# Course Introduction

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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**


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# Course Team Member

- Lecturer: Prof. Xiaoyan Zhu;  A/Prof. Minlie Huang
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- TA
  - Pei Ke 柯沛 (kepei1106@outlook.com)
  - Shiyao Wang 王诗瑶 (sy-wang14@mails.tsinghua.edu.cn)
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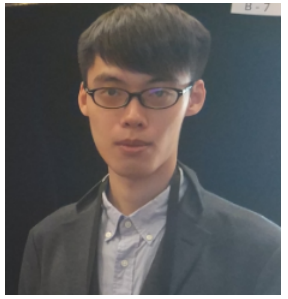


# Table of Content


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

- Special tracks
  - Deep Learning for NLP
  - Deep Reinforcement Learning
  - Memory Network + Sequence-level Learning (by TA)
- Course Review

# Keywords

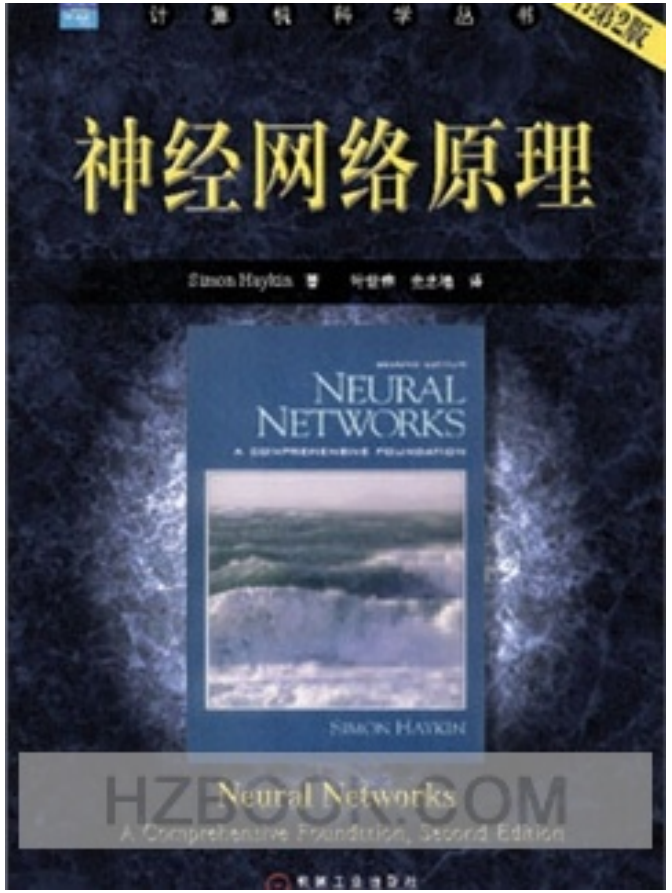
- Neural Network
- Deep Learning
- Convolutional Neural Network
- Recurrent Neural Network
- Autoencoders
- Deep Reinforcement Learning

# 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 python (4th week)
  - Implement MLP\CNN with Tensorflow (6th week)
  - Implement RNN on text classification with Tensorflow (8th week)
- Final project (**40 credits**)
  - Proposal/final presentations
  - Code and report
- Submission date (**to be announced**)

# 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`** 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 work on MNIST digits classification by using convolutional neural network (CNN)
  - implement forward/backward functions of **`Conv2D/AvgPool2D/SoftmaxCrossEntropyLoss`** layers (*hard*)
  - construct a CNN to predict labels and compare the difference of results you obtained in MLP homework
  - visualize the output of first convolution layer after **`ReLU`** for 4 different digit images

# Homework III

- In this homework, you need to implement multilayer perceptron (MLP) and convolutional neural networks (CNN) to preform MNIST 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 VI

- 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**
  - Implement **attention** mechanism to improve accuracy

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

Staff

Taste

# Final Project

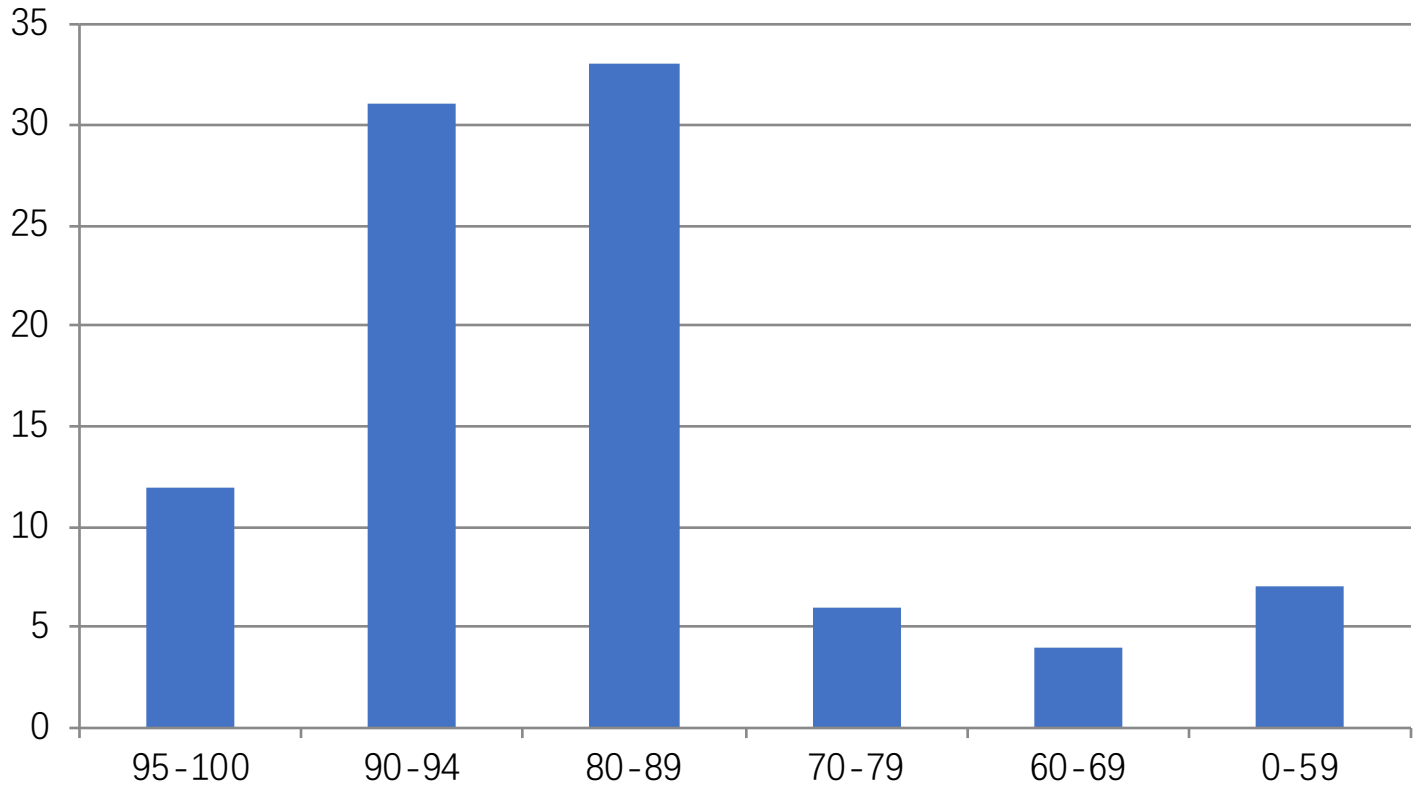
- The Course Project is an opportunity for you to apply what you have learned in class to a problem of your interest. Potential projects usually fall into these two tracks:
  - **Applications**: Apply neural networks to problems related to your particular domain of interest. Pick a real-world problem 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

- 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)
- **Start as early as possible!**

# Evaluation

- Score distribution in Fall 2017



# 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

# Wechat Group

- Only for communication in this course

2018人工神经网络课程群

Valid until 9/24 and will update upon joining group