3rd Year Project Final Report
SleepAppnea

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March 20, 2014

Abstract

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1 Introduction

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2 Medical Information

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3 Rationale

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4 The app

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5 Design Process

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5.1 Questionnaire selection

5.2 Signal Analysis - simple method

5.3 Machine Learning – Theory

Machine learning, a branch of artificial intelligence, concerns the construction and study of systems that can learn from data [2]. The supervised classification problem in machine learning concerns finding the unknown target function that classifies certain input data into classes based on some set of training examples containing labelled input data.

In our case, given a sampled sound signal of a sleeper, we want to identify apnoea periods. In particular, we represent our input (sampled sound signal) as $\{s_i\}_{i=1}^{T}$, and we want to output the classifiers for every K samples, $\{y_i\}_{i=1}^{T^*}$, where the classifier $y_i \in \{0, 1\}$ corresponds to samples $\{s_j\}_{j=(i-1)K+1}^{iK}$ of the signal (we note that $T^* = \lfloor \frac{T}{K} \rfloor$).

We have researched three models for our problem which we will discuss in this section. Firstly, we will discuss Support Vector Machines which are one of the most widely used algorithms in Machine Learning today, then we will discuss the State-Space and Hidden Markov Models, which might be more well-suited to our problem due to their temporal nature.

5.3.1 Support Vector Machines

Here, we present the theory for Support Vector Machines (SVMs) based on the lecture notes from Prof. Andrew Ng [1]. SVMs are one of the most widely used and many argue among the best "off-the-shelf" supervised learning algorithms. This is mainly due to the sound theoretical framework, efficiency and good generalisation guarantees even for high-dimensional and linearly non-separable data.

Notation Having m training examples, where

- $\mathbf{x}^{(i)} \in \mathbb{R}^d$ is the d-dimensional i-th training data.
- $y^{(i)} \in \{-1, 1\}$ is the i-th training label.

we want to find the parameters $\mathbf{w} \in \mathbb{R}^d$ which describe the hyperplane $\mathbf{w}^T\mathbf{x} + b = 0$ that separates our two classes. Thus, we can define our classifier as $h_{\mathbf{w},b}(\mathbf{x}) = g\left(\mathbf{w}^T\mathbf{x}\right)$, such that $g(z) = 1$ if $z \geq 0$ and $g(z) = -1$ otherwise. Note that this is a non-probabilistic learning model as we are not considering the probability of each class or the data.

Objectives The main intuition behind SVMs is that

5.3.2 State-Space Models

5.3.3 Hidden Markov Models

5.3.4 Dimensionality Reduction

Spectrograms sdffasdf

Principal Components Analysis fdsafasd

5.4 Machine Learning - Experiments

5.5 Android

6 Conclusion

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References

[1] Andrew Ng. Cs229 - lecture notes. Course website, 2013.

[2] Wikipedia. Machine learning — Wikipedia, the free encyclopedia, 2014. [Online; accessed 18-March-2014].