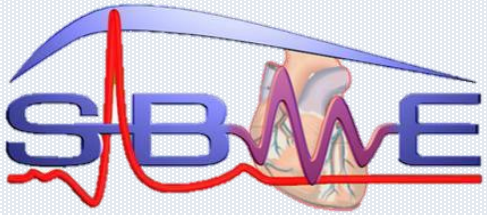

Advanced Topics in Systems Machine Learning

Introduction

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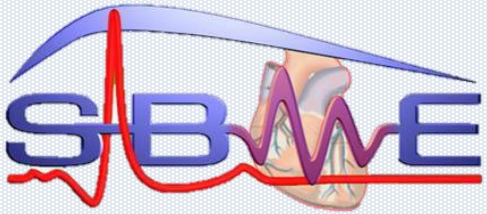
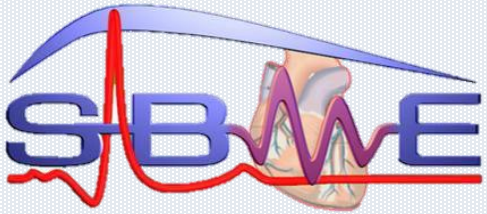
What is Machine Learning(ML)?

- Arthur Samuel: "It is a science that gives the computer the ability to learn without the need to write a program".
- It is about seeking a predictive and/or executable understanding of natural/ artificial subjects, phenomena, or activities from …
- Grew out of work in AI: dream to Mimic human brain.



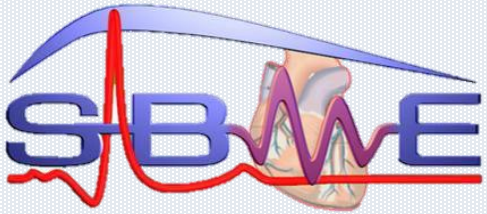
ML Related Disciplines

- Developed as a new capability for computers
- Touches many aspects in industry and basic science
- Examples:
  - Database mining
    - web click data,
    - medical records,: CAD systems, developmental and cognitive phycology
    - computational biology(: Gene sequences, DNA sequence
    - Engineering
  - Applications can't program by hand
    - autonomous helicopters : how to fly by itself
    - handwriting recognition : Mail address reading
    - Natural language processing
    - computer vision
  - Self customized programs
    - Amazon,
    - Netflix product recommendations: Customize preferences
  - Understand human learning
    - Understanding Brain functions
    - Real AI



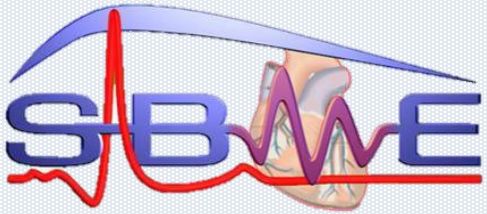
Course Description

- Course Objectives:
  - Define Machine learning, and its different tools
  - Develop these machine learning systems
  - Gain Tricks of ML tools well in order to gain more success
  - Knowledge of Best practices for system designs



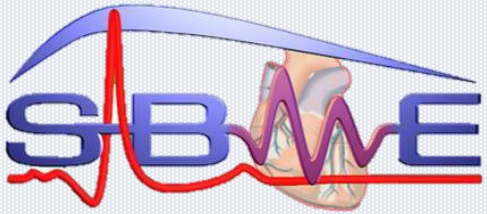
Course Description

- Course Outline
  - Introduction
  - Logistic Regression and Symbolic Problem representation
  - Regularization
  - Machine Learning System Design and practical advice for system building
  - Neural Networks
  - Support Vector Machines
  - Genetic Algorithm
  - Clustering
  - Dimensionality Reduction
  - Reinforcement Learning
  - Recommender systems
  - Deep Learning
  - Large scale Machine Learning
  - Application Example



Course Description

- Reference Books
  - Christopher Bishop, Pattern Recognition and Machine Learning. Springer, 2006.
  - Richard Duda, Peter Hart and David Stork, Pattern Classification, 2nd ed. John Wiley & Sons, 2001.
  - Tom Mitchell, Machine Learning. McGraw-Hill, 1997.
- Grading Policy
  - Paper critiques
  - Sheets and exercises
  - Final Project
- Programing Tools:
  - Matlab/ Octave / Python

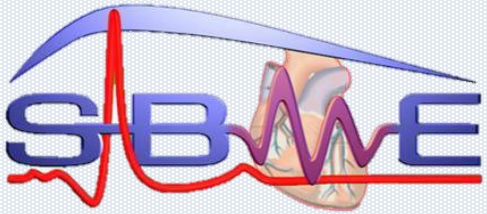


History of Machine Learning

- 1950's, Samuel's wrote a checkers playing program. And the
- The checkers playing program learns over time what are good board positions and what are bad board positions.
- learn to play checkers better than Arthur Samuel himself was able to.
- the computer was able to get so much checkers-playing experience that it eventually became a better checkers
- Tom Mitchell defines machine learning by

"A computer program is said to learn from experience E, with respect to some task T, and some performance measure P, if its performance on T as measured by P improves with experience E"

- The experience E: the experience of having the program play 10'sof 1000's of games against itself.
- The task t, will be the task of playing checkers.
- The performance measure p, will be the probability that it wins the next game of checkers against some new opponent.



Defining the Learning Task

- Checkers board game:
  - T: Playing checkers
  - P: Percentage of games won against an arbitrary opponent
  - E: Playing practice games against itself
- Handwriting Recognition
  - T: Recognizing hand-written words
  - P: Percentage of words correctly classified
  - E: Database of human-labeled images of handwritten words
- Automatic driving
  - T: Driving on four-lane highways using vision sensors
  - P: Average distance traveled before a human-judged error
  - E: A sequence of images and steering commands recorded while observing a human driver.
- Email Filtering
  - T: Categorize email messages as spam or legitimate.
  - P: Percentage of email messages correctly classified.
  - E: Database of emails, some with human-given labels