Manassas Machine Learning 101 and Beyond

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Who am I?

- Bridgette Townsend
  - Software Engineer
    - Embedded Systems (vehicles, mobile devices, etc.)
    - Vulnerability Researcher
  - PhD Student
    - Data Science

Introduction

[in • tro • duc • tion]

- What is Artificial Learning/Machine Learning (ML)
- ML Fundamentals
- Getting Started (Optional)

Artificial Intelligence

[ar • ti • fi • cial • in • tell • i • gence]

Artificial Intelligence (AI) aims to create intelligent systems based on human intelligence.

Machine Learning

[ma • chine • lear • ning]

Machine learning is a subset of AI, leveraging large data sets to optimize computer systems for specific tasks.

Beginnings

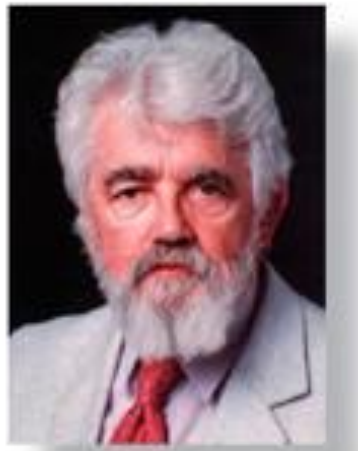
[be • gi • nings]

1950: Alan Turing proposes the Turing Test as a measure of machine intelligence.

1956: AI is born at the Dartmouth conference organized by John McCarthy, father of Artificial Intelligence.

1958: John McCarthy defined the Lisp language.

Alan Turing



John McCarthy

The birth of AI - Dartmouth Conference 1956
(New Hampshire, USA)


John MacCarthy


Marvin Minsky


Claude Shannon


Ray Solomonoff


Alan Newell


Herbert Simon


Arthur Samuel


Oliver Selfridge


Nathaniel Rochester


Trenchard More

The proposal for the conference included this assertion:

"every aspect of learning or any other feature of intelligence can be so precisely described that a machine can be made to simulate it".

John McCarthy persuaded the attendees to accept "Artificial Intelligence" as the name of this new field.

- Predictive maintenance or condition monitoring
- Warranty reserve estimation
- Propensity to buy
- Demand forecasting
- Process optimization
- Telematics

Manufacturing

- Predictive inventory planning
- Recommendation engines
- Upsell and cross-channel marketing
- Market segmentation and targeting
- Customer ROI and lifetime value

Retail

- Alerts and diagnostics from real-time patient data
- Disease identification and risk stratification
- Patient triage optimization
- Proactive health management
- Healthcare provider sentiment analysis

Healthcare and Life Sciences

- Aircraft scheduling
- Dynamic pricing
- Social media – consumer feedback and interaction analysis
- Customer complaint resolution
- Traffic patterns and congestion management

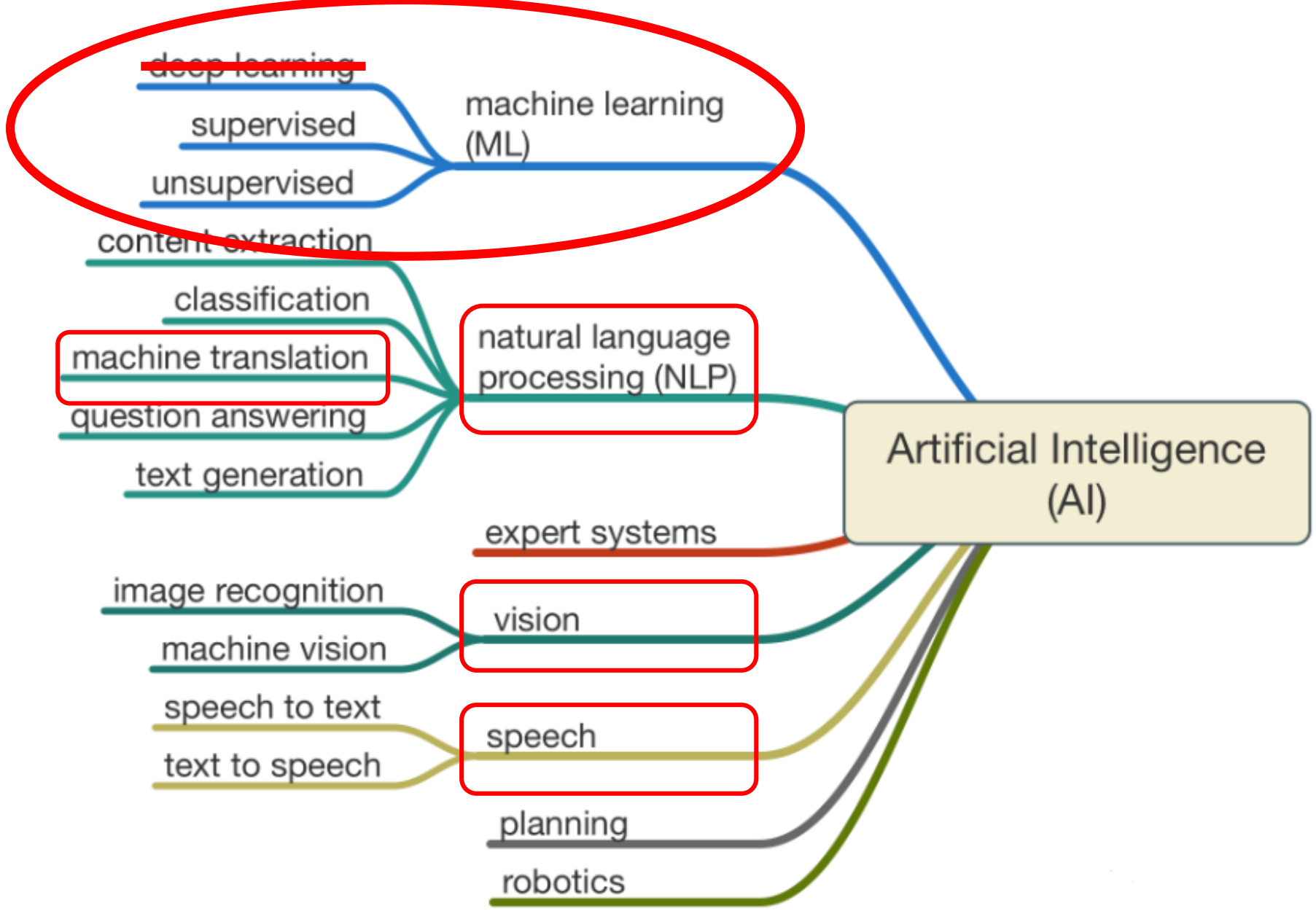
Travel and Hospitality

- Risk analytics and regulation
- Customer Segmentation
- Cross-selling and up-selling
- Sales and marketing campaign management
- Credit worthiness evaluation

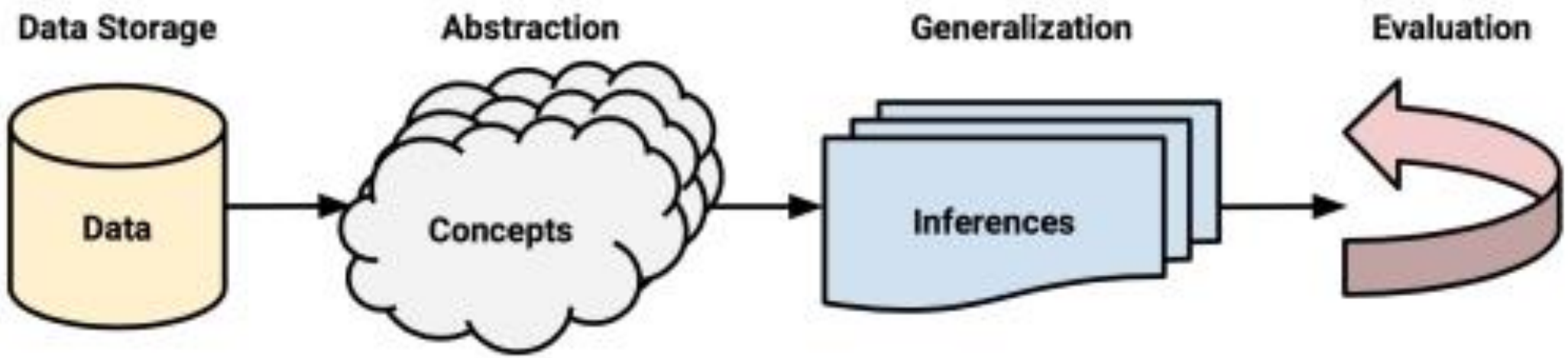
Financial Services

- Power usage analytics
- Seismic data processing
- Carbon emissions and trading
- Customer-specific pricing
- Smart grid management
- Energy demand and supply optimization

Energy, Feedstock, and Utilities


deep learning
supervised
unsupervised
machine learning (ML)
content extraction
classification
machine translation
question answering
text generation
natural language processing (NLP)
Artificial Intelligence (AI)
expert systems
image recognition
machine vision
vision
speech to text
text to speech
speech
planning
robotics

Basic Learning Process for Humans or Machines



CLASSICAL MACHINE LEARNING

Data is pre-categorized or numerical

SUPERVISED

Predict a category

CLASSIFICATION

«Divide the socks by color»

Predict a number

REGRESSION

«Divide the ties by length»

Data is not labeled in any way

UNSUPERVISED

Divide by similarity

CLUSTERING

«Split up similar clothing into stacks»

Find hidden dependencies

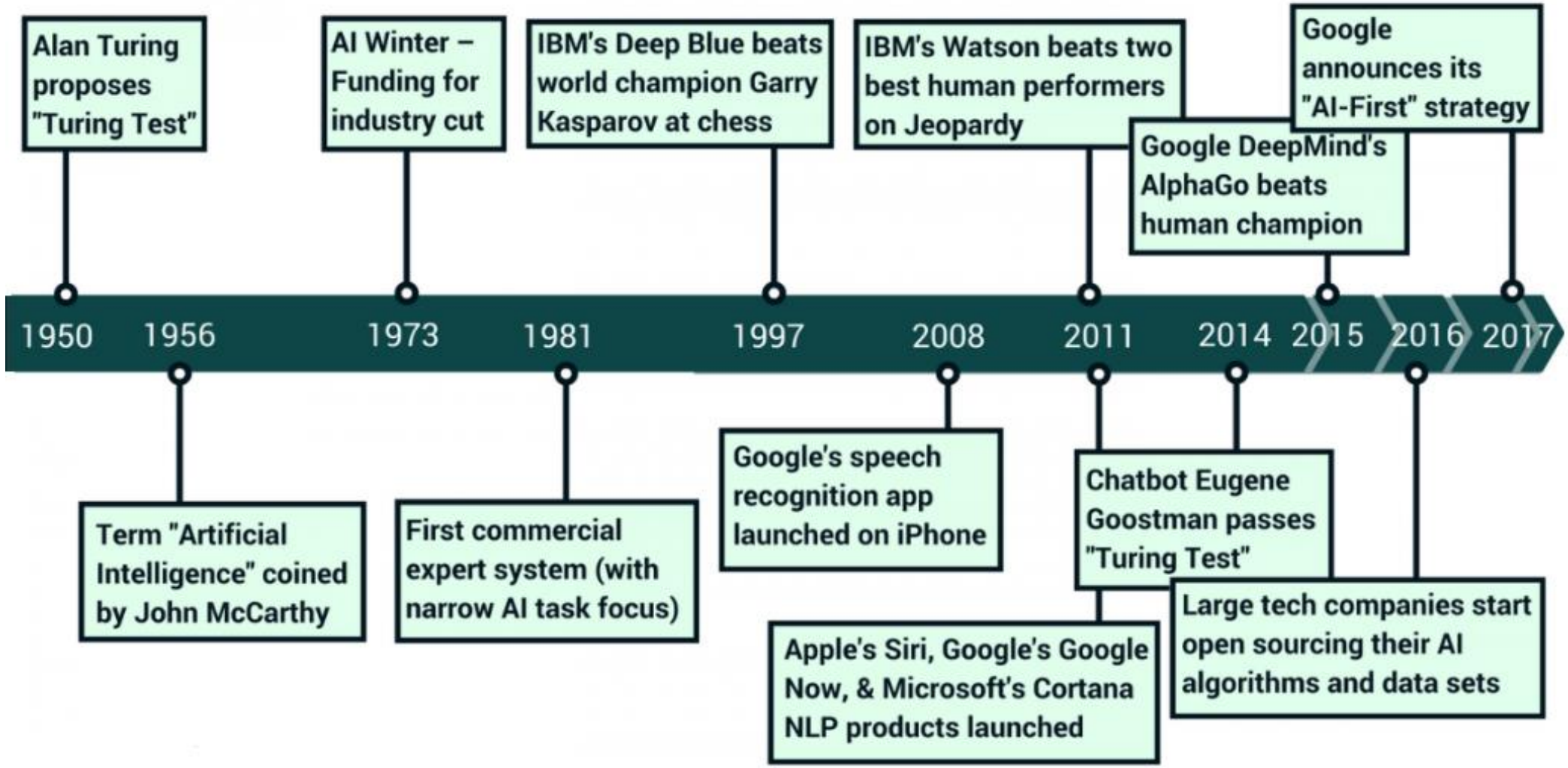
DIMENSION REDUCTION (generalization)

«Make the best outfits from the given clothes»

Identify sequences

ASSOCIATION

«Find what clothes I often wear together»


Alan Turing proposes "Turing Test"
AI Winter – Funding for industry cut
IBM's Deep Blue beats world champion Garry Kasparov at chess
IBM's Watson beats two best human performers on Jeopardy
Google DeepMind's AlphaGo beats human champion
Google announces its "AI-First" strategy
1950
1956
1973
1981
1997
2008
2011
2014
2015
2016
2017
Term "Artificial Intelligence" coined by John McCarthy
First commercial expert system (with narrow AI task focus)
Google's speech recognition app launched on iPhone
Chatbot Eugene Goostman passes "Turing Test"
Apple's Siri, Google's Google Now, & Microsoft's Cortana NLP products launched
Large tech companies start open sourcing their AI algorithms and data sets

Supervised Learning Algorithms

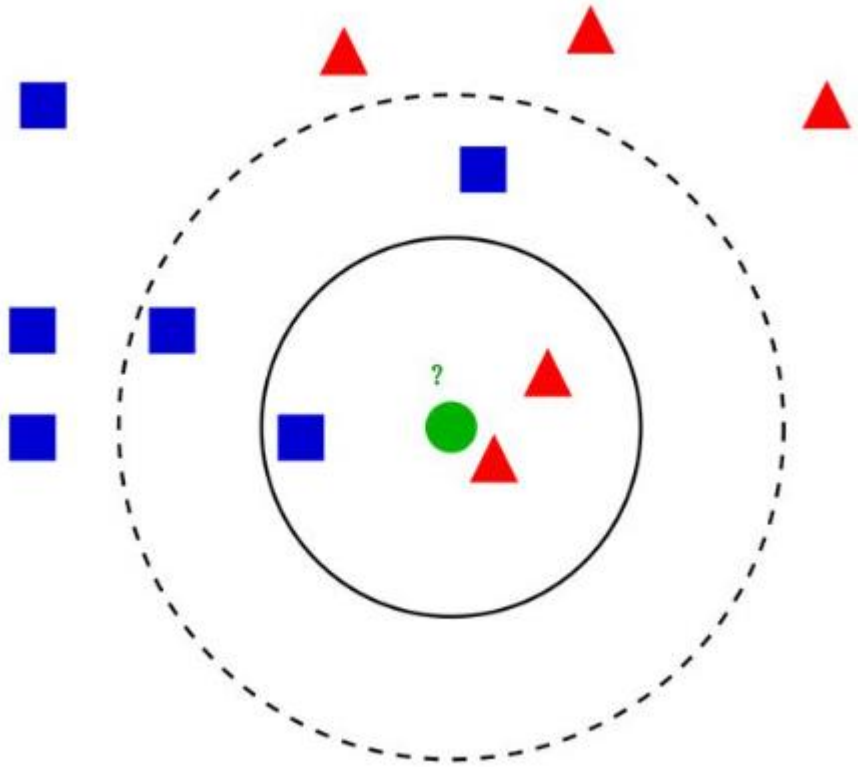
- K Nearest Neighbors
- Naïve Bayes Classifier
- Regression Methods
- Support Vector Methods
- Decision Trees

Unsupervised Learning Algorithms

- Clustering
  - K Means Clustering
- Self-Organizing Maps

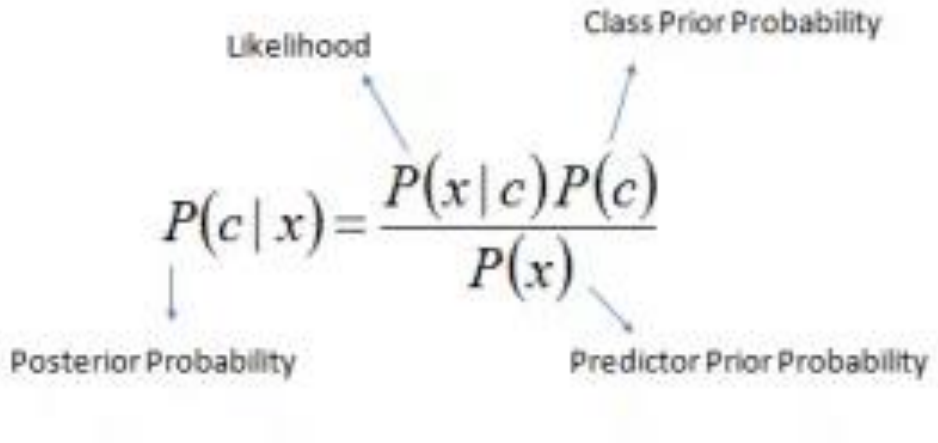
K nearest neighbors (KNN)

- Supervised Learning technique
- Take classified data represented by a vector of features
- Measure distances between the new data point and the nearest K of our already-classified data and conclude to which class our new data point belongs.
- Can also be used for regression, instead of having classes we can associate a number with each data point



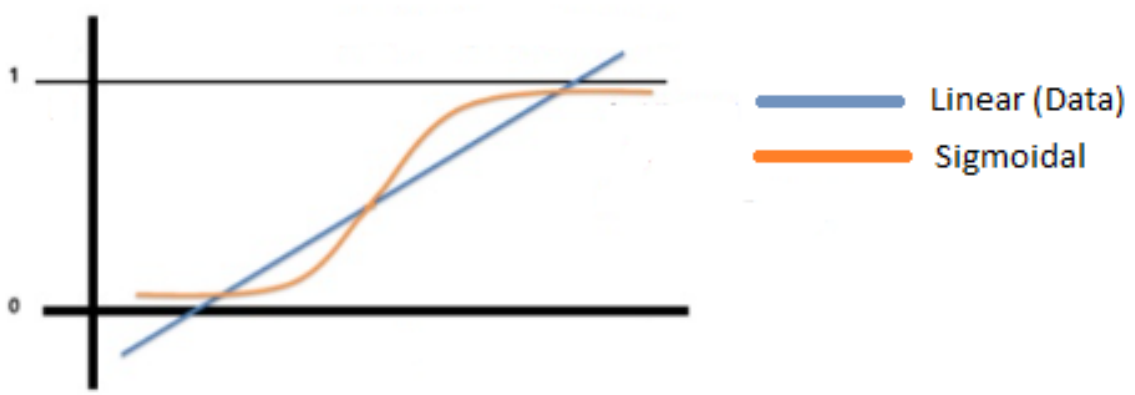
Naïve Bayes Classifier

- Supervised Learning
- Samples of data representative of different classes
- Calculate the probability of new data being in each class



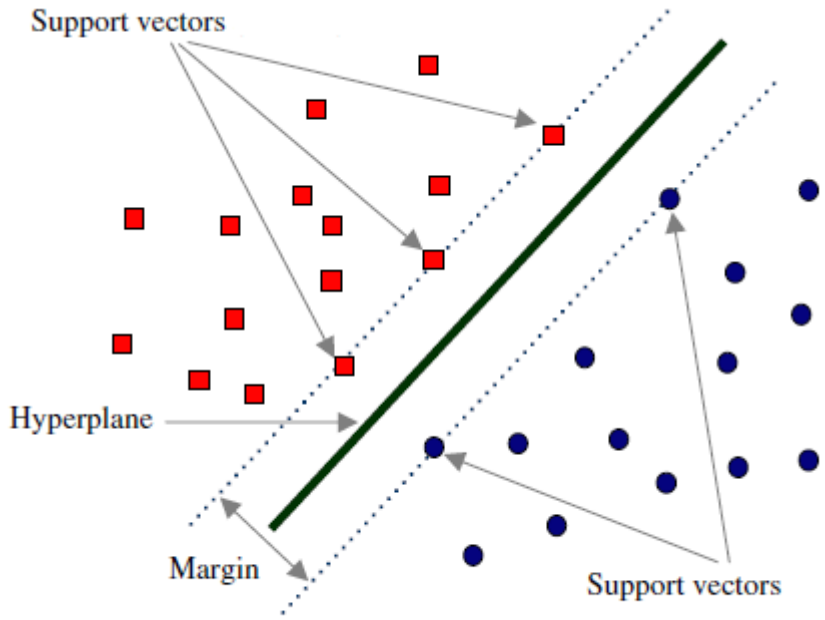
Regression Methods

- Supervised Learning
- They try to explain a dependent variable in terms of independent variables
- Independent variables are numerical
- Fit straight-line, polynomials or other functions to predict the dependent variables
- Can also be used for classification when the dependent variables are usually zeros and ones



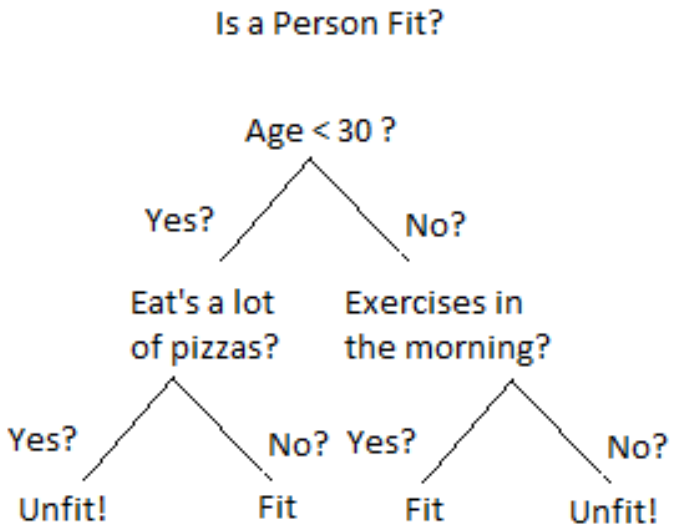
Support Vector Machines (SVM)

- Supervised Leaning
- Used for classification
- Classified data represented by vectors of features
- Divides data according to which side of a hyperplane in feature space each point lies



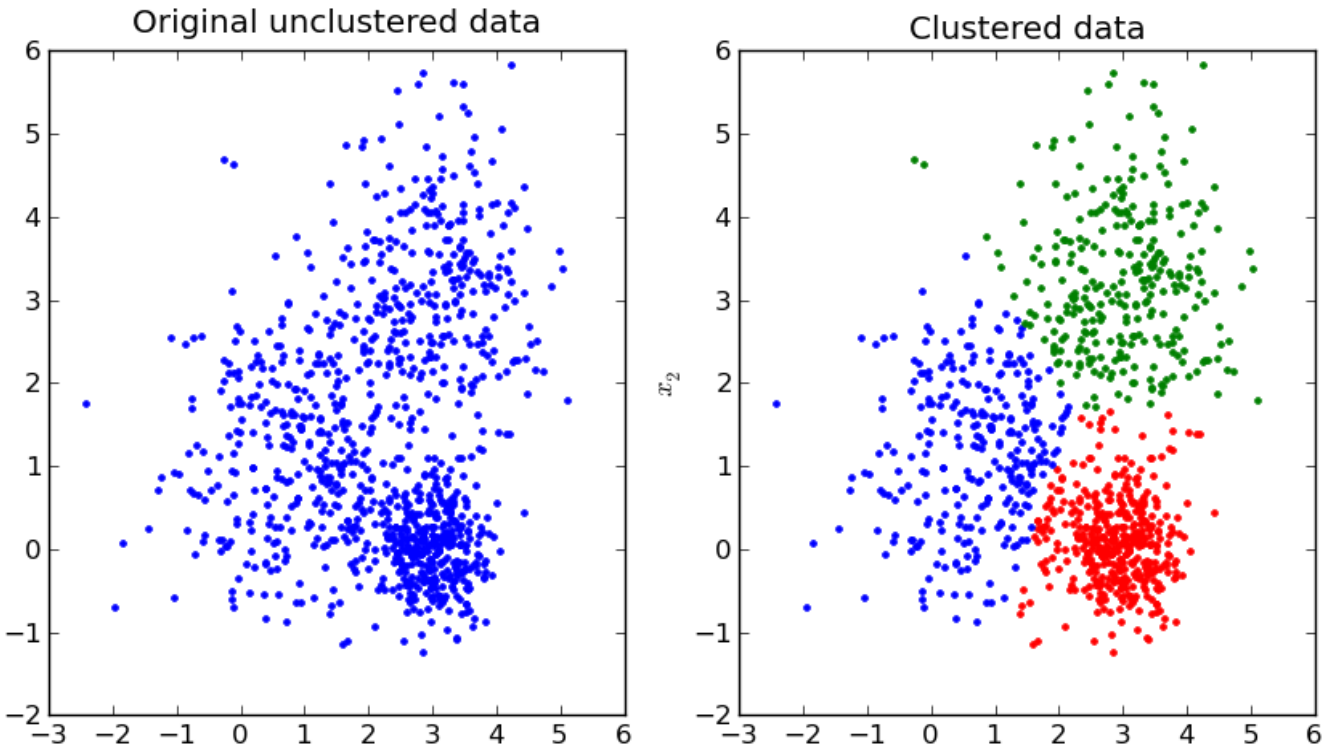
Decision Trees

- Supervised learning
- Can be used for classification and regression
- A decision tree is just a flowchart



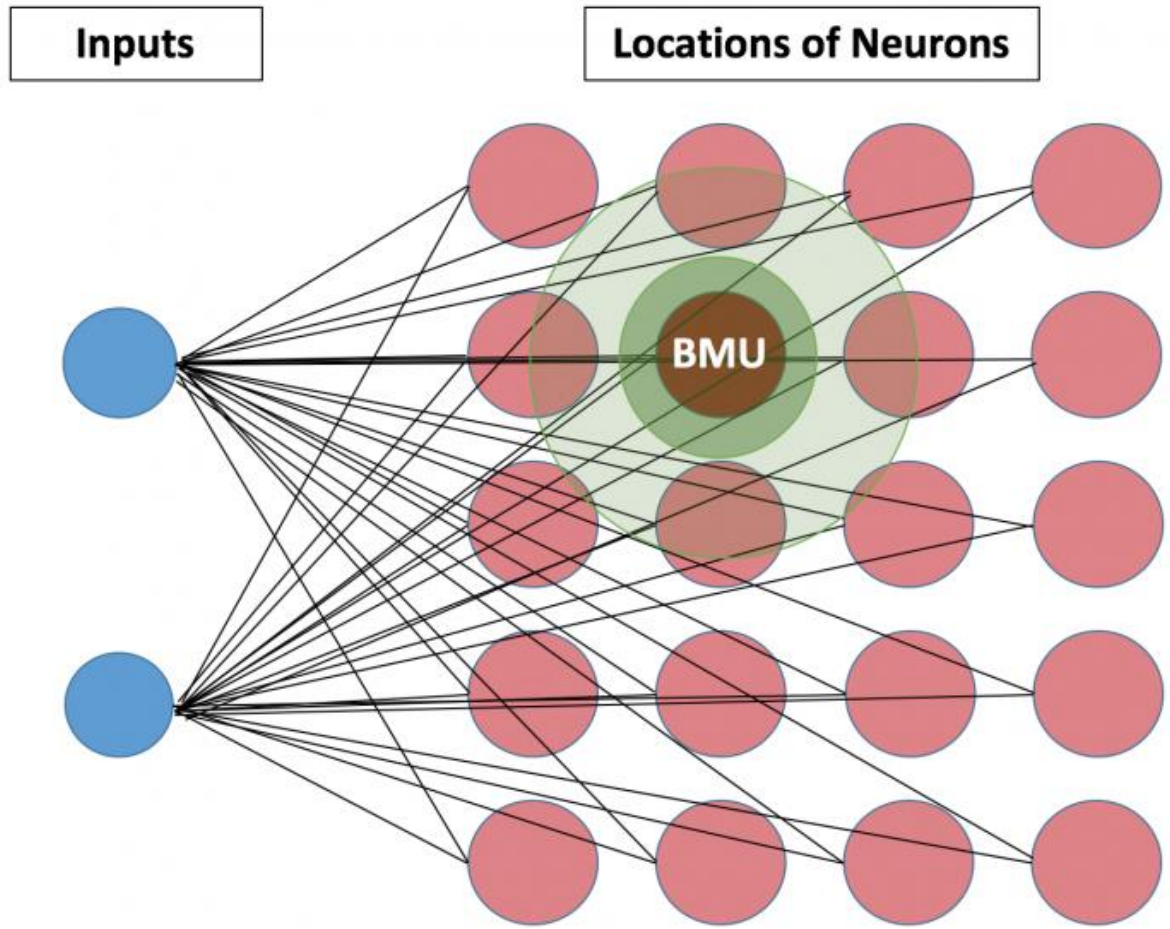
K Means Clustering

- Unsupervised Learning technique
- Each data point is represented as a vector
- Each entry in the vector represents a feature
- Data points are not labeled or classified
- Data points are grouped in a sensible way



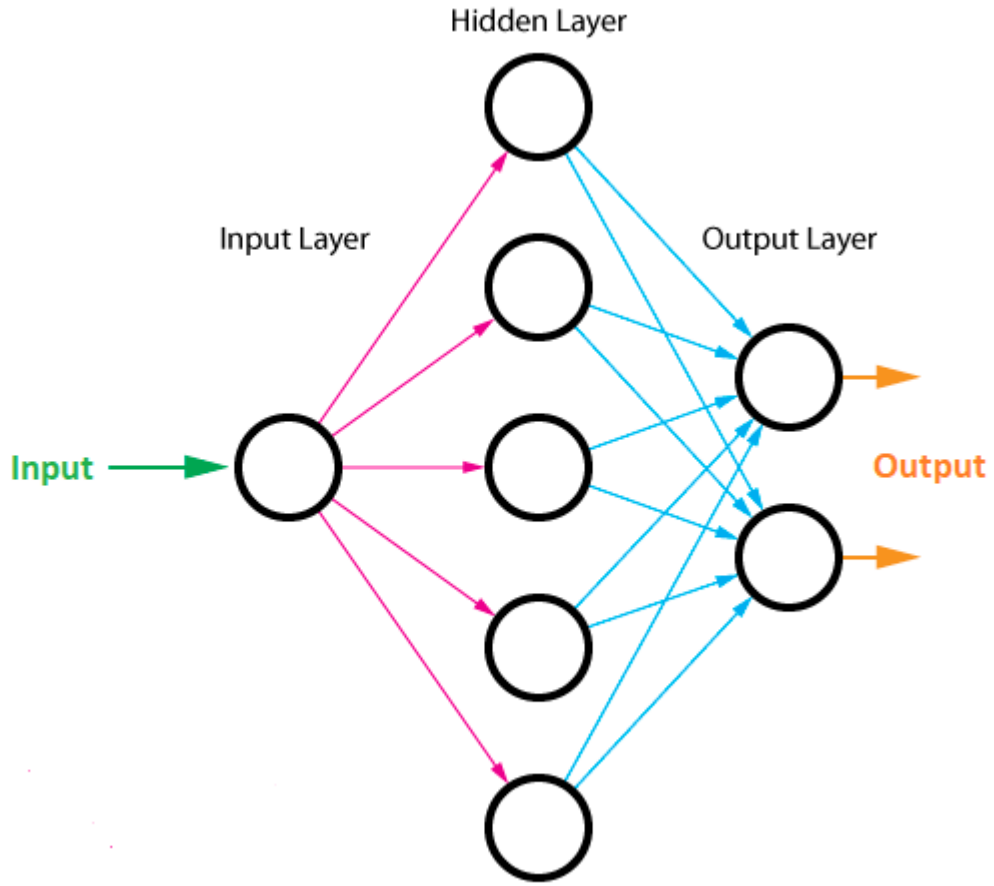
Self-Organizing Maps

- Unsupervised Learning
- Start off with vectors of features for all data points
- They are grouped together according to how similar the vectors are
- Some people think of this technique as a version of a neural network
  - The method is a typically 2-d picture consisting of square array of cells.
  - A particular kind of SOM known as a kohonen networks. This SOM has a feed-forward structure with a single computational layer arranged in row and columns.



Neural Networks

- Can be used for supervised or unsupervised learning
- Meant to mimic what happens in the brain
- An input vector is transformed typically by multiplying a matrix
- Deep Learning – neural nets with deep layers. Increased number of hidden layers and nodes that integrate to estimate the output(s)

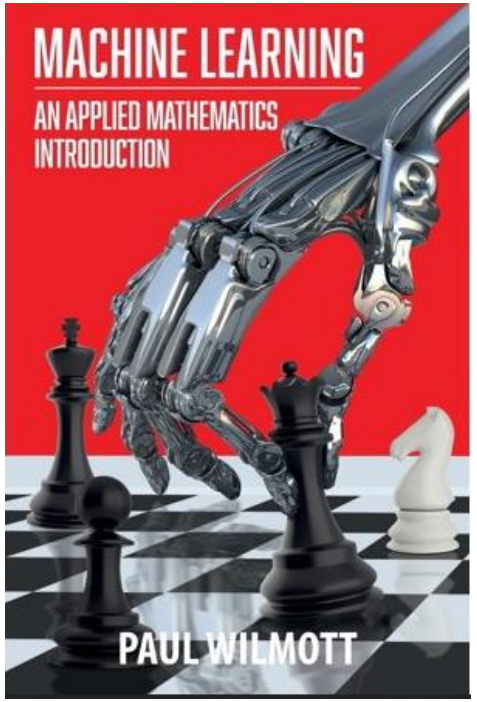


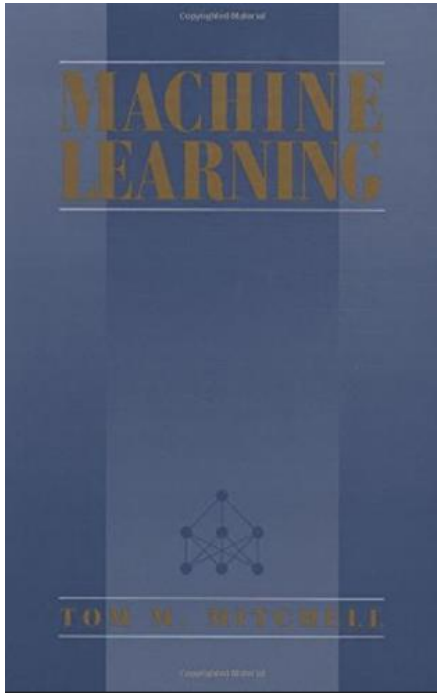
Getting Started

- Tons of information available on YouTube
- Take Andrew Ng’s machine learning course
- Download Jupyter Notebook or Anaconda Python/R Distribution to start programming
- Read books, papers and blogs
- Keep coming to this meetup ☺

Book References on material covered today

- Machine Learning: An Applied Mathematics Introduction by Paul Wilmott
- Machine Learning by Tom M. Mitchell





Recommended Papers

- Computing Machinery And Intelligence by Alan M. Turing
- Mastering The Game of Go without Human Knowledge by David Silver, et. al.