

Machine Learning on Time Series with Python

Francesco Mosconi
Head of Data Science, Kickback Co.



Kickback

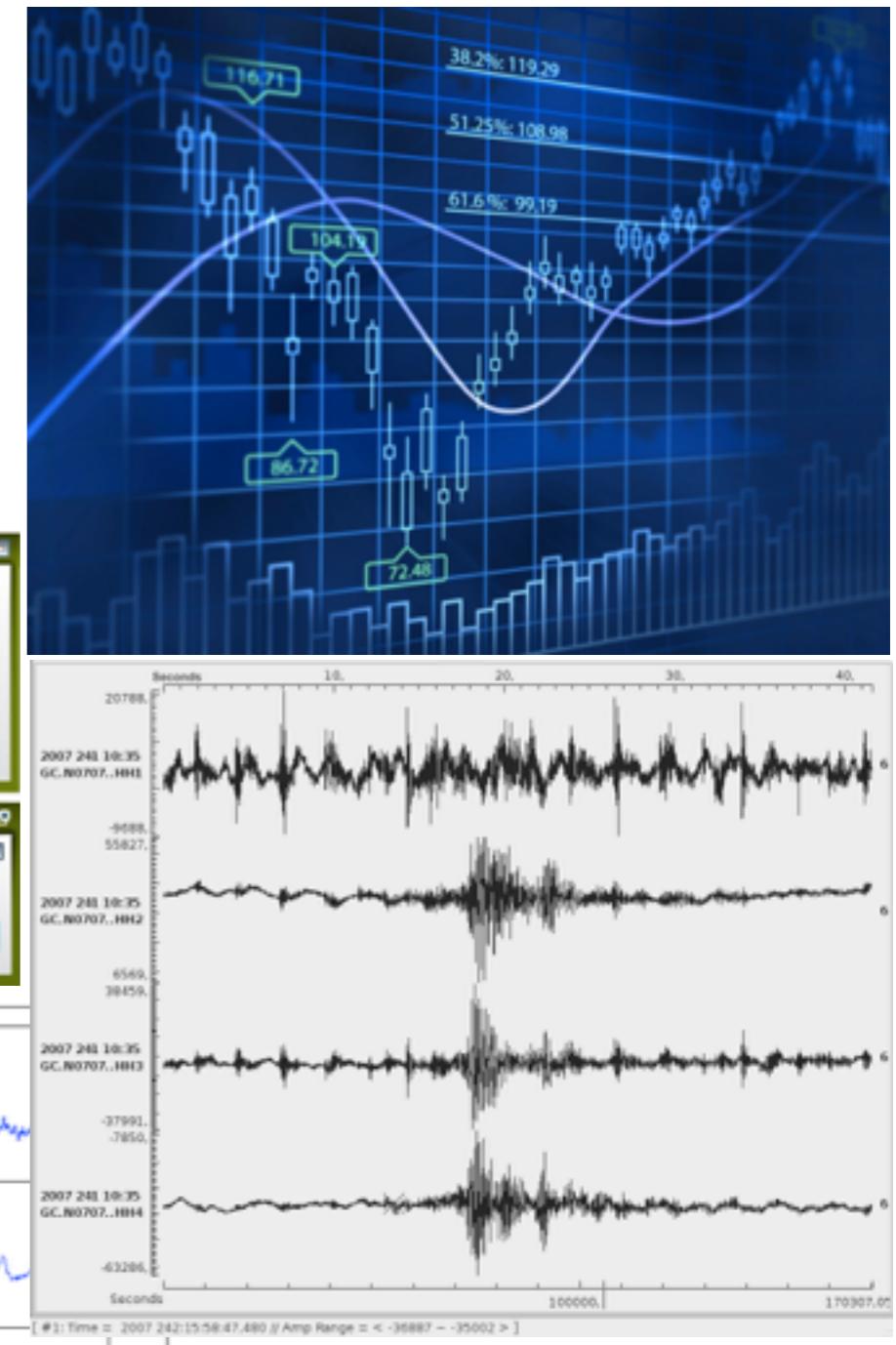
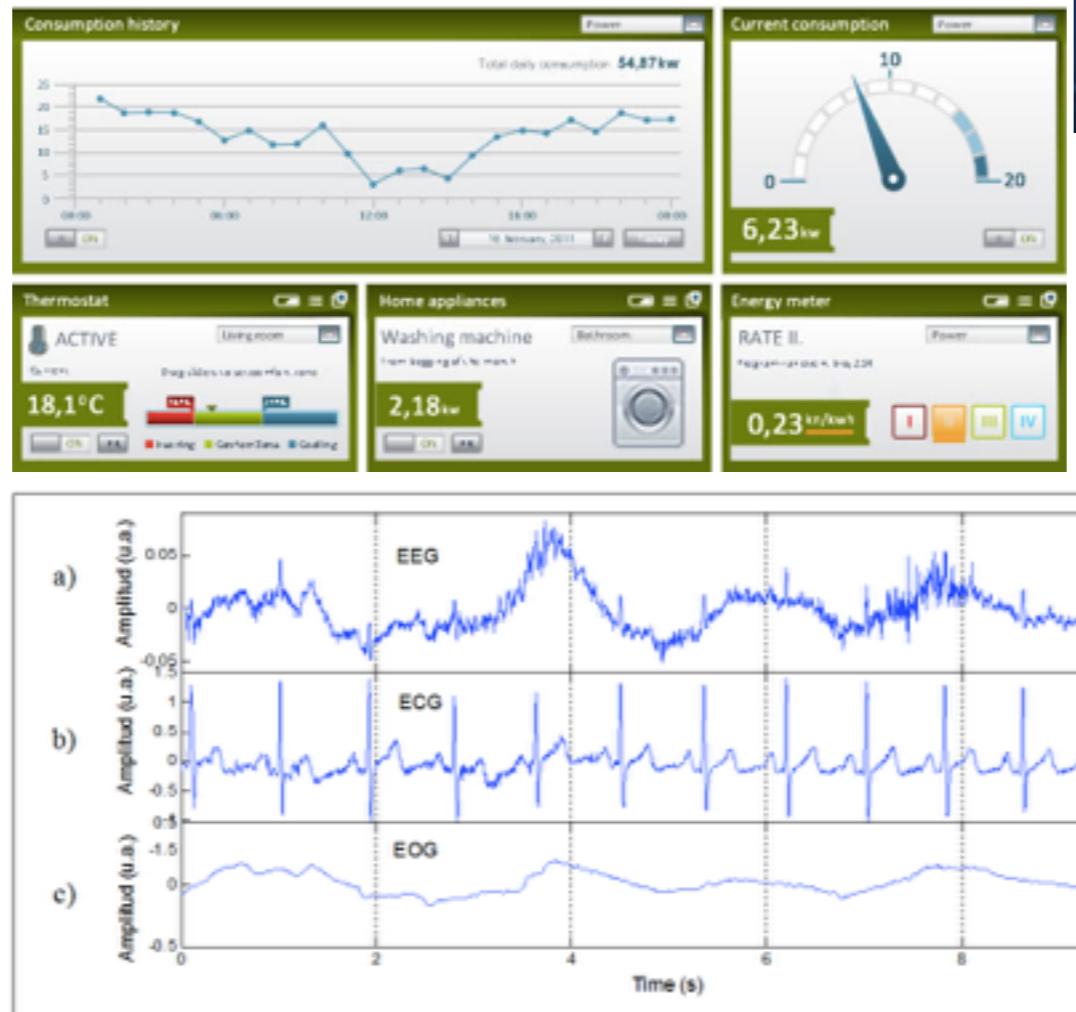
- Biggest, fastest and easiest way to play video games for money online
- Millions of games played
- Tens of thousands games every day
- Tens of thousands players
- 128 tick/s servers
- Average game lasts 10 minutes

=> Billions of time series data points per day!

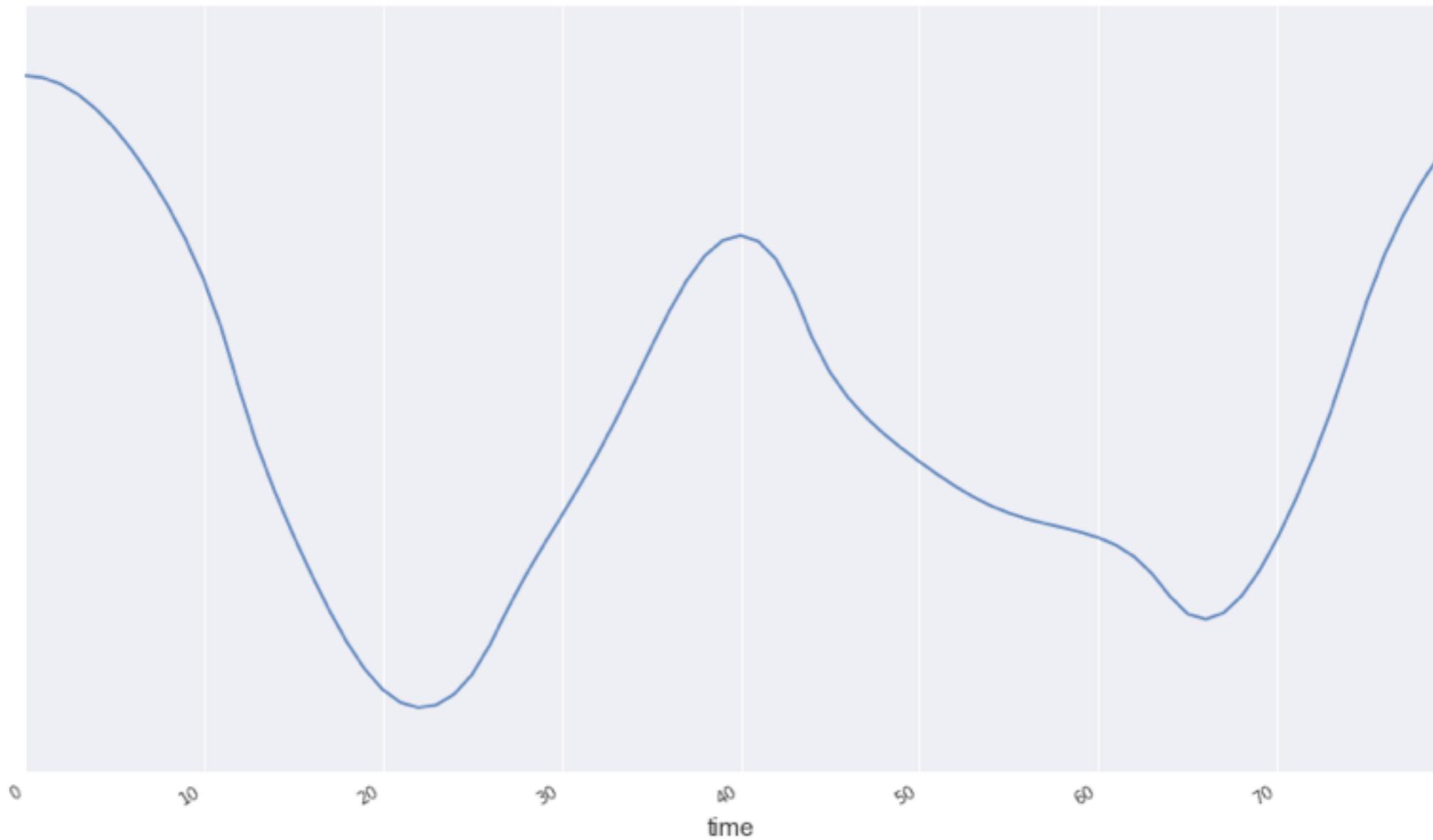


Time Series

- Stock market
- Music
- Biosensors, biosignals (EEG, EKG, ECG, Wearables, etc...)
- Website monitoring and analytics
- Video Games
- IoT
- Energy Monitoring
- Earthquakes
- Weather
- Sunspots
- ...



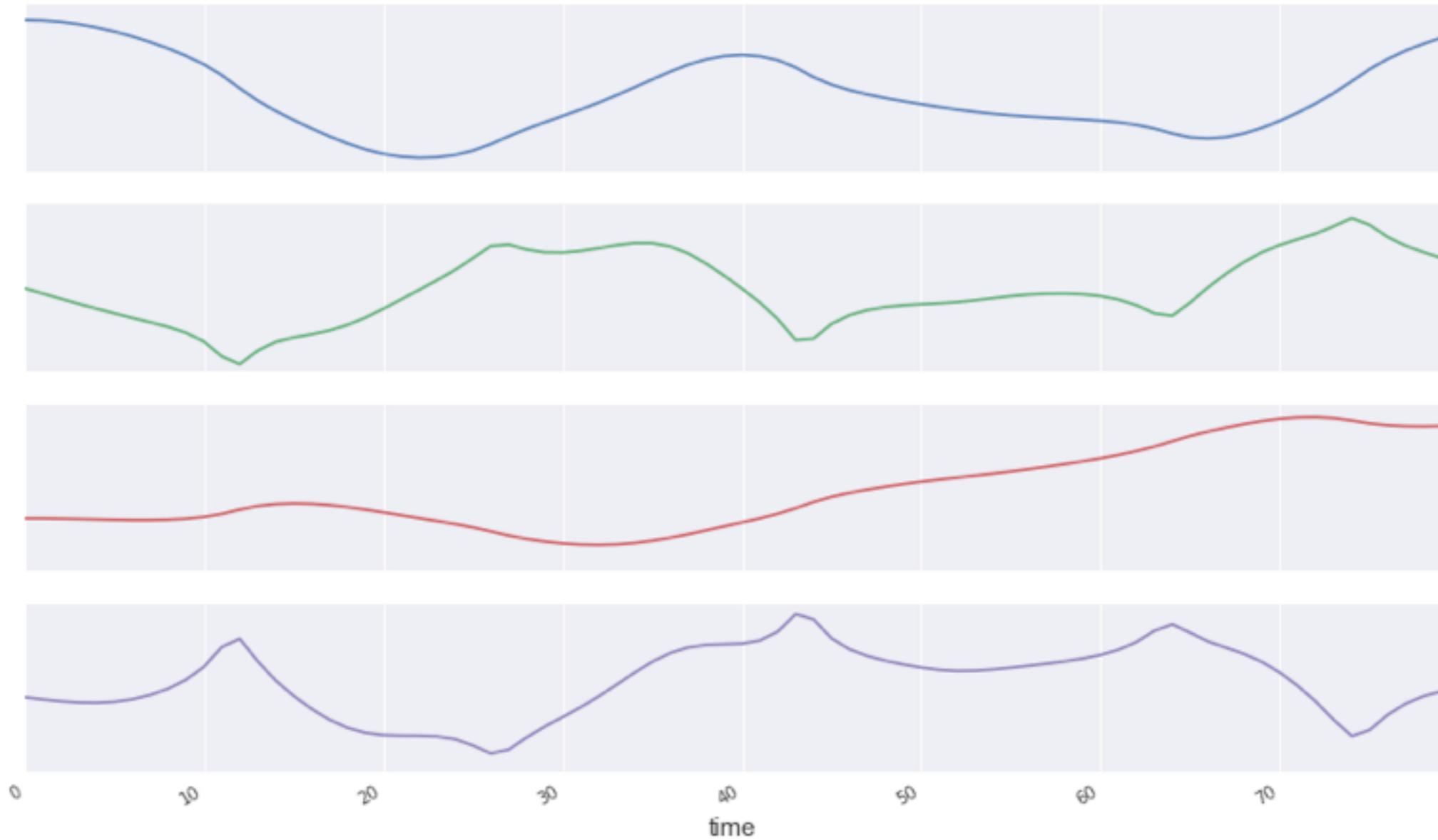
Time Series



Sequence of points with timestamps i.e. an ORDERED collection of numbers



Time Series



Could be multi-varied too, i.e. VECTOR as a function of time

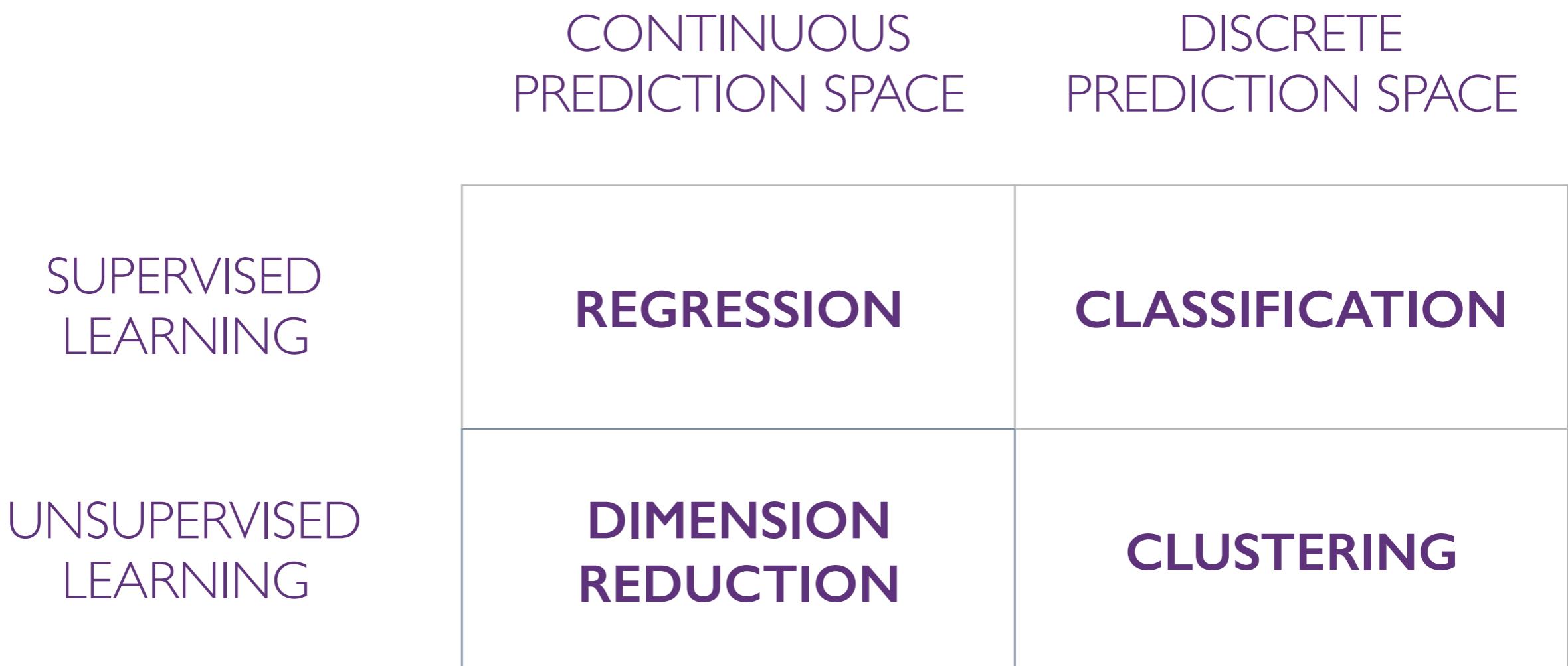


Typical ML problems

you tell me...



Typical ML problems

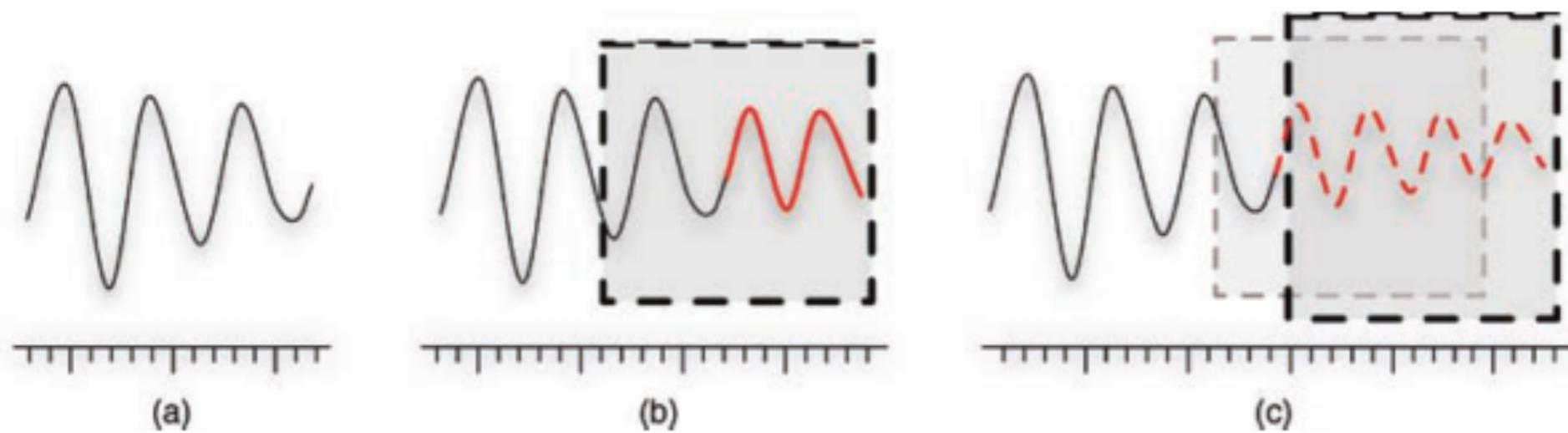


ML for Time Series

- Prediction of future values (regression)
- Pattern recognition & segmentation (classification, clustering, anomaly detection, dim reduction)
- Compression, noise reduction (preprocessing)



Prediction



Use past to predict the future



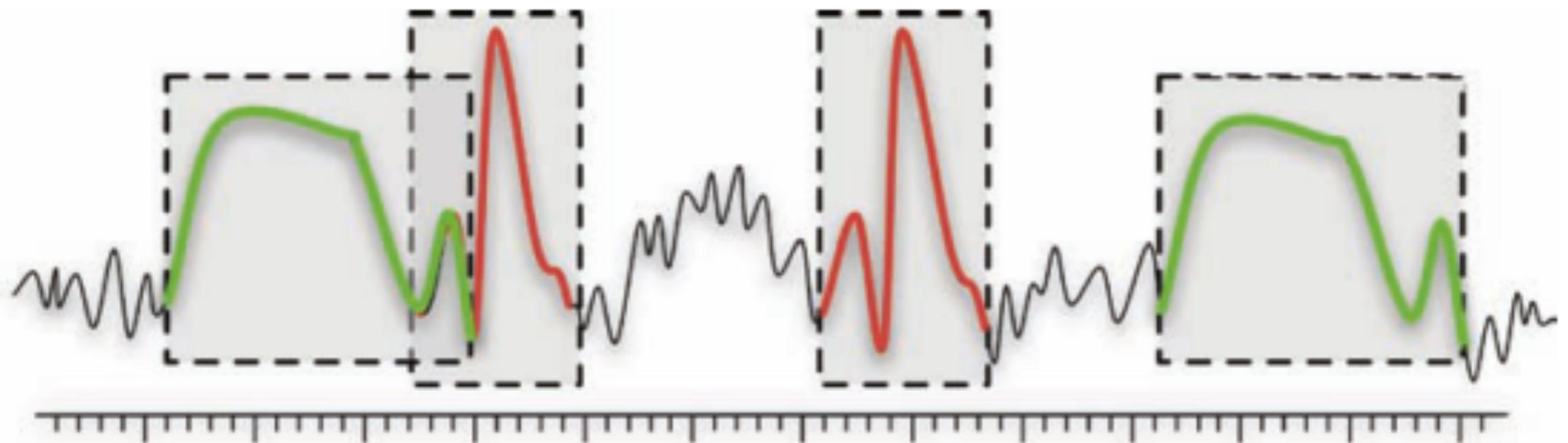
Anomaly Detection



Detect deviation from standard behavior



Motif Discovery

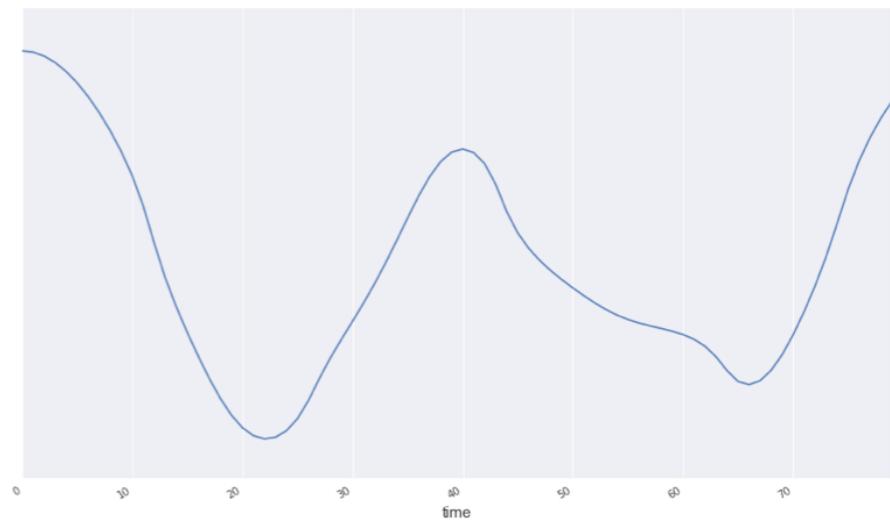


Find recurring patterns

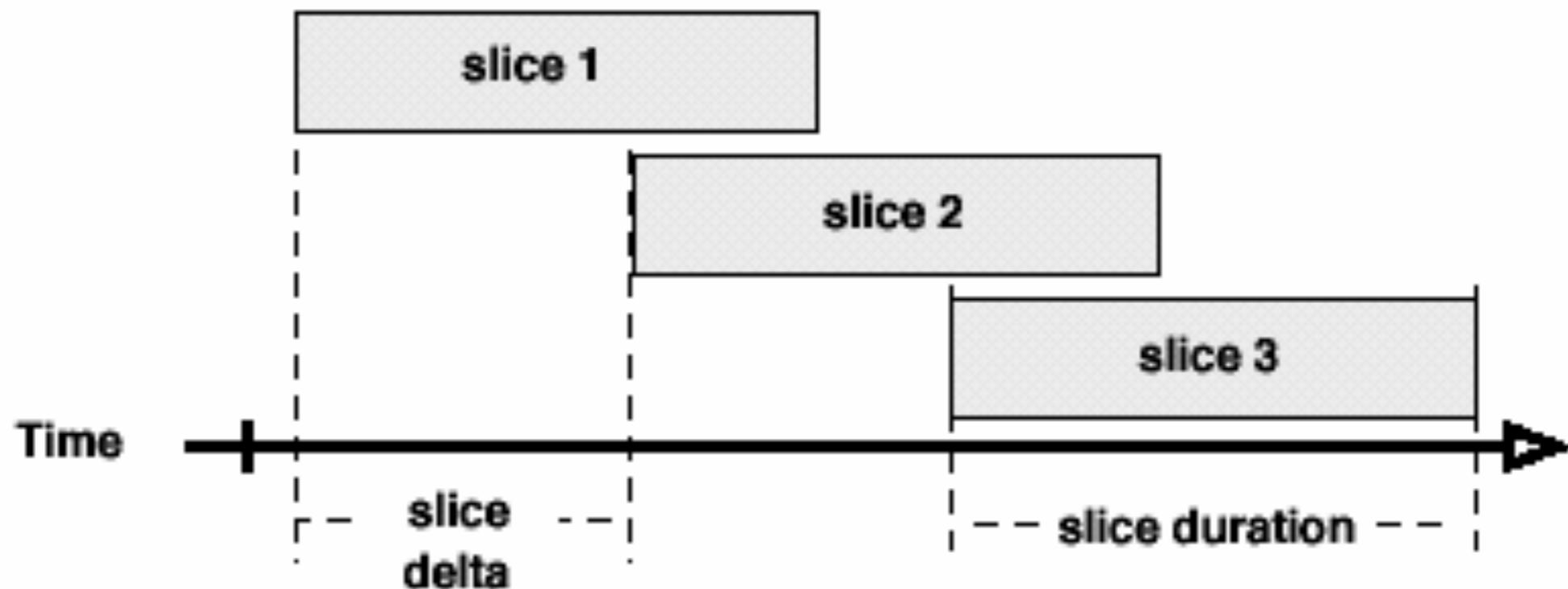


Caution Required

- Ordered events
- Correlation in Time
- Periodicity
- Past Future ...



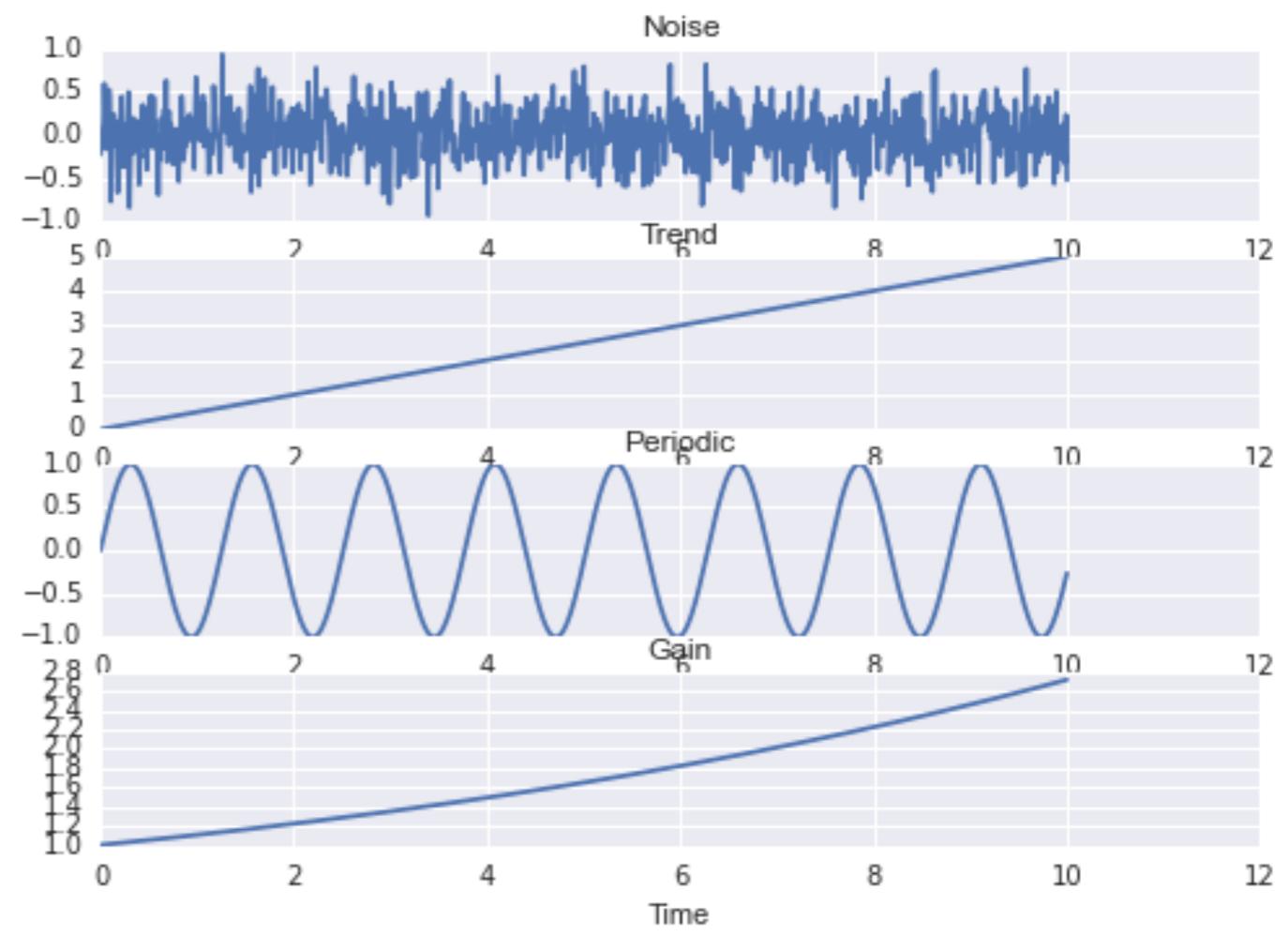
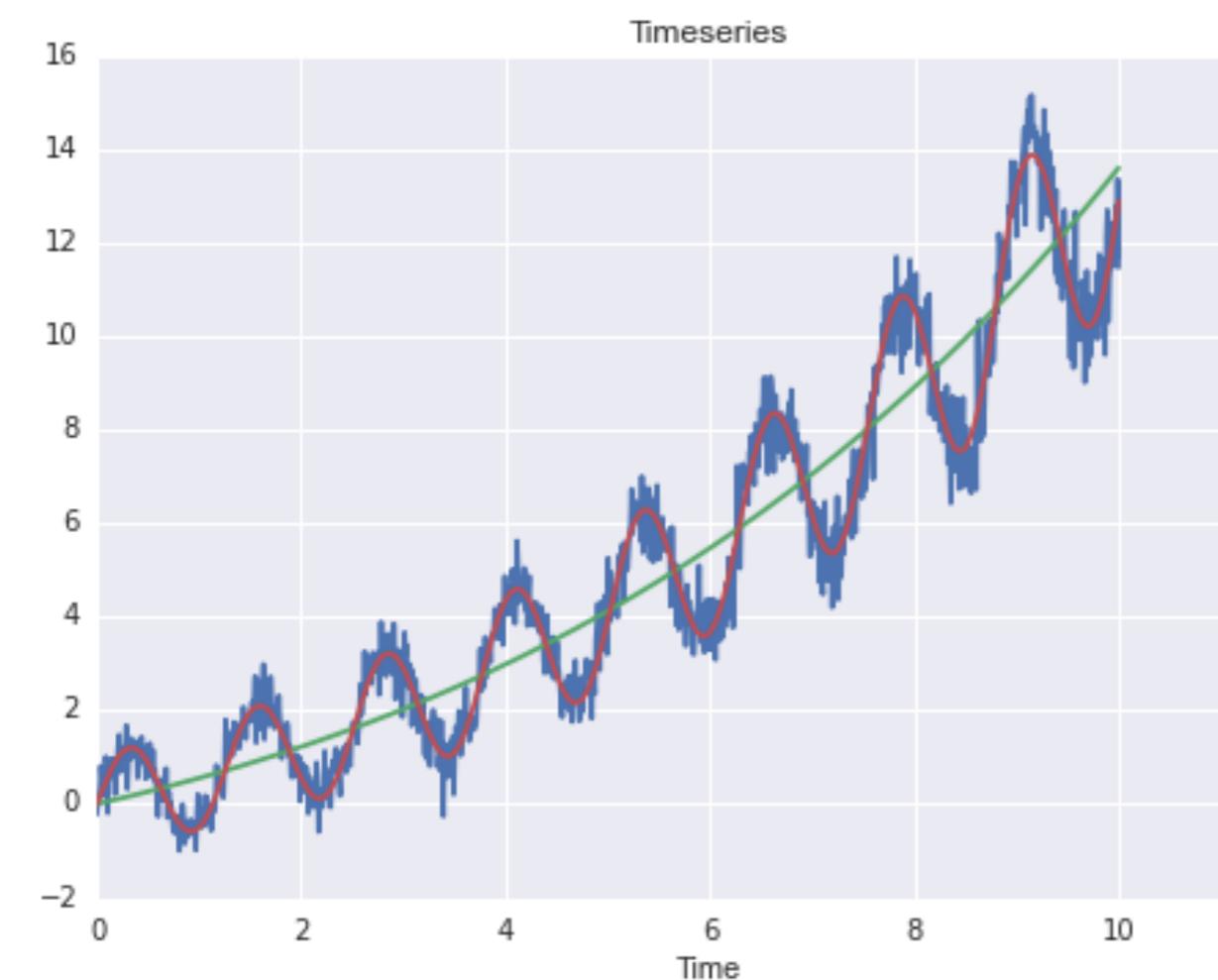
Rolling windows



- For each window calculate features:
 - Stats: Mean, Stdev, Moments
 - Frequency: Spectral Band Power, Entropy
 - Autoregressive model parameters
 - FFT, Hjorth, Mann-Kendall ...
 - Correlation dimension, integral, density, entropy
 - etc....



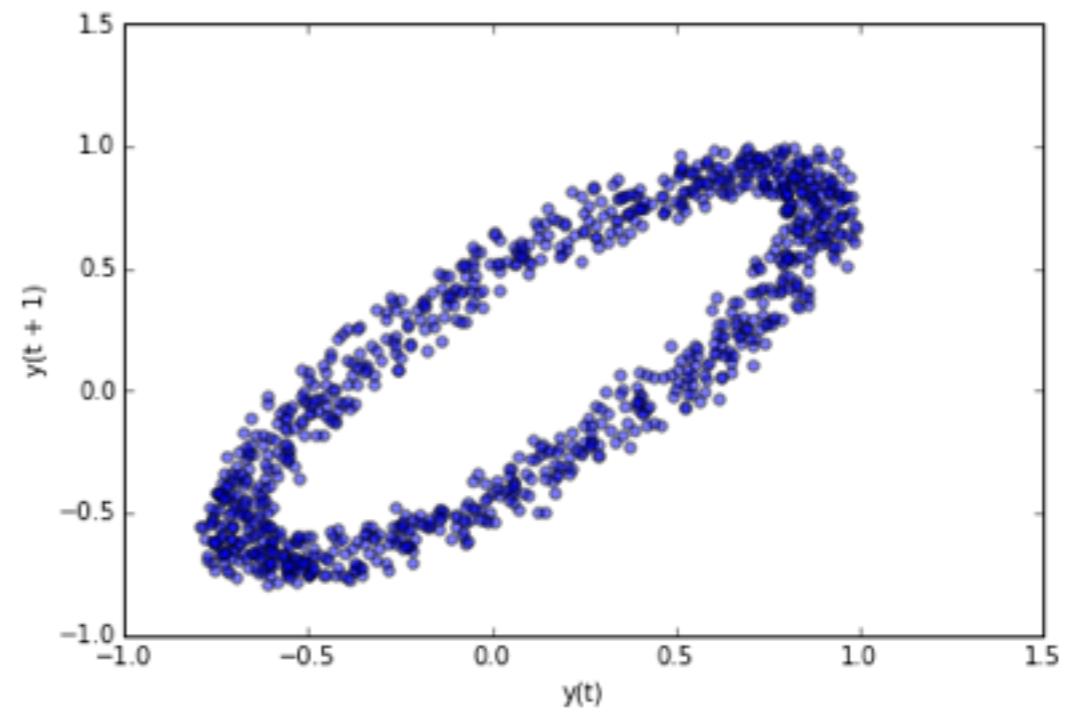
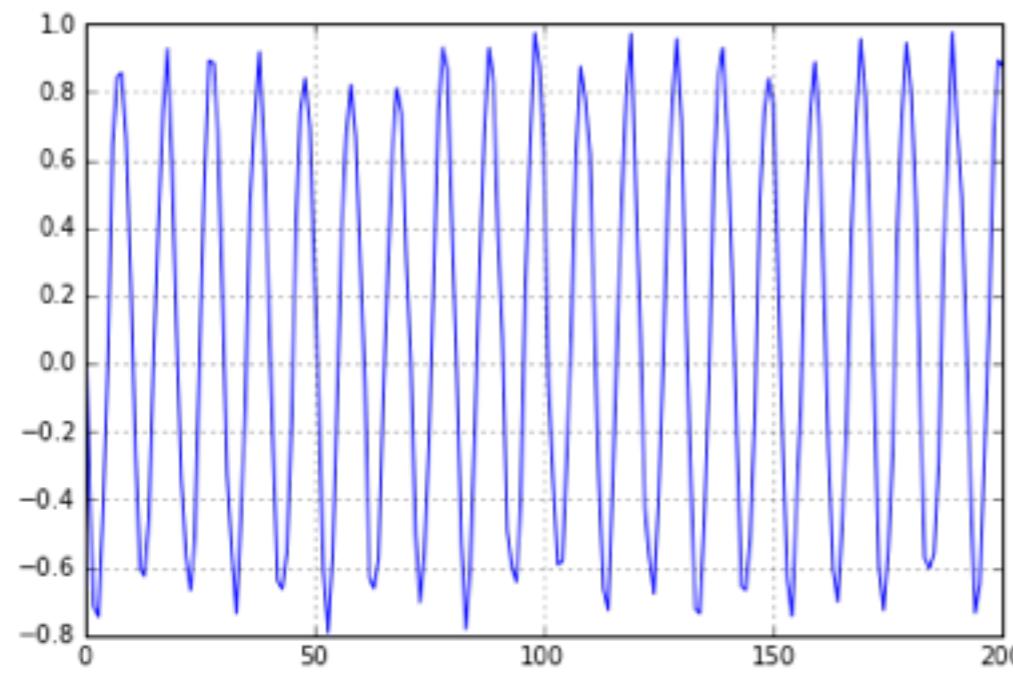
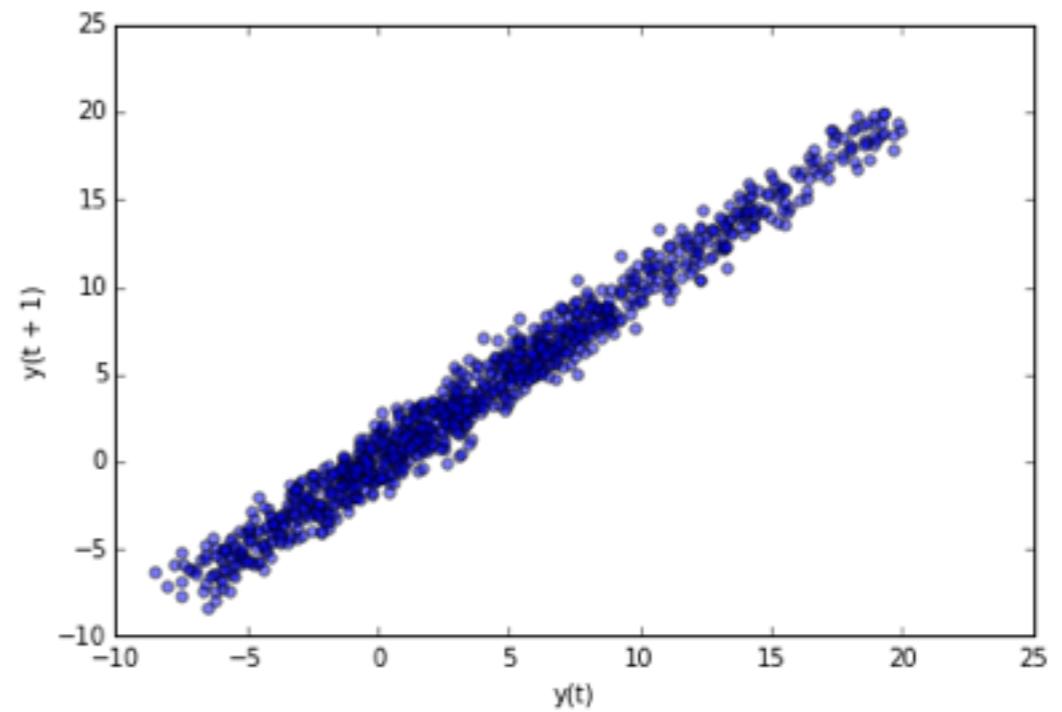
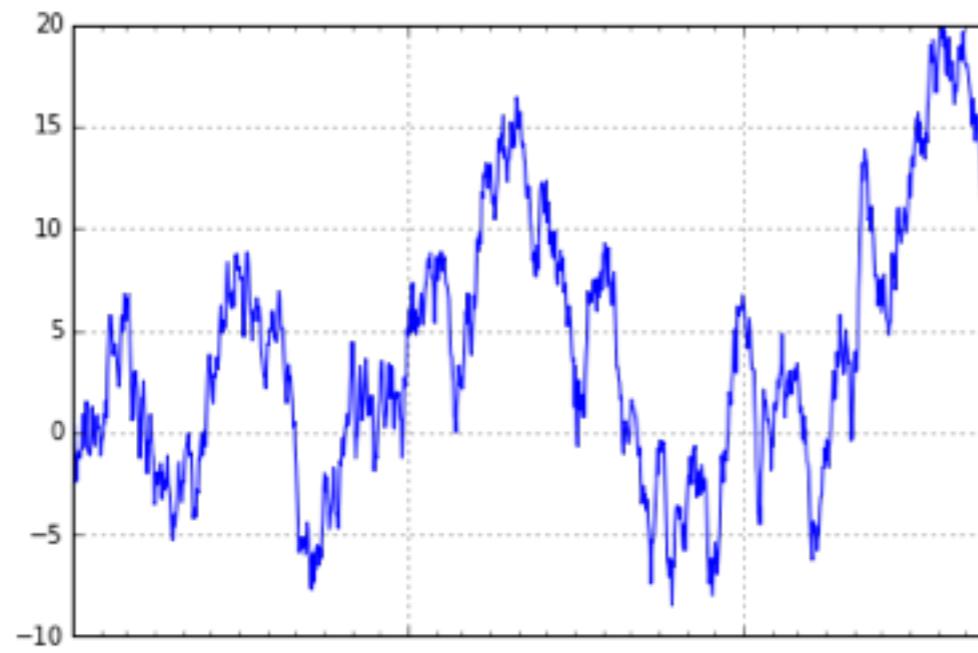
Trend and Seasonality



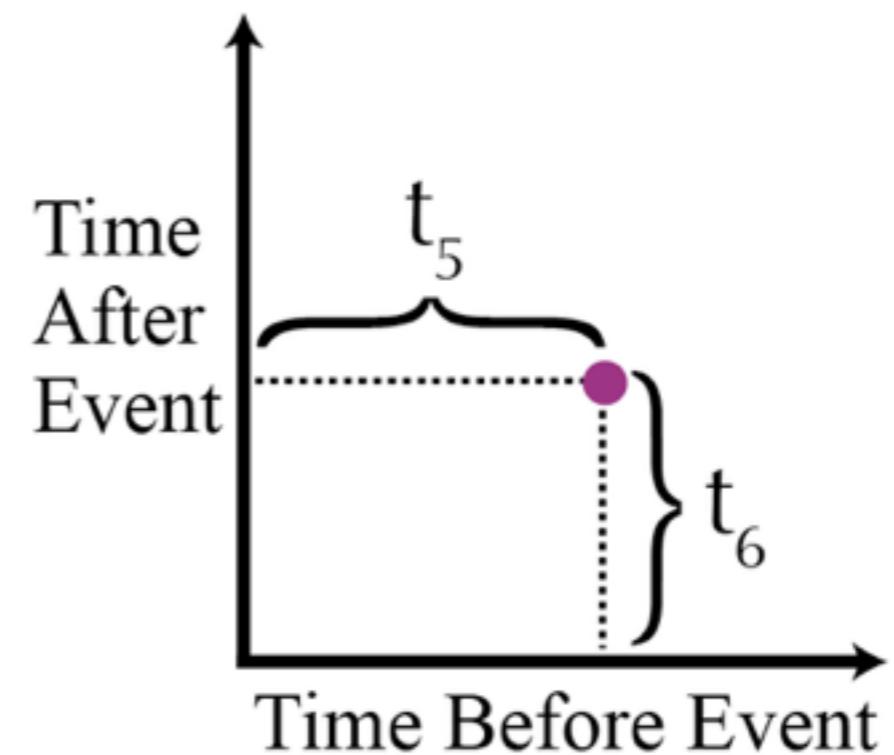
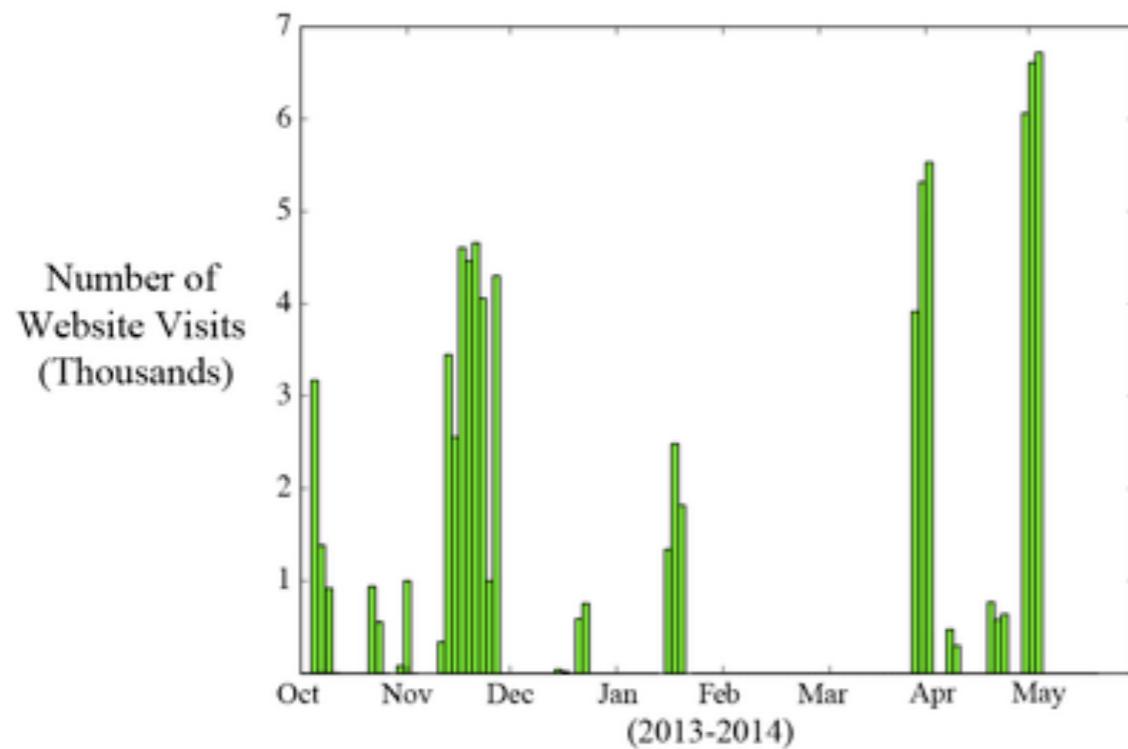
Other tips and tricks



Lag plot



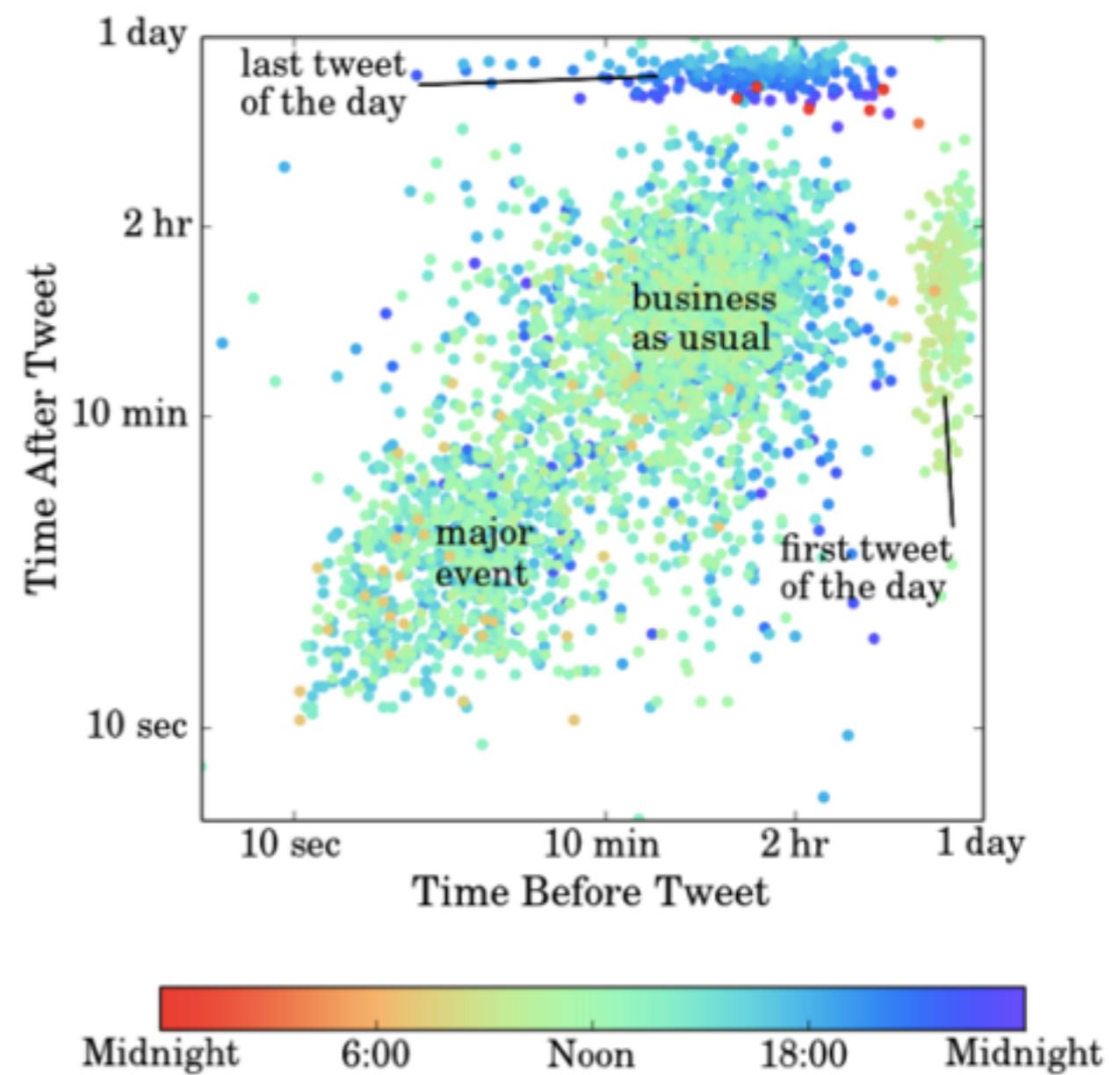
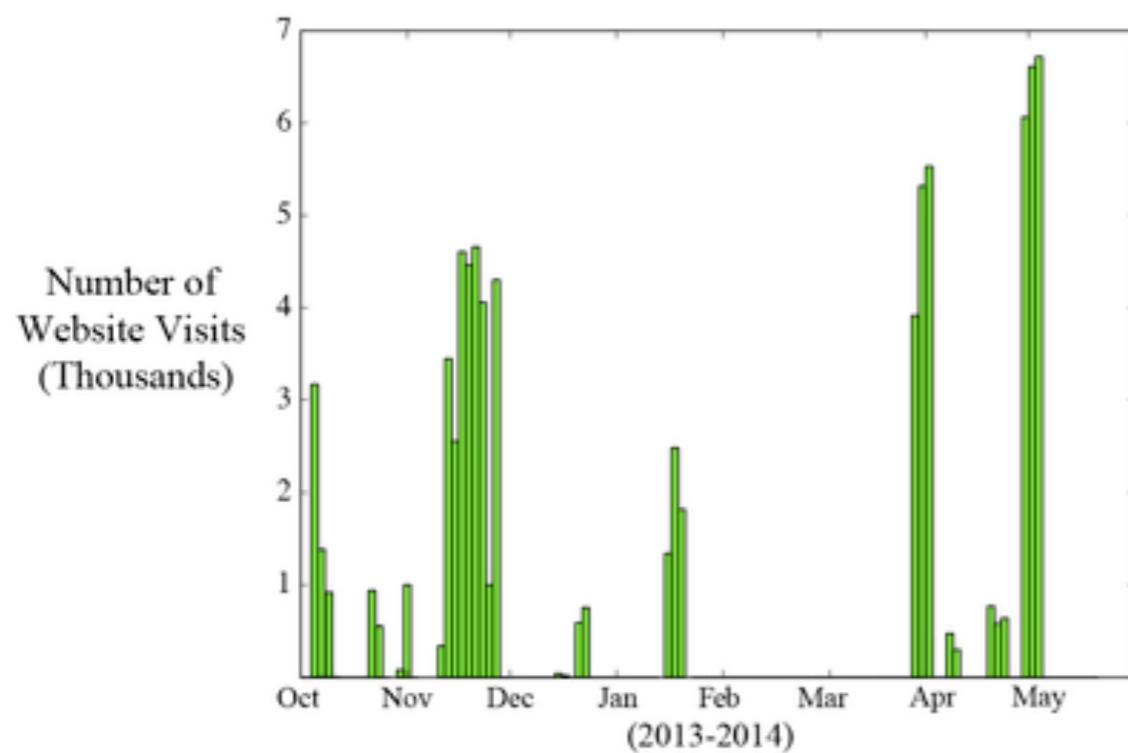
Time maps



<https://districtdatalabs.silvrback.com/time-maps-visualizing-discrete-events-across-many-timescales>



Time maps



<https://districtdatalabs.silvrback.com/time-maps-visualizing-discrete-events-across-many-timescales>



Most important thing

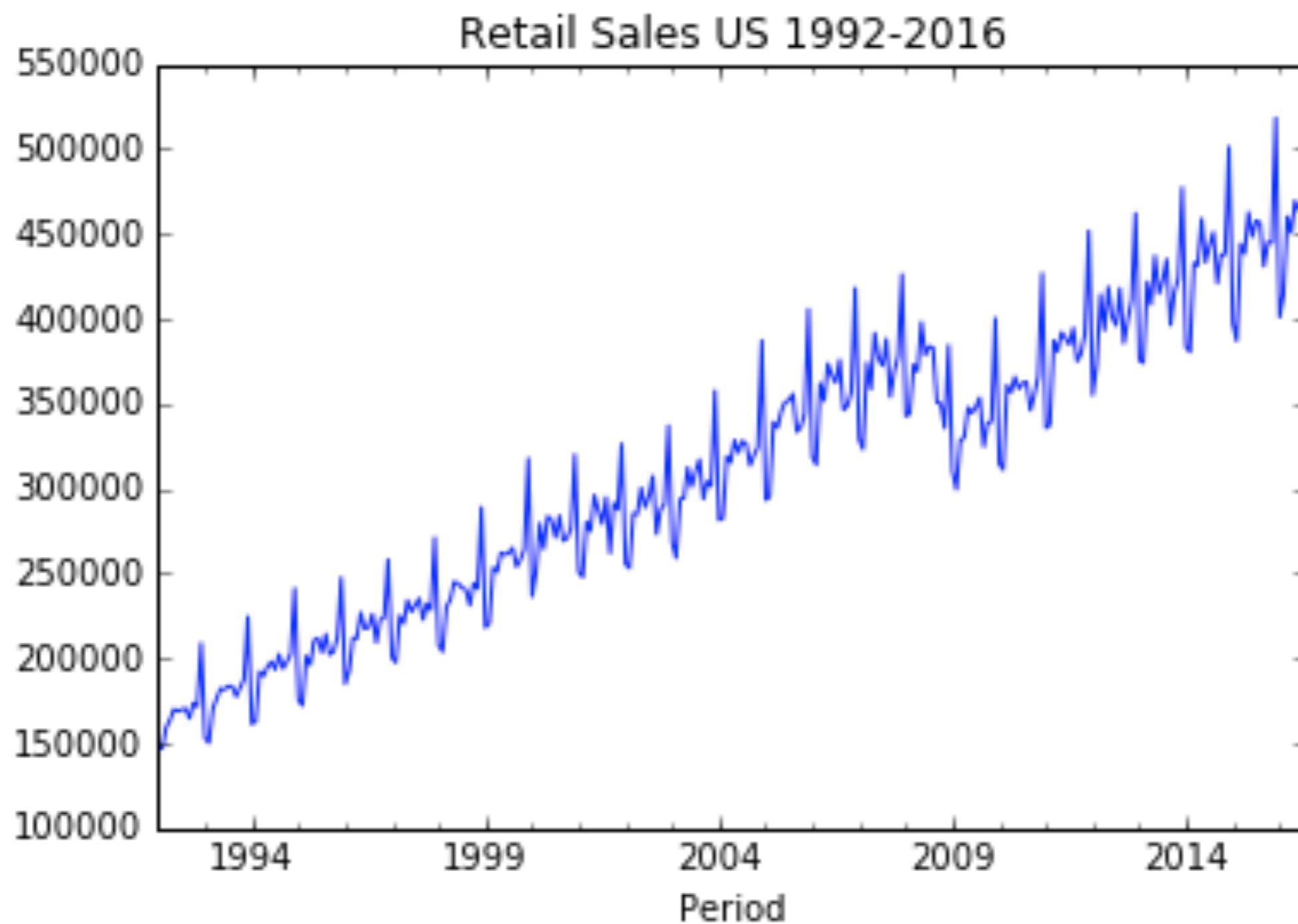
No time-travel cheating!!!!



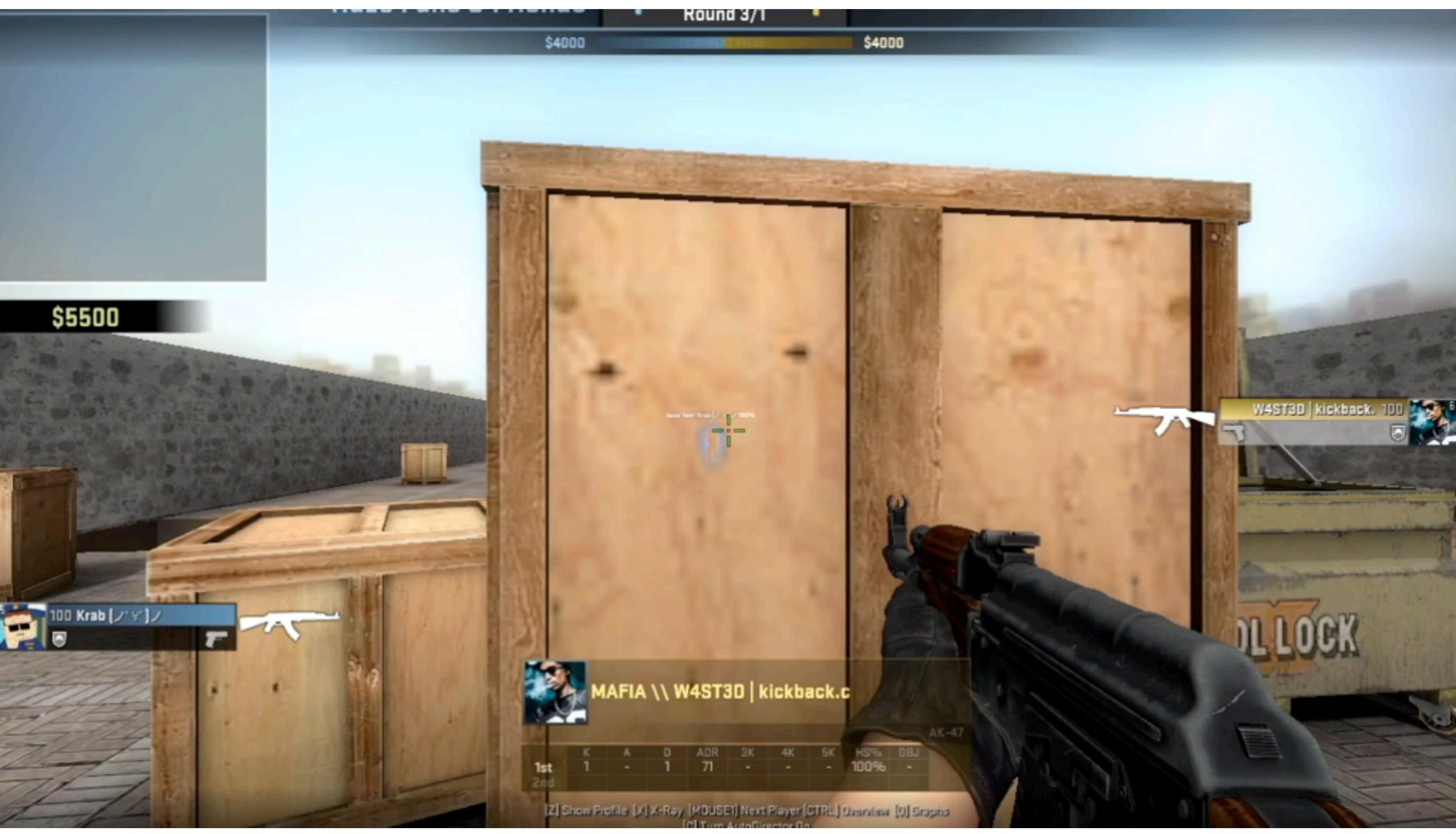
Motivating example 1



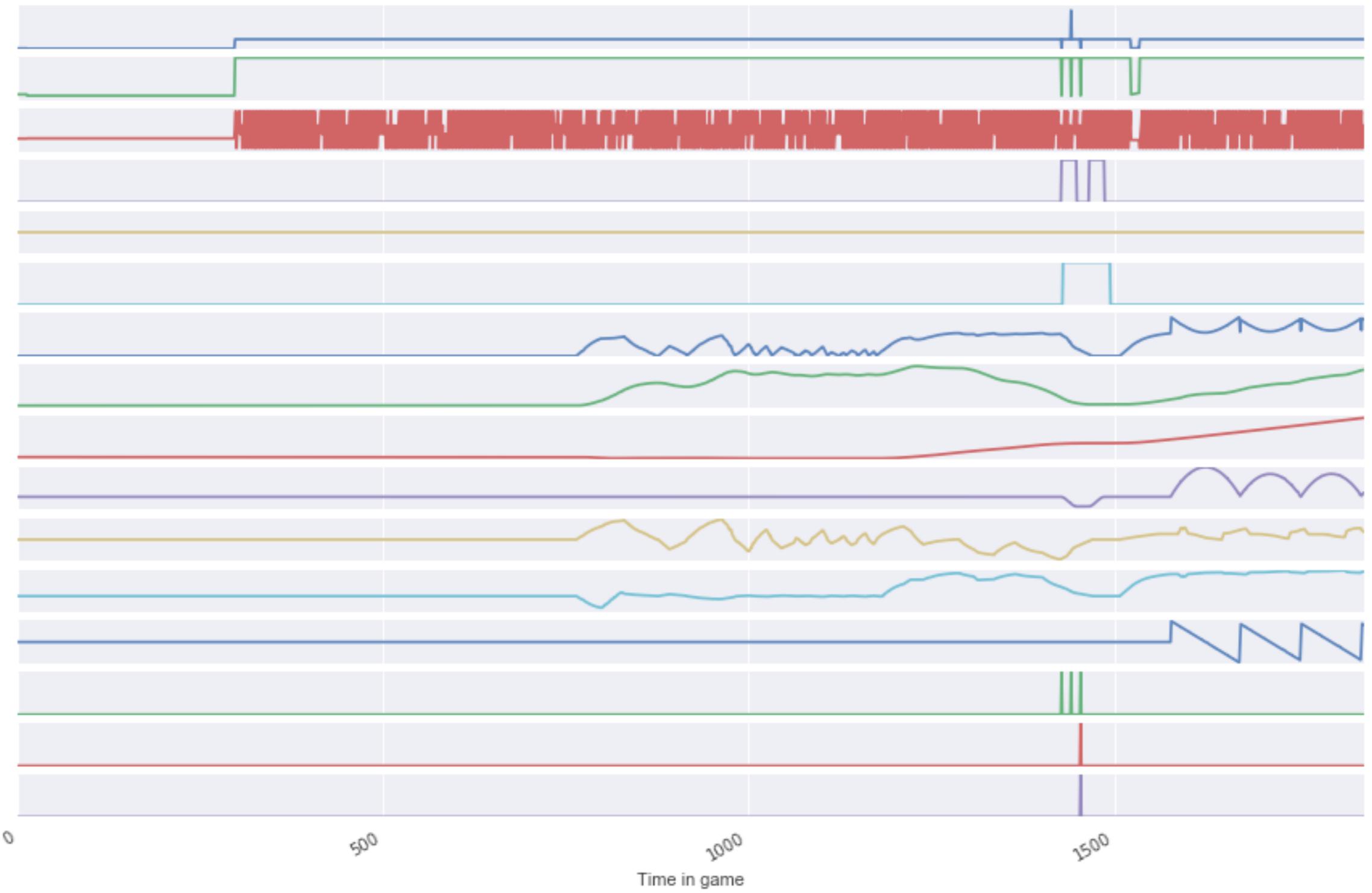
Motivating example



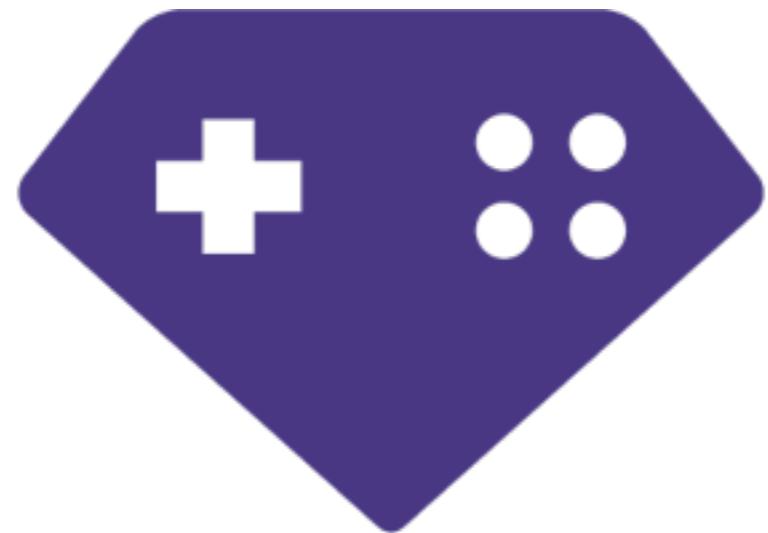
Motivating example 2



Motivating example



Questions?



**MAKE MONEY
PLAYING VIDEOGAMES**

We are hiring!

fra@kickback.com

kickback.com/careers

