THE UNIVERSITY OF TENNESSEE KNOXVILLE

AICIP RESEARCH

COSC 522 – Machine Learning

Introduction

Hairong Qi, Gonzalez Family Professor
Electrical Engineering and Computer Science
University of Tennessee, Knoxville
https://www.eecs.utk.edu/people/hairong-qi/
Email: hqi@utk.edu

UT_COSC522 F24 | General | Microsoft Teams

Outline

AICIP RESEARCH

- 1. Related courses offered at UT and their differences
- 2. What are we going to learn in this class?
- 3. Do I have enough background?
- 4. Syllabus
- 5. Terminologies

1. Courses at UT and Differences

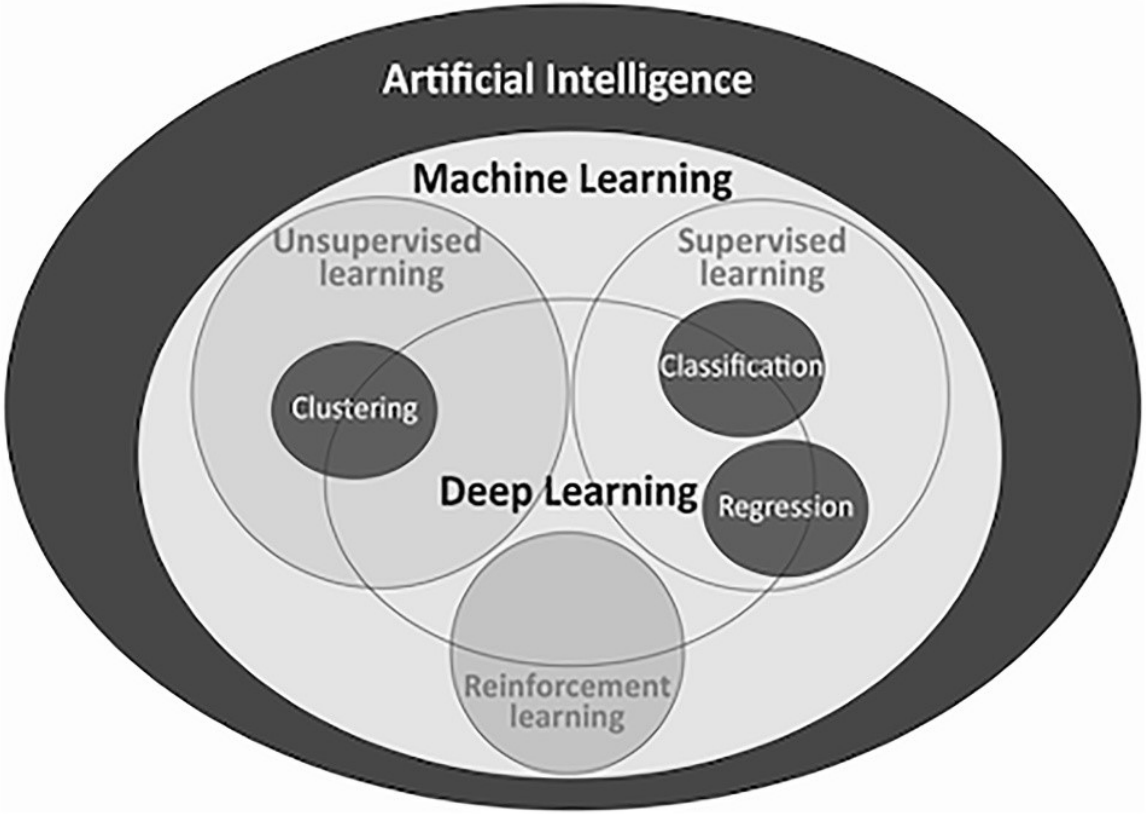
AICIP RESEARCH

- Intro to Machine Learning (COSC 325)
- Machine Learning (COSC 522)
- Artificial Intelligence (COSC 423/523)
- Natural Language Processing (COSC 524)
- Deep Learning (COSC 424/525)
- Data Mining and Analytics (COSC 426/526)
- Biologically-Inspired Computation (COSC 420/527)
- Reinforcement Learning (ECE 414/517)
- Special Topic Class: Adversarial Learning (ECE 599)

- Machine Learning Minor (15 hours)
- Artificial Intelligence and Machine Learning Graduate Certificate (15 hours)

AICIP RESEARCH

AI vs. ML vs. DL
Supervised vs. Unsupervised vs. Reinforcement Learning



M. Mafu, "Advances in artificial intelligence and machine learning for quantum communication applications," IET Quantum Communication, 2024, DOI: 10.1049/qtc2.12094

A Comparison between AI and ML Contents

AICIP RESEARCH

Artificial Intelligence: A Modern Approach

(Fourth edition, 2020)

by Stuart Russell and Peter Norvig

The leading textbook in Artificial Intelligence, used in over **1400** schools in over **120** countries.

Table of Contents

http://aima.cs.berkeley.edu/

A Bit of History of AI Development

AICIP RESEARCH

- 1956-1976
  - 1956, The Dartmouth Summer Research Project on Artificial Intelligence, organized by John McCarthy, Marvin Minsky, Nathaniel Rochester, and Claude Shannon

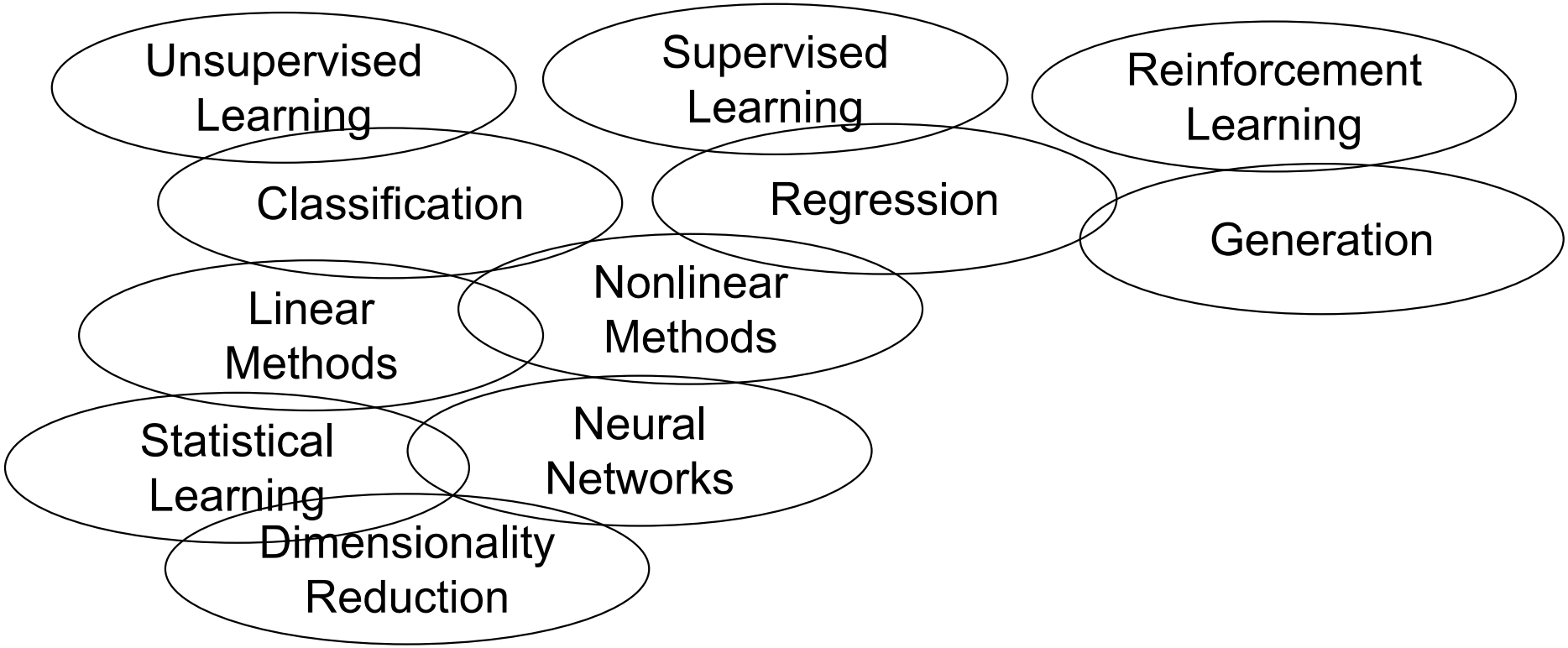
> We propose that a 2 month, 10 man study of artificial intelligence be carried out during the summer of 1956 at Dartmouth College ... The study is to proceed on the basis of the conjecture that every aspect of learning or any other feature of intelligence can in principle be so precisely described that a machine can be made to simulate it. An attempt will be made to find how to make machines use language, form abstractions and concepts, solve kinds of problems now reserved for humans, and improve themselves. We think that a significant advance can be made in one or more of these problems if a carefully selected group of scientists work on it together for a summer.

  - The rise of symbolic methods, systems focused on limited domains, deductive vs. inductive systems
  - 1973, the Lighthill report by James Lighthill, “Artificial Intelligence: A General Survey” - automata, robotics, neural network
  - 1976, the AI Winter
- 1976-2006
  - 1986, BP algorithm
  - ~1995, The Fifth Generation Computer
- 2006-???
  - 2006, Hinton (U. of Toronto), Bengio (U. of Montreal), LeCun (NYU)
  - 2012, ImageNet by Fei-Fei Li (2010-2017) and AlexNet

https://en.wikipedia.org/wiki/Dartmouth_workshop
https://en.wikipedia.org/wiki/Lighthill_report

2. Topics Covered

AICIP RESEARCH



Solve Real-World Problems!!!

3. Pre-/Co-requisites

AICIP RESEARCH

- Probability
- Linear Algebra
- Multivariate Calculus
- Python Programming
  - Jupyter notebook
  - colab

4. Syllabus – Course Policy

AICIP RESEARCH

- Assignment is due 11:59pm on the due date with electronic submission through Canvas.
- Late policy: Each student is given a 48-hour grace period cumulatively for all assignment. The unused grace period will be counted toward bonus (0 ~ 1pt) added to the final average. The bonus is modeled as a Gaussian with an std TBD.
- Grading
  - Homework (5): 25%
  - Project (4): 32%
  - Tests (2): 28%
  - Final Project Report and Presentation: 10+5%
  - Graduate Seminar (The TRUST Seminar): 1%

AICIP RESEARCH

4. Syllabus – Course Description

- Theoretical and practical aspects of machine learning techniques related to pattern recognition. Statistical methods studied include Bayesian and linear classifiers, support vector machines, neural networks, and unsupervised learning. Syntactic methods include grammatical inference, string matching and Markov chains. Ensemble methods include random forests, adaptive boosting, and classifier fusion.

4. Syllabus - Schedule

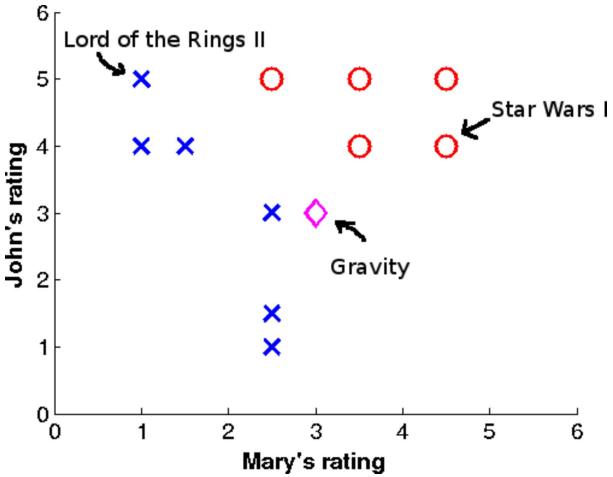
AICIP RESEARCH

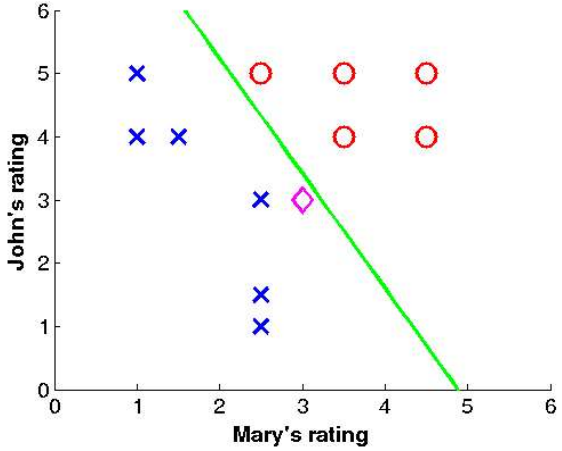
Date	Topics	Reading	Assignment
	Part 1: Statistical Methods		
	Baysian Learning		
08/20	Introduction and Baysian Decision Theory		
08/22	Parametric Learning		
08/27	Non-Parametric Learning		
08/29	ML with Python (taught by TA)		
09/03	Recap		
09/05	Homework and Project Discussion (taught by TA)		
	Neural Networks		
09/10	Biological Neuron and Perceptron		
09/12	Back Propagation and Gradient Descent		
09/17	Kernel Methods		
09/19	Support Vector Machine		
09/24	SVM		
09/26	Test 1		
	Regression		
10/01	Linear Regression		
10/03	Logistic Regression		
~~10/08~~	~~Fall Break (No Class)~~		
	Unsupervised Learning		
10/10	k-means		
10/15	Hierarchical methods and auto-encoder		
10/17	recap		
	Dimensionality Reduction		
10/22	Supervised methods		
10/24	Unsupervised methods		
	Part 2: Ensemble Methods		
10/29	Decision Tree and Random Forests		
10/31	Boosting and AdaBoost		
	Baysian-based Fusion		
~~11/05~~	~~Election Day (No Class)~~		
11/07	Test 2		
	Part 3: Reinforcement Learning (TBD)		
11/12	RL		
11/14	RL		
	Part 4: Syntactic Methods (TBD)		
11/19	Markov Chain		
11/21	NLP		
11/26	NLP		
~~11/28~~	~~Thanksgiving (No Class)~~		
12/03	Semi-supervised Learning and Self-supervised Learning		
12/11	Final Presentation (3:30-6:00PM)		

AICIP RESEARCH

5. Terminologies through a Toy Example

Movie name	Mary's rating	John's rating	I like?
Lord of the Rings II	1	5	No
...	...	...	...
Star Wars I	4.5	4	Yes
Gravity	3	3	?





- Supervised learning:
  - Training data vs. testing data
  - Training: given input-output pairs
- Features
- Samples
- Dimensions