[Lab] Reinforcement Learning: Automated Trading System (ATS) with Q-learning

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Due: Before the end of today lab session
Evaluation: Show your Python code & results to the Professor and answer the questions that Professor may ask you.
Remark:

- Only groups of two or three people accepted (three preferable). Forbidden groups of one or larger than three people.
- Code in Python and comment your code. No image capture or other document is accepted.
- No plagiarism. If plagiarism happens, both the "lender" and the "borrower" will have a zero.
- Code yourself from scratch **following the theory given in class**. No pre-lab will be considered if you use someone else's code.
- Do thoroughly all the demanded tasks.
- Study the theory.
- NO late work will be considered, and there is no make-up session.

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1 Problem

Suppose that you initially have 5000 USD and no share. Suppose that you want to invest on the stock of Bank of America. Define your portfolio as a function of time and as the sum of the cash and of the number of shares multiplied by the share value that you have for a given time. You will consider three actions: hold, buy, and sell. The number of shares that you buy or sell can be considered to be always 10. Define the state and the reward functions at your will. Choose also the learning rate and the discount factor at your will. To simplify the problem, you can ignore the transaction fee. But, if you want to make the problem more realistic, you can consider it to be proportional to the volume that you buy or you sell.

2 Tasks

1. Download the file that contain daily stock prices of *Bank of America* ("bank_of_america.csv" file obtained from Yahoo! Finance), which range from March 29, 2012 to March 28, 2017 (1287 days). The file contains 7 columns, but you are going to use only the data from two columns: Date and Closed (in USD).
2. Use the entire dataset for training. (Do NOT separate the data into training and test).
3. Implement the Q-learning algorithm explained in class to find the sequence of policies that maximize the portfolio.
4. Now download the file that contain daily stock prices of *General Electric* ("ge.csv" file obtained from Yahoo! Finance), which range from March 29, 2012 to March 28, 2017 (1287 days). The file contains 7 columns, but you are going to use only the data from two columns: Date and Closed (in USD). Use this data to test the Q-learning algorithm that you just trained.
5. Show the plots of actions and profits over time.
6. Discuss about the performance of your algorithm.

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