PROBLEM

- In an e-commerce application we would like to give predictions on user's actions
- For example, we would like to know whether a user would like to ask for more information (***more_info***) based on
  - whether the data are from the educational domain (***edu***)
  - whether it's a first visit (***first***)
  - whether more goods have been already purchased from an affiliated company (***bought***)
  - whether she has visited a famous information store (***visited***)

THE DATA

Example	*bought*	*edu*	*first*	*visited*	*more_info*
e1	FALSE	TRUE	FALSE	FALSE	TRUE
e2	TRUE	FALSE	TRUE	FALSE	FALSE
e3	FALSE	FALSE	TRUE	TRUE	TRUE
e4	FALSE	FALSE	TRUE	FALSE	FALSE
e5	FALSE	FALSE	FALSE	TRUE	FALSE
e6	TRUE	FALSE	FALSE	TRUE	TRUE
e7	TRUE	FALSE	FALSE	FALSE	TRUE
e8	FALSE	TRUE	TRUE	TRUE	FALSE
e9	FALSE	TRUE	TRUE	FALSE	FALSE
e10	TRUE	TRUE	TRUE	FALSE	TRUE
e11	TRUE	TRUE	FALSE	TRUE	TRUE
e12	FALSE	FALSE	FALSE	FALSE	TRUE

PROBLEM

- We want to use the data to learn the value of more_info
- Suppose the error of a decision tree is defined as a number of misclassified examples
- The optimal decision tree is the one with minimal error

QUESTIONS

(1) Give the optimal decision tree with only one node (i.e., with no splits). What is the error of this tree?

(2) Give the optimal decision tree of depth 2 (i.e., the root node is the only node with children). For each leaf in the tree, give the examples that are filtered to that node. What is the error of this tree?

(3) Give the decision tree for this problem. Try to split on on the attribute that reduces the error the most. For each node in the tree specify which examples are filtered to that node. Define a program for the tree (HINT: remember the if-then-else view over the decision trees)

(4) Give two instances that do not appear in the examples and show how they are classified using the smallest decision tree. Use this to explain the bias inherent in the tree. (How does the bias give you these particular predictions?)

(5) How can overfitting occur in the learned network? Explain in terms of the example.