IDS 576 (Spring 2017)
Advanced Predictive Models and Applications for Business Analytics

Overview

The goal of this class is to cover advanced machine learning techniques not covered in IDS 572. Broadly, we will cover topics spanning graphical models and deep learning. Graphical models are a very useful tool set for inferring outcomes and making predictions conditional on preceding events, even when we do not have full information. They have found success in tracking, speech recognition, language modeling (Hidden Markov Models), image segmentation (Markov Random Fields) and many other applications. Similarly, we will study the basics of deep learning architectures, their design choices and how they are trained using gradient methods. We will also study recurrent and convolutional architectures which achieve state of the art in challenging prediction tasks in computer vision and text applications.

Logistics

Lectures: Wednesdays 6.00 to 8.30 PM 2LCC C001

Instructor: Theja Tulabandhula, UH 2404 (`theja@uic.edu`)
Instructor Office Hours: Wednesdays 8.30 - 9.30 PM and Thursdays 3.00 - 5.00 PM[1]

TA: Minghong Xu (`mxu29@uic.edu`)
TA Office Hours: TBD

Course materials will be available on Blackboard.
Attendance is essential and will be randomly assessed. Cell phones need to be switched off and being on time is expected.

Prerequisites

- Linear Algebra, Calculus, Statistics, Probability (see for instance, `http://www.deeplearningbook.org/` Part I) and IDS 572.
- Also, basic familiarity with Python (Jupyter/IPython) will be assumed. We will potentially use the following modules: Tensorflow, Theano, Keras, Pandas, Numpy, Scipy and Matplotlib among others.

[1] 1) Other times/email less preferred due to time constraints. 2) Attempt to make use of TA office hours first. 3) Please put sufficient effort before seeking help.

Assignments and Project

- There will be two (lengthy) assignments and one project that assess your understanding of the lecture material (details will be posted on Blackboard). Make use of TA and Instructor office hours.
- They should be completed in groups of three students. The self-formed groups, once decided, cannot be changed during the semester. You will communicate your groups when handing in your work for the first assignment.
- Assignment solutions will be evaluated based on correctness, content and clarity of presentation (40%-40%-20% split). No credit will be given if sufficient explanation of how results were obtained is not provided. Use of published materials is allowed, but the sources should be **explicitly** stated in your solutions.
- Projects will also be evaluated based on the above criteria, viz., correctness (35%), content (35%) and clarity (20%), in their reports. Further, there will be a presentation (10%) by each group, which will be held in class on **April 26 2017**[2]. More details will be provided on Blackboard.
- All solutions and reports need to be uploaded on Blackboard (one per group) as a pdf by their respective due dates. Late submission after the due date will attract a 25% point deduction per day.

Exam

- An in-class exam will be held on **March 29th 2017**[3]. There will be no separate final exam during the exam week.
- The exam is closed book, but one 8.5×11-inch notesheet is allowed. No computers are allowed.
- No make-up exam will be given except for provable unforeseen circumstances (medical emergencies etc). In these cases, the student should contact the TA before the exam. No case will be considered after the exam is over.

Grades

- Assignments: 10%+10%
- Project: 50%
- Exam: 25%
- Attendance: 5%

[2]Do not make travel plans on this date.
[3]Do not make travel plans on this date.

Tentative Topics in the Syllabus

Deep Learning

- Focus on applications:
  - Text (word2vec, tSNE for visualization), speech and vision
  - Use in deep reinforcement learning (DQN and AlphaGo)
- Focus on:
  - Nonlinearities and objective functions
  - Chain rule, backpropagation and gradient descent
  - Dropout, hyperparameter tuning and other design choices
  - Autodiff packages such as Tensorflow, Theano, Caffe and Torch
- Hands on:
  - Train a logistic regression classifier and a SVR (examples of shallow models)
  - Train a CNN for a supervised classification task and learn about the architectural choices,
  - Train a specific RNN (LSTM) for image captioning (char-rnn)

Probabilistic Graphical Models

- Focus on applications:
  - Text, speech and vision
- Focus on:
  - HMMs
  - Markov Random Fields
  - Bayesian Networks
  - Gibbs Distribution
  - Learning and inference (including intractability and approximate inference)
- Hands on:
  - PyMC

Academic Integrity

Students are expected to follow University guidelines on academic integrity and honesty. Plagiarism without attribution, fabrication, cheating will net zero points. Violations will be escalated to the department administration. Please review `http://www.uis.edu/academicintegrity/policy/`.