

### 3. Gini Decision Tree

<u>Outlook</u>	<u>Temperature</u>	<u>Humidity</u>	<u>Wind</u>	<u>Play Tennis</u>
Overcast: 4	Hot: 4	Normal: 7	Weak: 8	yes: 9
Sunny: 5	Mild: 6	High: 7	Strong: 6	no: 5
Rain: 5	Cool: 4			

$$\text{Play Tennis} = \text{Gini}(S) = 1 - \left( \left( \frac{9}{14} \right)^2 + \left( \frac{5}{14} \right)^2 \right) = 0.46$$

#### Outlook

$$\text{Sunny} = 1 - \left( \left( \frac{2}{5} \right)^2 + \left( \frac{3}{5} \right)^2 \right) = 0.480$$

$$\text{Overcast} = 1 - \left( \left( \frac{4}{4} \right)^2 + (0)^2 \right) = 0$$

$$\text{Rain} = 1 - \left( \left( \frac{3}{5} \right)^2 + \left( \frac{2}{5} \right)^2 \right) = 0.480$$

$$\text{Gini}(S|\text{Outlook}) = \left( \frac{5}{14} \cdot 0.480 \right) + \left( \frac{4}{14} \cdot 0 \right) + \left( \frac{5}{14} \cdot 0.480 \right) = 0.342$$

$$\text{Gain} = 0.460 - 0.342 = 0.118 \quad \leftarrow$$

#### Temperature

$$\text{Hot} = 1 - \left( \left( \frac{2}{4} \right)^2 + \left( \frac{2}{4} \right)^2 \right) = .5$$

$$\text{Mild} = 1 - \left( \left( \frac{4}{6} \right)^2 + \left( \frac{2}{6} \right)^2 \right) = .444$$

$$\text{Cold} = 1 - \left( \left( \frac{3}{4} \right)^2 + \left( \frac{1}{4} \right)^2 \right) = .375$$

$$\text{Gini}(S|\text{Temperature}) = \left( \frac{4}{14} \cdot .5 \right) + \left( \frac{6}{14} \cdot .444 \right) + \left( \frac{4}{14} \cdot .375 \right) = 0.440$$

$$\text{Gini Gain} = 0.460 - 0.440 = 0.020$$

#### Humidity

$$\text{High} = 1 - \left( \left( \frac{3}{7} \right)^2 + \left( \frac{4}{7} \right)^2 \right) = 0.490$$

$$\text{Normal} = 1 - \left( \left( \frac{6}{7} \right)^2 + \left( \frac{1}{7} \right)^2 \right) = 0.245$$

$$\text{Gini}(S|\text{Humidity}) = \left( \frac{7}{14} \cdot .490 \right) + \left( \frac{7}{14} \cdot .245 \right) = .367$$

$$\text{Gain} = 0.460 - .367 = 0.093$$

#### Wind

$$\text{Weak} : 1 - \left( \left( \frac{6}{8} \right)^2 + \left( \frac{2}{8} \right)^2 \right) = .375$$

$$\text{Strong} : 1 - \left( \left( \frac{3}{6} \right)^2 + \left( \frac{3}{6} \right)^2 \right) = .5$$

$$\text{Gini}(S|\text{Wind}) = \left( \frac{8}{14} \cdot .375 \right) + \left( \frac{6}{14} \cdot .5 \right) = .428$$

$$\text{Gain} = 0.460 - .428 = 0.032$$