CHL7001H S1 Applied Deep Learning

Lecture 1: Introduction I

Course Information

Course information

- Focus on practical and theoretical methodologies in machine learning and deep learning.
    a. First 2/3 : supervised learning and data preprocessing
    b. Last 1/3 : model deployment
- **Prerequisites:**
    a. Python hands-on experience
    b. Introductory machine learning knowledge
    c. Linear algebra, multivariable calculus, probability theory

Course information

- Marking: 100% course project (2 - 4 students)
    - 15% proposal + 25% final presentation (August 13/15 in class) + 60% final report
        - **Deadlines**: proposal - July 9 at 11:59pm, final report - August 15 at 11:59 pm
- See course information handout for detailed policies.

Software and computing resources

- **UNIX-compatible operating system**
  - While it's possible to use Windows, for simplicity we will only be supporting **Linux** and **macOS**. If you have Windows, you can dual-boot Linux or run it in a virtual machine (Ubuntu).
- **Python 3**:
  - Anaconda (Recommended): the easiest way to quickly get set up for machine learning in any environment. It provides conda, which is both a package manager and a Python environment manager.
  - PyCharm (Recommended): Python IDE.
- **Google Colab**: is a web-based iPython Notebook service that has access to a free Nvidia K80 GPU per Google account.
- **Google Cloud**: is a suite of cloud computing. You can get $300 free credits when sign up. Additional $50 per student. (URL will be sent out later)

Course information

Course web page:

https://chl7001-adl.github.io/CHL7001-Applied-Deep-Learning/

Includes detailed course information.

Important dates

- Tuesday, July 2, Final date to **enroll** in July-August S section courses.
- Monday, July 15, Final date to **drop** July-August S section courses without academic penalty.

http://www.dlsph.utoronto.ca/2019-summer-session-important-dates-and-deadlines/

Course information

We will use **Slack** for discussions.

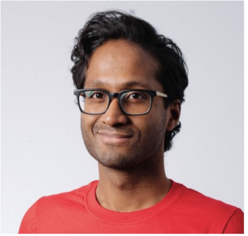
- Sign up at chl7001hs1-2019.slack.com (invites will be sent through your email).
- Your grade does not depend on your participation on Slack. It's just a good platform for asking questions, discussing with your instructors and your peers.

We prefer Slack to email.

Schedule

Week	Lecture	Topic	Workshop	Content
1	June 18	Introduction & ML workflow	June 20	Software installation and environment configuration
2	June 25	Review of fundamental ML theory and concepts	June 27	Guest talk
3	July 2	Neural networks	July 4	ML code walkthrough
4	July 9	Deep learning and Tensorflow	July 11	Tensorflow
5	July 16	Data preprocessing	July 18	Data preprocessing in Python
6	July 23	The Cloud and why its is important	July 25	How to use the Cloud effectively
7	July 30	Properly packaging and serving models	August 1	Experiment management
8	August 6	Distributed systems for models	August 8	How to use docker to monitor your model
9	August 13	Project presentation	August 15	Project presentation

Our instructors and guest speakers



Ragavan Thurairatnam

Chief of Machine Learning

Marc Tyndel

Machine Learning Engineer

Jodie Zhu

Machine Learning Engineer

Cole Clifford

Machine Learning Engineer

Danny Luo

Machine Learning Engineer

Hashiam Kadhim

Machine Learning Engineer

Rayhane Mama

Machine Learning Engineer

SOURCE: [Dessa]

Project

- Teams 2-4 students, one project report/presentation.
- Opportunity to deploy ML to solve real-world problems!
- Mentored by industry engineers from Dessa!
- **We prefer topic in healthcare, pharmaceuticals or life science, but not required.**

Data sources

- MIMIC: ~40k patients from the BIDMC ICU.
- GEMINI: ~240k admissions from Toronto-area teaching hospitals.
- ICES: Longitudinal data on population of Ontario.
- Kaggle: A few health-related datasets.
- Bring Your Own Data

Pitch your ideas

- Special guest lecture will be given on June 27.
- Pitch your crazy ideas to hire team members (if spots left).
- Learn from our experienced engineers how to approach and tackle the problem!

State of DL

Google Develops Deep Learning Tool to Enhance Lung Cancer Detection

Google researchers developed a deep learning tool that can detect lung cancer with a level of accuracy that is on par or better than human radiologists.

Science News *from research organizations*

Scientists use machine learning to improve gut disease diagnosis

Machines use Google-type algorithms on biopsy images to help children get treatment faster

Date: June 17, 2019

Source: University of Virginia School of Engineering and Applied Science

TECH \ ARTIFICIAL INTELLIGENCE

This AI-generated Joe Rogan fake has to be heard to be believed

The most realistic AI voice clone we've heard

By James Vincent | May 17, 2019, 7:28am EDT

Image classification

SOURCE: Google Health Technology MAY 2019.

Types of

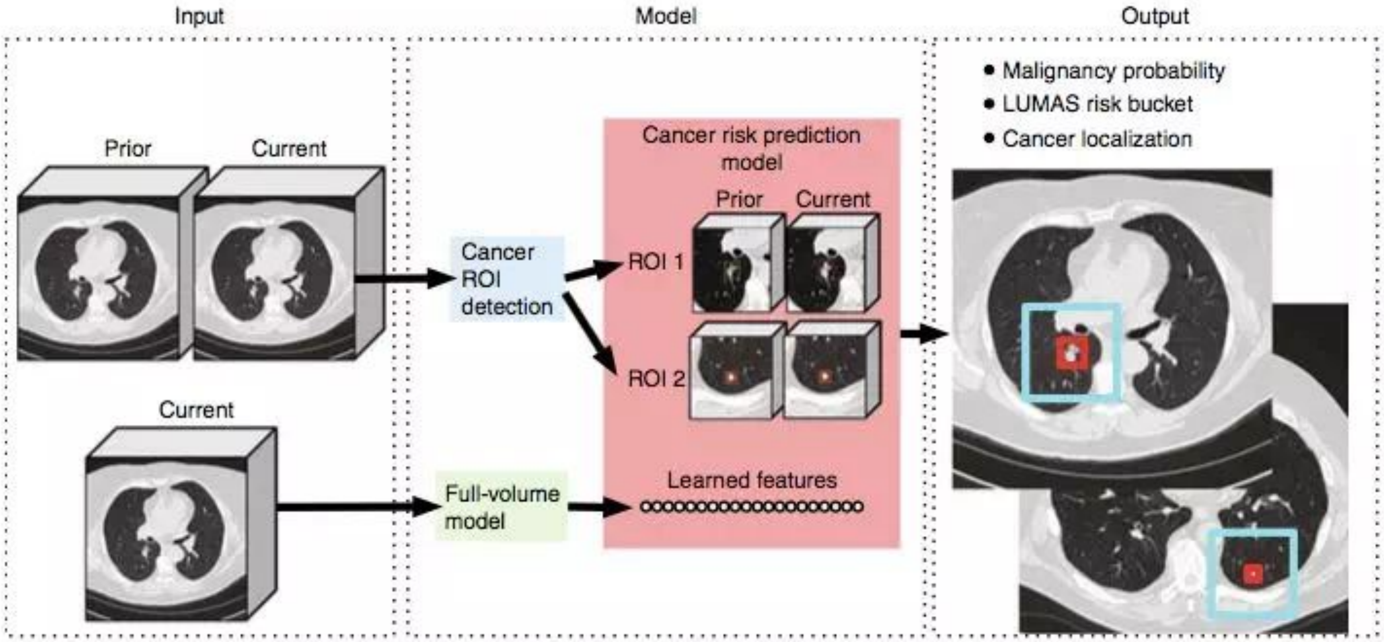
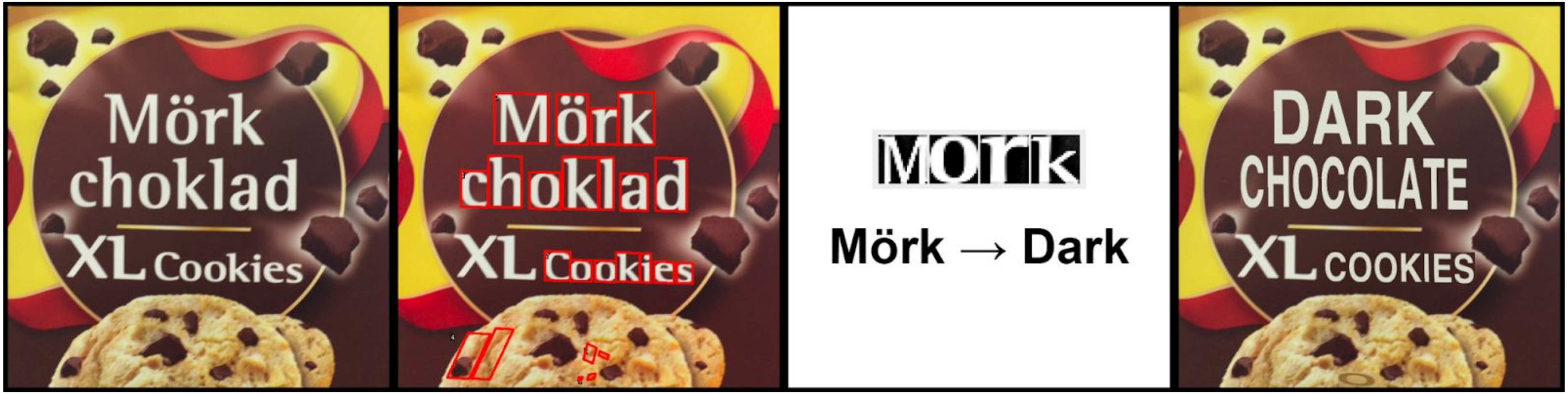


Fig. 1 | Overall modeling framework. For each patient, the model uses a primary LDCT volume and, if available, a prior LDCT volume as input. The model then analyzes suspicious and volumetric ROIs as well as the whole-LDCT volume and outputs an overall malignancy prediction for the case, a risk bucket score (LUMAS) and localization for predicted cancerous nodules.

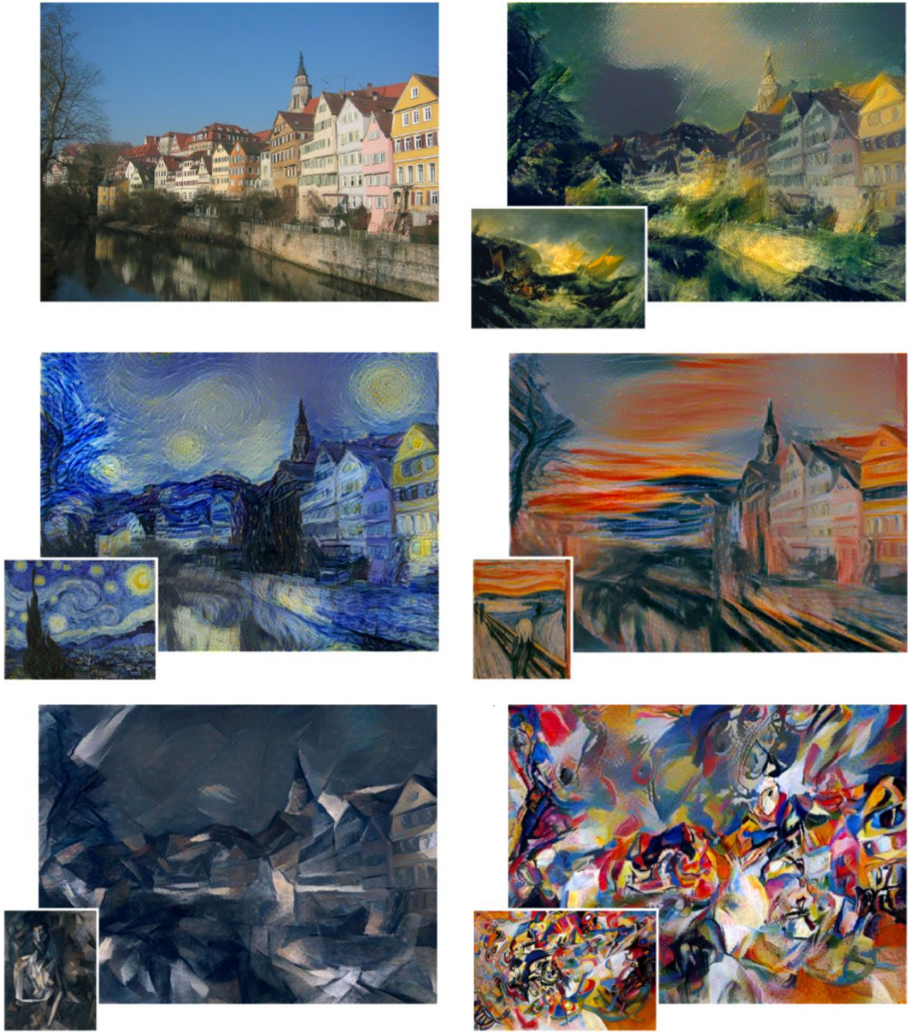
SOURCE: [Google Health Technology]() MAY 2019.

Translation in images



SOURCE: Google AI Blog

Style transfer



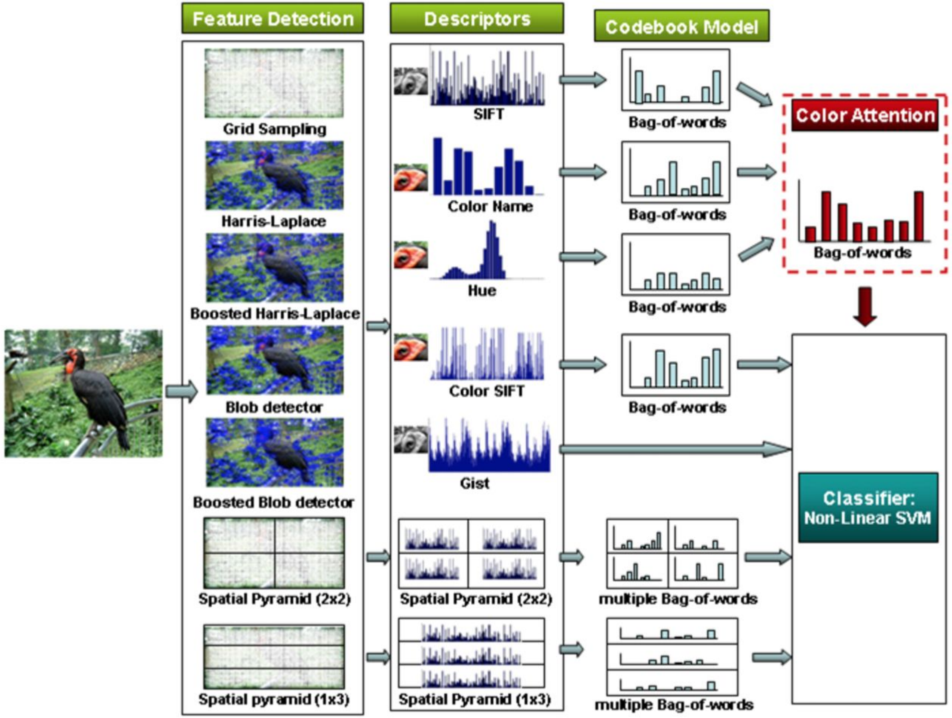
SOURCE: [A Neural Algorithm of Artistic Style]


Being a robot has it's benefits,

How we got here



How people used to do it



EARLY ARTIFICIAL INTELLIGENCE

1958 - Perceptron model

MACHINE LEARNING

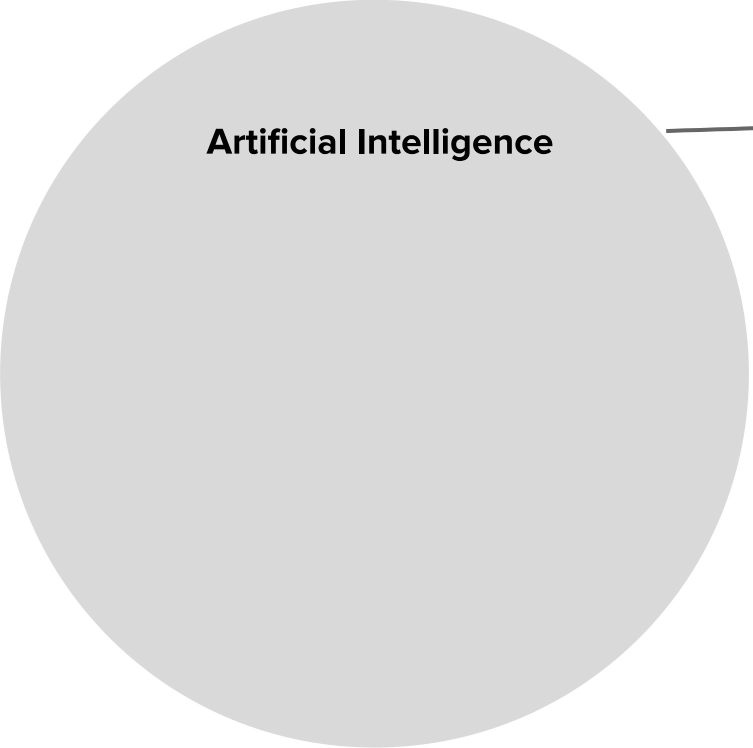
1988 - Backpropagation
1990s - Markov chain Monte Carlo, variational inference, kernels and SVM, and etc

DEEP LEARNING

2012 - AlexNet
2016 - AlphaGo
2017 - Deepfake,
2018 - Google Duplex

1950's 1960's 1970's 1980's 1990's 2000's 2010's 2012 2016

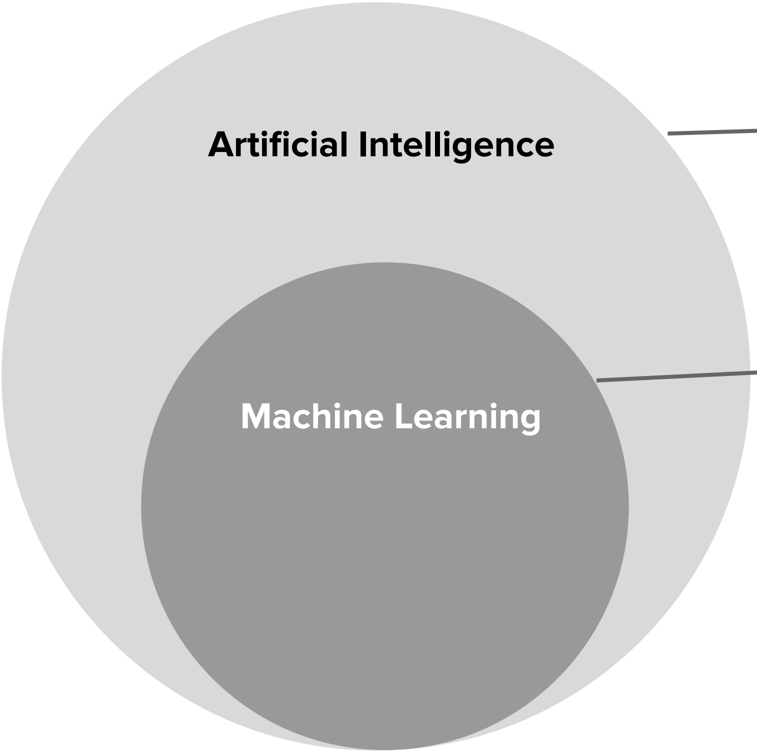
DL ⊂ ML ⊂ AI



Imitate intelligent human behaviors

Narrow AI: Systems designed specific tasks

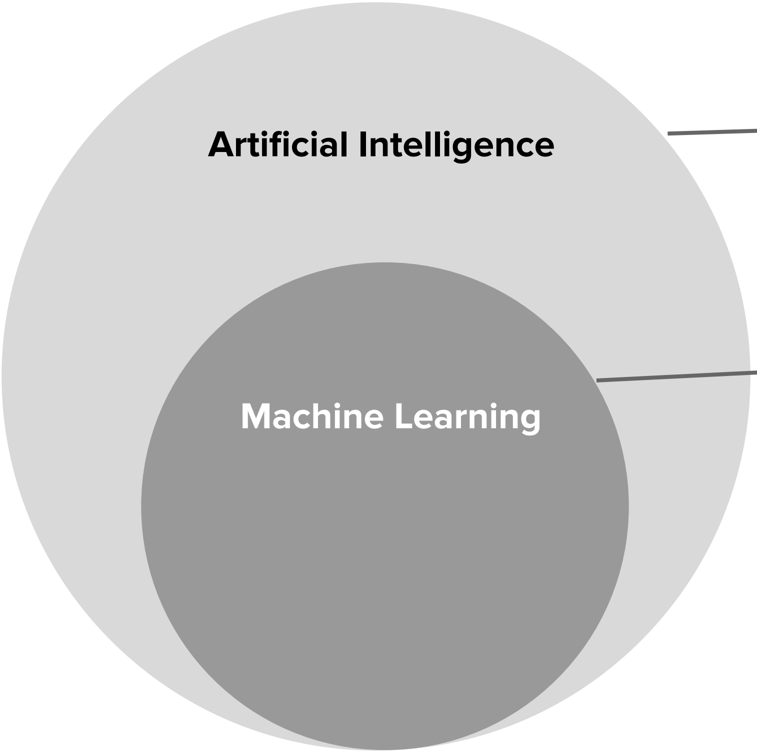
DL ⊂ ML ⊂ AI



Imitate intelligent human behaviors
Narrow AI: Systems designed specific tasks

"A field of AI that uses algorithms to give machine the ability to 'learn' from data without being explicitly programmed"

DL ⊂ ML ⊂ AI



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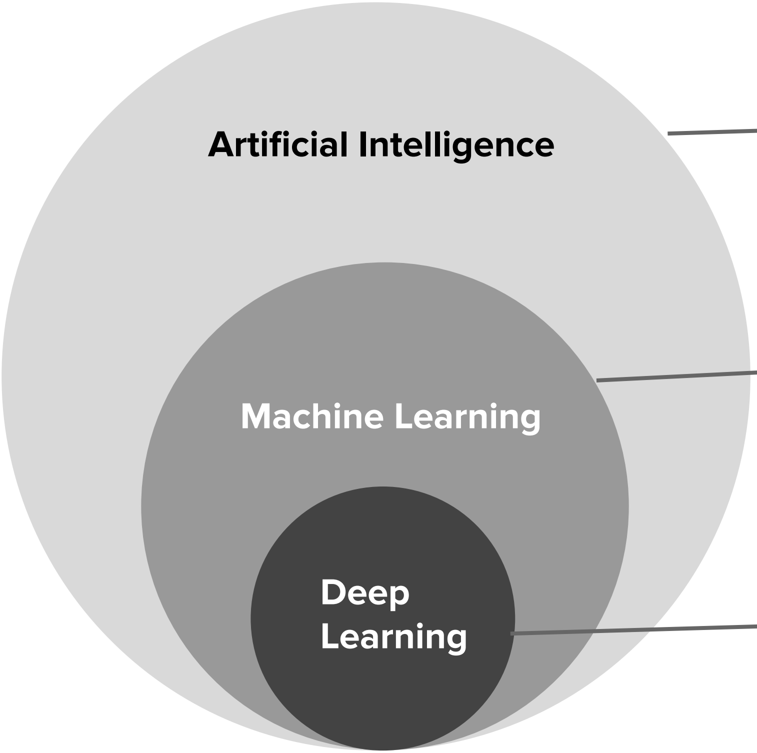
Lecture 2, 3

DL $\subset$ ML $\subset$ AI



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Narrow AI: Systems designed specific tasks

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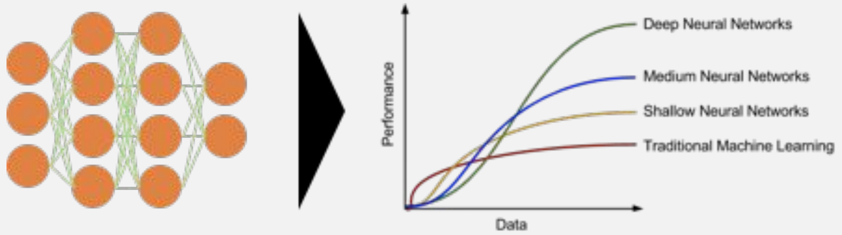
Lecture 2, 3



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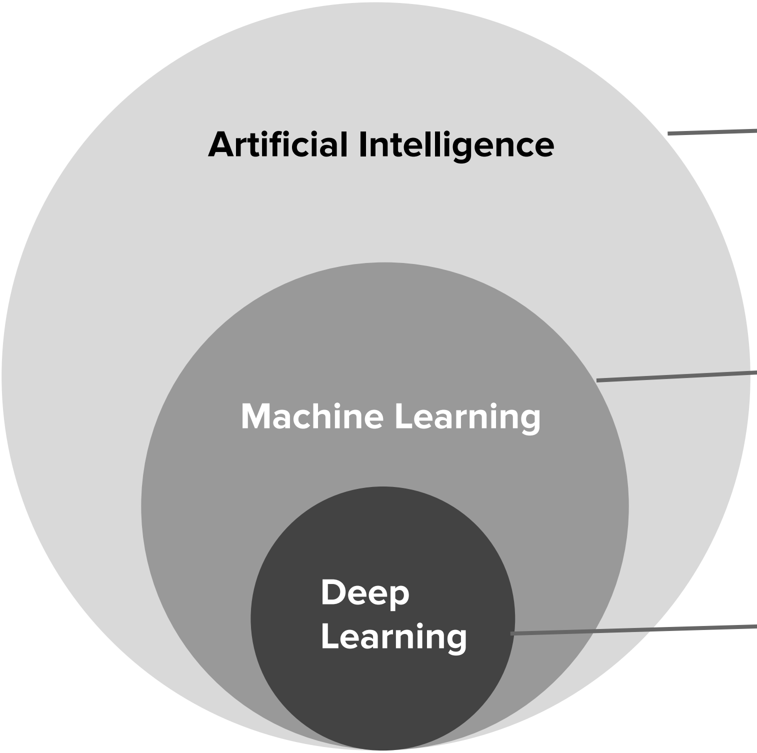

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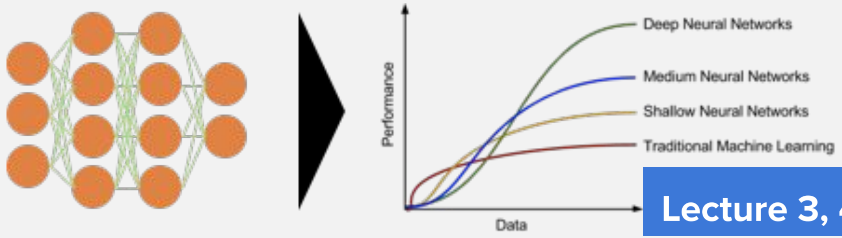


Lecture 3, 4

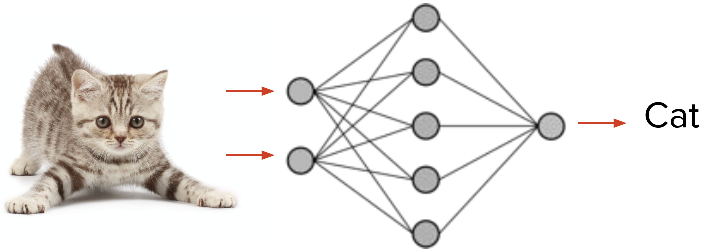
UofT

How Alex approached it

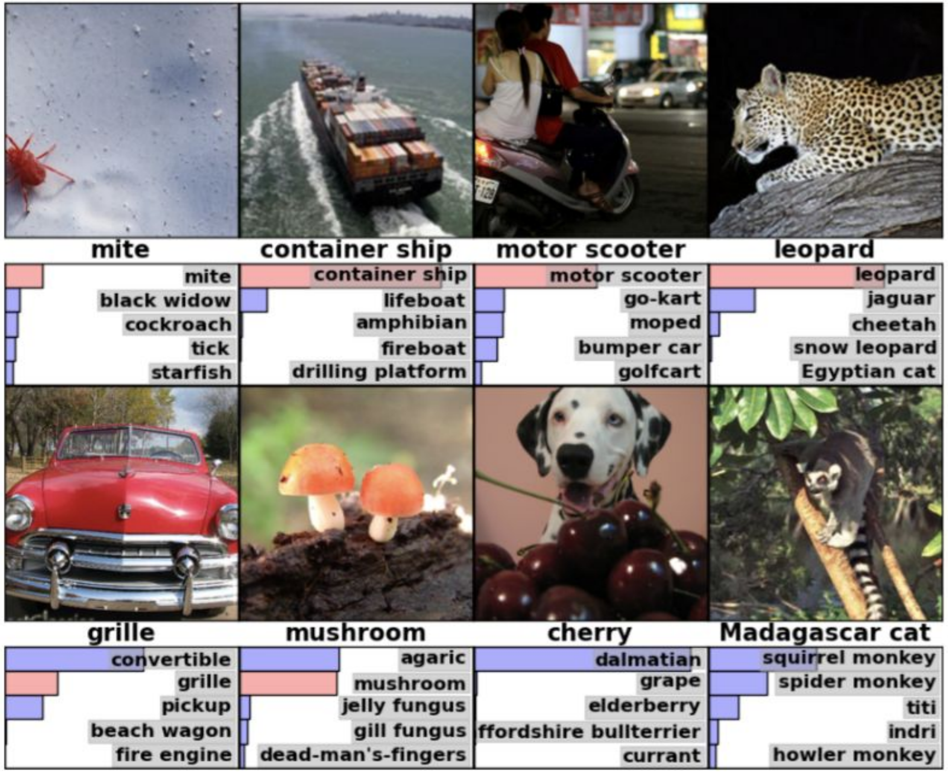
Cat

Cat

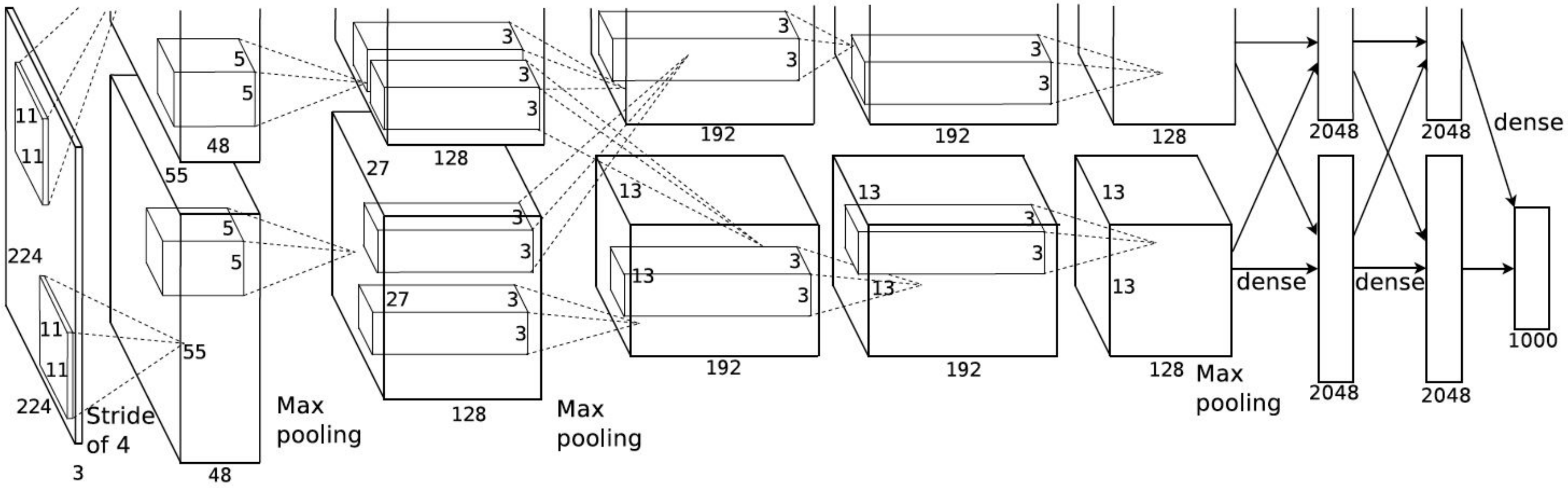
Not cat



How Alex approached it



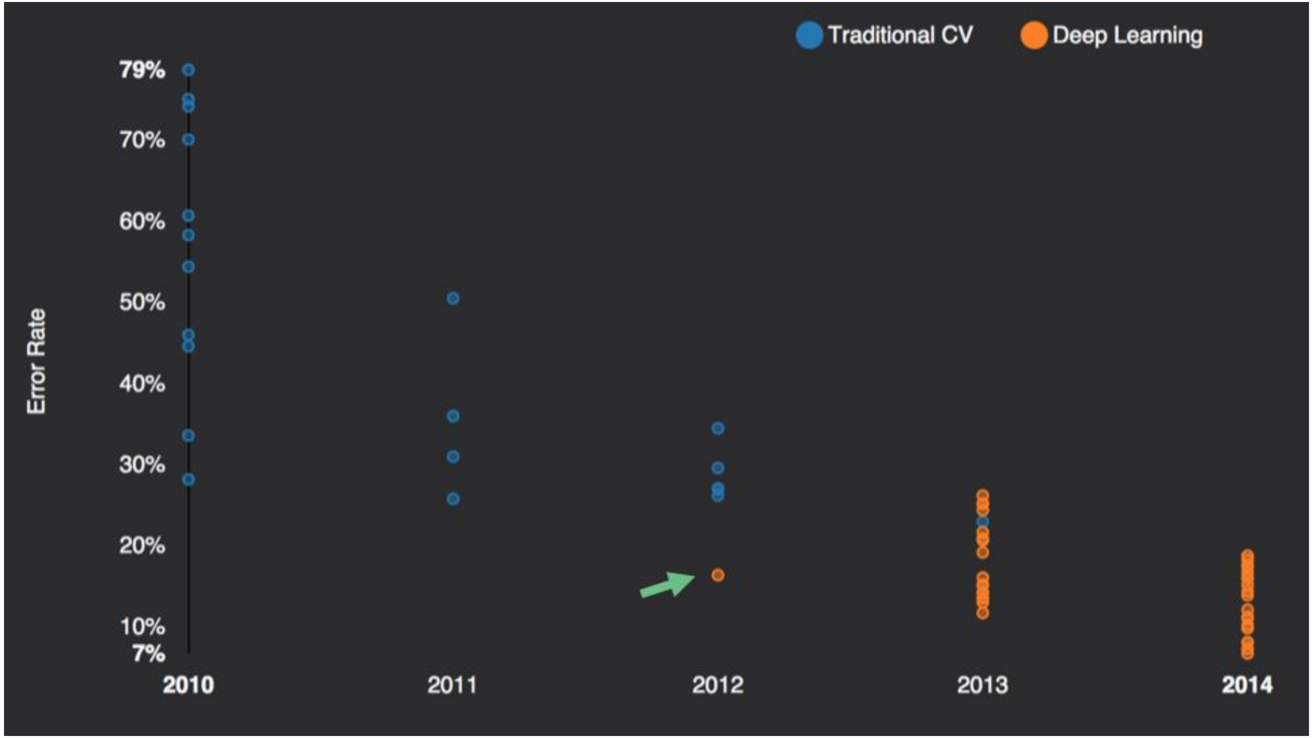
SOURCE: [Imagenet]()



Krizhevsky et al. 2012

SOURCE: [ImageNet Classification with Deep Convolutional Neural Networks]

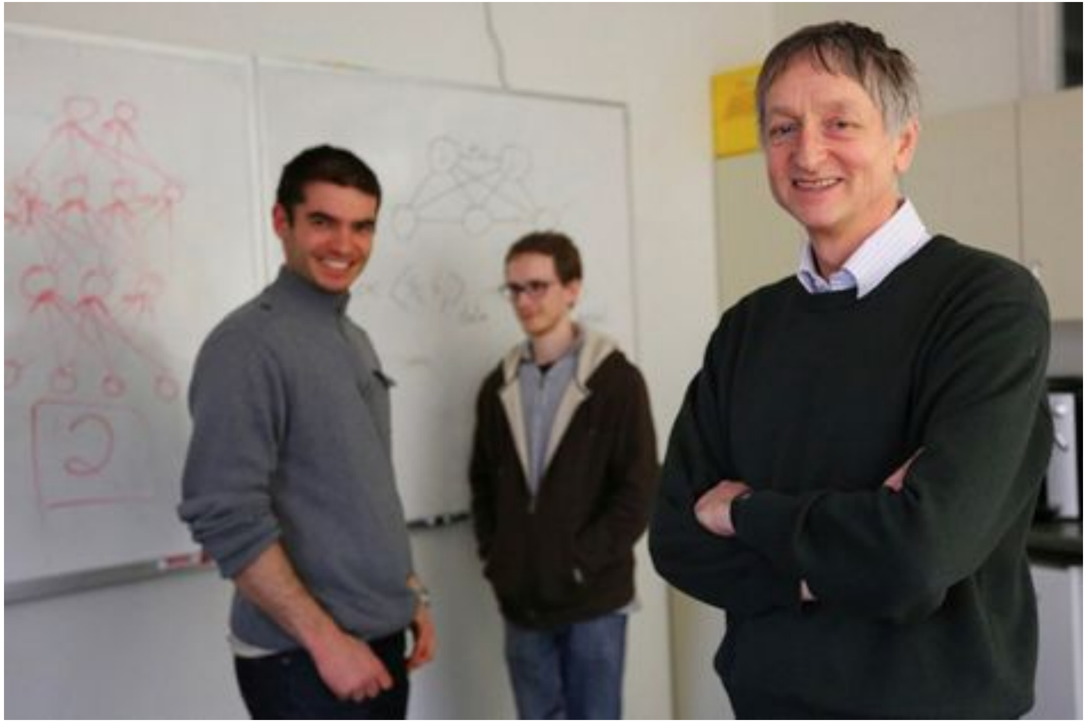
How deep learning performed



How people used to do it

VS

Aftermath



Why is this story a big deal?

- DL able to solve a problem which might be too complex for humans.
- Able to do this just by looking at data (no domain expert needed).
- Took only a personal home computer to do (cheap!).

All of this means that we could possibly solve many more unsolved problems without tons of $ or time.

A few years later, this proved to be true!

Why is this story a big deal?

Market summary >

NVIDIA Corporation

NASDAQ: NVDA

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Overview | News | Compare | Financials

145.50 USD +1.72 (1.20%) ↑

Closed: Jun. 7, 7:56 p.m. EDT · Disclaimer

After hours 145.50 0.00 (0.00%)

1 day | 5 days | 1 month | 6 months | YTD | 1 year | 5 years | Max

Open	144.02	Div yield	0.44%
High	146.88	Prev close	143.78
Low	143.25	52-wk high	292.76
Mkt cap	88.61B	52-wk low	124.46
P/E ratio	27.58		

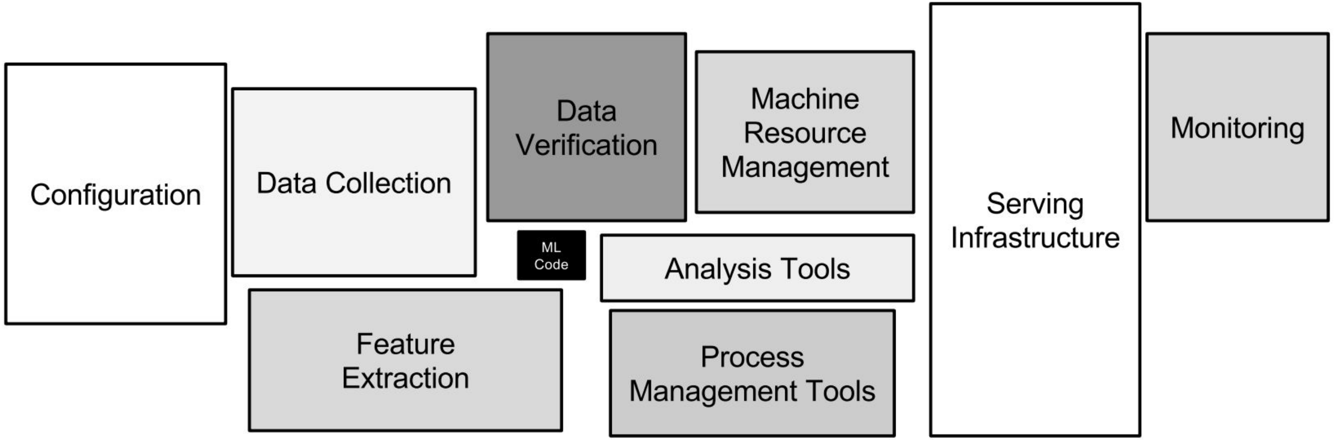
SOURCE: [NASDAQ]()

Why this class?

Real-world ML systems

SOURCE: [Hidden Technical Debt in Machine Learning Systems]

Real-world ML systems



SOURCE: Hidden Technical Debt in Machine Learning Systems

Challenges - Example

Reliability

Reproducibility

Efficiency

In this course, we will cover

- how to best apply and evaluate machine learning models for research and practical settings.
- build and deploy systems that leverage machine learning to achieve goals.
- set up and maintain an ML development infrastructure to improve efficiency and shorten project timelines.

Questions?