Comprehensive Course Notes

Ryan Gess

April 21, 2024

Contents

1 Data Structures

1.1 Stacks and Queues

1.1.1 Stacks

First in, Last out

1.1.2 Queues

First in, First out

1.1.3 Dynamic Programming

2 Computer Networks

3 Concurrency and Parallelism

4 Computer Security

5 Machine Learning

5.1 Decision Trees

Definition 5.1 (Gini Impurity)**.** Helps to determine the feature to split on. Select the feature with the lowest impurity score

$$Gini(D) = 1 - \sum_{i=1}^{k} p_i^2$$

Definition 5.2 (Entropy)**.** High entropy is more unpredictable, lower entropy is more organized and predictable.
Entropy:

$$H(Y) = -\sum_{y \in Y} P(Y = y) log_2 P(Y = y)$$

Specific Conditional Entropy:

$$H(Y|X = x) = -\sum_{y \in Y} P(Y = y|X = x) log_2 P(Y = y|X = x)$$

Conditional Entropy:

$$H(Y|X) = \sum_{x \in X} P(X = x) H(Y|X = x)$$

Mutual Information: If we know X, how much does this reduce our uncertainty about Y?

$$I(Y; X) = H(Y) - H(Y|X) = H(X) - H(X|Y)$$

5.2 K-Nearest Neighbors

Classify a point with a majority vote of it's 'k' nearest neighbors. Slow with large number of features.

5.3 Readings

5.3.1 Listen Attend Spell