Assignment 12: Reinforcement Learning

Brandon Trinkle

Arizona State University

Course Number: IFT 360

Professor Durgesh Sharma

9/29/24

**Reinforcement Learning**

**Medical diagnosis of cancer patients**

**Suitability**: Not suitable

* Medical diagnosis is a high-stakes application where any mistake can have severe consequences, potentially leading to misdiagnosis, incorrect treatments, or even loss of life. Reinforcement learning relies on trial and error, which is inappropriate in this context because there’s no room for learning from mistakes when each decision could impact a patient’s health. Instead, more reliable and less error-prone methods like supervised learning with carefully curated and validated data are preferable.

**Recommending the next action to an auto-pilot**

**Suitability**: Not suitable

* In a real-world setting, an incorrect action from an auto-pilot system could lead to accidents, resulting in severe damage, injury, or even fatalities, making it a high-cost environment. However, using reinforcement learning in a simulated environment can be suitable, as mistakes can be made, learned from, and corrected without any real-world repercussions. Through simulation, the system can experiment with various actions, refine its decision-making, and transfer this knowledge to real-world scenarios once it's deemed safe.

**Exploring an area with limited space to explore**

**Suitability**: Suitable

* In an exploration task, reinforcement learning can be effective if the area is controlled, and mistakes have minimal impact, such as bumping into obstacles or taking incorrect paths. This low-cost nature allows the agent to learn efficient navigation strategies without incurring significant penalties for errors. Additionally, the ability to learn through trial and error makes Reinforcement Learning an excellent choice for environments where exploration is needed but errors do not cause harm or substantial loss.

**Identifying plants based on their physical features**

**Suitability**: Not suitable

* Although misidentifying a plant has a very low cost, reinforcement learning is still not appropriate for this task. This is because plant identification doesn't involve interaction or sequential decision-making, which are fundamental aspects of reinforcement learning. Instead, it is a straightforward classification problem that is better addressed using supervised learning, where the model learns from labeled data without needing to rely on trial and error.

**Recommending buying/selling decisions for stocks**

**Suitability**: Not suitable

* In real-world stock trading, mistakes can be extremely costly, leading to significant financial losses, which makes reinforcement learning a risky choice. However, in a simulated trading environment, reinforcement learning is suitable because mistakes have no real-world financial impact, allowing the model to learn from various strategies and market behaviors. This enables the Reinforcement Learning agent to develop and refine its trading policies without the risk of monetary loss, making it a more viable option in a simulated environment.

**Controlling a robot arm that assembles toys**

**Suitability**: Suitable

* Reinforcement learning is suitable for controlling a robot arm in environments where mistakes, such as dropping parts or assembling them incorrectly, incur minimal costs or can be quickly corrected. This low-cost environment enables the robot to experiment, learn from its actions, and improve its efficiency and accuracy over time. Moreover, since the consequences of errors are generally insignificant, the Reinforcement Learning agent can refine its assembly techniques, making it a practical application for reinforcement learning.

**Training a self-driving car in a simulated environment**

**Suitability**: Suitable

* Training a self-driving car in a simulated environment is ideal for reinforcement learning, as mistakes in this context have zero real-world cost. The agent can make errors, such as collisions or incorrect maneuvers, and learn from them without posing any danger to people or property. This allows the model to explore a wide range of scenarios, refine its decision-making skills, and gain experience in a risk-free setting before being deployed in real-world situations.

**Training a self-driving car in a real environment (driving in real streets)**

**Suitability**: Not suitable

* In a real-world driving environment, mistakes made by a self-driving car can be extremely costly, leading to accidents, injuries, or even fatalities, making this an unsuitable application for reinforcement learning. The high risk associated with trial and error in this context is unacceptable, as errors could result in severe consequences. Therefore, while Reinforcement Learning models can be trained in simulations, direct training in real-world streets is inappropriate due to the high cost of potential mistakes.