Predicting PV Power Plants Construction Locations Using GCN

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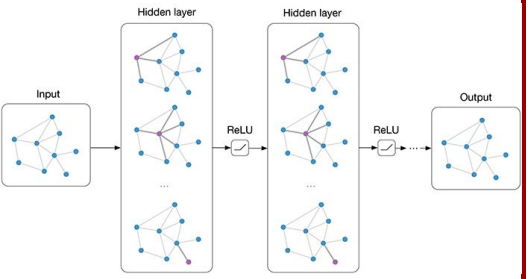
Check out our Github!

Background

- Renewable energy sources are important, while photovoltaic cells are promising
- We would like to solve the problem: where to build these power plants?
- We would like to build an AI and ask it the question while it considers the geographical and economical conditions

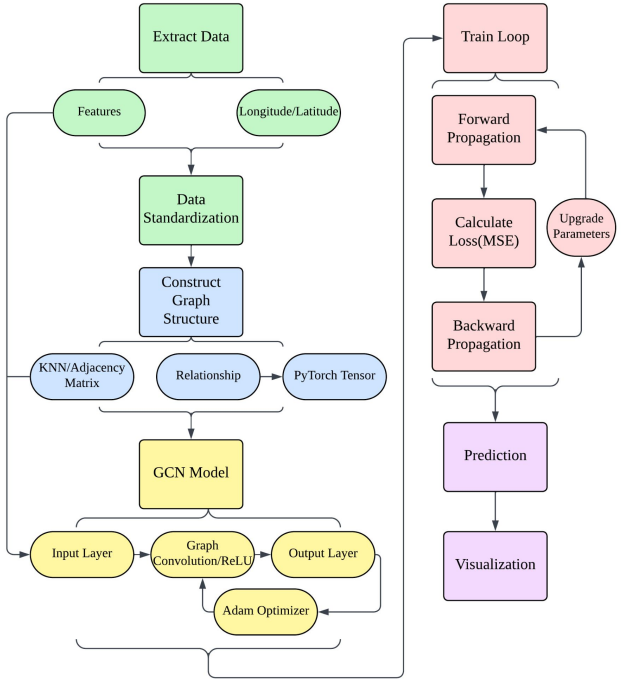
About GCN model



- It processes graph-structured data
- Nodes represent data points in a graph and edges capture relationships between nodes
- GCN learns features through neighborhood aggregation
- Each node updates based on its neighbors
- It uses layers to propagate information
- A graph is represented by adjacency matrix(A) and feature matrix(X)
- The GCN layer operation can be expressed as:

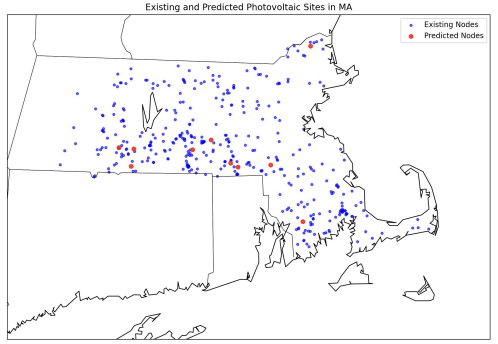
$$H^{(l+1)} = \sigma\left(\widetilde{D}^{-1/2}\widetilde{A}\widetilde{D}^{-1/2}H^{(l)}W^{(l)}\right)$$

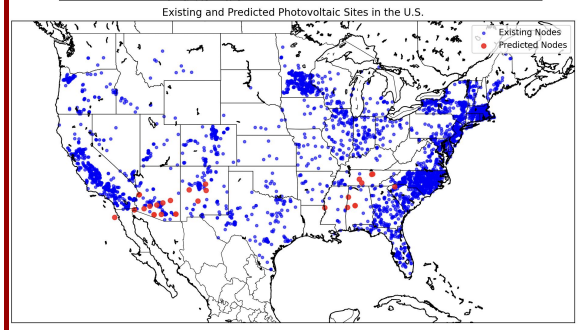
Our procedure in a nutshell



- Use PyTorch's deep learning framework, pandas and geography drawing libraries
- Extract longitude/latitude and features from existing PV power plants
- Standardize Data
- Construct graph structure using KNN and PyTorch tensor
- Define GCN model with graph convolution layer, ReLU function and Adam optimizer
- Set training loop to 500 rounds and use backward propagation and MSE loss function to update parameters
- Based on the trained GCN model, predict 30 most probable positions of PV plants in the future, and visualize the output in a map

Our result





Our data

Our data is a set of data from photovoltaic cells built and relevant information from the state it is in. There are mainly three concepts in the data we used to train the model:

- The geographic location: longitude, latitude, sunlight, and power generation
- The economical conditions: population, gdp, power consumption, house price
- The policy: energy expenditure covered by the government