Assignment6: MDP, Decision Trees

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Exercise 6.2 (Sunbathing)

Eight people go sunbathing. They are categorized by the attributes Hair and Lotion and the result of whether they got sunburned.

1. Which quantity does the information theoretic decision tree learning algorithm use to pick the attribute to split on?

   Information gain: $Gain(A) = I(P(C)) - \sum_a P(A = a) \cdot I(P(C|A = a))$, where $I(P(C)) = \sum_i -P_i \cdot \log_2(P_i)$

2. Compute that quantity for the attributes Hair and Lotion. (Simplify as much as you can without computing logarithms.)

   $$P(C) = \langle P(C = Yes), P(C = No) \rangle = \langle \frac{2}{8}, \frac{6}{8} \rangle \Rightarrow I(P(C)) \approx 0.81$$

   - Hair

     $\sum_{a \in \{Light, Dark\}} P(Hair = a) \cdot I(P(C|Hair = a)) = \frac{5}{8} \cdot I(\langle \frac{2}{5}, \frac{3}{5} \rangle) + \frac{3}{8} \cdot I(\langle 0, 1 \rangle) \approx 0.61 \Rightarrow Gain(Hair) = 0.2$

   - Lotion

     $\sum_{a \in \{No, Yes\}} P(Lotion = a) \cdot I(P(C|Lotion = a)) = \frac{6}{8} \cdot I(\langle \frac{2}{6}, \frac{4}{6} \rangle) + \frac{2}{8} \cdot I(\langle 0, 1 \rangle) \approx 0.69 \Rightarrow Gain(Lotion) = 0.12$

3. Assuming the logarithms are computed, how does the algorithm pick the attribute?

   Algorithm picks the attribute with largest Information gain. Hence, Hair is the best attribute to split on.