

# CS 7750: Solutions to homework 1

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September 11, 2014

## Exercises

**2.2** Let us examine the rationality of various vaccum-cleaner agent functions.

**a.** Show that the simple vaccum-cleaner agent function described in Figure 2.8 is indeed rational under the assumptions listed on page 38.

**Answers:** The agent function in the Figure 2.8 will check if the current status is "Dirty" then perform "Suck" action otherwise it will move to the other square then repeat throughout the agent's lifetime. Assuming that the clean square remains clean and one award point is given for each clean square at each time step over 1000 time steps, the agent will obtain 1998 out of 2000 score for the case that both squares are "Dirty" and more score for other environment configurations. Therefore, the agent is indeed rational given the above assumptions.

**b.** Describe a rational agent function for the case in which each movement costs one point. Does the corresponding agent program require internal state?

**Answers:** In the case that a rational agent function give a penalty of one point for each movement, the corresponding agent program should store an internal state for all clean squares and do nothing "NoOp" instead of moving "Right" and "Left" endlessly and if the square can become dirty again the agent should periodically check and re-clean if needed.

**2.3** For each of the following assertions, say whether it is true or false and support your answer with examples or counterexamples where appropriate.

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

**Answers:** (False) An agent can still be perfectly rational with partial information about its environment. For example, people crossing the street given they have looked at both sides of the street and found no incoming cars passing. The decision to go across the street to the other side is rational without fully understanding what is happening on the entire street.

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

**Answers:** (True) Simple reflex agents take into account only the current percept, ignoring the sequence of entire percept history. This will make them poorly perform in a stochastic or sequential environment such as chess game, or finding best route that agents' current action determine the possible actions they can perform in the future.

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

**Answers:** (True) A simple task environment that is single-agent, fully observable, deterministic, episodic, static, and discrete implies simple solution. Vacuum-cleaner world in the textbook is a good example. The simple-reflex agents, the simplest form of agents that only match a state against pre-defined conditions, rationally address the vacuum-cleaner problem given the above simple task environment without employing advanced model, goal or utility-based behaviours.

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

**Answers:** (False) An agent function is a mathematical function that map a sequence of perceptions into action thus the input for the agent function is the entire percept sequence while an agent program is the concrete implementation of the agent function and it only receive current percept to operate since nothing more is available from the environment. Figure 2.8 illustrates the agent program for REFLEX-VACCU-AGENT.

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

**Answers:** (False) Since there are infinite numbers of agent functions and problems yet to be solved and they will require infinite time to implement every agent functions in the universe. For all the program/machine combination we are having today are only the subset of the problems have been solved to date.

## 2.4

- a. PEAS description of the task environment:

Agent Type	Performance Measure	Environment	Actuators	Sensors
Playing soccer	Goal score	Field, ball, other players, and weather	Feet, hands	Eye and body
Exploring the subsurface oceans of Titan	Water density	Titan's surface and space	Spacecraft, and radar	Radio signal frequencies receiver
Shopping for used AI books on the Internet	Price	The internet, website, and payment methods	Online transactions	Website content(HTML)
Playing a tennis match	Score	Court, ball, net, and opponent	Hands and racket	Eye
Practicing tennis against a wall	Numbers of ball hit	Wall, and ball	Hands and racket	Eye
Performing a high jump	Height	Ground, bar, and weather	Feet	Eye and body
Knitting a sweater	Speed	Needle, yarn and lighting	Hands	Eye
Bidding on an item at an auction	Price	Place, time, items and audiences	Hands and mouth	Eye and ear

- a. Characteristic properties of the task environment:

Task Environment	Observable	Agents	Deterministic	Episodic	Static	Discrete
Playing soccer	Partially	Multi	Stochastic	Sequential	Dynamic	Continuous
Exploring the subsurface oceans of Titan	Partially	Single	Stochastic	Sequential	Dynamic	Continuous
Shopping for used AI books on the Internet	Partially	Single	Stochastic	Sequential	Semi	Discrete
Playing a tennis match	Partially	Multi	Stochastic	Sequential	Dynamic	Discrete
Practicing tennis against a wall	Fully	Single	Stochastic	Sequential	Dynamic	Discrete
Performing a high jump	Fully	Single	Deterministic	Episodic	Static	Discrete
Knitting a sweater	Fully	Single	Deterministic	Sequential	Static	Discrete
Bidding on an item at an auction	Fully	Multi	Stochastic	Episodic	Dynamic	Discrete

**2.6** This exercise explores the differences between agent functions and agent programs.

**a.** Can there be more than one agent program that implement a given agent function? Give an example, or show why one is not possible.

**Answer:** Yes, it is absolutely possible that a given agent function is implemented by more than one designer and then each designer will produce its own agent program for both research and commercial purposes. For instance, mobile phones may be produced by different vendors who follow the same compliant standard for frequencies transceiver.

**b.** Are there agent functions that cannot be implemented by agent program?

**Answer:** Yes, There are agent functions that cannot be implemented by agent program.

**c.** Given a fixed machine architecture, does each agent program implement exactly one agent function?

**Answer:** Yes, for a given machine architecture, each agent program implement one and only one agent function. One good example would be the REFLEX-VACCUM-AGENT program in Figure 2.8 that only implement the simple reflex agent function for the vacuum-cleaner world.