Activity Classification Using Android Phone Sensors

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Motivation

- Reminder of last parking spot
- Medical monitoring
- Automatic actions based on activity
  - Automatically switch to driving mode

Project Goal

I know what you did last summer

Create an Android application that uses the phone's sensors to determine human activity in real time.

Background

Smartphones

- Processing power
- Sensors
  - Accelerometer
  - Gyroscope (orientation)

50Hz
3-axis

Challenges

Algorithmic

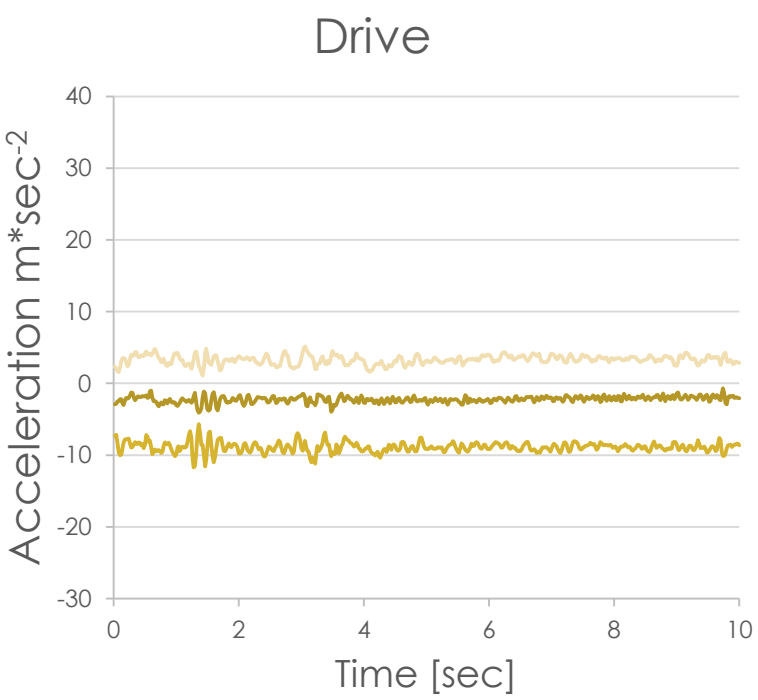
- Noisy signal
- Performance

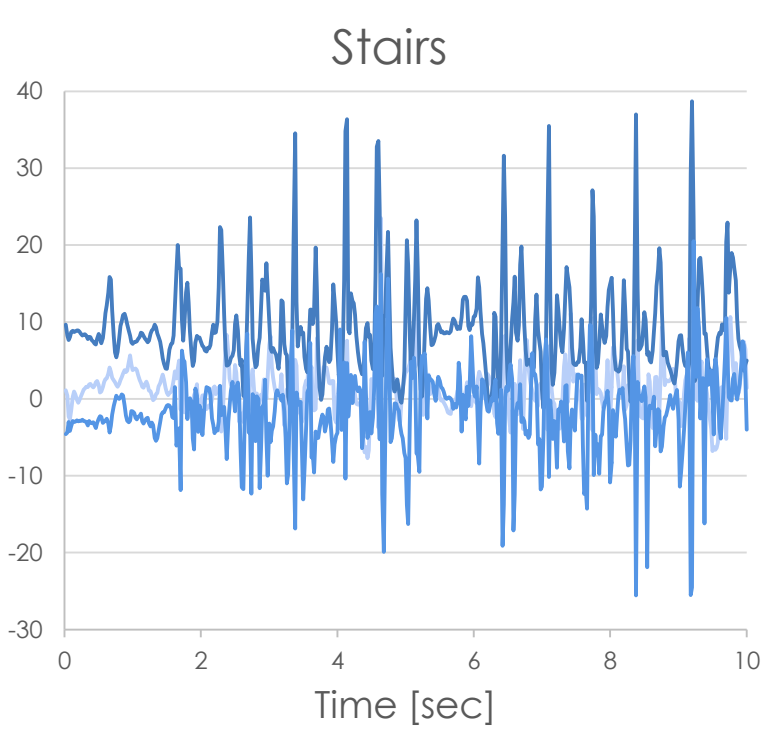
Implementation

- Concurrency
- Battery drain

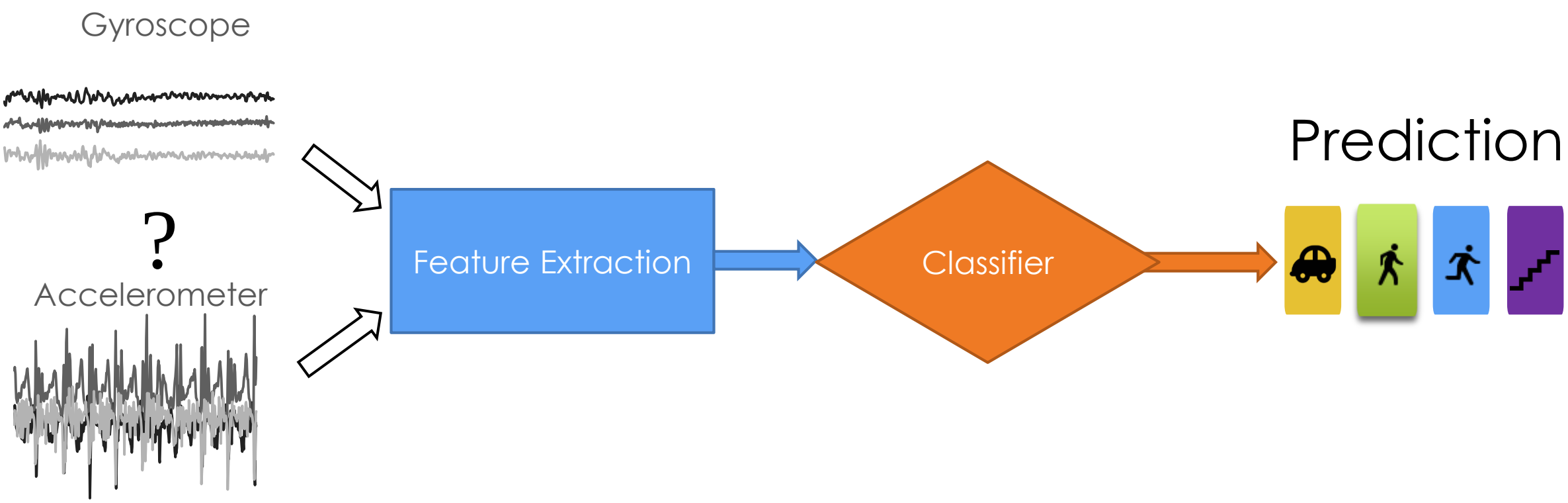
Preparing for Demo

Raw Data - Accelerometer

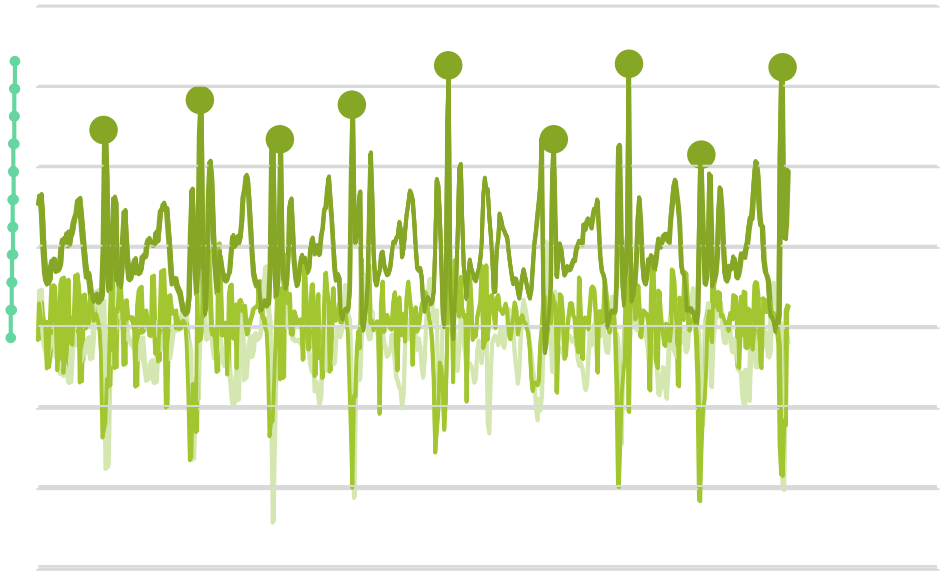




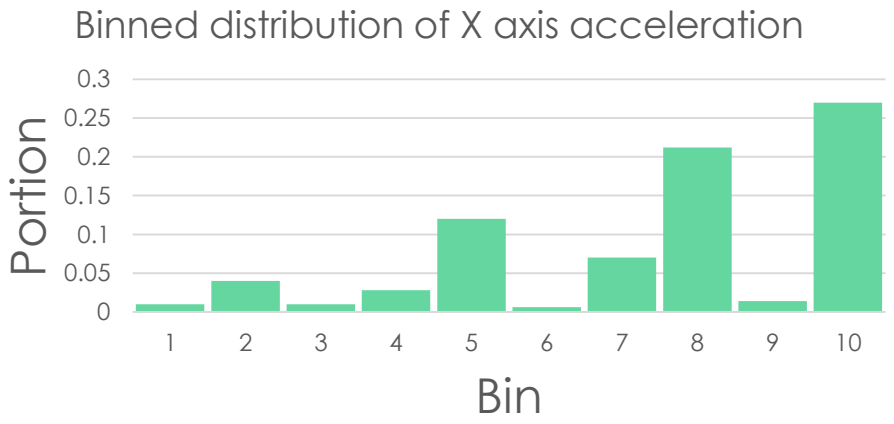
Process Overview



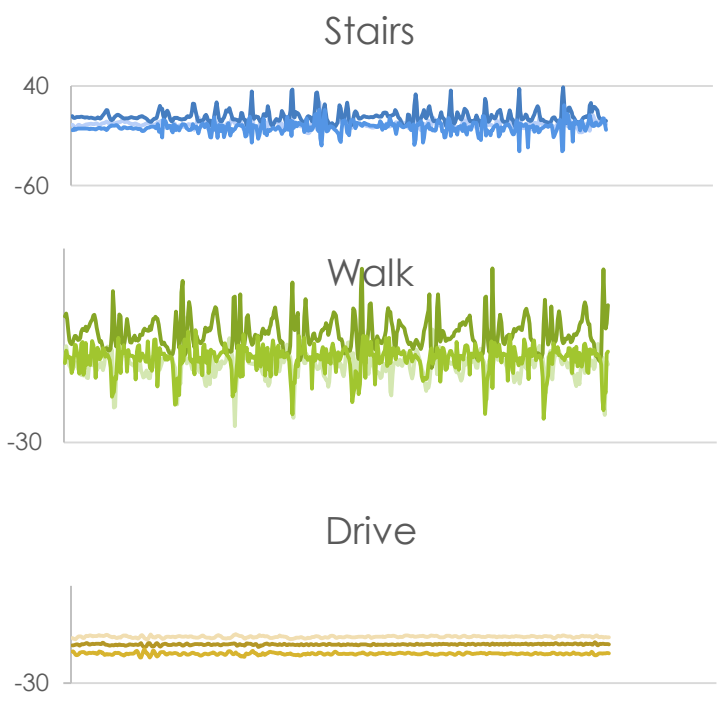
Feature Extraction

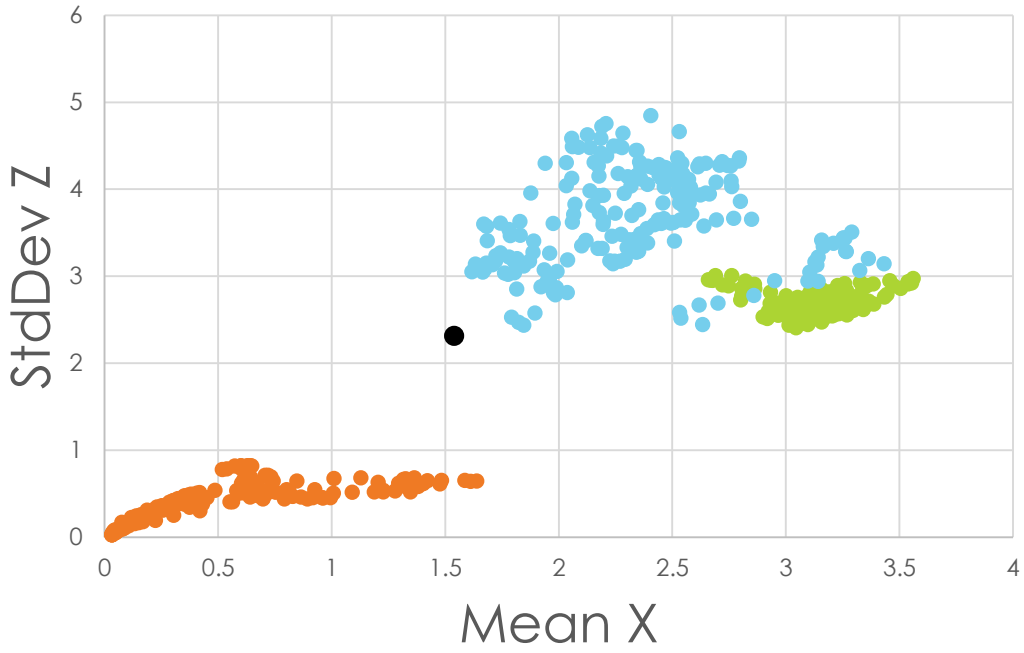


- average acceleration
- standard deviation
- peak distance
- binned distribution



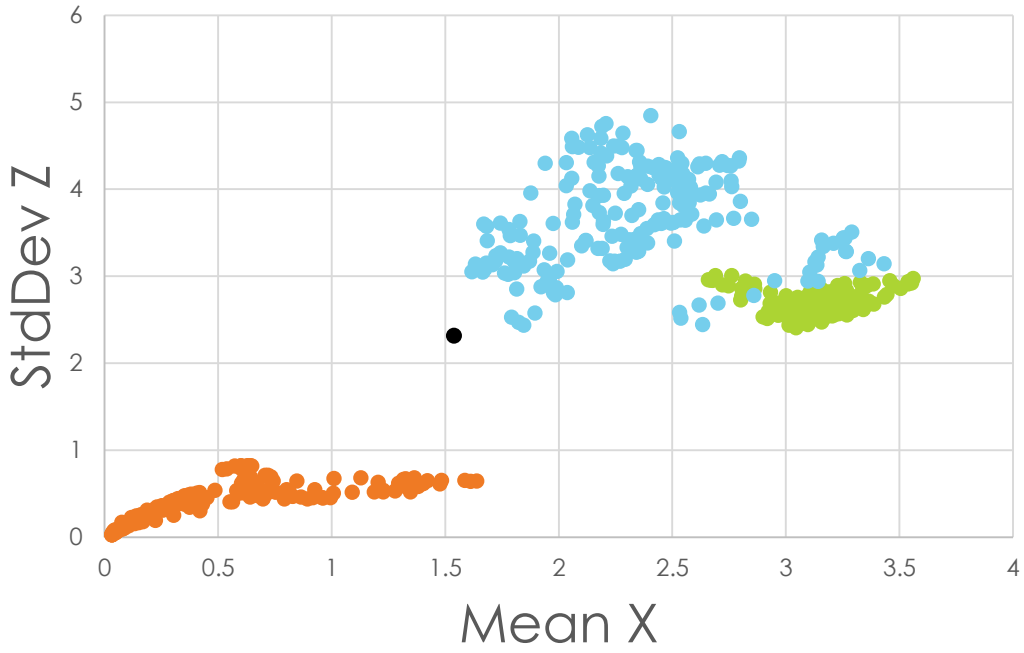
Feature Extraction





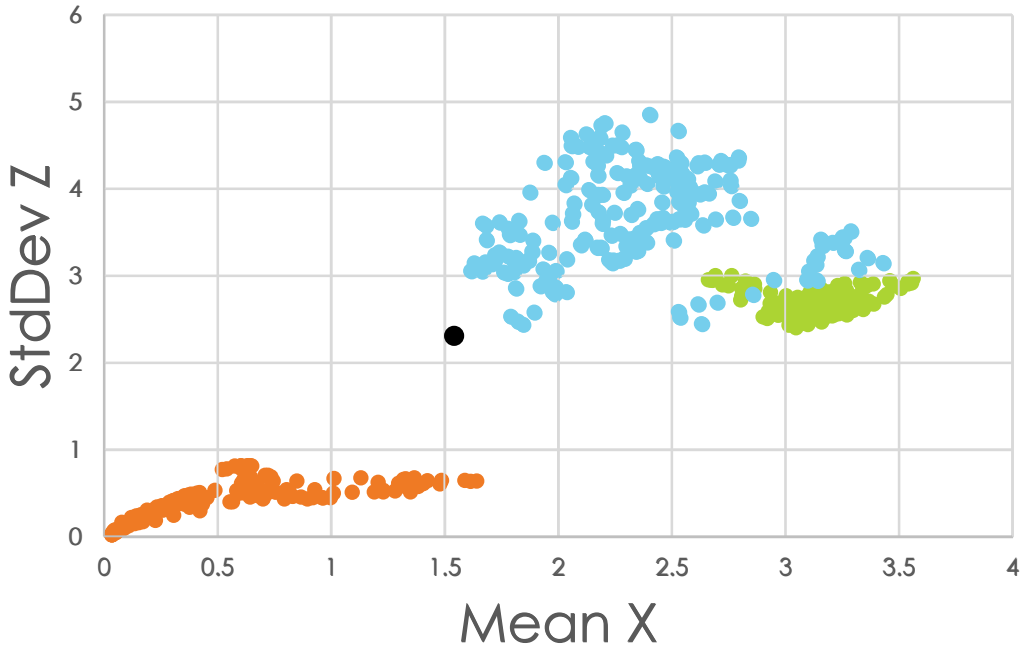
Classification

- Goal: prior data + feature vector = prediction
- Our classifier: Naïve Bayes
  - Quick
  - Small training set
  - Handles overlapping

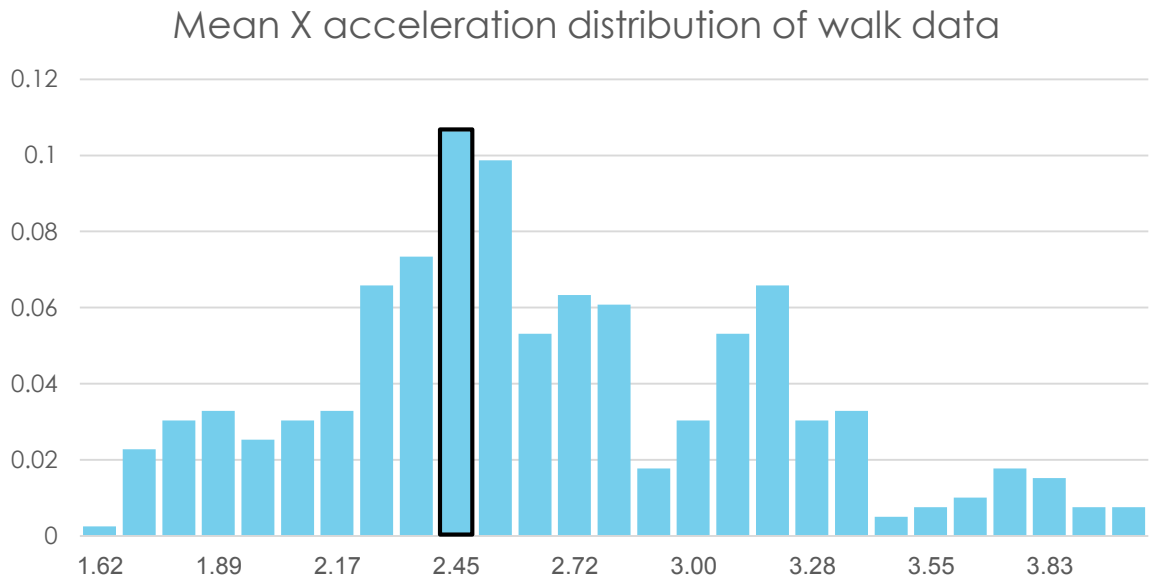


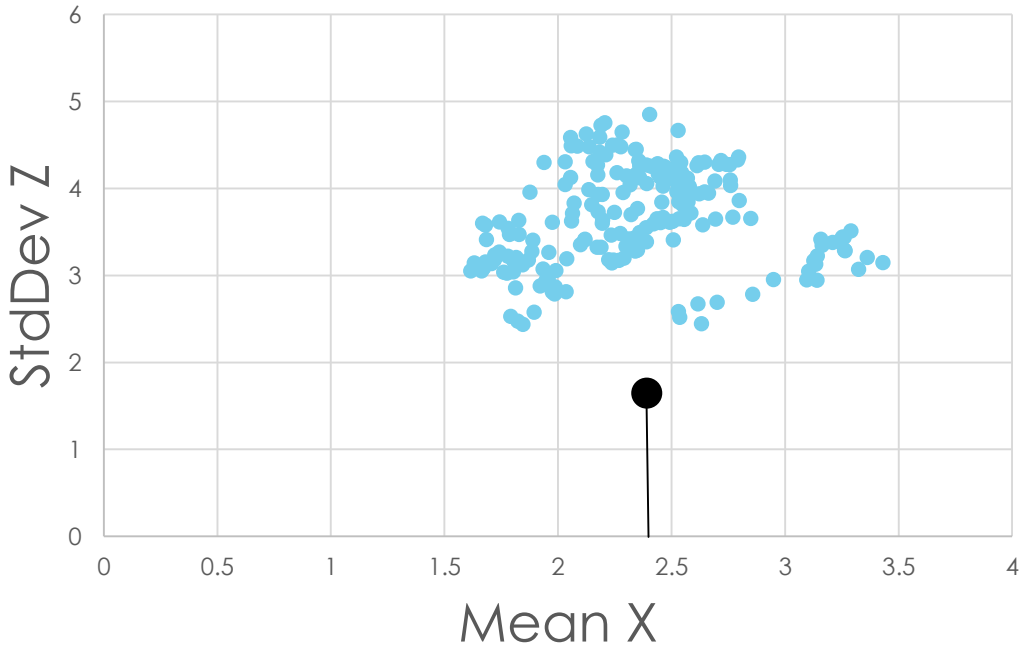
Classifiers – Naïve Bayes

- Return most likely class, c, given a feature vector, $\vec{f}$.
- Assumption: features are independent.
- $P(c_i|\vec{f}) = P(c_i)P(\vec{f}|c_i) = P(c_i)\prod_{j=1}^{n} P(f_j|c_i)$



Classifiers – Naïve Bayes





Mean: 2.61
Std. dev.: 0.51

$$P(f_j|c_i)$$

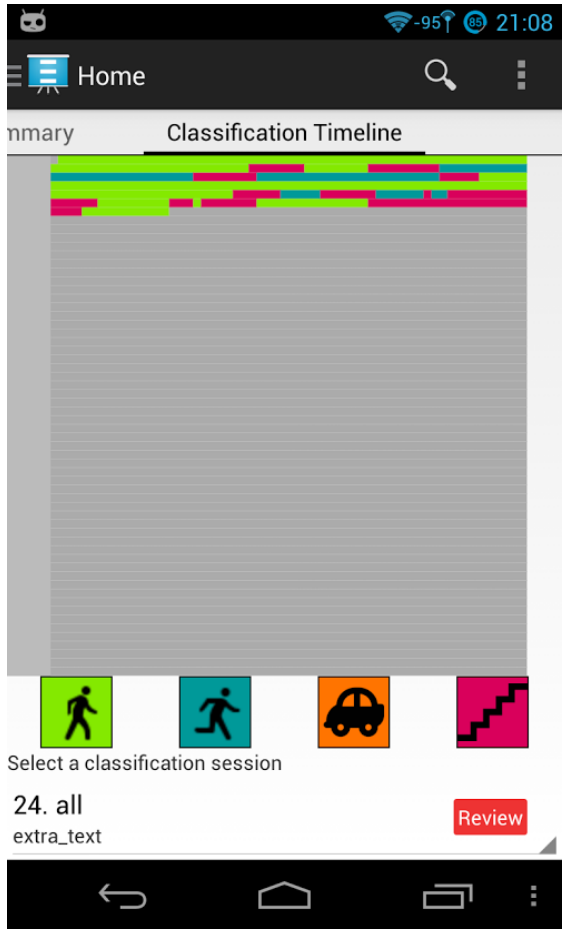
Classifiers – Naïve Bayes

$$P(c_i|\vec{f}) = P(c_i)\prod_{j=1}^{n} P(f_j|c_i)$$

$$classify(f_1, \dots, f_n) = \underset{c_i}{\operatorname{argmax}}\, P(C = c_i)\prod_{j=1}^{n} P(F_j = f_j|C = c_i)$$

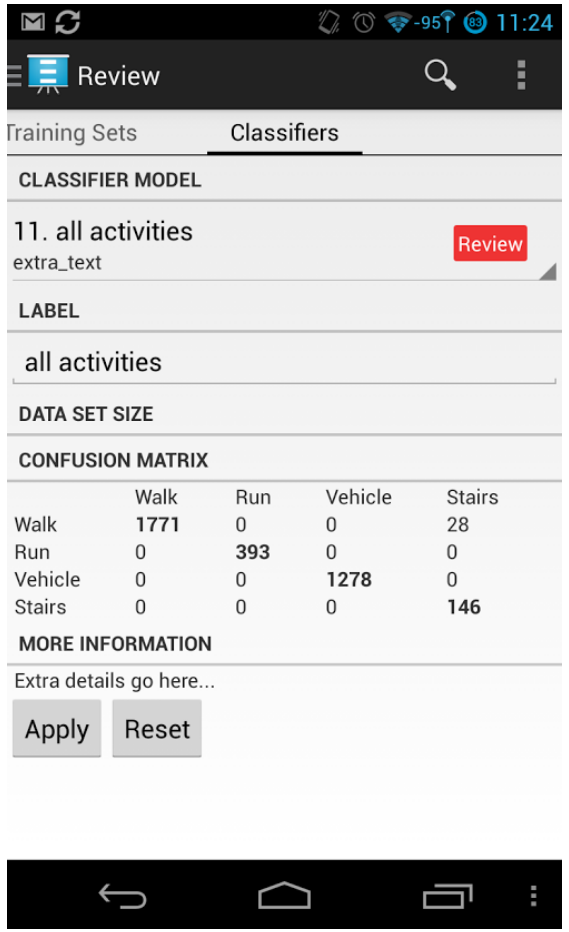
Android Implementation

- Used a Machine learning lib called *Weka*.
- Used services that run in separate threads.
- Asynchronous communication with the UI.
- UI design and implementation takes a lot of time.



Results and conclusion

- We created an application that determine human activity in real time using the phone's sensors.
- Typical accuracy – 94~96%.
- Sometimes confuses between stairs and walk.



Future suggestions

- More extensive training set
- More features
- Use more sensors
- Add activities
- Try other classifiers

Demo time