Predicting the onset of fever from High-frequency Physiologic waveform data

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Background

- Definition: Body Temperature >= 38
- Diagnosis of fever is a major challenging task to the physician which often remains undiagnosed and delays the treatment.
- Monitoring of the fever can provide valuable information for diagnosis and prognosis of various diseases.
- Solving the effectiveness of treatments and expediting the treatment process.

Background

- Predicting dengue fever using CNN and Regression models on DengAI: Predicting Disease Spread data (existing work)
  - Surrounding data is used i.e. data included the number of cases in each location, temperature of the surrounding, precipitation, humidity, vegetation and the time of the year the data was collected

- We are using different regression methods in our model and looking at the data retrospectively to predict the onset of fever.
  - Filtering out the data in such a way that we only take the data before the event(s) of the fever

Problem Statement

Predicting the onset of fever in ICU patients using high frequency physiologic sensor data using machine learning regression methods

Dataset

- High frequency physiologic ICU sensor data
- Number of patients: 722
- Number of observations: ~5.46 million
- Number of physiologic variables: 35
  - Respiratory Rate
  - Blood Pressures
  - ECG probes
  - CO2
  - Temperature
  - Date

Data Pre-processing

- Data Availability (subsetting dataset and only taking variable having >= 90% data)
  - Seven variables

- If missing data in the variable then do forward fill

Experimental Design

For cases:

1. Identify a fever episode temp >= 38
2. Look up to 6 hours back from fever event and use the data
3. Calculate the delta (FeverTime-RecordedDateTime)
4. Extract signal processing features from 6 hour window and use delta from fever as y
5. If a patient had multiple fever episodes during their stay, treat each episode as independent if there is atleast a 24h gap between them

Experimental Design contd.

For Controls:

1. Identify patients who never had any temperature over 38 or under 34 degrees Celsius

2. Create a Random Fever Time

3. Calculate the delta (random FeverTime-RecordedDateTime)

4. Randomly select a 6 hour window data

5. Extract signal processing features from the 6 hour window
   a. Set all y to a random time

Build regression models

Progress so far..

- Created multiple fever events for each patients
- Selected data by going 6 hours back from Fever Event
- Selected 7 of the 35 variables due to data availability (>90%)
  - Blood pressures, resp rate, pulse, ECG
- Number of all fever events (cases): 16,093
- Number of controls : 112 (from 722 patients)

Identification of Signal Processing features from physiologic variables

Feature extraction and feature selection using tsfresh

- 6,352 features were selected

Conclusion and Future Work

- Identified signal processing features that discriminate between fever patients and controls.
- Regression model

Hurdles

- Large volume of data, in the order of million data points
- Memory Error

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Thank you!

Extra Slides..

35 Variables

'MDC_CO2_RESP_RATE', 'MDC_CONC_AWAY_CO2_ET',
'MDC_CONC_AWAY_CO2_INSP', 'MDC_ECG_AMPL_ST_AVF', 'MDC_ECG_AMPL_ST_AVL',
'MDC_ECG_AMPL_ST_AVR', 'MDC_ECG_AMPL_ST_I', 'MDC_ECG_AMPL_ST_II',
'MDC_ECG_AMPL_ST_III', 'MDC_ECG_AMPL_ST_V', 'MDC_ECG_CARD_BEAT_RATE',
'MDC_ECG_PACED_BEAT_RATE', 'MDC_ECG_V_P_C_RATE',
'MDC_PRESS_BLD_ART_DIA', 'MDC_PRESS_BLD_ART_MEAN',
'MDC_PRESS_BLD_ART_PULM_DIA', 'MDC_PRESS_BLD_ART_PULM_MEAN',
'MDC_PRESS_BLD_ART_PULM_SYS', 'MDC_PRESS_BLD_ART_SYS',
'MDC_PRESS_BLD_ATR_LEFT_MEAN', 'MDC_PRESS_BLD_DIA',
'MDC_PRESS_BLD_MEAN', 'MDC_PRESS_BLD_SYS',
'MDC_PRESS_BLD_VEN_CENT_MEAN', 'MDC_PRESS_CEREB_PERF',
'MDC_PRESS_CUFF_DIA', 'MDC_PRESS_CUFF_MEAN', 'MDC_PRESS_CUFF_SYS',
'MDC_PRESS_INTRA_CRAN_MEAN', 'MDC_PULS_OXIM_PULS_RATE',
'MDC_PULS_OXIM_SAT_O2', 'MDC_TEMP', 'MDC_TTHOR_RESP_RATE'

Selected 7 variables

7 Variables

MDC_PRESS_CUFF_SYS
MDC_PRESS_CUFF_MEAN
MDC_PRESS_CUFF_DIA
MDC_PULS_OXIM_SAT_O2
MDC_PULS_OXIM_PULS_RATE
MDC_ECG_CARD_BEAT_RATE
MDC_TTHOR_RESP_RATE