AI Practice Final

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You have 120 minutes for the exam. Write your name on the top right corner of every sheet on this test (2 points). Good luck!

1 Search

Look at Figure 1 carefully. Subsequent subsections refer to this figure. For answers in this section,

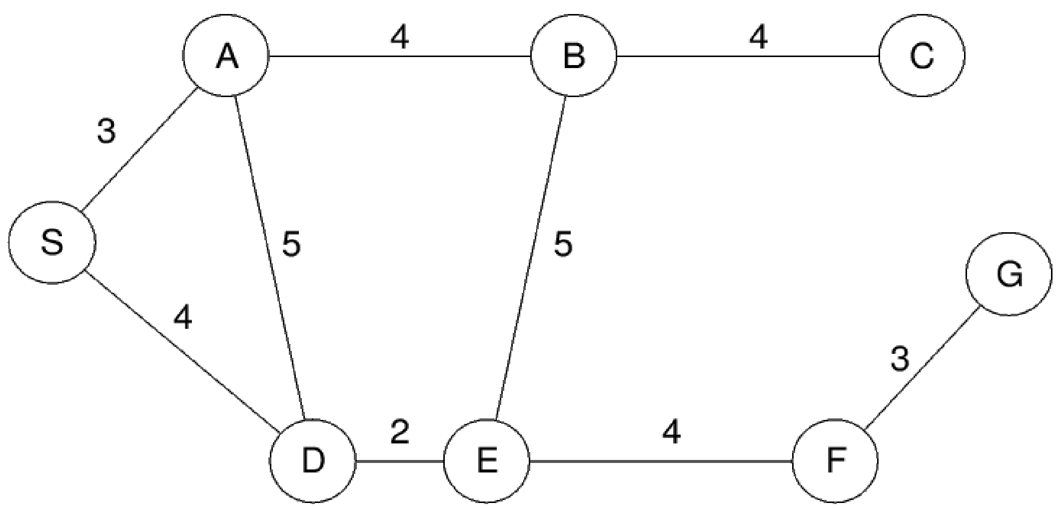


Figure 1: Cities and distances between them.

please keep child nodes in alphabetic order from left to right. We will take off 5 points for each violation of this ordering.

questions on next page...

1.1 Exhaustive Search (8 points)

Draw the exhaustive graph-search tree for paths from S to G corresponding to the net in figure 1. This would show all possible paths from S to G.

1.2 Depth First Search (8 points)

Draw the graph-search tree and **list the cities visited in the order** that a depth first search would create for finding a path from S to G for the net shown in the figure. Stop the first time you reach the goal state.

1.3 Breadth First Search (8 points)

Draw the graph-search tree and **list the cities visited in the order** that a breadth first search would create for finding a path from S to G for the net shown in the figure. Stop the first time you reach the goal state.

1.4 Uniform Cost Search (8 points)

Draw the graph-search tree and **list the cities visited in the order** that Uniform cost search would search the net to go from S to G in the figure.

1.5 Greedy Search (8 points)

Draw the tree and list the cities visited in the order that hill-climbing search would search the net in the figure for paths from S to G. Figure 2 gives you straight line distances between cities.

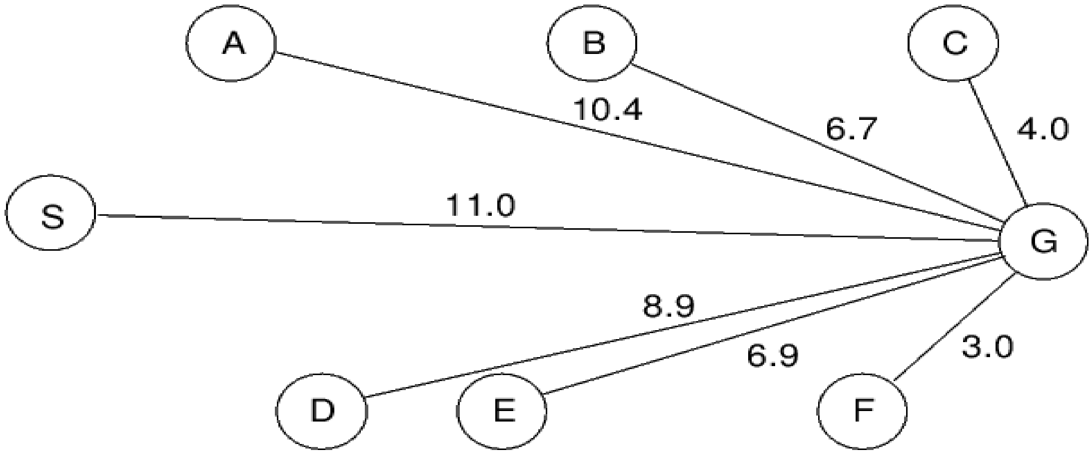


Figure 2: Straight line distance between Cities

1.6 A* (8 points)

Draw the tree and list the cities **visited** in the order that A* would search the net in the figure for paths from S to G. Figure 2 gives you straight line distances between the cities.

2 Minimax and Alpha-Beta Pruning (15 points)

2.1 Minimax (5 points)

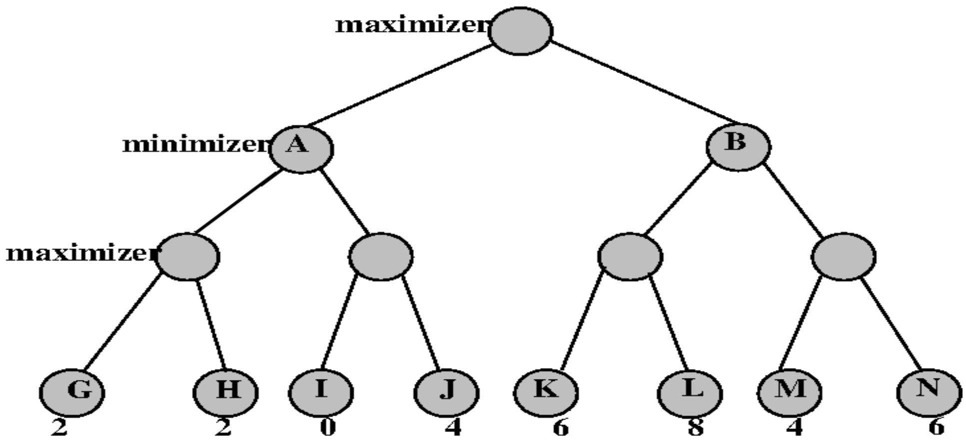


Figure 3: A game tree for minimax.

Run the minimax procedure on the tree in figure 3.

1. In Figure 3 write the value for each interior node as assigned by minimax next to the node (4 points).
2. Indicate the winning branch or move (A or B) at the root node (1 point).

2.2 Alpha-beta pruning (5 points)

Run the minimax procedure with alpha beta pruning on the same tree (in Figure 3) and reproduced below.

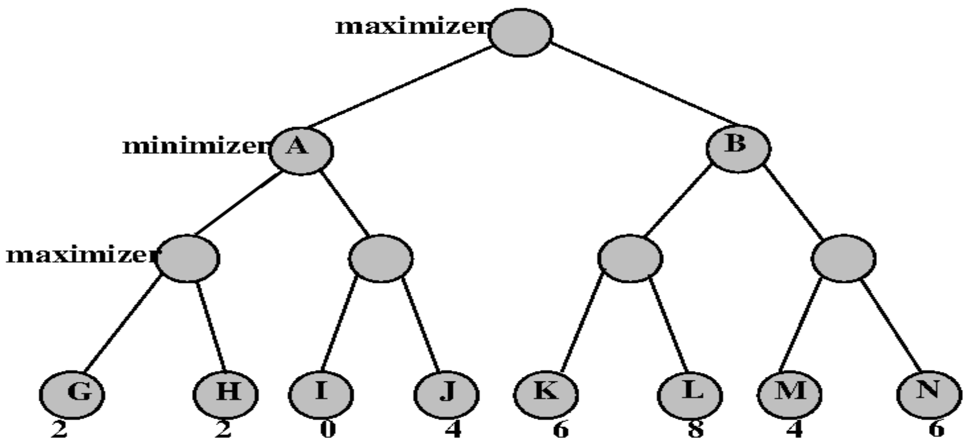


Figure 4: A game tree for minimax.

1. In Figure 4 indicate the winning move (A or B) (1 point)
2. List the nodes whose static values do **not** need to be computed (4 points) assuming that nodes are generated and examined in left-to-right order

2.3 More Alpha-beta pruning (5 points)

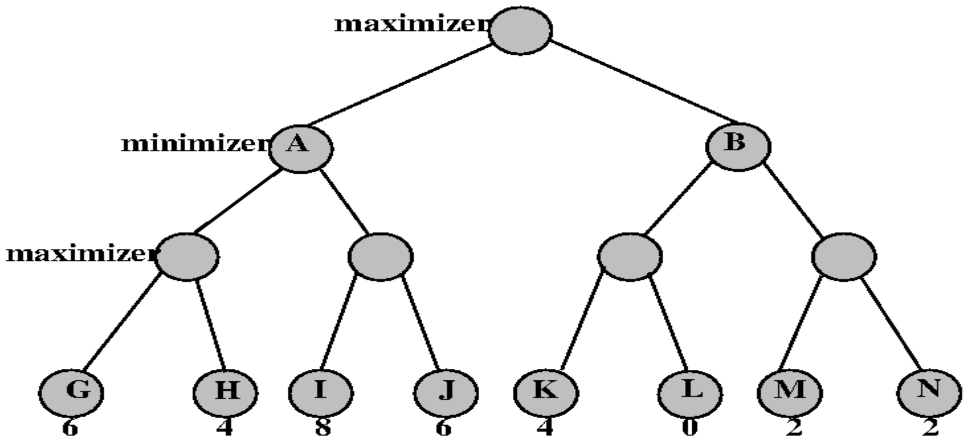


Figure 5: A game tree for minimax.

Run the minimax procedure with alpha beta pruning on the tree in Figure 5. This is a mirror image of the tree in Figure 3.

1. Indicate the winning branch or move (A or B) at the root node (1 point)

2. List the nodes whose static values do **not** need to be computed (4 points)

3 Genetic Algorithms (15 points)

1. (2 points) Only considering the effects of fitness-proportional selection, how many copies of an individual should I expect in the next generation if
   - There is 1 copy of the individual in the current generation
   - The individual's fitness is 32
   - The average fitness of the population is 32

2. (2 points) Only considering the effects of fitness-proportional selection, how many copies of an individual should I expect in the next generation if
   - There is one copy of the individual in the current generation
   - The individual's fitness is 40
   - The average fitness of the population is 32

3. (2 points) Only considering the effects of fitness-proportional selection, how many copies of an individual should I expect in the next generation if

   - There are two copies of the individual in the current generation
   - The individual's fitness is 48
   - The average fitness of the population is 32

4. (2 points) What has the higher probability of disruption: the schema $10**0$ or the schema $1****$?

If the fitnesses of individuals are as follows

- $000 = 5$
- $001 = 4$
- $010 = 4$
- $011 = 2$
- $100 = 4$
- $101 = 2$
- $110 = 2$
- $111 = 14$

5. (2 points) What is the fitness of the schema: $11*$?

6. (2 points) If a genetic algorithm's population is made up of the strings $[000, 010, 100, 001]$ and their associated fitnesses from above, what is the probability of selection of the string 010?

7. (3 points) Give the name of the algorithm that results from the following special case: A genetic algorithm with population size = 1

4 The Turing Test (5 points)

- The Turing Test gives a clear-cut yes-or-no answer.

  (True/False, 2 points): __________

- It is possible for thinking entities to fail the turing test

  (True/False, 2 points): __________

- In “A Coffeehouse Conversation on the Turing Test,”what is Hoftadter’s answer to: “If you could ask just one question in the Turing Test, what would it be?”

  (1 points) __________

5 Non-deterministic Environments (5 points)

In an erratic vacuum world (Figure 6), the Suck action works as follows

- When applied to a dirty square the action cleans the square and sometimes cleans the dirt in an adjacent square too.
- When applied to a clean square the action sometimes deposits dirt on the carpet

Draw the first level of the And-Or tree corresponding to finding a solution to the problem of starting in state 1 (Figure 6) and getting both tiles clean.

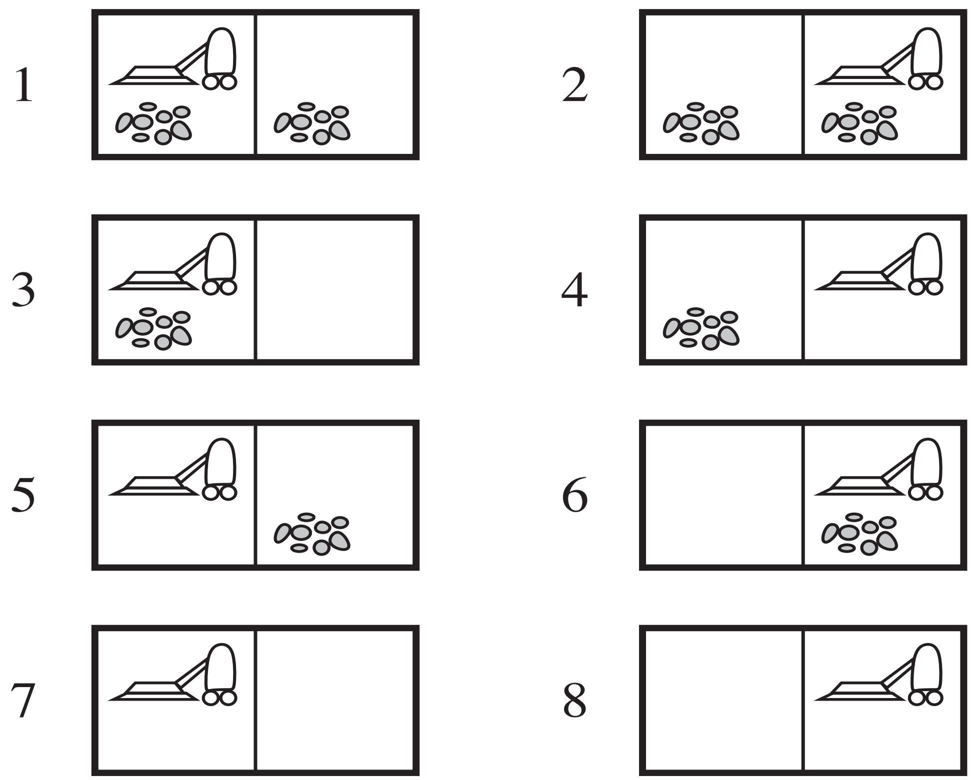


Figure 6: Vacuum world states.

6 Logic

1. The textbook defines four binary logical connectives. And, Or, $\implies$, and $\iff$. How many binary connectives can there be?

   ____

2. Consider a vocabulary with only four propositions, A, B, C, and D. How many models are there for the following sentences:

   - $B \vee C$

     ____

   - $B \wedge C$

     ____

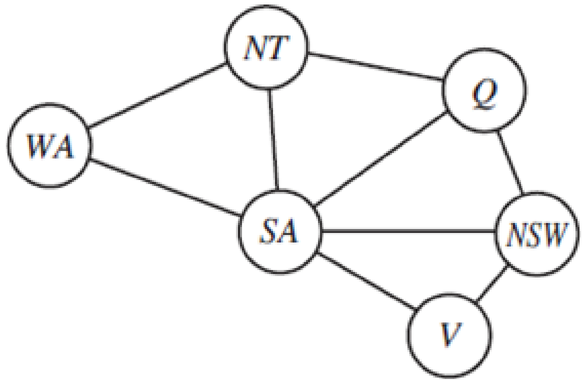
3. Use enumeration to determine if this sentence valid.

   $[(Food \implies Party) \vee (Drinks \implies Party)] \implies [(Food \wedge Drinks) \implies Party]$

   ____

7 Constraint Satisfaction Problems

Given the constraint graph below and the contraint that adjacent nodes may not have the same color. Provide a complete assignment of the colors r, g, b to the nodes of the graph that satisfies the constraint.



- WA

- NT

- SA

- Q

- NSW

- V

8 Neural Networks (5 points)

Consider the artificial neural network below (Figure 8). Robert, Raquel, and Romeo are siblings, and Joan, James, and Juliet are siblings. All other pairs are acquaintances. What values of W_1

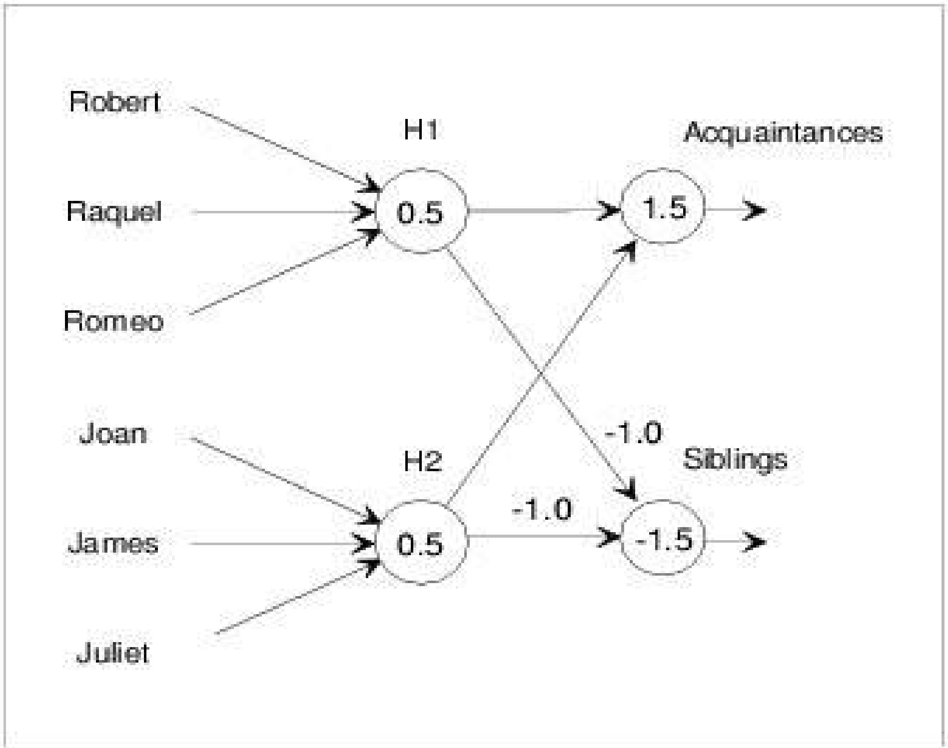


Figure 7: Siblings and Acquaintances

and W_2 would enable correct classification of acquaintances and siblings for this network.

1. W_1: ______________________________

2. W_2: ______________________________

9 Decision Trees (5 points)

Consider the data tabulated below.

ID	Hair	Height	Weight	Lotion	Result
Sarah	Blonde	Average	Light	No	Sunburn
Dana	Blonde	Tall	Average	Yes	none
Alex	Brown	Tall	Average	Yes	None
Annie	Blonde	Short	Average	No	Sunburn
Emily	Red	Average	Heavy	No	Sunburn
Pete	Brown	Tall	Heavy	No	None
John	Brown	Average	Heavy	No	None
Katie	Blonde	Short	Light	Yes	None

Figure 8: Siblings and Acquaintances

- What is the average entropy computed for each attribute?
  - Hair
  - Height
  - Weight
  - Lotion

- What attribute would be chosen for the root of the decision tree?

10 True/False (5 points)

- Rule-based deduction systems may run either forward or backward (T/F)
- Deep Thought uses the alpha-beta procedure when playing chess (T/F)
- Depth first search can supply compatible bindings for forward chaining (T/F)
- Exhaustive search of the 3x3 tic-tac-toe game tree is possible with current computers(T/F)
- Exhaustive search of the Chess game tree is possible with current computers (T/F)