# Cardiff School of Computer Science & Informatics

## One semester individual project
### Initial plan
### 40 Credits

# Machine translation of guitar audio

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February 3, 2014

# 1  Introduction

Musical transcription requires trying to discern information such as individual notes and their timings from a piece of recorded music, this is often a laborious process for musicians and instrumentalists and normally requires a large amount of experience (although this will vary depending on the complexity of the piece of music).
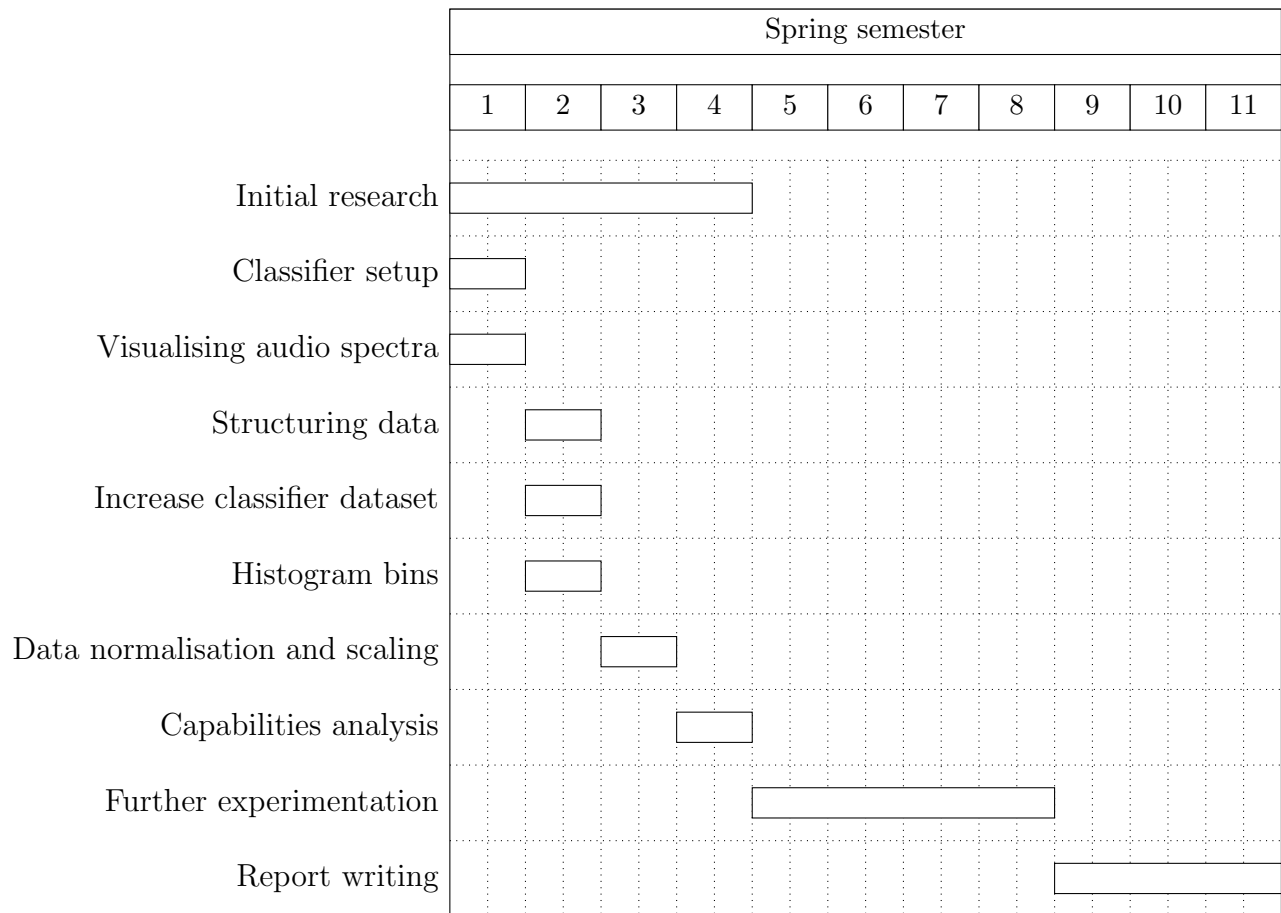
The aim for this project is to try and remove some of the workload for the musician and use machine learning principles and a knowledge of the structure of the audio data to computationally transcribe certain features of recorded guitar music.

Novel uses for this technology may include (but are certainly not limited to):

- Live guitar training tools that can compare a students playing accuracy to that of a pre-recorded piece.

- A companion to professional songwriters who want to record structure and tabulate their ideas whilst they are developing music but don't want to slow themselves by having to manually write phrases down.

- Gamification in a 'Rock Band' or 'Guitar Hero' style environment with users accruing points based on how many songs they have learnt and the accuracy for which they can play them.

# 2 Weekly plan

## 2.1 Gantt chart

| | Spring semester | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| Initial research | ████ | ████ | ████ | ████ | | | | | | | |
| Classifier setup | ██ | | | | | | | | | | |
| Visualising audio spectra | ██ | | | | | | | | | | |
| Structuring data | | ██ | | | | | | | | | |
| Increase classifier dataset | | ██ | | | | | | | | | |
| Histogram bins | | ██ | | | | | | | | | |
| Data normalisation and scaling | | | ██ | | | | | | | | |
| Capabilities analysis | | | | ██ | | | | | | | |
| Further experimentation | | | | | ████ | ████ | ████ | ██ | | | |
| Report writing | | | | | | | | | ██ | ████ | ████ |

## 2.2 Week 1

### 2.2.1 Background research

This general research will be used to appreciate both various approaches taken by researchers on the topic of machine transcription in the musical domain. This will also involve finding code snippets and ideas from scientific papers that may be helpful and reduce the workload allowing more research to be completed in the allotted time.

### 2.2.2 Classifier

Initial research will be done into different type of machine learning and classifiers. This will also cover the initial set up of the classifier, as it is important to ensure that the classifier is working properly before the project starts, hence tests will be run in the first week.

### 2.2.3 Understanding and obtaining sample data

Understanding the difference between similar signals (i.e. two different guitars playing the same note) and if there is any difference at all is crucial to the success of the project. It is possible for a human to pick out the difference between different types and style of guitar playing, so the idea is that by visually comparing the signals of two similar but different samples it will give an insight into ways that the data may be classified and what features the classifier may end up recognising.

## 2.3 Week 2

### 2.3.1 Structuring data

Organising and ensuring that all of the supplied samples are labelled correctly is crucial to the success of this project. The reason for this is that the samples will be much easier to parse, compare and ultimately be used to train and test the classifier. A standard format and folder structure will be used with all of the samples that have been obtained, this task will involve defining those structures and justifying why they have been used

### 2.3.2 Classifier

Improvements will be made to the data supplied to the classifier, more data shall be input and an attempt will be made to classify more features.

### 2.3.3 Histogram bins

Experiment with histograms of different and possibly even variable bin sizes, how this affects classification and whether it can provide a quicker and more accurate result.

## 2.4 Weeks 3 - 4

### 2.4.1 Data normalisation and scaling

Attempts will be made to modify the data so that it is represented in a more usable format, this will include scaling it to fit the musical scale as opposed to the linear scale that it is naturally represented by and also to normalise the guitar audio on the amplitude of the signal.

### 2.4.2 Capabilities analysis

This is a really important step in the project as by this point it should be known how feasible the previous methods will be and whether it will be possible to classify the guitar audio in the way that has been initially been investigated.

## 2.5 Weeks 5 - 8

### 2.5.1 Further research and experimentation

Similar training will be done with the classifier trying to further improve the size of the dataset that it uses. This may even involve trying to classify other instruments that are similar or perhaps trying to build a more feature complete system. This has been left quite open to allow for maximum flexibility depending on the results of earlier experimentation.

## 2.6 Weeks 9 - 11

### 2.6.1 Report writing

Whilst this task will be an ongoing one, there will be a large focus on completing the report over these weeks.

# 3 Tools

## 3.1 Matlab

Matlab will be used for most of the audio processing tasks in this project due to the fact that it excels at providing a fast prototyping environment. This is aided by tools such as its native fast fourier transform and excellent graphing capabilities which are essential for understanding the structure of audio and will help in understanding how to classify sounds.

# 4 Code quality

## 4.1 Naming and commenting

Logical names and coding standards shall be followed. Comments shall be added wherever appropriate.

## 4.2 Git

Git repositories will be made to ensure that it is possible to keep track of changes and progress more easily.