AI2 Module 3
Tutorial 2
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Part 1

In this tutorial you will simulate the decision tree learning algorithm.
The Boolean concept is:

Shall I wait at a restaurant?

and the attributes in this learning problem are:

Alternate: whether there is another restaurant nearby

Bar: is there a bar area to wait in?

Fri/Sat: true on Fridays and Saturdays

Hungry: are we hungry?

Patrons: how many people are in the restaurant (values *some,none,full*)

Price: the price range

Raining: whether it is raining outside

Reservation: whether we made a reservation

**Type:** the type of restaurant (*French,Thai,Italian,Burger*)

WaitEstimate: the wait time estimated

The examples are given in the following table:

Example	Attributes										Goal
	Alt	Bar	Fri	Hungry	Patrons	Price	Rain	Reserve	Type	Estimate	
X1	Yes	No	No	No	Some	$$$	No	Yes	French	0-30	yes
X2	Yes	No	No	Yes	Full	$	No	No	Thai	30-60	No
X3	No	yes	No	No	Some	$	No	No	Burger	0-10	yes
X4	Yes	No	Yes	Yes	Full	$	No	No	Thai	10-30	yes
X5	Yes	No	No	Full	Full	$$$	No	Yes	French	> 60	No
X6	No	Yes	No	yes	Some	$$	Yes	Yes	Italian	0-10	Yes
X7	No	Yes	No	No	None	$	Yes	No	Burger	0-10	No
X8	No	No	No	Yes	Some	$$	Yes	Yes	Thai	0-10	Yes
X9	No	Yes	Yes	No	Full	$	Yes	No	Burger	> 60	No
X10	Yes	Yes	Yes	Yes	Full	$$$	No	Yes	Italian	10-30	No
X11	No	No	No	No	None	$	No	No	Thai	0-10	No
X12	Yes	Yes	Yes	Yes	Full	$	No	No	Burger	30-60	Yes

For reference, the diagram below shows a somewhat complicated decision tree drawn by hand by someone. Hopefully, the decision tree that you will discover will be more compact.
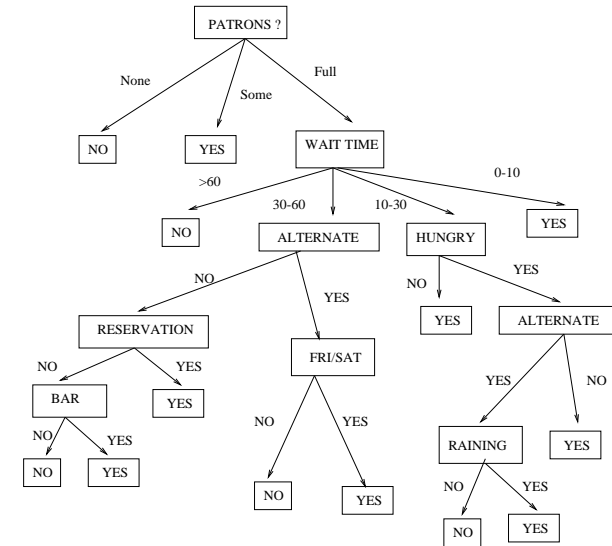
Questions:

1. Simulate the operation of the algorithm for the first split. Compute the *Gain*() for attributes Patrons, Type, and Hungry. The equations are given on slides 2-33, 2-34. You may need the following values: $\log_2 3 = 1.585$, $\log_2 1.5 = 0.585$, $I(X, 0) = I(0, X) = 0$ and $I(X, X) = 1$.

   Assuming that other attributes are not better than the three just considered, which attribute should be chosen?

2. Simulate the next splits by looking at the resulting partitions and evaluating intuitively which of the these is the most "skewed" one. Continue this until all examples are classified correctly.

3. Is the decision tree that you obtained reasonable? What could be the cause of unreasonable results?

Part 2

Question (from September 2001 Exams):

Consider the following situation:

A decision tree is to be used to classify instances as positive and negative. During the construction of the tree, a split on an attribute A with 3 values yields 3 subsets such that

- subset 1 has 2 positive examples and 8 negative examples

- subset 2 has 2 negative examples only

- subset 3 has 4 positive examples and 4 negative examples

Write an expression for *information gain* after the split. You do *not* need to compute the value of the expression.