Machine Learning
CSCE 4205/5215

Course Overview

Instructor: Zeenat Tariq

Course Topics

Module 1: Introduction: Machine Learning concepts

Module 2: Computational foundations, Exploratory data analysis

Module 3: Supervised Learning methods

Module 4: Bayesian Networks

Module 5: Ensemble Learning

Module 6: Unsupervised Learning, Semi supervised learning

Module 7: Dimensionality reduction, feature selection and engineering

Module 8: Deep Learning

Topic Details

- Intro. to Machine Learning
- Categories of machine learning and data representation
- Data visualization, Exploratory data analysis
- Introduction to Supervised Learning Methods
- K nearest neighbors classifiers
- Tree based Methods, Decision Tree, Random Forest
- Support vector machines, Linear and Logistic regression
- Bayesian learning
- Ensemble Learning: Bagging, Boosting, Ada boosting
- K means clustering
- Feature Selection/extraction, engineering and transformation
- Dimensionality Reduction, Intro. to PCA and autoencoders
- Deep learning, Reinforcement learning

Prerequisites

- Knowledge of basic computer science skills
- Familiarity with theory of probability
- Familiarity with random variables
- Familiarity with multivariable calculus and linear algebra
- Basic programming (in Python and NumPy)

Grading Criteria

- 25% Participation activities
- 20% Assignments (2-3)
- 25% Presentations (Project Presentation)
- 15% Quizzes (Open book 3-4)
- 15% Exam
- Bonus (Possible one extra credit activity)

Grading Policy

- A: 90-100%
- B: 80-89%
- C: 70-79%
- D: 60-69%
- F: 59 and below

What is Machine Learning?
An Overview.

"Machine learning is the hot new thing."

-- John L. Hennessy, President of Stanford (2000-2016)

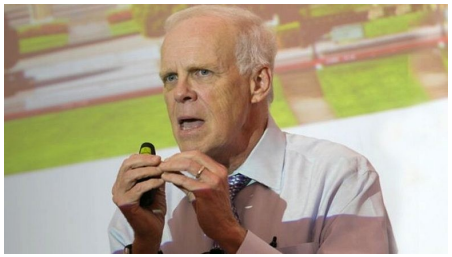


Image Source: https://www.innovateli.com/hennessy-grad-keeps-gifting/

"A breakthrough in machine learning would be worth ten Microsofts"

-- Bill Gates, Microsoft Co-founder

Image source:
https://www.gatesnotes.com/Books

[...] machine learning is a subcategory within the field of computer science, which allows you to implement artificial intelligence. So it's kind of a mechanism to get you to artificial intelligence.

-- Rana el Kaliouby, CEO at Affectiva

Image Source: https://fortune.com/2019/03/08/rana-el-kaliouby-ceo-affectiva/

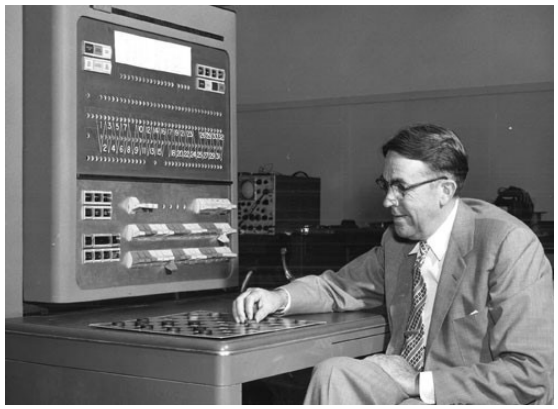


Image Source: https://history-computer.com/ModernComputer/thinkers/images/Arthur-Samuel1.jpg

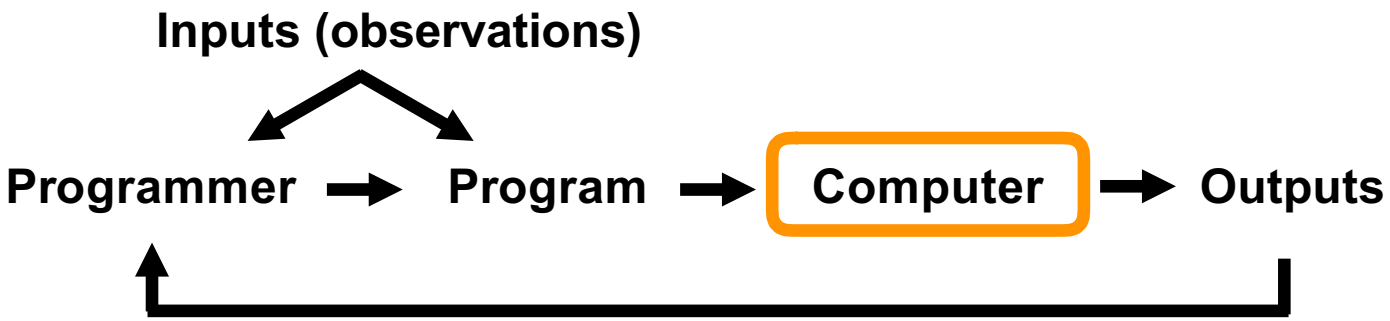
"Machine learning is the field of study that gives computers the ability to learn without being explicitly programmed"

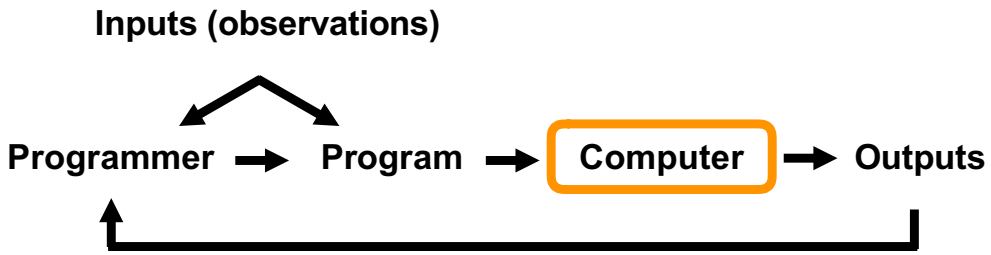
— Arthur L. Samuel, AI pioneer, 1959

(This is likely not an original quote but a paraphrased version of Samuel's sentence "Programming computers to learn from experience should eventually eliminate the need for much of this detailed programming e↵ort.")

Arthur L Samuel. "Some studies in machine learning using the game of checkers". In: *IBM Journal of research and development* 3.3 (1959), pp. 210–229.

The Traditional Programming Paradigm





Machine learning is the field of study that gives computers the ability to learn without being explicitly programmed

— Arthur Samuel (1959)

• We will not only use the machines for their intelligence, we will also collaborate with them in ways that we cannot even imagine.

-- Fei Fei Li, Director of Stanford's artificial intelligence lab

Image Source: https://en.wikipedia.org/wiki/Fei-Fei_Li#/ media/File:Fei-Fei_Li_at_AI_for_Good_2017.jpg

"A computer program is said to learn from experience *E* with respect to some class of tasks *T* and performance measure *P*, if its performance at tasks in *T*, as measured by *P*, improves with experience *E*."

— Tom Mitchell, Professor at Carnegie Mellon University

Tom M Mitchell et al. "Machine learning. 1997". In: *Burr Ridge, IL: McGraw Hill* 45.37 (1997), pp. 870–877.

"A computer program is said to **learn** from experience *E* with respect to some class of tasks *T* and performance measure *P*, if its performance at tasks in *T*, as measured by *P*, improves with experience *E*."

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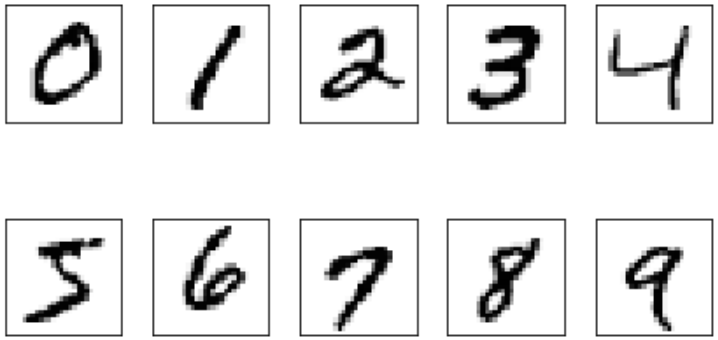
Handwriting Recognition Example:



- Task *T*: ?
- Performance measure *P* : ?
- Training experience *E*: ?

Some Applications of Machine Learning

- Email spam and malware filtering
- Speech Recognition
- Image Recognition
- Traffic prediction
- Product recommendation
- Medical diagnosis
- Self driving cars