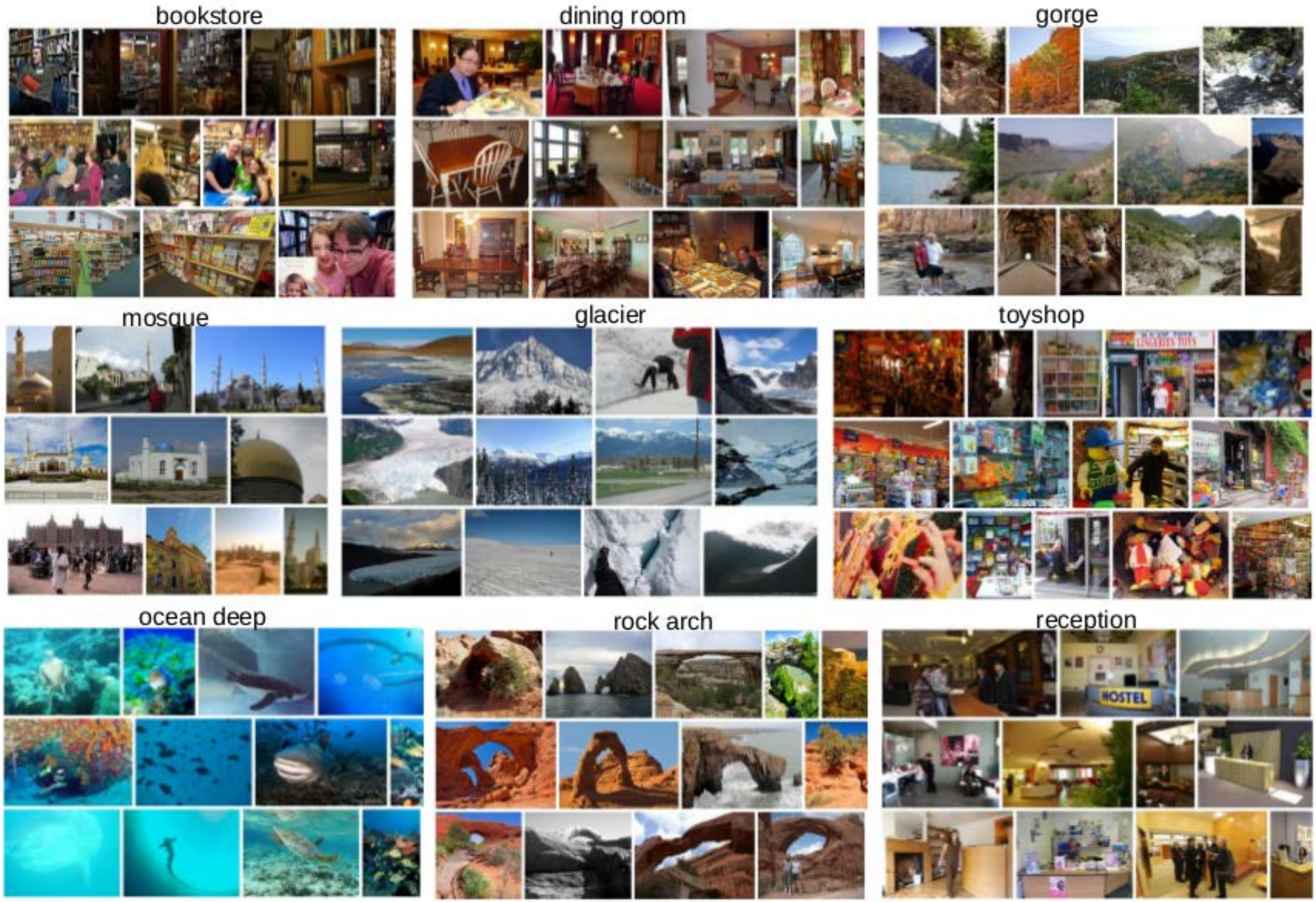
Single Image Classification

Instruction **Is this a cliff scene?** Submit (790 images left)

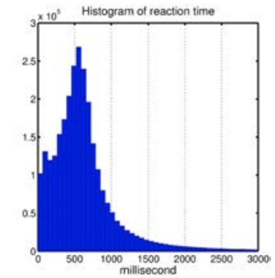
Definition: a high, steep or overhanging face of rock.

Amazon Mechanical Turk:

Single Image Classification – Second


bookstore
dining room
gorge
mosque
glacier
toyshop
ocean deep
rock arch
reception

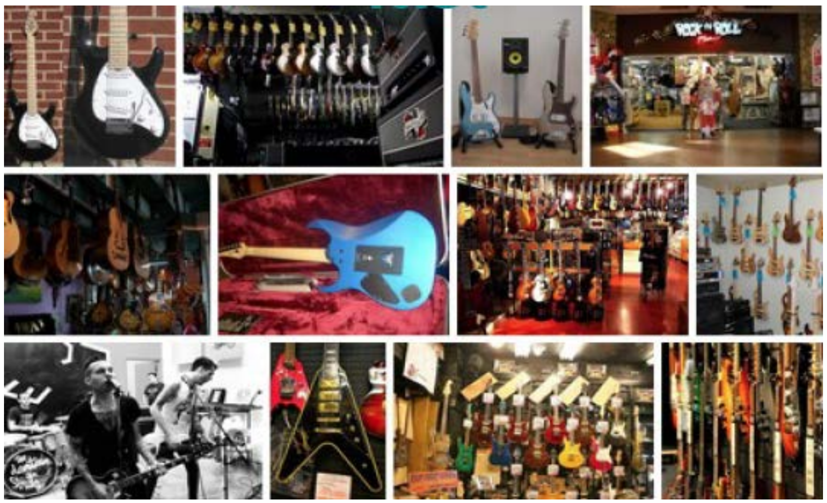
A signature of Prototypicality



Fast RT

Slow RT

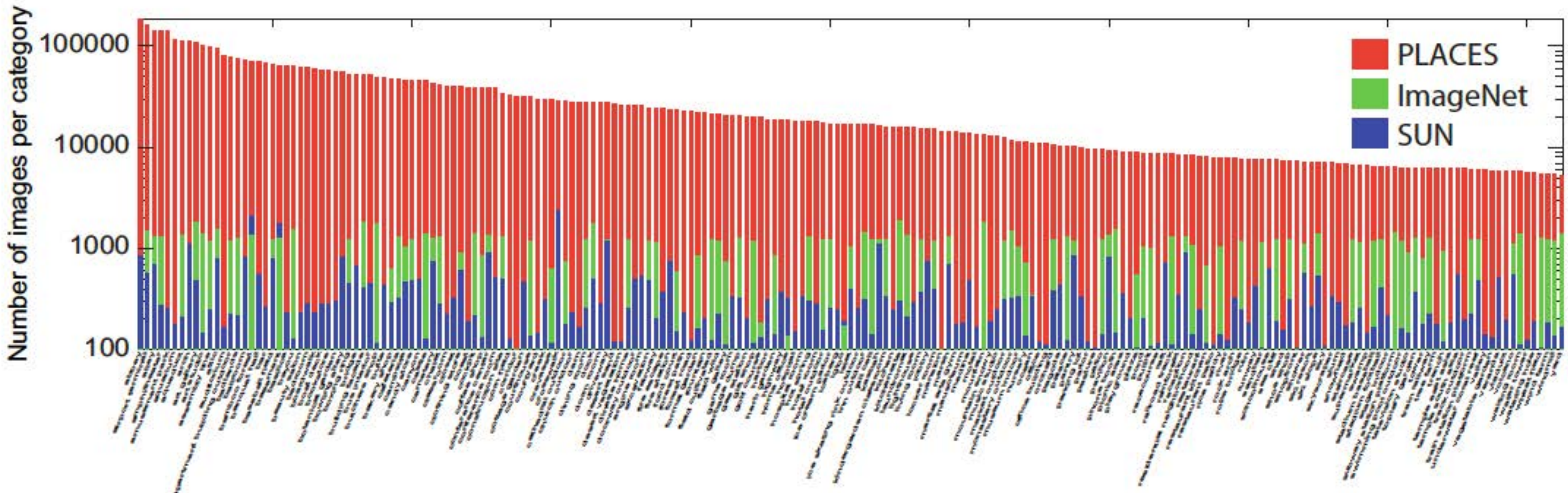
Music Store



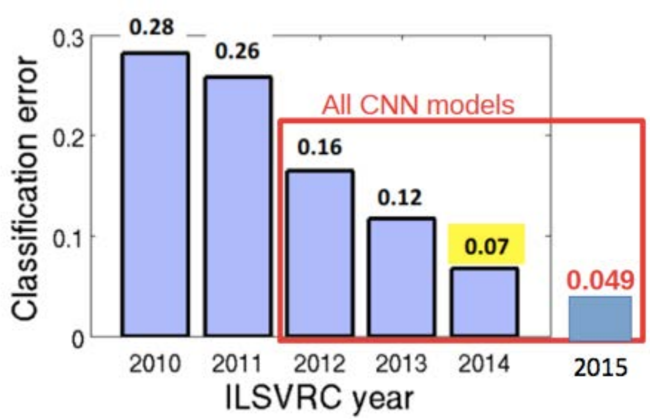
Phone Booth


High coverage across categories
bookstore
dining room
gorge
mosque
glacier
toyshop
High diversity within category
spare bedroom
messy bedroom
teenage bedroom
romantic bedroom
crazy bedroom

places



IMAGENET

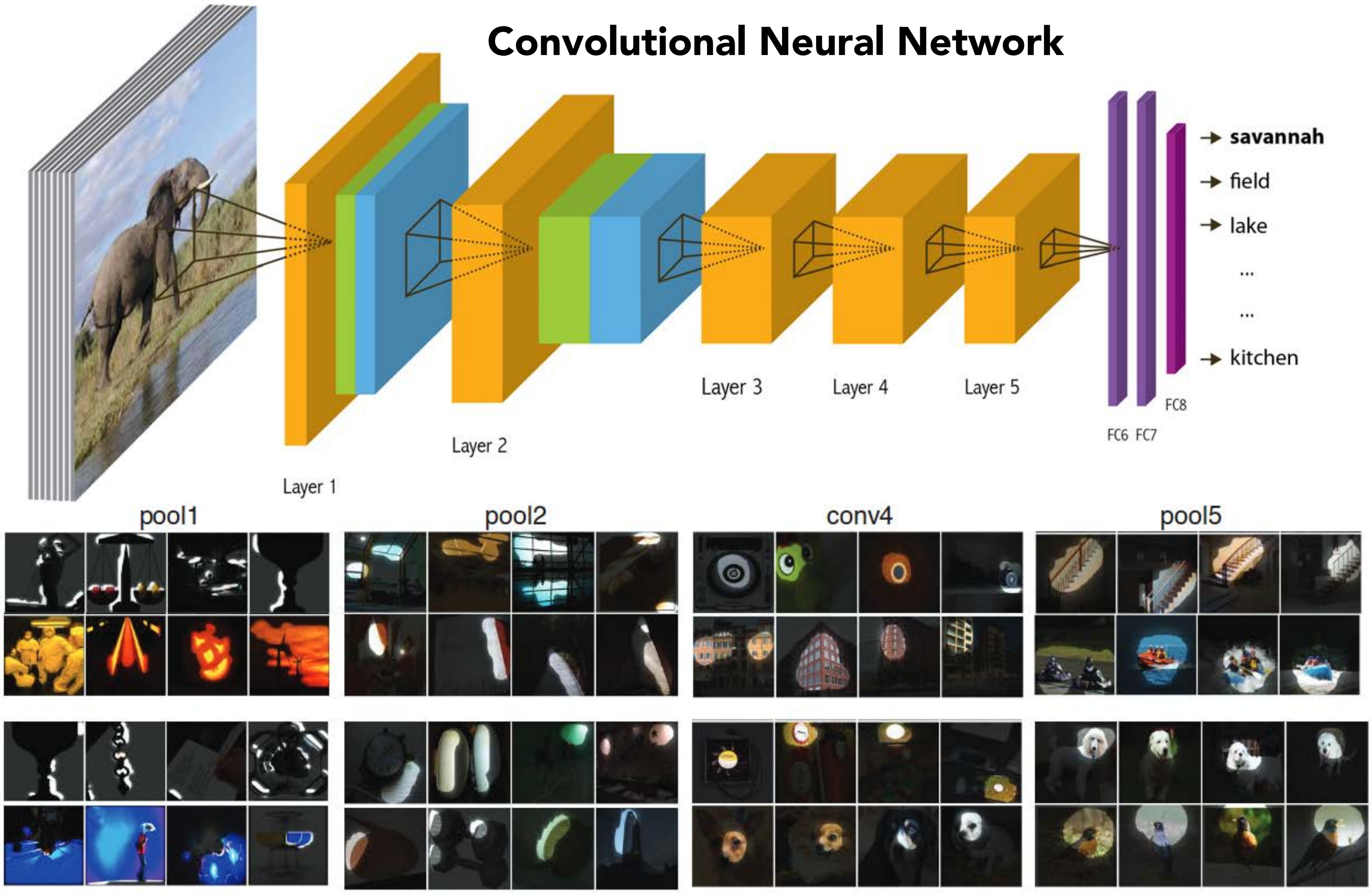


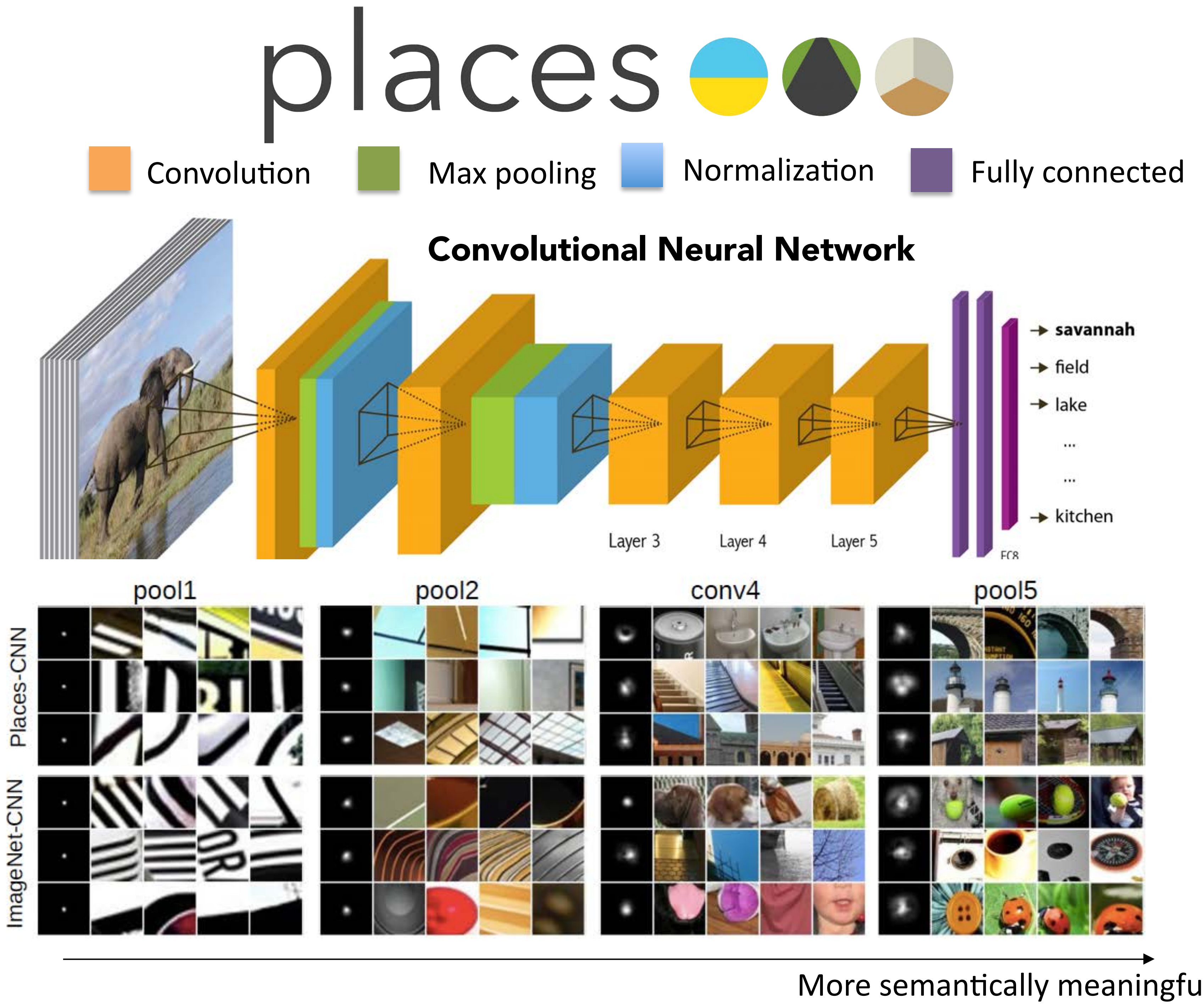
places

Nov 2015: Top 5 error: 25%

places

Convolution Max pooling Normalization Fully connected




places
Convolution
Max pooling
Normalization
Fully connected
Convolutional Neural Network
savannah
field
lake
...
...
kitchen
Layer 3
Layer 4
Layer 5
pool1
pool2
conv4
pool5
Places-CNN
ImageNet-CNN
More semantically meaningful

Mini Place challenge: 100 categories

readme.txt

- Training data (100K - 1000 images per category), Validation data (10K, 100 images per category), Test data (10K – 100 images per category). Jpeg, 128 * 128
- Object annotations for a subset of the images – 3503 train images and 371 validation images
- The evaluation server available from Tuesday Nov 24 – submit your prediction of the test set for final evaluation and ranking in the challenge leaderboard. Open until Dec 1.
- Errors with 5 guesses will be used to rank the results and determine the winner

Mini Place challenge

Examples of things to do

- Train different types of classifiers such as classifiers on objects and scenes to improve scene classification
- Train a variety of networks and try ensemble methods (combine outputs from various networks trained with different random seeds and/or also networks with different architectures)
- Try averaging the prediction from multiple crops
- Try different architectures of deep networks on mini places dataset (different numbers of units per layer, types of activation functions for neurons for different layers, provide supervision to intermediate layers)
- Try out different learning parameters (i.e., learning rate, weight decay, momentum and so on) to maximize performance