

Initial Plan

Building Energy Usage Prediction



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CM3203 One Semester Individual Project

40 Credits

Project Description

With the significant growth of population, the demand and usage of energy has significantly increased. This increase of energy consumption in buildings has had several negative impacts. High energy usage not only leads to higher costs, but detrimental effects to the environment. Burning fossil fuels to produce energy emits greenhouse gasses such as carbon dioxide, this further adds to the greenhouse effect. This air pollution has several negative impacts to the environment including changes in weather, sea levels rising from ice melting at the north/south poles, acid rain from sulphur dioxide and many more.

I plan to develop a machine learning model that will predict the energy consumption of buildings based on historic usage rates and observed weather. These models can be used to improve building efficiencies, to help reduce these costs and environmental impacts. Machine learning models can be used to predict energy usage in buildings, the results and trends can be used to improve usage within buildings. These trends will allow design considerations to be made in the early stages, as well as management choices to maintain efficiencies.

I will aim to use a provided dataset to develop models for different areas of metered energy usage. These models are for:

- Chilled water
- Electric
- Hot water
- Steam meters

For the above models I will also have to select a relevant machine learning model. These models can be categorized as supervised, unsupervised and reinforcement learning models.

Project Aims and Objectives

Main aims

I aim to develop a machine learning model that will be able to accurately predict energy consumption within buildings. I will use data such as historic usage rates and weather to create these models. I will aim to create four different models corresponding to different metered energy usage areas, where these are; chilled water, electric, hot water and steam meters.

I should then aim to evaluate these models to see to what extent and accuracy these models perform at. I will look at the trends and patterns seen from the obtained models and will make relevant evaluations; these should be documented.

To achieve the above I have created some main objectives that I will need to complete throughout this project. These are shown from the next page.

Objectives

Complete relevant background reading and research relevant projects.

- Researching relevant projects, whilst also studying how machine learning can be used to predict building energy usage.
- Doing research on different types of machine learning algorithm (Supervised, unsupervised and reinforcement) and research into further algorithms such as linear or logistic regression.
- Learning about relevant python libraries such as Scikit-Learn and TensorFlow.

Obtain the dataset and complete relevant pre-processing steps.

- Applying steps such as exploratory data analysis on the dataset. Make smaller visualisations of the data to find outliers or other patterns.
- Apply pre-processing to clean the dataset, as the quality of the dataset will affect the ability of the model to learn.

Choosing and building the machine learning model.

- Do further research on relevant machine learning algorithms/models.
- Implement select machine learning algorithms that suit the needs of this project and dataset.
- Train the dataset with the machine learning algorithm.

Evaluating and testing the created models.

- Evaluate and document with the effectiveness of the created models.
- Test the extent to which the models are able to accurately predict building energy usage.
- I will also compare the accuracies of the models.
- Attempt to tune the models to increase effectiveness.

Analysing results and documentation.

- All steps of the project should be reported into a single document, which will be the final report.
- I will look at the trends or patterns seen within the dataset/obtained models. These will be documented as a part of my evaluation in the final report.

Ethics

I will not need to be concerned with any ethical issue with my project. I will be using a public dataset, where I should not need to worry about breaking any ethical conducts. If any case arises where ethical considerations are needed to be made, I will take relevant actions to ensure no ethical conducts are broken.

Work Plan

Below is a work plan showing the tasks I intend to complete each week. These goals are the deliverables that I should achieve in said week. All these deliverables will be a part of my final report. I have summarized my deliverables into a Gantt chart which is shown in the next pages.

Week 1 starting 31-01-2022

- Draft and complete the initial report. This should be submitted by the date **7/02/2022**.
- Background reading on relevant projects to building energy usage. Look at any other relevant documentation.
- Background research on machine learning algorithms and techniques (i.e., supervised/unsupervised/reinforcement, regression etc).

Week 2 starting 07-02-2022

- Further research on relevant projects and machine learning models.
- Research how Python could be used to implement the machine learning techniques, and look into relevant libraries.

Week 3 starting 14-02-2022

- Obtain the dataset that I will be working with.
- Apply exploratory data analysis steps onto the dataset. I should create smaller visualisations of the obtained dataset. This will help see if the data contains any anomalies or issues.
- Apply any relevant pre-processing steps, ensuring the dataset is clear. If this is not done properly, the created models might not give good quality results.

Week 4 starting 21-02-2022

- Apply any remaining pre-processing steps onto the dataset.
- Start to develop selected machine algorithms.
- Meeting with supervisor

Week 5 starting 28-02-2022 to Week 6 starting 07-03-2022

- Continue developing selected machine learning algorithms.
- Test and debug these models, to ensure it does not contain any significant errors.
- Implementation of these algorithms should be complete.

Week 7 starting 14-03-2022 to Week 9 starting 28-03-2022

- Train the dataset with the previously created models.
- Evaluate the accuracies of the implemented models.
- Test the extent the models are able to accurately predict building energy usage.
- At **Week 9** start report writing.

Easter Break 02-04-2022 to 24-04-2022

- This time has been kept at free space.
- I should complete any remaining work from previous tasks that have yet to be completed.
- At this point I should have the models created and evaluated. Where in the following weeks I should complete the final report writing.

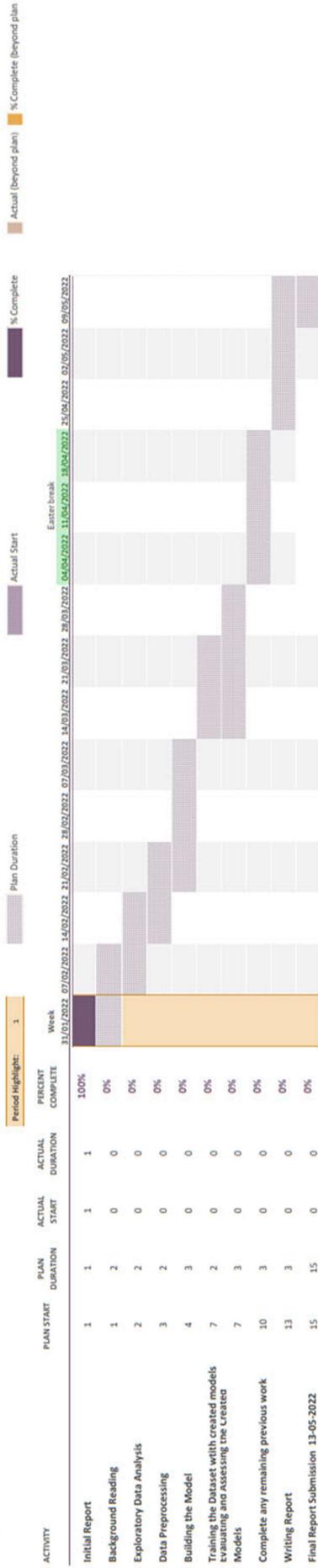
Weeks 10 starting 25-04-2022 to Week 11 starting 02-05-2022

- Continue report writing.
- At **Week 11** meeting with supervisor.

Week 12 starting 09-05-2022

- Complete all final sections of the report.
- Proof read and check all sections of the report (At least twice).
- The final report should be submitted by **13-05-2022**.

Project Plan



Bibliography

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- ⁴ Dhariya Kumar 2018. *Introduction to Data Preprocessing in Machine Learning*. Available at: <https://towardsdatascience.com/introduction-to-data-preprocessing-in-machine-learning-a9fa83a5dc9d> [Accessed: 01/02/2022]
- ⁵ Pragati Beheti 2022. *A Simple Guide to Data Preprocessing in Machine Learning*. Available at: <https://www.v7labs.com/blog/data-preprocessing-guide> [Accessed: 02/02/2022]
- ⁶ Paul Collins 2022. *Greenhouse effect: Causes and consequences on the climate*. Available at: <https://climate.selectra.com/en/environment/greenhouse-effect> [Accessed: 01/02/2022]
- ⁷ ASHRAE 2020. *Great Energy Predictor III*. Available at: <https://www.kaggle.com/c/ashrae-energy-prediction/overview> [Accessed: 03/02/2022]