Artificial Neural Networks and Deep Learning

Syllabus

開課系所: 資訊工程學系 Department of Computer Science and Information Engineering 課程中文名稱:人工神經網路與深度學習

A. <u>Prerequisites(先修課程):</u>

- Proficiency in Python, high-level familiarity in C/C++
- Calculus, Linear Algebra You should be comfortable taking derivatives and understanding matrix vector operations and notation.
- Basic Probability and Statistics You should know basics of probabilities, gaussian distributions, mean, standard deviation, etc.
- B. <u>Objective(教學目的)</u>:

The objectives of this course are to study the basic neural networks architecture and theory, explore the recent development of deep learning, and extend to their advanced applications. The students are to be exposed to a broad range of domain-specific applications study and analysis, and state-of-art research in neural networks and deep learning. Recent developments in neural network (aka "deep learning") approaches have greatly advanced the performance of the state-of-the-art visual recognition systems. This course is a deep dive into details of the deep learning architectures with a focus on learning end-to-end models for these tasks, particularly image classification. During the 18-week course, students will learn to implement, train and debug their own neural networks. We will focus on teaching how to set up the problem of image recognition, the learning algorithms (e.g. backpropagation), practical engineering tricks for training and fine-tuning the networks and guide the students through hands-on assignments and a final course project.

C. <u>Course Outline (內容綱要)</u>:

Part I Fundamentals

- 1. Introduction to Artificial Neural Networks and Deep Learning.
- 2. Linear Classifier: TLU and Perceptron

Part II Supervised Learning

- 3. Non-linear Classifier: Back-propagation
- 4. Convolutional Neural Networks

Part III Unsupervised Learning

- 5. Competitive Learning
- 6. Self-organization Feature Maps
- 7. Unsupervised Deep Learning

Part IV Others

- 8. Co-learning Workshop: the state-of-art deep learning paradigms-AlexNet, VGG, GoogLeNet, ResNet, ResNeXt, SENet, etc..
- * Workshop for Deep Learning Programming Practices will be arranged

D. <u>Future Job Skill Highlight(未來職涯發展):</u>

Deep learning has emerged as one of the most active technology areas within the broader field of artificial intelligence. According to the new market research report "Deep Learning Market by Application (Image Recognition, Signal Recognition, Data Mining), Offering (Hardware (Von Neumann and Neuromorphic Chip), and Software), End-User Industry, and Geography - Global Forecasts to 2022", the deep learning market is expected to be worth USD 1,722.9 Million by 2022. Deep learning is primarily an enabling technology, making areas like machine perception, big data analytics, finance, manufacturing, media, and healthcare much stronger. Therefor, the demand and capacity of AI and deep learning talents in the job market is overwhelmingly increasing. Machine Learning and deep learning has been essential knowledge that the students must equip themselves for either conducting research or pursue better career.

E. Grading Policy :

- 1. Programming Assignment #1: 15% (accuracy: 75%, presentation: 25%)
- 2. Programming Assignment #1: 15% (accuracy: 75%, presentation: 25%)
- 3. Programming Assignment #2: 15% (accuracy: 75%, presentation: 25%)
- 4. Midterm Exam: 30%.
- 5. Term Projects and Presentation: 25% (accuracy: 75%, presentation: 25%)
- 6. Take out 1% from the final score per absence

F. <u>Handout: (http://www.csie.ntpu.edu.tw/~dalton)</u>

G. <u>References:</u>

- 1. Deep Learning, by Ian Goodfellow and Yoshua Bengio and Aaron Courville, MIT Press, 2016
- 2. Neural Networks and Deep Learning, by Michael Nielsen, 2017

3. Deep Learning with Python, Nikhil Ketkar, Apress, 2017

- 4. Neural Networks and Machine Learning, Simon Haykin, 3nd ed., Pearson, 2009
- 5. Stanford University, Convolutional Neural Network for Visual Recognition,

http://cs231n.stanford.edu/

6. UC Berkeley, Deep Learning, https://github.com/joanbruna/stat212b