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CS 1675: Intro to Machine Learning

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<u>Problem Assignment 7</u>

Problem 1. Decision trees

Part a.

Test Error of Unrestricted Tree

= 0.2751

Test Error of Restricted Tree

= 0.2576

The tree that is best for prediction is the restricted tree since it provides a lower test error
compared to that of the unrestricted tree. We should always try to backprune since decision trees
are susceptible to overfitting, and when you backprune it can help with this issue and reduce the
likelihood.

Part b.

Example	1	2	3	4	5	6
MaxNumSplits	25	30	20	20	20	15
MinParentSize	10	10	10	15	15	15
MinLeafSize	2	2	2	2	4	4
Error	0.2576	0.2620	0.2445	0.2358	0.2227	0.2795

After experimenting with the decision tree function fitctree.m and its optional parameters, by
reducing the MaxNumSplits and increasing both the MinParentSize and MinLeafSize, at a
certain threshold the error can be reduced down to 0.227 (Example 5).

Problem 2. Conditional independence

Given:

$$P(A, B|C) = P(A|C)P(B|C)$$

From the definition of conditional probability:

$$P(A|B) = \frac{P(A, B)}{P(B)}$$

Therefore:

$$P(A|B, C) = \frac{P(A, B|C)}{P(B|C)}$$

$$P(A|B, C) = \frac{P(A|C)P(B|C)}{P(B|C)}$$

$$P(A|B, C) = P(A|C)$$

Problem 3. Bayesian belief networks

Part a.

$$P(E = F, B = F, A = F, J = T, M = F)$$

$$= P(E = F)P(B = F)P(A = F|B = F, E = F)P(J = T|A = F)P(M = F|A = F)$$

Part b.

$$P(E = F, B = F, A = F, J = T, M = F)$$

$$= P(E = F)P(B = F)P(A = F|B = F, E = F)P(J = T|A = F)P(M = F|A = F)$$

$$= (0.998) * (0.999) * (0.999) * (0.05) * (0.99)$$

$$= 0.049$$