

Lecture 0: Course Introduction

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Course Goals

- to learn how neural networks work for solving different problems
- to learn how we design neural networks for solving different problems
- to learn how we implement neural networks using a programming framework

Course Contents

- Introduction to PyTorch
- Neural Networks and Multilayer Perceptron
- Convolutional Neural Networks
- Recurrent Neural Networks
- Autoencoders
- Transfer Learning
- Deep Reinforcement Learning
- Generative Adversarial Networks
- Some Applications of Neural Networks

Referenced Materials

Books

Pro Deep Learning with PyTorch (https://i.imgur.com/YQNfuBn.png =210x) https://www.tenlong.com.tw/products/9781788624336?list_name=srh success Ian Goodfellow, Yoshua Bengio and Aaron Courville, "Deep Learning", An MIT Press book, 2016. Free online version: (https://i.imgur.com/kx6Sats.jpg =210x) http://www.deeplearningbook.org/, (including many course materials) success 深度學習框架PyTorch : 入門與實踐 (https://i.imgur.com/3SeWhEQ.png =210x) https://www.tenlong.com.tw/products/9787121330773?list_name=srh

Online Courses

Udacity Online Course- Intro to Deep Learning with PyTorch https://www.udacity.com/course/deep-learning-pytorch--ud188

Tutorials of Web Pages and Video Lectures

Neural Network Programming - Deep Learning with PyTorch http://deeplizard.com/learn/video/v5cngxo4mlg PyTorch Documentation https://pytorch.org/docs/stable/index.html Machine Learning & Deep Learning Fundamentals http://deeplizard.com/learn/video/gZmobeGL0Yg Stanford University's Lectures of Deep Learning https://www.youtube.com/playlist?list=PL3FW7Lu3i5JvHM8ljYj-zLfQRF3EO8sYv Reinforcement Learning - Introducing Goal Oriented Intelligence http://deeplizard.com/learn/video/nyjbcRQ-uQ8 Machine Learning by 台大李弘毅教授 (in Chinese) https://www.youtube.com/playlist?list=PLJV_el3uVTsPy9oCRY30oBPNLCo89yu49 Deep Learning Theory by 台大李弘毅教授 (in Chinese) https://www.youtube.com/playlist?list=PLJV_el3uVTsOh1F5eo9txAta4iww0Kp8K Dee Reinforcement Learning by 台大李弘毅教授 (in Chinese) https://www.youtube.com/playlist?list=PLJV_el3uVTsODxQFgzMzPLa16h6B8kWM Generative Adversarial Networks by 台大李弘毅教授 (in Chinese) https://www.youtube.com/playlist?list=PLJV_el3uVTsMq6JEFpW35BCiOQTsoqWnw

Grade Evaluation

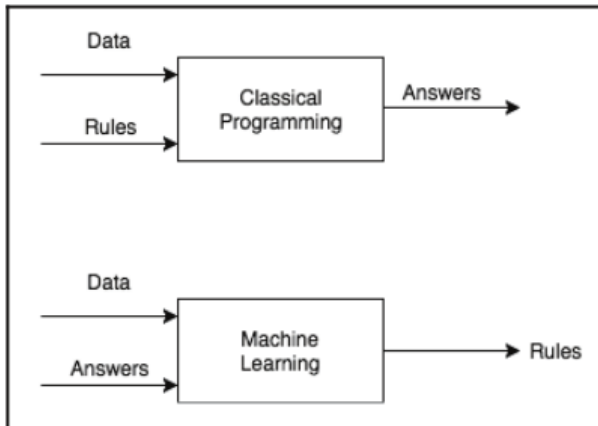
- Three Programming Assignments (60%):
 - Shallow Neural Networks: Multi Layer Perceptrons (20%)
 - Deep Neural Networks: Convolutional Neural Networks (20%)
 - Recurrent Neural Networks: LSTM (20%)
- One Open-book Midterm Exam (30%)
- Class Attendance and Interactions (10%)

Required Backgrounds

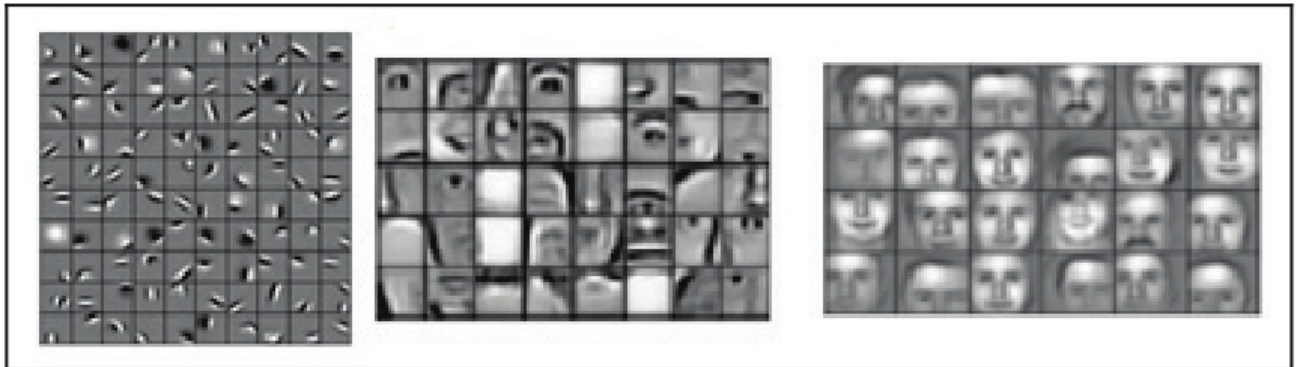
- Math
 - Calculus
 - Linear Algebra
 - Probability and Statistics
- Programming
 - Python
 - For your reference (Professor CCC's Video Lectures in Chinese): http://web.csie.ndhu.edu.tw/ccchiang/Data/VLectures/CCC_Python.htm
 - Python Tutorial for Beginners (Telusko's Video Lectures in English) https://www.youtube.com/playlist?list=PLsyebzWxl7poL9JTVyndKe62ieoN-MZ3
 - PyTorch Programming:
 - 周莫煩: https://www.youtube.com/playlist?list=PLXO45tsB95cJxT0mL0P3-G0rBcLSvVvKH (in Chinese)
 - PyTorch ZeroToAll Tutorial: https://www.youtube.com/playlist?list=PLIMkM4tgfnJ31-dbh09JTww7gNty6o_2m (in English)

AI, Machine Learning (ML) and Deep Learning (DL)

- AI refers generally to the intelligence acquired by machines/computers to mimic the humans abilities for doing various tasks.
 - In the era of early AI, people believed that AI can be achieved by computer programs with hard coded rules (**Symbolic AI**).
 - But it has been proved that this approach was almost incapable of solving complex problems such as image recognition, object detection, object segmentation, language translation, and natural-language-understanding tasks.
 - Machine learning (ML) is a sub-field of AI and has become popular in the last 10 years.
 - Unlike the symbolic AI, ML systems look at tons of data and come up with rules to predict outcomes for unseen data.



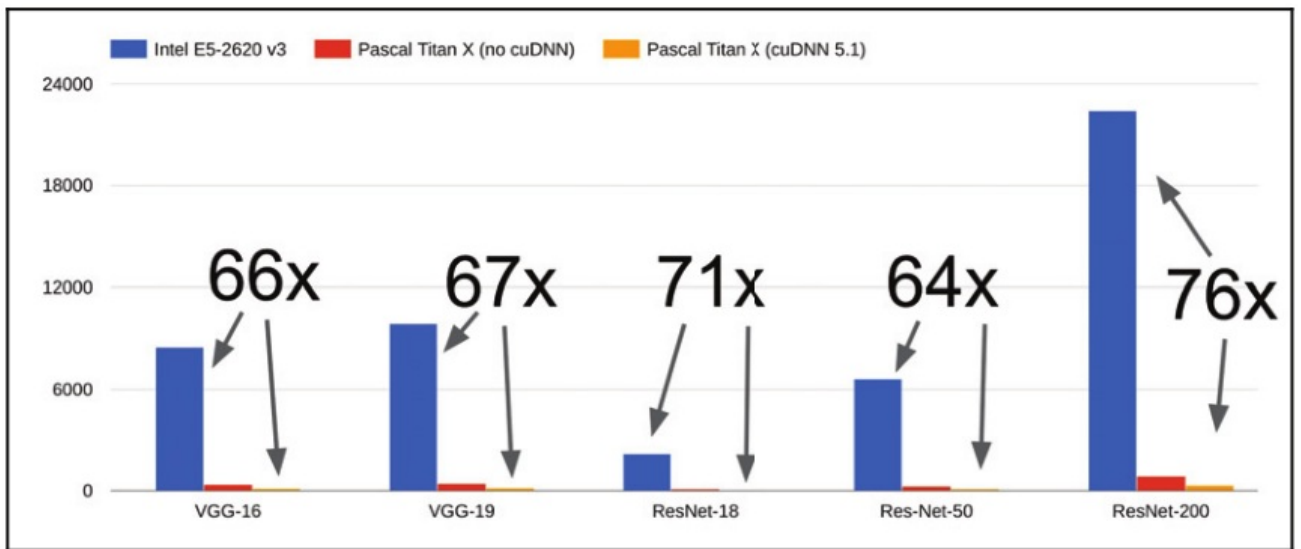
- When dealing with **unstructured data** that reveal no direct **explicit features**, ML systems suffer from the problem of extracting effective features from the data (feature engineering). <https://i.imgur.com/59nEwML.png> =550x
- Recently, DL emerges as a more popular approach to achieve AI for its ability to learn the extraction of features automatically.



- History of DL:

Techniques	Year
Neural networks	1943
Backpropagation	Early 1960s
Convolution Neural Networks	1979
Recurrent neural networks	1980
Long Short-Term Memory	1997

- Relationship among AI, ML, and DL
 - AI comes first (the largest), then machine learning (which blossomed later), and finally DL which is driving today's AI explosion !! <https://i.imgur.com/paCqYtK.png> =500x
- Why does the DL prevail now?
 - Hardware availability



Performance benchmark of neural architectures on CPUs and GPUs (Image source: http://cs231n.stanford.edu/slides/2017/cs231n_2017_lecture8.pdf)

- Data and models
 - Data
 - MNIST
 - COCO dataset
 - CIFAR
 - The Street View House Numbers
 - PASCAL VOC
 - Wikipedia dump
 - 20 Newsgroups
 - Penn Treebank
 - Kaggle
 - Models
 - ImageNet
 - VGG
 - ResNet
 - Inception
 - DenseNet
 - RNN
 - LSTM
 - AutoEncoders
 - Generative Adversarial Networks (GAN)
 - Reinforcement Learning (RL)
 - ...
- Deep learning frameworks
 - TensorFlow
 - Caffe2
 - Keras
 - Theano
 - PyTorch
 - Chainer
 - DyNet
 - MXNet
 - CNTK