Technical PhD Seminar Series

**Machine Learning and EnGINEERING APPLICATIONS**

Spring SEMESTER 2018

# Introduction

Machine Learning together with data streams offer a new and universal way of looking at the world phenomena, which is radically different than classical disciplinary and theory based approaches. Opposite to theory driven approaches, machine learning, which is a relatively new field of research inverts the process of scientific modeling. By asking a proper question and having a lot of observations around that question, machine learning promises to learn good answers from the provided data sets. Therefore, the trained models have a larger capacity to deal with unique and complex problems that have no a priori descriptive theories.

# Format

However, while new machine learning algorithms such as deep learning have created a new wave of applications in computer vision and natural language translation, there are a lot of complex engineering applications, yet to be investigated.

Therefore, while during the last semesters our main focus has been mainly on machine learning techniques and concepts, this semester we focus at the intersection of several specific applications and machine learning techniques.

|  |  |
| --- | --- |
| **Applications** | **Main Machine Learning Topics** |
| * Real Estate Market Dynamics * City Pattern Mining   + Urban Air Quality Estimation   + Geo-Visualization of High Dimensional Patterns * Urban Morphology (Study of Urban Forms) * Structural Design and Design Space Exploration * Learning Physics: How to speed up slow physics based methods   + Topology Optimization   + Computational Fluid Dynamics (e.g. Wind, Water and Heat) * Systemic Risk in Economic and Transportation Networks * Natural Language Processing | * Least Square Method, Gradient Descent, Back-Propagation * Ensembles for Classification and Predictions * Self Organizing Maps and Dimensionality Reduction Techniques * PCA and Deep Auto-Encoders * Multi-Layer Perceptron * Convolutional Neural Networks and Representation Learning * Recurrent Neural Networks * Markov Chains |

# Expectations From The Participants

Everybody is welcome to attend to (any-all of) the lectures. But those who register for this course are highly encouraged to actively participate in the discussions and bring their own problems/projects that can be approached by machine learning.

Also, all the participants are highly encouraged to check the presentations of the last semesters:

2016: <https://github.com/sevamoo/data_driven_modeling_2016>

2017: <https://github.com/sevamoo/data_driven_modeling_2017>

**Dates: Tuesdays 14:00-16:00**

**Introduction: Tuesday, February 20, 2018**

**Place: Chair for CAAD, D-ARCH/ITA/CAAD HIB E16**

**Course tutor: Vahid Moosavi**