

CS 520 Final: Question 4 - GoatDiscoveryBot

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You cannot be graded on what you don't write down. Complete each question to the best of your ability. If you write code to solve one of the problems, you must submit that code along with your final answers. Explain your process and algorithms. Be explicit. Answers, without evidence of the thought and process that led to them, will not earn credit.

You are a **GoatDiscoveryBot**. Your job is to discover goats. You know there is a goat hidden in one of three locations, *A*, *B*, or *C*.

- a) Logically, how could you model this information? Probabilistically, how could you model this information?

*Hint: Consider the events **In A**, **In B**, **In C**.*

At this point, you want to search a location for the goat. How can you determine which location to select?

- b) Under the logical formulation, how can you compare the value/results of actions 'Select A', 'Select B', 'Select C'? Is there an obvious choice of best action?
- c) Under the probabilistic formulation, how can you compare the value/results of actions 'Select A', 'Select B', 'Select C'? Is there an obvious choice of best action?

Suppose, for argument's sake, you select location *A*. Before you search location *A*, you consult your friend, **CouldBeMoreHelpfulBot** (who knows where the goat is, but will only tell you where the goat isn't). **CBMHBot** will look at the two locations you didn't pick, and name one of them that does not have the goat. **CBMHBot** tells you the goat is not in location *B*. Given this new information:

- d) Update your logical formulation to reflect this new information.
- e) Update your probabilistic formulation to reflect this new information. *Hint: The **CBMHBot**'s decision to tell you the goat is not in *B* depended both on which location you selected, and where the goat actually is.*

At this point, you want to re-assess your earlier decision of which action to take as you now have more information than you did previously.

- f) Under the logical formulation, how can you compare the value/results of actions 'Re-Select A', 'Re-Select B', 'Re-Select C'? Is there an obvious choice of best action?
- g) Under the probabilistic formulation, how can you compare the value/results of actions 'Re-Select A', 'Re-Select B', 'Re-Select C'? Is there an obvious choice of best action?

Did **CouldBeMoreHelpfulBot** provide anything of actual value?

- h) Under the logical formulation, having initially selected location *A*, should you stick with location *A* or change? Justify your choice.
- i) Under the probabilistic formulation, having initially selected location *A*, should you stick with location *A* or change? Justify your choice.

Bringing it all together:

- j) Who is more successful in their mission, **LogicalGoatDiscoveryBot** or **ProbabilisticGoatDiscoveryBot**? Justify.

*Bonus: You initially select location A. Suppose that you know CouldBeMoreHelpfulBot is biased, in the following way: **if** CBMHBot has a choice between telling you B and C, then CBMHBot tells you B with probability p , and C with probability $1 - p$. CBMHBot tells you that the goat is not in location B. What is the utility of sticking with your initial selection? What is the utility of switching to C? What is the rational choice, and does it depend on p ?*