UNIT 3: LEARNING

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INTRODUCTION

- Reinforcement learning problems involve learning what to do—how to map situations to actions—so as to maximize a numerical reward signal.

- In an essential way they are closed-loop problems because the learning system's actions influence its later inputs.

- Moreover, the learner is not told which actions to take, as in many forms of machine learning, but instead must discover which actions yield the most reward by trying them out. I

- n the most interesting and challenging cases, actions may affect not only the immediate reward but also the next situation and, through that, all subsequent rewards. T

- hese three characteristics—being closed-loop in an essential way, not having direct instructions as to what actions to take, and where the consequences of actions, including reward signals, play out over extended time periods—are the three most important distinguishing features of reinforcement learning problems.

Reinforcement learning

- Reinforcement learning is an area of Machine Learning.

- It is about taking suitable action to maximize reward in a particular situation.

- It is employed by various software and machines to find the best possible behavior or path it should take in a specific situation.

- Reinforcement learning differs from supervised learning in a way that in supervised learning the training data has the answer key with it so the model is trained with the correct answer itself whereas

- in reinforcement learning, there is no answer but the reinforcement agent decides what to do to perform the given task.

- In the absence of a training dataset, it is bound to learn from its experience.

Example: The problem is as follows: 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.
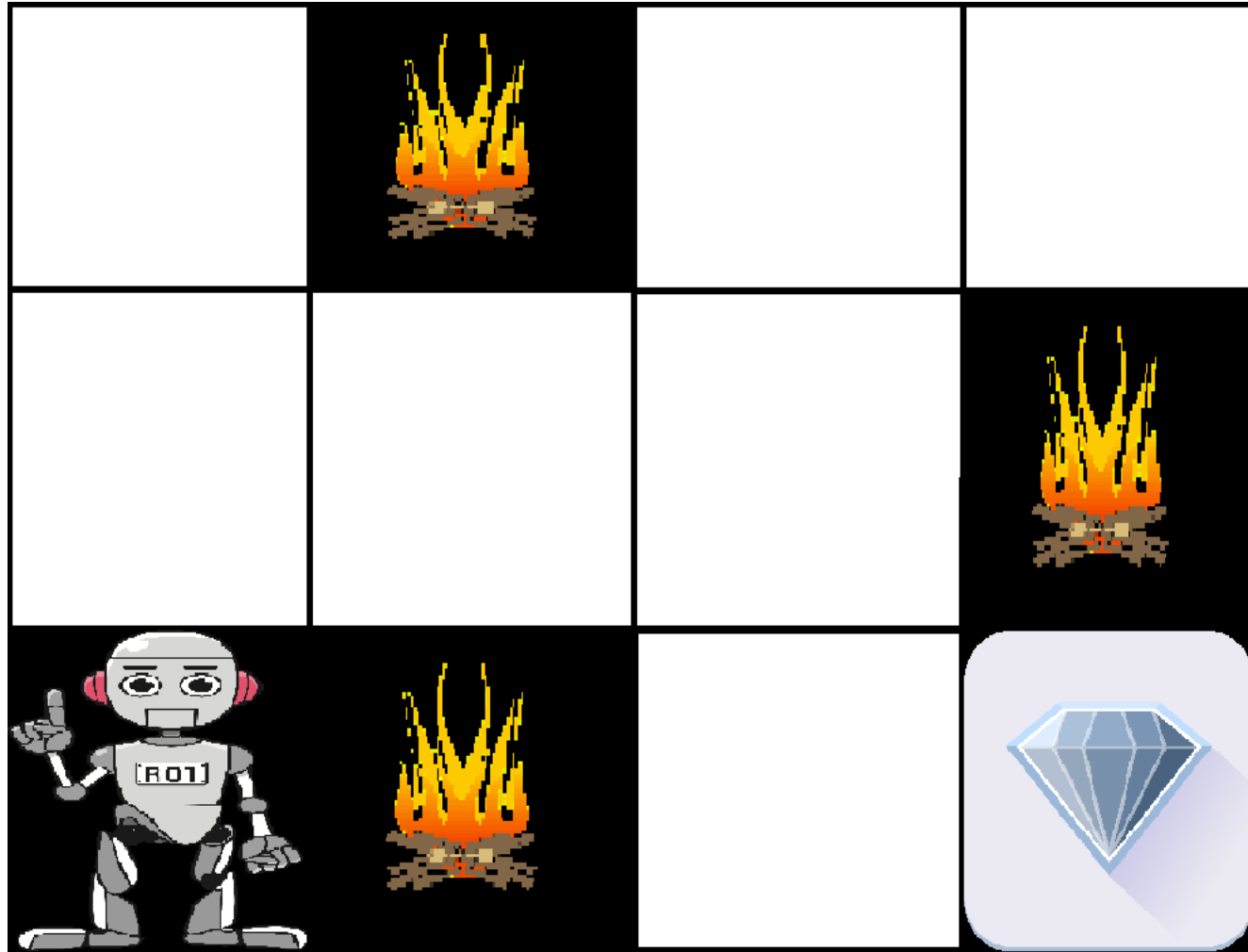
- The image shows the robot, diamond, and fire.

- The goal of the robot is to get the reward that is the diamond and avoid the hurdles that are fired.

- 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.

Main points in Reinforcement learning

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- Input: The input should be an initial state from which the model will start
- Output: There are many possible outputs as there are a variety of solutions to a particular problem
- Training: The training is based upon the input, The model will return a state and the user will decide to reward or punish the model based on its output.
- The model keeps continues to learn.
- The best solution is decided based on the maximum reward.

Difference between Reinforcement learning and Supervised learning:

Reinforcement learning	Supervised learning
Reinforcement learning is all about making decisions sequentially. In simple words, we can say that the output depends on the state of the current input and the next input depends on the output of the previous input	In Supervised learning, the decision is made on the initial input or the input given at the start
In Reinforcement learning decision is dependent, So we give labels to sequences of dependent decisions	In supervised learning the decisions are independent of each other so labels are given to each decision.
Example: Chess game	Example: Object recognition

Types of Reinforcement: There are two types of Reinforcement:

- **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 behavior.

- Advantages of reinforcement learning are:

  - Maximizes Performance

  - Sustain Change for a long period of time

  - Too much Reinforcement can lead to an overload of states which can diminish the results

Negative –

- Negative Reinforcement is defined as strengthening of behavior because a negative condition is stopped or avoided. Advantages of reinforcement learning:

- Increases Behavior

- Provide defiance to a minimum standard of performance

- It Only provides enough to meet up the minimum behavior

Various Practical applications of Reinforcement Learning -

- RL can be used in robotics for industrial automation.
- RL can be used in machine learning and data processing
- RL can be used to create training systems that provide custom instruction and materials according to the requirement of students.

RL can be used in large environments in the following situations:

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A model of the environment is known, but an analytic solution is not available;

- ▶ Only a simulation model of the environment is given (the subject of simulation-based optimization)

- ▶ The only way to collect information about the environment is to interact with it.

VS UNSUPERVISED ..

- Reinforcement learning is also different from what machine learning researchers call unsupervised learning, which is typically about finding structure hidden in collections of unlabeled data.

- The terms supervised learning and unsupervised learning appear to exhaustively classify machine learning paradigms, but they do not.

- Although one might be tempted to think of reinforcement learning as a kind of unsupervised learning because it does not rely on examples of correct behavior, reinforcement learning is trying to maximize a reward signal instead of trying to find hidden structure.

- Uncovering structure in an agent's experience can

- certainly be useful in reinforcement learning, but by itself does not address the reinforcement learning agent's problem of maximizing a reward signal

CONCLUSION

- Reinforcement learning is a computational approach to understanding and automating goal-directed learning and decision-making.

- It is distinguished from other computational approaches by its emphasis on learning by an agent from direct interaction with its environment, without relying on exemplary supervision or complete models of the environment.

- In our opinion, reinforcement learning is the first field to seriously address the computational issues that arise when learning from interaction with an environment in order to achieve long-term goals.