

Assignment Part II: Prediction and Trading System

Abstract:

The report contains insights about the AI Assignment section 2 which clarifies about the forecast and exchanging framework for smart house. The task incorporates distinctive operators that is equipped for taking care of various work that is determined for them. There are 5 distinct agents that controls diverse things in the house to give the most extreme solace to the general population living in the house. The fundamental target is to make a self-learning home automation system (HAS) that limits the cost of vitality or even makes a benefit if conceivable through the product agents.

These product operators can control heat in washroom floor and heater, controlling battery i.e. charging and releasing, keeping up security in the house and making the buy and offer of vitality. The task is done in visual studio 2017 utilizing c# as a programming language. Exceed expectations information is taken from yr.no to take the information for 100 days for every hour to make a Q learning watch the outcome and choose as indicated by the vitality require in the house.

Introduction

Algorithmic trading system is the use of computer algorithms to automatically make trading decisions, submit orders, and manage those orders after submission. Assignment is a project to implement the AI to maintain maximum comfort on the house using 5 agents to control temperature in the house and minimize the cost of energy in the house. These agents constitute the basic platform for a smart home installation in a house that is going to be implemented in the project. The agents are initialized and monitored from a single panel. Qlearning is a reinforcement learning technique that can handle problems with stochastic transitions and rewards, without requiring any adaptations.

The family members go to work and school at regular hours apart from Saturday and Sundays. So, there is a home and away signal for each agent. Simulation for 100 days is run using Monte Carlo method. Agent 1 controls heated floor in the bathroom and the boiler. The temperature in the bathroom when the house is inhabited must be 24c. The hot water maintains the temperature of 75C. Agent 2 controls the central heater that assures and maintain a comfortable temperature when people are at home. Agent 3 controls the battery so that it is charged and discharged as per the need. Agent 4 controls the security of the house and makes sure that the doors and windows are closed and secured when the people leave the home and it emits home and away signal which is used by other agents. Agent 5 is a responsible for making the decision about purchase and sale of energy to and from the market and it is an agent that implements learning algorithm to perform its duty.

Each hour temperature data is taken for 100 days from yr.no site from the month of January 1st to march 9th as more amount of the energy is consumed during the winter. The outside temperature is taken from the site to use in the program. When other agents receive the signal from the security agent 4 that the house is in the AWAY or HOME state they respond accordingly. Agent 1 and agent 2 will reduce the temperature when there is AWAY mode and restore to its original level when the family gets home. When the set temperature is lowered the electricity at home per hour goes down. Similarly, agent 3 recharges the battery when the battery is not full. Energy level for the battery must never fall below the 20% level. Agent 5 monitors the energy flow in the building and on contrary it requests agent 3 to fill up energy if the price in the market is affordable or if there is a surplus from the solar panels. Agent 5 also figures out how much energy the solar panel will produce by checking

the weather forecast. Similarly, it estimates the price next day and decides how much to sell or buy every day to sustain the necessary consumption and to keep the battery in shape.

Task to be done

Agents 1 and agents 2(Bathroom and Boiler agent)

These agents always pursue the best possible comfort in every state and cannot negotiate the signal from agent 4. They will get as much electricity to maintain maximum comfort in the house as they sell comfort for price. Actions to be performed:

- Yield to agent 4 on Home/Away signal
- Reduce set point on demand from agent 5 for penalty
- Expected value for one KWH in reduced comfort is 20 credits.

Agent 3(Battery Agent)

Agent 3 acts as battery management system and provides for charging and discharging of battery.

Actions to be performed:

- Pursue maximum energy capacity
- Discharge the battery on demand from agent 5 for a penalty
- Expected value for one KWH in reduced battery level is 5 credits.

Agent 4(Security Controller)

Actions to be performed:

- Buy energy
- Discharge battery
- Request low set points
- Disconnect the boiler

Agent 5(Decision Maker)

Agent 5 is a Qlearner that learns to minimize the cost of energy for the benefit of household while maintaining the comfort level. It sells surplus energy to the market for 0.3 NOK and buys for 1.2 between the hours 6-24. Between 0 and 6 it pays 0.8 NOK.

Agent 5 may find itself in three different major states i.e. balance, negative unbalance and positive unbalance. Balance means there is perfect balance between supply and demand and there is nothing to do. If there is positive unbalance the agent must sell, charge the battery or increase the demand. If there is more consumption than supply then the agent must perform one of the following task: buy externally, discharge the battery or reduce the consumption.

Actions to be performed:

- Manage balance between demand and supply all the times
- Buy and sell energy
- Minimize the cost
- Request support from agent 3 battery for a price
- Request support from agent 1 and 2 to reduce consumption for price

Method implemented:

The program is first begun as windows frame application and extra strategies are executed on this. House atomization framework is where the vast majority of the outlining are incorporated, and it goes about as interface for associating all the agents attempts to make re-enactments for hundred days. At the point when the run technique is being used, it runs the information for 100 days and 24 hours to discover the state, temperature, day and hours. Numeric up down esteem is utilized to set the greatest and least incentive amid the recreation of the program. Invoke technique is utilized to print the incentive in UI. The home atomization framework which is a shape is utilized as a part of the program to interface the frame with every one of the strategies inside the program. The Agent1 is bathroom floor and boiler controller that compute most extreme heater utilization, greatest and least washroom floor utilization amid two distinct states. It additionally set the base and greatest temperature per the condition or the condition of the house. The outside temperature is taken from the exceed expectations loader i.e. the information from yr.no site. It likewise sets the new temperature checking the condition of the house and controls the boiler to keep up temperature in the house. The utilization of boiler is 0.5Kw every hour and is either in on or off state. After detachment, it devours 2kw for the principal hour, at that point 0.5Kw. For the restroom floor the temperature is between 23 to 25 degree Celsius when the state is home and is between 20 to 25 when the state is away. What's more, the utilization is 0.2Kw every hour when open air temperature is more prominent than set temperature.

Agent 2 is temperature controller that is in charge of focal warming and utilization. Same as agent 1 it likewise sets least and greatest temperature and discover the vitality stack in the house. It ascertains the heap per the information from exceed expectations record that is set to outside temperature and temperature per the condition of the house. The utilization is figured as distinction set temperature and outside temperature in addition to 0.8 i.e. utilization = 0.8kw every hour when outside temperature is more noteworthy than equivalent to set temperature.

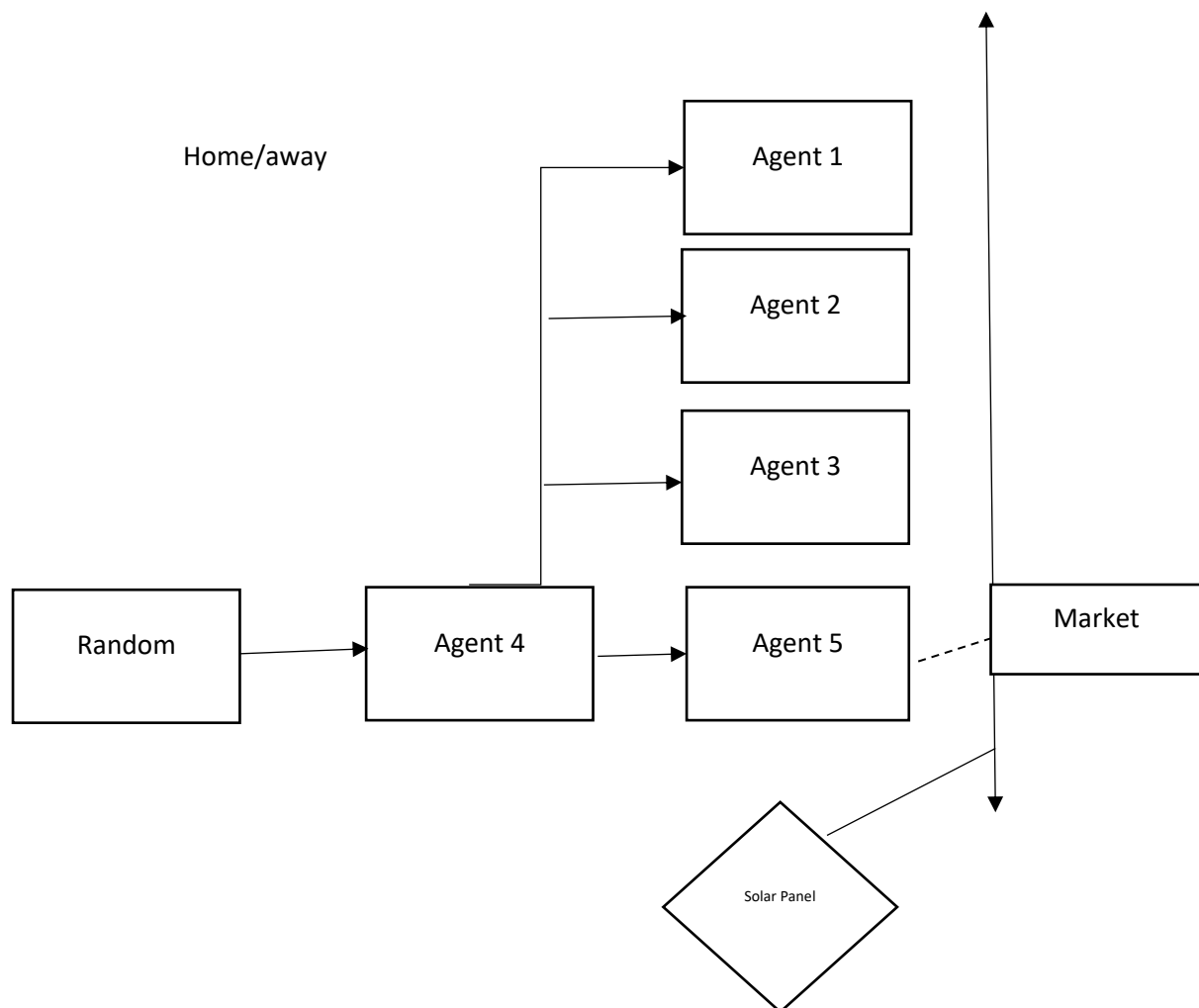
Agent 3 oversees controlling the battery. As battery charges and releases at the rate of 1 kw for every hour. The battery limit is 7KWH and it can never be lower than 20%. Along these lines, for that two strategies i.e. charging, and releasing is characterized to check the status of the battery. It likewise contains the techniques for two distinct states and strategies that profits the limit of battery under charging and releasing strategy for the battery by watching the states.

Agent 4 goes about as a security controller that incorporates the techniques for states for the producing the state i.e. either home or away. It incorporates the arbitrary capacity and the likelihood cluster for being the family at home.

Agent 5 is an agent that likewise goes about as qlearner. It likewise incorporates the strategy for figuring the aggregate load flag that has created shape agent 1 and agent 2, technique for solar panel, purchasing and offering of energy, ascertaining energy level in the battery, arrange work (that utilizations sigmoid capacity) to arrange the cost for the vitality, including the hub, filling the lattices and printing the qmatrix esteem. It likewise contains technique for producing the chart and introducing the grids and discover the prizes. It figures the utilization per the heap computed from agent 1 and agent 2 and takes the choice for purchasing and offering of the vitality. There are two

strategies for stacking exceed expectations document and for the climate information. Exceed expectations loader contains the code for stacking the exceed expectations document to the venture which utilizes library capacity to peruse the information on the exceed expectations organization and execute in the code. Uncommonly yield temperature for the particular hour and day is taken from the exceed expectations loader and executed to the distinctive agents inside the program. Technique node contains id for child node and a constructor to include node various way which is additionally utilized as a part of creating and filling the matrices.

Flowchart of the Project



Output of the Project:

The image displays three sequential screenshots of a 'Smart Home' simulation interface. Each window shows five agents (Agent 1 to Agent 5) with their respective attributes. The simulation speed is set to 100 in the first screenshot, 5000 in the second, and 5000 in the third. The 'Start Smart Home' button is visible in each window.

Agent 1

- Day:
- Hour:
- State:
- Consumption heated floor:

Agent 2

- Day:
- Hour:
- State:
- Consumption central heating:

Agent 3

- Day:
- Hour:
- State:
- Battery level:

Agent 4

- Day:
- Hour:
- State:

Agent 5

- Day:
- Hour:
- State:
- Solar Panel:
- Action cost:

Simulation speed: 100 Start Smart Home

Agent 1

- Day: 1
- Hour: 1
- State: Home
- Consumption heated floor: 6.25 kW/h

Agent 2

- Day: 1
- Hour: 1
- State: Home
- Consumption central heating: 10.9 kW/h

Agent 3

- Day: 1
- Hour: 1
- State: Home
- Battery level: 7 kW

Agent 4

- Day: 1
- Hour: 1
- State: Home

Agent 5

- Day: 1
- Hour: 1
- State: Home
- Solar Panel: 0 kW/h
- Action cost: 0.8 credit

Simulation speed: 5000 Start Smart Home

Agent 1

- Day: 2
- Hour: 1
- State: Home
- Consumption heated floor: 6.75 kW/h

Agent 2

- Day: 2
- Hour: 1
- State: Home
- Consumption central heating: 11.9 kW/h

Agent 3

- Day: 2
- Hour: 1
- State: Home
- Battery level: 7 kW

Agent 4

- Day: 2
- Hour: 1
- State: Home

Agent 5

- Day: 2
- Hour: 1
- State: Home
- Solar Panel: 0 kW/h
- Action cost: 0.8 credit

Simulation speed: 5000 Start Smart Home

Discussion of the result:

The result for the states, the credits and the hours works perfectly within the project. But there is a problem while implementing qlearning in the project because there were lots of exceptional errors and probably most of them were sort out. Similarly there is a problem while setting the goal node because there was a casting error while implementing that. I have referred to previous task done by fellows. I have initialized the graph and set the reward matrix and qmatrix but stucked into the problem while setting the goal node, So I had to refer previous tasks for this.

Conclusion:

From the task 2 It helped me part to comprehend c# as the code is composed on a similar programming stage and more about Smart house framework or computerization framework that could be executed in the house to deal with the vitality stream in the house. Correspondingly, keeping up the most extreme solace in the house by controlling the temperature through various agents and utilizing the exceed expectations loader and its information on the undertaking was additionally a testing assignment.

References:

<https://msdn.microsoft.com/en-us/library/ms173160.aspx>

<http://stackoverflow.com/questions/17577184/importing-excel-into-a-datatable-quickly>

https://source.uit.no/jli042/Assignment_2_SmartHome

<https://en.wikipedia.org/wiki/Q-learning>