

INFS 4020 – Big Data Concepts (SP2 2022)

Course	Big Data Concepts (INFS 4020)
Name	Gitae Bae
Email	<u>baegy002@mymail.unisa.edu.au</u>
Identifier	110310861
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Assignment 1 – Technology Review

[Gitaе Bae]

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Contents

Introduction.....	3
Overview of Banking	3
Overview of Reinforcement.....	4
Limitations and Issues to Using Reinforcement Learning.....	8
References.....	8

Introduction

When people hear the word “money”, they would have many thoughts about what to need, an indispensable thing or money does not follow happiness. But, no one would deny that money is super necessary, regardless of whether it is rich or poor. In addition, People are interested and worried about money these days in the world and there are many crimes and murders related to money all over the world. On the street, people can often see many homeless are going about begging. That is why money is essential for life and people can't do anything without money. It is explained by combining Ai technology as reinforcement learning with finance. Hence, here are some examples of an overview of banking, an overview of reinforcement learning, using reinforcement in banking and limitations and issues to using reinforcement learning applying reinforcement learning are explained through research, development and analysis.

Overview of Banking

The banking industry began with banks which became the prototype of merchants in the ancient world, and farmers and traders who procured goods between cities took out loans. Today, Banks work an important role in the global economies. Technologies have permitted banks to expand their range all over the world and there is no longer a requirement for customers to go to bank branches for every transaction (TechnoFunc 2020). As most of the transactions can occur online the development in cross-border activities has also grown the demand for banks that can give various services across borders to different nationalities (TechnoFunc 2020). So, many people can transfer money easily to each other and don't need to go integrally anymore. Financial companies are committed to creating a digital environment that delivers an optimal customer experience through the tight integration of back-end systems and customer operations. At the same time, many companies are investing in several services for digitalisation, from consumer-facing financial products and mobile payment platforms to asset and investment management services. Otherwise, they can't beat the competition against fintech startups that ignore traditional financial services processes and do challenge creative financial products and innovative work processes as high skills. In addition, with the spread of COVID-19 recently, the rate of work, issues, and complaints has increased significantly. In this way, many companies have decided to upgrade and expand AI helping services including AI counselling robots and Chatbot services. Now, It can apply for new deposits and instalment savings and credit loans through AI bankers. For example, kiosks will be more and more in each store and like this, AI will become as time goes by in all areas.

Overview of Reinforcement

Many researchers have insisted that reinforcement learning will replicate human cognitive abilities and develop to the level of artificial general intelligence in the future. Reinforcement learning is one of the ways to learn through trial and error (Chui, Manyika, Miremadi, Henke, Chung, Nel & Malhotra 2018). It refers to a training method in which the algorithm finds a combination itself that can produce optimal results through various attempts. In the case of humans, when learning to walk, it does not teach them in detail which leg to spread and how much to step on. A child who has just begun to step on his feet sometimes falls and learns to walk slowly while stumbling. Based on this reinforcement learning, it is an algorithm that finds goals by learning through mistakes and rewards (Chui, Manyika, Miremadi, Henke, Chung, Nel & Malhotra 2018). Existing neural networks learn weights and biases through labelled data, they use the concept of compensation to learn weights and biases. The goal is to learn the best behaviour or policy. Generally, reinforcement learning has been used in all industries such as agriculture, high tech, retail, travel, oil and gas, because it means that it is essential. For example, it is the case of the online game AI bot which is called AlphaGo.



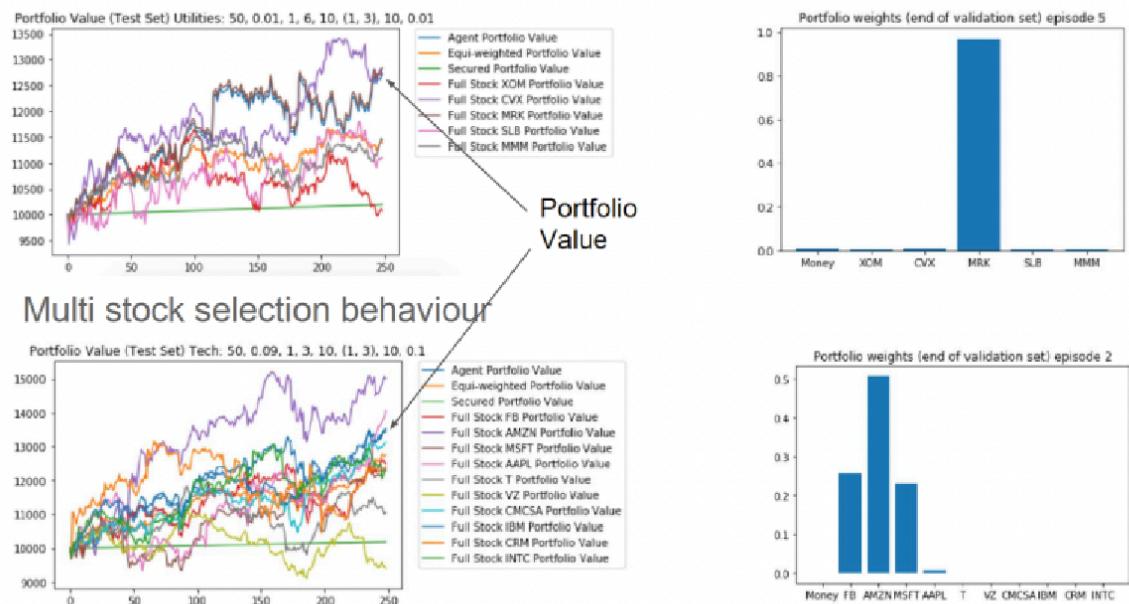
Figure 1. Alphago & Sedol Lee's Brain Match Image (intelliPaat 2020)

AlphaGo versus Sedol Lee who is Korean and the best Go player in the world. This Go match was held five times a week. The best Go artificial intelligence program and the best human champion drew attention to do Go, and AlphaGo won Sedol Lee. The final result was 4 wins and one loss. That is why Ai has developed a lot and has more potential for development and it is amazing and forward-looking. Maybe, the machine can have outgrown the human. Finally, reinforcement learning has disadvantages and advantages. It is a learning method that had existed before, but previous algorithms had not produced good results enough to be applied in real life. Another big problem with reinforcement learning is that the system can be in danger, such as breaking or falling during the learning process. However, recent research has become actively that model-based methods are generally more data-efficient than model-free methods. In addition, since the advent of deep learning, neural networks have been applied to reinforcement learning and they can be approached to complex problems. More specifically, classical algorithms need to calculate all the rewards for the coming states, but if the states space is as large as real life, it cannot be calculated realistically. Lately, complex problems can be solved by approximate value through neural networks instead of calculating them. Reinforcement learning has often use cases concerning banks and various financial services and seems appropriate for transaction and investment management.

Using Reinforcement in Banking

There are so many reinforcement learnings used in banking and here are approximately 7 examples. Firstly, it is portfolio optimization that is targeted to advance benefit allocation for portfolios on perpetual support to assist customers reach their financial aims (Garg 2019). AI Portfolio Administrator supplement benefit administrator by building, monitoring & automatically rebalancing a portfolio (Garg 2019). AI Portfolio Administrator assists to increase both efficiency and effectiveness of human administrators (Garg 2019). With the help of Deep Policy Network Reinforcement Learning, the allocation of benefits is able to be developed over time (Chatterjee 2021).

Single stock selection behaviour



Source

Figure 2. Portfolio Value Graph (Amrouni, Moulin & Mizrahi 2022)

Next, It is option pricing is that reinforcement learning is able to be applied to make a model for derivatives pricing (Garg 2019). The model gives instantaneous and compatible hedging and pricing of a derivative, unequal to many other business models (Garg 2019).

Thirdly, It is optimal trading that is targeted at making a robotic trader that brings about value from dealing in financial businesses (Garg 2019). Innovation and analysis in Deep reinforcement learning gives a framework for the construction such an agent (Garg 2019). RL agents have been able to study optimal trading methods which outperformed the easy Buy & Hold method (Garg 2019).

Besides, it is recommendation systems that exist to solve the issue of selecting one among plenty (Garg 2019). Collaborative filtering or content based ways to advocate items (Garg 2019). Values of accepting reinforcement learning over conventional systems include conquering cold-start issues, online learning and intelligible suggestions (Garg 2019). These systems are able to support advocating the right stocks to customers while dealing (Chatterjee 2021).

Also, it is conversational chat-bots that can respond to customers and answer questions on behalf of people's works and are trained in reinforcement learning that is able to get big strengths to have stock trading and finance.

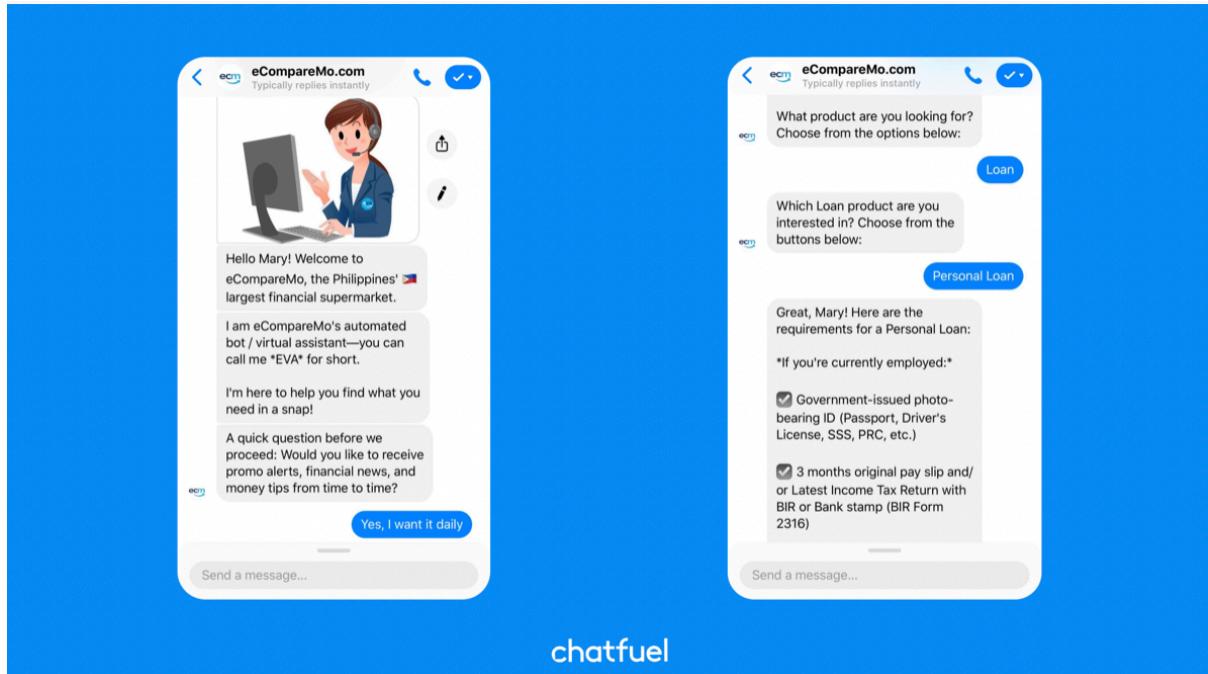


Figure 3. Chat Bot Example (chatfuel)

When it comes to this bot, It is trading bot powered with reinforcement learning that is able to study from the trading and stock business environment by combining with it (Chatterjee 2021). They use trial and error to increase their learning method based on the traits of each and every stock recorded in the stock business (Chatterjee 2021).

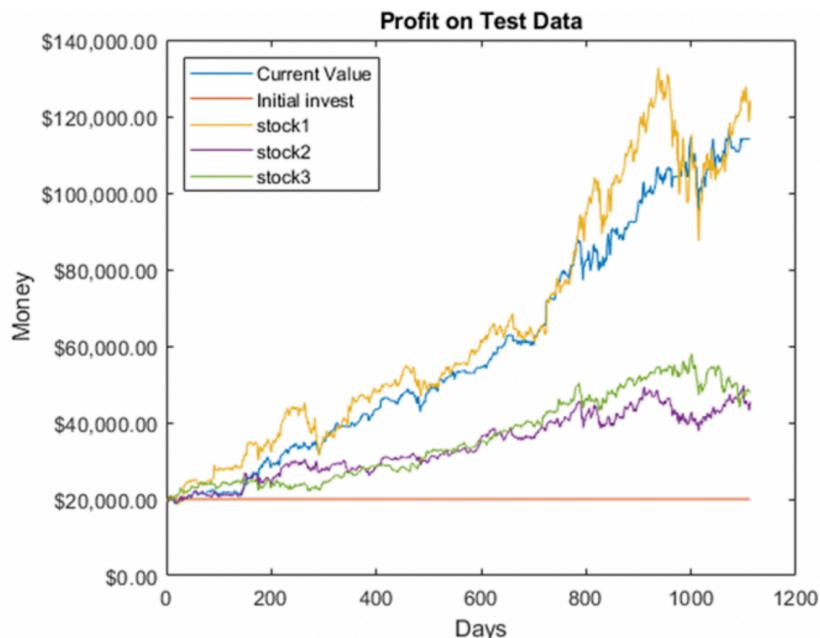


Figure 4. Trading Increasing Graph (Willingham 2021)

Finally, it is P2P lending that is a method of giving individuals and markets with loans through online services (Chatterjee 2021). In P2P setting, administrators should manage portfolios of loans (Garg 2019). Reinforcement learning supports the lenders determine the fund allocation by increasing the risk-return profile in the context of continuous investment decision-making (Garg 2019). The result is able to be formulated as convex optimization similar to optimization formulation for Stock portfolio optimization (Garg 2019).

The screenshot shows a web-based P2P lending platform interface. At the top, there are navigation tabs: INVEST (selected), MY INVESTMENTS, INVESTMENT PORTFOLIO, and ACCOUNT. Below these are secondary tabs: MARKET (selected), SECONDARY MARKET, AUTOMATIC INVESTMENT, and a green button labeled CREATE AUTO INVESTMENT. The main content area displays a table of investment opportunities:

Credit	Creditworthiness rating	Interest rate	Maturity	Amount	Amount invested	Offer closes	
K543658384 2018-11-28 18:41 R	A	11.00%	48 months	1857.40€	27.99% (519.93€)	12d. 2h. 59min.	<button>INVEST</button>
K144298925 2018-11-28 17:46	B	16.00%	48 months	3000.00€	9.34% (280.09€)	13d. 2h. 59min.	<button>INVEST</button>
K927466397 2018-11-28 16:31	B	19.00%	60 months	2400.00€	55.65% (1335.52€)	13d. 2h. 59min.	<button>INVEST</button>
K175257797 2018-11-28 16:12 2	C	19.00%	60 months	3700.00€	11.10% (410.60€)	13d. 2h. 59min.	<button>INVEST</button>
K172119823 2018-11-28 15:15 R	B	18.00%	60 months	8443.44€	5.61% (474.02€)	12d. 2h. 59min.	<button>INVEST</button>

Figure 5. P2P Lending Investment (Perzhanovskiy 2020)

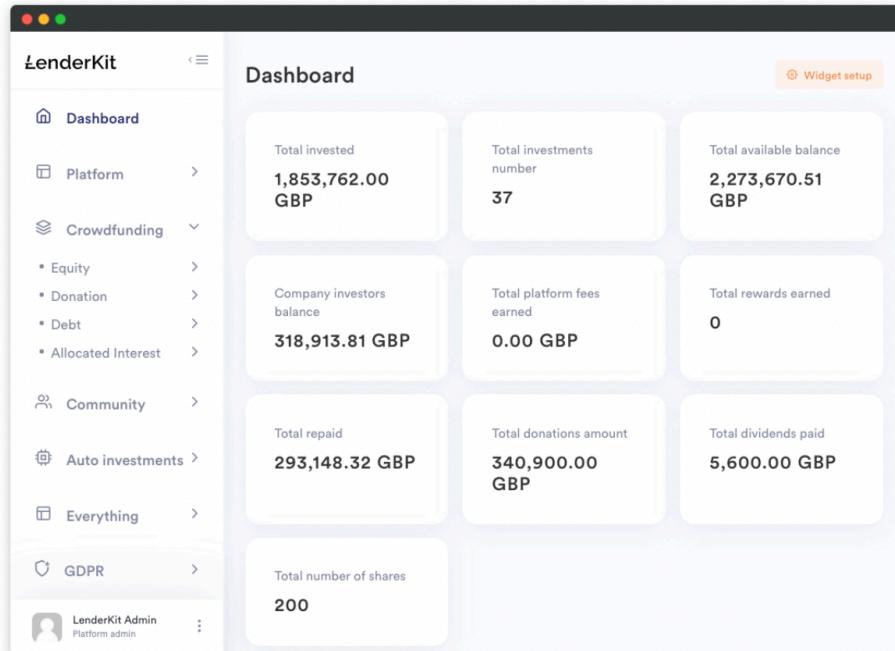


Figure 6. P2P Lending Investment Dashboard (Perzhanovskiy 2020)

Limitations and Issues to Using Reinforcement Learning

Eventually, in this report, the business is a convoluted system and it's difficult for machine learning systems to understand stocks based only on historical data (Chatterjee 2021). The achievement of machine learning based dealing methods is able to be good, but it is also able to bring about you to exhaust your savings (Chatterjee 2021). Too much reinforcement learning can cause an overload of states, which can decrease the outcome (Joy 2022). Reinforcement learning is not desirable to apply for resolving easy issues (Joy 2022). Reinforcement learning requires a lot of data and much calculation and that is to say, it is data-hungry (Joy 2022). Briefly, sample efficiency is very low and it can break the system or put it in danger such as falling during the learning process. Problem is that the performance is not satisfactory yet and it performs complex exercises in a system, it is not easy to find an appropriate compensation function. The final result of it may be unstable and difficult to reproduce and there are even cases where you fail to learn. It is almost the same when applied in banking. First of all, it is not easy to achieve perfect implementation. Because reinforcement learning in banking goes through trial and error that has to go through a lot of failures, which costs a lot of time and money. That is why there are such restrictions.

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