**Artificial Intelligence - Chapter 2: Exercises Solutions**

# Exercises 2.1 - 2.3

**2.1** Suppose that the performance measure is concerned with just the first T time steps of the environment and ignores everything thereafter. Show that a rational agent’s action may depend not just on the state of the environment but also on the time step it has reached.

**Answer:** - Rational action depends on both state and time step. - Example: Delivery robot earning points only in first 5 minutes; action differs at time = 1 vs time = T.

**2.2** Vacuum-cleaner agent functions.

1. Simple reflex agent (Figure 2.3) is rational under assumptions (two squares, +1 per cleaned square, no move penalty) because it ensures dirt is removed and maximizes performance.
2. Rational agent when movement costs 1 point:

* If square dirty → Suck
* Else → Stay
* Internal state needed if dirt reappears or multiple squares.

1. Unknown geography or dirt reappears:

* Agent must explore and learn map/layout.
* Learning improves efficiency: patrol frequency, dirt patterns.

**2.3** True/False assertions: (a) False – partial sensors can still be rational depending on environment. (b) True – pure reflex fails in maze-like environments. (c) True – environment where all actions have same effect. (d) False – input to program includes internal state, function uses percept history. (e) True in principle, false in practice for infinite percept histories. (f) True – deterministic environment where all actions yield same result. (g) True – same agent rational in multiple environments. (h) False – unobservable does not guarantee rationality. (i) False – stochastic games like poker, rational maximizes expected payoff but can lose.

# Exercises 2.4 - 2.13

**2.4** PEAS description: (a) Soccer – P: Goals, teamwork; E: field, players; A: run, kick; S: vision; Dynamic, multi-agent. (b) Titan exploration – P: area explored; E: subsurface water; A: propellers; S: sonar, cameras; partially observable. (c) Online book shopping – P: price, time; E: website; A: mouse/keyboard; S: listings; semi-dynamic. (d) Tennis match – P: points; E: court, opponent; A: move, hit; S: vision; competitive. (e) Tennis practice wall – P: successful returns; deterministic. (f) High jump – P: bar cleared; deterministic, episodic. (g) Knitting – P: quality sweater; sequential, deterministic. (h) Auction – P: win bid; E: auction system; A: place bid; S: bid info; stochastic, multi-agent.

**2.5** Terms: - Agent, Agent function, Agent program, Rationality, Autonomy, Reflex agent, Model-based, Goal-based, Utility-based, Learning agent – definitions as described.

**2.6** Agent functions vs programs: (a) Multiple programs can implement same function. (b) Some functions cannot be implemented (infinite percept histories). (c) One program = one function. (d) n bits → 2^n programs. (e) Faster machine doesn’t change function.

**2.7** Pseudocode: Goal-based agent and Utility-based agent pseudocode.

**2.8** Performance simulator – modular environment, sensors, actuators, performance scoring.

**2.9** Simple reflex agent – Suck if dirty, else move left/right; record scores.

**2.10** Movement costs: (a) Simple reflex not rational. (b) Reflex + state works. (c) With full environment percepts, rational.

**2.11** Unknown geography: (a) Simple reflex not rational. (b) Randomized reflex sometimes better. (c) Poor performance in oscillating environment. (d) Reflex with state performs well.

**2.12** Bump sensor failure – avoid repeated failed moves.

**2.13** Stochastic cases: (a) Murphy’s law – probabilistic reasoning. (b) Small children – optimal patrol intervals.

**End of Solutions**