

Recent Advances in Deep Learning: Learning Structured, Robust, and Multimodal Models

Abstract

Statistical machine learning is a very dynamic field that lies at the intersection of Statistics and computational sciences. The goal of statistical machine learning is to develop algorithms that can "learn" from data using statistical and computational methods. Over the last decade, numerous research fields, such as computational biology, neuroscience, artificial intelligence, data mining, signal processing, finance have been strongly influenced by advances in machine learning.

This one-day course provides detailed overview of statistical models for data mining, inference and prediction, as well as about recent advances in deep learning techniques. Some knowledge of statistical modeling, especially regression techniques will be useful. Specific topics to be covered include:

Outline of the Day

WHAT IS MACHINE LEARNING?

- What is machine learning?
- Where is machine learning used? The data mining process
- Types of models: supervised learning models: classification, regression; Unsupervised learning models: clustering, density modeling, dimensionality reduction

INTRODUCTION TO MODELING

We will consider commonly used algorithms:

- Classical Regression,
- Logistic Regression for Classification,
- Lasso and Related Methods,
- PCA (Principal Components Analysis), SVD and its variations,
- Autoencoder models

INTRODUCTION TO DEEP LEARNING

- Neural Networks, Graphical Models
- Markov Random Fields, Conditional Random Fields
- Restricted Boltzmann Machines and their generalizations
- Deep Belief Networks, Deep Boltzmann Machines, Hierarchical-Deep Models

APPROXIMATE INFERENCE ALGORITHMS FOR FITTING DEEP LEARNING MODELS

- Approximate variational inference, mean-field inference
Markov chain Monte Carlo, Gibbs sampling, and Metropolis-Hastings algorithm

APPLICATIONS AND MODEL EVALUATION

- We will consider various application domains, including computer vision, speech recognition, natural language processing, and collaborative filtering / building recommender systems.

Biography



Dr. Ruslan Salakhutdinov received his PhD in computer science from the University of Toronto in 2009. After spending two post-doctoral years at the Massachusetts Institute of Technology Artificial Intelligence Lab, he joined the University of Toronto as an Assistant Professor in the Departments of Statistics and Computer Science. His primary interests lie in artificial intelligence, machine learning, deep learning, and large-scale optimization. His main research goal is to understand the computational and statistical principles required for discovering structure in large amounts of data. He is an action editor of the Journal of Machine Learning Research and served on the senior programme committee of several learning conferences including NIPS and ICML. He is an Alfred P. Sloan Research Fellow, Microsoft Research Faculty Fellow, a recipient of the Early Researcher Award, Connaught New Researcher Award, Google Faculty Research Award, and is a Fellow of the Canadian Institute for Advanced Research.

Schedule

08:30-09:15	Registration & Breakfast
09:15-09:30	Welcoming Remarks <i>Wendy Lou, Janet McDougall, Leonid Khinkis, Ruth Croxford</i>
	Introduction <i>Georges Monette</i>
09:30-10:45	OVERVIEW OF MACHINE LEARNING <i>Ruslan Salakhutdinov</i>
10:45-11:00	Coffee Break
11:00-12:30	INTRODUCTION TO MODELING <i>Ruslan Salakhutdinov</i>
12:30-14:00	Networking Lunch Career-Advice Panel: <i>Ruth Croxford, Lorinda Simms, and Tony Panzarella</i>
13:00-14:00	Poster Presentations
14:00-15:15	INTRODUCTION TO DEEP LEARNING <i>Ruslan Salakhutdinov</i>
15:15-15:30	Coffee Break
15:30-16:30	APPROXIMATE INFERENCE METHODS FOR DEEP LEARNING <i>Ruslan Salakhutdinov</i>
16:30-17:00	APPLICATION AND MODEL EVALUATION <i>Ruslan Salakhutdinov</i>
17:00-17:15	Awards Presentation & Closing Remarks <i>Wendy Lou, Paul Corey, Georges Monette</i>
17:15-18:00	SORA Annual General Meeting <i>Xin Gao, Hugh McCague</i>
18:00-20:00	Networking Dinner (optional, pay for your own)