

# Machine Learning Basics

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# Outline

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- Recap of last week: Signal Processing
- What is machine learning?
- How is it relevant to brain frequencies/BCI creation?
- Binary Classification
  - Commonly Used Models
- Multiclass Classification
  - Commonly Used Models
- Interactive Coding Demo (Python)
- Walkthrough of NeuroAssist (last year's eye classifier project)

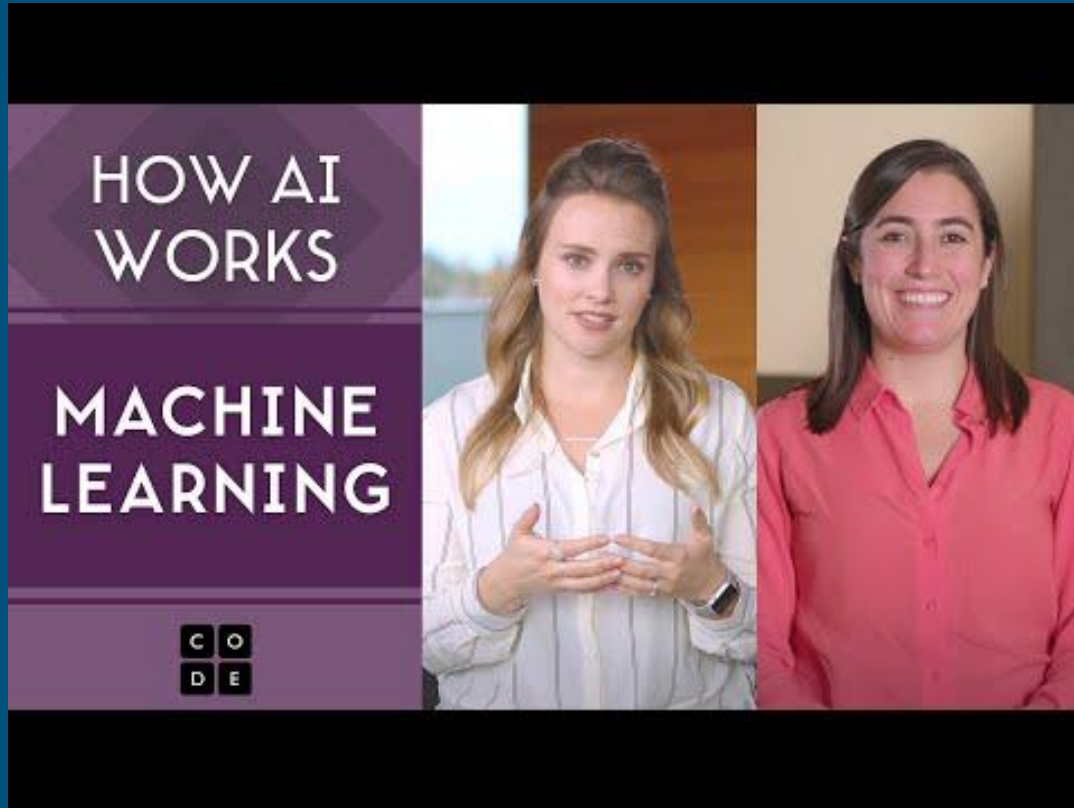
# Recap

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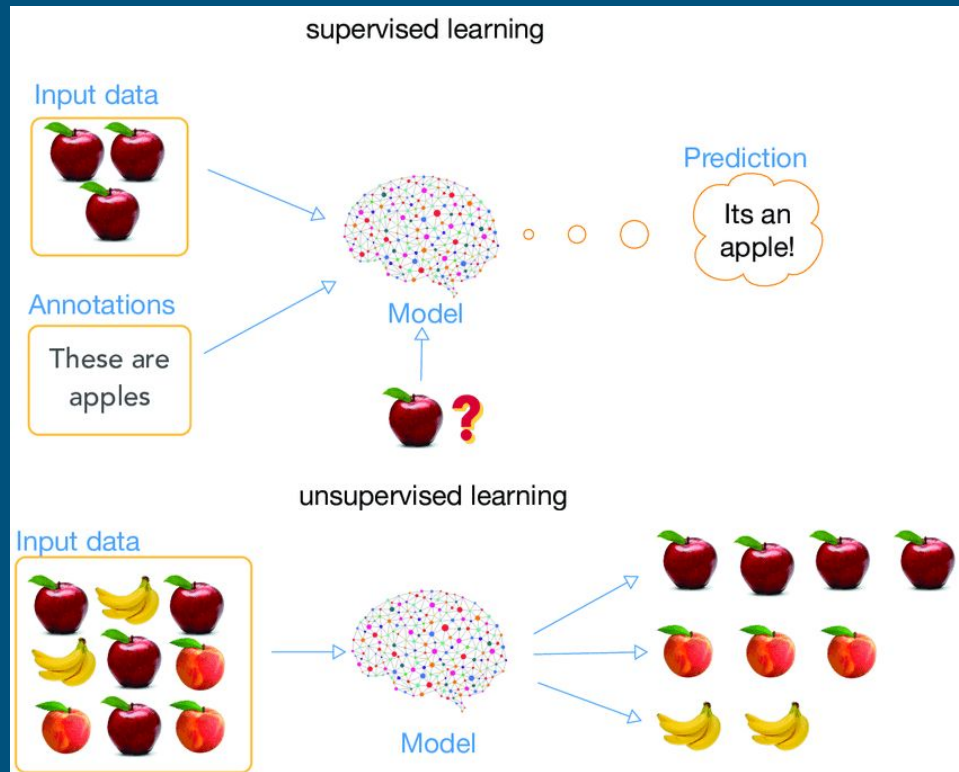
- How to Process a Brain Signal
  - a. Get data
    - either from file or live streaming
    - we will likely use live streaming in practice (we'll go more into this next week!)
  - b. Plot the raw data's psd (power spectral density)
  - c. Set up a band pass filter for the new data
    - i.e. `filtered = raw.filter(0.5, 30)``
    - Takes the raw data and sets up a band pass filter from 0.5-30 Hz
  - d. Plot this and see that the psd is now from 0.5-30Hz and filters out

# What is Machine Learning? (High Level Overview)

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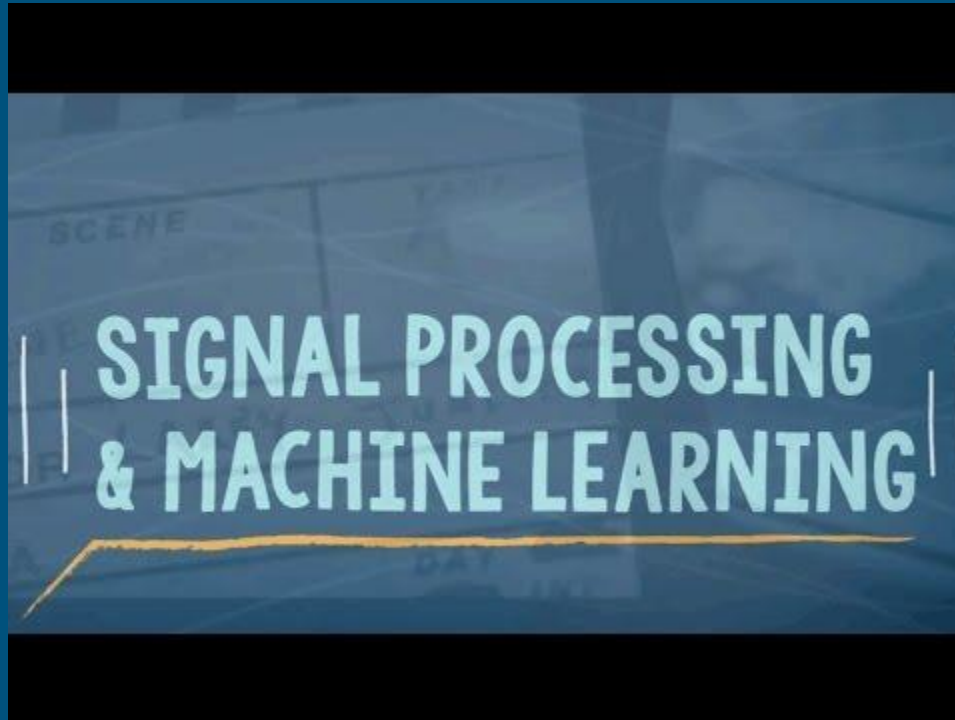
# Supervised vs. Unsupervised Learning



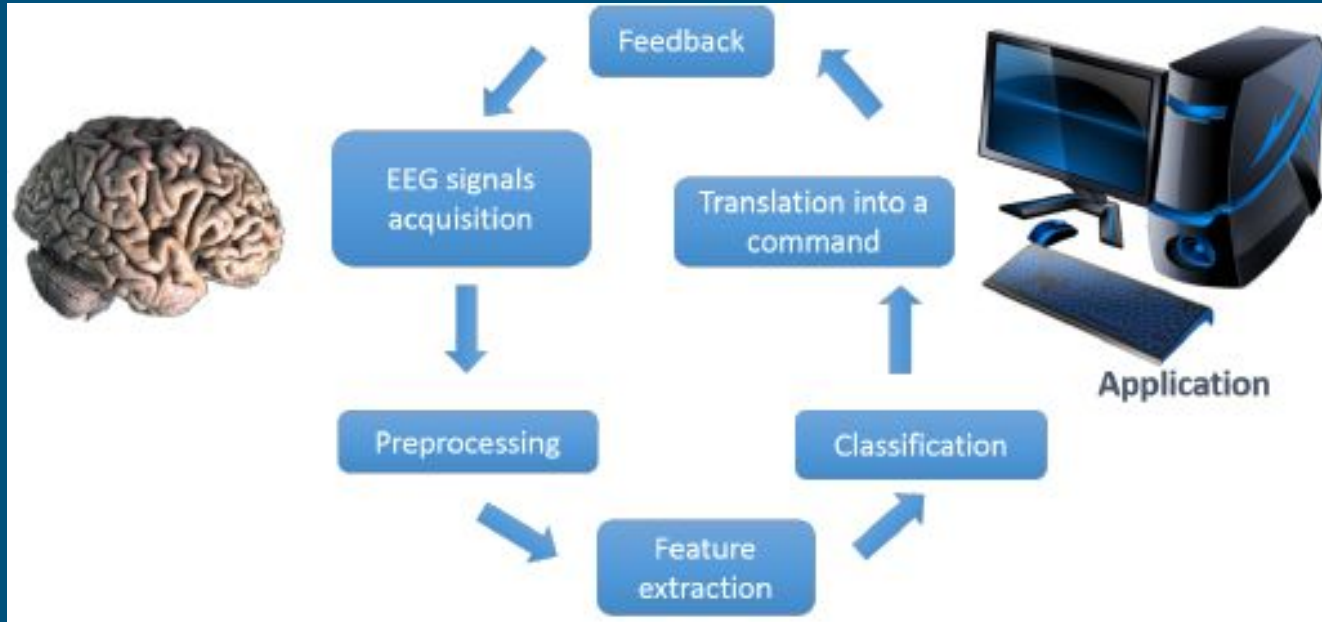


# Signal Processing Using Machine Learning

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# ML With BCI Architecture



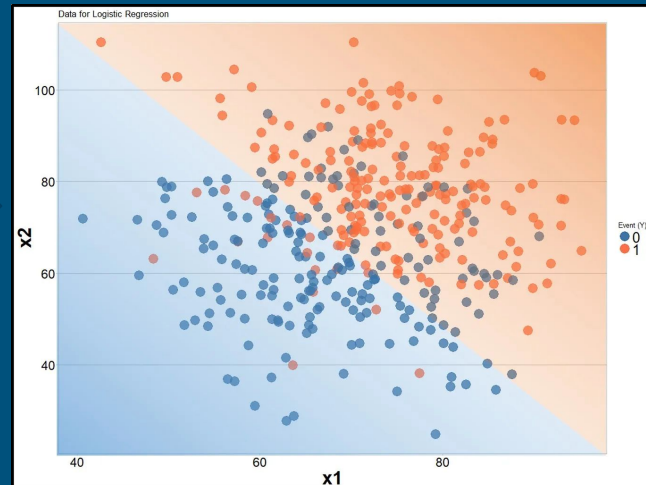
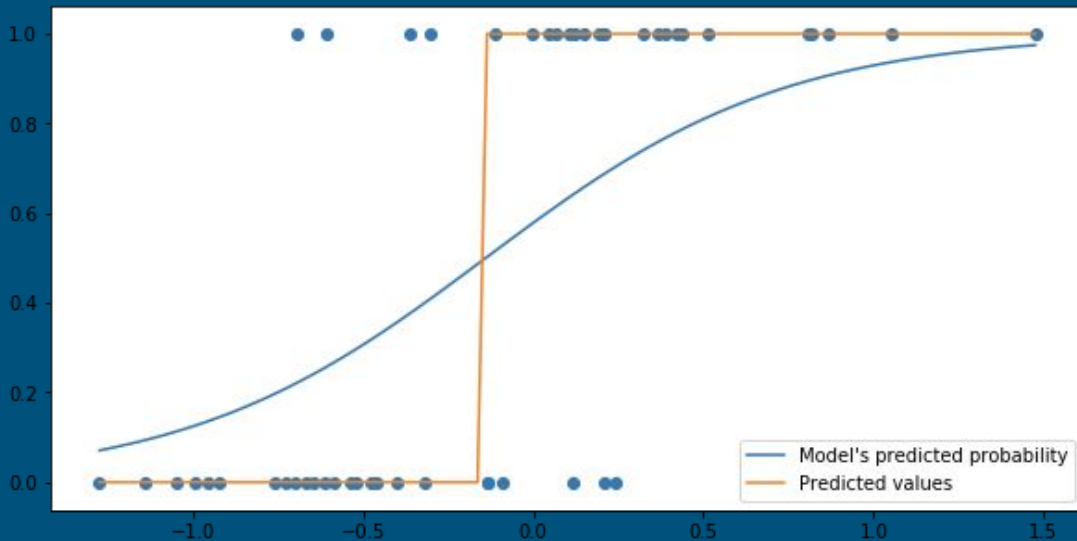
# Binary Classification

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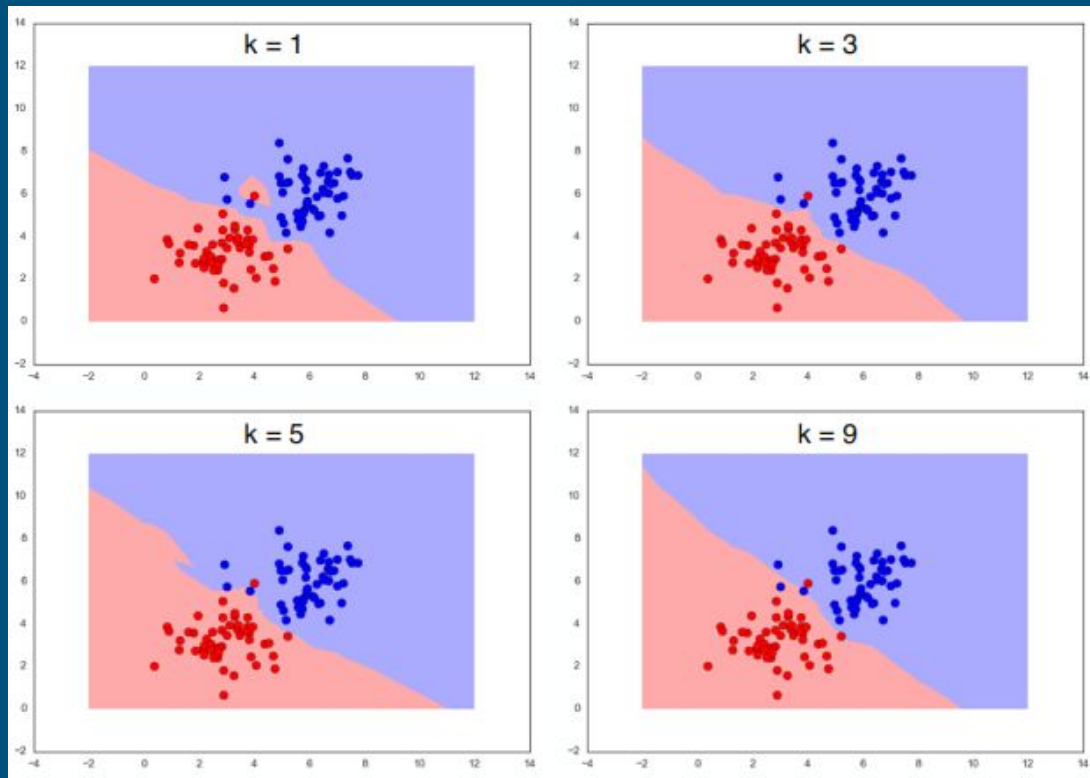
- Classifying elements of a set into two groups on the basis of a classification rule
- Real-world examples:
  - Email Classification: Spam/Not Spam
  - Medical Detection: Cancer/Not Cancer
  - Eye Movement Classification: Blinking/Rest State



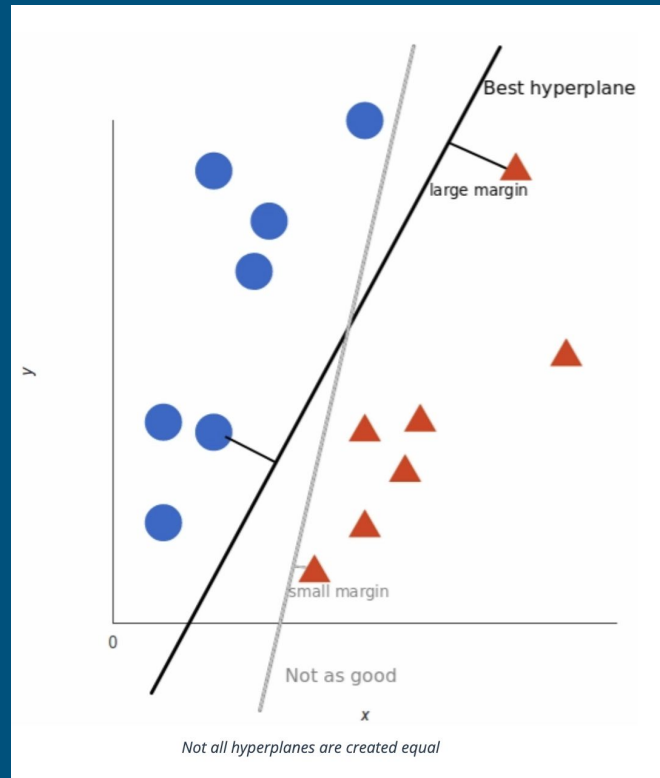
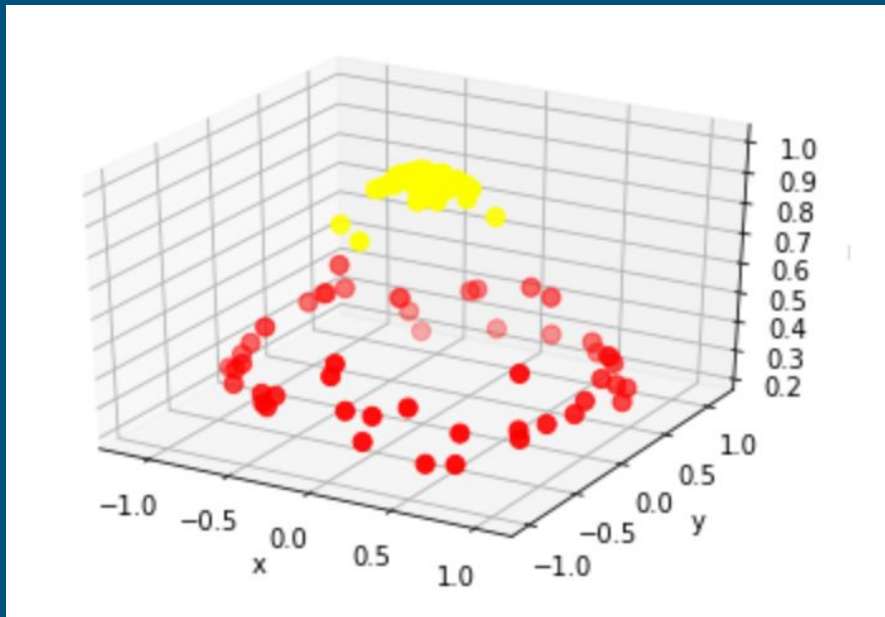
# Commonly used Binary Classification Models: Logistic Regression



# Commonly used Binary Classification Models: k-nearest neighbors

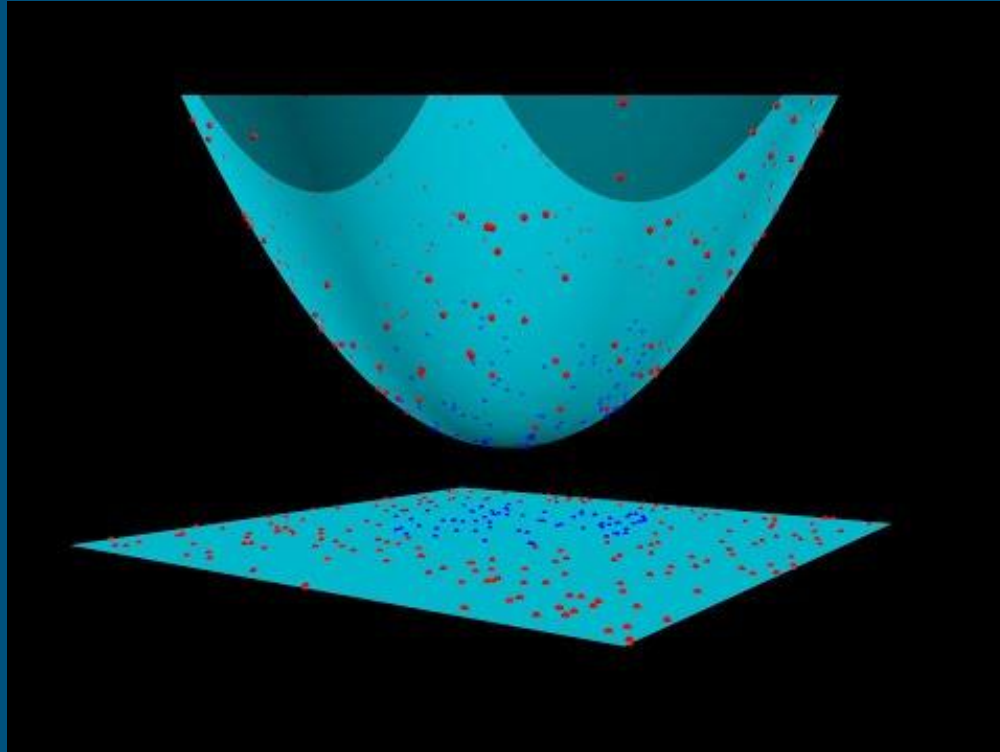


# Commonly used Binary Classification Models: Support Vector Machines (SVM)



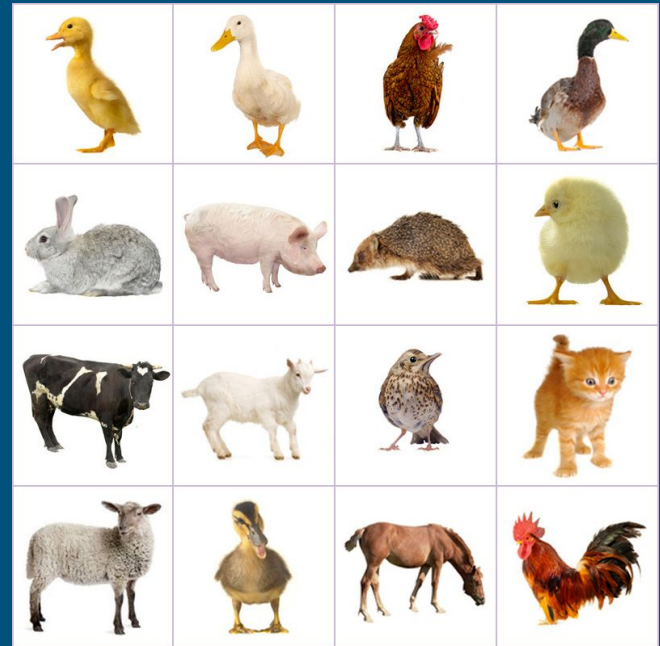
# Commonly used Binary Classification Models: Support Vector Machines (SVM)

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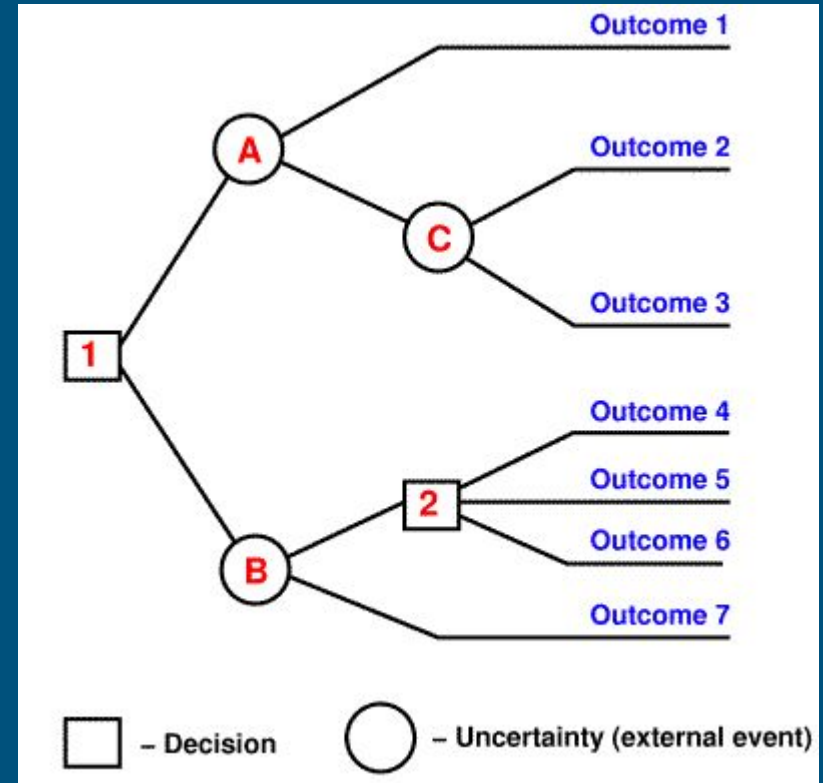
# Multiclass Classification

- Similar to Binary Classification except with 3+ classes
- Mutually exclusive classes
- Examples
  - Blinking, right to left, up to down
  - Motor Imagery

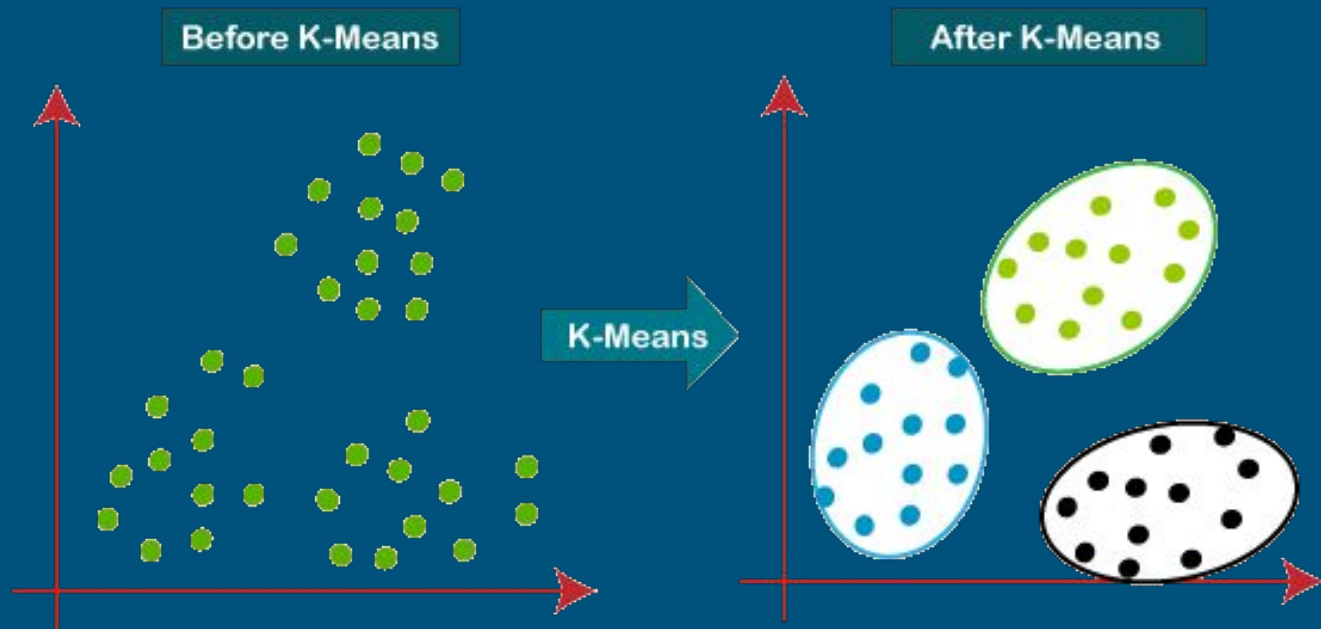


# Commonly used Multiclass Classification Models: Decision Trees

- Random Forest

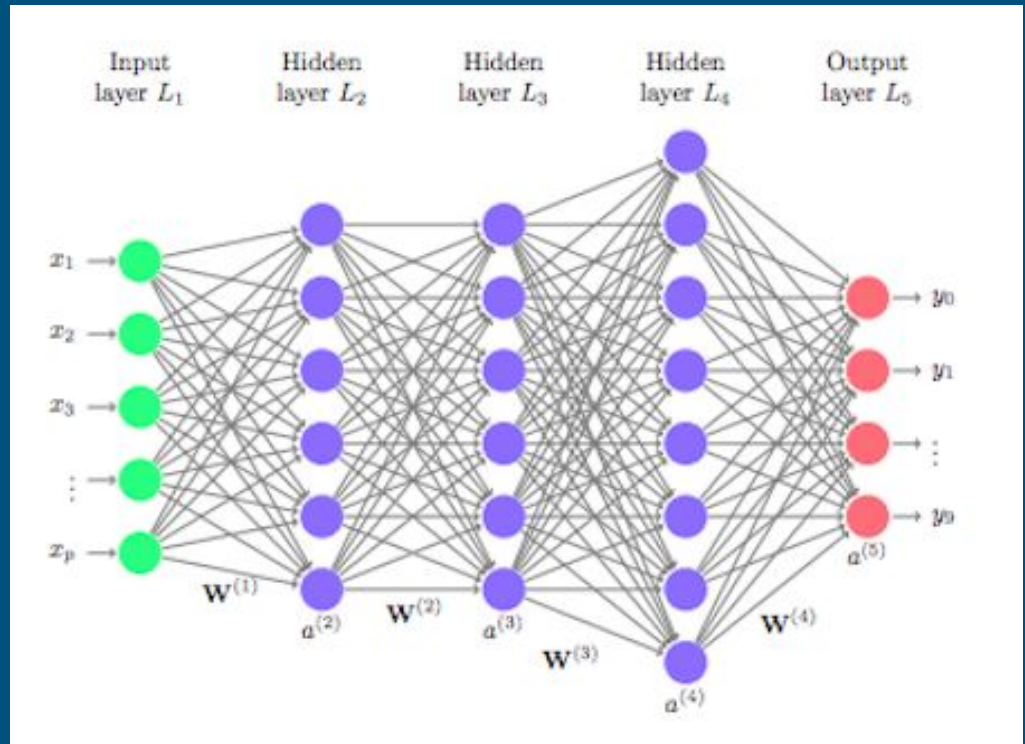


# Commonly used Multiclass Classification Models: K Means



# Deep Learning

- Subset of ML
- Uses neural networks
- Not exactly a model





# Thank You

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