Research Internship

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Keywords: Supply Chain, Reinforcement Learning, Deep Q-Learning

About Us

Flowlity is today the most advanced and intelligent supply chain planning solution on the market. Our SaaS platform provides real-time stock optimization and replenishment using machine learning and optimization.

Subject

The beer game consists of a serial supply chain network with four agents : a retailer, a warehouse, a distributor, and a manufacturer—who must make independent replenishment decisions with limited information. The game is widely used in classroom settings to demonstrate the bullwhip effect, a phenomenon in which order variability increases as one moves upstream in the supply chain, as well as the importance of communication and coordination in the supply chain. The bullwhip effect occurs for a number of reasons, some rational [1] and some behavioral [2]. It is an inadvertent outcome that emerges when the players try to achieve the stated purpose of the game, which is to minimize costs.

In this internship, we are interested not in the bullwhip effect but in the stated purpose, i.e., the minimization of supply chain costs, which underlies the decision making inevery real-world supply chain. Reinforcement learning (noted RL) is an area of machine learning that has been successfully applied to solve complex sequential decision problems [3]. RL is concerned with the question of how an agent should choose an action to maximize a cumulative reward. RL is a popular tool in telecommunications, robot control, and game playing, to name a few. RL considers an agent that interacts with an environment. In each time step, the agent observes the current state of the system, chooses an action, and gets rewards ; and then the system transitions randomly into the next state. This procedure is known as a Markov decision process (MDP), and RL algorithms can be applied to solve this type of problem. We are interested in applying RL to supply chain management problems. In particular, we would like to start the internship with a study of RL applied to the beer game. Depending on the intern background on RL, he could start to implement and test a tabular Q-learning algorithm [4] which is easier but probably performs worse, or a Deep Q-Network[5] which is harder but has promising results.

The next step of the internship could go invarious directions (depending on the need of the company and the interest of the intern) :

- Search for better algorithms for the beer game (literature review, implementation and analysis) or extend the beer game RL algorithm (for continuous actions or withactor-critic methods for example)
- Modelisation of the supply chain for one of the company client (what is the statespace and action space representation, how to define the multi-agent part in our application, implement and test the RL algorithm for the beer game in this model
- Study the impact of probabilistic forecast of the demand (integrate the probabilistic forecast of the demand in the RL algorithm in the information available to the agents and analyse the evolution of the performances).

The continuation of the internship in PHD could be possible. (CIFRE Thesis)

Linked articles

1 The Bullwhip Effect in Supply Chains. Hau L. Lee, V. Padmanabhan, Seungjin Whang.
2 Modeling Managerial Behavior : Misperceptions of Feedback in a Dynamic Decision Making Experiment. John Sterman.
3 Reinforcement Learning : An Introduction. Richard S. Sutton and Andrew G. Barto.
4 A reinforcement learning model for supply chain ordering management : An application tot he beer gameS. Kamal Chaharsooghi, Jafar Heydari, S. Hessameddin Zegordi.
5 A Deep Q-Network for the Beer Game : A Deep Reinforcement Learning algorithm to Solve Inventory Optimization Problems. Afshin Oroojlooyjadid, Mohammad Reza Nazari, Lawrence Snyder, Martin Takáč

Requirements & Competencies

— Top Universities, Eng. School
— Excellent level in Mathematics and Computer science particularly in ML/DL & Optimization
— Knowledge or interest for the Supply Chain
— Python : Tensorflow, Pytorch, Gym
— Tools : Github/Zenhub, Azure
— Comfort turning ideas into code

Bénéfices

— Pass Navigo
— Lunchr Card
— Flexibilité, Convivialité, Aventure Humaine
— Startup spirit : flexibility, friendliness, proximity, flat hierarchy

Informations supplémentaires

Si vous vous reconnaissez dans cette offre envoyez votre CV et lettre de motivation à arthur@flowlity.com.