CS310 Specification - Draft

Efficient Allocation of Renewable Energy Sources Under Uncertainty Across the UK

Problem

Insert preface about environmental justification for looking into the subject . AI is a very useful tool for tackling optimisation problems where the number of variables creates a number of combinations too big for any real minimisation or maximisation effort to made. As such it is the perfect tool to apply to finding an efficient allocation of a set budget for investing in new renewable energy sources. With such a wide range of varying locations across the country the choices of where to allocate funds quickly becomes a complicated one, especially when considering the statistically uncertain factors such as maintenance and most importantly for renewables, weather.

When considering a choice location and of energy source there are a range of factors to consider in evaluating the value of the decision. The costs of a choice will be impacted by the setup and connection costs, the initial production cost and the cost of repairs, meanwhile the output of a location will vary depending on the weather of any given day. This exposes the other area of the problem, the need to consider the statistical uncertainty of events such as faults requiring repair and "profitable" weather patterns occurring when evaluating a choice.

Objectives

The main aim of this project is to create a program that can find an allocation of a variable budget that maximises the power generated by the set of chosen locations. In order to reach this aim there will be smaller incremental objectives that need to be met to build into the final working result.

Core Objectives

1. Define a varied set of viable location options by collecting a list of currently used locations and future planned sites, as well as examining features that make for a good site to allow for better understanding of the choices made.
2. Design a "performance" function to evaluate a location's "score" taking into consideration the uncertainty and variation over time in values such as sun light time, sun intensity and windspeed.
3. Design a "cost" function to consider costs of production, transport and setup, while accounting for the cost of repair in comparison to chance of a fault occurring.
4. Create a list of commonly used optimisation problem algorithms to examine which are suitable for an allocation task of this nature.
5. Implement the chosen algorithm in Python making use of evaluation and cost functions as described in objective 2 & 3. The program will take an input set of locations and a budget value and return a maximum power output achieved by the budget.

These are the core parts of the project which are required to have successfully implemented the goal of this project. However these objectives have some areas for expansion which could potentially be investigated given the core aspects are implemented successfully with additional time to spare.

Potential areas for extension

1. Extend the evaluation function to consider long term trends in the weather to all for the program to make allocations based on future worth.
2. Implement more than one of the most relevant algorithms and benchmark performance on time taken, accuracy, and consistency.

Methods

To be completed

Timetable

To be completed

Resources

The main resources needed for this project is the historical weather data required to evaluate the suitability of different locations. Using a mix of sources from visualcrossing.com [1] and the Met Office[2], will help ensure a full range of data for each chosen location as well as acting as a fail safe in the unlikely event of either sources removing access to this information. The project will be built in the base Python 3.9 language, this is a widely supported language with no chance of becoming unavailable within the duration of this project.

Sources:

- https://www.visualcrossing.com/weather-history# - detailed weather data for locations and data
- https://www.metoffice.gov.uk/research/climate/maps-and-data/historic-station-data

Risks

The main risks this project will face are data loss and issues with falling behind schedule. In order to prevent and mitigate the problems caused by these risk we will take the following measures:

- Data Backup:
    - By using Git as a version control protocol for the project we can make use of GitHub's private repositories to keep a regularly updated backed up to a central online location.
    - To avoid the unlikely case of losing access to the repository causing any issues we will also be pulling up to date versions of the code base and project documentation to at least 2 different computers (a personal Laptop and Desktop most regularly).
- Time management:
    - As part of this document the timetable will help build an expectation of where the project should be every week.
    - Project management tools such as Kanban boards can be used to break down the tasks ensure regular progress is being made on the development.

Ethical Considerations

This project does not make use of anything requiring any considerations of this kind.