Student Project Ideas

Description

E-Lab
2020

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1. Neighborhood Power Plant

1.1. The goal of the project

Around Europe, people are installing more and more solar power generation units. The generated electricity is used either for own household or sold to the electricity grid. So, right now the neighbor with solar production is selling its excess power to the grid and the neighbor without the solar production is buying from the grid. By doing this, both neighbors are paying the electricity transmission fee (ca 1/3 of total electricity bill). This fee could be avoided if the electricity could be moved directly between the neighbors.

The goal of the project is to develop a prototype of “Virtual Neighborhood Power Plant” – a software that decides what amount of locally produced solar energy should be consumed in the neighborhood.

1.2. Tasks and starting points

You’ll receive the following datasets:

- Actual hourly electricity prices for 1-year period;
- Actual electricity distribution fees;
- Simulated electricity consumption data of 10 households;
- Simulated solar production data for 4 residential solar units.

Tasks:

1. Prepare the data for analysis.
2. Develop a solution that decides what amount of locally produced electricity should be consumed in the neighborhood and what amount should be sold to the grid.
3. Calculate the monetary gain from the perspective of neighborhood – how much was saved (by buying local energy) and how much additional money was earned (by selling excess solar power).
4. Develop a graphical user interface (GUI) that enables to visualize the energy movements (production and consumption) in the neighborhood.

2. Electric Vehicle Charging Predictor

2.1. The goal of the project

Electric Vehicles (EVs) will be a game changer for the electricity industry. On the one hand, we’ll see a rise in electricity consumption. On the other hand, EV batteries could be used to store the green energy. In both cases, we need a good solution to predict the behavior of electric vehicles.

The goal of the project is to develop a prototype for predicting the battery level (SoC - State-of-Charge) and whether the EV will be connected to the charger or not.

2.2. Tasks and starting points

You’ll receive the following datasets:

- Simulated data of 100 electric vehicles that includes information about each EV and the hourly data about the state-of-charge for 1-year period.

Tasks:

1. Prepare the dataset for time-series analysis;
2. Develop a prediction model that forecasts the grid-connection and the state-of-charge for every electric vehicle.
3. Develop an API endpoint that takes the electric vehicle ID as an input and gives the next 24h state-of-charge prediction (with confidence intervals) as an output.
4. Develop a graphical user interface (GUI) that enables to insert vehicle ID as an input and shows state-of-charge prediction as a time-series graph with confidence intervals.

3. Grid congestion manager

3.1. The goal of the project

It can be expected that there will be a widespread adoption of Electric Vehicles (EVs) during the next decade which results in sharp increase of the electricity consumption. The electricity grid is not built for such high additional load that might occur when all EV owners plug in their vehicle after getting back from work. To avoid huge investments, we have to develop a solution that A. predicts grid overload and B. carries out smart charging. Here, smart charging means changing the default charging behavior such that the total electricity consumption stays within grid limits.

The goal of the project is to develop a prototype of the Grid congestion manager that predicts the overload and carries out smart charging.

3.2. Tasks and starting points

As a starting point, you'll receive the following datasets:

- Grid topology that reflects the capabilities of the grid at given location (the capabilities of the substations, electric lines, etc.)
- Simulated data of 100 electric vehicles that includes information about each EV and the prediction of their charging pattern.

Tasks:

1. Prepare the datasets for analysis;
2. Develop a prediction model that forecasts the grid load in specific location based on EV charging forecast.
3. Develop a model for smart charging – a model that divides the electricity consumption of EVs such that the limits of the grid won't be exceeded and all of the EV owners receive the similar experience.
4. Develop a graphical user interface (GUI) with following functionality:
    a. enables to select a time of day (hour) and location as an input and shows grid load forecast.
    b. shows the optimized charging schedule if there is a threat of grid congestion.

4. Solar production forecast

4.1. The goal of the project

Around Europe, people are installing more and more solar power generation units. In electricity system, the consumption and production always need to be balanced. Thus, we need a solution for predicting the solar energy production of each household.

The goal of the project is to create a solar production forecast solution.

4.2. Tasks and starting points

You'll receive the following data as an input:

- Simulated historical data of 100 households: the amount of electricity consumed and the amount of solar energy produced.

Tasks:

- Find a source of weather data that matches the locations of simulated households;
- Prepare the datasets for analysis;
- Develop a prediction model that takes the historical data as an input and gives a solar production forecast for the next 24 hours.
- Develop a graphical user interface (GUI) that enables to upload the file with historical data (electricity consumption and solar production of a single household during the last 30 days) and generates a graph with next 24 hours solar production prediction with confidence intervals.

5. Solar Potential Calculator

5.1. Goal of the project

The goal of the project is to create a software solution for estimating solar electricity production potential of Estonian buildings.

5.2. Problem statement

Eesti Energia is moving fast towards energy production from the renewable sources (mainly wind and solar). Many private households in Estonia has the potential of installing small solar production unit either on roof or on free garden area. Currently, **we are not aware who are those potential customers and what could be the estimated size of their small production unit**.

5.3. Principles and starting points

These data sources should be used as starting points:

- Open-source aerophoto warehouse by Maa-amet (https://fotoladu.maaamet.ee/). Includes simple API access available, where one can ask the image by defining its geographical coordinates (example: https://fotoladu.maaamet.ee/etak.php?B=59.420826774381965&L=24.697852488050824).

- Open-source data of Ehitisregister (building registry) (https://avaandmed.ehr.ee/) that enables to download the reports with the main characteristics of all buildings in Estonia (incl. the area of the building)

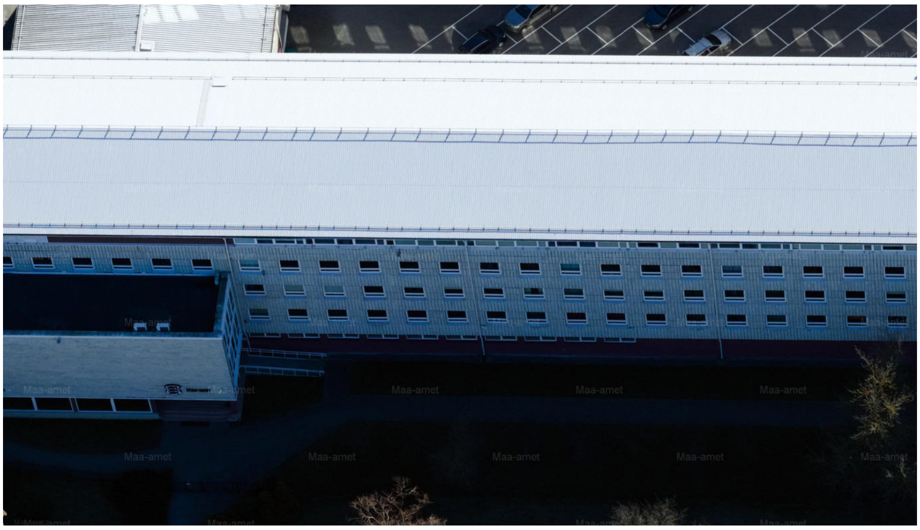

Figure 1. Image example from maaamet fotoladu

5.4. Tasks

The project is seeking an answer to the following questions:

- Are we able to detect potential customers of Solar based on aerophotos?
- Are we able to calculate the potential size of roof-based-solar?

To achieve this, following tasks needs to be carried out:

- Exploratory analysis of datasets
- Generating the training data
- Training computer vision models
- Mapping coordinates to addresses
- Creating a dashboard with buildings and their potential
- Documenting the results

6. Mining Vehicle Analytics

6.1. Goal of the project

The goal of the project is to analyze and describe the possibilities of detecting sub-optimal driving patterns from available data.

6.2. Problem statement

Eesti Energia is mining the oil-shale. The transportation cost of oil-shale accounts for ~1/5 of total mining costs.

Vehicle operators are not always following the optimal driving pattern. Thus, if we were to have a solution for detecting sub-optimal driving patterns near real-time, then there would be a potential to reduce transportation costs.

6.3. Principles and starting points

There are 3 datasets available through APIs:

1. vehicle_data – general description of vehicles;
2. trip_data – the summarized data about each "trip" of mining vehicles (start time, end time, distance, duration, start loc, end loc, etc).
3. live_data – raw, 3 second resolution data about the speed, distance, power, GPS position, etc. of each vehicle.

Those datasets are the starting points of the work. The team should explore the data and test different hypotheses of finding near real-time sub-optimal driving patterns.

6.4. Tasks

The project seeks an answer to following questions:

- Data: from Ecofleet API
- What is the general profile of our mining vehicles (descriptive analytics based on mining vehicles activity).
- How accurately are we able to predict the fuel efficiency of specific vehicle?
- How accurately are we able to predict the fuel efficiency of drivers?

Tasks:

- Exploratory analysis of datasets;
- Creating hypotheses about finding sub-optimal driving patterns;
- Testing hypotheses (incl. training ml models if needed);
- Writing the documentation of how to use the best solution (NB: will be done if the best solution yields accuracy of >80%)
- Writing a report of the project;