Machine Learning

Lecture 4 : Reinforcement Learning

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Unit 1 Syllabus

01 —— ML Introduction

Definition, traditional programming vs machine learning algorithms

02 —— Supervised Learning

Learning a system

03 —— Unsupervised & reinforcement learning

Radix sort, Counting sort and Bucket sort.

Lecture Overview

Lecture Contents

- **Reinforcement Learning**
- **Working of Reinforcement Leaning**
- **Applications of Reinforcement Learning**

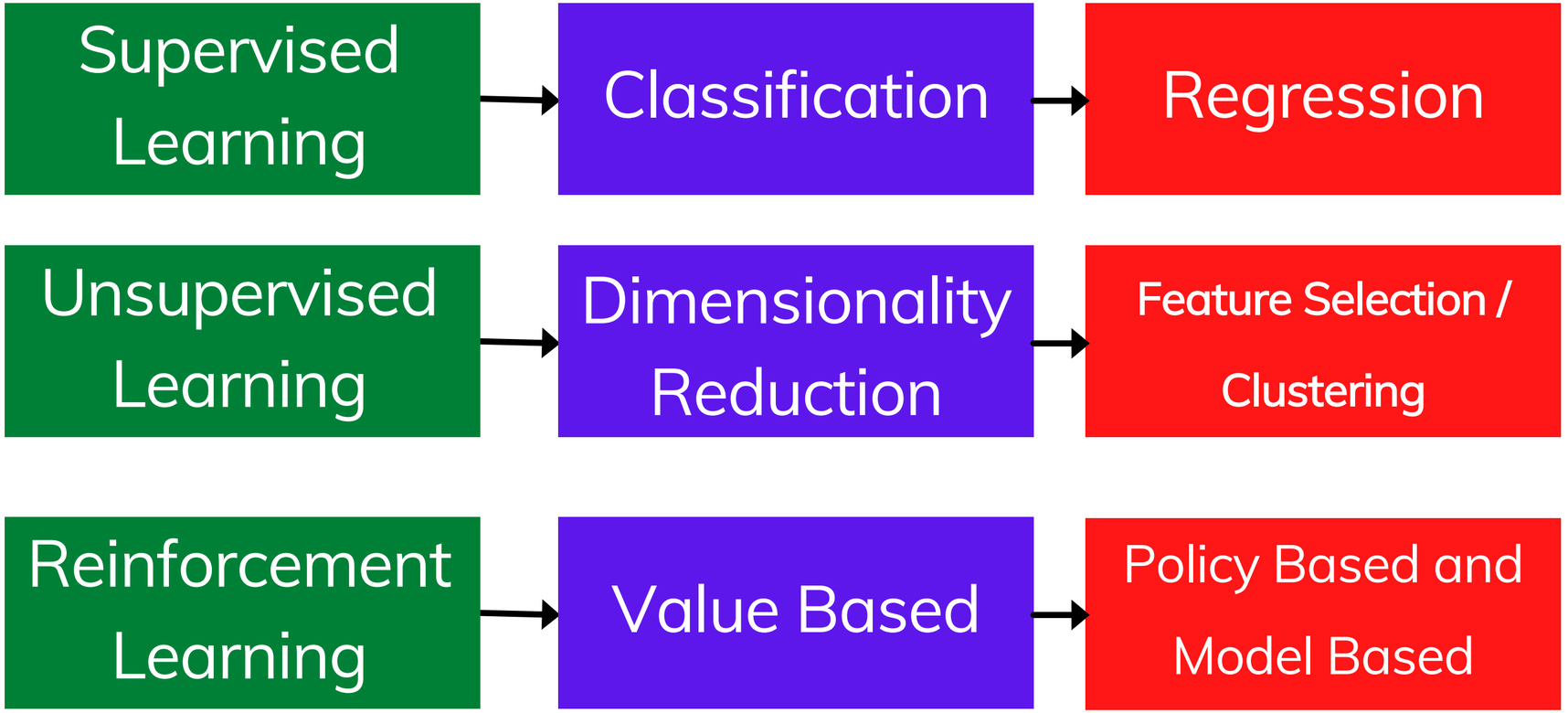
Lecture Objective

To have a good idea about Reinforcement Learning and its background.

Lecture Outcome

Understand and apply the concepts of Reinforcement Learning on real time problems.

Machine Learning Types



Important Terms used in Reinforcement Learning:

- Agent: It is an assumed entity which performs actions in an environment to gain some reward.
- **Environment (e)**: A scenario that an agent has to face.
- **Reward (R)**: An immediate return given to an agent when he or she performs specific action or task.
- **State (s)**: State refers to the current situation returned by the environment.
- **Policy (π)**: It is a strategy which applies by the agent to decide the next action based on the current state

Why to use Reinforcement Learning:

- It helps you to find which situation needs an action
- Helps you to discover which action yields the highest reward over the longer period.
- It also provides the learning agent with a reward function.
- It also allows to figure out the best method for obtaining large rewards.

When not to use RL: When you have enough data to solve the problem, and it is computing-heavy and time-consuming

Reinforcement Learning

- Reinforcement learning is the training of machine learning models to make a sequence of decisions.
- The agent (another name for reinforcement learning algorithms performing the task) learns to achieve a goal in an uncertain, potentially complex environment.
- In reinforcement learning, an artificial intelligence faces a game-like situation.
- The computer employs trial and error to come up with a solution to the problem.

How Reinforcement Learning works?

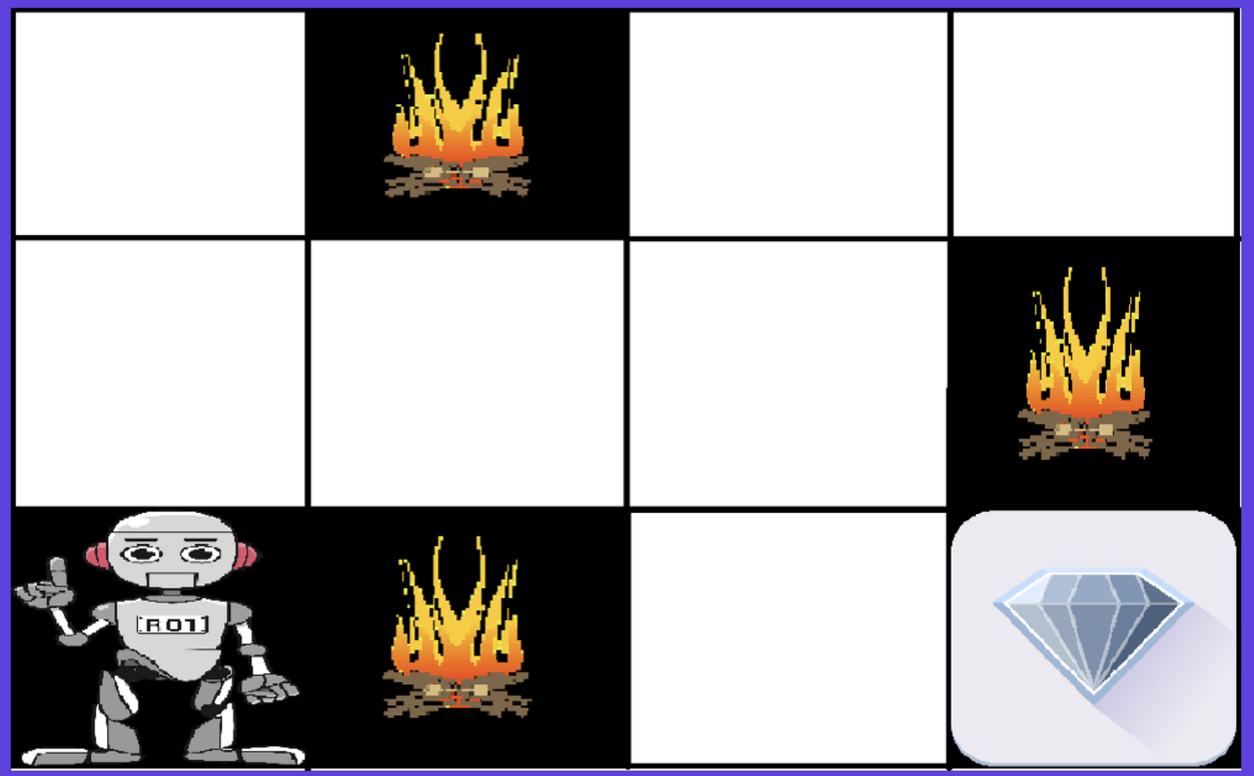
- The designer sets the reward policy–that is, the rules of the game–he gives the model no hints or suggestions for how to solve the game.
- It’s up to the model to figure out how to perform the task to maximize the reward.
- The tasks might starting from totally random trials and finishing with sophisticated tactics and superhuman skills.
- By leveraging the power of search and many trials, reinforcement learning is currently the most effective way to hint machine’s creativity.

Reinforcement Learning Used for

- Robotics. Robots can learn to perform tasks in the physical world using this technique.
- **Video gameplay**. Reinforcement learning has been used to teach bots to play a number of video games.
- **Resource management**. Given finite resources and a defined goal, reinforcement learning can help enterprises plan how to allocate resources.

Working of Reinforcement Learning: An Example

We have an agent and a reward, with many hurdles in between. The agent is supposed to find the best possible path to reach the reward. The following problem explains the problem more easily.



Working of Reinforcement Learning: An Example

- The above image shows the robot, diamond, and fire.
- The goal of the robot is to get the reward that is the diamond and avoid the hurdles that are fire.
- The robot learns by trying all the possible paths and then choosing the path which gives him the reward with the least hurdles.
- Each right step will give the robot a reward and each wrong step will subtract the reward of the robot.
- The total reward will be calculated when it reaches the final reward that is the diamond.

Types of Reinforcement Learning:

Reinforcement learning classified into two categories of problems:

- Positive
- Negative

Positive

Positive Reinforcement is defined as when an event, occurs due to a particular behavior, increases the strength and the frequency of the behavior.

- In other words, it has a positive effect on behaviour.
- Advantages:
  - Maximizes Performance
  - Sustain Change for a long period of time

Supervised Learning Types

Reinforcement learning classified into two categories of problems:

- Positive
- **Negative**

Negative

- It is defined as strengthening of a behavior because a negative condition is stopped or avoided.

Algorithms Used in Reinforcement Learning

- **Value-Based:** Here, you should try to maximize a value function V(s).

- **Policy-based**: Here, you try to come up with such a policy that the action performed in every state helps you to gain maximum reward in the future.

- **Model-Based**: Here, you need to create a virtual model for each environment.

- Markov Decision Process
- Q learning

Applications of Reinforcement Learning

- Robotics for industrial automation.
- Business strategy planning
- Data processing
- Aircraft control and robot motion control

Thank You!