Assignment 6
Machine Learning
Fall 1995
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1. Consider again the example application of Bayes rule in Chapter 6. Suppose the doctor decides to order a second laboratory test for the same patient, and suppose the second test returns a positive result as well. What are the posterior probabilities of *cancer* and $\neg$*cancer* following these two tests? Assume that the two tests are independent.

2. Consider the concept learning algorithm *FindG*, which outputs a maximally general consistent hypothesis (e.g., some maximally general member of the version space).

   (a) Specify distributions $P(h)$ and $P(D|h)$ under which *FindG* is guaranteed to output a MAP hypothesis.

   (b) Specify distributions $P(h)$ and $P(D|h)$ under which *FindG* is not guaranteed to output a MAP hypothesis.

   (c) Specify distributions $P(h)$ and $P(D|h)$ under which *FindG* is guaranteed to output a ML hypothesis but not a MAP hypothesis.

3. Consider the problem of learning the target concept "pairs of people who live in the same house", denoted by the predicate LiveTogether(x,y). Below is a positive example of the concept.

LiveTogether(Joe, Sue)	
Person(Joe)	Person(Sue)
Sex(Joe, male)	Sex(Sue, female)
Hair-Color(Joe, black)	Hair-Color(Sue, brown)
Height(Joe, short)	Height(Sue, short)
Nationality(Joe, US)	Nationality(Sue, US)
Mother(Joe, Mary)	Mother(Sue, Mary)
Age(Joe, 8)	Age(Sue, 6)

   The following domain theory is helpful for acquiring the LiveTogether concept:

LiveTogether(x, y) :- InSameFamily(x, y)
LiveTogether(x, y) :- FraternityBrothers(x, y)
InSameFamily(x, y) :- Married(x, y)
InSameFamily(x, y) :- Youngster(x) AND Youngster(y) AND SameMother(x, y)
SameMother(x, y) :- Mother(x, z) AND Mother(y, z)
Youngster(x) :- Age(x, a) AND LessThan(a, 10)

Apply the Prolog-EBG algorithm to the task of generalizing from the above instance, using the above domain theory.

3A. Show a hand-trace of the Prolog-EBG algorithm applied to this problem. In particular, show the explanation generated for the training instance, show the result of regressing the target concept through this explanation, and show the resulting generalization.

3B. Suppose that the target concept is "people who live with Joe" instead of "pairs of people who live together". Write down this target concept in terms of the above formalism. Assuming the same training instance and domain theory as before, what generalization will Prolog-EBG produce for this new target concept? (you need not show your work for this part, just the final answer).