



Attempt the following questions.

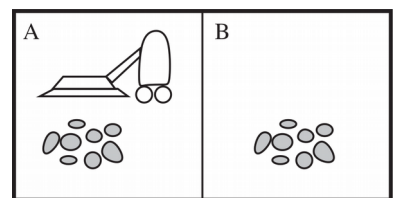
**Question 1:****(05 pts)**

- Are reflex actions (such as flinching from a hot stove) rational? Are they intelligent? (01 pt)
- Why would evolution tend to result in systems that act rationally? What goals are such systems designed to achieve? (01 pt)
- How could introspection—reporting on one’s inner thoughts—be inaccurate? Could I be wrong about what I’m thinking? Discuss. (01 pt)
- Is AI a science, or is it engineering? Or neither or both? Explain. (01 pt)
- “Surely animals, humans, and computers cannot be intelligent—they can do only what their constituent atoms are told to do by the laws of physics.” Is the latter statement true, and does it imply the former? (01 pt)

**Question 2:****(05 pts)**

- Write pseudocode agent programs for the goal-based and utility-based agents. (02 pt)
- Implement a performance-measuring environment simulator for the vacuum-cleaner world. Your implementation should be modular so that the sensors, actuators, and environment characteristics (size, shape, dirt placement, etc.) can be changed easily. (03 pt)

- The performance measure awards one point for each clean square at each time step, over a “lifetime” of 1000 time steps.
- The “geography” of the environment is known a priori but the dirt distribution and the initial location of the agent are not. Clean squares stay clean and sucking cleans the current square. The Left and Right actions move the agent left and right except when this would take the agent outside the environment, in which case the agent remains where it is.
- The only available actions are Left, Right, and Suck.
- The agent correctly perceives its location and whether that location contains dirt.

**Question 3:****(05 pts)**

Consider a state space where the start state is number 1 and each state  $k$  has two successors: numbers  $2k$  and  $2k + 1$ .

- Draw the portion of the state space for states 1 to 15. (01 pt)
- Suppose the goal state is 11. List the order in which nodes will be visited for breadth-first search, depth-limited search with limit 3, and iterative deepening search. (01 pt)
- How well would bidirectional search work on this problem? What is the branching factor in each direction of the bidirectional search? (01 pt)
- Does the answer to (c) suggest a reformulation of the problem that would allow you to solve the problem of getting from state 1 to a given goal state with almost no search? (01 pt)
- Call the action going from  $k$  to  $2k$  Left, and the action going to  $2k + 1$  Right. Can you find an algorithm that outputs the solution to this problem without any search at all? (01 pt)

**Question 4:****(05 pts)**

- Prove each of the following statements, or give a counterexample: (03 pts)
  - Breadth-first search is a special case of uniform-cost search.
  - Depth-first search is a special case of best-first tree search.
  - Uniform-cost search is a special case of  $A^*$  search.
- Prove that if a heuristic is consistent, it must be admissible. Construct an admissible heuristic that is not consistent. (02 pts)

Good Luck  
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