CLASSIFICATION OF SMARTWATCH MOTION USING MACHINE LEARNING

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Mason LIFE


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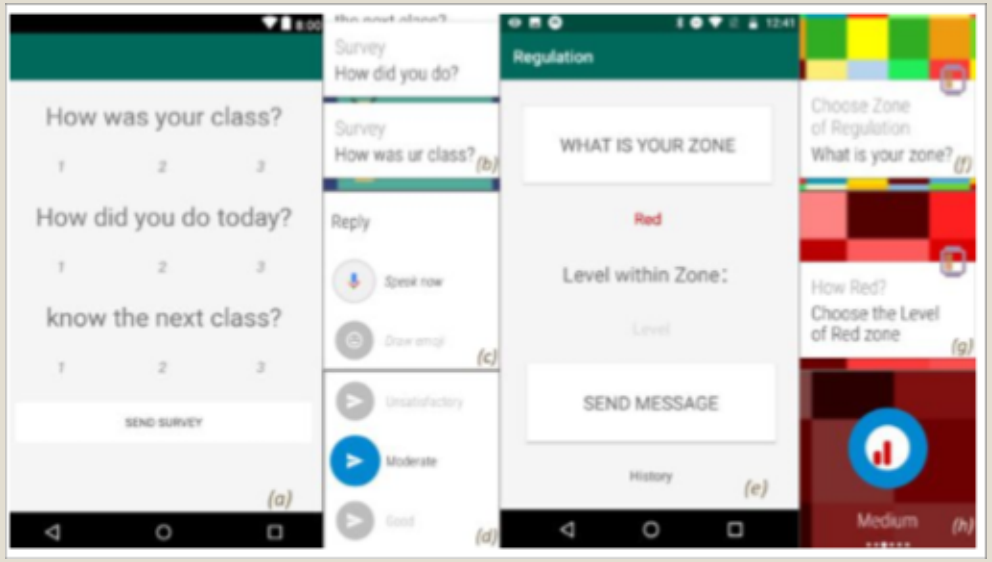
WeLi Application



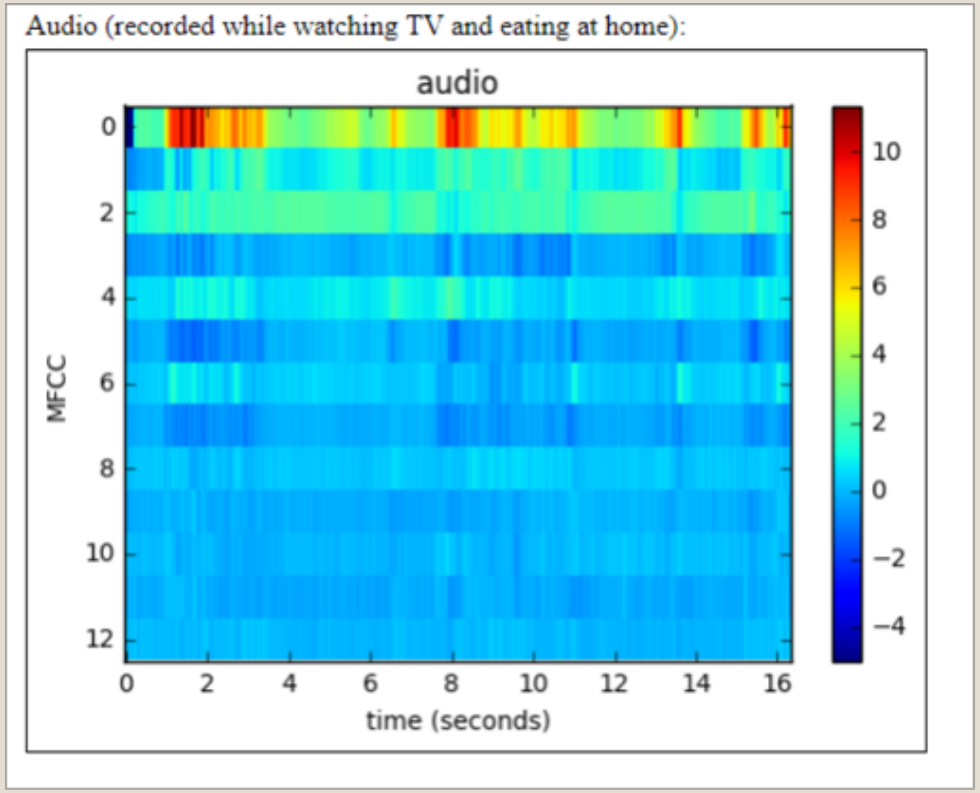
Research Question

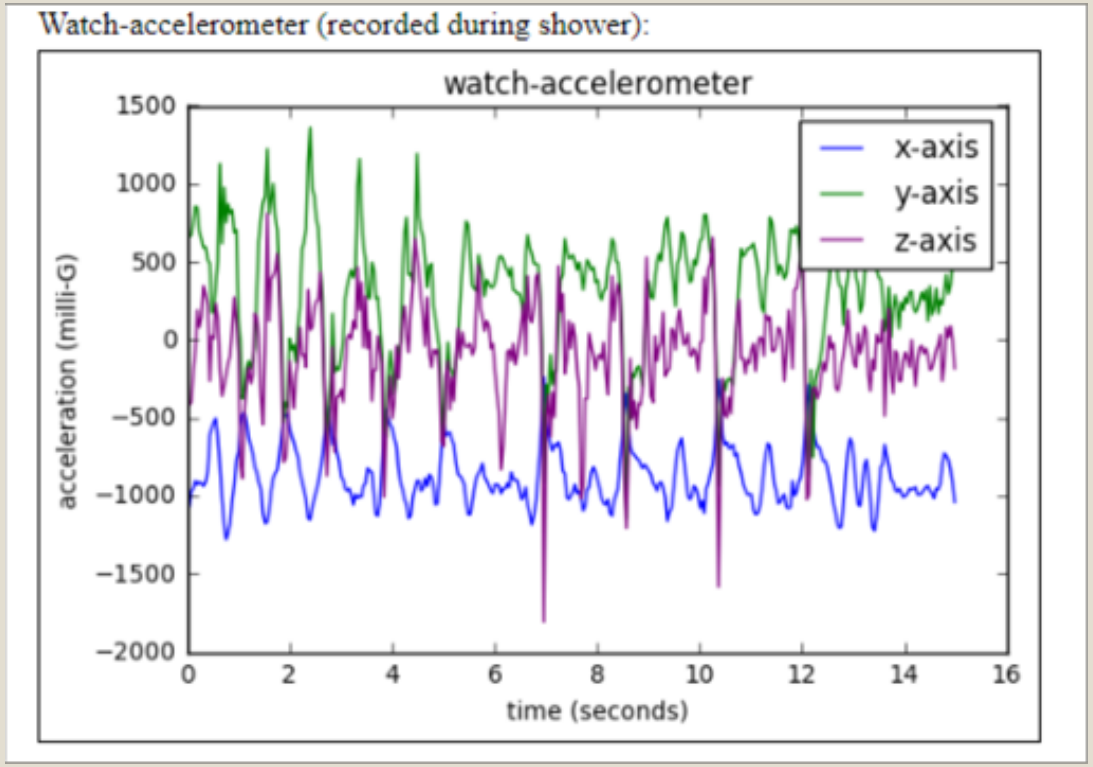
How accurately can a student's behavior be automatically classified based on the available sensors in the devices used in the Wearable LIFE project?

Challenges

- Making dataset reflective
- Missing datapoints/labels
- Tutorial Code

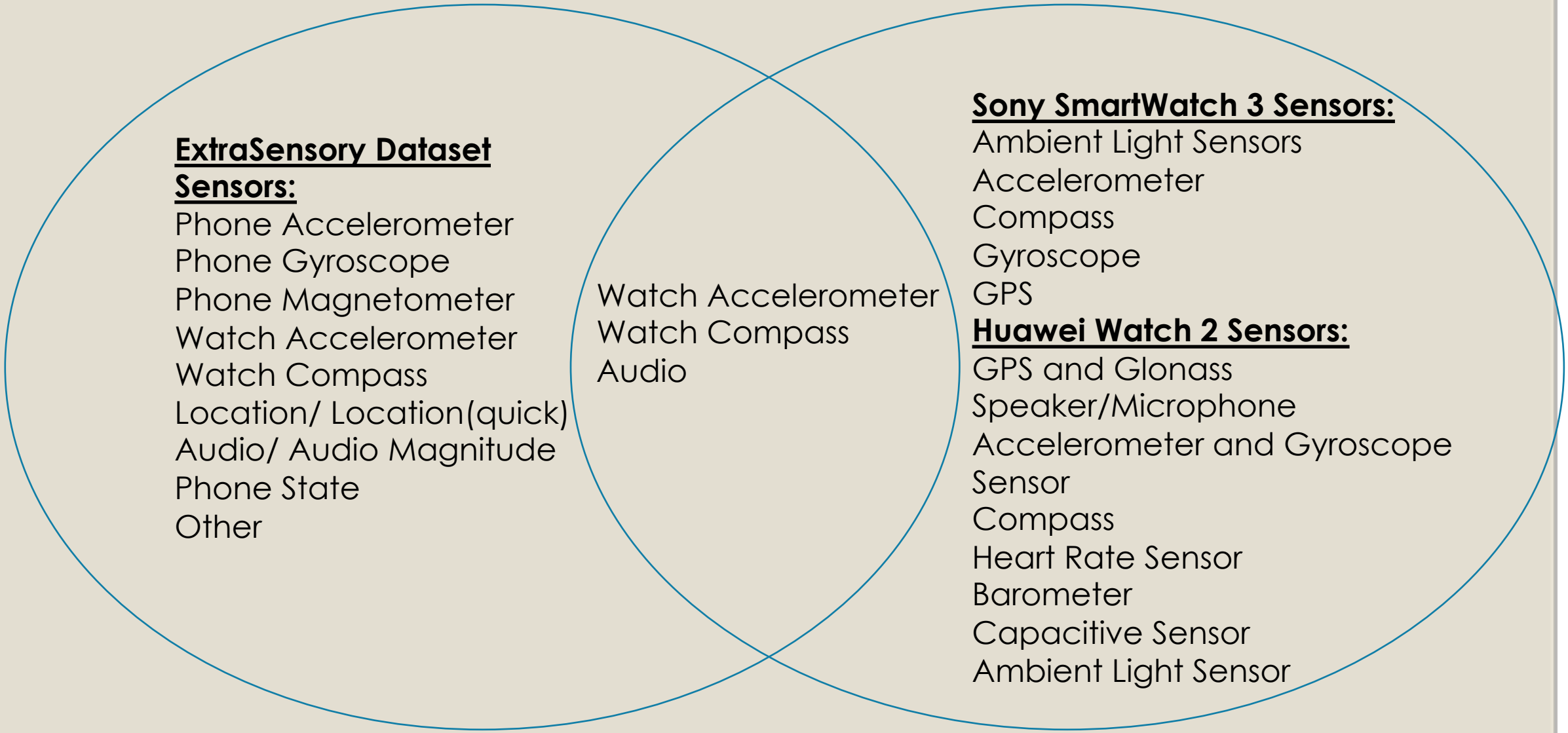
ExtraSensory Dataset Repository





Both graphs taken from the ExtraSensory Dataset: http://extrasensory.ucsd.edu/

Relevant Sensors



Relevant Labels

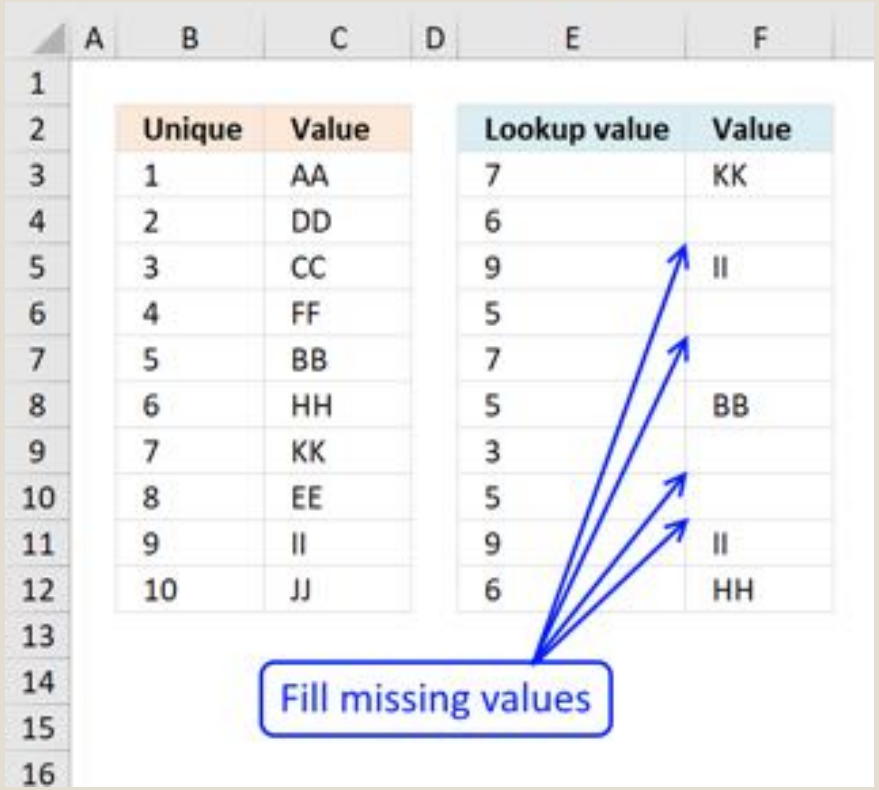
- Lying down
- Sitting
- Walking/Running
- Sleeping
- Watching TV
- Using the Internet
- Doing computer work
- Singing
- Talking
- Eating
- Grooming
- Elevator
- Stairs
- With Friends

```
import numpy as np;
import gzip;
import StringIO;

def parse_header_of_csv(csv_str):
    # Isolate the headline columns:
    headline = csv_str[:csv_str.index('\n')];
    columns = headline.split(',');

    # The first column should be timestamp:
    assert columns[0] == 'timestamp';
    # The last column should be label_source:
    assert columns[-1] == 'label_source';

    # Search for the column of the first label:
    for (ci,col) in enumerate(columns):
        if col.startswith('label:'):
            first_label_ind = ci;
            break;
        pass;

    # Feature columns come after timestamp and before the labels:
    feature_names = columns[1:first_label_ind];
```

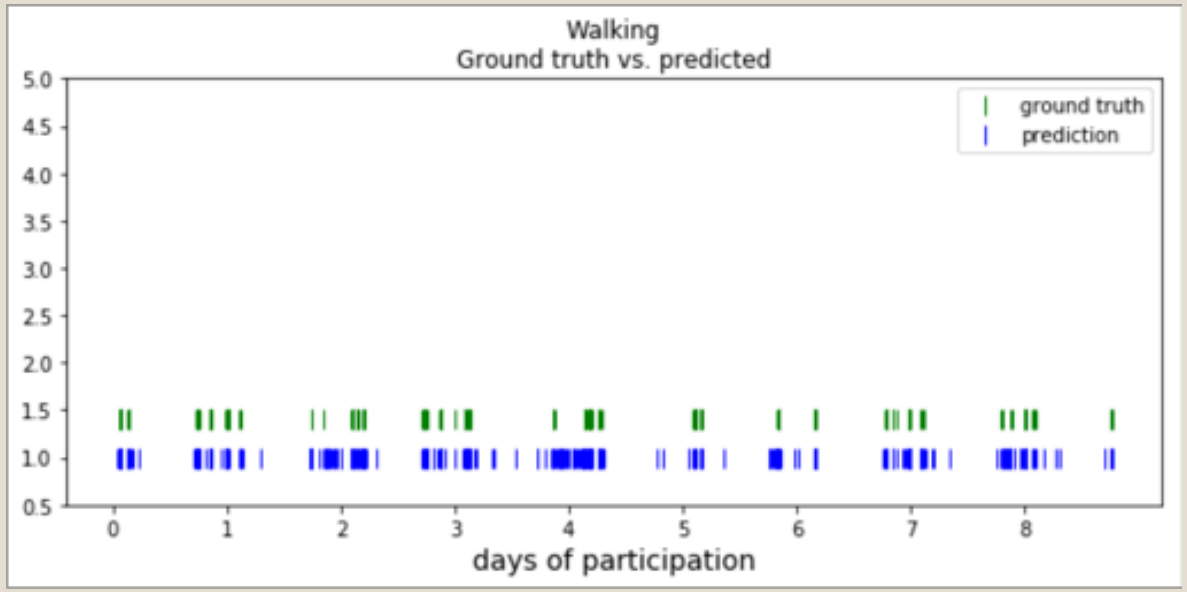
How to Handle Missing Data

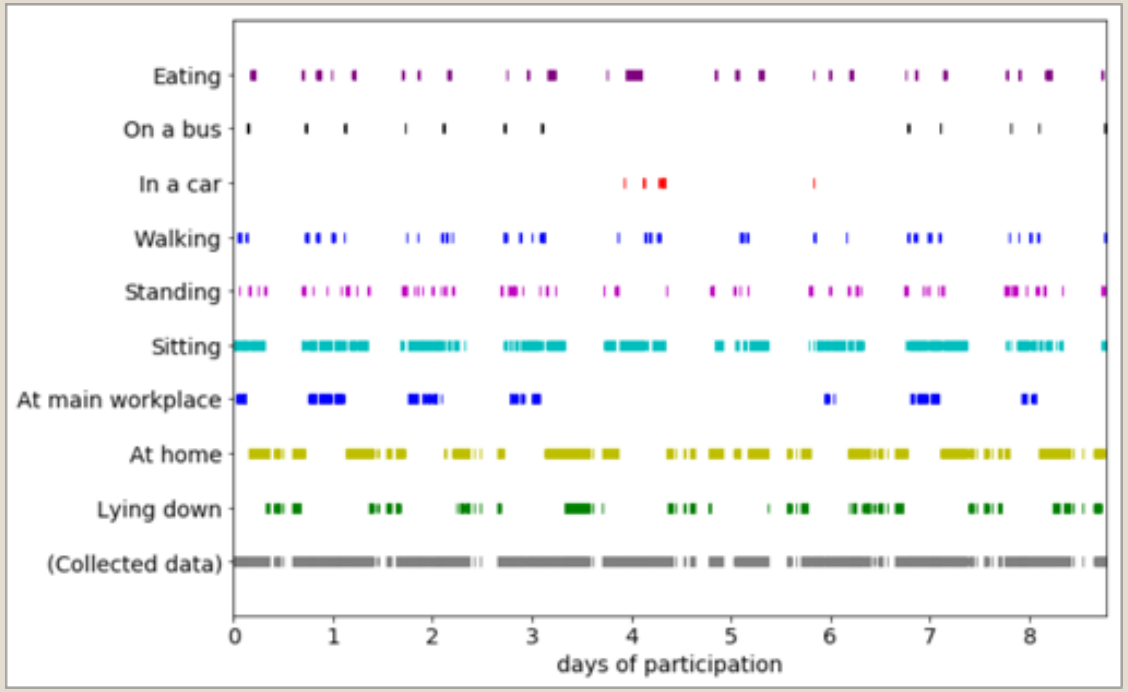
NaN

- Decided keeping missing data points could skew data
- Accuracy and relevancy → Delete missing data points from set



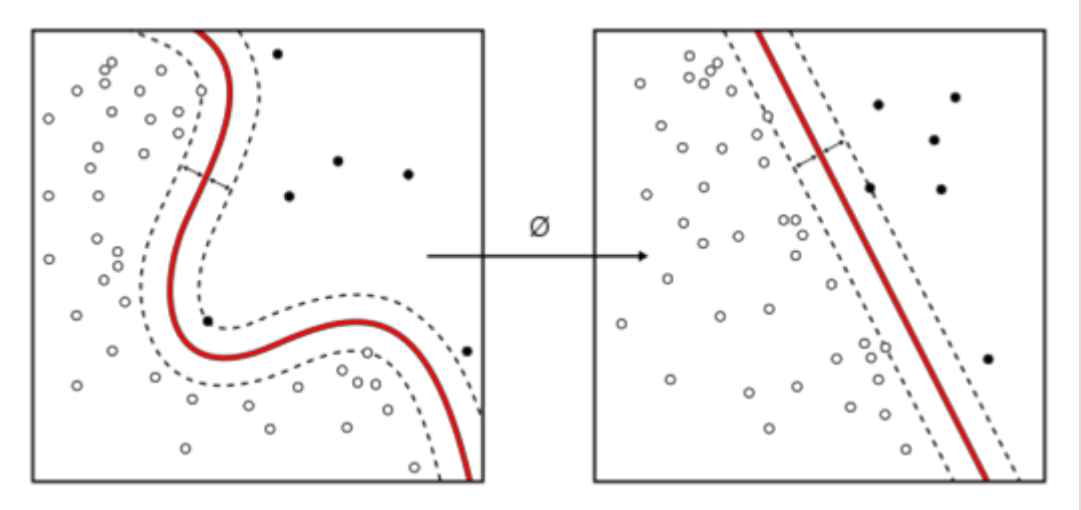
ExtraSensory Dataset Tutorial

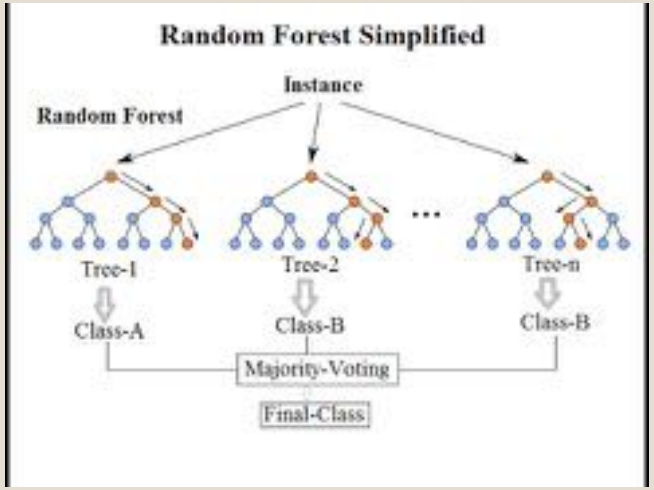


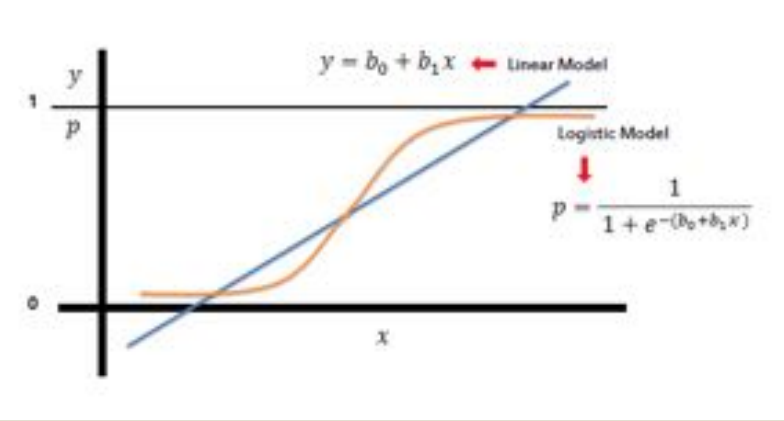


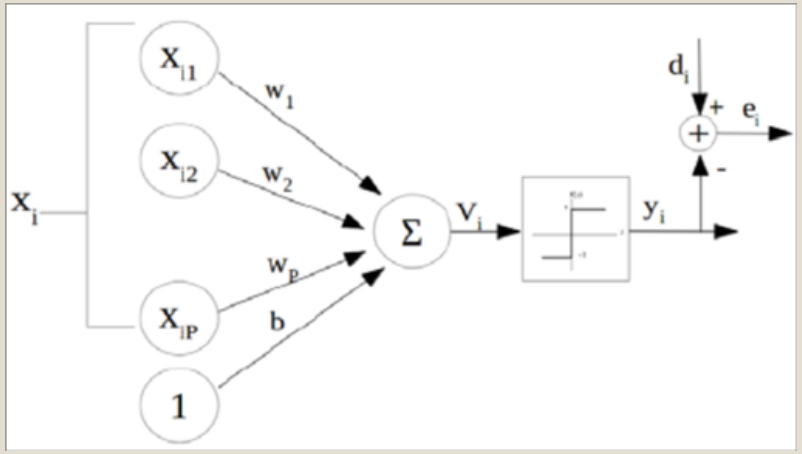
Models

- Random Forest
- Logistic Regression
- Voted perceptron
- Naive Bayes



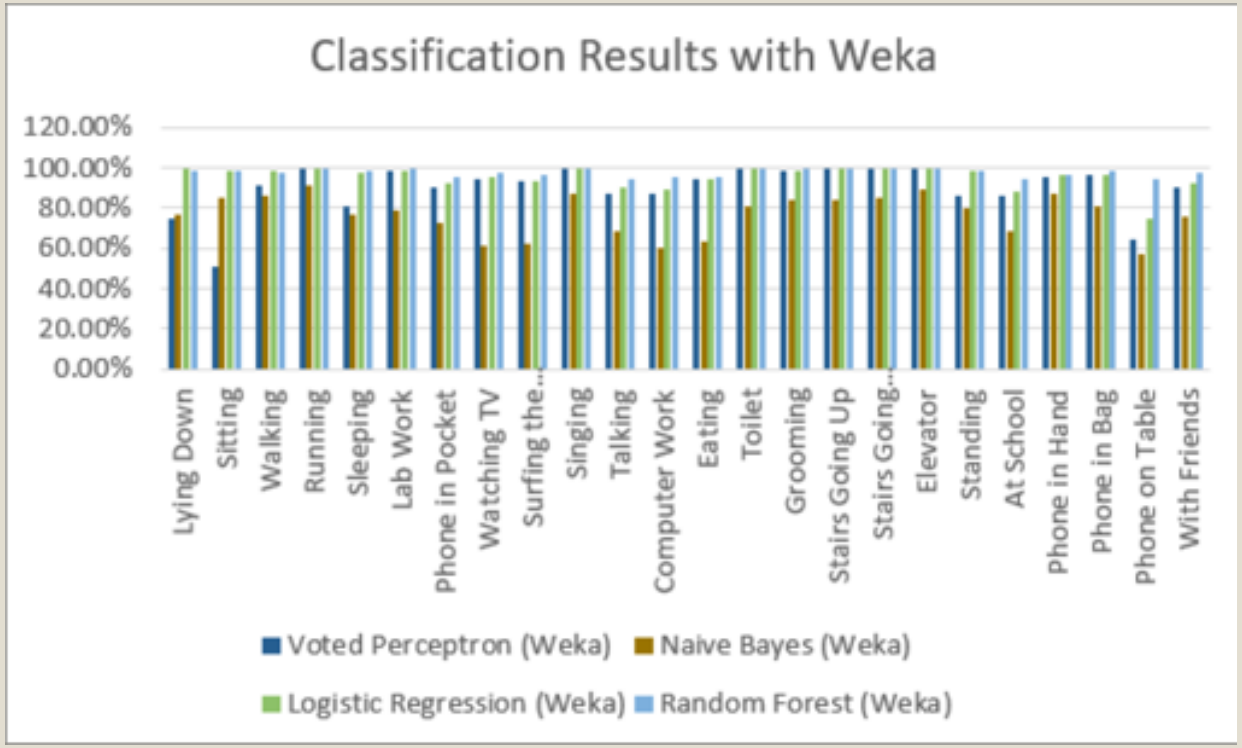






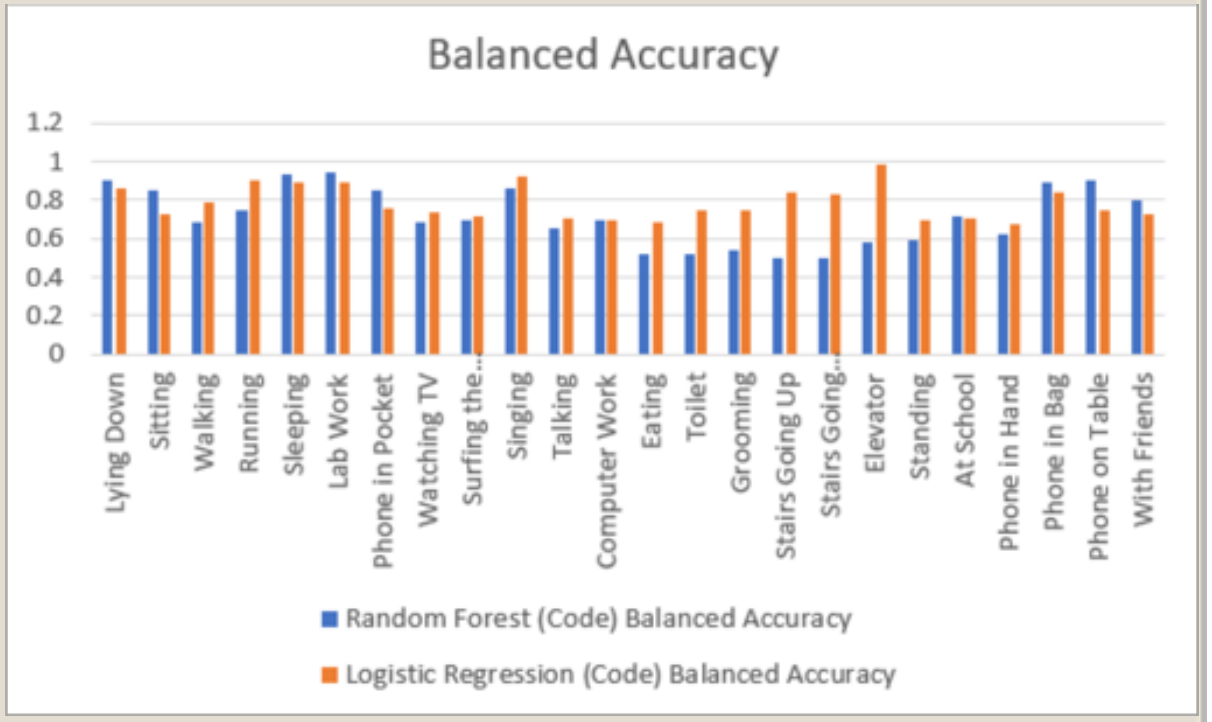
Results (Weka)

	Voted Perceptron (Weka)	Naive Bayes (Weka)	Logistic Regression (Weka)	Random Forest (Weka)
Lying Down	75.01%	76.92%	99.70%	98.87%
Sitting	51.17%	85.16%	98.68%	98.73%
Walking	91.43%	86.14%	98.80%	97.90%
Running	99.45%	91.77%	99.85%	99.73%
Sleeping	80.61%	77.12%	97.18%	98.78%
Lab Work	98.18%	78.96%	99.03%	99.40%
Phone in Pocket	90.59%	73.15%	92.30%	95.53%
Watching TV	94.31%	61.23%	94.99%	97.02%
Surfing the Internet	93.09%	62.72%	93.48%	96.95%
Singing	99.87%	87.04%	99.92%	99.91%
Talking	86.70%	68.75%	90.77%	94.19%
Computer Work	87.40%	60.46%	89.52%	95.36%
Eating	94.03%	63.76%	94.07%	95.18%
Toilet	99.20%	80.53%	99.20%	99.31%
Grooming	98.85%	83.66%	98.83%	99.08%
Stairs Going Up	99.73%	83.57%	99.89%	99.85%
Stairs Going Down	99.74%	85.14%	99.91%	99.85%
Elevator	99.97%	89.01%	99.94%	99.98%
Standing	85.75%	79.49%	98.78%	98.51%
At School	86.21%	68.49%	87.79%	94.14%
Phone in Hand	95.89%	87.08%	96.04%	96.80%
Phone in Bag	96.49%	81.32%	96.62%	98.09%
Phone on Table	64.25%	57.59%	74.62%	93.90%
With Friends	90.31%	75.54%	92.41%	97.19%



Results (Code)

	Logistic Regression (Code)			Random Forest (Code)		
	Precision	Accuracy	Balanced Accuracy	Precision	Accuracy	Balanced Accuracy
Lying Down	0.66	0.85	0.86	0.95	0.94	0.9
Sitting	0.71	0.73	0.73	0.81	0.85	0.85
Walking	0.27	0.8	0.79	0.81	0.94	0.68
Running	0.09	0.9	0.9	0.97	0.99	0.75
Sleeping	0.64	0.87	0.89	0.96	0.97	0.93
Lab Work	0.48	0.87	0.89	0.98	0.98	0.94
Phone in Pocket	0.45	0.76	0.76	0.97	0.93	0.85
Watching TV	0.21	0.73	0.74	0.98	0.94	0.68
Surfing the Internet	0.23	0.7	0.72	0.94	0.93	0.7
Singing	0.18	0.92	0.92	1	1	0.86
Talking	0.29	0.69	0.71	0.95	0.89	0.65
Computer Work	0.3	0.69	0.7	0.96	0.9	0.7
Eating	0.12	0.67	0.69	0.98	0.94	0.52
Toilet	0.03	0.74	0.75	0.94	0.99	0.52
Grooming	0.05	0.75	0.75	1	0.98	0.54
Stairs Going Up	0.04	0.82	0.84	1	0.99	0.5
Stairs Going Down	0.04	0.82	0.83	1	0.99	0.5
Elevator	0.06	0.98	0.99	1	1	0.58
Standing	0.28	0.71	0.7	0.95	0.88	0.59
At School	0.33	0.71	0.71	0.98	0.9	0.72
Phone in Hand	0.17	0.69	0.67	0.99	0.93	0.62
Phone in Bag	0.41	0.85	0.84	0.99	0.97	0.89
Phone on Table	0.86	0.76	0.75	0.92	0.92	0.9
With Friends	0.36	0.72	0.73	0.95	0.93	0.8



Future Work

- Collect more data to test models
- Map specific motions to interventions
- Incorporate model into WeLi application

Acknowledgements

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Pictures found at:

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