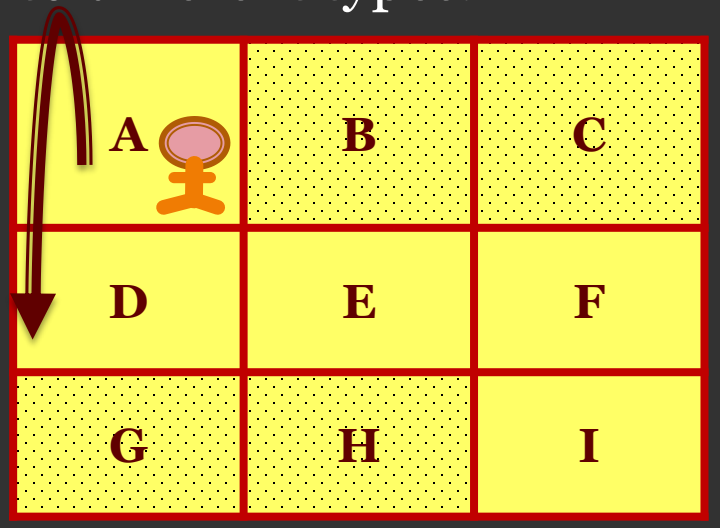
Environment Types

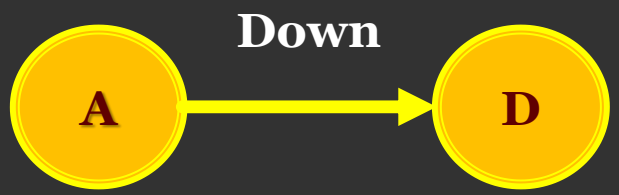
- It is the world where agent stays and can be categorized into different types.

- **Deterministic Versus Stochastic**
- Discrete Versus Continuous
- Episodic Versus Non-Episodic
- Single Versus Multi-agent



In a **deterministic environment** it is certain that an agent performs action a in the state s, it always reaches state s′.

For example: Consider the grid world environment, lets say the agent is in state A, when it moves down from state A, it always reaches the state D.



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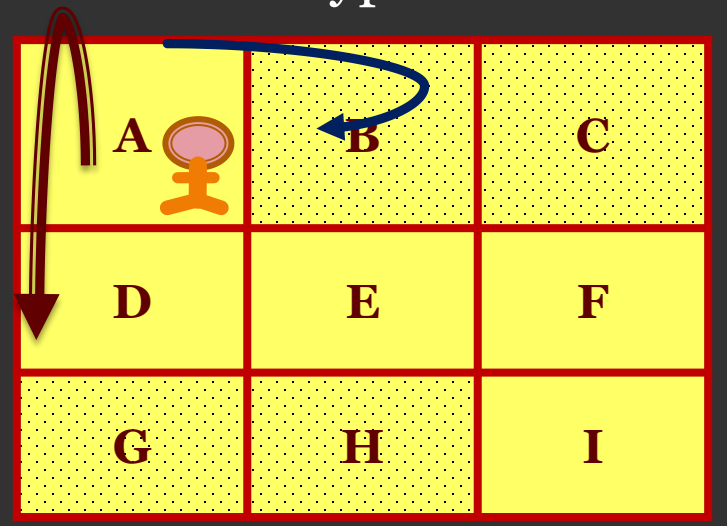
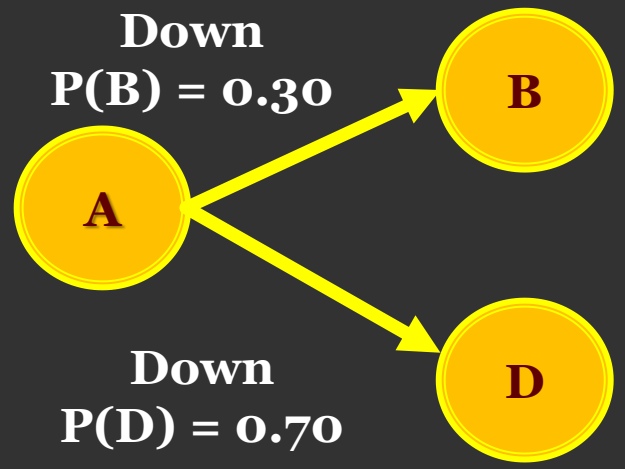


In a **STOCHASTIC environment** can't say by performing action a in state s the agent always reaches state s′ as there is randomness.

For example: Consider the grid world environment, lets say the agent is in state A, now if it moves down from state A, then the agent does not always reach D, it reaches state D 70% of time and state B 30% of time.

If the agent moves down in state A, then agent reaches state D 70% probability and state B 30% probability.



Environment Types

Deterministic

- The current state and action can completely determine the next state of the environment.
- No uncertainty.
- Next state is observable.
- Tic-tac-toe a fully observable, deterministic. It is a very small problem. However, most of AI based problem solving are not deterministic.
- On the contrary is a non-deterministic environment, the same task performed twice may produce different results or may even fail completely.
- Examples: Non-deterministic environment: physical world: Robot on Mars
- Deterministic environment: Tic Tac Toe game

Stochastic

- It is random in nature and cannot be determined completely by the agent.
- Uncertain
- Next state is totally unpredictable.
- Self driving vehicles are classical example of stochastic AI process.

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Environment's action space is discrete, in grid world environment, there is a discrete action space, which consists of the actions ***[up, down, left, right]*** and thus grid world environment is discrete.

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In a continuous environment, environment action space is continuous. For example, ***a agent is trained to drive a car, then the action space is continuous, with several continuous actions such as changing car's speed, the number of degrees the agent needs to rotate the wheel,*** and so on.

Environment Types

Discrete

- An environment is said to be discrete if there are a finite number of actions that can be performed within it.
- A game of chess or checkers where there are a set number of moves.

Continuous

- Taxi driving: There could be a route from to anywhere to anywhere else.
- The more complex an environment is, the harder it is to decide which action to perform.
- The most complex environment is one that is inaccessible, non-deterministic, non-episodic, dynamic and continuous.

Environment Types

- It is the world where agent stays and can be categorized into different types.

  - Deterministic Versus Stochastic
  - Discrete Versus Continuous
  - **Episodic Versus Non-Episodic (Sequential)**
  - Single Versus Multi-agent

In an ***episodic environment***, each agent's performance is the result of a series of independent tasks performed. There is no link between the agent's performance and other different scenarios. In other words, the agent decides which action is best to take, it will only consider the task at hand and doesn't have to consider the effect it may have on future tasks.

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The ***sequential environment*** is an environment where the next state is dependent on the current action. So agent current action can change all of the future states of the environment.

Environment Types

Episodic

- Episodic is an environment where each state is independent of each other.
- The action on a state has nothing to do with the next state.
- Real-life Example: A support bot (agent) answer to a question and then answer to another question and so on. So each question-answer is a single episode.
- Episodic environment: mail sorting system.

Non-Episodic or Sequential

- The sequential environment is an environment where the next state is dependent on the current action. So agent current action can change all of the future states of the environment.
- Real-life Example: Playing tennis is a perfect example where a player observes the opponent's shot and takes action.
- Non-episodic environment: chess game

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  - Episodic Versus Non-Episodic (Sequential)
  - **Single Versus Multi-agent**

In single agent environment all actions are performed by a single agent in the environment.

Environment Types

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  - Deterministic Versus Stochastic
  - Discrete Versus Continuous
  - Episodic Versus Non-Episodic(Sequential)
  - **Single Versus Multi-agent**

If two or more agents are taking actions in the environment, it is known as a ***multi-agent environment.***

Environment Types

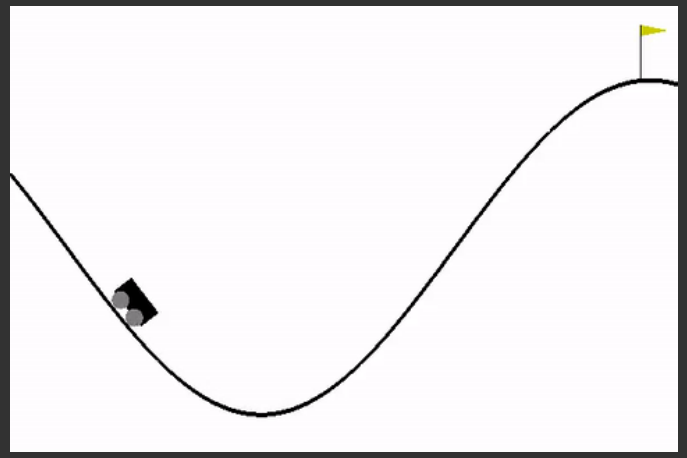
Single - Agent

- Playing tennis against the ball is a single agent environment where there is only one player.

Multi-Agent

- Playing a soccer match is a multi-agent environment.

Open Gym AI
– a tool kit for simulating RL



Mountain Car Environment

Frozen Lake Environment

Balancing Cart