Artificial Intelligence & Machine Learning (18CS71)

Infosys Springboard Course Report

Course Title: Hands-On Reinforcement Learning with Python

From:
Vithesh Shetty V
1JT20CS113

Introduction

Embark on an intensive hands-on exploration of Reinforcement Learning (RL) with Python. This professional-level course delves into the core principles and techniques of RL, empowering you to design and train intelligent agents that learn through interaction. Master powerful algorithms like Q-learning, navigate dynamic environments, and unlock the potential of Neural Networks for optimal decision-making. Hone your coding skills, conduct insightful experiments, and witness the transformative power of self-learning AI. Prepare to push the boundaries of intelligent systems and shape the future of RL applications.

Course Content

Module 1: Getting Started With Reinforcement Learning Using OpenAI Gym

- Introduction to reinforcement learning (RL): Key concepts, terminology, goals, and applications.
- OpenAI Gym environment: Setting up and using this toolkit to create and interact with RL environments.
- Basic RL algorithms: Hands-on experience with simple RL algorithms to gain practical understanding.

Module 2: Lights, Camera, Action: Building Blocks of Reinforcement Learning

- Agents, environments, actions, rewards, and states: Core components of RL frameworks.
- Exploration vs. exploitation: Balancing the need to explore new possibilities and exploit known rewards.
- Value functions and policy functions: Representing the agent's knowledge and decision-making strategies.

Module 3: The Multi-Armed Bandit

- A simple RL problem: Focusing on balancing exploration and exploitation.
- Algorithms for multi-armed bandits: Epsilon-greedy, UCB1, Thompson sampling.
- Applications of multi-armed bandits: Real-world examples and use cases.

Module 4: The Contextual Bandit

- **Extending the multi-armed bandit to include context:** Using additional information to guide decisions.
- **Contextual bandit algorithms:** LinUCB, contextual Thompson sampling.
- **Applications of contextual bandits:** Personalization, recommendation systems.

Module 5: Dynamic Programming Prediction, Control, and Value Approximation

- **Dynamic programming:** A foundational technique for solving RL problems with perfect knowledge of the environment.
- **Policy evaluation and policy iteration:** Algorithms for finding optimal policies.
- **Value function approximation:** Techniques for handling large or continuous state spaces.

Module 6: Markov Decision Processes and Neural Networks

- **Markov decision processes (MDPs):** A mathematical framework for modeling RL problems.
- **Neural networks for RL:** Using deep learning to represent value functions and policies.
- **Deep Q-learning:** A popular method for combining neural networks and RL.

Module 7: Model-Free Prediction & Control With Monte Carlo (MC)

- **Model-free RL:** Learning without prior knowledge of the environment's dynamics.
- **Monte Carlo methods:** Estimating value functions and policies through random sampling.
- **Monte Carlo control:** Using Monte Carlo methods for decision-making.

Module 8: Model-Free Prediction & Control With Temporal Difference (TD)

- **Temporal difference learning:** Bootstrapping techniques for more efficient learning.
- **Q-learning:** A popular TD algorithm for control problems.
- **SARSA:** An on-policy TD algorithm.

Key Understandings

1. Core Concepts: Grasp the fundamental building blocks of RL, from agents and environments to rewards and decision-making strategies.
2. Practical Skills: Code and experiment with powerful RL algorithms like Q-learning and SARSA using OpenAI Gym, a popular toolkit for creating RL environments.
3. Real-World Applications: Understand how RL tackles problems like optimizing choices in clinical trials or personalizing recommendations in online systems.
4. Advanced Techniques: Deepen your knowledge with Markov Decision Processes (MDPs) for formalizing RL problems and delve into Deep Q-learning for complex decision-making.

Conclusion

In conclusion, the "Hands-On Reinforcement Learning with Python" course has been a comprehensive journey through the fundamentals and applications of reinforcement learning (RL). From OpenAI Gym setup to exploring advanced techniques like Deep Q-learning, the course covered multi-armed bandits, contextual bandits, dynamic programming, and model-free prediction and control. The emphasis on practical examples, algorithms, and assessments ensures participants are well-prepared to apply RL concepts in real-world scenarios. Overall, the course equips developers with the skills needed to make meaningful contributions to the dynamic field of reinforcement learning