Multiagent Simulations for Electricity Markets

Game Theory and Deep Reinforcement to improve forecasting in electricity markets with structural multiagent simulations

Project Members

Team: Simulacrum

- Denizalp Goktas - Computer Science PhD Candidate, Brown University
- Amy Greenwald, PhD - Computer Science Professor, Brown University
- Sadie Zhao - Computer Science PhD Student, Harvard University

Partner: Base Power Company (Base)

Base provides reliable and cost-effective electricity through their proprietary backup battery systems installed in customers' properties.

- Chase Dowling, PhD - ERCOT Trading Lead, Base Power Company
- Jared Greene - Engineer, Base Power Company

Project Summary

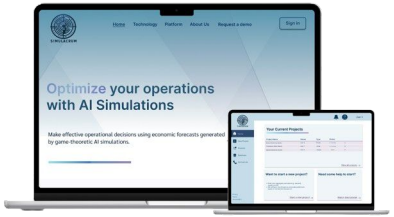
Utility Partner's Problem:
Existing forecasting methods fail to make accurate forecasts of the **demand, supply, and prices** of electricity due to **new market structures, market entrants, technological advancements, or regulatory changes**, leading Base to (dis)charge its batteries inefficiently, and as such limiting Base's ability to backup its customers and stabilize the grid.

Project Objective:
Develop and implement a **structural multiagent simulation** to forecast demand, supply and prices of electricity which can better adjust its outputs in response to new market structures, market entrants, technological advancements, or regulatory changes compared to widely used forecasting models.

Simulacrum's Technology:
A **Deep Reinforcement Learning** framework to estimate the parameters of **structural multiagent simulations** from past time-series data.

Simulacrum's Solution:
we will develop an end-to-end software framework that streamline and automate the process of

- estimating parameters of a structural multiagent simulation for continuously updated electricity market data
- simulating agents' future behavior to generate forecasts



Project Implementation Plan

Stage 1: Development of the Game Model (Month 1)
Task: Develop a parametric game model that represents the Texas electricity market.

Stage 2: Software Framework Development (Months 2-4)
Tasks: Develop and backtest the software for structural model estimation.

Stage 3: Initial Setup and Data Integration (Month 5)
Tasks: Establish data pipelines with Base's systems. Conduct initial data cleaning and integration.

Stage 4: Integration and Pilot Testing (Month 6)
Tasks: Integrate the software with Base's operational systems, optimize software framework for real-time operation, and begin forward testing.

Project Impact

- More accurate forecast demand, supply, and prices in electricity markets.
- More efficient prediction-based operations for companies, such as (dis)charge scheduling, delivery management, etc.
- Reduce energy supply disruptions and increase security of critical energy infrastructures.