



# HMM Term Project

CMPT 318 GROUP 12

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# Project Scope



To do principal component analysis on energy grid data to discern valuable data for training models



To develop and train HMMs for the purpose of anomaly detection in energy grid data

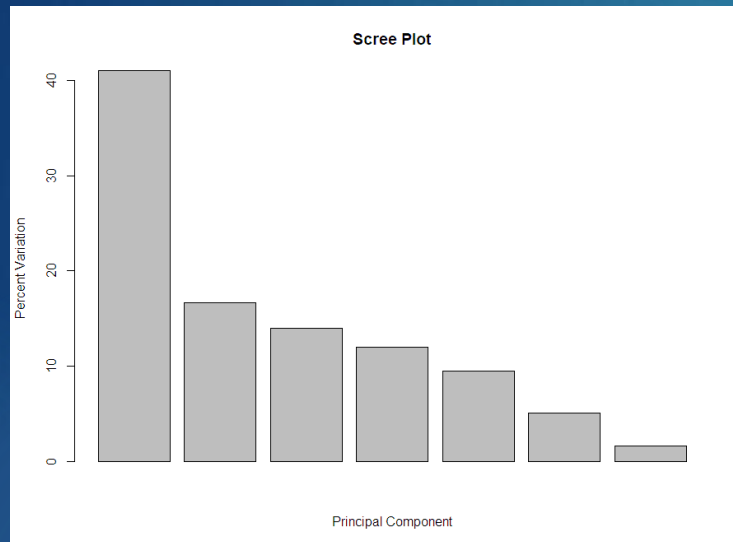


Learn how to properly fit HMMs to training data to achieve good results with testing data



To test trained models on anomalous datasets

# PCA



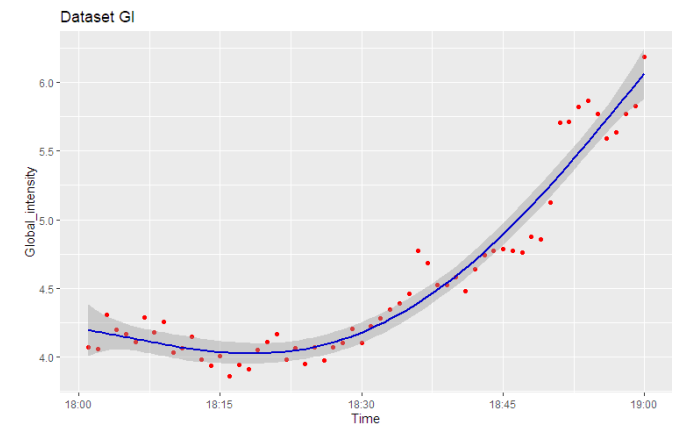
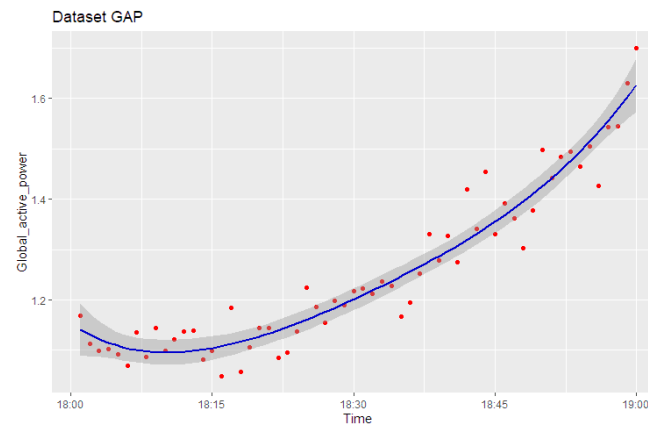
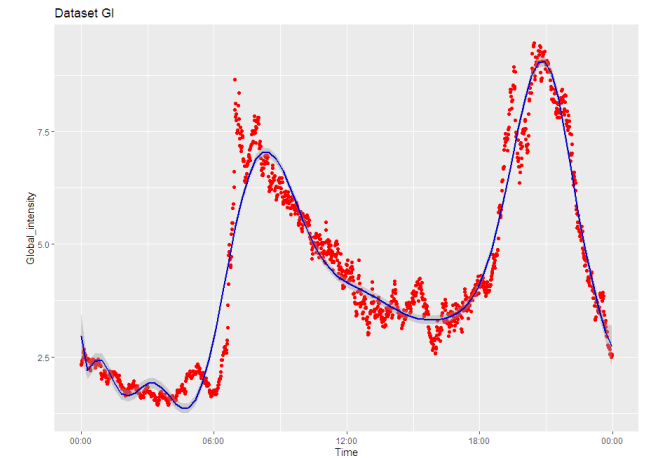
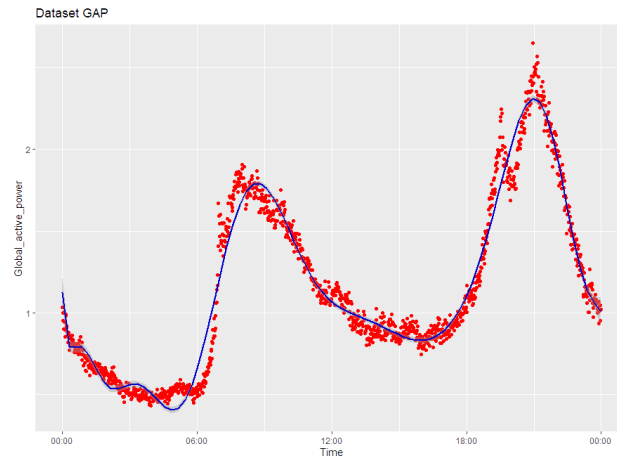
- ▶ Global Intensity
- ▶ Global active power



Global_intensity	Global_active_power	Sub_metering_3	voltage
-0.5664544	-0.5128988	-0.3671846	0.3549207
Sub_metering_1	Sub_metering_2	Global_reactive_power	
-0.2430386	-0.2367884	-0.2003361	

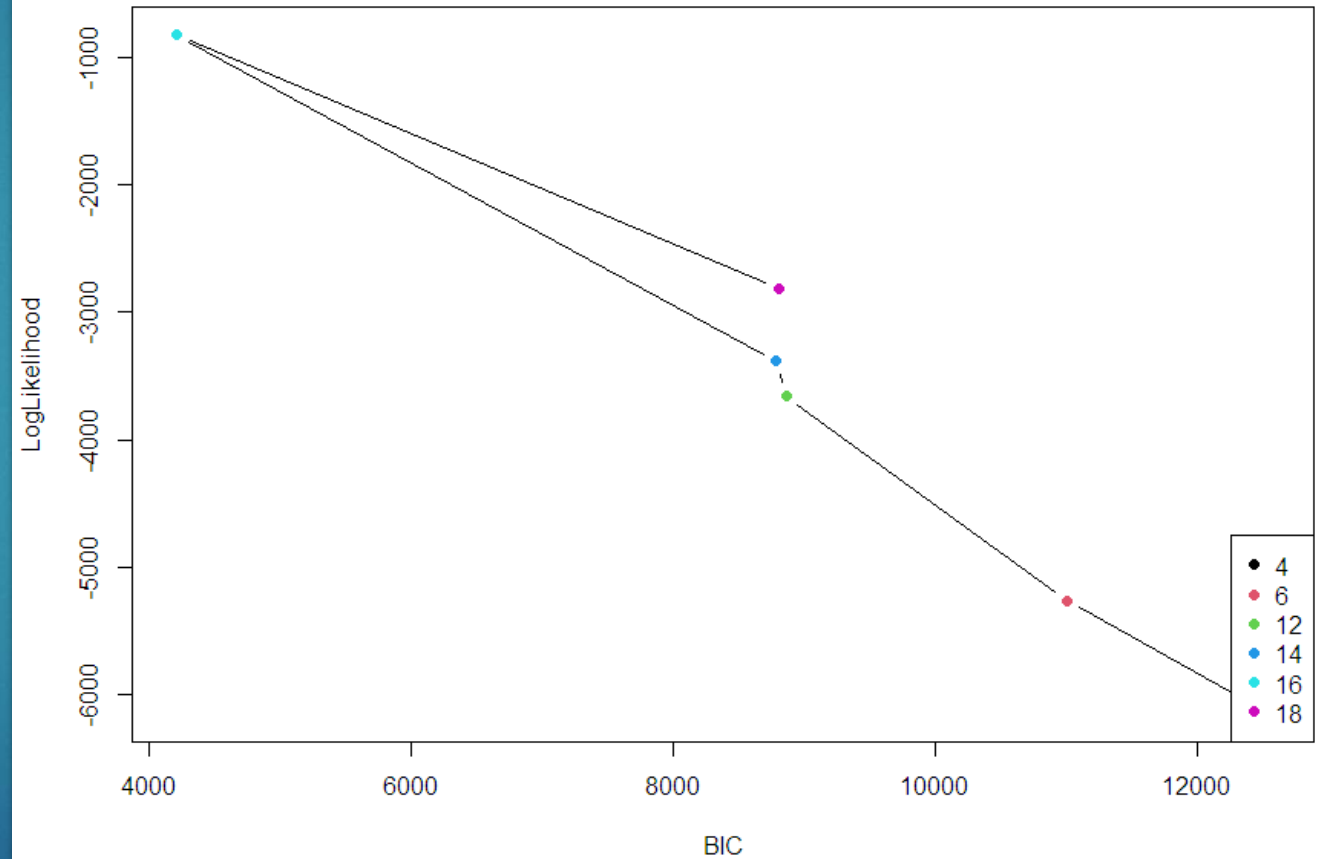
# Time window selection

- ▶ Rational
- ▶ Data division
- ▶ Testing and Training



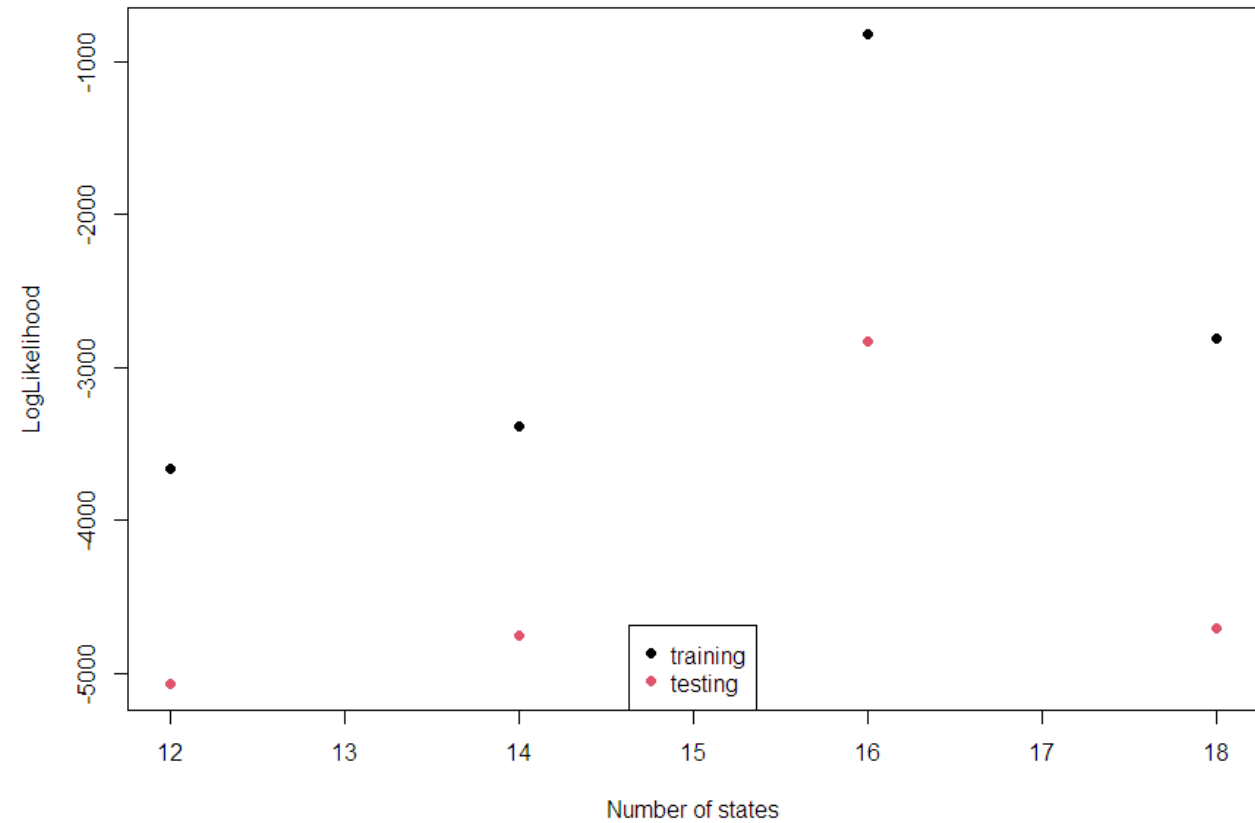
# Markov Model Training

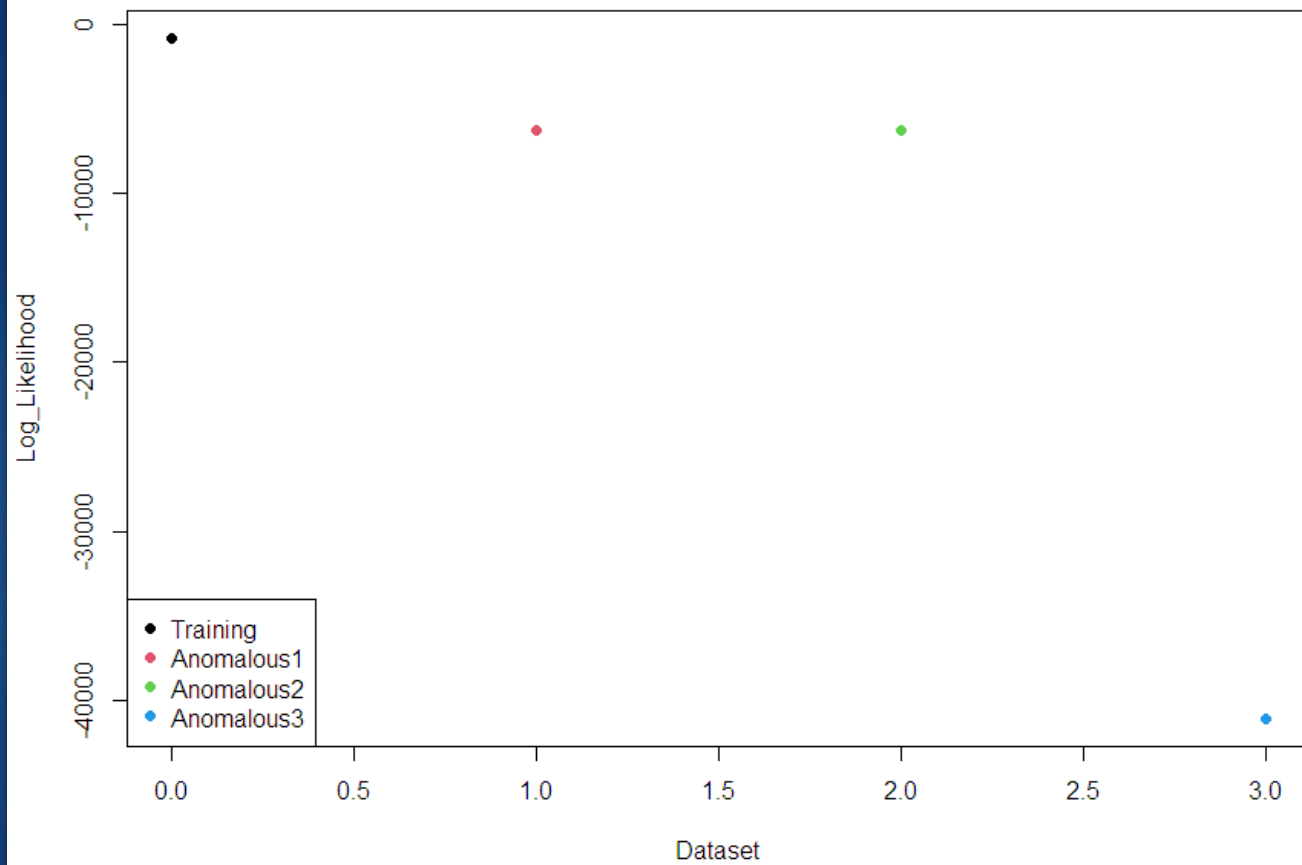
- ▶ Selecting models for testing
- ▶ Model instability
- ▶ Overfitting and underfitting



# Markov Model Testing

- ▶ Final model selection
- ▶ Process
- ▶ Normalization





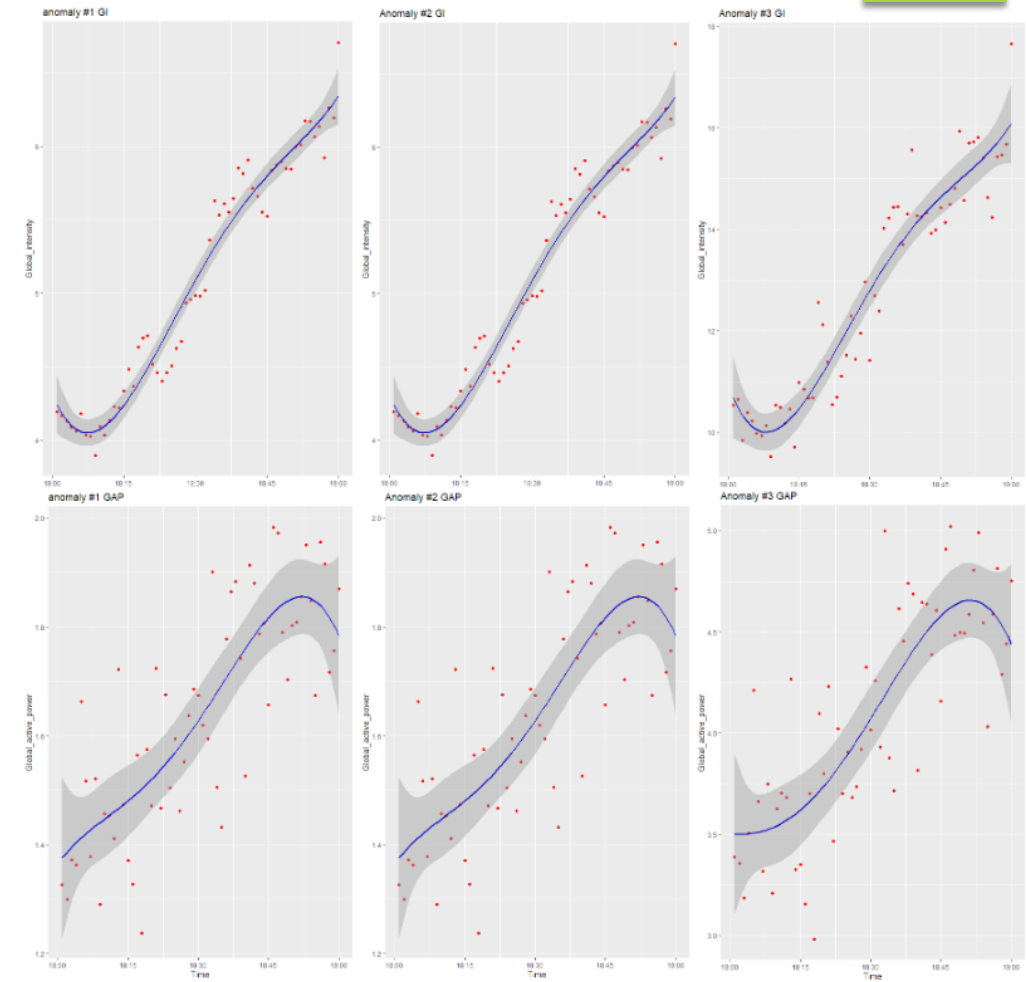
# Anomaly Detection

- ▶ Results
- ▶ Further exploration

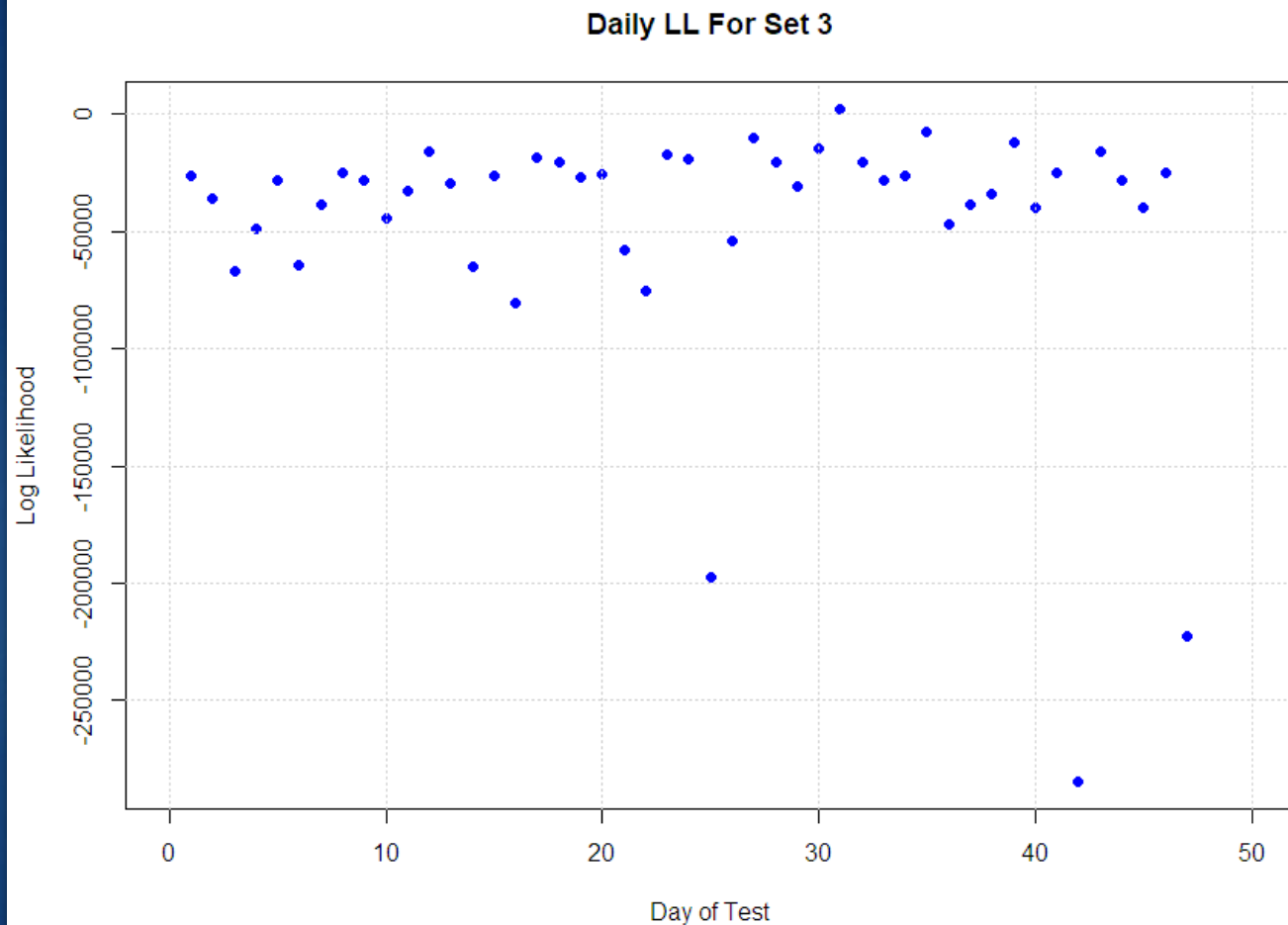


# Anomaly Detection

- ▶ Additional data exploration
- ▶ Data irregularities







# Anomaly Detection

- Points of interest
- Interpretation

# Conclusion



Benefits of HMMs



Difficulties encountered



Potential applications