# Data Science

## Decision Tree Learning

# OBJECTIVE

- WHAT IS A DECISION TREE? HOW DO WE USE IT?
- HOW TO BUILD A DECISION TREE
- ADVANTAGES & DISADVANTAGES
- TUNING PARAMETERS
- BUILDING A DECISION TREE IN PYTHON

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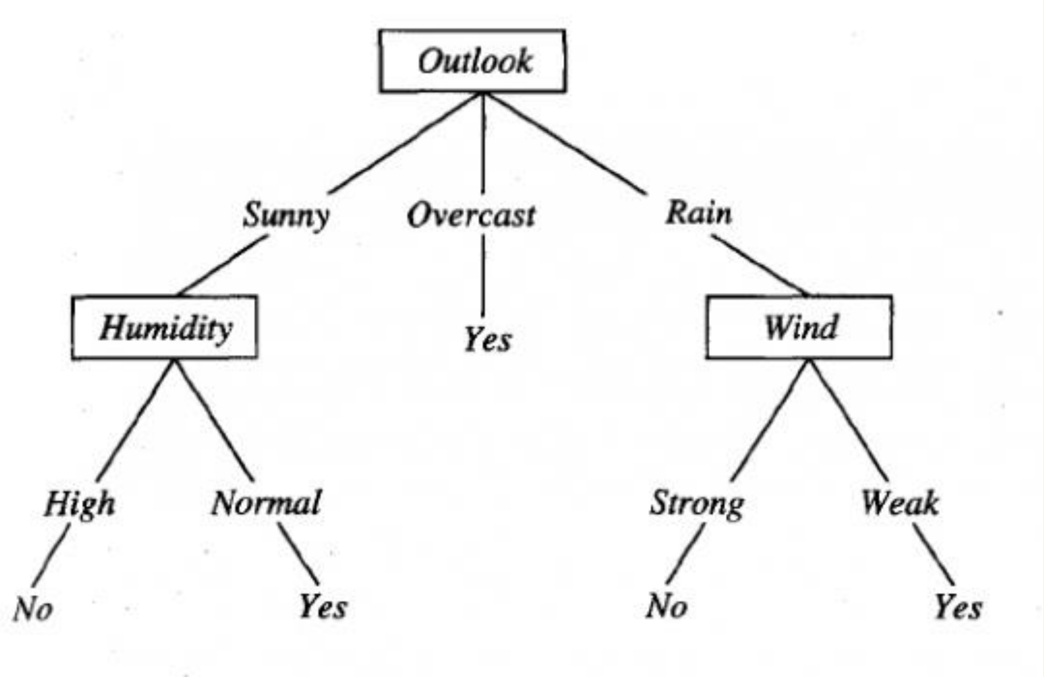
# WHAT IS A DECISION TREE?

- Supervised learning algorithm
  - Regression: Numerical
  - Classification: Categorical
- Builds a tree by repeatedly splitting the dataset
- Easy to interpret
- Variable importance and selection
- Sets the foundation for state of the art ensemble techniques

# WHAT IS A DECISION TREE?

## Will there be a tennis match today?




Quinlan 1986

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- Leaf nodes show the prediction
- Important variables are higher in the tree

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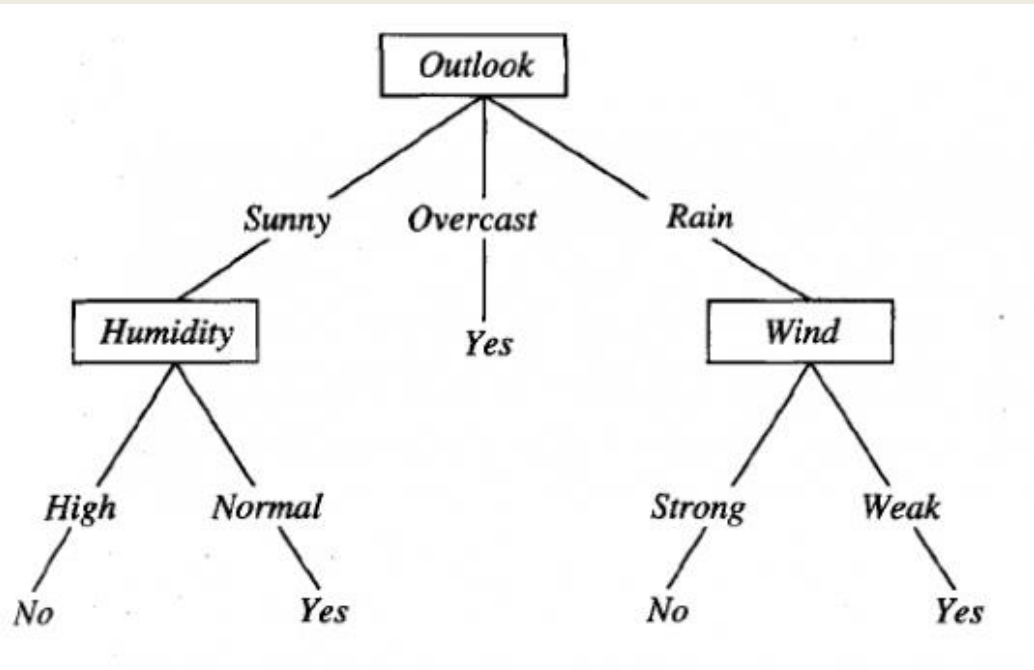


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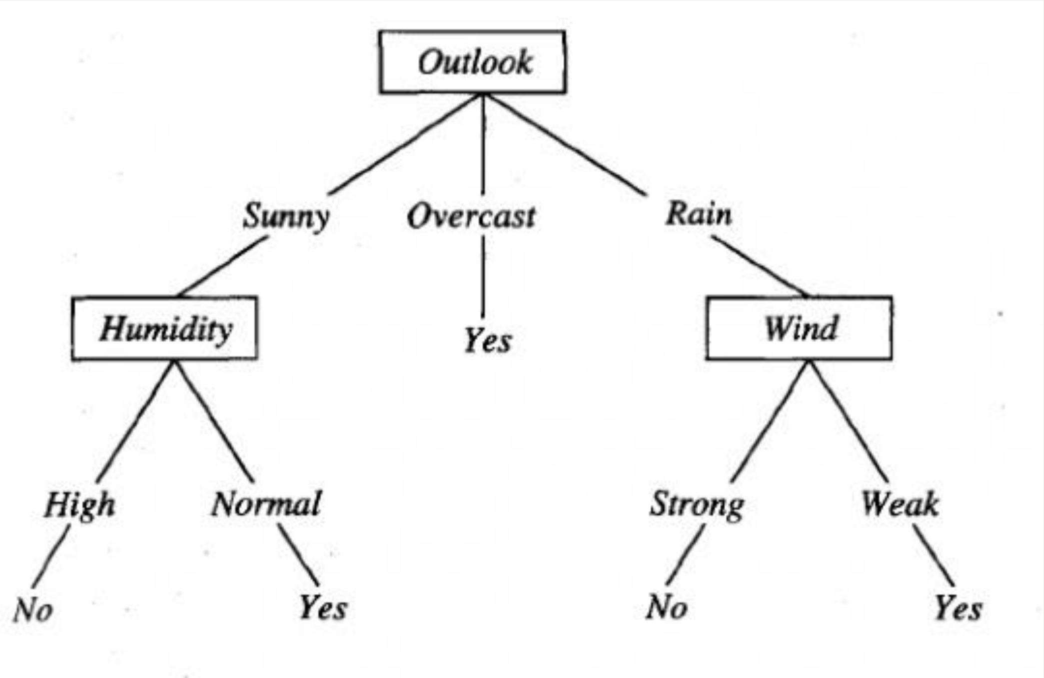


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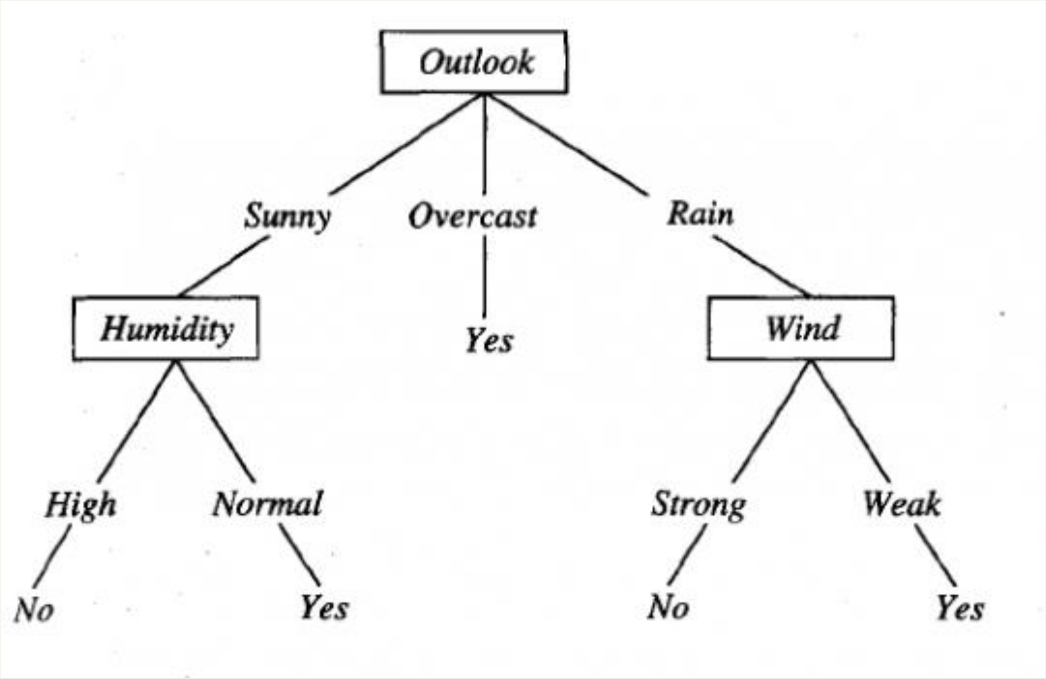


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Q2: Sunny outlook with normal humidity. Tennis Match?

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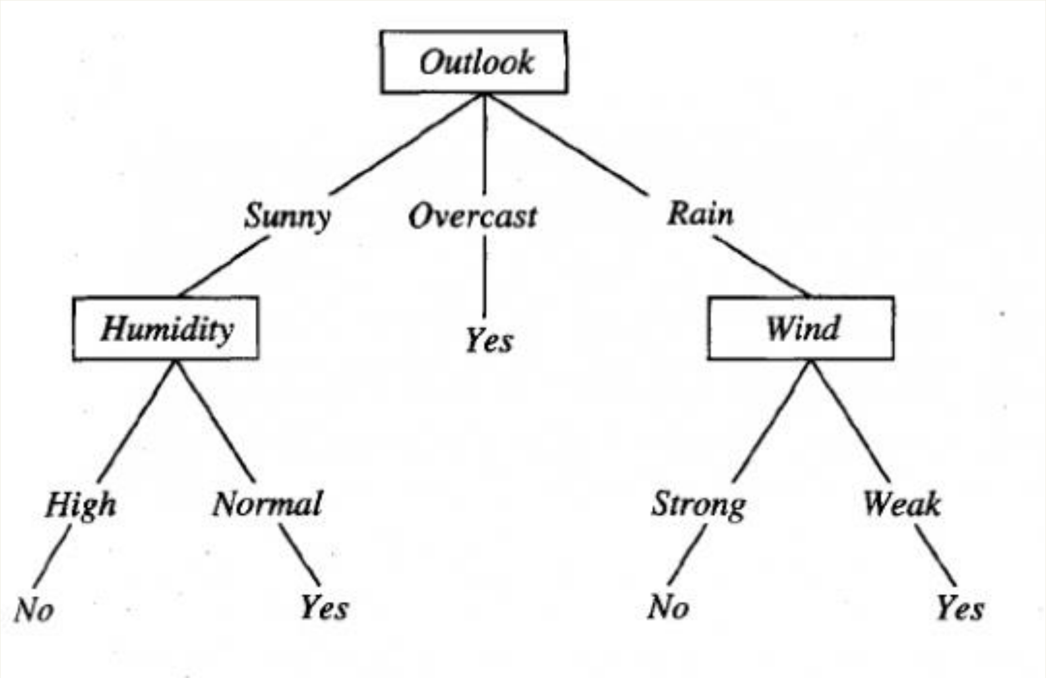


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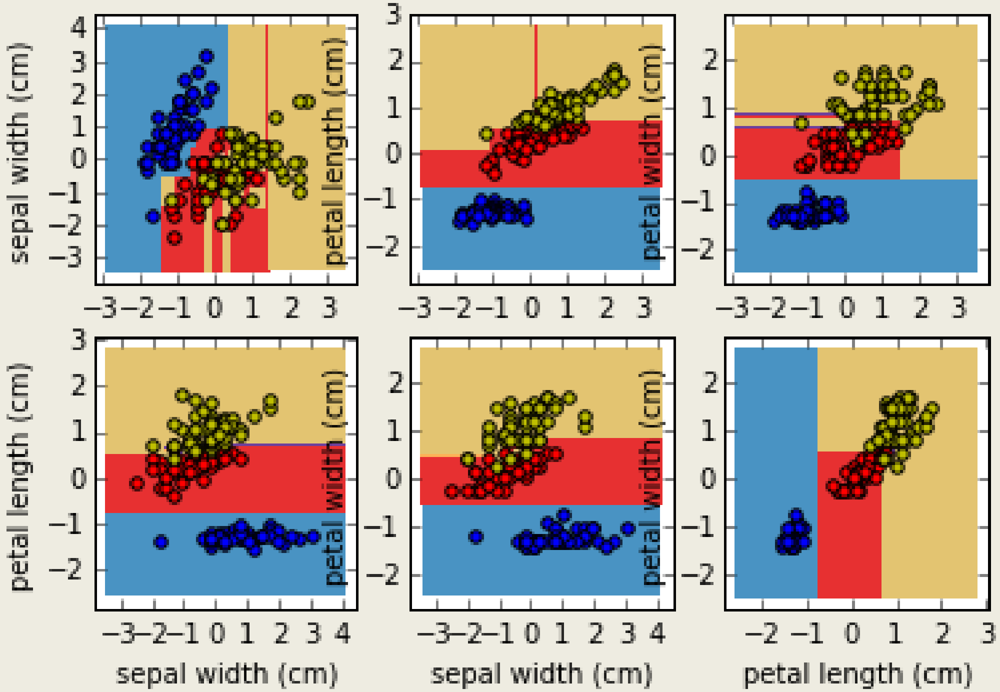


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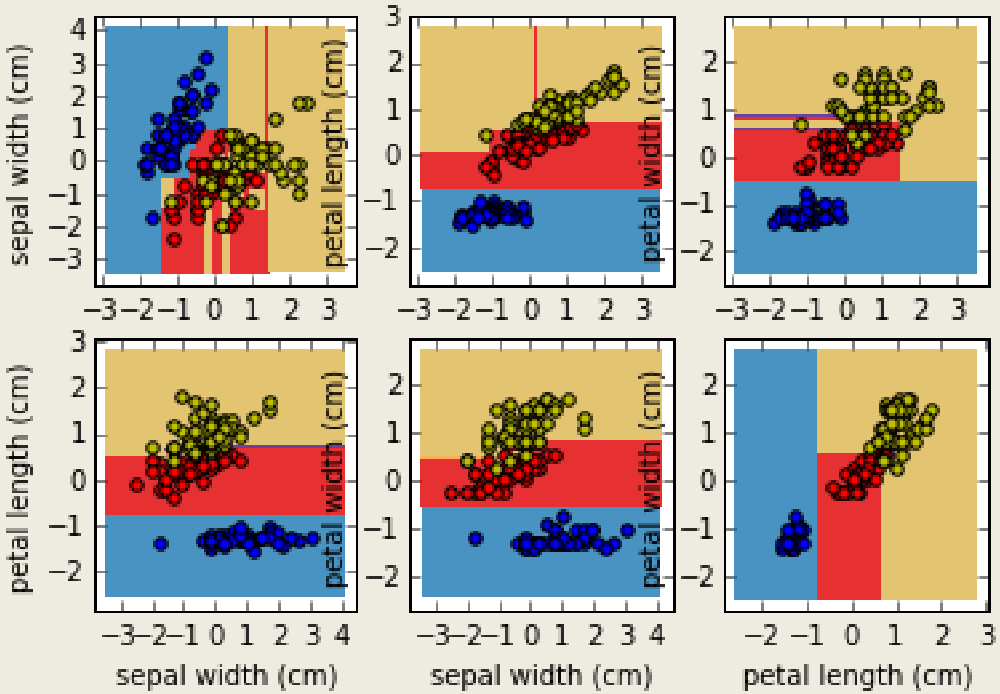


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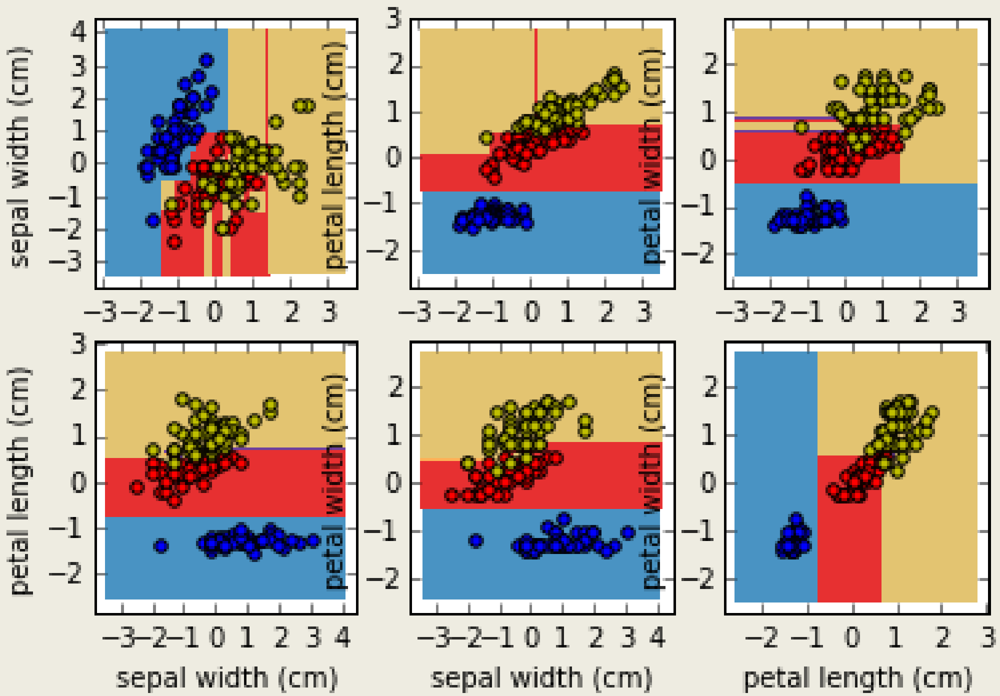


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A: Feature space is partitioned into rectangles. Take a vote or average within rectangle.

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Q: What questions would you ask?

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<u>Questions:</u>

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Q: Why are these questions important?
Q: Any ideas on how to solve these problems?

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Questions:

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  - Information Gain
  - Gini Impurity
  - Etc
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| X | Y | Z | C |
|---|---|---|---|
| 1 | 1 | 1 | 1 |
| 1 | 1 | 0 | 1 |
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Example:

Q: What feature is the best?

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## What is Information Gain?

- Entropy(Parent) = 1
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- Entropy(Parent) = 1
- X: C1 = -(1/3)log(1/3) – (2/3)log(2/3) = .9184, C2 = 0
  - Info Gain = 1- (3/4)*0.9184 – 0 = 0.3112
- Y: ?

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A: Feature Y is the best feature

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- **Y: C1 = 0, C2 = 0**
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# Advantage & Disadvantages

Advantages:

- Can handle continuous and categorical predictors
- Interpretability
- Ensembles are extremely powerful

Disadvantages

- Overfitting
- Predictive power
- High Variance

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