Project Description:

Cardiac arrest has a hospital mortality rate of ~80% and is a serious concern for many ICU patients. A paper (Ho et al., 2013) published in the Journal of Machine Learning Research made a first attempt at creating a dynamic cardiac risk estimation model which incorporates different temporal signatures in a patient’s risk trajectory. Their model, DYNACARE, allows for real-time interpretability and predictability of a cardiac arrest event. They have two flavors of DYNACARE, a switching model with two latent variables, one controlling the stochastic volatility and the other capturing the binary state of the process, along with a threshold model with a single latent variable controlling the risk trajectory.

We seek to improve upon their work by trying a variety of models including recurrent neural networks and other higher-dimensional graphical models, as well as various ensembles of these models. We hope to have both a theoretical and experimental justification explaining our improvements, which will be written up in a paper. The general intuition is that by increasing the complexity of the model, we will be able to increase predictive power and give a better hazard function which conveys the risk of the patient. There may be some trade-offs involved with interpretability, which we will explain in the paper.
Deliverables

Do background research on: (They say most of research is figuring out the right question to ask)

- Kalman filtering
- Particle filtering
- Forwards backwards algorithm
- Inference on graphical models
- Parameter estimation on graphical models
- Recurrent Neural Nets
  - GRU
  - LSTM
- Recurrent Neural Nets for multivariable time series with missing data using LSTM or GRUs
- The DYNACARE paper
- Other papers which look at temporal patterns including:
  - Kennedy and Turley, 2011
  - Batal et al., 2012
  - Wang et al., 2012
  - Carvalho et al., 2011

Design the graphical models
Design the RNN
Get the code which puts the data into our black box working (i.e. cleaning, formatting data)
Get the code which evaluates the output emitted by our black box working (i.e. cost function, regularization)
Code up the RNN
Code up the graphical models
Analyze our findings
Write the abstract of the paper
Write the introduction of the paper
Write the models section of the paper
Write the experiment section of the paper
Write the conclusion of the paper