AI Society
Meeting #1
Spring 2020

Basics of Machine Learning

Curriculum

- Week 2 -› Basics of Machine Learning
- Week 3 -› Linear/Logistic regression
- Week 4 -› K-means
- Week 5 -› Principal Component Analysis
- Week 6 -› K-Nearest Neighbor
- Week 7 -› Support Vector Machines
- Week 8 -› Basics of Deep Learning
- Week 9 -› Basics of Natural Language Processing
- Week 10 -› Long Short Term Memory/Recurrent Neural Networks

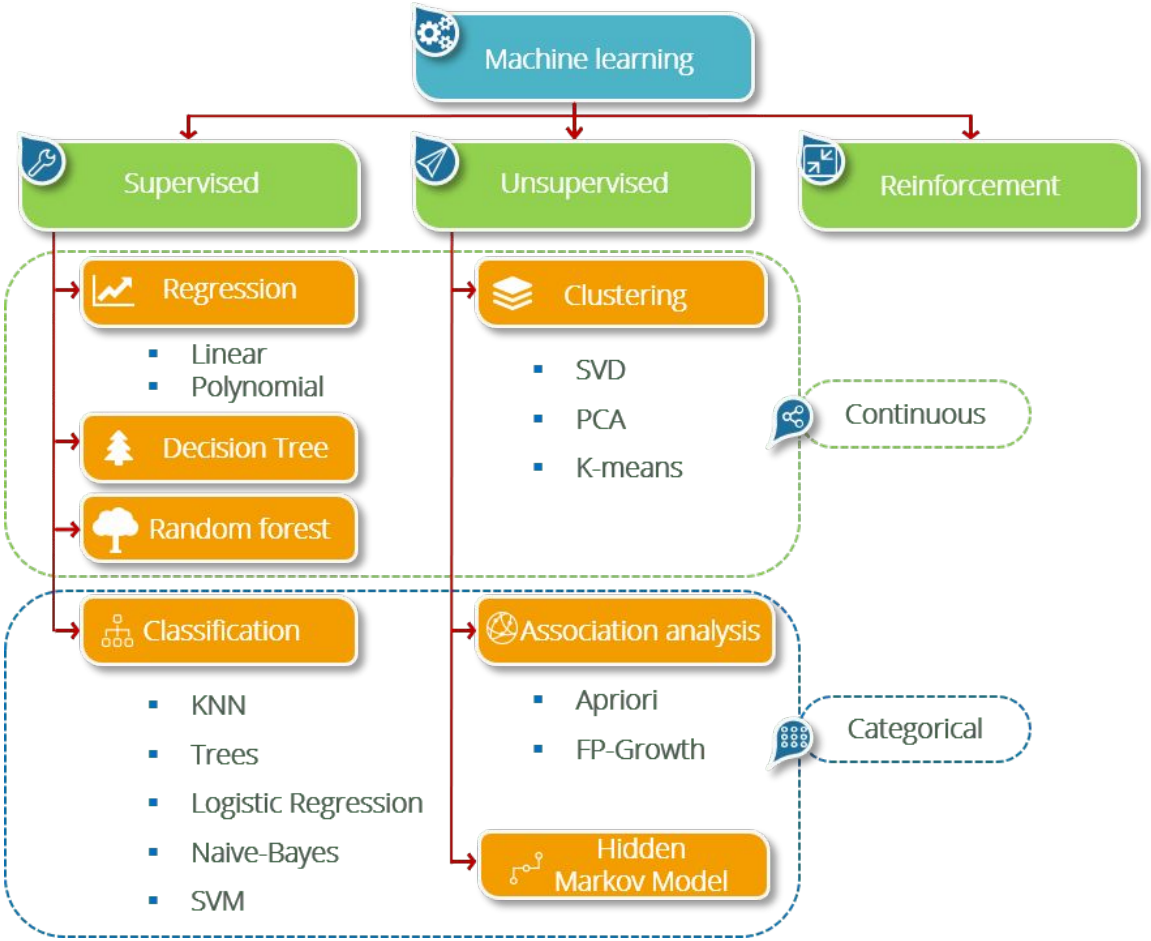
Outline

1. Introduction
2. Supervised Learning
3. Unsupervised Learning
4. Reinforcement Learning
5. Applications: Self driving @ Uber
6. Some Resources and conferences
7. Questions

Introduction

Introduction

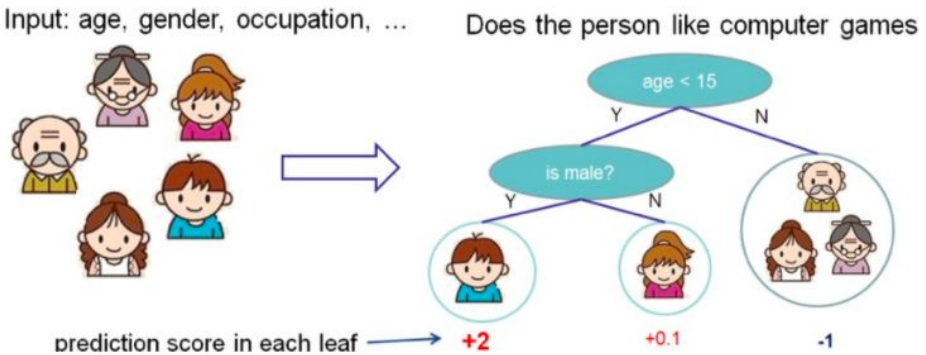
1. What is Machine Learning?
    a. Prerequisites: Statistics + Linear Algebra + Programming
    b. Use cases: Sentiment Analysis, Recommendation Systems, Image/speech recognition
2. Computer Vision vs Data Science vs Data Engineering
3. History and Modern-day use; how are tech companies making use of AI and ML?
4. Classes at UCD on AI/ML
    a. ECS 170, ECS 171, ECS 174, ECS 189G series, ECS 165A
    b. STA 141 series (Statistical Data Science); ML track
    c. EEC 193A/B (self driving: senior design)


Machine learning
Supervised
Unsupervised
Reinforcement
Regression
Linear
Polynomial
Decision Tree
Random forest
Clustering
SVD
PCA
K-means
Continuous
Classification
KNN
Trees
Logistic Regression
Naive-Bayes
SVM
Association analysis
Apriori
FP-Growth
Categorical
Hidden Markov Model

Supervised Learning - task driven

Supervised Learning

- System is presented with labeled data
- Predict the output variable (independent) from the input (dependent) variable
- Classification (categorical)
  - Predicting yes/no/a color
  - KNN
  - SVM
  - Random Forests
- Regression (numerical)
  - Predicting the price of an apartment
  - Linear Regression, polynomial



Unsupervised Learning - data driven

Unsupervised Learning

- System is presented with unlabeled, uncategorized data
- Algorithms act on the data without prior training
- The output is dependent upon the coded algorithms
- Great way of testing the AI
- Clustering (K means, KNN - predicting the outcome for a new user)
- Dimensionality Reduction (PCA, SVD - new uncorrelated variables)

Reinforcement Learning - learns from trying

Reinforcement Learning

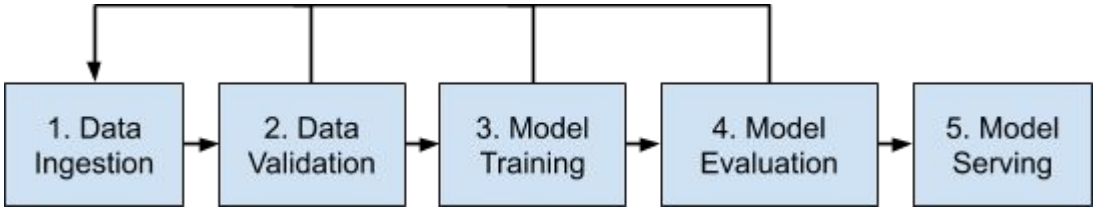
- Algorithms learn to react to an environment
- Maximize rewards
- Elements: agent, environment, action, rewards
- Markov process -- Check out Google PageRank
- One example from (determining placements of ad on a webpage)
  - **Agent.** The program you train, with the aim of doing a job you specify (The program making decisions on how many ads are appropriate for a page.)
  - **Environment.** The world, real or virtual, in which the agent performs action (The web page)
  - **Action.** A move made by the agent, which causes a status change in the environment (putting another ad on the page; dropping an ad from the page; neither adding nor removing.)
  - **Rewards.** The evaluation of an action, which can be positive or negative (Positive when revenue increases; negative when revenue drops)
- Source: https://medium.com/ai%C2%B3-theory-practice-business/reinforcement-learning-part-1-a-brief-introduction-a53a849771cf

Application (high-level)

Application

- Brief dive into an ML application @Uber ATG
- Self driving vehicle components
  - **Perception:** This component uses sensor information from the vehicle to detect actors in a given scene through ML models. It identifies probabilities for each object's type (vehicle, pedestrian, bicycle, etc.) and its 3D coordinates. Detection allows the self-driving vehicle to see different objects in the environment, interpreting what and where they are.
  - **Prediction:** This component uses the Perception component output (the type of actor and 3D coordinates of all actors in the scene), as well as high-definition maps, to predict actors' future trajectories over *n* seconds in a given scene using ML models. The Prediction component allows the self-driving vehicle to anticipate where actors will most likely be located at various points in the future.
  - **Motion Planning:** This component uses the self-driving vehicle's destination, the predicted trajectories of all actors in the scene, the high definition map, and other mechanisms to plan the path of the vehicle.
  - **Control:** This component steers the self-driving vehicle's wheels and operates its brakes and accelerator to follow the path created by the Motion Planning component.
- Source: https://eng.uber.com/machine-learning-model-life-cycle-version-control/

- ML Model cycle



- Data Ingestion
  - Images from the vehicle's cameras
  - LiDAR 3D point information
  - Radar information
  - The state of the vehicle, including location, speed, acceleration and heading
  - Map information, such as the vehicle's route and lanes it used
  - Ground truth labels
- And much more...
- Image and content sourced from: https://eng.uber.com/machine-learning-model-life-cycle-version-control/

Resources and Conferences

Resources

Andrew NG's Machine Learning Course

Geek Squad Tutoring: Python, MATLAB (Offered by ChemE Department @ UCD)

Google's Python Class

Linear Algebra by Gilbert Strang (MIT OCW)

TensorFlow, Keras, Deep Learning using MNIST: Google

The Deep Learning book

Conferences

ICML

KDD

NIPS (NeurIPS)

CVPR

Questions

Thank you!
Next week: Linear/Logistic Regression