QUESTION 1

a. *An agent that senses only partial information about the state cannot be perfectly rational.*

False. Perfect rationality refers to the ability to make good decisions given the sensor information received.

b. *There exist task environments in which no pure reflex agent can behave rationally.*

True. A pure reflex agent ignores previous percepts, so cannot obtain an optimal state estimate in a partially observable environment. For example, correspondence chess is played by sending moves; if the other player's move is the current percept, a reflex agent could not keep track of the board state and would have to respond to, say, "a4" in the same way regardless of the position in which it was played.

c. *There exists a task environment in which every agent is rational.*

True. For example, in an environment with a single state, such that all actions have the same reward, it doesn't matter which action is taken. More generally, any environment that is reward-invariant under permutation of the actions will satisfy this property.

d. *The input to an agent program is the same as the input to the agent function.*

False. The agent function, notionally speaking, takes as input the entire percept sequence up to that point,

whereas the agent program takes the current percept only.

e. *Every agent function is implementable by some program/machine combination.*

False. For example, the environment may contain Turing machines and input tapes and the agent's job is to solve the halting problem; there is an agent *function* that specifies the right answers, but no agent program can implement it. Another example would be an agent function that requires solving intractable problem instances of arbitrary size in constant time.

f. *Suppose an agent selects its action uniformly at random from the set of possible actions. There exists a deterministic task environment in which this agent is rational.*

True. This is a special case of (c); if it doesn't matter which action you take, selecting randomly is rational.

g. *It is possible for a given agent to be perfectly rational in two distinct task environments.*

True. For example, we can arbitrarily modify the parts of the environment that are unreachable by any optimal policy as long as they stay unreachable.

h. *Every agent is rational in an unobservable environment.*

False. Some actions are stupid—and the agent may know this if it has a model of the environment—even if one cannot perceive the environment state.

i. *A perfectly rational poker-playing agent never loses.*

False. Unless it draws the perfect hand, the agent can always lose if an opponent has better cards. This can happen for game after game. The correct statement is that the agent's expected winnings are nonnegative.

QUESTION 2

Task environment	**P**erformance measure	**E**nvironment	**A**ctuators	**S**ensors
1. Crossword puzzle	Correct answers, time spent	Crossword, prompts, hints	Pen-using jointed arm/hand	Camera, scanner
2. Poker agent	Money won, number of wins	Dealt cards, community cards	Jointed arm and hand	Camera, scanner
3. Taxi driving	Profit, safety, law compliance	Roads, other vehicles, people	Steering wheel, brake, horn	Cameras, GPS, speedometer
4. Interactive tutor	Students' score, satisfaction	Students, textbooks	Screen to display solution	Keyboard, touch screen, camera
5. Cooking agent	Edibility, review, food waste	Kitchen, utensils, ingredients	Jointed arm and hand	Thermometer, camera

Task environment	Properties
1. Crossword puzzle	Fully observable, single-agent, deterministic, sequential, static, discrete
2. Poker agent	Partially observable, multi-agent, stochastic, sequential, static, discrete
3. Taxi driving	Partially observable, multi-agent, stochastic, sequential, dynamic, continuous
4. Interactive tutor	Partially observable, multi-agent, stochastic, sequential, static, discrete
5. Cooking agent	Partially observable, single-agent, stochastic, sequential, dynamic, continuous

Note: Answers to the above questioan are not fully complete and open to interpretation. There are no fixed answers.

QUESTION 3

(a) It suffices to show that for all possible actual environments (i.e., all dirt distributions and initial locations), this agent cleans the squares at least as fast as any other agent. This is trivially true when there is no dirt. When there is dirt in the initial location and none in the other location, the world is clean after one step; no agent can do better. When there is no dirt in the initial location but dirt in the other, the world is clean after two steps; no agent can do better. When there is dirt in both locations, the world is clean after three steps; no agent can do better.

(b)

- The agent in (a) keeps moving backwards and forwards even after the world is clean.

- It is better to do NoOp once the world is clean.

- Now, since the agent's percept doesn't say whether the other square is clean, the agent must have some memory to say whether the other square has already been cleaned.

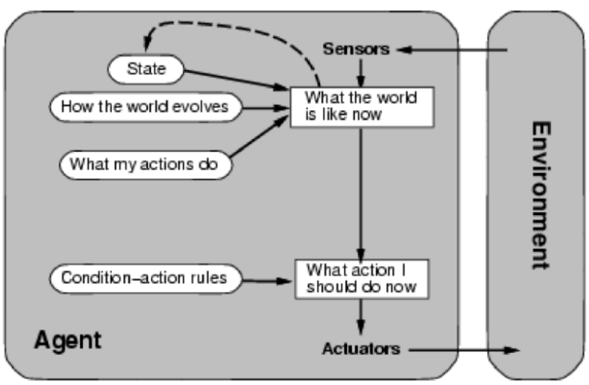
QUESTION 4

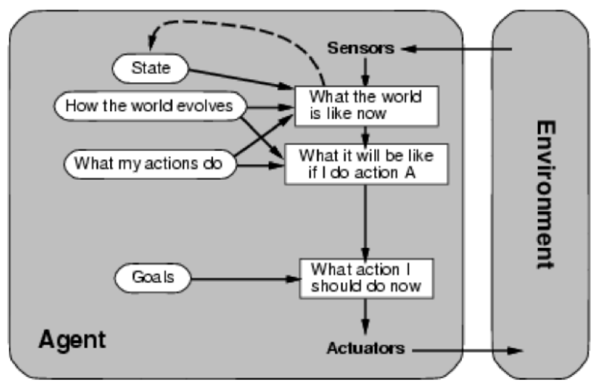
```
function GOAL-BASED-AGENT(percept) returns an action
   persistent: state, the agent's current conception of the world state
               model, a description of how the next state depends on current state and action
               goal, a description of the desired goal state
               plan, a sequence of actions to take, initially empty
               action, the most recent action, initially none

   state ← UPDATE-STATE(state, action, percept, model)
   if GOAL-ACHIEVED(state,goal) then return a null action
   if plan is empty then
plan ← PLAN(state,goal,model)
   action ← FIRST(plan)
   plan ← REST(plan)
   return action
```

Figure S2.1 A goal-based agent.

__**Explanation:**__





Compared to a model-based reflex agent, which keeps an internal model of the state, but essentially operates on a set of condition-action rules, a goal-based agent operates on the idea of having a goal state to be achieved.

Thus, the model of the goal-based agent is similar to the model-based reflex agent in terms of using the agent's recent perception of the environment (percept), the current internal conception of the environment (state), the most recent action (action), and the internal model (model) in order to update the environment conception (state).

Then, the state is checked to see whether it is the desirable state, based on the define goals. If so, the agent terminates its operation. If not, the agent checks out its plan, a sequence of actions to take, stored as a queue. If the plan runs out, and the desired state is not reached, a new plan is formulated based on the environment conception and the goal. The first action is operated, and the plan moves forward.