Course Introduction

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Conversational Artificial Intelligence
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Who am I (Minlie Huang)?

- Dr. Minlie Huang
  - Associate Professor
  - Work at Tsinghua since 2006
- Research interests
  - Artificial intelligence
  - **Deep learning in NLP**
  - **Deep reinforcement learning in NLP**
  - Natural language processing
  - Dialogue systems, sentiment analysis

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Conversational Artificial Intelligence

http://coai.cs.tsinghua.edu.cn

Course Team Member

- Lecturer: Prof. Xiaoyan Zhu; A/Prof. Minlie Huang
- Office: FIT 3-509; FIT 4-504
- TA
  - Fei Huang 黄斐 (huangfei382@163.com)
  - Qi Zhu 朱祺 (zhu-q18@mails.tsinghua.edu.cn)
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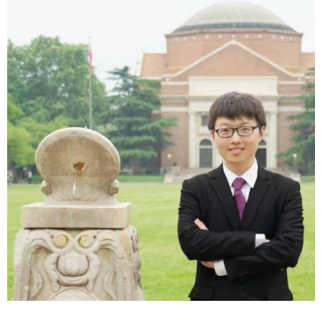
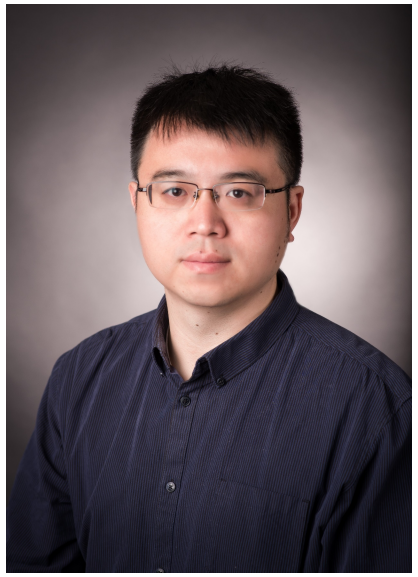
  - Chujie Zheng 郑楚杰 (zcj16@mails.tsinghua.edu.cn)
  - Jian Guan 关健 (j-guan19@mails.tsinghua.edu.cn)



Guest Lecturers (旷视)

- **孙剑**，现任旷视首席科学家、旷视研究院院长，主要研究方向是基于深度学习的图像理解、人脸识别、和计算摄影学。
- **范浩强**，毕业于清华大学交叉信息学院，主要研究方向为计算摄影。在 CVPR/ICCV/AAAI 等顶级学术会议上发表学术论文 20 篇，获 300 Faces in-the-Wild Challenge(ICCV2013) /FDDB/LFW 等多项挑战赛冠军。
- **张祥雨**，现任旷视研究院基础模型组负责人。师从孙剑博士和何恺明博士，研究方向包括深度卷积网络设计，深度模型的裁剪与加速等。曾在CVPR/ ICCV/ECCV/NIPS/TPAMI 等顶级会议/ 期刊上发表论文十余篇，获CVPR 2016 最佳论文奖，并多次获得顶级视觉竞赛ImageNet/COCO 冠军。代表作包括ResNet/ ShuffleNet v1/v2 等，Google Scholar 引用数40000+。
- **周舒畅**，低位宽网络Dorefa-net发明人，NIST TRAIT ‘16 第一名，现从事神经网络结构与体系结构交叉方向研究。



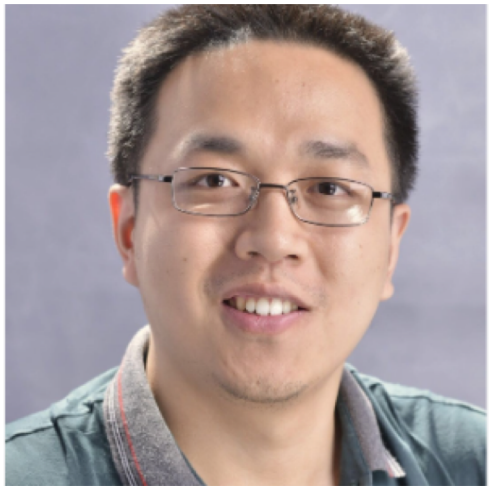


Table of Content

- Background
- MLP (Multi-layer Perceptrons)
- Platform for DL (PyTorch+Tensorflow, by TA)
- CNN (Convolutional Neural Networks)
- RNN (Recurrent Neural Network) + LSTM (Long short-term Memory Network)
- Autoencoder
- Advanced topics in Computer Vision (by 旷视)
- Neural Network Approximation (by 旷视)

- Special tracks
  - Deep Learning for NLP
  - Deep Reinforcement Learning
  - Introduction to GANs (by 旷视)
- Course Review

Keywords

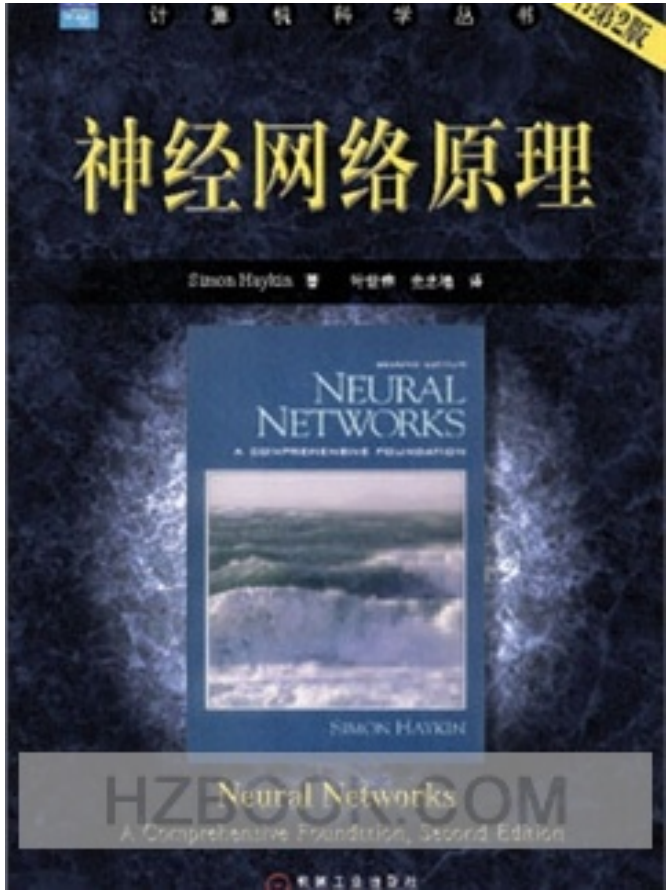
- Neural Network
- Deep Learning
- Convolutional Neural Network
- Recurrent Neural Network
- Autoencoders
- Deep Reinforcement Learning

Textbooks

- Simon Haykin’ s《Neural Networks and Learning Machines》(Third Edition) 机械工业出版社.
- Lecture notes and additional literature

References：

- 《Neural Networks and Intellect》, Oxford University Press. Inc. 2001
- 《人工神经网络教程》韩力群编著，2006年，北京邮电大学出版社



Resources

- Stanford University
  - CS229: Machine Learning http://cs229.stanford.edu/
  - CS231n: Convolutional Neural Networks for Visual Recognition http://cs231n.stanford.edu/
  - CS224n: Natural Language Processing with Deep Learning http://web.stanford.edu/class/cs224n/
- Carnegie Mellon University
  - CS 10-701: Machine Learning http://www.cs.cmu.edu/~epxing/Class/10701/index.html
  - CS 11-747: Neural Networks for NLP http://phontron.com/class/nn4nlp2017/index.html
  - CS 16-385: Computer Vision http://www.cs.cmu.edu/~16385/
- Massachusetts Institute of Technology
  - CS 6.036: Introduction to Machine Learning http://courses.csail.mit.edu/6.036/
  - CS 6.869: Advances in Computer Vision http://6.869.csail.mit.edu/fa17/
  - CS 6.864: Advanced Natural Language Processing http://courses.csail.mit.edu/6.864/

Resources

- University of Toronto
  - CSC321: Neural Networks for Machine Learning http://www.cs.toronto.edu/~tijmen/csc321/
- University of Montreal
  - Deep Learning and Reinforcement Learning https://mila.quebec/en/cours/deep-learning-summer-school-2017/

- 中文资料(偏向自然语言处理)：https://nndl.github.io/

Evaluation

- 4 Homeworks (**15*4=60 credits**)
  - Implement MLP with python （2nd week)
  - Implement CNN with Tensorflow (4th week)
  - Implement RNN on text classification Tensorflow (6th week)
  - Generate adversarial samples for image classification (8th week)
- Final project (**40 credits**)
  - Proposal/final presentations (16th week)
  - Code and report (17th week)

Homework I

- In this homework, you need to implement multilayer perceptron (MLP) to perform MNIST digits classification
  - Implement the forward/backward functions of **`Linear/Relu/Sigmoid/EuclideanLoss/Softmax`** layers
  - Construct a neural network with one hidden layer, and compare the difference of results when using **`Sigmoid`** and **`Relu`** as activation function
  - Construct a neural network with two hidden layers, and compare the difference results between one layer architecture and two layers architecture.

Homework II

- In this homework, you need to implement multilayer perceptron (MLP) and convolutional neural networks (CNN) to perform image classification with Tensorflow.
- MLP
  - Implement MLP code with Tensorflow.
  - Compare the difference of results when: 1) using **`Sigmoid`** and **`Relu`** activation function and 2) using one and two hidden layers.
- CNN
  - Implement CNN code with Tensorflow.
  - Compare the difference of results when: 1) using different convolutional window size and 2) using different hidden layers.

Homework III

- In this homework, you need work on sentence-level **sentiment classification** with Tensorflow.
  - Implement various **RNN** frameworks
  - Implement basic RNN units, e.g. **GRU** and **LSTM**
  - Extract features from pretrained BERT, and finetune your MLP

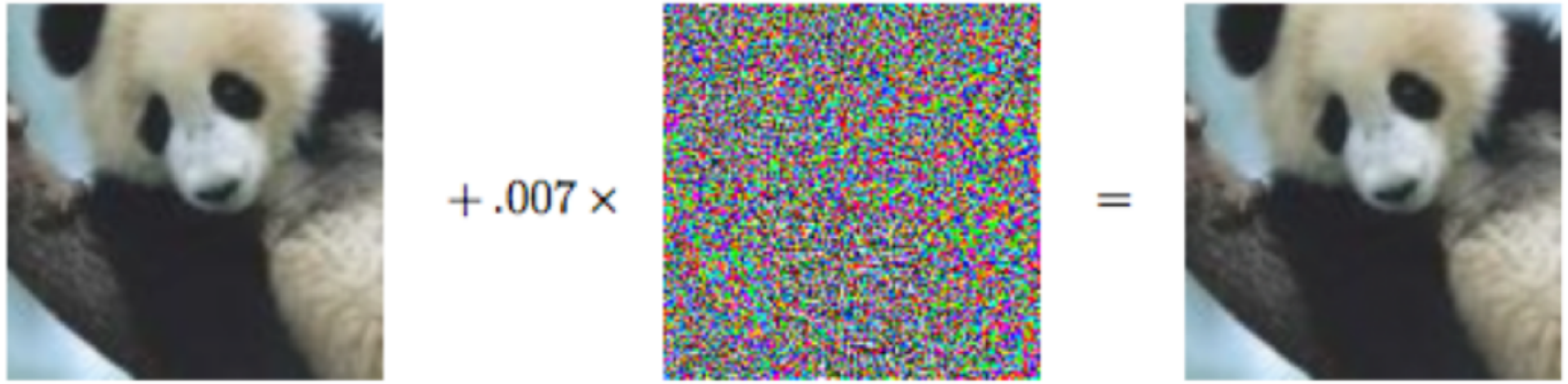
Staffs are not that friendly,
but the taste covers all.”

Staff

Taste

Homework IV

- In this homework, you need to **generate adversarial examples** with Tensorflow.
  - Implement **untargeted and targeted attack** to a trained classifier
  - Compare the success rate with **different loss functions** (e.g., cross entropy, hinge loss, lasso regularization, ridge regularization, etc.)



Final Project

- The Course Project is an opportunity for you to apply what you have learned in class to a problem of your interest. Potential projects usually fall into these two tracks:
  - **Applications**: Apply neural networks to problems related to your particular domain of interest. Pick a real-world problem and apply neural network to solve it
  - **Models**: Build a new model (algorithm) with neural network, or a new variant of existing models, and apply it to tackle tasks
- Potential topics:
  - Object Recognition, Object Detection, Image Captioning ……
  - Sentiment Classification, Dialogue Generation, Reading Comprehension ……
  - Generative Models, Reinforcement Learning ……

More about Final Project

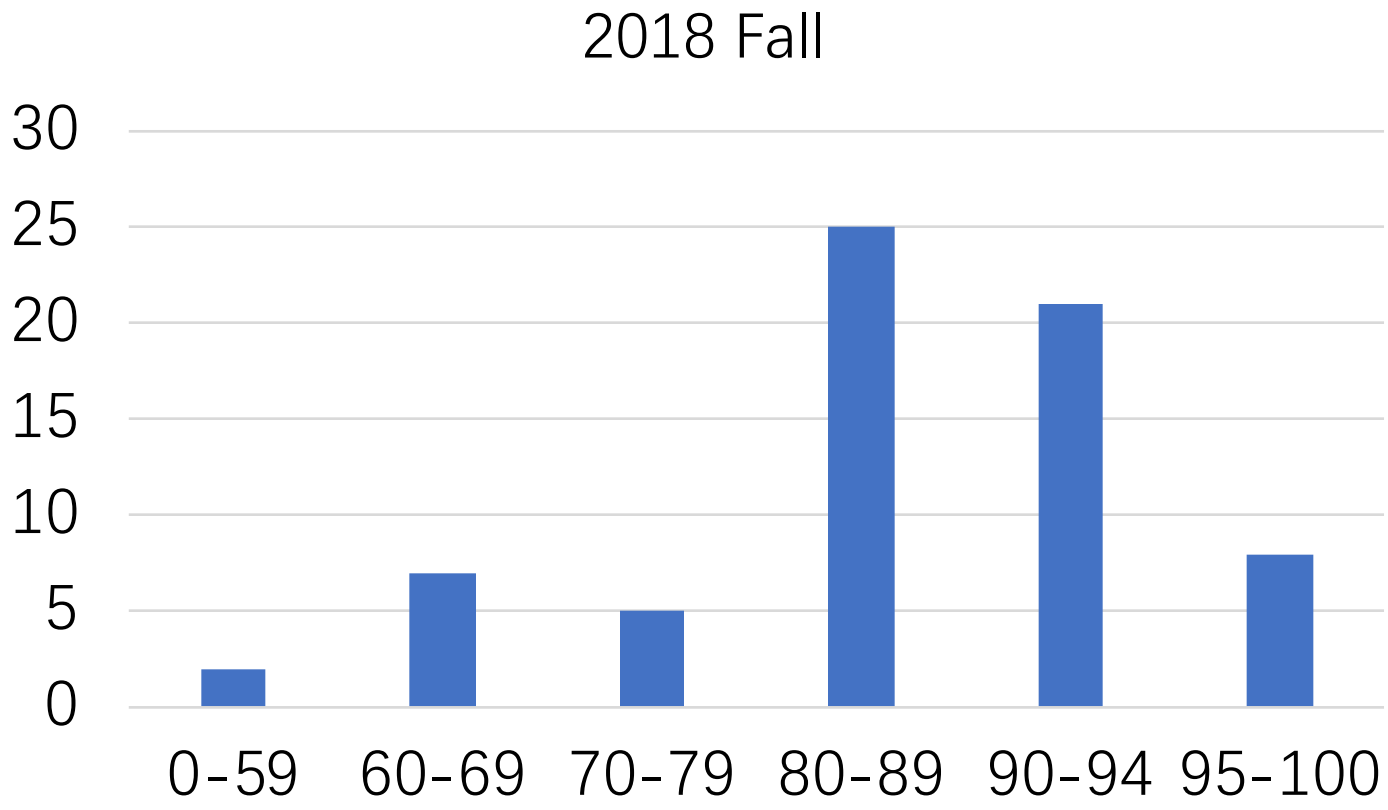
- Team project (2 or 3 students / team)
- Release a candidate list of topics **before Oct. 1**
- Can be an **ongoing research** project (before **half-completed**)
- Can be a **new research** project in lab (ask help from your supervisor)

- We will provide **1 GPU within two months** for each team (by **Face++**)
- From **Nov. 1 to Dec. 31**

- **Start as early as possible!**

Evaluation

- Score distribution in Fall 2018

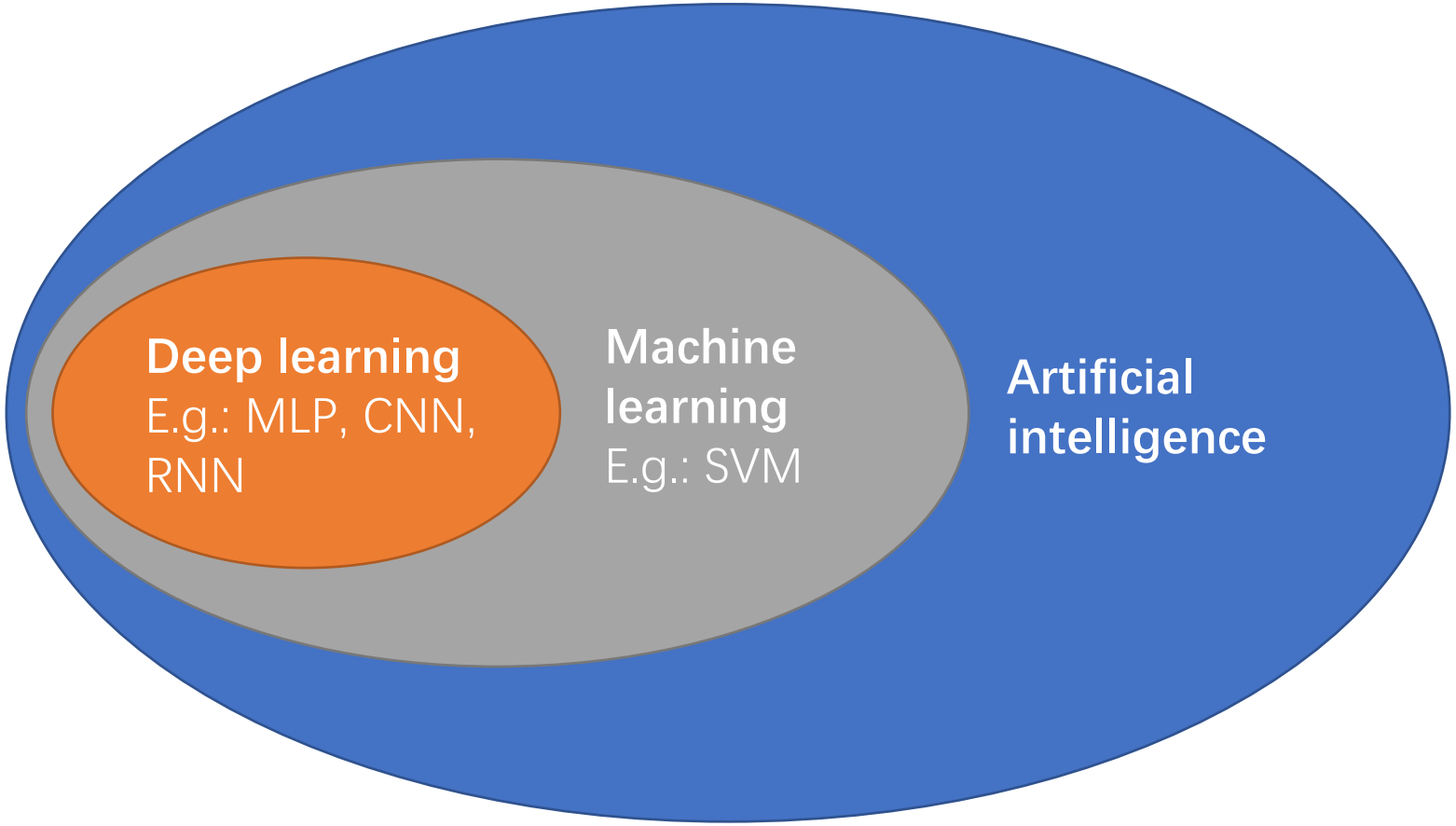


Important Things!

- No **Plagiarism** in homework (**0 credits**)
  - Even you do not know how-to-do, you need to type the codes by yourself, and conduct the experiments
- No **Delay** (**-1 for one-day delay, till 0**) for any homework

Why this course?

- Deep learning
- DL theories
- Combining ML with DL



Who is recommended to select this course

- 对深度学习一无所知，渴望学习新知识
- 对深度学习一知半解，想系统全面学习

- 劝退：
  - 已经精通深度学习，基本四次作业全都已经做过
  - 只是想凑个学分，划划水

Wechat Group

- Only for communication in this course

2019人工神经网络课程群

该二维码7天内(9月13日前)有效，重新进入将更新