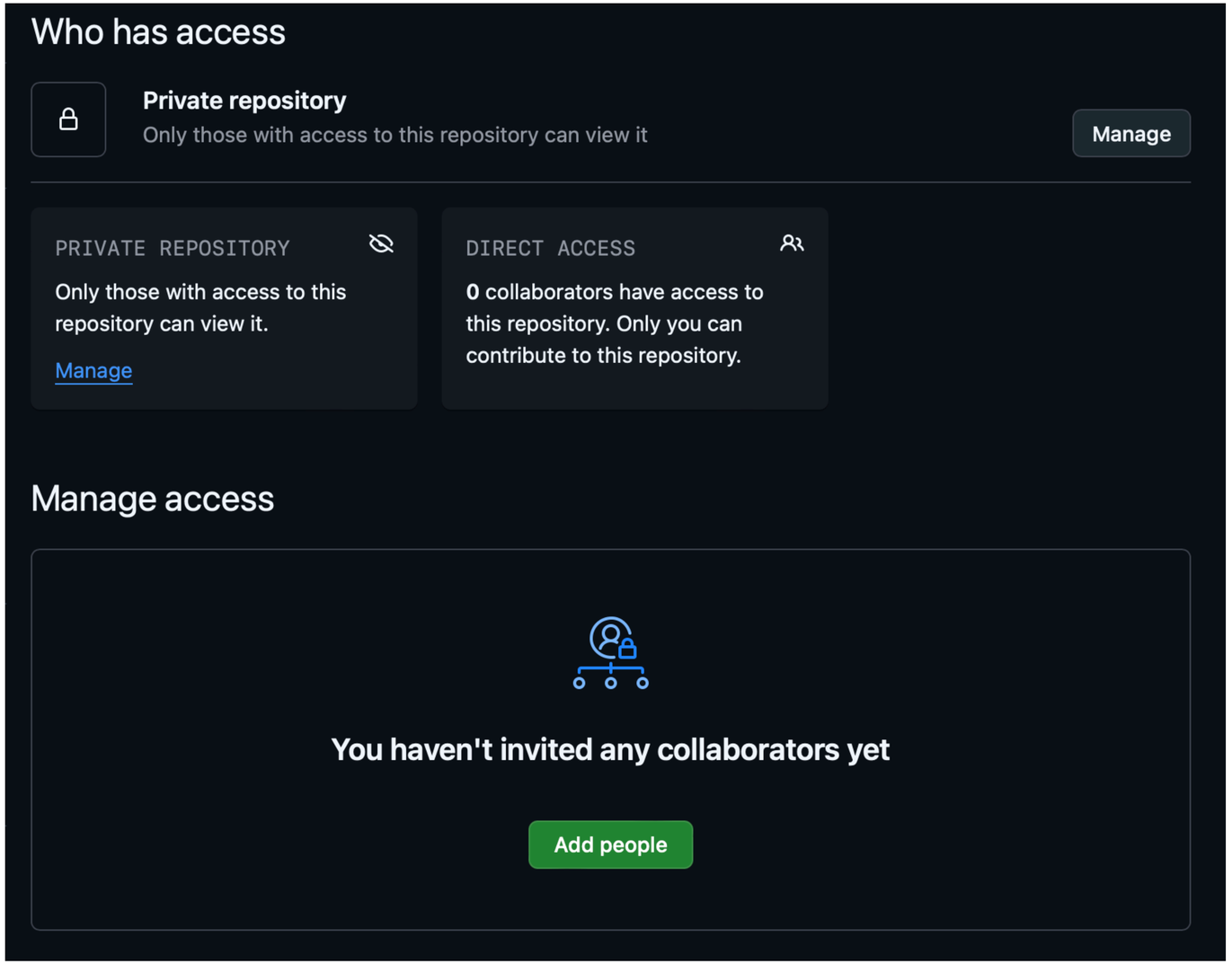
Load Prediction using ML: Bachelor's Project

Omar Abdesslem, 09/01/2025

Adding you to Github Repository



Exploring similar/existing ideas

- Similar research has been made in:
- Ho Chi Minh, Vietnam by Hung Duc Nguyen:
- Tianjin, China by MINGFEI ZHANG:
- California, US by Ruksi Korpisara: Conclusion: LSTMs >>>
- Kaggle: many models for different countries, to be looked into further , Gradient Boost models, some GRU|LSTM models

Exploring similar research

Hung Duc Nguyen, Ho Chi Minh

- Focuses on Short term load forecasting. “Compares Long Short-Term Memory Model (LSTMs), Gated Recurrent Network Model (GRUs), and CNNs ”
- Feature Generation:
- Hours, days, months seperate indicators
- Weekend indicator: “The weekday index distinguishes weekdays and weekends, as well as makes a distinction between Saturdays and Sundays. In particular, for a given hour, the value of ‘weekend’ is equal to “0”, if the hour is on a weekday, equal to ‘1’ if the hour is on a Saturday, and equal to ‘2’ if the hour is on a Sunday.”
- Holiday indicator (Easter, New Year’s etc)

Exploring similar research

Hung Duc Nguyen, Ho Chi Minh

- Multi-step forecasting attains the greatest precision when using 120-hour input sequences to predict 24- hour horizons.

TABLE V
FORECASTING PERFORMANCE COMPARISON

Methods	Single-step forecasting			Multi-step forecasting		
	MAE (MW)	*MAPE (%)*	*RMSE (MW)*	*MAE (MW)*	*MAPE (%)*	*RMSE (MW)*
GRU	29.34	1.47	43.36	62.37	3.15	87.70
LSTM	30.86	1.56	45.66	63.77	3.26	91.19
CNN	31.05	1.58	46.06	64.55	3.24	90.31

Exploring similar research

Tianjin, China by MINGFEI ZHANG

- “It indicates that forecasting models based on LSTM out- perform other methods, including auto-regressive integrated moving average (ARIMA), support vector regression (SVR), and traditional feed-forward neural network (FNN)”
- Although RNN-based load forecasting models have achieved better performance than historical models, the accuracy is still unsatisfactory for practical use due to the poor performance on forecasting peak and valley load values.
- Using CNN provides good results but is too slow owing to a large number of learn-able parameters in convolution operation
- ==> proposed input attention mechanism (IAM) and hidden connection mechanism (HCM) to greatly enhance the accuracy and efficiency of RNN-based load forecasting models

Exploring similar research

Tianjin, China by MINGFEI ZHANG

- “It turns out that the models with IAM and HCM have higher accuracy and faster training efficiency than any other fore- casting models... Results show that RNNs with IAM is substantially improved in terms of accuracy but decreased in terms of efficiency, while RNNs with HCM mainly contributes greatly to efficiency” especially for hourly predicitions

Exploring similar research

Tianjin, China by MINGFEI ZHANG

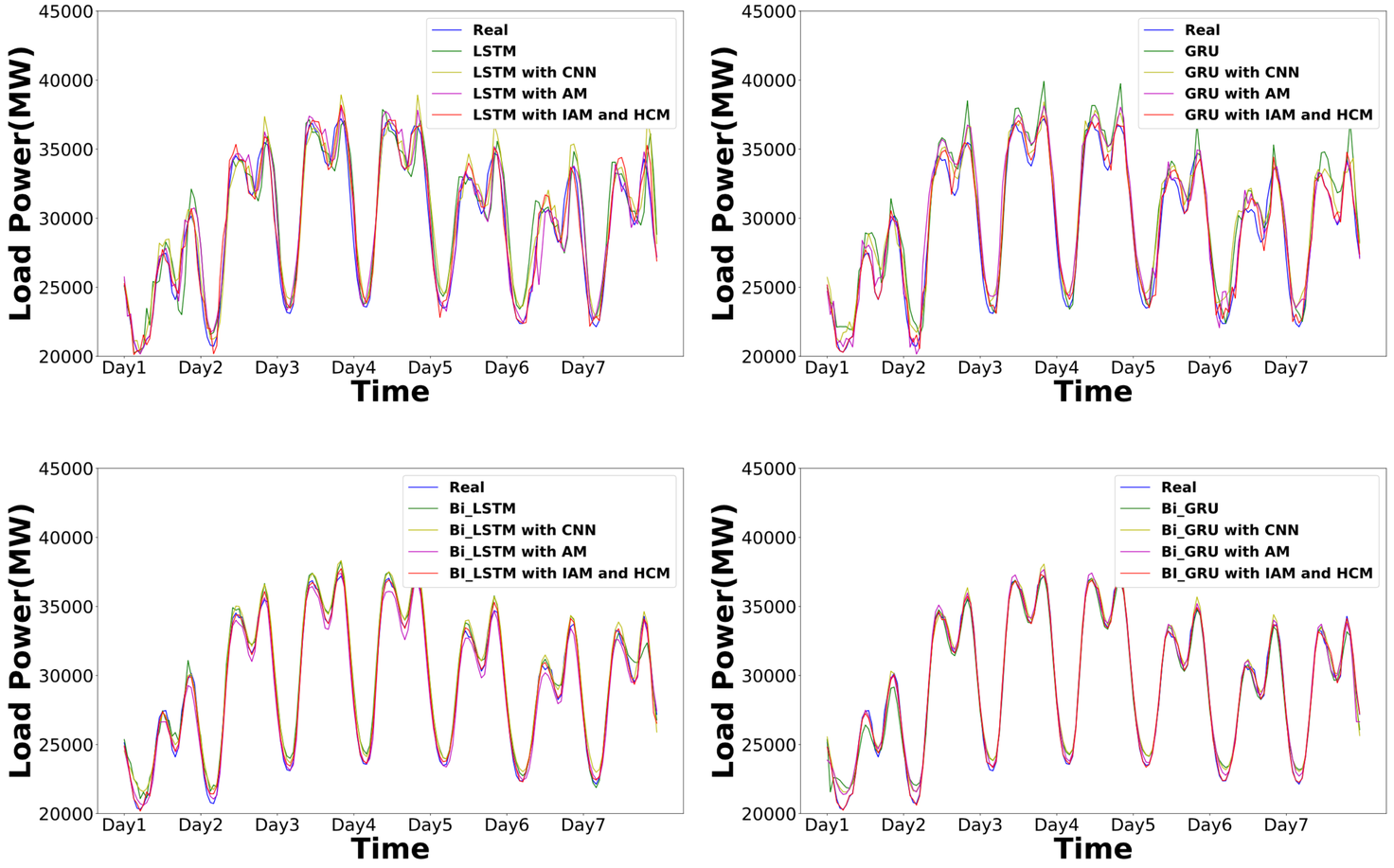
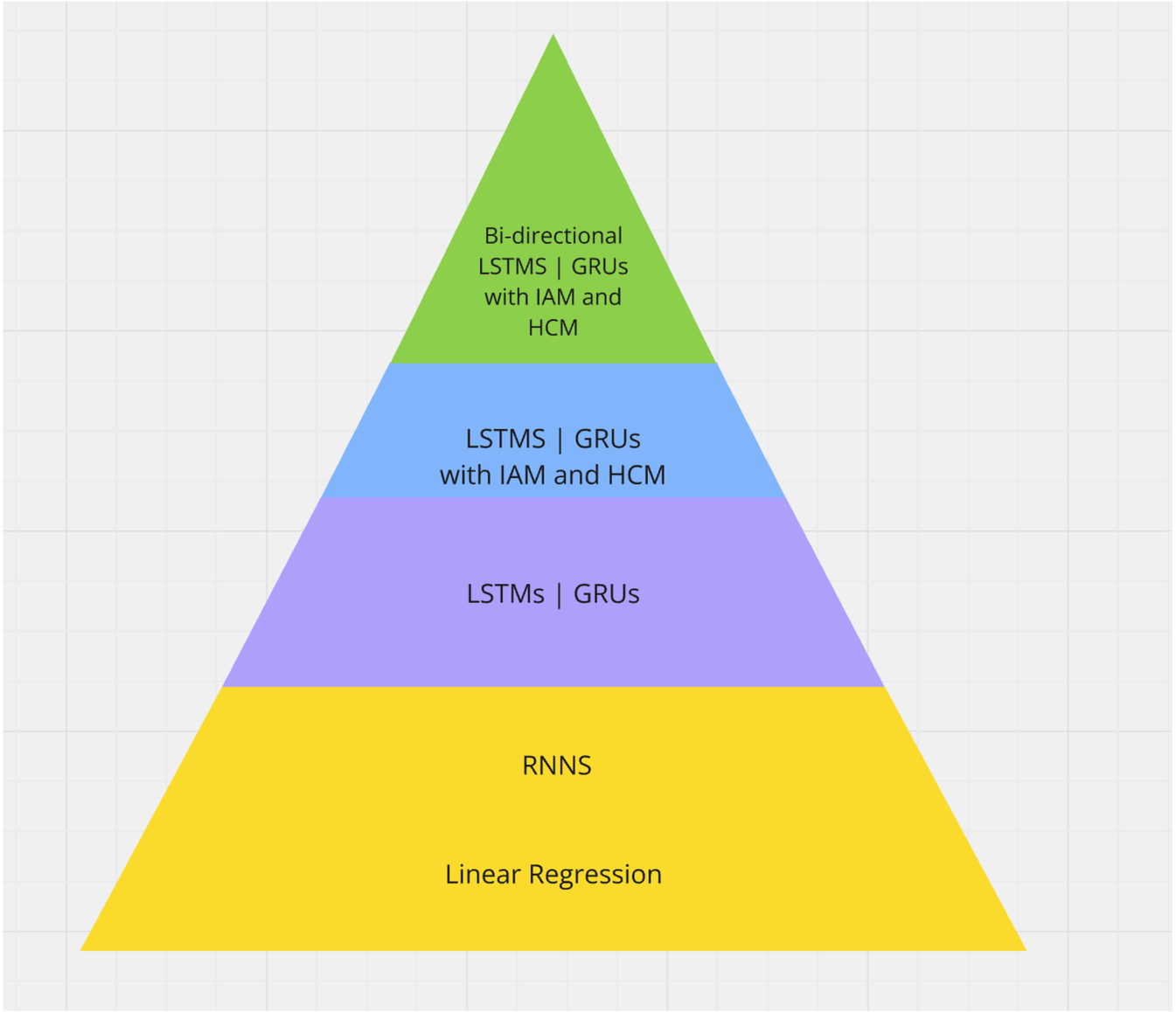


FIGURE 12. Weekly prediction results of all models on EG dataset.

Best Models for Load Forecasting according to studies



Objectives and Description Review

PROBLEMATIQUE

Load forecasting is the process of predicting how much electricity will be needed at a given time and how that demand will affect the energy grid(1).It is essential for determining Energy Production and maintaining Grid stability.
Traditional load forecasting methods relied on statistical and mathematical models.
This Bachelor Work aims to use Machine Learning for such predictions.

(1) IBM

Objectives and Description Review

OBJECTIFS

Visualise the Production / Consumption Data
Setting a Baseline Model
Setting model evaluation Metric
Create a Medium Term Forecasting Model (Predicting Total Amount of Energy Consumed per day/Week)

Does SwissGrid have reserve batteries?

Yes and No

- Emergency batteries and generators are in place in key areas of the power grid (Like the Control Room, HQs)
- First, SwissGrid gets and sells its energy from various plants (independent, state-owned, foreign). These plants are primarily fuel, nuclear, and thermo powered, called Balancing Groups. If the demand cannot be fulfilled through the Balancing Power Plants, Reserve Power Plants will be notified asap.
- Switzerland has reserve energy in case of emergencies in the form of reserve power plants (mostly) and emergency power groups(centrales de réserve).
- Reserve centers are usually huge Diesel / Fuel Buckets + Generator, with some Hydraulic Energy reservoirs
- Fuel Plants are very reliable (all you need is Generator + Fuel). In emergencies like COVID, CH stocks up on fuel.

Issues

- Degradation of the Diesel as it gets old. (1)
- Filter clogging(1)
- Environmental impact

- Solution: more storage of energy from renewable sources using pumped storage plants / batteries (2)
- (1)- SEM, Réserve d’hiver
- (2)- More Grid Stability thanks to energy storage