

Artificial Intelligence and Machine Learning

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Today

- Course Overview & Logistics
- What is AI?
- Brief history of AI (1950 - today)
- What makes AI hard?
- What is ML?
- AI/ML-related jobs
- Linear Algebra Review

Course Goals

- ศึกษาเกี่ยวกับ ปัญญาประดิษฐ์ และ การเรียนรู้ของเครื่อง
 - ประวัติความเป็นมาของ AI
 - การเรียนรู้ของเครื่อง (**Machine Learning**)
 - การเรียนรู้แบบมีผู้สอน/ไม่มีผู้สอน (**Supervised/Unsupervised Learning**)
 - การเลือกแบบจำลอง (**Model Selection**)
 - การลดขนาดมิติข้อมูล (**Dimensionality Reduction**)
 - โครงข่ายประสาทเทียม (**Neural Networks**)
- ควรลงมาก่อน: Data Structure, Prob & Stats, Calculus

Topics to be covered

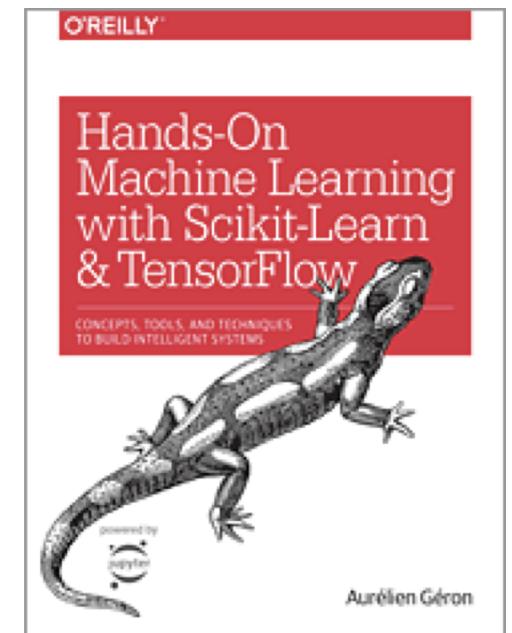
- Supervised Learning
- K-Nearest Neighbors (k-NN)
- Model Selection, Bias-Variance Trade-off, Cross Validation
- Linear Regression
- Logistic Regression
- Decision Tree
- SVM

===== MIDTERM =====

- Decision Tree
- Neural Networks
- CNN, RNN
- Reinforcement Learning
- Classical AI: Searching

Tools

- Language: Python (Scikit-learn, Keras/Tensorflow)
- Book: Hands-On Machine Learning with Scikit-Learn & Tensorflow
- Course site: https://pratch.github.io/ml_course/
- LINE

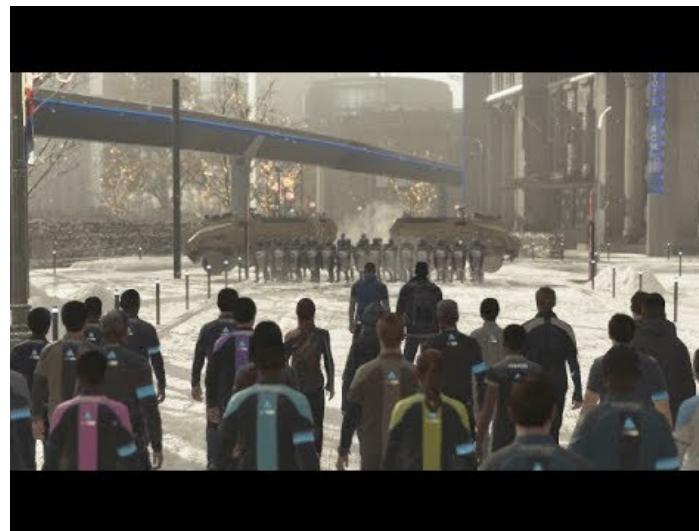
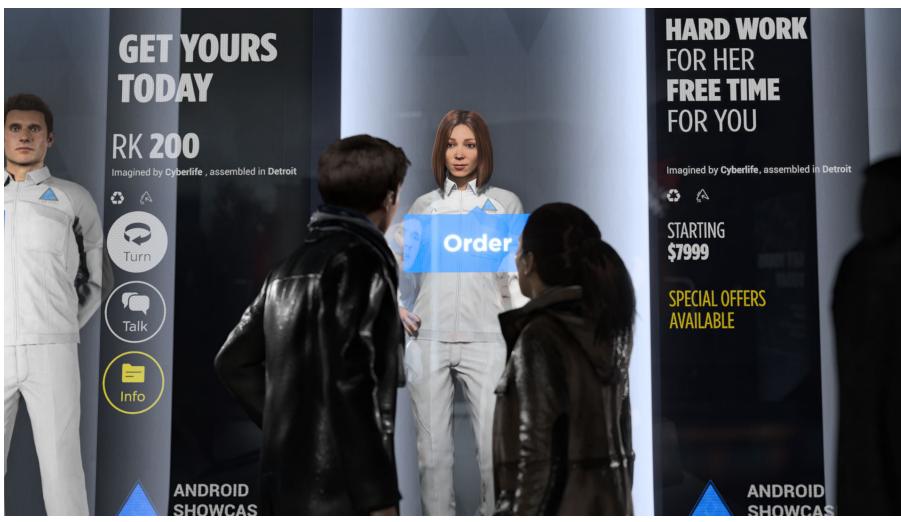


Grading

- Programming (40%)
- Midterm (25%)
- Final (25%)
- Attendance (10%)

What is Artificial Intelligence (AI)?

- Study of how to make machines do tasks that require human intelligence
 - Such machines are called “Intelligent Agents”
- Goal (debatable)
 - Do we want a machine that perfectly mimics human?
 - Also making the same mistakes as human
 - Do we want a machine that thinks and acts rationally?
 - Always maximizing the chance of achieving a goal

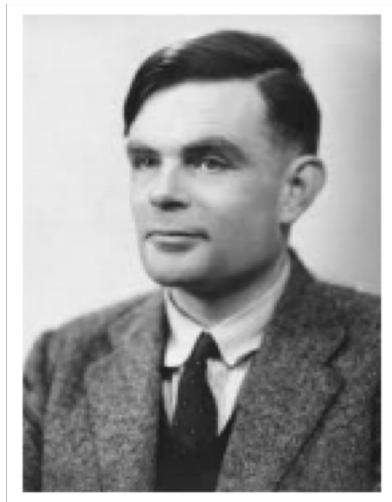


Strong AI vs Weak AI

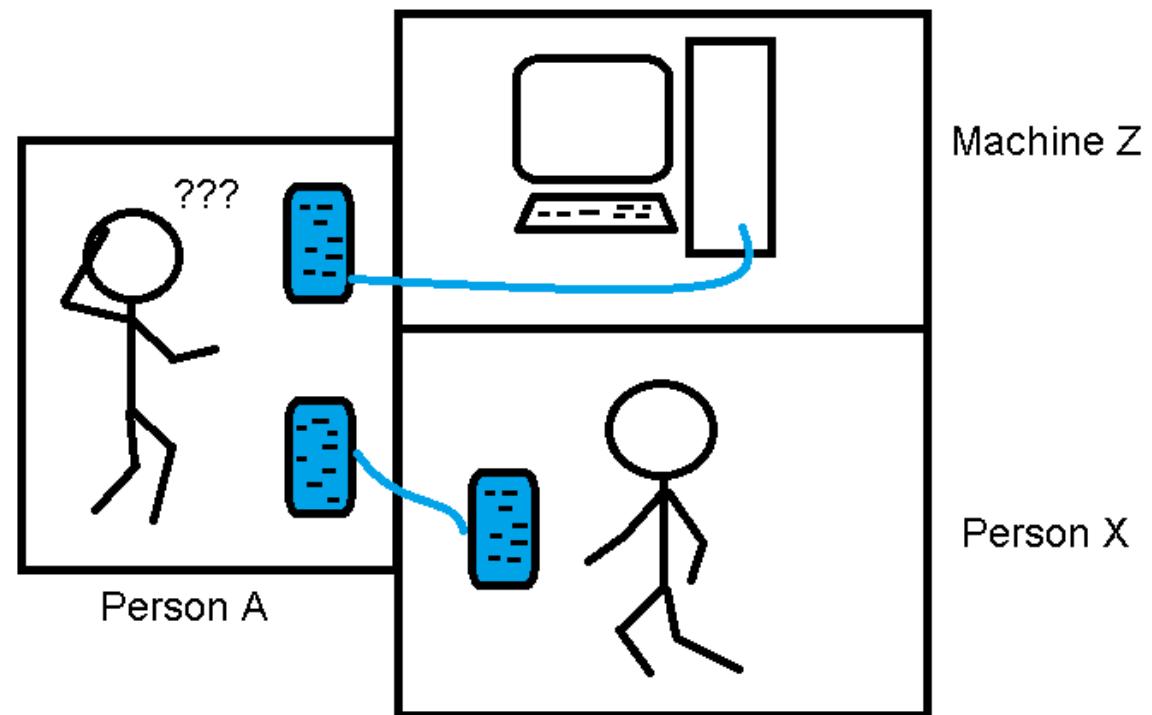
- **Strong AI** (Artificial General Intelligence) is the AI that can perform all tasks as well as or better than human
 - Reasoning
 - Learning
 - Planning
 - Communicating

Strong AI vs Weak AI

- **Turing Test** is a simple test to see if a machine has achieved general intelligence



Alan Turing, 1950

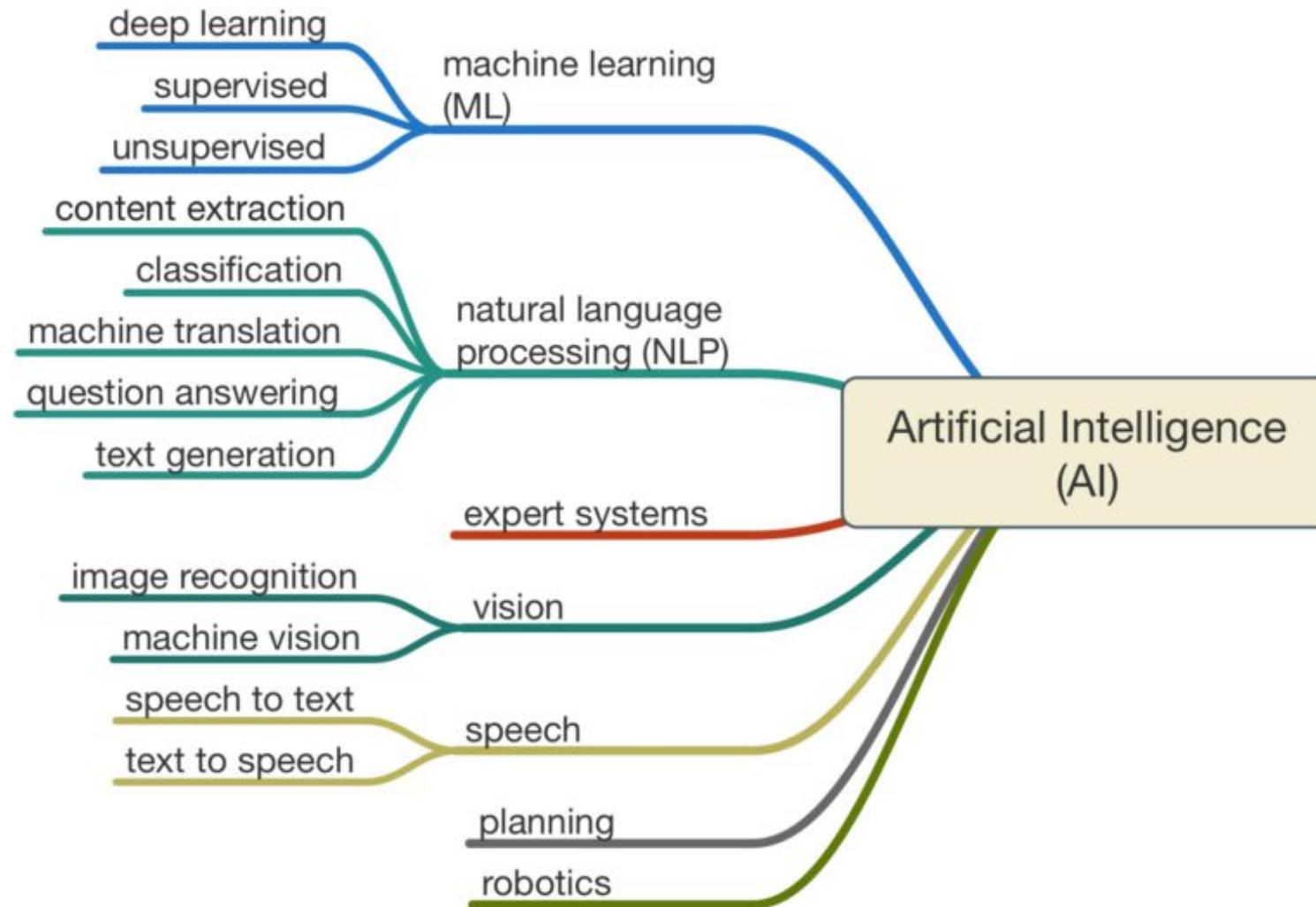


Strong AI vs Weak AI

- **Weak AI** (Narrow AI) is the AI that focuses on only **one** task, e.g.
 - Image Recognition
 - Translation
 - Playing Chess, Atari games
- Most of AI today are considered weak
- This course mostly concerns with weak AI

Branches of AI

<http://www.legalexecutiveinstitute.com/artificial-intelligence-in-law-the-state-of-play-2016-part-1/>



Brief History of AI

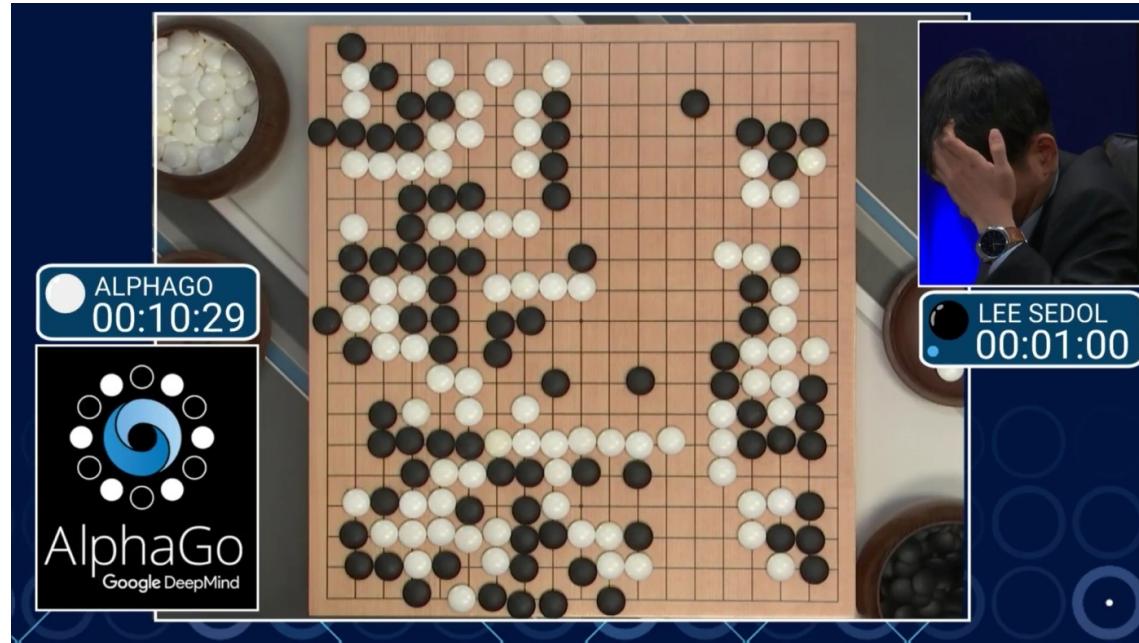
- 700 BC เทพนิยายเกี่ยวกับ Hephaestus ผู้สร้างหุ่นยนต์ Talos
- 400 BC อริสโตเตลคิดค้นศาสตร์การให้เหตุผลเชิงตรรกية (formal reasoning)
- 1837 Charles Babbage/Ada Lovelace สร้างเครื่องคำนวณสั่งงานผ่านโปรแกรม
- 1943 Warren McCulloch คิดค้นแนวคิดเกี่ยวกับ Neural Network
- 1950 Alan Turing คิดค้น Turing Test สำหรับวัดความฉลาดของ AI
- 1955 กำหนดศาสตร์ “AI” (โดย John McCarthy ร่วมกับ Marvin Minsky)
- 1964 หุ่นยนต์คุยกับคนได้ ELIZA
- 1969 นักวิจัยทดสอบทิ้ง Neural Net เมื่อเจอข้อจำกัดของวิธี
- 1974-80 AI Winter ข้อจำกัดทางเทคนิคทำให้การพัฒนา AI หยุดชะงัก

Brief History of AI (cont.)

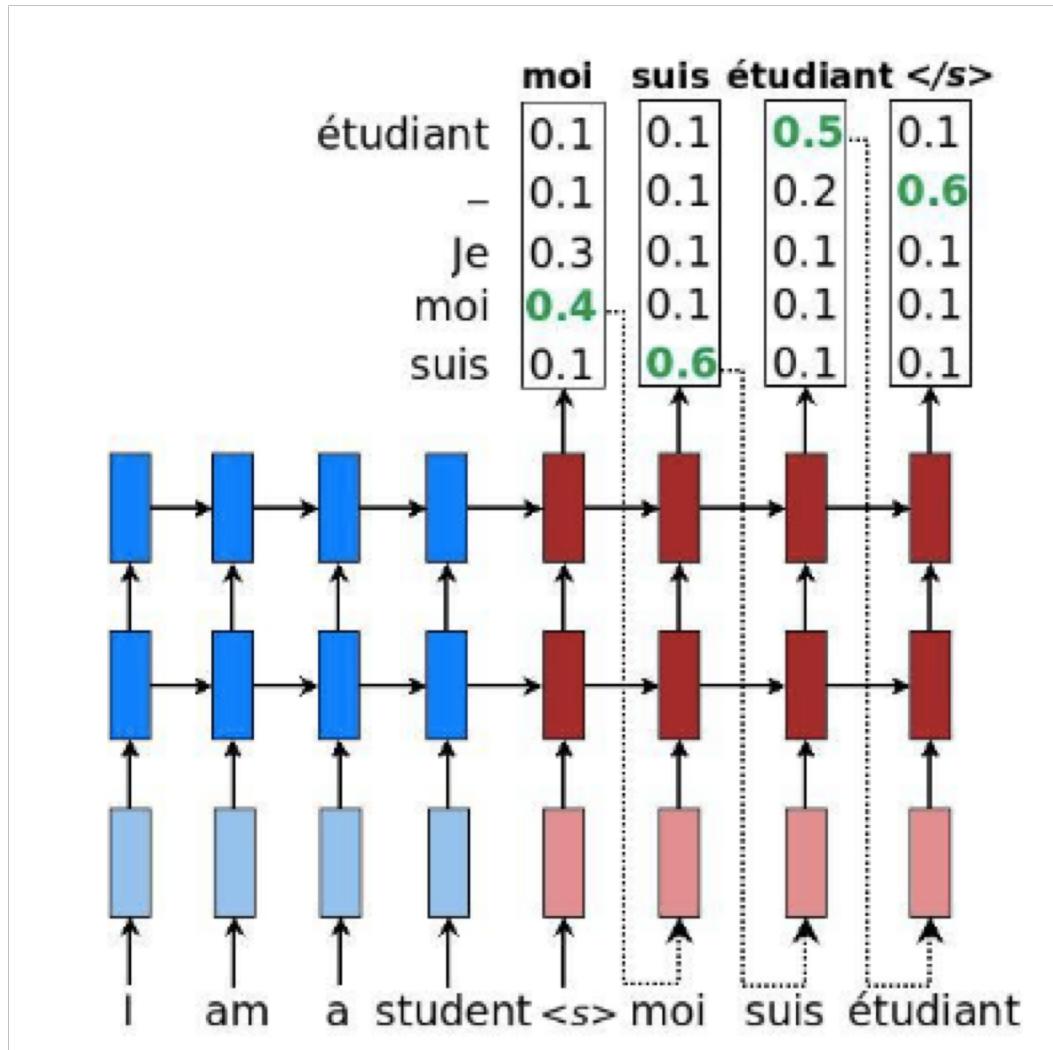
- 1980-87 ยุคของระบบผู้เชี่ยวชาญ (expert system) พัฒนาด้วยภาษา Lisp
- 1986 Neural Net กลับมาด้วยอัลกอริทึม Backpropagation
แต่ก็ແປ່ໄປໃນຊ່ວງປີ 2000
- 1997 Deep Blue ຂອງ IBM/CMU ເລີ່ມທຳກຽດກູກຈະແໜ່ງປິໂລກ Garry Kasparov
- 2009 Google ສ້າງ self-driving car
- 2011 IBM Watson ຈະແໜ່ງປິເກມ Jeopardy!
- 2012 AlexNet ຈະກາຣແຂງຂັ້ນ ImageNet ທຳให້ Neural Net ກລັບມາເພື່ອງຝູ

Today's AI

- In 2016, Google DeepMind's AlphaGo used **deep neural networks** and **reinforcement learning** to beat 9-dan professional Lee Sedol 4-1
- Beat World No. 1 Ke Jie in 2017



Machine Translation



<https://www.tensorflow.org/tutorials/seq2seq>

Drawing Classification

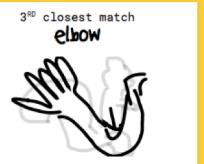
← Back

You were asked to draw squirrel

You drew this, and the neural net recognized it.

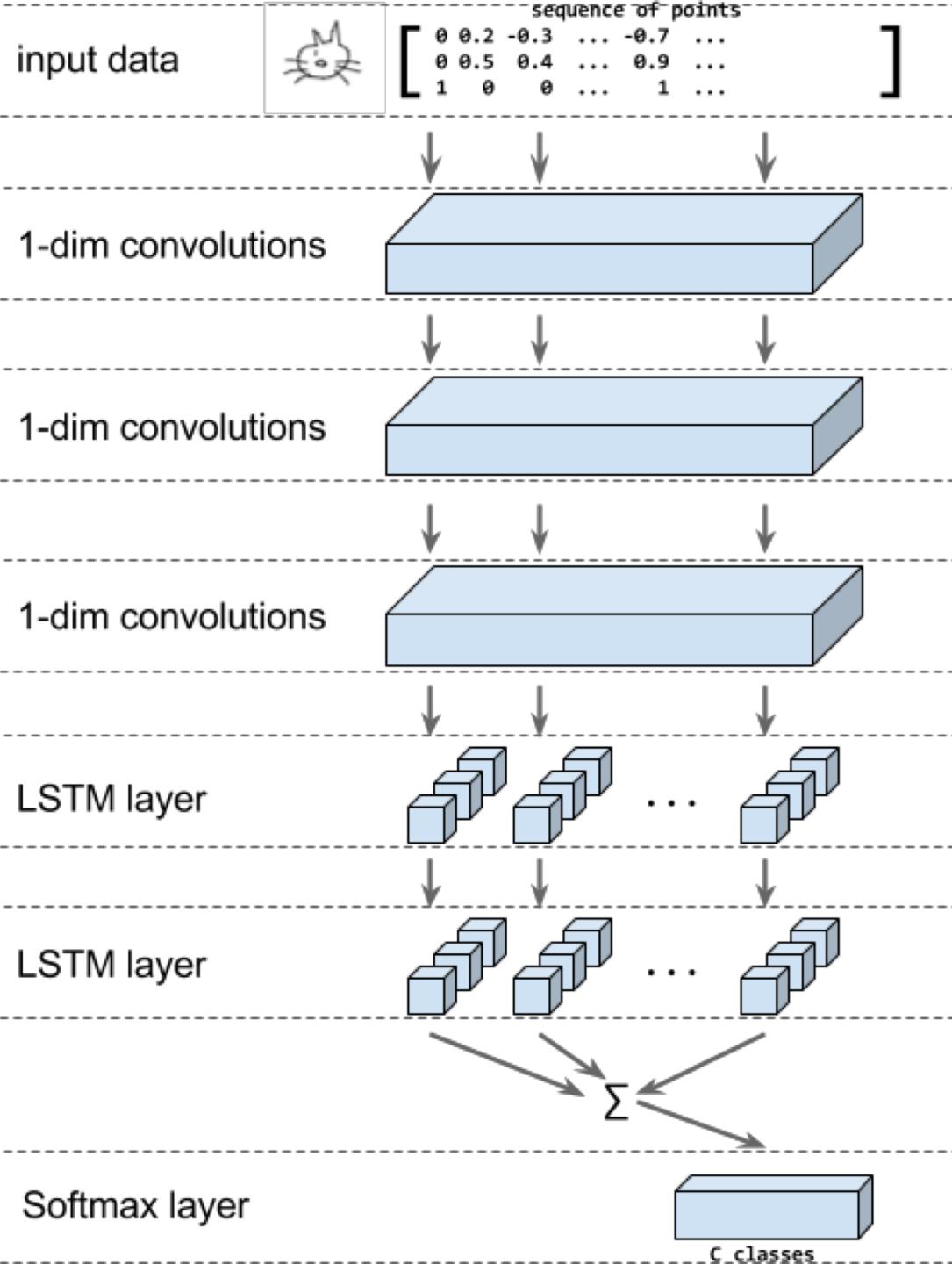


It also thought your drawing looked like these:

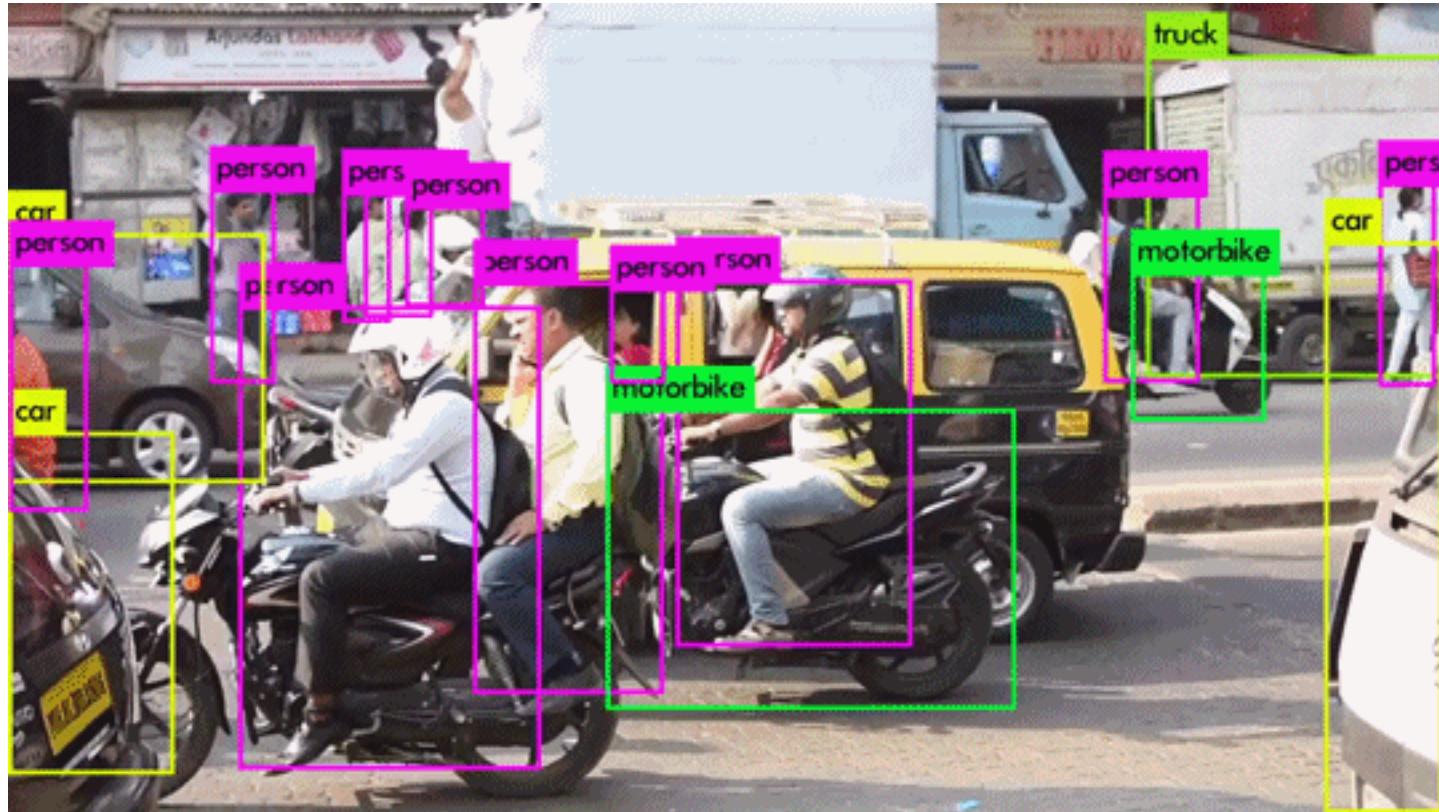


How does it know what squirrel looks like?
It learned by looking at these examples drawn by other people.

https://www.tensorflow.org/tutorials/recurrent_quickdraw
<https://quickdraw.withgoogle.com/data>

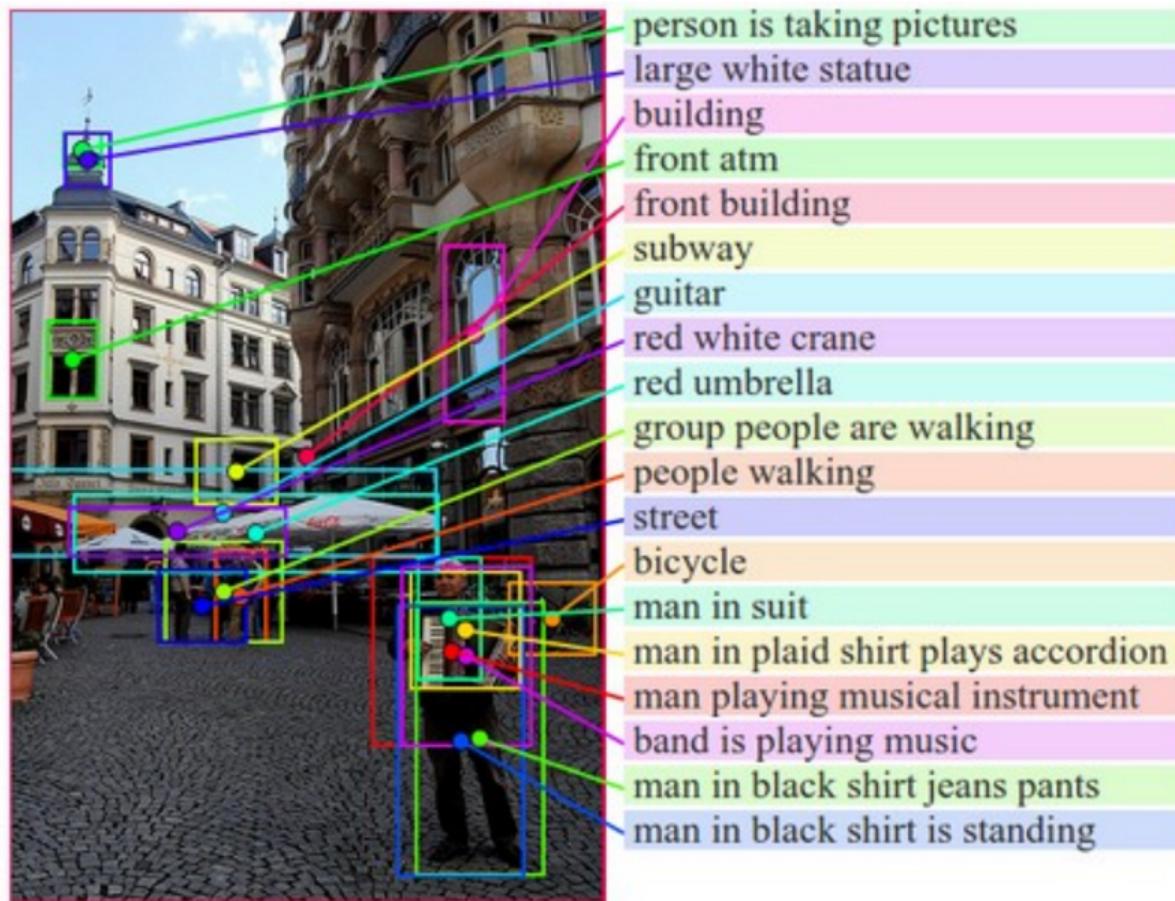


Real-time Image Recognition



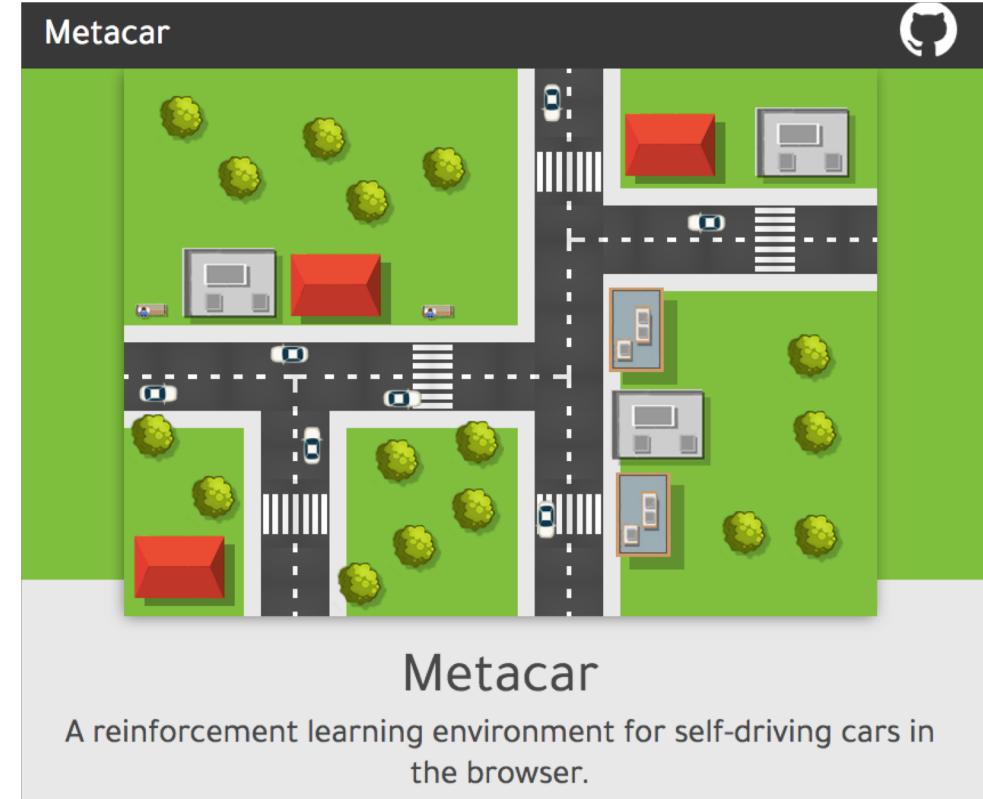
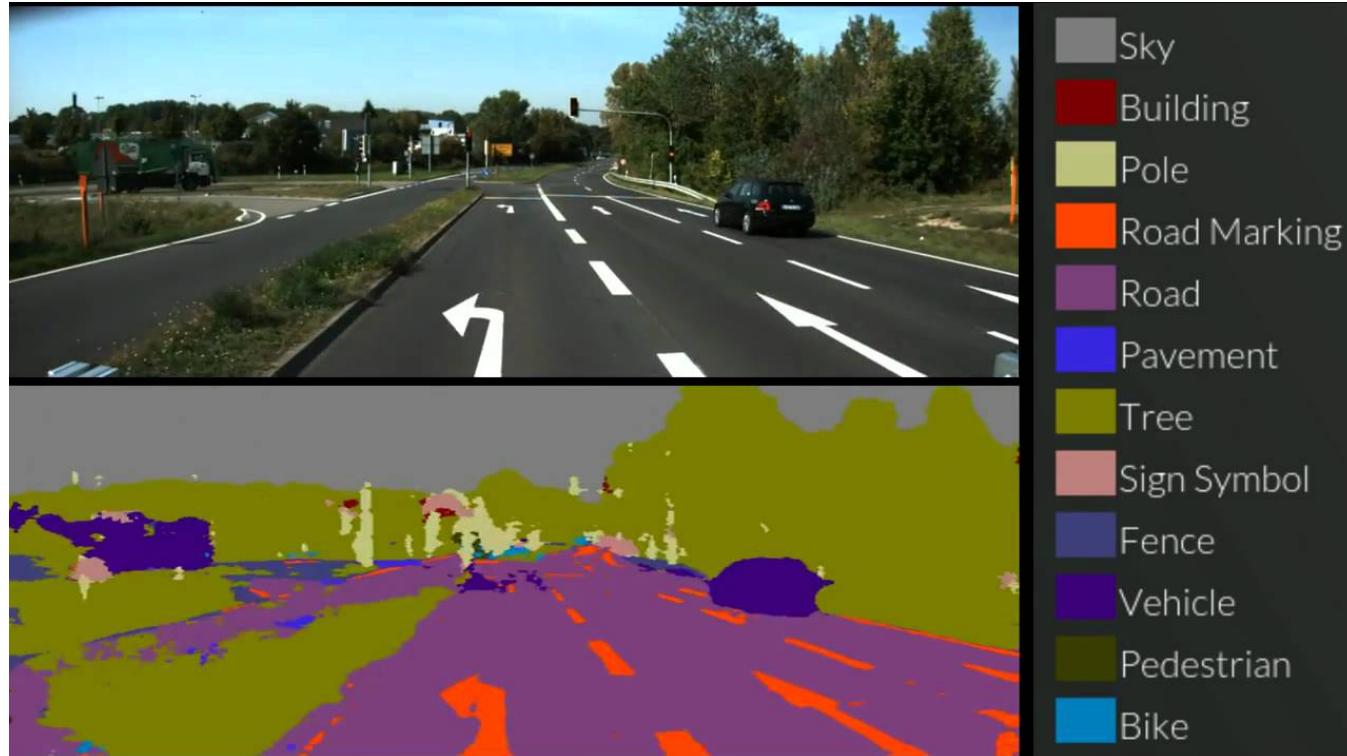
<https://pjreddie.com/darknet/yolo/>

Image Description



[Karpathy 2015] <https://cs.stanford.edu/people/karpathy/cvpr2015.pdf>

Self-Driving Cars



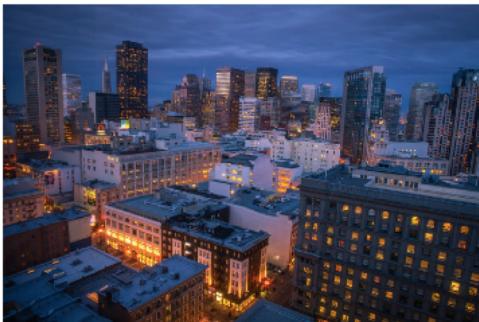
<https://www.metacar-project.com/>
<https://selfdrivingcars.mit.edu/>

Image Generation

Text description	This bird is red and brown in color, with a stubby beak	The bird is short and stubby with yellow on its body	A bird with a medium orange bill white body gray wings and webbed feet	This small black bird has a short, slightly curved bill and long legs	A small bird with varying shades of brown with white under the eyes	A small yellow bird with a black crown and a short black pointed beak	This small bird has a white breast, light grey head, and black wings and tail
64x64 GAN-INT-CLS [22]							
128x128 GAWWN [20]							
256x256 StackGAN							

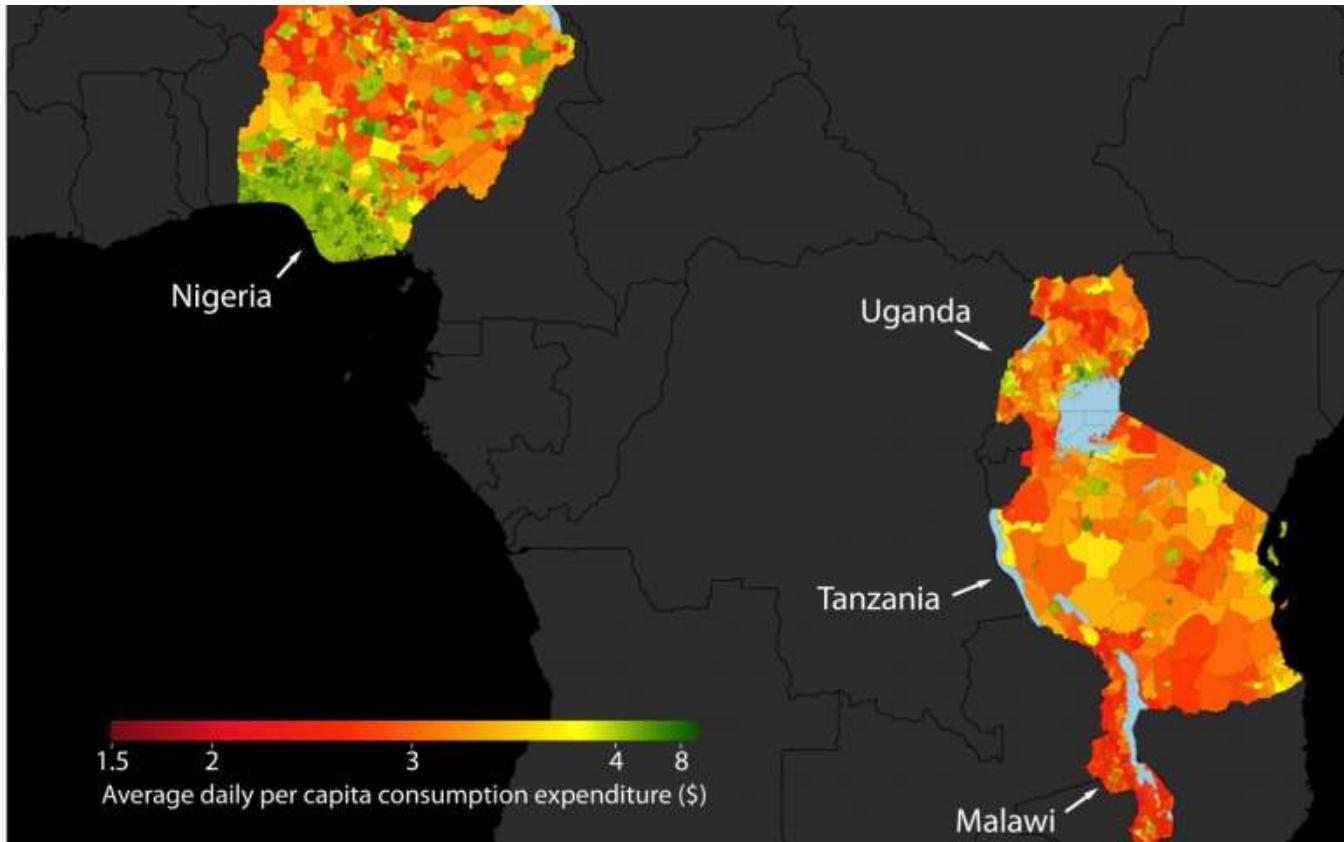
Figure 3. Example results by our proposed StackGAN, GAWWN [20], and GAN-INT-CLS [22] conditioned on text descriptions from CUB test set. GAWWN and GAN-INT-CLS generate 16 images for each text description, respectively. We select the best one for each of them to compare with our StackGAN.

Art Style Transfer



<https://github.com/fzliu/style-transfer>

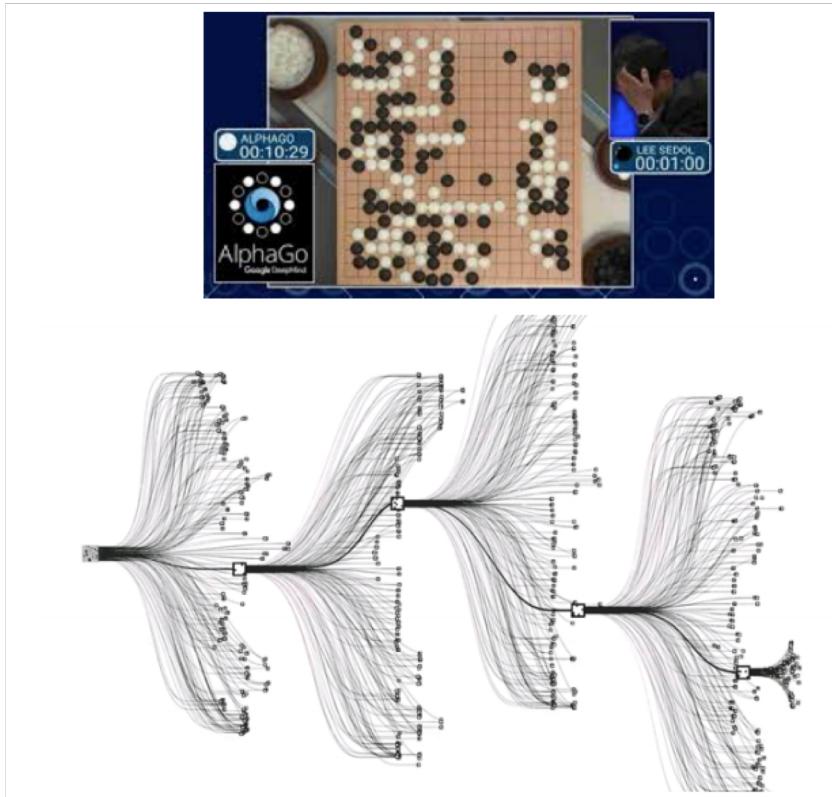
Predicting Poverty



<https://phys.org/news/2016-08-scientists-combine-satellite-machine-poverty.html>

What makes AI hard?

- Two sources of complexity



Computational Complexity
(need more CPUs)

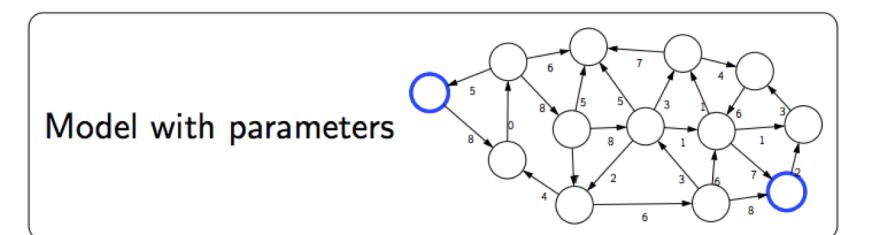
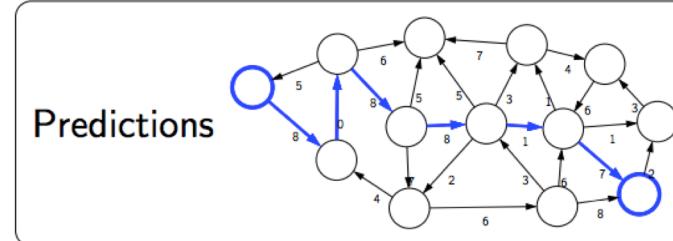
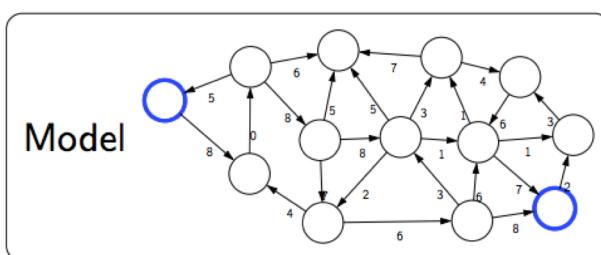
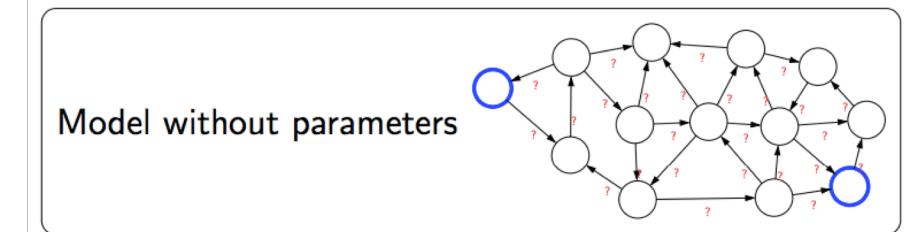
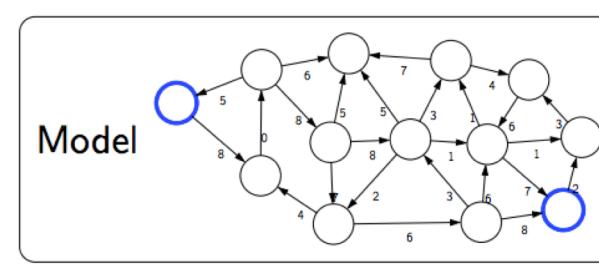
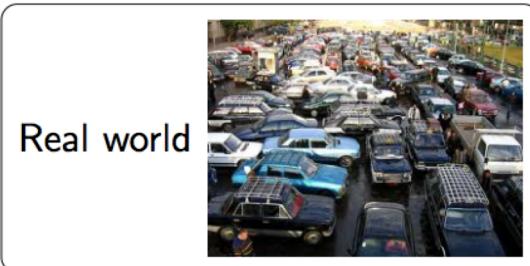
这是什么意思?

Information Complexity
(need more data)

How to solve hard AI tasks?

- **Model-Inference-Learning** paradigm

- Model simplify real world into math objects
- Inference answer questions of interest using the model
- Learning use data to build more accurate model

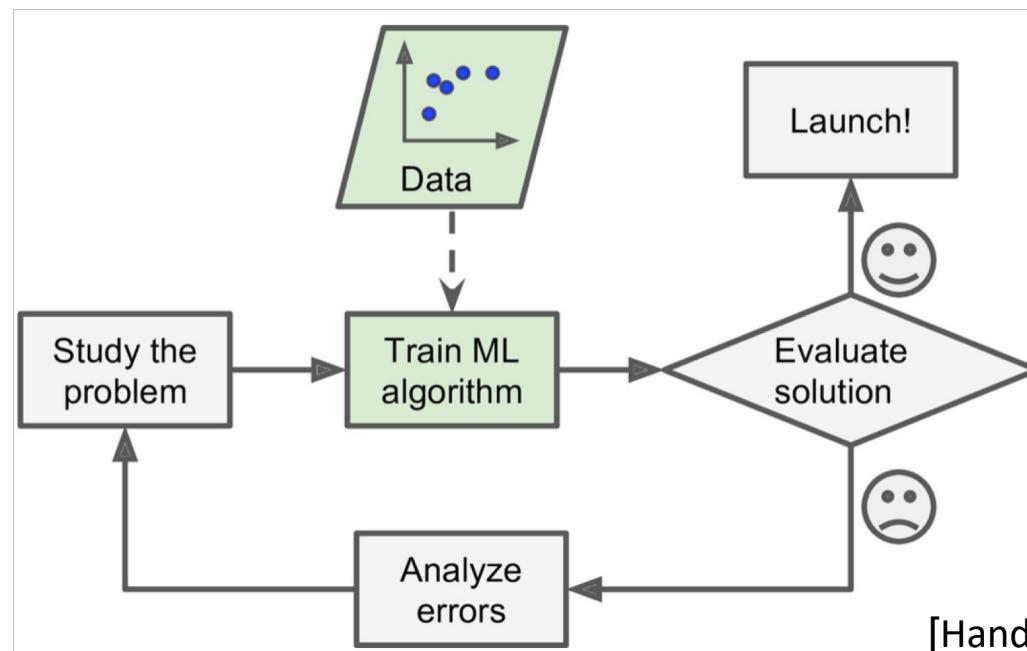


AI Solution Space



What is Machine Learning?

- The science of getting machines to “learn” from data and make predictions **without being explicitly programmed**
 - Solves specific AI tasks
 - Uses statistical techniques



What is Machine Learning?

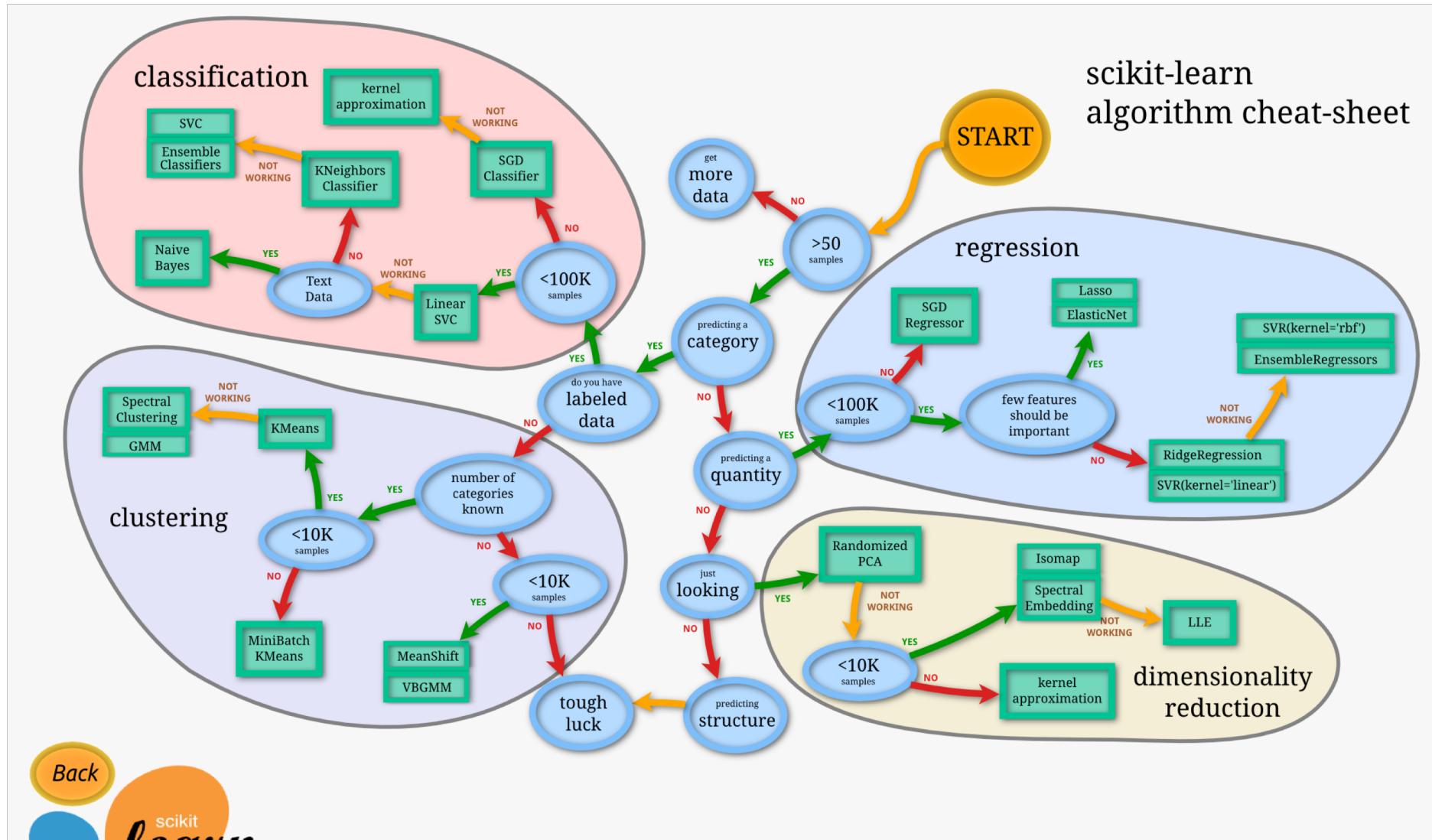
- More formally...

$$f : \mathcal{X} \rightarrow \mathbb{R}.$$

- inputs \mathcal{X} can be **any kind of objects**
 - ▶ images, text, audio, sequence of amino acids, ...
- output y is a **real number**
 - ▶ classification, regression, ...
- many way to construct f :
 - ▶ $f(x) = a \cdot \varphi(x) + b,$
 - ▶ $f(x) = \text{decision tree},$
 - ▶ $f(x) = \text{neural network}$

ML Techniques

http://scikit-learn.org/stable/tutorial/machine_learning_map/index.html



Why learn ML?

-- AI related jobs

- Data Scientist
- Data Engineer
- Researcher
- Professor
- Game Programmer

https://www.glassdoor.com/List/Best-Jobs-in-America-LST_KQ0,20.htm

50 Best Jobs in America

This report ranks jobs according to each job's Glassdoor Job Score, determined by combining three factors: number of job openings, salary, and overall job satisfaction rating.

United States | 2018 | 0 Shares | [f](#) [t](#) [in](#) [e](#)

Rank	Job Title	Job Score	Job Satisfaction	Median Base Salary	Job Openings
1	Data Scientist	4.8 / 5	4.2 / 5	\$110,000	4,524
2	DevOps Engineer	4.6 / 5	4.0 / 5		

Awards

- Best Places to Work
- Top CEOs
- Best Places to Interview

Lists

- Best Jobs
- Best Cities for Jobs
- Highest Paying Jobs
- Oddball Interview Questions

Trends

- Overview
- Job Trends



Essential Linear Algebra

- Matrix
- Vector
- Addition
- Scalar Multiplication
- Matrix-Vector Multiplication
- Matrix-Matrix Multiplication

Recap: Exercises

- Weak AI ต่างจาก Strong AI อย่างไร
- Turing Test มีจุดมุ่งหมายเพื่อทดสอบอะไร ด้วยวิธีการใด
- การที่ AlphaGo สามารถเล่นเกม Go ชนะแชมป์โลก Lee Sedol ได้นั้น แสดงว่า AlphaGo ถือเป็น Weak AI หรือ Strong AI
- การเขียนโปรแกรมควบคุม bot ในเกม Pong โดยสั่งให้แผ่นกระดาんเลื่อนไปตามตำแหน่งลูกบอล นับว่าเป็น Machine Learning หรือไม่

Next week

- Python Tutorial
- Supervised Learning
- K-NN

Recap: Topics to be covered

- Supervised Learning
- K-Nearest Neighbors (k-NN)
- Model Selection, Bias-Variance Trade-off, Cross Validation
- Linear Regression
- Logistic Regression
- Decision Tree
- SVM

MIDTERM

- Decision Tree
- Neural Networks
- CNN, RNN
- Reinforcement Learning
- Classical AI: Searching