FAI LAB 2a
Intelligent Agents

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Ex. 1

For each of the following activities, give a **PEAS** description of the task environment and characterize it in terms of their **properties**:

1. Robot playing soccer.
2. Exploring the subsurface oceans of Titan.
3. Shopping for used AI books on the Internet.
4. Playing a 1 vs. 1 poker match.
5. Performing a high jump.
6. Knitting a sweater.

Ex. 1.1

Robot playing soccer

Performance metric:

Environment:

Actuators:

Sensors:

Ex. 1.1

Robot playing soccer

Performance metric: win/lose, # goals, ...

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Environment: the pitch, both teams, the ball, ...

Actuators:

Sensors:

Ex. 1.1

Robot playing soccer

Performance metric: win/lose, # goals, ...

Environment: the pitch, both teams, the ball, ...

Actuators: robot legs, arms, ...

Sensors:

Ex. 1.1

Robot playing soccer

Performance metric: win/lose, # goals, ...

Environment: the pitch, both teams, the ball, ...

Actuators: robot legs, arms, ...

Sensors: camera, gyroscope, accelerometer, ...

Ex. 1.1

Properties:

- **Full** / **partial** observability
- **Deterministic** / **nondeterministic** behaviour
- **Episodic** / **sequential**
- **Static** / **dynamic**
- **Discrete** / **continuous**
- **Single** / **multi** -agent

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Ex. 1.2

Exploring the subsurface oceans of Titan.

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Partially observable, nondeterministic, sequential, dynamic, continuous, single agent (unless there are alien life forms that are usefully modeled as agents).

Ex. 1.3

Shopping for used AI books on the Internet.

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Shopping for used AI books on the Internet.

Partially observable, deterministic, sequential, static, discrete, single agent. This can be multi-agent and dynamic if we buy books via auction, or dynamic if we purchase on a long enough scale that book offers change.

Ex. 1.4

Playing a 1 vs. 1 poker match.

Ex. 1.4

Playing a 1 vs. 1 poker match.

Partially observable, nondeterministic, sequential, static, discrete, multi-agent.

Ex. 1.5

Performing a high jump.

Ex. 1.5

Performing a high jump.

Fully observable, nondeterministic, sequential, static, continuous, single-agent.

Ex. 1.6

Knitting a sweater.

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Knitting a sweater.

Fully observable, nondeterministic, sequential, static, continuous, single-agent.

Ex. 2

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

1. An agent that senses only partial information about the state cannot be perfectly rational.
2. There exist task environments in which no pure reflex agent can behave rationally.
3. There exists a task environment in which every agent is rational.
4. The input to an agent program is the same as the input to the agent function.
5. Every agent function is implementable by some program/machine combination.
6. 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.
7. It is possible for a given agent to be perfectly rational in two distinct task environments.
8. Every agent is rational in an unobservable environment.
9. A perfectly rational poker-playing agent never loses.

Ex. 2.1

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

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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.

Ex. 2.2

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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.

Ex. 2.3

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

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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.

Ex. 2.4

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

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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.

Ex. 2.5

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

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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.

Ex. 2.6

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True. This is a special case of 2.3; if it doesn't matter which action you take, selecting randomly is rational.

Ex. 2.7

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

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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.

Ex. 2.8

Every agent is rational in an unobservable environment.

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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.

Ex. 2.9

A perfectly rational poker-playing agent never loses.

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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.