COS 470/570

Final Exam

Spring 2017

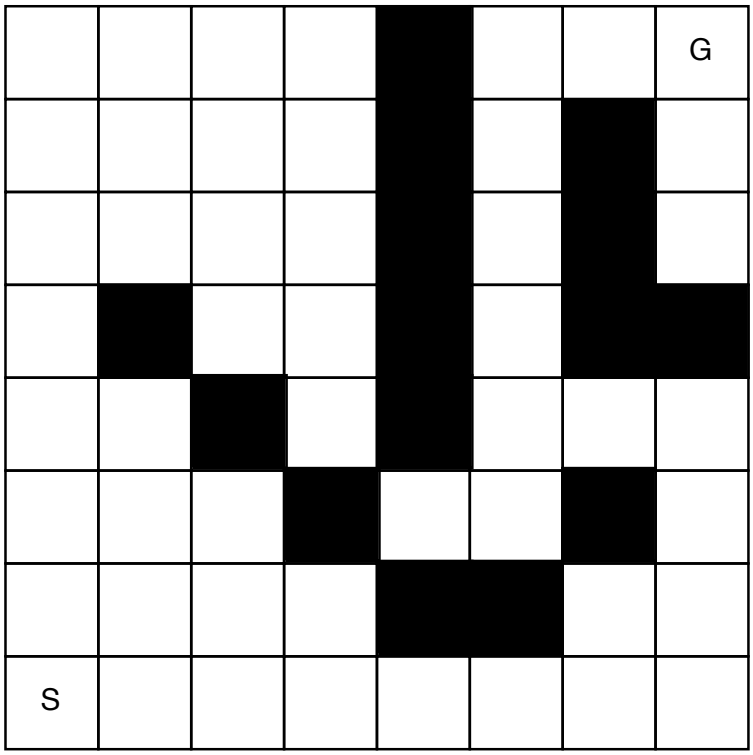
Put your name on the back of all the pages, not on the front. Answer the questions in the space provided. If you need additional space, answer on the back of the test, but make sure that you clearly label your answers. Each question is worth 5 points, for a total of 100 pts. There are 10 pages. Good luck, and it was a pleasure teaching you this semester!

1. Define *AI technique*.

2. Complete the following table with "Y" or "N" in each box:

Search	Complete?	Optimal?	Heuristic?	Uses only local information?
Depth-first search				
Breadth-first search				
Iterative-deepening DFS				
Hill climbing, no backtracking				
Hill climbing, with backtracking				
Uniform cost				
Simulated annealing				
A*				

3. In the following "robot world" grid, "S" is the start location, "G" is the goal location, and black squares are obstacles. Using A* with a Manhattan distance heuristic, put a dot in each square that is expanded (i.e., whose children are placed on the open queue) during the execution of the algorithm. Show the final path as well. Your robot can only go up, down, left, or right (i.e., no diagonals).



4. Choose <u>one</u> of the following and describe how it can be thought of as a search problem:
   (a) Non-linear planning
   (b) Learning in convolutional neural networks
   (c) Decision-tree learning where the goal is an optimal decision tree
   (d) Solving a problem with a genetic algorithm

5. Describe how you would use constraint satisfaction to solve a map-coloring problem.

6. Describe in general terms how you would extend minimax to handle a game such as Chinese checkers, which has more than two players but no uncertainty/randomness.

7. Describe how you would go about solving the traveling salesperson problem using a genetic algorithm.

8. Describe the *backpropagation algorithm*. Be specific, but your answer does not need to include any differential equations.

9. Compare and contrast the kind of fully-connected feedforward neural networks we first learned about in the class to convolutional neural networks.

10. For each of the following, represent the statement in first-order logic (FOL). If it cannot be represented in FOL, indicate that and give the reason(s). If you absolutely need additional predicates, invent them—but if you could do the problem with the existing predicates, you will lose points!

    (a) Every human who loves someone is nice. (Predicates: Human(x), Loves(x,y), Nice(x))

    (b) Any sufficiently advanced technology can be mistaken for magic. (Predicates: Technology(x), MoreAdvanced(x,y), MistakenFor(x,y))

    (c) The statement that everybody loves somebody is more accurate than the statement everyone loves everyone. (Person(x), Loves(x,y), MoreAccurate(x,y), Statement(x))

11. Given the description logic concepts `Person` (with role `hasChild`), `Female`, `Male`, `Teacher` (with role `worksAt`), `College`:
    (a) Define a new concept `Professor`

    (b) Define a new concept "a mother who is also a professor"

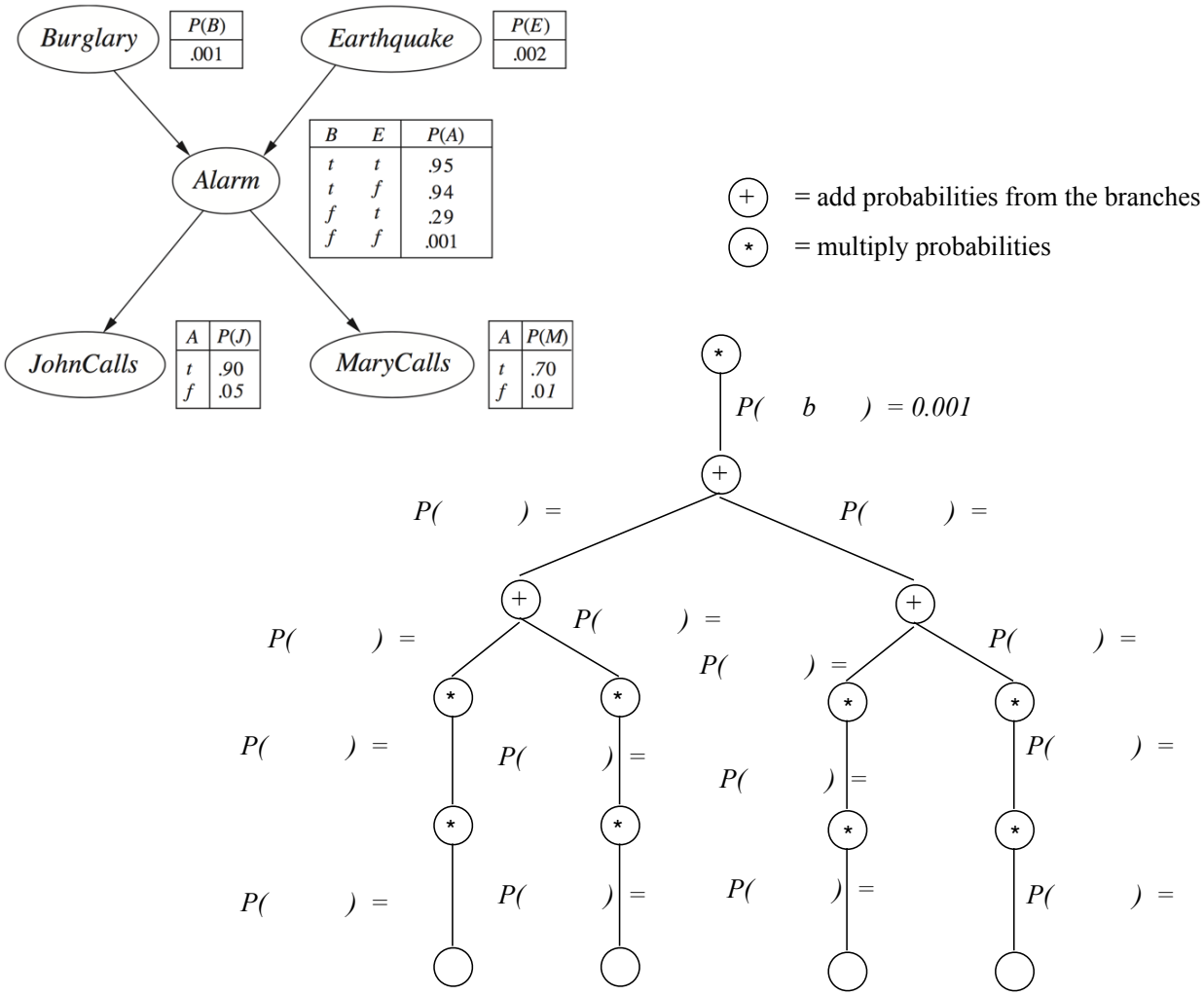
12. Compare and contrast a rule-based system (forward or backward) to a resolution theorem prover.

13. Compare and contrast plan graph-based planning and nonlinear planning.

14. In general, how would you go about incorporating hierarchical planning into graph plan-based planning?

15. Compare and contrast symbolic machine learning with neural network-based learning.

16. Using the Bayesian network below, fill in the computation tree to show how you would compute the probability that there has been a burglary if Mary calls but John does not call.



17. Discuss the similarities and differences between syntax-first and semantic natural language processing.

18. Briefly one of the following multiagent systems in general terms:
    (a) contracting (e.g., the Contract Net Protocol)
    (b) partial-global planning

19. Suppose you are told to design a controller for a robot whose mission is to travel around campus looking (via a video camera) for a particular person to give a message to. What AI techniques would you need? Justify your answer.

20. Discuss the future of AI as you see it, backing up your claims based on what you learned in class.