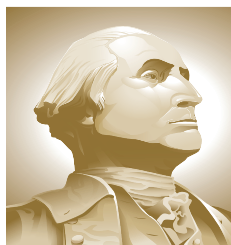


Introduction to Machine Learning

Machine Learning II

Lecture 1-a



**THE GEORGE
WASHINGTON
UNIVERSITY**

WASHINGTON, DC

What is Machine learning?

- What is Machine Learning (ML)?
- In a technical term, ML is to program computers so that they can learn from input data.
- Learning is the process of acquisition of knowledge or skills through experience.
- The input to this learning process is training data and the output is some expertise that can perform some task.
- Since computers were invented, we wanted to know, computers might be made to learn. How to program them to learn and improve automatically.



Machine Learning in Our Life

- Imagine:
- Computers learn from medical records which treatments are most effective for new diseases
- Computers learn from houses experience to optimize energy costs based on patterns of occupants usage.
- Computers learn from evolving interests of their users in order to highlight especially relevant stories from the online morning newspaper.
- Computer cannot learn nearly as well as people learn yet. However, algorithms have been invented that are effective for certain types of learning tasks, and a theoretical understanding of learning is beginning to emerge.

- Aerospace

- High performance aircraft autopilots, flight path simulations, aircraft control systems, autopilot enhancements, aircraft component simulations, aircraft component fault detectors

- Automotive

- Automobile automatic guidance systems, fuel injector control, automatic braking systems, misfire detection, virtual emission sensors, warranty activity analyzers

- Banking

- Check and other document readers, credit application evaluators, cash forecasting, firm classification, exchange rate forecasting, predicting loan recovery rates, measuring credit risk

More Machine Learning Applications

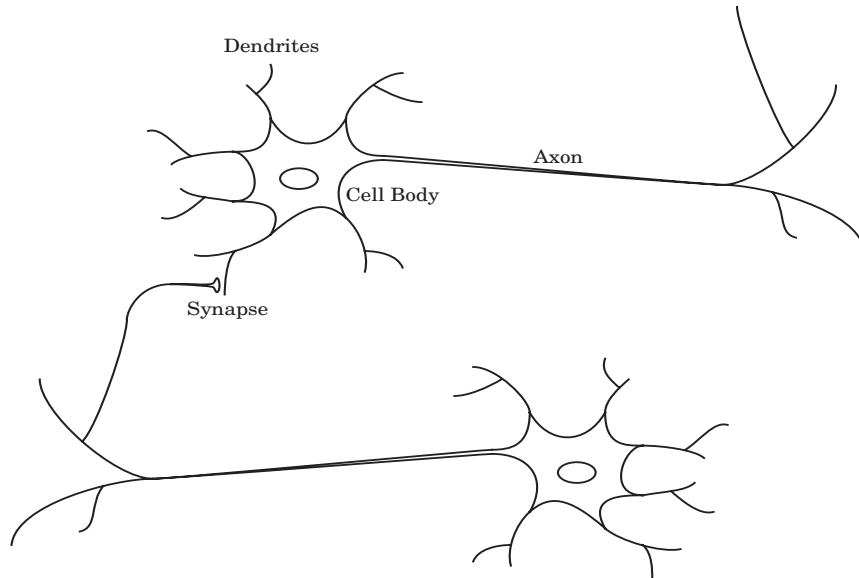
- Medical
 - Breast cancer cell analysis, EEG and ECG analysis, prosthesis design, optimization of transplant times, hospital expense reduction, hospital quality improvement, emergency room test advisement
- Defense
 - Weapon steering, target tracking, object discrimination, facial recognition, new kinds of sensors, sonar, radar and image signal processing including data compression.
- Speech
 - Speech recognition, speech compression, vowel classification, text to speech synthesis
- Financial
 - Real estate appraisal, loan advisor, mortgage screening, corporate bond rating, credit line use analysis.

What is Deep Learning?

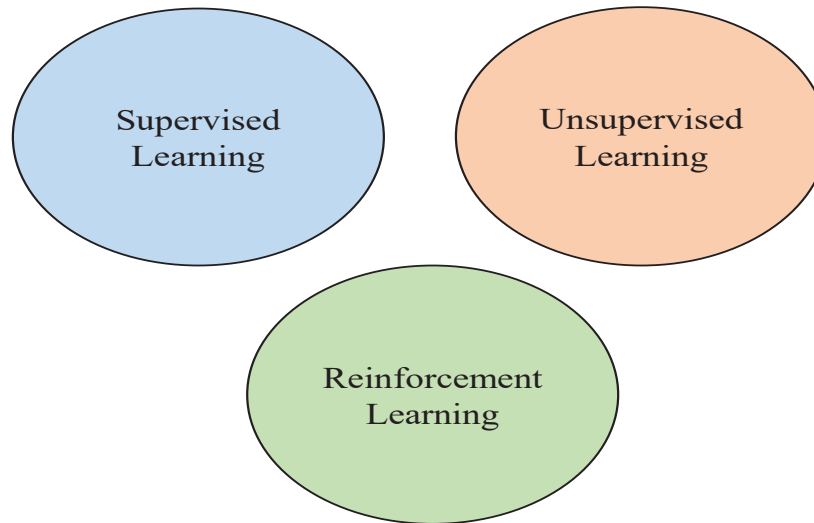
- "Deep learning (also known as deep structured learning or hierarchical learning) is part of a broader family of machine learning methods based on learning data representations, as opposed to task-specific algorithms. Learning can be supervised, partially supervised or unsupervised."

- 8 Inspirational Applications of Deep Learning
- 10 Deep Learning Applications
- 18 DEEP LEARNING STARTUPS
- GPU Application

- The brain consists of a large number (approximately 10^{11}) of highly connected elements (approximately 10^4 connections per element) called neurons.



- The three different types of machine learning.



Supervised learning is a method to:

- Approximate a function from a training data set.
- Training data set includes both input and target.
- For each input data there is a target (desired results) associated with.
- Analyzing the training data set to approximate the function, it is called a classifier or pattern recognition (output is discrete) or a regression function (output is continuous).

Unsupervised learning is a method to:

- Infer a function from a training data set.
- Training data set includes just the inputs.
- For each input data there is no target.
- Since there is no target there is no error to evaluate the model.
- This distinguishes unsupervised learning from supervised learning.
- Mostly is used in the clustering applications.

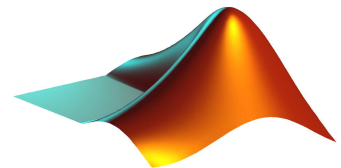
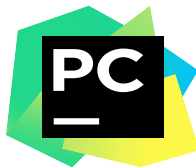
Reinforcement learning is a method to:

- How to map situations to actions.
- It is based on penalty for making mistakes and rewards for any success.
- For each input data there is no target.
- The learning happens based on the trail and error.
- It is inspired by behaviorist psychology.
- Mostly is used game theory, control theory and multi agent systems and so on.

- **Fitting** (nonlinear regression). Map between a set of inputs and a corresponding set of targets. (e.g., estimate home prices from tax rate, estimate emission levels from fuel consumption and speed, predict body fat level from body measurements.)
- **Pattern recognition** (*classification*). Classify inputs into a set of target categories. (e.g., classify a tumor as benign or malignant, from uniformity of cell size.)
- **Clustering** (*segmentation*) Group data by similarity. (e.g., group customers according to buying patterns, group genes with related expression patterns.)
- **Prediction** (time series analysis, system identification, filtering or dynamic modeling). Predict the future value of some time series. (e.g., predict the future value of some stock.)

We are going to use:

- Matlab (licensed).
- Python (Open source), widely used in machine learning field.
Pycharm community is going to be used through the course.



We are going to use Cloud Services in this course with Data Science Server Remote Desktop(DSRL) :

- Amazon Web Services and Google Cloud Platform.
- Pycharm community (Must), [Link](#)

