Praatalign: an interactive Praat plug-in for performing phonetic forced alignment

A detailed manual for version 1.8

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Chapter 1

Introduction

1.1 Introduction

Praatalign is a plug-in for Praat that can be used to do forced phonetic alignment on speech signals and in particular free speech. Praatalign combines the powerful HTK toolkit and the well trained MAUS models with the interactivity and modularity of Praat to create an interactive, intuitive and extendible application. Text in `monospace` means that the word is a command, variable or value. Praatalign has the capability to work with python-programmed phonetizers, practical orthography, dictionaries and pronunciation rules.

Chapter 2

Installation

2.1 Preparation

The installation of the program is very straightforward, however installing the dependencies might not be on some systems. Some programs are not included in the package due to licencing and environment compatibility but they do need to be installed in order for the plug-in to work properly. All programs Praatalign depends on are free and open source. The following list of programs need to be installed with their installation instructions.

- **Praat**
  Praat is a program that allows you to do phonetic analysis and annotations with a computer and Praatalign uses Praat to provide an interactive user interface to the annotated sound files.
  - **Windows**
    You can download and install Praat with the instructions on `http://www.fon.hum.uva.nl/praat/download_win.html`.
  - **Mac**
    You can download and install Praat with the instructions on `http://www.fon.hum.uva.nl/praat/download_mac.html`.
  - **Linux and other *NIX**
    In most of the cases the standard package manager coming with the Linux distribution also Praat. However this is usually an old version so use with care. You can download and install the latest Praat with the instructions on `http://www.fon.hum.uva.nl/praat/download_linux.html`.
- **Python**
  Python is used to interpret the scripts that run the core of the aligner. The script uses specifically Python 2. Python 3 is not supported. All scripts are tested with Python 2.7.x, older version might work.
  - **Windows**
    You can download and install from the Windows MSI installer found on this page under the Latest Python 2 Release link `https://www.python.org/downloads/windows/`.
  - **Mac**
    Mac OS X 10.8 comes with Python 2.7 preinstalled. If you run an obscure version without Python you can download it on `https://www.python.org/downloads/mac-osx/`.
  - **Linux and other *NIX**
    In almost all cases the standard package manager comes with a sufficiently up to date Python version and most of the distributions have Python preinstalled. If you work with

an obscure system that does not have a package manager or the Python version in it is obselete you can download Python on `https://www.python.org/downloads/source/`.

- **SoX**
  For processing the sound files in a very detailed and controlled way we use SoX. Although Praat also has sound processing capabilities SoX works better is some situations, this is because Praat does not allow you to specify certain options like sampling rate for all formats.

  - **Windows**
    You can download SoX on `http://sourceforge.net/projects/sox/files/sox/`. Either download the executable and run it or unzip the zipfile.
  - **Mac**
    You can download SoX on `http://sourceforge.net/projects/sox/files/sox/`. Download the zipfile and drag the contects to you `Applications`. Another option is to use homebrew and type `brew install sox` in a terminal.
  - **Linux and other *NIX**
    In almost all cases the standard package manager comes with a sufficiently up to date SoX version. If you work with an obscure system that does not have a package manager or the SoX version in it is obselete it on `http://sourceforge.net/projects/sox/files/sox/14.4.2/`

- **HCopy & HVite**
  HCopy and HVite are programs from the HTK toolkit and due to licencing issues we can not provide the binaries in a direct way. The program is for free but you are not allowed to distribute it.

  - **Windows**
    You can download a zip file containing precompiled Windows executables on `http://htk.eng.cam.ac.uk/ftp/software/htk-3.3-windows-binary.zip`. Just unzip them and make sure to add them to `%PATH%` or to point Praatalign to it in the setup screen.
  - **Mac, Linux and other *NIX**
    Installing HCopy and HVite is probably the hardest on Linux and Mac since you need to compile the binaries yourself. You can find the latest version on `http://htk.eng.cam.ac.uk/ftp/software/`. Download the zipfile, extract the zipfile and go to the folder with your terminal. While you can compile the entire toolkit, Praatalign is only interested in HCopy and HVite. Thus the following commands suffice:

```
$ ./configure --disable-hlmtools --disable-hslab
$ make -j4 htktools
```

    When the compilation has succeeded you can either add the binary directory `HTKTools` to `$PATH` or point Praatalign to the binaries in the setup screen.

2.2 Installation

The installation of the plug-in is very easy but the method differs for different systems.[1]

2.2.1 Automated installation

Run the installation script for your system.

[1] The plugin is tested on Windows 7, Windows Server 2008 via Windows Terminal Services, Windows 10, Linux and Mac. Other versions or other operating systems might also work but are untested.

- **Mac, Linux or *NIX**: `install.sh`
  Depending on the operating system you either have to run the script from the terminal or double click it from some explorer like program. Running the script from the terminal is very easy and preferred. Just start a terminal program and type the full and exact path in the terminal and press enter. For example on a Mac this will something like be: `/Users/frobnicator/Downloads/praatalign/install.sh`.

- **Windows**: `install_win.bat`
  This installation script can be double clicked from the explorer and it will install Praatalign. When the installation is finished you can press Enter to make the windows disappear.

2.2.2 Manual installation

Copy the contents of the root directory to(you have to create the directory if it does not already exist):

- **Linux and *NIX**
  `${HOME}/.praat-dir/plugin_pralign/`.

- **Windows**
  `%USERPROFILE%\Praat\plugin_pralign/`

- **Mac**
  `${HOME}/Library/Preferences/Praat Prefs/plugin_pralign/`

Chapter 3

Documentation

3.1 General information

With the Praatalign plugin you can currently align out of the box the data using Spanish, English, Dutch or SAMPA acoustic models from MAUS [1] created by Schiel et al. [1]. These models are already included in the package. Other models from MAUS can be easily added and will be in the future. If you like to have a language added please contact us. Presets for Australian English, Estonian, German, Hungarian, Italian, New Zealand English Polish and Portuguese are available at minimum.

Dictionary, ruleset, universal phonetizer all other files are, and should be, encoded in `UTF-8`. To enforce this the plug-in changes the default behaviour of Praat every time Praat loads to make sure Praats reading and writing preferences are set to `UTF-8`.

When the plug-in is successfully installed several menu items are added in the `TextGrid` editor under the `Interval` menu. The added functionality only works when you are editing a `TextGrid` and a `LongSound` or a `Sound`[2]. Currently the plugin is only tested on `WAVE` files. It should however work on all sound filetypes SoX can detect from the extension.

3.2 Menu items

Almost all menu items will fail when there is no settings file present. The settings file has to be created by running `Set up forced alignment...` interactively or by running `settings_ni.praat` in a script.

3.2.1 `Generate dictionary from tier`

This functions allows the user to generate a dictionary containing all the missing or unphonetizable words from the currently selected tier using the current settings the plugin is initialized with. The plugin will prompt you after pressing the button for a location for the dictionary file. When this process is done the user can add the pronunciations after every entry that is found in the skeleton dictionary. Note that there is no sanitation applied on the words. This means that if the phonetizer removes punctuation it can still be present in the dictionary.

3.2.2 `Clean selection`

This function is a helper function to clean up old or wrong alignment. When the function runs all annotation data within the selection within the selected tier will be removed.

[1] `http://www.bas.uni-muenchen.de/Bas/BasMAUS.html`

[2] Sound files are written to disk prior to alignment, thus `Longsound` is preferred

Note that this is not necessary to do before an alignment because this function runs by default before any alignment.

3.2.3 `Align current interval`

This function aligns the current selected interval on the current selected tier. When selecting a small interval it should not take much time at all. When you select an interval from an output tier(phone, word, canonical or log) the function will prompt you to make sure this is what you want to do. This functions first clears out the annotations on the output tiers.

3.2.4 `Align current tier`

This function aligns the entire selected tier. Aligning an entire tier can take some time, especially when you have a lot of pronunciation variants. This functions first clears out the annotations on the output tiers.

3.2.5 `Set up forced alignment...`

This functions spawns two option menus that will create the necessary settings file. When you finish the forms a settings file is written to disk.

Basic options

The first form contains all the basic settings needed for alignment. It also shows the version of the plugin on the first line. The following options can be entered. All settings are analogous to the names of the settings in the `settings_ni.praat` script.

- `new`: Name of the output tier storing the phone level alignment

  In this option you specify the name of the tier where the phone level alignment is stored, this can be either an existing tier or a non existing tier. If the tier does not exist it will be created upon doing the first alignment. When you leave this field empty no phone level tier will be created.

- `wrd`: Name of the output tier storing the word level alignment

  In this option you specify the name of the tier where the word level alignment is stored, this can be either an existing tier or a non existing tier. If the tier does not exist it will be created upon doing the first alignment. When you leave this field empty no word level tier will be created.

- `can`: Name of the output tier storing the canonical pronunciation

  In this option you specify the name of the tier where the canonical pronunciation of every word is stored, this can be either an existing tier or a non existing tier. If the tier does not exist it will be created upon doing the first alignment. When you leave this field empty no canonical pronunciation tier will be created.

- `llh`: Name of the output tier storing the log likelihood

  In this option you specify the name of the tier where the log likelihood of every phone is stored , this can be either an existing tier or a non existing tier. If the tier does not exist it will be created upon doing the first alignment. When you leave this field empty no log likelihood tier will be created.

- `model`: Select model

  In this option you specify which acoustic model to use. More info about the models can be found in Section 5.3.

- `lan`: Select model

  In this option you specify which phonetizer to use. More info about the models can be found in Section 3.5.

  Note that if you select the universal phonetizer you will be prompted to select the universal phonetizer file. More about the universal phonetizer in Section 3.5.3

- `dic`, `dictionary`: Select a dictionary file

  In this option you can specify a dictionary file. When you tick the box you will be prompted to select a dictionary file. When a dictionary is already selected the `dictionary` option is added which contains the path to the file. When you want to switch to using no dictionary you can clear that box and leave the `dic` box unticked.

- `rul`, `ruleset`: Select a ruleset file

  In this option you can specify a ruleset file. When you tick the box you will be prompted to select a ruleset file. When a ruleset is already selected the `ruleset` option is added which contains the path to the file. When you want to switch to using no ruleset you can clear that box and leave the `rul` box unticked.

- `pho`, `phonetizer`: Select a universal phonetizer file

  This option will only appear if a phonetizer file has been set previously. When no phonetizer file has ever been set and the universal phonetizer is used you will be prompted for it anyways since it is mandatory. When you tick the box you will be prompted to select a phonetizer file. The current phonetizer file is shown in `phonetize`

- `thr`: Set the size to add to the annotations

  In this option you can specify an extra margin used for every annotation. When the annotations are placed to close to the real sound the initial pause can clobber up the beginning of speech and that can reduce the performance. Setting the `thr` value to 0.1 will for example increase all boundaries from annotations with 100ms. Note that this does not change the original annotation and it will only increase the widen the annotation when there is room to do so, meaning that it will not create overlap with other annotations.

Advanced options

The second form contains all the more advanced settings needed for alignment. It shouldn't be necessary to change these options regularly. All settings are analogous to the names of the settings in the `settings_ni.praat` script.

- `log`: Set a location for the logfile

  In this option you can specify a location to write a debug log to. When you want to switch to not using a logfile you can redirect the log to either `/dev/null` on Linux, Mac and other *NIX systems and `nul` on Windows.

- `sox`: Set a SoX executable

  In this option you can specify a SoX executable. When you tick the box you will be prompted to select a SoX executable. When a SoX executable is already selected the `soxex` option is added which contains the path to the executable. When you want to switch to using the SoX executable in `PATH` you can clear that box leave the `sox` box unticked.

  - **Windows**
    If you have installed sox using the MSI you can find `sox.exe` in `C:\Program Files (x86)\sox-14-4-1` or `C:\Program Files\sox-14-4-1`. If you just downloaded the zip file you can just point to the location you extracted the archive and select `sox.exe`.

  - **Mac**
    If you dragged sox to the `Applications` you can find it there and you can just point to the sox executable. If you installed sox via homebrew it is probably already in `$PATH`. If this is not the case you can find the location by typing in a terminal `which sox` and pointing Praatalign to that location.
  - **Linux and other *NIX**
    If you have installed sox using a package manager it probably already is in your `$PATH`. If this is not the case you can find the location by typing in a terminal: `which sox` and pointing Praatalign to location.

- `hvite`: Set a HVite executable

  In this option you can specify a HVite executable. When you tick the box you will be prompted to select a HVite executable. When a HVite executable is already selected the `hviteex` option is added which contains the path to the executable. When you want to switch to using the HVite executable in `PATH` you can clear that box leave the `hvite` box unticked.

  - **Windows**
    Point to the directory where you unzipped the file from HTK and select `HVite.exe`.
  - **Mac, Linux, and other *NIX**
    Point to the directory where you compiled the tools from HTK and select `HVite`. It resides in the `HTKTools` directory.

- `hcopy`: Set a HCopy executable

  In this option you can specify a HCopy executable. When you tick the box you will be prompted to select a HCopy executable. When a HCopy executable is already selected the `hcopyex` option is added which contains the path to the executable. When you want to switch to using the HCopy executable in `PATH` you can clear that box leave the `hcopy` box unticked.

  - **Windows**
    Point to the directory where you unzipped the file from HTK and select `HCopy.exe`.
  - **Mac, Linux, and other *NIX**
    Point to the directory where you compiled the tools from HTK and select `HCopy`. It resides in the `HTKTools` directory.

- `python`: Set a Python executable

  In this option you can specify a Python executable. When you tick the box you will be prompted to select a Python executable. When a Python executable is already selected the `pythonex` option is added which contains the path to the executable. When you want to switch to using the Python executable in `PATH` you can clear that box leave the `python` box unticked.

  - **Windows**
    Python can usually be found in `C:\Python27`. From there you can select `python.exe`
  - **Mac, Linux, and other *NIX**
    If you have installed sox using a package manager it probably already is in your `$PATH`. If this is not the case you can find the location by typing in a terminal: `which python` and pointing Praatalign to that location. Note that in some systems `python` symlinks to `python3`, in that case point Praatalign to `python2`. If you still can not find the executable you can try using the search function in the file manager.

3.3 Dictionary

To phonetize words Praatalign either uses the provided phonetizer or a dictionary. Dictionaries are plain text files that contain words and one or more pronunciations. A dictionary file is a `UTF-8` encoded file containing non-empty lines separated by a newline character[3]. Lines starting with a `#` will be ignored and can thus be used as comments. The format of a dictionary entry is a word followed by a tab followed by tab separated pronunciations. An example dictionary can be found in Listing 3.1

```
1 # This is comment
2 # This is a word with two possible pronunciations
3 ado<TAB>a d o<TAB>a o
4 # These are words with one possible pronunciation
5 empatar<TAB>e m p a t a r
6 empataran<TAB>e m p a t a r a n
```

Listing 3.1: Example dictionary

3.4 Ruleset

Besides generating pronunciation by using the dictionary and phonetization you can also use rulesets to define pronunciation variants. Ruleset make you able to define general rules applied over all words(phonetized words and dictionary words). In this way you can easily define for example deletion rules. A ruleset file is a `UTF-8` encoded file containing non-empty lines separated by a newline character. Lines starting with a `#` will be ignored and can thus be used as comments. There are two ways of defining rules for a ruleset.

- **Simple**
  Simple rules are just find and replace queries. The first column is the target and the second column is the replace value. For example the deletion rule `a d o -> a o` can be written as `a d o<TAB>a o`.

- **Regular**
  Regular rules are like regular expressions and are therefore much more expressive but also more complicated to write. Regular rules start with a single tab character to denote that they are in fact regular expressions. For example a deletion rule that deletes a `d` between two vowels and potentially also across word boundaries can be written like `<TAB>([aouie] #?) d ([aouie])<TAB>\1 \2`. Internally we use the `re.sub` function from the Python `re` library[4]. Besides that there are some extra shortcuts and options:

  - `\v` for vowels(`[aoeiu]`)
  - `\c` for consonants(`[^aoeiu]`)
  - `#` for a inter word silence

3.5 Phonetizers

3.5.1 Spanish

The Spanish phonetizer is designed only to work with the spanish models. It removes a lot of non speech annotated symbols and does some tricks to get exceptions well phonetized. It can be seen as an example of writing an advanced phonetizer in Python.

[3] On Mac, Linux, and *NIX this is default, on Windows this can cause problems. When using Praatalign on windows please refrain to a text editor that has newline capabilities like Notepad++

[4] `https://docs.python.org/2/library/re.html`

3.5.2 Tzeltal

The Tzeltal phonetizer is an example of how to use the SAMPA models to align a new language. Thus it only works for the SAMPA models. It removes some non speech annotated symbols and does an almost literal character to character translation.

3.5.3 Universal

When you select the universal phonetizer you will be prompted to point the plugin to an universal phonetizer file. A universal phonetizer file is a `UTF-8` encoded file containing non-empty lines separated by a newline character. Every line contains a translation from practical orthography to phonetic transcription and the order of appearance in the file is the order of importance in the phonetizer. When a word gets phonetized the phonetizer tries to match the first rule in the phonetizer file. For example see the start of an example file listed in Listing 3.2 representing a translation from spanish orthography to phonetic transcription. The safest order is always the order in which the biggest sections are topmost in the file.

```
1  gue<TAB>g
2  gui<TAB>g
3  ch<TAB>t S
4  ce<TAB>T
5  ci<TAB>T
6  cé<TAB>T
7  gü<TAB>g u
8  ll<TAB>jj
9  qu<TAB>k
10 ñ<TAB>J
11 ç<TAB>T
12 j<TAB>x
13 c<TAB>k
14 v<TAB>b
15 w<TAB>b
16 z<TAB>T
17 y<TAB>j
18 q<TAB>k
19 ...
```

Listing 3.2: Example universal phonetizer file

3.5.4 None

The None phonetizer is a dummy phonetizer that does nothing. This means that every word should be available in the dictionary.

3.6 Scriptability and batch processing

Note that this section is not updated as often as it should. Always check the exact format in `settings_ni.praat`.

3.6.1 Non interactive settings file creation

Although the Praatalign script is inherently interactive it is still possible to batch process corpora using simple praat scripts. To facilitate this function a file called `$DIR/settings_ni.praat` can be run where `$DIR` is the location of the plugin files. The location of the plugin files for your operating system can be found in Section 2.2 in the manual installation section. The `settings_ni.praat` is a stripped down version of the settings dialog present in the aligner. Since it is using a praat form to ask for the user input, in contrary to the pause dialog in the normal settings scirpt, it can be run non interactively by running the script from a praat script.

For example if you want to setup the aligner to align a tzeltal file with all custom values on linux under the user frobnicator you can put this in your script to setup the aligner:

```
runScript: "/home/frobnicator/.praat-dir/plugin_pralign/settings_ni.praat",
..."phon", "wrd", "can", "llh", "sampa", "tzeltal", "None", "/path/to/dict",
..."/path/to/ruleset", 0, "/some/path/to/logfile",
..."/usr/bin/sox", "/usr/bin/HVite", "/usr/bin/HCopy", "python"
```

Note that due to the lack of interactivity the format is a little bit different. The differences are:

- `lan` must be the language code as in the interactive settings.
- `mod` must be the model code as in the interactive settings.
- `pho` must be the path to the universal phonetizer. When you do not want to use a universal phonetizer you must use `None`.
- `dic` and `rul` must be the full path, when you do not want to use a dictionary or ruleset you must use `None`.
- `sox`, `hvb`, `hcb`, and `py` must be the full path, when you do not want a custom location you must use respectively `sox`, `HVite`, `HCopy` and `python`

3.6.2 Example

When you then open a `TextGrid` and a `LongSound` file and do `View & Edit` to open the editor you can run the alignment from the script using the button text as function. For example the script could look like the script in Listing 3.3.

```
# We assume the LongSound and TextGrid are selected previously

# Generate the settings file
        runScript: "/home/frobnicator/.praat-dir/plugin_pralign/settings_ni.praat",
..."phon", "wrd", "can", "llh", "sampa", "tzeltal", "None", "/path/to/dict",
..."/path/to/ruleset", 0, "/some/path/to/logfile",
..."/usr/bin/sox", "/usr/bin/HVite", "/usr/bin/HCopy", "python"

# Spawn the editor
View & Edit

# Open the editor
editor: "TextGrid " + objectname$
        # This bit of code is a small snippet to select a specific tier with the
        # index: tiernum, tiernum is obtained by querying all tiers outside the
        # editor and finding the tier that matches the name
        currenttiernum = -1
        while currenttiernum <> tiernum
                Select next tier
                inf$ = Editor info
                currenttiernum = extractNumber(inf$, "Selected tier: ")
        endwhile

        # Do the actual alignment
        Align current tier
        # When this is done aligned data can be found in: custom_phone_tier and
        # custom_word_tier.
endeditor
```

Listing 3.3: Example scriptability

3.7 Troubleshooting

- **Some words are ignored and thus not aligned**
  Some phonetizers phonetize unphonetizable words into an empty word to avoid throwing exceptions. When words are not phonetized it means that it is not in the dictionary nor phonetizable. To fix this you can edit the phonetizer or add the word to the dictionary.

- Pop-up stating: **Error! check the text window for details...**
  This means something went wrong in the python script. Check the info window. Usually it is a missing binary, ruleset etc. It could also be that you used a phone that does not exist in the model

- Pop-up stating: **Unknown IO error**
  Some IO error occurred of an unknown type. Please check the logfile.

- Log stating: `sox FAIL trim: Position 1 is behind the following position.` You are aligning an annotation that lies outside the wave file.

- **Other errors**
  When the plugin crashes without any reason you should enable logging in the settings menu to see where it crashes. If the problem is not solvable please file a bugreport via github [5] or contact us directly via e-mail.

[5] `https://github.com/dopefishh/praatalign/issues`

Chapter 4

Extending Praatalign

4.1 Introduction

Extending the aligner with new languages should be very easy for languages that can be mapped on the current SAMPA model or on any other existing model(maus model). Adding a language with a new model could be possible but no support will be given, however you can always try, you can even try getting help. Adding a language requires a couple of components that need to be written or adapted.

4.2 Phonetizer

Phonetization of your language is the most elegant solution of translating the graphemes to phonemes. Implementing a phonetizer is as easy as implementing one function called `phonetizeword`. A skeleton class can be found in `phonetizer.py`. The function in the skeleton class is accompanied by comments. A phonetized utterance is always of the following form:
`utt=[word1, word2, ..., wordn]`, `word=[pron1, pron2, ..., pronn]` and `pron=[phone1, phone2, ..., phonen]` and every phone is a string. So if you want to use the skeleton class with the `phonetizeword` function you need to return a list of lists of strings where every string is a phone from the model. If you also want to do utterance based translation you need to return a list of lists of lists of strings.

4.3 Dictionary

If you do not want to use a phonetizer you can also suffice with only using a dictionary based translation. Dictionary based translation still needs to be loaded as a phonetizer though. All phonetizers include also a dictionary based lookup. In the `phonetizer.py` a dictionary phonetizer is already present called `PhonetizerDictionary`. There is also a loopback phonetizer that takes the literal annotation as transcription. This phonetizer is currently not used but could be used when an exact phonetic translation is already available.

4.4 Adding the language to the aligner

When you have the translation from grapheme to phoneme the only thing that needs to be done is adding it to the script files.

- `phonetizer.py`
  On the bottom of this file there is a dictionary containing all the translations from language code to phonetizer and parameters directory. You need to add your language to that dictionary.

- `settings.praat`
  In this file you need to add stuff on multiple locations, namely within the second `if` that relies in the first outer `if` block you need to add your language with its appropriate position. When you want your language on top you need to adapt the other numbers too.

  Finally within the `pause` block you need to add your language code in the `optionMenu:` block on the same position as specified earlier.

When you have changed these files properly your language should be available in the menus and work out of the box.

Chapter 5

Appendices

5.1 How to cite

```
@misc{praatalign1.9,
        author={Lubbers, Mart and Torreira, Francisco},
        title={Praatalign: an interactive Praat plug-in for performing phonetic
            forced alignment},
        howpublished={\url{https://github.com/dopefishh/praatalign}},
        year={2013-2015},
        note={Version 1.9}
}
```

Listing 5.1: Bibtex snippet

5.2 Licence

```
The MIT License (MIT)

Copyright (c) <year> <copyright holders>

Permission is hereby granted, free of charge, to any person obtaining a copy
of this software and associated documentation files (the "Software"), to deal
in the Software without restriction, including without limitation the rights
to use, copy, modify, merge, publish, distribute, sublicense, and/or sell
copies of the Software, and to permit persons to whom the Software is
furnished to do so, subject to the following conditions:

The above copyright notice and this permission notice shall be included in
all copies or substantial portions of the Software.

THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR
IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY,
FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE
AUTHORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER
LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM,
OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN
THE SOFTWARE.
```

5.3 Acoustic model phone specifications

5.3.1 Spanish

The Spanish mapping is an exact mapping with the spanish SAMPA phoneset[1].

Symbol	Word	Transcription

[1] http://www.phon.ucl.ac.uk/home/sampa/spanish.htm

Plosives	p	padre	p a D r e
	b	vino	b i n o
	t	tomo	t o m o
	d	donde	d o n d e
	k	casa	k a s a
	g	gata	g a t a
Affricatives	tS	mucho	m u tS o
	jj	hielo	jj e l o
Fricatives	f	fácil	f a T i l
	B	cabra	k a B r a
	T	cinco	T i n k o
	D	nada	n a D a
	s	sala	s a l a
	x	mujer	m u x e r
	G	luego	l w e G o
Nasals	m	mismo	m i s m o
	n	nunca	n u n k a
	J	año	a J o
Liquids	l	lejos	l e x o s
	L	caballo	k a b a L o
	r	puro	p u r o
	rr	torre	t o rr e
Semivowels	j	rei	rr e j
		pie	p j e
	w	deuda	d e w D a
		muy	m w i
Vowels	i	pico	p i k o
	e	pero	p e r o
	a	valle	b a L e
	o	toro	t o r o
	u	duro	d u r o
Special	<	word initial silence	
	>	word final silence	
	#	inter word silence	
	<nib>	non speech sound	

Table 5.1: Spanish phone specification

5.3.2 Dutch

The Dutch mapping is an almost[2] exact mapping with the dutch SAMPA phoneset[3]

	Praatalign	Word	Transcription
Plosives	p	pak	p A k
	b	bak	b A k
	t	tak	t A k
	d	dak	d A k
	k	kap	k A p
	g	goal	g o: l
Fricatives	f	fel	f E l
	v	vel	v E l
	s	sein	s E i n
	z	zijn	z E i n
	x	toch	t o x
	G	goed	G u t

[2]Derivations are marked in bold

[3]`http://www.phon.ucl.ac.uk/home/sampa/dutch.htm`

	h	hand	h A n t
	Z	bagage	b A g a: Z @
	S	show	S o: u
Sonorants	m	met	m E t
	n	net	n E t
	N	bang	b A N
	l	land	l A n t
	r	rand	r A n t
	w	wit	w I t
	j	ja	j a:
Checked vowels	I	pit	p I t
	E	pet	p E t
	A	pat	p A t
	O	pot	p O t
	Y	put	p Y t
	@	gemakkelijk	G @ m A k @ l @ k
Free vowels	i	vier	v i r
	y	vuur	v y r
	u	voer	v u r
	a:	naam	n a: m
	e:	veer	v e: r
	P2:	deur	d P2: r
	o:	voor	v o: r
	EI	fijn	f EI n
	P9y	huis	h P9y s
	Au	goud	x Au t
Dipthongs	a:i	draai	d r a: i
	o:i	mooi	m o: i
	ui	roeiboot	r ui b o: t
	iu	nieuw	n iu
	yu	duw	d yu
	e:u	sneeuw	s n e: u
Marginal vowels	E:	créme	k r E: m
	P9:	freule	f r P9: l @
	O:	roze	r O: z @
Special	<	word initial silence	
	>	word final silence	
	#	inter word silence	
	<nib>	non speech sound	

Table 5.2: Dutch phone specification

5.3.3 English

The English mapping is an exact[4] exact mapping with the english SAMPA phoneset[5] with some borrowed phones.

Also there is conversion script for the English CMU dictionary[6] located in `./par.eng/cmu2praatalign.py` that converts the CMU dictionary to Praatalign format. The scripts is a Python script and should download the dictionary if you haven't done it yourself and will write it to a `dict.eng` file by default. The usage is: `python cmu2praatalign.py [inputfile [outputfile]]`.

	Symbol	Word	Transcription
Plosives	p	pen	
	b	but	

[4]Derivations are marked in bold

[5]`https://www.phon.ucl.ac.uk/home/sampa/english.htm`

[6]`http://www.speech.cs.cmu.edu/cgi-bin/cmudict`

	t	two	
	d	do	
	k	skill	
	g	go	
Affricatives	tS	chair	
	dZ	gin	
Fricatives	f	fool	
	v	voice	
	T	thing	
	D	this	
	s	sin	
	z	zoo	
	S	she	
	Z	pleasure	
	h	ham	
Nasals	m	man	
	n	no	
	N	ring	
Liquids	r	perro	
	l	left	
Sonorant glides	w	we	
	j	yes	
Checked vowels	I	English city	
	e	bear	
	{	cat	
	Q	cough	
	V	run	
	U	put	
Short vowels	@	about	
Free vowels	i:	ease	
	eI	raise	
	aI	rise	
	OI	noise	
	u:	lose	
	@U	nose	
	aU	rouse	
	3:	furs	
	A:	stars	
	O:	cause	
	I@	dears	
	e@	stairs	
	U@	cures	
Special	<	word initial silence	
	>	word final silence	
	#	inter word silence	
	<nib>	non speech sound	

	Symbol	description	example(language)
Borrowed phones	a~	nasalized central open vowel	vent(fra)
	E~	nasalized lengthened front half open unrounded vowel	(deu)
	o~	nasalized back half closed rounded vowel	bon(fra)
	6:	lengthened central neutral unrounded vowel	(aus)
	}:	lengthened central closed rounded vowel	pool(aus)
	e:	lengthened front half closed unrounded vowel	mehr(deu)

o:	lengthened back half closed rounded vowel	Sohle(deu)
@}	diphthong	
Ae	diphthong	(aus)
{I	diphthong	(aus)
{O	diphthong	(aus)
oI	diphthong	(aus)
O	back half open rounded vowel	law(brit)
i	front closed unrounded vowel	see
u	back closed rounded vowel	soon
o	back half closed rounded vowel	sore(us)
E	front half open unrounded vowel	bed
6	central neutral unrounded vowel	besser(deu)
?	glottal stop	Verein(ger)
x	voiceless velar fricative	loch(scot)
C	voiceless palatal fricative	Ich(ger)
W	voiceless labial-velar fricative	

Table 5.3: English phone specification

5.3.4 SAMPA

Sym	description	examples	lang	type	location
i	front closed unrounded vowel	English see, Spanish sí, French vite, German mi.e.ten, Italian visto	xxx	vowel	front
I	front closed unrounded vowel, but somewhat more centralised and relaxed, in Polish: mid closed unrounded	English city, German mit	xxx	vowel	front
1	close central unrounded vowel	Russian mys	xxx	vowel	central
e	front half closed unrounded vowel	US English bear, Spanish él, French année, German mehr, Italian rete, Catalan més	xxx	vowel	front
E	front half open unrounded vowel	English bed, French même, German Herr, Männer, Italian ferro, Catalan mes, Spanish perro	xxx	vowel	front
{	front open unrounded vowel	English cat	xxx	vowel	front
y	front closed rounded vowel	French du, German Tür	xxx	vowel	front
2	front half closed rounded vowel	French deux (hence '2'), German Höhle	xxx	vowel	front

9	front half open rounded vowel	French neuf (hence '9'), German Hölle	xxx	vowel	front
@	central neutral unrounded vowel	English about, winner,German bitte	xxx	vowel	central
P6	central neutral unrounded vowel	German besser	xxx	vowel	central
3	front half open unrounded vowel, but somewhat more centralised and relaxed	English bird,nurse	xxx	vowel	central
a	central open vowel	Spanish da, barra, French bateau,lac, German Haar, Italian pazzo	xxx	vowel	front
}	central closed rounded vowel	Scottish English pool, Swedish sju	xxx	vowel	central
8	central neutral rounded vowel	Swedish kust	xxx	vowel	central
&	front open rounded vowel	American English that	xxx	vowel	front
M	back closed unrounded vowel	Japanese fuji, Korean eu	xxx	vowel	back
7	back half closed unrounded vowel	Korean eo	xxx	vowel	back
V	back half open unrounded vowel	RP and US English run,enough,strut	xxx	vowel	back
A	back open unrounded vowel	English arm, US English law, standard French âme	xxx	vowel	back
u	back closed rounded vowel	English soon, Spanish tú, French goût, German Hut, Mutter, Italian azzurro,tutto	xxx	vowel	back
U	back closed rounded vowel somewhat more centralised and relaxed	English put, Buddhist	xxx	vowel	back
o	back half closed rounded vowel	US English sore, Scottish English boat, Spanish yo, French beau, German Sohle, Italian dove, Catalan ona	xxx	vowel	back
O	back half open rounded vowel	British English law, caught, Italian cosa, Catalan dona, Spanish ojo, German Wort	xxx	vowel	back
Q	back open rounded vowel	British English not, cough	xxx	vowel	back

Y	lax [y]	German hübsch	xxx	vowel	front
p	voiceless bilabial plosive	English pen	xxx	plosive	bilabial
b	voiced bilabial plosive	English but	xxx	plosive	bilabial
t	voiceless alveolar plosive	English two, Spanish toma	xxx	plosive	alveolar
d	voiced alveolar plosive	English do, Italian cade	xxx	plosive	alveolar
ts	voiceless alveolar affricate	Italian calza, German zeit	xxx	affricate	alveolar
dz	voiced alveolar affricate	Italian zona	xxx	affricate	alveolar
tS	voiceless postalveolar affricate	English chair, , Spanish mucho	xxx	affricate	post-alveolar
dZ	voiced postalveolar affricate	English gin, Italian giorno	xxx	affricate	post-alveolar
pf	voiceless labial affricate	German Pferd	xxx	affricate	bilabial
c	voiceless palatal plosive	Hungarian tyúk 'hen'	xxx	plosive	palatal
k	voiceless velar plosive	English skill	xxx	plosive	velar
g	voiced velar plosive	English go	xxx	plosive	velar
q	voiceless uvular plosive	Arabic qof	xxx	plosive	uvular
B	voiced bilabial fricative	Catalan roba 'clothes'	xxx	fricative	bilabial
f	voiceless labiodental fricative	English fool, Spanish and Italian falso	xxx	fricative	labio-dental
v	voiced labiodental fricative	English voice, German Welt	xxx	fricative	labio-dental
T	voiceless dental fricative	English thing, Castilian Spanish caza	xxx	fricative	dental
D	voiced dental fricative	English this	xxx	fricative	dental
s	voiceless alveolar fricative	English see, Spanish sí	xxx	fricative	alveolar
z	voiced alveolar fricative	English zoo, German See	xxx	fricative	alveolar
S	voiceless postalveolar fricative	English she, French chemin	xxx	fricative	post-alveolar
Z	voiced postalveolar fricative	French jour, English pleasure	xxx	fricative	post-alveolar
C	voiceless palatal fricative	German Ich	xxx	fricative	palatal
x	voiceless velar fricative	Scots loch, Castilian Spanish ajo	xxx	fricative	velar
G	voiced velar fricative	Greek $\gamma\alpha\lambda\alpha$	xxx	fricative	velar
h	voiceless glottal fricative	English ham, German Hand	xxx	fricative	glottal
m	bilabial nasal	English man	xxx	nasal	bilabial
F	labiodental nasal	Spanish infierno, Hungarian kámfor	xxx	nasal	labio-dental
n	alveolar nasal	English, Spanish and Italian no	xxx	nasal	alveolar
J	palatal nasal	Spanish año, French oignon	xxx	nasal	palatal

N	velar nasal	English ring, Italian bianco, Tagalog ngayón	xxx	nasal	velar
l	alveolar lateral approximant	English left, Spanish largo	xxx	lateral-approximant	alveolar
L	palatal lateral approximant	Italian aglio, Catalan colla,	xxx	lateral-approximant	palatal
5	velarized dental lateral	English meal Catalan alga	xxx	lateral-approximant	dental-velar
4	alveolar tap	Spanish pero, American English muddy	use	tap	alveolar
r	alveolar trill	Spanish perro	xxx	trill	alveolar
R	uvular trill	German Reich	xxx	trill	uvular
P	labiodental approximant	Dutch Waar	xxx	approximant	labio-dental
w	labial-velar approximant	English we, French oui	xxx	approximant	labio-velar
H	labial-palatal approximant	French huit	xxx	approximant	labio-palatal
j	palatal approximant	English yes, French yeux	xxx	approximant	palatal
?	glottal stop	German Verein, Danish stød	xxx	plosive	glottal
W	voiceless labial-velar fricative		xxx	fricative	labio-velar
D:	lengthened voiced dental fricative		fin	fricative	dental
T:	lengthened voiceless dental fricative		fin	fricative	dental
i:	lengthened front closed unrounded vowel	mieten	deu	vowel	front
ii	lengthened front closed unrounded vowel in quantity II	riisu	ekk	vowel	front
ii:	lengthened front closed unrounded vowel in quantity III		ekk	vowel	front
e:	lengthened front half closed unrounded vowel	mehr	deu	vowel	front
ee	lengthened front half closed unrounded vowel in quantity II	keere	ekk	vowel	front
ee:	lengthened front half closed unrounded vowel in quantity III		ekk	vowel	front
E:	lengthened front half open unrounded vowel	Mär	deu	vowel	front
y:	lengthened front closed rounded vowel	Tür	deu	vowel	front
Y:	lengthened lax [y]	(Swiss German)	deu	vowel	front
2:	lengthened front half closed rounded vowel	Höhle	deu	vowel	front
a:	lengthened central open vowel	Haar	deu	vowel	central
u:	lengthened back closed rounded vowel	Hut	deu	vowel	back
o:	lengthened back half closed rounded vowel	Sohle	deu	vowel	back
3:	lengthened front half open unrounded vowel	furs	aus	vowel	front
A:	lengthened back open unrounded vowel	stars	aus	vowel	back
O:	lengthened back half open rounded vowel	cause	aus	vowel	back

P6:	lengthened central neutral unrounded vowel		aus	vowel	central
}:	lengthened central closed rounded vowel	pool	aus	vowel	central
Q:	lengthened open back rounded	(Swiss German)	aus	vowel	back
9:	lengthened front half open rounded vowel		nld	vowel	front
{{	lengthened front open unrounded vowel in quantity II	kääru	ekk	vowel	front
{:	lengthened front open unrounded vowel in quantity II	kääru	ekk	vowel	front
{{:	lengthened front open unrounded vowel in quantity III		ekk	vowel	front
yy	lengthened front closed rounded vowel (quantitiy II)	müüri	ekk	vowel	front
yy:	lengthened front closed rounded vowel (quantitiy III)		ekk	vowel	front
22	lengthened front half closed rounded vowel	nööri	ekk	vowel	front
22:	lengthened front half closed rounded vowel in quantity III		ekk	vowel	front
uu	lengthened back closed rounded vowel	kuuri	ekk	vowel	back
uu:	lengthened back closed rounded vowel in quantity III		ekk	vowel	back
oo	lengthened back half closed rounded vowel	poori	ekk	vowel	back
oo:	lengthened back half closed rounded vowel in quantity III		ekk	vowel	back
77	back half closed unrounded vowel in quantity II	sõõre	ekk	vowel	back
7:	back half closed unrounded vowel in quantity II	sõõre	ekk	vowel	back
77:	back half closed unrounded vowel in quantity III		ekk	vowel	back
AA	lengthened back open unrounded vowel in quantity II	vaaru	ekk	vowel	back
AA:	lengthened back open unrounded vowel in quantity III		ekk	vowel	back
aU	diphthong	Haus	deu	diphthong	front>back
aI	diphthong	Bein	deu	diphthong	front
ai	diphthong		ita	diphthong	front
a:i	diphthong		nld	diphthong	front
Ae	diphthong		aus	diphthong	back>front
Au	diphthong		nld	diphthong	back
OY	diphthong	heulen	deu	diphthong	back>front
eI	diphthong	raise	aus	diphthong	front
e@	diphthong	stairs	aus	diphthong	front>central
ei	diphthong		ita	diphthong	front
e:i	diphthong		nld	diphthong	front
eU	diphthong		por	diphthong	front>back
EI	diphthong	raise	eng	diphthong	front
Ei	diphthong		ita	diphthong	front

{I	diphthong		aus	diphthong	front
{O	diphthong		aus	diphthong	front>back
I@	diphthong	dears	aus	diphthong	front>central
Ii:	diphthong	accede	aus	diphthong	front
I:	lengthened front closed unrounded vowel	(Swiss German)	deu	vowel	front
i:@	diphthong	memorial	nze	diphthong	central>front
io	diphthong		ita	diphthong	front>back
iu	diphthong		nld	diphthong	front>back
ja	diphthong		ita	diphthong	front
jo	diphthong		ita	diphthong	front>back
ju	diphthong		ita	diphthong	front>back
oI	diphthong		aus	diphthong	back>front
oi	diphthong		ita	diphthong	back>front
o:i	diphthong		nld	diphthong	back>front
oU	diphthong		por	diphthong	back
oE	diphthong		ita	diphthong	back>front
OI	diphthong	noise	aus	diphthong	back>front
Oi	diphthong		ita	diphthong	back>front
ue	diphthong		ita	diphthong	back>front
ui	diphthong		nld	diphthong	back>front
U@	diphthong	cures	aus	diphthong	back>central
U:	lenthened back closed rounded vowel somewhat more centralised and relaxed	(Swiss German)	deu	vowel	back
wa	diphthong		ita	diphthong	front
we	diphthong		ita	diphthong	front
wi	diphthong		ita	diphthong	front
wO	diphthong		ita	diphthong	back
yu	diphthong		nld	diphthong	front>back
@U	diphthong	nose	aus	diphthong	central>back
@}	diphthong		aus	diphthong	central
@@	geminate of schwa in quantity II		ekk	vowel	central
@:	geminate of schwa in quantity II		ekk	vowel	central
@@:	geminate of schwa in quantity III		ekk	vowel	central
9y	diphthong		nld	diphthong	back>front
QI	diphthong	abide	aus	diphthong	central>front
U}	diphthong	abuse	aus	diphthong	central>back
VU	diphtong	acetone	aus	diphthong	central>back
Vi	diphthong	abased	aus	diphthong	central>front
{o	diphthong	accounts	aus	diphthong	front>back
2i	diphthong		ekk	diphthong	back>front
2i:	diphthong		ekk	diphthong	back>front
7o:	diphthong		ekk	diphthong	back
7u:	diphthong		ekk	diphthong	back
7u	diphthong		ekk	diphthong	back
Ai	diphthong		ekk	diphthong	back>front
Ai:	diphthong		ekk	diphthong	back>front
Ao:	diphthong		ekk	diphthong	back
Au:	diphthong		ekk	diphthong	back
Ae:	diphthong		ekk	diphthong	back>front
ei:	diphthong		ekk	diphthong	front
e:u	diphthong		nld	diphthong	front
i	nasalized front closed unrounded vowel		xxx	vowel	front
e	nasalized front half closed unrounded vowel	vin	fra	vowel	front

a	nasalized central open vowel	vent	fra	vowel	front
o	nasalized back half closed rounded vowel	bon	fra	vowel	back
9	nasalized front half open rounded vowel	brun,neuv	fra	vowel	front
E	nasalized lengthened front half open unrounded vowel		deu	vowel	front
O	nasalized back half open rounded vowel		deu	vowel	back
u	nasalized back closed rounded vowel		xxx	vowel	back
a:	nasalized lengthened central open vowel		deu	vowel	central
E:	nasalized lengthened front half open unrounded vowel		deu	vowel	front
o:	nasalized lengthened back half closed rounded vowel		deu	vowel	back
O:	nasalized lengthened back half open rounded vowel		nld	vowel	back
ts_j	palatalized voiceless alveolar affricate	c'ma	pol	affricate	post-alveolar
dz_j	palatalized voiced alveolar affricate	dz'wig	pol	affricate	alveolar
s_j	palatalized voiceless alveolar fricative	syk	pol	fricative	alveolar
s_js	palatalized voiceless alveolar fricative in quantity II	kassi	ekk	fricative	alveolar
s_j:s	palatalized voiceless alveolar fricative in quantity III		ekk	fricative	alveolar
z_j	palatalized voiced alveolar fricative	zbir	pol	fricative	alveolar
n_j	palatalized alveolar nasal	kon'	pol	nasal	alveolar
n_jn	palatalized alveolar nasal in quantity II	panni	ekk	nasal	alveolar
n_j:n	palatalized alveolar nasal in quantity III		ekk	nasal	alveolar
l_j	palatalized alveolar lateral approximant	pali	ekk	lateral-approximant	alveolar
l_jl	palatalized alveolar lateral approximant in quantity II	palli	ekk	lateral-approximant	alveolar
l_j:l	palatalized alveolar lateral approximant in quantity III		ekk	lateral-approximant	alveolar
t_j	palatalized voiceless alveolar plosive	padi	ekk	plosive	alveolar
t_jt	palatalized voiceless alveolar plosive in quantity II	pati	ekk	plosive	alveolar
t_j:t	palatalized voiceless alveolar plosive in quantity III		ekk	plosive	alveolar
d_j	palatalized voiced alveolar plosive	gyár	hun	plosive	alveolar
dd_j	geminate of d'	egy	hun	plosive	alveolar
g_j	palatalized voiced velar plosive	Gienek	pol	plosive	velar
x_j	palatalized voiceless velar fricative	hiacynt	pol	fricative	velar
k_j	palatalized voiceless velar plosive	kierowca	pol	plosive	velar
p_j	palatalized voiceless bilabial plosive	piasek	pol	plosive	bilabial

xx_j	geminate of x'		hun	fricative	velar
p_h	aspirated voiceless bilabial plosive		spa	plosive	bilabial
t_h	aspirated voiceless alveolar plosive		spa	plosive	alveolar
k_h	aspirated voiceless velar plosive		spa	plosive	velar
tt	geminate of t	fatto	ita	fricative	bilabial
t:	lengthened t	että	fin	plosive	alveolar
t:t	geminate of t in quantity III		ekk	plosive	alveolar
pp	geminate of p		ita	plosive	bilabial
p:	lengthened p		fin	plosive	bilabial
p:p	geminate of p in quantity III		ekk	plosive	bilabial
kk	geminate of k		ita	plosive	velar
k:	lengthened k	takkinsa	fin	plosive	velar
k:k	geminate of k in quantity III		ekk	plosive	velar
dd	geminate of d		ita	plosive	alveolar
gg	geminate of g		ita	plosive	velar
g:	lengthened g		fin	plosive	velar
bb	geminate of b		ita	plosive	bilabial
b:	lengthened b		fin	plosive	bilabial
ttS	geminate of tS		ita	affricate	post-alveolar
tts	geminate of ts		ita	affricate	alveolar
ddZ	geminate of dZ		ita	affricate	post-alveolar
ddz	geminate of dz	zona	ita	affricate	alveolar
vv	geminate of v		ita	fricative	labio-dental
v:	lengthened v		fin	fricative	labio-dental
v:v	geminate of v in quantity III		ekk	fricative	labio-dental
ss	geminate of s		ita	fricative	alveolar
s:	lengthened s		fin	fricative	alveolar
s:s	geminate of s in quantity III		ekk	fricative	alveolar
zz	geminate of z		hun	fricative	alveolar
SS	geminate of S		ita	fricative	post-alveolar
S:	lengthened S		fin	fricative	post-alveolar
S:S	geminate of S in quantity III		ekk	fricative	post-alveolar
ZZ	geminate of Z		hun	fricative	post-alveolar
xx	geminate of x		hun	fricative	velar
rr	geminate of r		ita	trill	alveolar
r:	lengthened r		fin	trill	alveolar
r:r	geminate of r in quantity III		ekk	trill	alveolar
RR	geminate of R in quantity II		ekk	trill	uvular
nn	geminate of n		ita	nasal	alveolar
n:	lengthened n		fin	nasal	alveolar
n:n	geminate of n in quantity III		ekk	nasal	alveolar
NN	geminate of N	(Swiss German)	deu	nasal	velar
N:	lengthened N		fin	nasal	velar
N_j	palatalized velar nasal		ekk	nasal	velar
ww	geminate of w	(Swiss German)	deu	approximant	labio-velar
mm	geminate of m		ita	nasal	bilabial
m:	lengthened m	hommasta	fin	nasal	bilabial
m:m	geminate of m in quantity III		ekk	nasal	bilabial
FF	geminate of F		hun	nasal	labio-dental
LL	geminate of L		ita	lateral-approximant	palatal
ll	geminate of l		ita	lateral-approximant	alveolar
l:	lengthened l	jolla	fin	lateral-approximant	alveolar
l:l	geminate of l in quantity III		ekk	approximant	alveolar

JJ	geminate of J		ita	nasal	palatal
jj	geminate of j		ekk	approximant	palatal
j:	lengthened j		fin	approximant	palatal
j:j	geminate of j in quantity III		ekk	approximant	palatal
ff	geminate of f		ita	fricative	bilabial
f:	lengthened f		fin	fricative	bilabial
f:f	geminate of f in quantity III		ekk	fricative	bilabial
hh	geminate of h		ekk	fricative	glottal
h:	lengthened h		fin	fricative	glottal
h:h	geminate of h in quantity III		ekk	fricative	glottal
ttS_cl	closure of ttS		ita	affricate	post-alveolar
ttS_rl	release of ttS		ita	affricate	post-alveolar
tts_cl	closure of tts		ita	affricate	alveolar
tts_rl	release of tts		ita	affricate	alveolar
ddZ_cl	closure of ddZ		ita	affricate	post-alveolar
ddZ_rl	release of ddZ		ita	affricate	post-alveolar
ddz_cl	closure of ddz	zona	ita	affricate	alveolar
ddz_rl	release of ddz	zona	ita	affricate	alveolar
tS_cl	closure of tS		ita	affricate	post-alveolar
tS_rl	release of tS		ita	affricate	post-alveolar
ts_cl	closure of ts		ita	affricate	alveolar
ts_rl	release of ts		ita	affricate	alveolar
dZ_cl	closure of dZ		ita	affricate	post-alveolar
dZ_rl	release of dZ		ita	affricate	post-alveolar
dz_cl	closure of dz		ita	affricate	alveolar
dz_rl	release of dz		ita	affricate	alveolar
tt_rl	release of tt		ita	plosive	alveolar
tt_cl	closure of tt		ita	plosive	alveolar
pp_cl	closure of pp		ita	plosive	bilabial
pp_rl	release of pp		ita	plosive	bilabial
kk_cl	closure of kk		ita	plosive	velar
kk_rl	release of kk		ita	plosive	velar
dd_cl	release of dd		ita	plosive	alveolar
dd_rl	release of dd		ita	plosive	alveolar
gg_cl	release of gg		ita	plosive	velar
gg_rl	release of gg		ita	plosive	velar
bb_cl	release of bb		ita	plosive	bilabial
bb_rl	release of bb		ita	plosive	bilabial
t_cl	closure of t		ita	plosive	alveolar
t_rl	release of t		ita	plosive	alveolar
p_cl	closure of p		ita	plosive	bilabial
p_rl	release of p		ita	plosive	bilabial
k_cl	closure of k		ita	plosive	velar
k_rl	release of k		ita	plosive	velar
g_cl	closure of g		ita	plosive	velar
g_rl	release of g		ita	plosive	velar
d_cl	closure of d		ita	plosive	alveolar
d_rl	release of d		ita	plosive	alveolar
b_cl	closure of b		ita	plosive	bilabial
b_rl	release of b		ita	plosive	bilabial
<	recording initial silence		xxx	silence	silence
>	recording trailing silence		xxx	silence	silence
#	inter-word silence		xxx	silence	silence
<nib>	noise, non-human		xxx	noise	noise
<p:>	silence interval		xxx	silence	silence
<usb>	human noise, garbage		xxx	noise	noise
p_>	voiceless bilabial ejective	Georgian p'erangi	xxx	ejective	bilabial

t_>	voiceless alveolar ejective	Georgian zedat'ani	xxx	ejective	alveolar
ts_>	voiceless alveolar affricate ejective	Georgian ts'indebi	xxx	ejective	alveolar
ts‘	retroflex voiceless affricate	cyk	pol	affricate	retroflex
dz‘	retroflex voiced affricate	dzwon	pol	affricate	retroflex
3‘	retroflex front half open unrounded vowel	furs	use	vowel	front
tS_>	voiceless postalveolar affricate ejective	Georgian k'uch'is	xxx	ejective	post-alveolar
c_>	voiceless palatal ejective plosive	Georgian ch'	xxx	ejective	palatal
J-	voiced palatal plosive	Hungarian egy 'one'	xxx	plosive	palatal
k_>	voiceless velar ejective	Georgian uk'an	xxx	ejective	velar
q_>	voiceless uvular ejective	Georgian saavadmq'opo	xxx	ejective	uvular
p-	voiceless bilabial fricative	Japanese fu	xxx	fricative	bilabial
s‘	retroflex voiceless fricative	szyk	pol	fricative	retroflex
z‘	retroflex voiced fricative	żyto	pol	fricative	retroflex
j-	voiced palatal fricative	Spanish ayuda	xxx	fricative	palatal
M-	velar approximant	Spanish algo	xxx	approximant	velar
X-	voiceless pharyngeal fricative	Arabic h.â	xxx	fricative	pharyngeal
?-	voiced pharyngeal fricative	Arabic 'ayn	xxx	fricative	pharyngeal
h-	voiced glottal fricative	English	use	fricative	glottal
r-	alveolar approximant	English run	xxx	approximant	alveolar
N=	syllabic velar nasal	English walking	use	nasal	velar
n=	syllabic alveolar nasal	English Boston	use	nasal	alveolar
m=	syllabic bilabial nasal	English bottom	use	nasal	bilabial
l=	syllabic lateral	English bridal	use	lateral-approximant	alveolar

5.4 Version history

1.9 (2016-01-19)	• Better errors in textwindow. • Phonetizer file selector in settings. • Added the errors to align tier. • Temp files are cleaned up before alignment, therefore no ghost annotations when the alignment has failed.
1.8 (2015-11-19)	• Added support for `Sound`. • Changed email address of author. • Elaborated the installation instructions. • Splitted up the model and phonetizer selection. • Cleaned up the phone specifications. • Added an universal phonetizer. • Big book update with structural changes.
1.7a (2015-10-13)	• Fixed critical tier creation bug. • Added version to settings window.
1.7 (2015-10-08)	• More robuust tier creation. • Some typos fixed in the manual. • Updated the bibtex snippet. • Better tier alignment when the tier is empty. • Corrected some spelling errors. • Tidied the makefile for the book.
1.6a (2015-09-29)	• Fixed the dictionary generator for English. • Correctly added websites to the authors of the models.
1.60 (2015-09-07)	• Fixed menu name from `force` to `forced`. • Fixed silence problem in experimental models. • Added version to setup dialog. • Added language for using the general sampa model without phonetizer. • Created a better error when loading rulesets or dictionaries in non supported encodings or non existent files. • Changed the licence to MIT.
1.50 (2015-07-07)	• Spanish models merged in original master. • Procedures in different file, thus cleaner code. • Reinitialized repo. • Faster book compilation.
1.40 (2015-07-01)	• Added branch for own spanish models. • Updated book about ruleset. • Changed name in menu from `Setup...` to `Set up...`.
1.39 (2015-04-01)	• Fixed tier alignment.
1.3 (2015-03-25)	• Added option for custom python path. • Greatly simplified rulesets.
1.2 (2015-02-18)	• Simplified installation scripts. • Fixed a unicode bug in generating dictionaries.
1.1 (2015-01-30)	• Implemented better error messaging. • Simplified the python code into one file. • Fixed a bug that leaded to a messed up view. • Fixed small phonetization errors.
1.0 (2015-01-09)	• Converted the readme to a pdf. • Speeded up the process by disabling pitch, intensity, spectrum, pulses and formants while aligning, the settings do get restored afterwards. • Fixed a bug that leaded to a messed up view.
0.9a (2014-12-02)	• Small bugfix in dictionary generation fixed.
0.9	• Cleaned up some parts of the readme.

	• Added language specific information. • Added english as language. Although there is no phonetizing implemented. • README.html better with light background for code blocks. • Updated citing method with bibtex.
0.8 (2014-10-31)	• Removed all the binary folders. • Made the binary finding interactive. • Made all the file chooser dialogs interactive.
0.7 (2014-10-29)	• Added windows support. • Cleaned up documentation. • Removed binaries due htk licence.
0.6 (2014-10-22)	• Refactored and cleaned up the source.
0.5a (2014-09-08)	• Added comments to source code(praat). • Cleaned up source.
0.5 (2014-09-04)	• Fixed acronyms in spanish. • Fixed cleaning with extended boundaries. • Added rudimentary ruleset implementation.
0.4 (2014-08-29)	• Added option for enlarging the boundaries automatically.
0.21 (2014-08-13)	• Settings split in non interactive and interactive so that the interactive one reflects the current settings.
0.2 (2014-08-11)	• Better mac compatibility.
0.1a (2014-06-30)	• Tier alignment fixed. • Readme for dutch.
0.08 (2014-04-29)	• Cleaned up some stuff. • Added dutch. • Readme for spanish and sampa.
0.07 (2014-04-28)	• Non interactive alignment implemented. • Table of contents in readme.
0.06 (2014-04-25)	• Conversion to editor scripts.
0.05 (2014-04-03)	• Better readme. • Functional program for linux.
0.04 (2014-04-03)	• Pronunciation variants implemented.
0.03 (2014-03-31)	• Aligner works in python.
0.02 (2014-03-27)	• Python script around aligner started. • Phonetizer skeleton done.

Table 5.5: Version history

Bibliography

[1] F. Schiel, "Automatic phonetic transcription of non-prompted speech," in *Proc. of the ICPhS 1999*, (San Francisco), pp. 607–610, 1999.