# Deep Learning Crash Course


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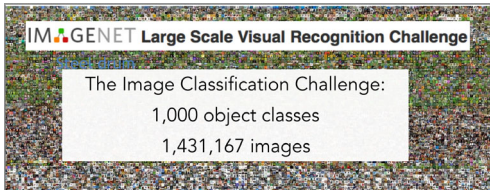
**Fall 2021**

www.deeplearningcrashcourse.org

# Deep Learning (DL) is making impact in many fields

Google Cat Study -
1000 computers with 16000 cores to recognize human faces, cat faces, human bodies etc. 2012.

https://arxiv.org/abs/1112.6209



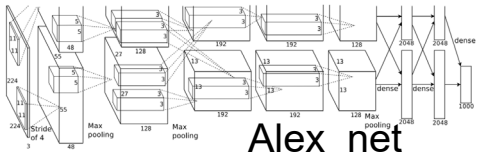
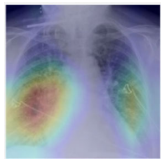




Figure 2: An illustration of the architecture of our CNN, explicitly showing the delineation of responsibilities between the two GPUs. One GPU runs the layer-parts at the top of the figure while the other runs the layer-parts at the bottom. The GPUs communicate only at certain layers. The network's input is 150,528-dimensional, and the number of neurons in the network's remaining layers is given by 253,440–186,624–64,896–64,896–43,264–4096–4096–1000.

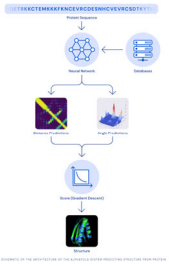
https://github.com/cs231n/cs231n.github.io

https://dl.acm.org/doi/10.1145/3065386

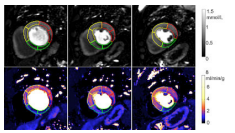
https://www.youtube.com/watch?v=tlThdr3O5Qo



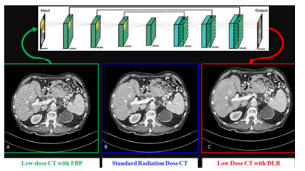
https://pubs.rsna.org/doi/10.1148/ryai.2021190228



https://deepmind.com/blog/article/AlphaFold-Using-AI-for-scientific-discovery

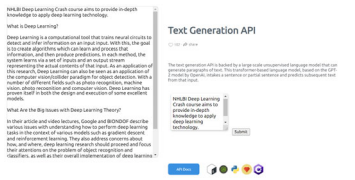


https://pubs.rsna.org/doi/10.1148/ryai.2020200009



https://www.sciencedirect.com/science/article/pii/S1120179720302866?via%3Dihub

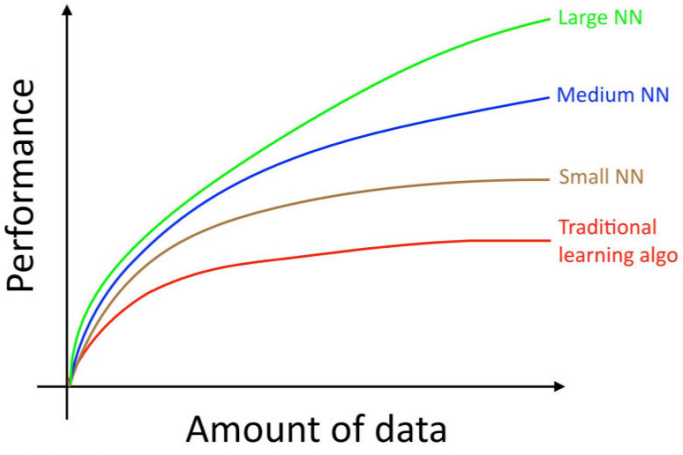
https://medium.com/vsinghbisen/how-ai-based-drone-works-artificial-intelligence-drone-use-cases-7f3d44b8abe3




https://deepai.org/machine-learning-model/text-generator

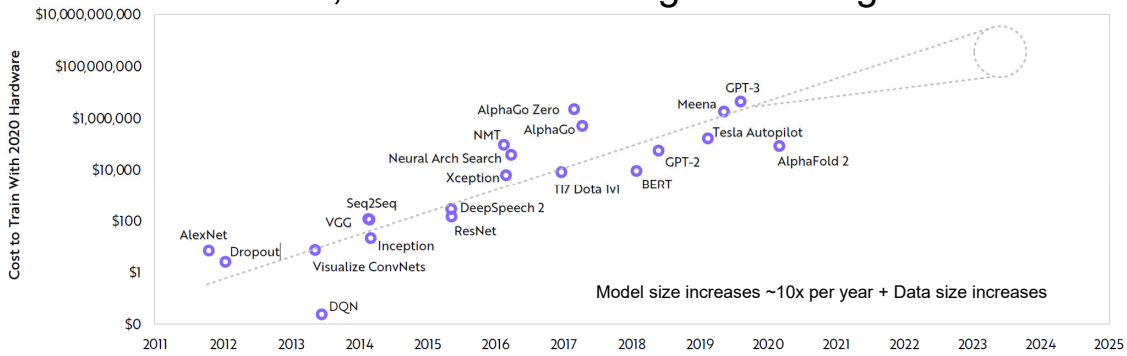
**Deep Learning** is one set of core technique which can serve many purposes …

# A combination of Data, Computing, Algorithm, Applications



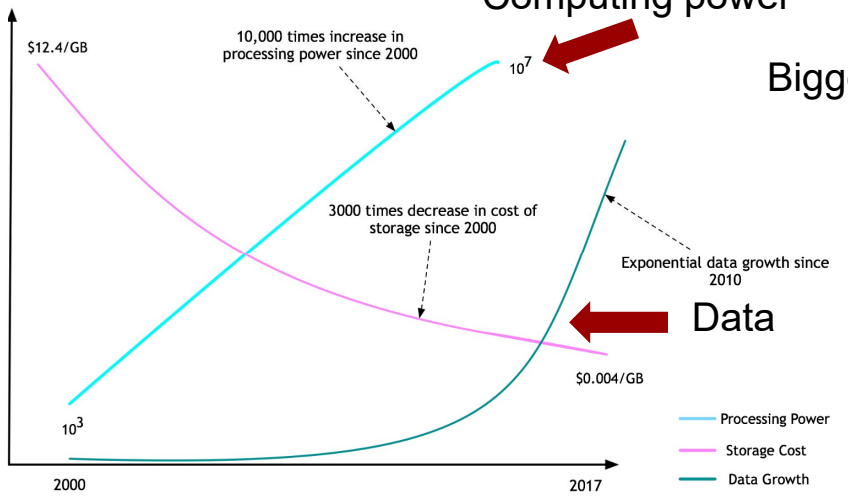

Why deep model is inevitable

So far, overall effect is higher training cost




Computing power

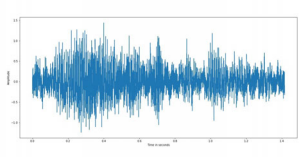
Bigger/better model

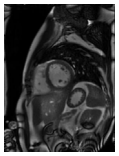


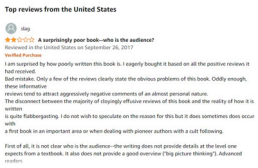

Data

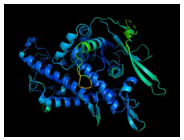
# Why learn DL: same technology, widely applicable

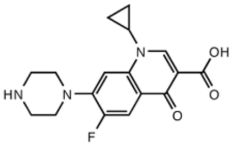
Multi-
modality data

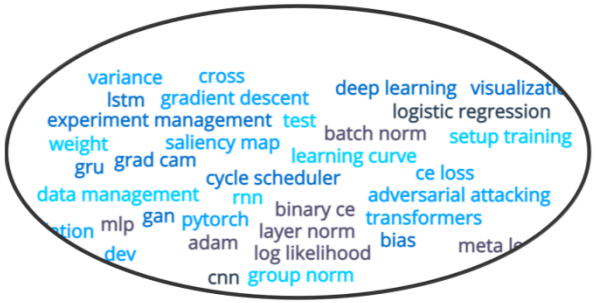








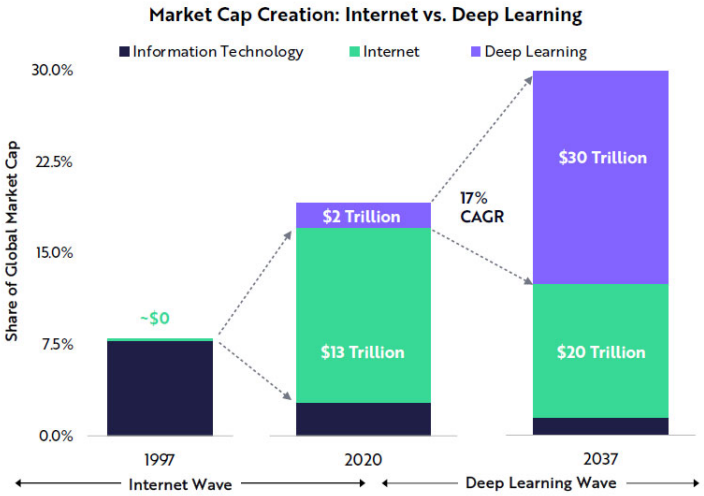

**We will learn what is in the deep learning toolbox**

- Automation
- AI assistant
- Prediction
- High duration system with 0% down time
- Super-human performance in some applications

- … still rapidly evolving

https://www.nature.com/articles/d41586-020-03348-4
https://towardsdatascience.com/review-deep-learning-in-drug-discovery-f4c89e3321e1

# Bright future with a long-way to go: not too late to get in




**According to ARK's research, deep learning will add $30 trillion to the global equity market capitalization during the next 15-20 years.**

-- Big Idea 2021, https://ark-invest.com/big-ideas-2021/

**AI ADOPTION by INDUSTRY & FUNCTION, 2020**

Source: McKinsey & Company, 2020 | Chart: 2021 AI Index Report

| Industry | Human Resources | Manufacturing | Marketing And Sales | Product and/or Service Development | Risk | Service Operations | Strategy and Corporate Finance | Supply-Chain Management |
|---|---|---|---|---|---|---|---|---|
| All Industries | 8% | 12% | 15% | 21% | 10% | 21% | 7% | 9% |
| Automotive and Assembly | 13% | 29% | 10% | 21% | 2% | 16% | 8% | 18% |
| Business, Legal, and Professional Services | 13% | 9% | 16% | 21% | 13% | 20% | 10% | 9% |
| Consumer Goods/Retail | 1% | 19% | 20% | 14% | 3% | 10% | 2% | 10% |
| Financial Services | 5% | 5% | 21% | 15% | 32% | 34% | 7% | 2% |
| Healthcare/Pharma | 3% | 12% | 16% | 15% | 4% | 11% | 2% | 6% |
| High Tech/Telecom | 14% | 11% | 26% | 37% | 14% | 39% | 9% | 12% |

% of Respondents

From a McKinsey survey to state whether AI has been adopted in at least one company function

https://aiindex.stanford.edu/wp-content/uploads/2021/03/2021-AI-Index-Report_Master.pdf

Just 16 percent of respondents say their companies have taken deep learning beyond the piloting stage.

**Adoption of DL has a long-way to go and requires innovation.**

# What we want to achieve

- Introduce the basics of deep learning
- Present in-depth how DL model works
- Provide practices to build your own model
- Grow interest and improve community awareness
- Prepare trainees and fellows for DL related jobs


After this course and assignments, start to apply DL to your field …

# For 2021 Fall offering

- Course logistics

# More information

- For this offering – www.deeplearningcrashcourse.org/nhlbi2021
  - Detailed introduction for every lecture
  - Reading list
- Information for Setup

  https://deeplearningcrashcourse.org/setup_ubuntu/

  https://deeplearningcrashcourse.org/setup_win10/
- Tech review session as we go
- Require to know python programming
  - Will demo some basics and how to debug the code

# Assignments

- Five assignments

| | |
|---|---|
| **A1** | Neural Network basics, Multi-layer Perceptron, Gradient descent |
| **A2** | Backprop, Hyperparameter searching, Setup training, Pytorch |
| **A3** | CNN, model training, Segmentation |
| **A4** | Recurrent and sequential models |
| **A5** | Model saving, saliency map, Adversarial attack, GAN, Transfer learning, Meta Learning |

- Many coding problems
- Tooling for testing, experimental management, hyper-parameter searching …