Syllabus: Machine Learning in Practice

1 Course Objectives

Machine learning is concerned with inductive learning algorithms that automatically generate an algorithm from a set of data. It has a huge potential for real-world algorithmic problems that are ill-defined or intractable such as image classification, object detection, and PSPACE-hard combinatorial games. This course introduces the basics of machine learning from the practical point of view, and focuses especially on the tools and applications of deep neural network such as DQN, AlphaGo, and TensorFlow.

2 Contents

- Introduction to machine learning
    - components: model architecture, objective function, optimization algorithm
    - types: supervised learning, unsupervised learning, reinforcement learning
    - existing techniques: multi-layer neural networks, support vector machines (SVM), Bayesian network, decision tree, k-nearest neighbor
- Software toolkit for machine learning: TensorFlow
- Neural networks
    - perceptrons, activation functions, multi-layer feed-forward networks
    - back-propagation learning, hyperparameter optimization, dropout
- Deep neural networks
    - convolution neural networks, convolution/pooling layers
    - recurrent neural networks, deep belief networks
- Reinforcement learning
    - Markov decisioin process, optimal policy, policy/value iteration
    - model-free learning, Monte-Carlo learning, temporal-difference learning
    - SARSA, Q-learning
    - deep reinforcement learning
- Case study: DQN, AlphaGo

3 Text & References

- "*Artificial Intelligence: A Modern Approach*", S. Russell and P. Norvig
- "*Machine Learning*", T. Mitchell
- "*Reinforcement Learning*", S. Sutton and A. Barto

- *"Fundamental of Deep Learning"*, N. Buduma
- *"First Contact with TensorFlow"*, J. Torres
  - On-line book (in English):
    `http://www.jorditorres.org/first-contact-with-tensorflow`
  - On-line book (in Korean):
    `https://tensorflowkorea.wordpress.com/2016/04/28/first-contact-with-tensorflow`
- Course materials on-line:
  - Stanford CS231n: `http://cs231n.stanford.edu`
  - Stanford CS229: `http://cs229.stanford.edu`
  - Stanford CS234: `http://cs234.stanford.edu`
  - MIT AI-related courses: `http://ocw.mit.edu/courses/find-by-topic/`
    `#cat=engineering&subcat=computerscience&spec=artificialintelligence`

4 Lecture Schedule

#	Topics	Practice/Assignment
1	Course Overview Python Language	tool installation numpy library
2	Machine Learning Overview TensorFlow Basics	regression, *k*-clustering
3	Neural Network	digit classifier
4	Convolutional Neural Network	image classifier
5	Reinforcement Learning	maze, breakout, catch
6	Deep Reinforcement Learning	
7	Combinatorial Games Search Heuristics for Games	simple games, tic-tac-toe
8	Monte-Carlo Policy Iteration AlphaGo	5×5 go