Software Project

2021-Fall

Prof. Hyunjung Shim

Introduction to SW Project

2021-Fall

Prof. Hyunjung Shim

Course Policy

First half (By Nov 2)

- **"Learn by implementation" phase**
- **Lecture followed by individual project**
- **TAs helps how to use codelab and pytorch.**

Remaining weeks (Four weeks for the competition)

- **Competition phase**
- **We will setup a small-scale competition project.**
- **Compete with others for tackling the same challenge**

So.. What are topics for project?

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Deep Learning

History of Neural Networks

STORY BY DATA

HISTORY OF NEURAL NETWORKS

1943-2019

1943 — **Warren McCulloch** & **Walter Pitts**, wrote a paper on how neurons might work; they modeled a simple neural network with electrical circuits.

1949 — **Donald Hebb** reinforced the concept of neurons in his book, *The Organization of Behavior*. It pointed out that neural pathways are strengthened each time they are used.

1950s — **Nathanial Rochester** from the IBM research laboratories led the first effort to simulate a neural network.

1956 — The **Dartmouth Summer Research Project** on Artificial Intelligence provided a boost to both artificial intelligence and neural networks.

1957 — **John von Neumann** suggested imitating simple neuron functions by using telegraph relays or vacuum tubes.

1958 — **Frank Rosenblatt** began work on the Perceptron; the oldest neural network still in use today.

1959 — **Bernard Widrow** & **Marcian Hoff** of Stanford developed models they called ADALINE and MADALINE; the first neural network to be applied to a real world problem.

1969 — **Marvin Minsky** & **Seymour Papert** proved the Perceptron to be limited in their book, *Perceptrons*.

1981 — Progress on neural network research halted due fear, unfulfilled claims, etc.

1982 — **John Hopfield** presented a paper to the national Academy of Sciences. His approach to create useful devices; he was likeable, articulate, and charismatic.

1982 — **US-Japan Joint Conference on Cooperative/ Competitive Neural Networks**; Japan announced their Fifth-Generation effort resulted in US worrying about being left behind and restarted the funding in US.

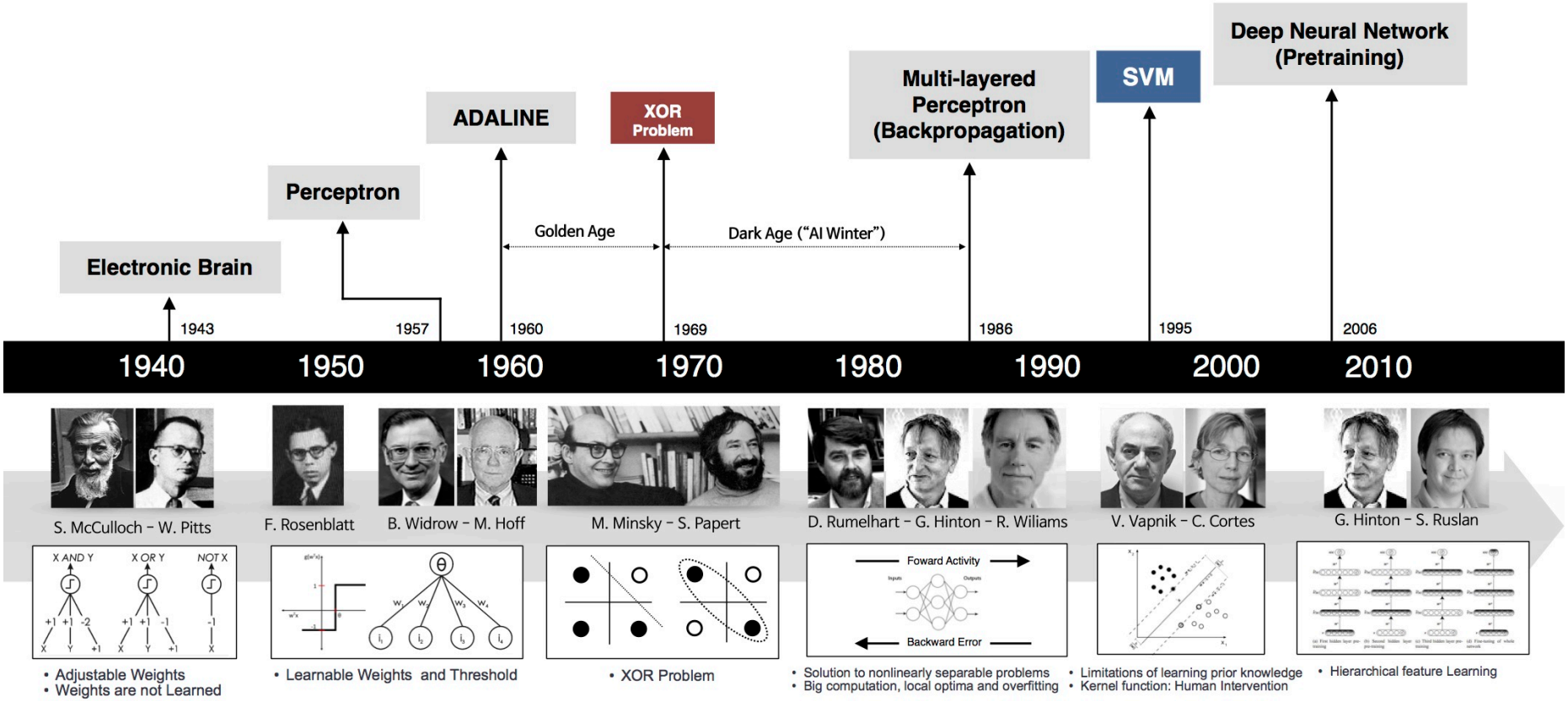
1985 — American Institute of Physics began what has become an annual meeting - **Neural Networks for Computing**.

1997 — A recurrent neural network framework, LSTM was proposed by **Schmidhuber** & **Hochreiter**.

1998 — **Yann LeCun** published *Gradient-Based Learning Applied to Document Recognition*.

NOW — Neural networks discussions are prevalent; the future is here!

History of Neural Networks



- Adjustable Weights
- Weights are not Learned

- Learnable Weights and Threshold

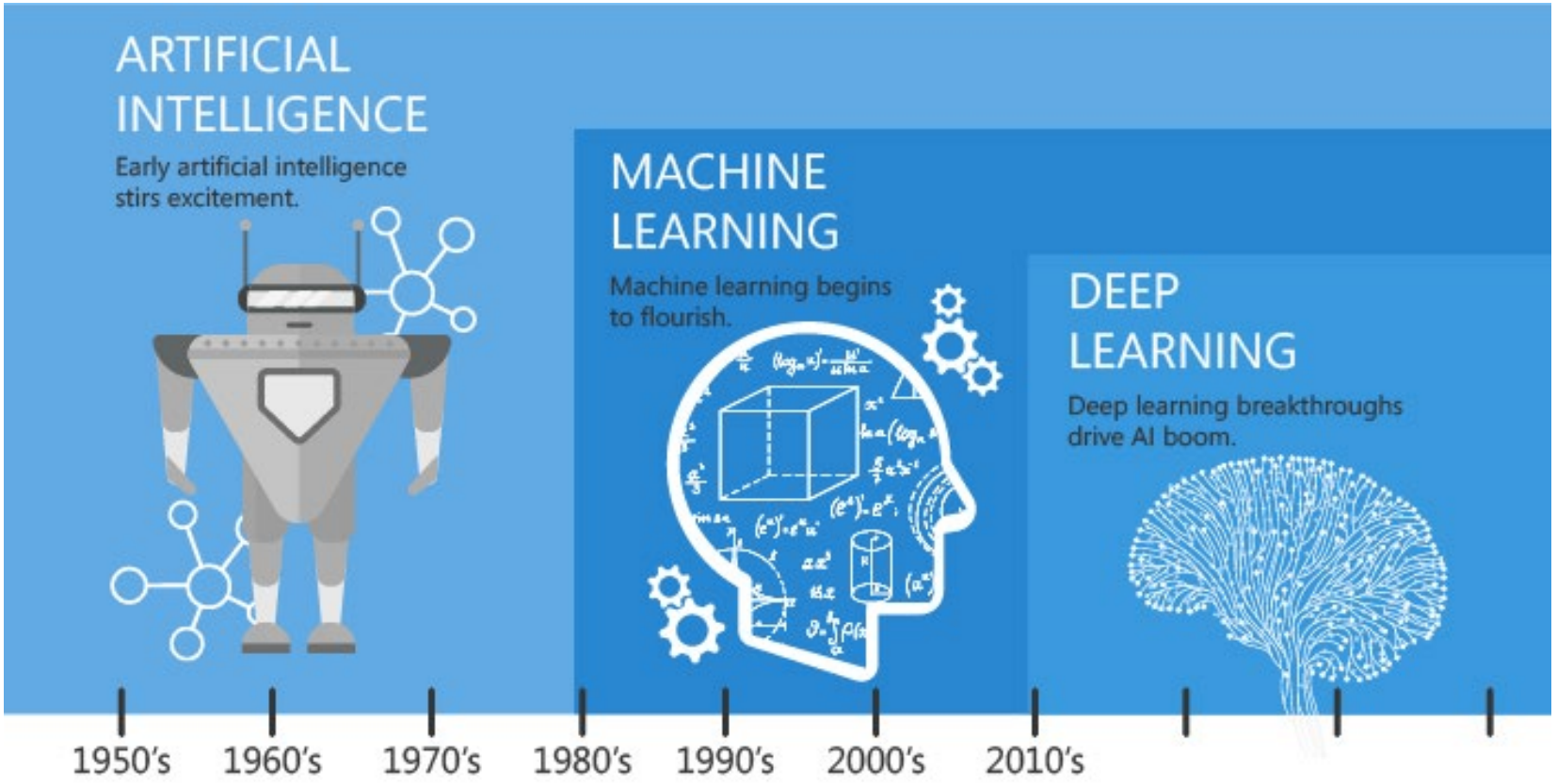
- XOR Problem

- Solution to nonlinearly separable problems
- Big computation, local optima and overfitting

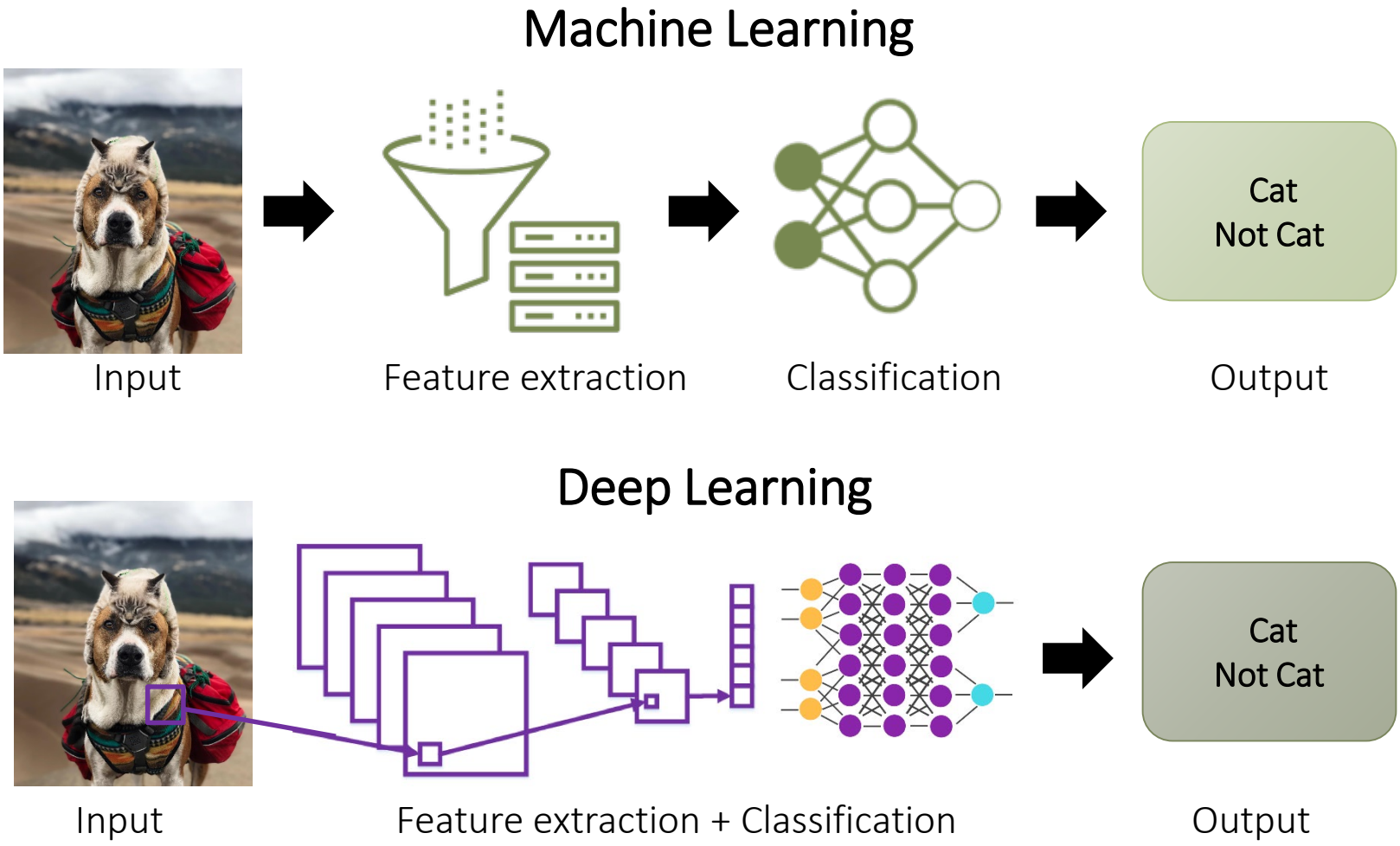
- Limitations of learning prior knowledge
- Kernel function: Human Intervention

- Hierarchical feature Learning

AI Journey: From AI to DL



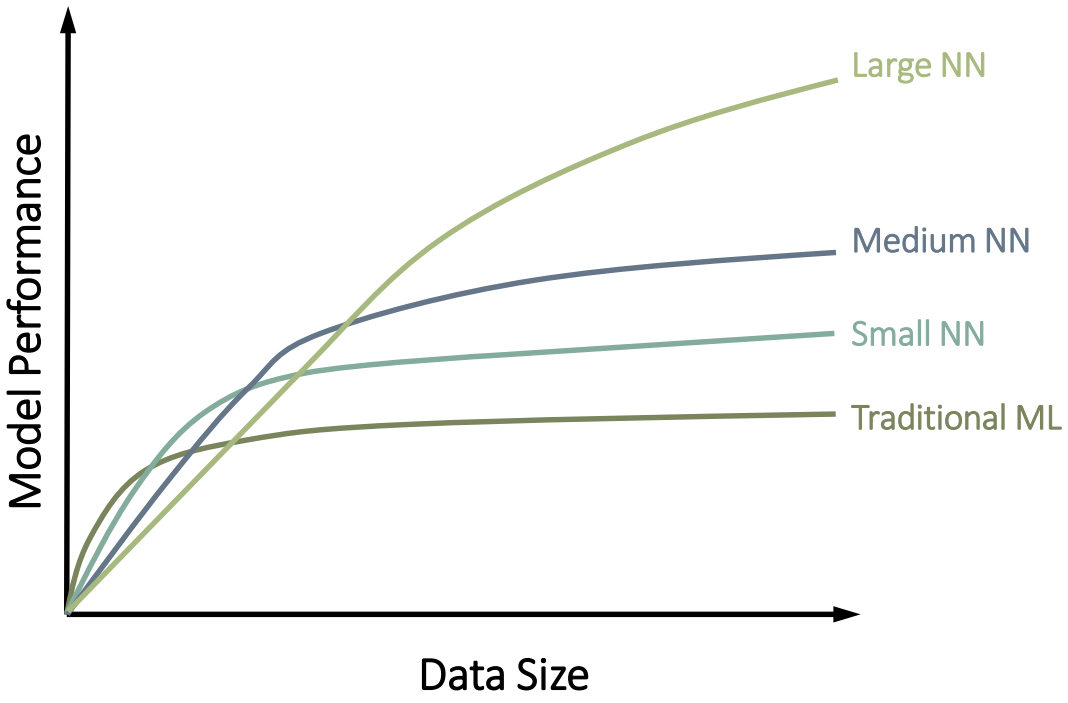
Conventional ML vs. Deep Learning



https://www.quora.com/What-is-the-difference-between-deep-learning-and-usual-machine-learning

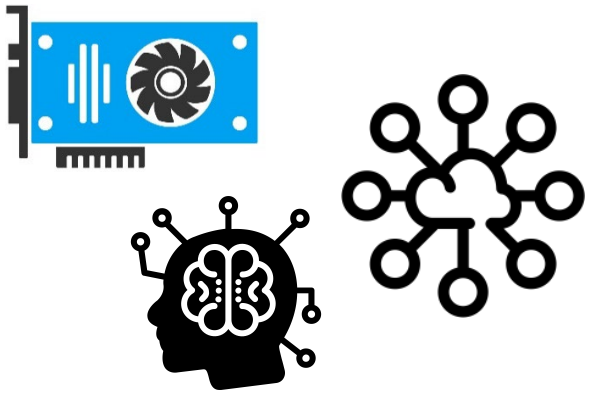
Why Deep Learning?

As the amount of data increases, deep learning shows better performance.



Why Now?

- Fast hardware (GPU)
- Availability of larger data (Big Data)
- Algorithm advancements



Turing Award Won by 3 Pioneers in DL

From left, Yann LeCun, Geoffrey Hinton and Yoshua Bengio. The researchers worked on key developments for neural networks, which are reshaping how computer systems are built.

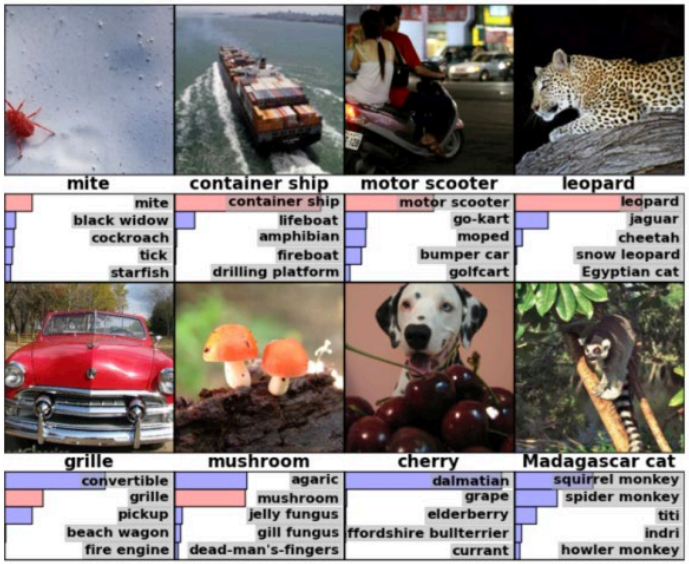
From left, Facebook, via Associated Press; Aaron Vincent Elkaim for The New York Times; Chad Buchanan/Getty Images

Vision with DL

Image Classification

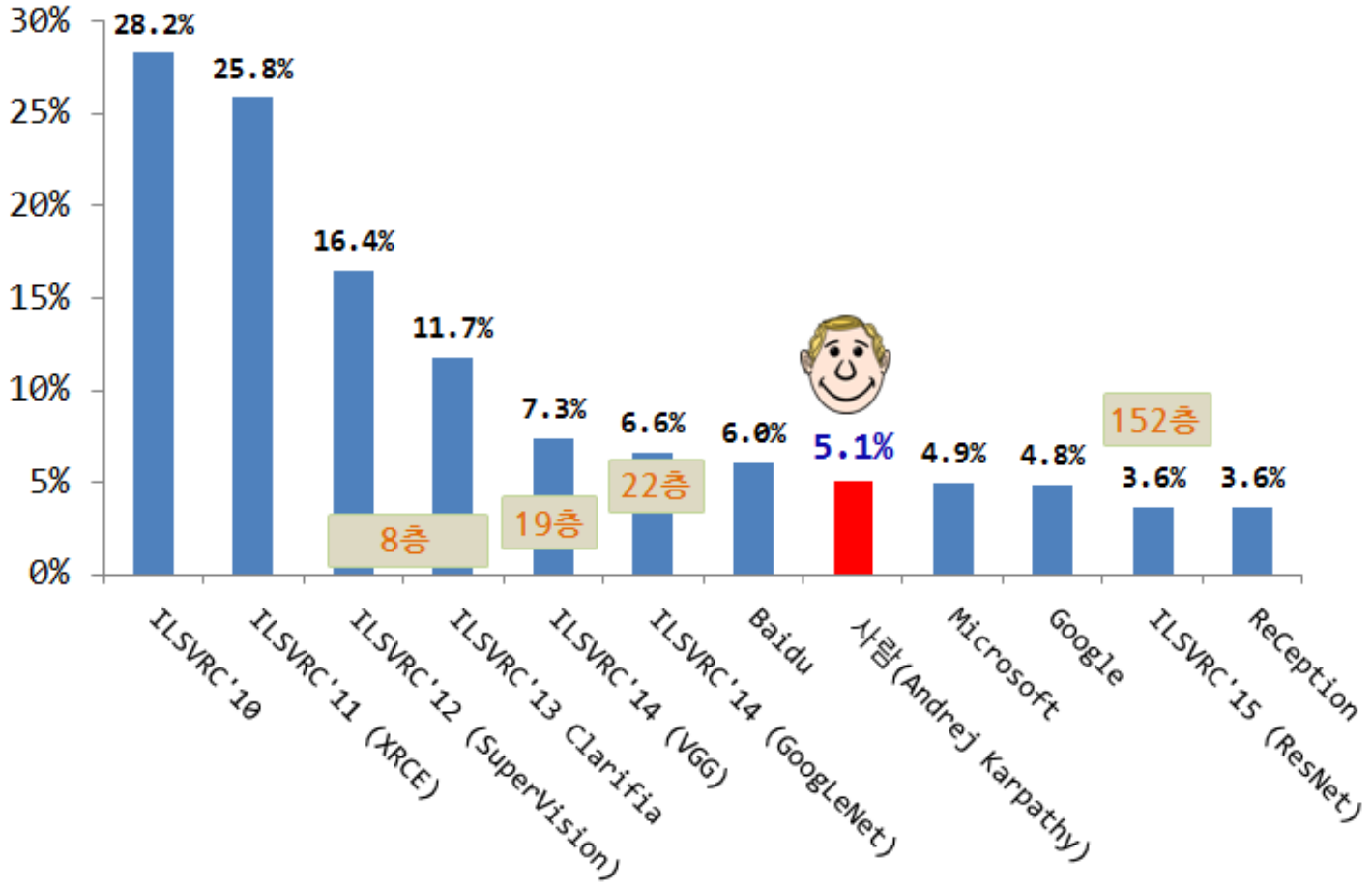
ImageNet Large Scale Visual Recognition Competition (ILSVRC)

1.2M training, 100k tes
(categories)

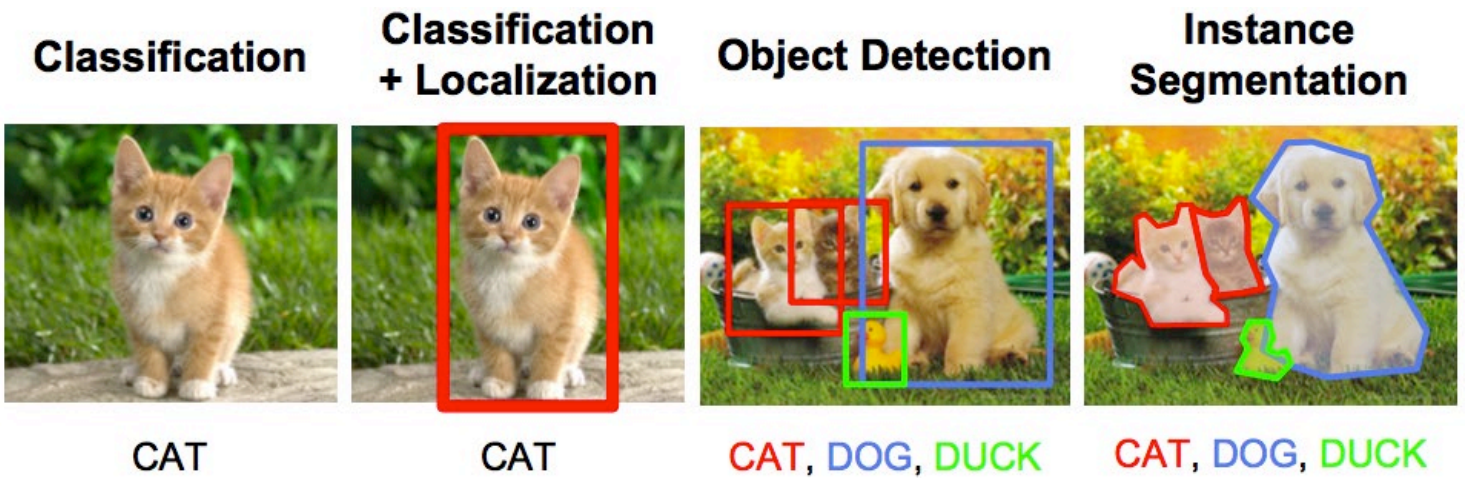


t-SNE visualization of CNN codes: https://cs.stanford.edu/people/karpathy/cnnembed/

Image Classification (Top-5 Error Rate)



Object Detection



https://mlwhiz.com/blog/2018/09/22/object_detection/

Video Summarization

https://www.youtube.com/watch?v=fISfDd35sXU

Image Generation: Faces

Training Data
(CelebA)

Sample Generator
(Karras et al, 2017)

2014

2015

2016

2017

2018

https://www.iangoodfellow.com/slides/2019-01-30.pdf

Image Generation: ImageNet

Odena et al., 2016 [1]

Miyato et al., 2017 [3]

Zhang et al., 2018 [2]

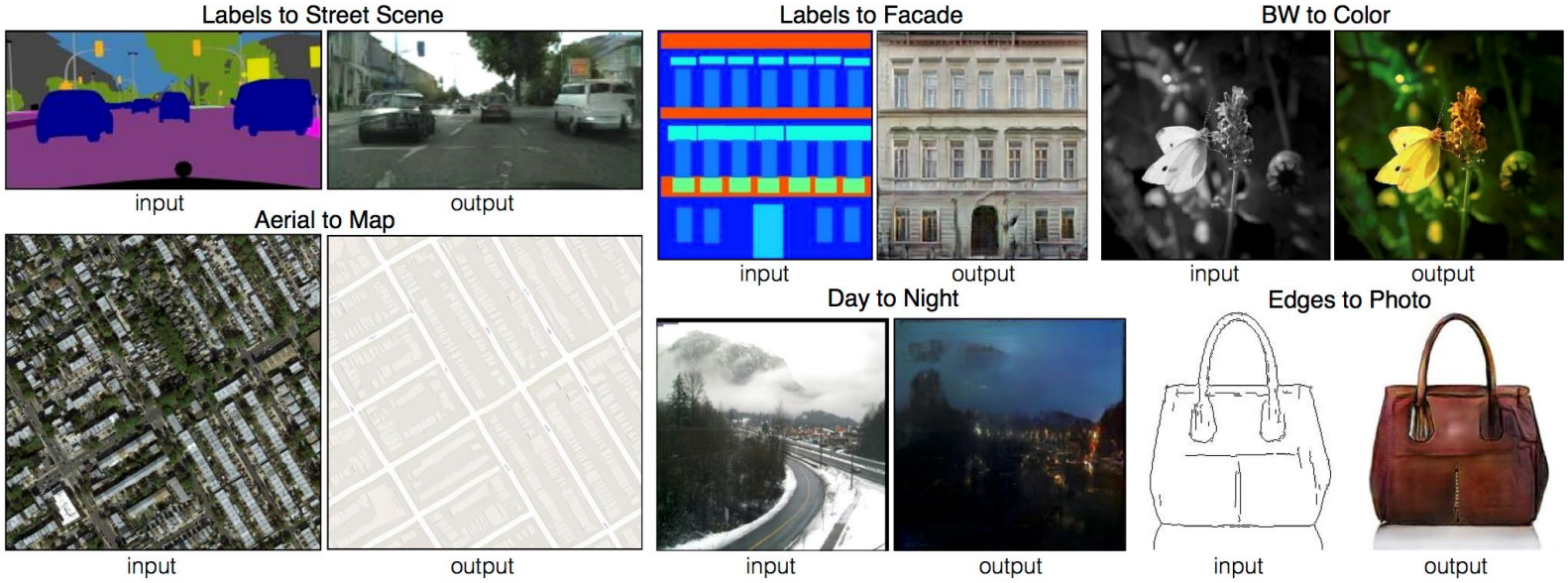
Brock et al., 2018 [4]

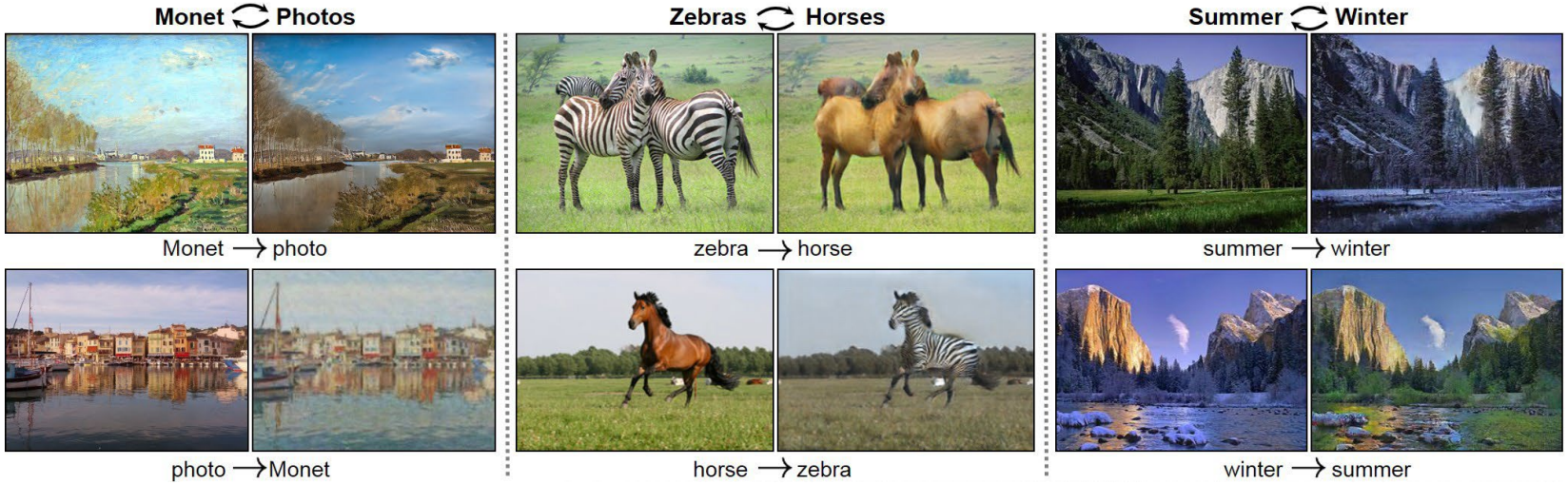
https://distill.pub/2019/gan-open-problems/

Image Style Transfer

"Image Style Transfer Using Convolutional Neural Networks," Leon A. Gatys, Alexander S. Ecker, Alexander S. Ecker, CVPR 2016

Image-to-Image Translation



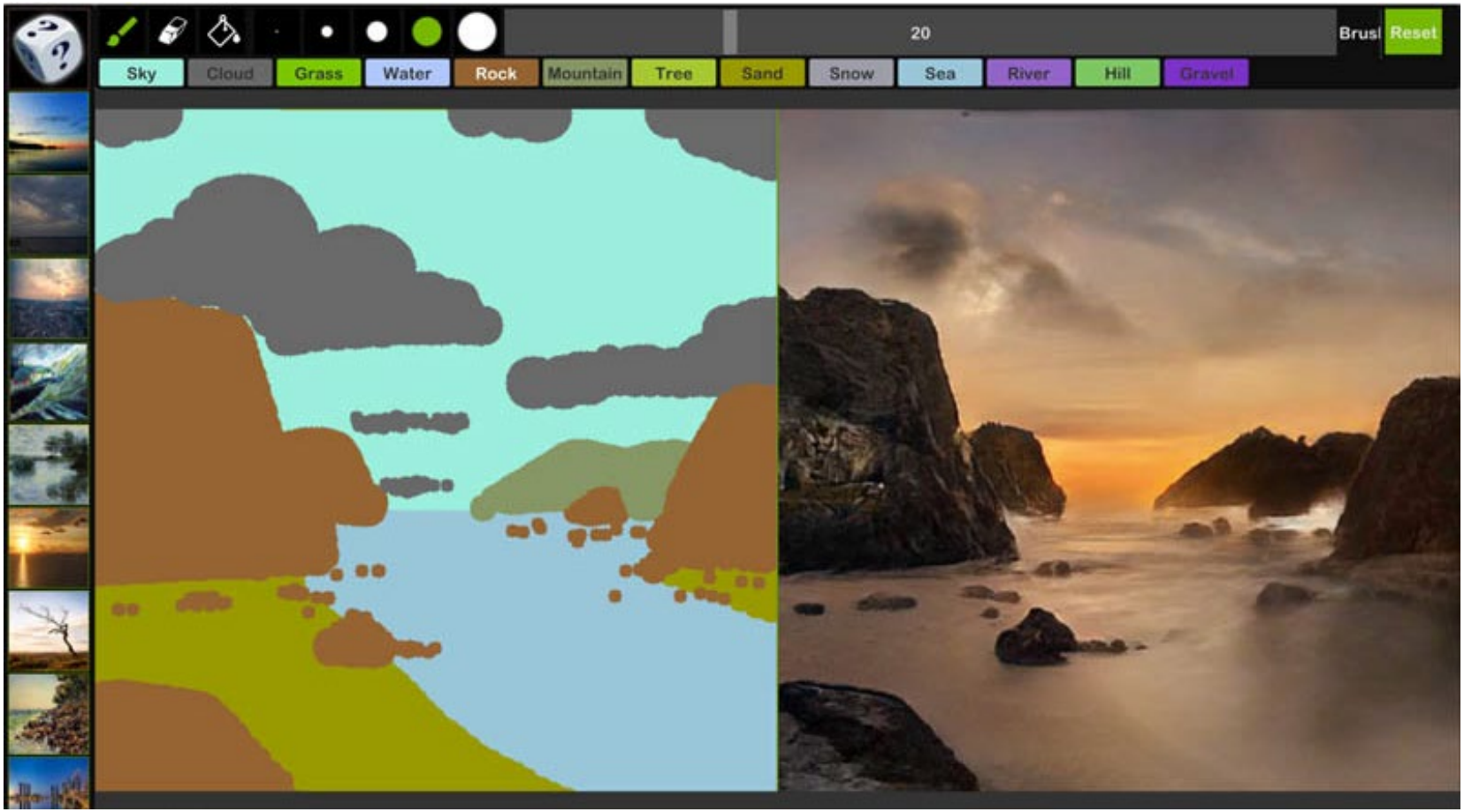


https://junyanz.github.io/CycleGAN/

Style-based Generation

"A Style-Based Generator Architecture for Generative Adversarial Networks," Toro Kerras, Samuli Laine, Timo Aila, CVPR 2019

Changing Sketches into Masterpieces



https://blogs.nvidia.com/blog/2019/03/18/gaugan-photorealistic-landscapes-nvidia-research/

https://www.nvidia.com/en-us/research/ai-playground/?ncid=so-twi-nz-92489

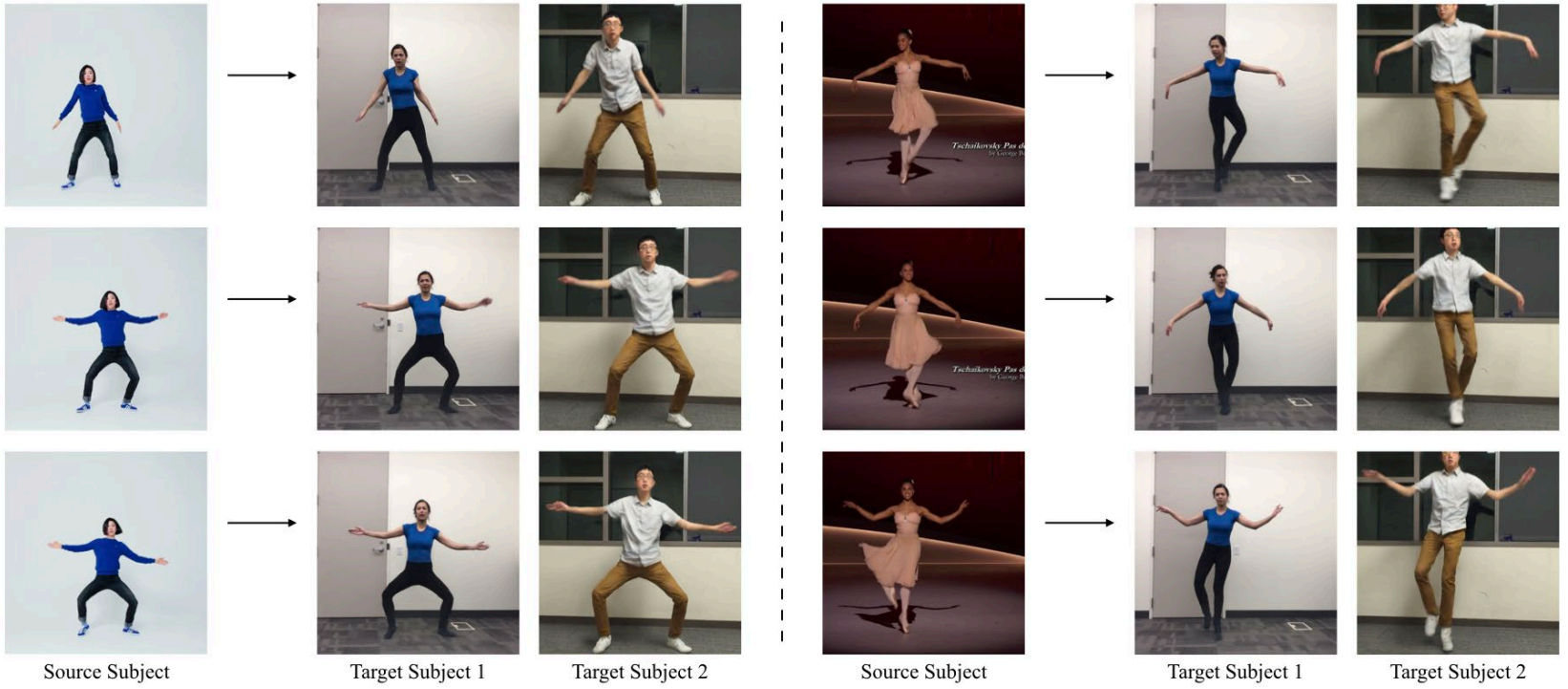
Video-to-Video Synthesis

Figure 1: Generating a photorealistic video from an input segmentation map video on Cityscapes. Top left: input. Top right: `pix2pixHD`. Bottom left: `COVST`. Bottom right: `vid2vid` (ours). *The figure is best viewed with Acrobat Reader. Click the image to play the video clip.*

https://tcwang0509.github.io/vid2vid/

Video-to-Video Synthesis

Everybody Dance Now



https://www.youtube.com/watch?v=PCBTZh41Ris

Image Captioning

"Show and Tell: A Neural Image Caption Generator," Oriol Vinyals, Alexander Toshev, Samy Bengio, Dumitru Erhan, CVPR 2015

Image Captioning with Visualization

"Knowing When to Look: Adaptive Attention via A Visual Sentinel for Image Captioning," Jiasen Lu, Caiming Xiong, Devi Parikh, Richard Socher, CVPR 2017

Bias in Image Captioning

Overcoming bias in captioning models

Wrong

Baseline:
*A **man** sitting at a desk with a laptop computer.*

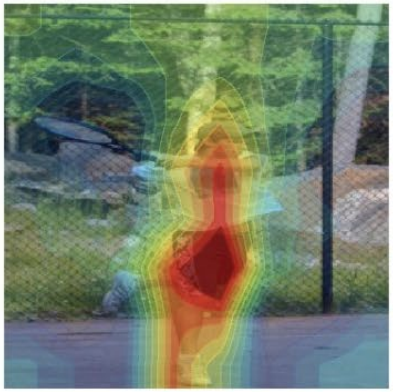
Right for the Right Reasons

Our Model:
*A **woman** sitting in front of a laptop computer.*

Right for the Wrong Reasons

Baseline:
*A **man** holding a tennis racquet on a tennis court.*

Right for the Right Reasons



Our Model:
*A **man** holding a tennis racquet on a tennis court.*

"Women also Snowboard: Overcoming Bias in Captioning Models," Kaylee Burns, Lisa Anne Hendricks, Kate Saenko, Trevor Darrell, Anna Rohrbach, 2019

Visual Question Answering

Who is wearing glasses?

man

woman

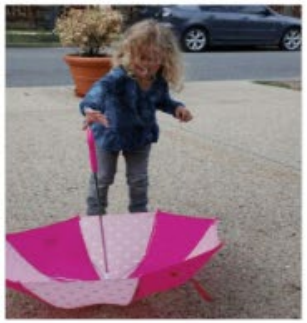
Where is the child sitting?

fridge

arms

Is the umbrella upside down?

yes



no

How many children are in the bed?

2

1

http://www.visualqa.org/

Demo: Visual Question Answering

http://www.visualqa.org/

Planning

Machine Learning Basics for SW Project

Consider observing a series of input vectors $\boldsymbol{x_1, x_2, \dots, x_n}$

Supervised Learning

*We are also given **target outputs** (**labels**, **responses**):*
$\boldsymbol{y_1, y_2, \dots, y_n}$
*The goal is to **predict correct output given a new input**.*

Weakly Supervised Learning

*The goal is to build predictive models by learning with **weak supervision**.*

Unsupervised Learning

*The goal is to build a statistical model for **latent representation of data**.*

From the next week

Supervised Learning for three weeks

Weakly supervised learning for two weeks

Few-shot Learning for one week

Unsupervised learning for one week

Course Policy

Individual project

7 assignments x 9~10% = 65%

Competition project

A total of 35%

Q&A

Questions?