**3rd year project diary**

**During summer 2016:**

1. Worked with Professor Stathis and Emanuele Uliana on a Multi-agent systems project. Involved creating a nice library that acts as a foundation for a multi-agent system anyone may want to build. I will use it to form the foundation of my system.
2. Reading Machine Learning - Tom M. Mitchell. – **STILL READING!**
3. Watched RL Course by David Silver - Lecture 1: Introduction to Reinforcement Learning and continued up to lecture 3 – **MAY CONTINUE**
4. 27/08/2016: Reading through <http://stevenmiller888.github.io/mind-how-to-build-a-neural-network/> and <http://stevenmiller888.github.io/mind-how-to-build-a-neural-network-part-2/> to get a feel for basic neural networks and how to build one.
5. Looking at using neural networks for time series prediction <https://www.cs.cmu.edu/afs/cs/academic/class/15782-f06/slides/timeseries.pdf>
6. <https://www.youtube.com/watch?v=E92jDCmJNek> Talk on learning with sequences: INTERESTING: LSTM – gated learning models (GRU model also worth looking into) Keras – Deep learning/ Neural Network Python library look into it!
7. <https://www.youtube.com/watch?v=iX5V1WpxxkY> CS231n Lecture 10 - Recurrent Neural Networks, Image Captioning, LSTM a lecture on LSTM and RNN, interesting stuff! I should try out an LSTM start to experiment with time series data, maybe try numpy

**First Term:**

02/09/2016 - Convocation with Zhiyuan about processing power needed when using LSTMs it is a lot! If I don’t have a capable machine I may have to scrap the idea and go with a moving window model instead

16/09/2016 Starting to write project plan

03/10/2016 started writing Smart Meters and Energy Demand Management report

08/10/2016 finished writing Smart Meters and Energy Demand Management report – 1 day after the planned finish time, I had a busy week in London and so lost afew days to write it, but it took about as long as planned. Read a lot on smart meters.  **Some things to think about:** --- Data differences between industrial and house-hold energy consumption – how will this affect the results of the ANN. Maybe only house-holds should be considered as industrial context may not have habits (is DR relevant to them?) --- Go into more detail about agents and why they are suitable for this project in the agents report.

08/10/2016 created a personal git repository to store all reports/programs.

10/10/2016 finalized the Smart Meters and Energy Demand Management report – checked grammar etc. Starting the Multi-agent systems report today. (Starting late been busy in London – have 2 weeks should be able to complete on time if focused.

**Meetings**

**12th October:** General discussion about the project and how to proceed. Discussed the multi-agent architecture to be used and what reports I will be writing this term.

**26th October:** Kostas was involved with discussions on the project. Talking about the different layers of the architecture – including where in the agent system the predictors should reside. Talked about having area/neighbourhood agents having prediction capabilities for the houses they are responsible for. Discussed moving away from the ANN model in favour of a simpler model. This may be the way to go as ANN can be difficult to use/explain. I have put the multi-agent report on hold to work on the data generation section of the project. We agreed that this section was more appropriate as a means to continue the project effectively as the data will be relied upon when starting the prediction section. A good portion of the Multi-agent system has been completed by this point, agent communication via sockets, house environments with (after data generation section has been completed – will be implemented) the capability of holding and retrieving data from a generic data generator. The presentation at the end of term should have a demonstration graphic of the prediction working – e.g. A graph with 2 lines, one for real data and one for the prediction. The lines will extend across the graph with time.

**9th November:** Kostas was involved in the meeting again. I briefly demonstrated the multi-agent system to Zhiyuan and Kostas as well as the data generation program and report. We discussed the architecture of the House Environment, Kostas suggested that a data reading agent should be used to get readings from the generator and forward them to the Smart Meter Agent. This method seems better than the current one – where the smart meter agent reads at a clock tick on a global timer. We again spoke about the ANN implementation and after looking at the data analysis section of the Data Generation report decided that testing different prediction models would be a good addition to the project. Having this meeting allowed me to finish the Introduction to Multi-Agent Systems report, specifically the sections about the architecture used in the project.

**23rd November:** Final meeting this term. With Zhiyuan only, we spoke about the presentation, interim viva and how to proceed with the project. He advocated that I had at least some machine learning work to present for the interim report. I will now work on some basic forecasting on generated data. The forecasting will be done using prebuilt time series machine learning packages (probably in R). At least some experimentation will be complete by the time the report is due, the rest will be done over the Christmas break. I will be implementing the most successful machine learning methods next term.

**Review**

I have not followed the original project plan, especially the sections related to ANNs. I was too ambitious with the time frames that I designated for each report/program, it would have been wiser to move the machine learning related tasks to the second term. Now knowing that an ANN based model may not be the way to go, it is fortunate that I had not already implemented the relevant proof of concept programs/written relevant reports. Most of the machine learning related work will be done next term.

**Meetings Second Term:**

**17th January 2017:** Meeting with Zhiyuan, We discussed the progression of the project, work over the Christmas break, and where to go next – what are the plans for this term. We agreed this this term should focus on integrating machine learning into the project. The agent section of the project is almost complete, it only requires integration of machine learning and agent minds (for the learning agents). We decided that Weka was the library of choice, over the next weeks I will spend time getting to grips with Weka and slowly integrate it into the project.

**31st January 2017:** Second meeting of the term with Zhiyuan. We discussed progress with Weka, I showed an example of the MultilayerPerceptronNetwork training and forecasting on some auto generated data – it did not do very well. We concluded that more work was needed to tweak and test different algorithms. I am now working on an automated algorithm tester (some meta-learning!) to try and find the best algorithm and parameters for the job. I had previously been using the built in Weka forecasting algorithms on their default settings.

**15th February 2017:** Midweek meeting with Zhiyuan and Kostas, I presented my work so far to them, which included drawing an outline of the structure of the project and showing my progress up to this point. We discussed where the project should go from there – that the feedback look should be implemented, this involves some kind of thresholding mechanism that a top level agent may use in order to request a change in behaviour of the underlying consumption models. The models should be able to be modified in a number of ways: shifting, magnitude etc. Once this has been implemented the next step will be to build a (basic) visualisation of the system and to test prediction models supplied to the PredictorAgent. I have no made much progress on the report at this point but it is important to finish the code as then I will have a complete project (and it will be easier to write about).

**1st March 2017:** Meeting with Zhiyuan. I demonstrated that the work to be done that was discussed in the last meeting had been completed, namely, the feedback loop, thresholds, and a way to alter the behaviour of consumers using ‘modifiers’. We discussed where to move next, Zhiyuan suggested that I present some interesting scenarios in my final report and that I should focus on writing about what the project has achieved so far. It should be noted here that of course the complete goals of the project have no be met – the machine learning/forecasting is lacking to say the least. It will however, likely be pursued in future work as it is a question of time not capability.