

CSE 571 Fall 2022

Homework 1

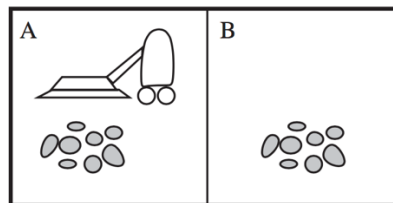
Due September 1, Thursday online

Homework Instructions: **Read Carefully**

1. Only typed answers will be accepted. Solutions with **ANY** written part (except for hand-drawn illustrating figures) will not be given any credits. If you need to write equations, use “Insert->Equation” with *Word*. *LaTeX* (e.g., *Overleaf*) also supports equation typesetting.
2. Do **NOT** include questions themselves in your answers. Failing to do some may result in failing the plagiarism check.
3. Answers without explanations will **NOT** be given any credits.

Be precise and concise in your answers. You may add hand-drawn figures when necessary.

Exercise 1.1 (15pt)



For each of the following assertions, answer whether it is true or false and support your answer with examples or counterexamples where appropriate. **Use our vacuum domain to construct examples as we discussed in class by providing the PEAS; you may change the task environment as needed.**

- a. An agent that senses only partial information about the environmental state cannot be rational.
- b. There exist task environments in which no simple reflex agent can behave rationally (no random actions allowed here).
- c. There exists a task environment in which every agent is rational.
- d. 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.
- e. Every agent is rational in an unobservable environment.

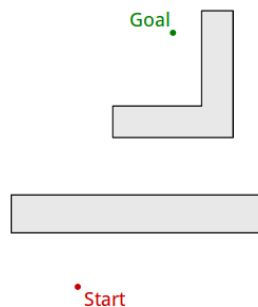
Exercise 1.2 (15pt)

Consider a modified version of the vacuum environment in which the geography of the environment—its extent, boundaries, and obstacles—is unknown, as is the initial dirt locations. The agent can go Up and Down as well as Left and Right. The agent will stay in place if it tries to move out of the boundaries or

move into obstacles. The agent can sense *its current location, whether there is dirt in it, and nothing else*.
The performance metric is to clean the space.

- a. Can a simple reflex agent be rational for this environment? Explain.
- b. Can a simple reflex agent with a *randomized* agent function (i.e., the action may be a random choice from a set of actions) outperform a simple reflex agent?
- c. When movements are penalized, can you design an environment in which your randomized agent will perform poorly?

Exercise 1.3 (12pt)



You are to design an agent that moves from a start location to a goal location with obstacles in between.
Assuming that your agent can sense its heading relative to the goal direction. Furthermore, it can detect an obstacle but only when it is next to it (i.e., tactile sensing). A simple way for the agent to interact with the environment is:

- 1) head toward goal if possible
- 2) when encountering an obstacle, always go left to follow the obstacle contour until you can head toward the goal again

- a. What is this type of agent that **best describes** the behavior above? Can you specify the agent function in pseudocode?
- b. If the obstacle configurations in the environment can change, can this agent always reach the goal location in environments where a path exists? If your answer is yes, explain your answer. Otherwise, justify your answer by giving an environment where it won't work.
- c. Can you use a model-based reflex agent to improve the agent? What additional sensors would you need?

Exercise 1.4 (8pt)

Consider the following conversation with two students concerning the performance metric for designing an intelligent agent:

A: In our class, we talk about that a poorly designed performance metric may lead to unintended consequences, such as the vacuum robot tries to suck at clean locations to create dirt to clean. So, how should we design performance metrics?

B: I believe we should introduce complex performance metrics that consider more factors, such as our discussion on auto taxi. The more complex a metric is, the better.

- a) (4pt) Discuss the benefits and limitations of designing complex metrics.

We discussed in class a goal-based agent can “predict” (model) the outcome of its actions, which is not possible with simple reflex agent.

b) (4pt) Does this make a goal-based agent always better than a simple reflex agent, given an achievable goal? Explain your answer.

Hint: what could possibly go wrong with a goal-based agent?