SPPAS

the automatic annotation and analysis of speech

Version 2.4

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Any and all constructive comments are welcome.

Contents

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Introduction

1.1 What is SPPAS?

1.1.1 Overview

SPPAS - the automatic annotation and analyses of speech is a scientific computer software package. SPPAS is daily developed with the aim to provide a robust and reliable software. Available for free, with open source code, there is simply no other package for linguists to simple use in both the automatic annotations of speech and the analyses of any kind of annotated data. You can imagine the annotations or analyses you need, SPPAS does the rest! It doesn't do? Send your suggestion to the author!

Annotating recordings is very labor-intensive and cost-ineffective since it has to be performed manually by experienced researchers with many hours of work. As the primary functionality, SPPAS proposes a set of **automatic or semi-automatic annotations of recordings**. In the present context, annotations are "defined as the practice of adding interpretative, linguistic information to an electronic corpus of spoken and/or written language data. 'Annotation' can also refer to the end-product of this process" (Leech, 1997). SPPAS automatizes the annotation processes and allows users to save time. In order to be used efficiently, SPPAS expects a rigorous methodology to collect data and to prepare them.

Linguistics annotation, especially when dealing with multiple domains, makes use of different tools within a given project. This implies a rigorous annotation framework to ensure compatibilities between annotations and time-saving. SPPAS annotation files are in a specific XML format with extension `xra`. **Annotations can be imported from and exported to a variety of other formats** including Praat (TextGrid, PitchTier, IntensityTier), Elan (eaf), Transcriber (trs), Annotation Pro (antx), Phonedit (mrk), Sclite (ctm, stm), HTK (lab, mlf), subtitles formats (srt, sub), CSV files…

"[…] when multiple annotations are integrated into a single data set, inter-relationships between the annotations can be explored both qualitatively (by using database queries that combine levels) and quantitatively (by running statistical analyses or machine learning algorithms)" (Chiarcos 2008). As a consequence, the annotations must be time-synchronized: annotations need to be time-aligned in order to be useful for purposes such as analyses. Some special features are offered in SPPAS for **managing annotated files and analyzing data**. Among others, it includes a tool to filter multi-levels annotations (Bigi and Saubesty, 2015). Other included tools are to estimate descriptive statistics, a version of the Time Group Analyzer (Gibbon 2013), manage annotated files, manage audio files, etc. These data analysis tools of SPPAS are mainly proposed in the

Graphical User Interface. However, advanced users can also access directly the Application Programming Interface, for example to estimate statistics or to manipulate annotated data.

1.1.2 User engagement

By using SPPAS, **you agree to cite a reference in your publications**. The full list of references is available in Chapter 7.

1.1.3 Need help

1. Many problems can be solved by updating the version of SPPAS.
2. When looking for more detail about some subject, one can search this documentation. This documentation is available in-line - see the SPPAS website, it is also included in the package in PDF format.
3. There is a F.A.Q. in the SPPAS web site.
4. There are tutorials in the SPPAS web site.
5. If none of the above helps, you may contact the author by e-mail. It is very important to indicate clearly:
    1. your operating system and its version,
    2. the version of SPPAS (supposed to be the last one), and
    3. for automatic annotations, send the log file, and a sample of the data on which a problem occurs.

1.1.4 About the author

Since January 2011, **Brigitte Bigi** is the main author of SPPAS. She has a tenured position of researcher at the French CNRS - Centre National de la Recherche Scientifique. She's working since 2009 at Laboratoire Parole et Langage in Aix-en-Provence, France.

More about the author:

- http://www.lpl-aix.fr/~bigi
- https://orcid.org/0000-0003-1834-6918

Contact the author by e-mail:

- to improve the quality of the linguistic resources,
- to add new linguistic resources,
- to help in development,
- to add new annotations or analysis methods,
- to declare an issue,
- or anything else!

Possible e-mails are:

- *contact@sppas.org* for general questions of users;
- *develop@sppas.org* for developer questions or for a bug alert.

Contributors

Here is the list of other contributors in programming:

- April 2012-June 2012: Alexandre Ranson;
- April 2012-July 2012: Cazembé Henry;
- April 2012-June 2013: Bastien Herbaut;
- March 2013-March 2014: Tatsuya Watanabe;
- April 2015-June 2015: Nicolas Chazeau;
- April 2015-June 2015: Jibril Saffi.

1.1.5 Licenses

SPPAS software, except documentation and resources, are distributed under the terms of the GNU GENERAL PUBLIC LICENSE v3.

Linguistic resources of SPPAS are either distributed:

- under the terms of the "GNU GENERAL PUBLIC LICENSE, v3", or
- on the terms of the "Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International Public License".

See the chapter 4 of this documentation for details about individual license of the proposed resources.

To summarize, SPPAS users are:

- free to study the source code and the resources of the software they use,
- free to share the software and resources with other people,
- free to modify the software and resources.

1.1.6 Supports

2011-2012:

Partly supported by ANR OTIM project (Ref. Nr. ANR-08-BLAN-0239), Tools for Multimodal Information Processing. Read more at: http://www.lpl-aix.fr/~otim/

2013-2015:

Partly supported by ORTOLANG (Ref. Nr. ANR-11-EQPX-0032) funded by the « Investissements d'Avenir » French Government program managed by the French National Research Agency (ANR). Read more at: http://www.ortolang.fr/

2014-2016:

SPPAS was also partly carried out thanks to the support of the following projects or groups:

- CoFee - Conversational Feedback http://cofee.hypotheses.org
- Variamu - Variations in Action: a MUltilingual approach http://variamu.hypotheses.org
- Team C3i of LPL http://www.lpl-aix.fr/~c3i
- Campus France, Procore PHC.

2017

The introduction of Naija language is supported by the French National Research Agency (ANR) NaijaSynCor.

1.2 Getting and installing

1.2.1 Websites

The main website of SPPAS is located at the following URL:

http://www.sppas.org

The source code with the most recent stable releases is hosted on github. From this website, anyone can download the current stable version and the development version:

https://github.com/brigittebigi/sppas

1.2.2 External programs

On the main website, it is possible to find information about the software requirements. In fact, other programs are required for SPPAS to operate. Of course, they must be installed before using SPPAS, and *only once*. This operation takes 5 up to 10 minutes depending on the operating system.

The following software are required:

1. Python 2.7.x
2. wxPython 3.0
3. julius >= 4.1 (and/or HVite 3.4)

It is very important to take care about the versions. With Python 3.4+, SPPAS provides all the features it is supposed to, except the Graphical User Interface.

An installation guide is available on the website, depending on the operating system: http://www.sppas.org/installation.html. **Please, closely follow the instructions.**

Notice that administrator rights are required to perform the installations. In case of difficulty arising from the installation of such software, you're invited to consult the web first. It probably will provide the right solution. If, however, the problems were to persist, contact the author by e-mail.

Figure 1.1: Operating systems

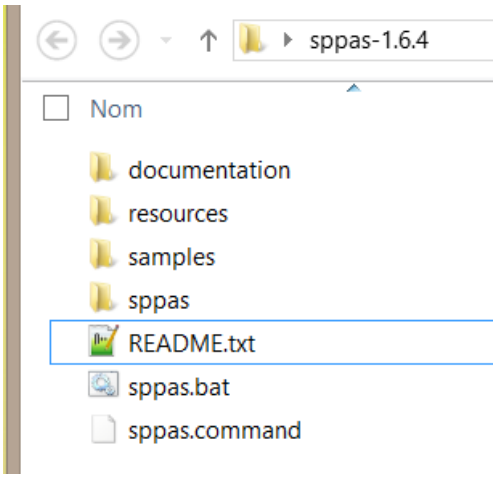

Figure 1.2: SPPAS Package content

1.2.3 Download and install SPPAS

The main website contains the `Download` page to download recent versions. There is a unique version of SPPAS which does not depend on the operating system. The only obvious difference depending on the system is how it looks on the computer screen.

SPPAS is ready to run, so it does not need elaborate installation. All you need to do is to copy the SPPAS package from the website to somewhere on your computer. Choose *a location with preferably only US-ASCII characters in the name of the path*.

The package of SPPAS is compressed and zipped, so you will need to *decompress and unpack* it once you've got it.

1.2.4 The package

Unlike many other software tool, SPPAS is not distributed as an executable program only. Instead, **everything is done so that users can check / change operation**. It is particularly suitable for automatic annotations: it allows anyone to adapt automatic annotations to its own needs. The package of SPPAS is then a directory with content as files and folders.

The SPPAS package contains:

- the `README.txt` file, which aims to be read
- the files `sppas.bat` and `sppas.command` to execute the Graphical User Interface
- the `resources` directory contains data that are used by automatic annotations (lexicons, dictionaries, …)
- the `samples` directory contains data of various languages; they are distributed to test various features of SPPAS
- the `plugins` directory
- the `sppas` directory contains the program itself
- the `documentation` directory contains:
  - the terms of the licenses
  - the printable documentation
  - the printable list of features
  - the printable version of the main reference published in "the Phonetician" journal
  - the orthographic transcription convention
  - the folder `scripting_solutions` is a set of python scripts corresponding to the exercises proposed in the chapter "Scripting with Python and SPPAS"

1.2.5 Update

SPPAS is constantly being improved and new packages are published frequently (about 10 versions a year). It is important to update regularly in order to get the latest functions and corrections.

Updating SPPAS is very easy and fast:

1. Download the last updated package from the web site;
2. Unpack the downloaded package.

1.3 Features

1.3.1 How to use SPPAS?

There are three main ways to use SPPAS:

1. The Graphical User Interface (GUI) is as user-friendly as possible:
   - double-click on the `sppas.bat` file, under Windows;
   - double-click on the `sppas.command` file, under MacOS or Linux.
2. The Command-line User Interface (CLI), with a set of programs, each one essentially independent of the others, that can be run on its own at the level of the shell.
3. Scripting with Python and SPPAS provides the more powerful way.

Features of SPPAS can then be used either with a Command-line User Interface (CLI) or a Graphical User Interface (GUI). So, there's no specific difficulty by using this software. Advanced users can also access directly the Application Programming Interface - API.

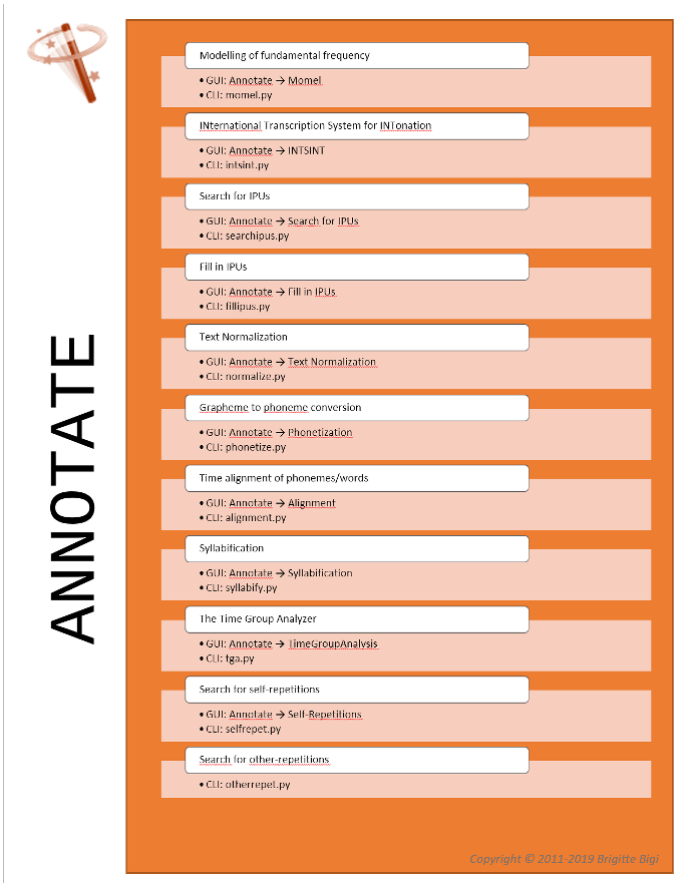

Figure 1.3: SPPAS Automatic annotations

1.3.2 What SPPAS can do?

Features of SPPAS can be divided into 3 categories:

1. Annotate
2. Analyze
3. Convert

The three next figures list the features of each category and the interface to get access to it.

1.4 Main and important recommendations

1.4.1 About files

There is a list of important things to keep in mind while using SPPAS. They are summarized as follows and detailed in the chapters of this documentation:

1. Speech audio files:
    - only `wav` and `au` files

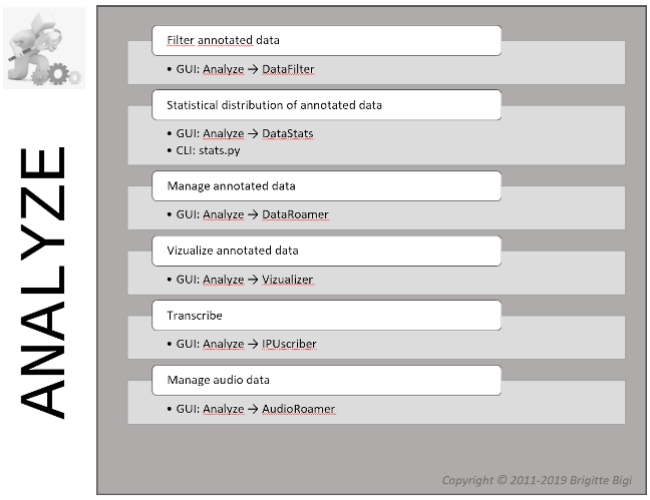

Figure 1.4: SPPAS Automatic analysis

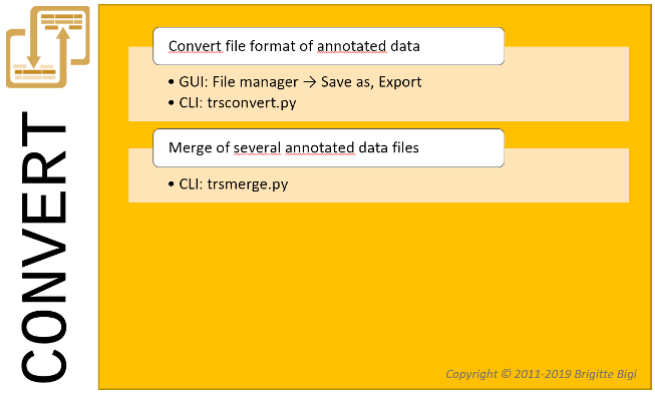

Figure 1.5: SPPAS Automatic file conversion

- only mono (= one channel)
- frame rate is preferably 16000hz
- bit rate is preferably 16 bits
- good recording quality is expected. It is obviously required to never convert from a compressed file, like mp3 for example.

2. Annotated data files:

   - *UTF-8* encoding only
   - it is recommended to use only US-ASCII characters in file names (including the path)

For audio files, other frame rates and bit rates are accepted: the audio file is converted in 16 bits/16000Hz in a copy of the file then SPPAS is using the latter.

1.4.2 About automatic annotations

The quality of the results for most of the automatic annotations is highly influenced by **the quality of the data the annotation takes in input**. This is a politically correct way to say: *Garbage in, garbage out!*

Annotations are based on the use of linguistic resources. Resources for several languages are gently shared and freely available in the package of SPPAS. The quality of the automatic annotations is largely influenced by **the quality of the linguistic resources**.

1.4.3 About linguistic resources

Users are of crucial importance for resource development. The users of SPPAS are invited to contribute to improve them. They can release the improvements to the public, so that the whole community benefits.

1.5 Interoperability and compatibility: convert files

In the scope of the compatibility between SPPAS data and annotated data from other software tools or programs, SPPAS is able to open/save and convert files.

The conversion of a file to another file is the process of changing the form of the presentation of the data, and not the data itself. Every time, when data file is to be used, they must be converted to a readable format for the next application. A data conversion is normally an automated process to some extent. SPPAS provide the possibility to automatically import and export the work done on some various file formats from a wide range of other software tools. For the users, the visible change will be only a different file extension but for software it is the difference between understanding of the contents of the file and the inability to read it.

The conversion of file formats is then a difficult task and it can imply that some data are left. Representing annotated data in SPPAS is of crucial importance for its automatic annotations, its analysis of annotations and for the software to be able to automatically annotate and analyze any kind of data files. SPPAS then includes an original and generic enough annotation representation framework. This framework for annotations is very rich and contain several information like alternative labels or alternative localizations of annotations, a tier hierarchy, controlled vocabularies, etc. A native format named XRA was then developed to fit in such data representation. The physical level of representation of XRA obviously makes use of XML, XML-related standards and stand-off annotation. Due to an intuitive naming convention, XRA documents are human readable as far as possible within the limits of XML.

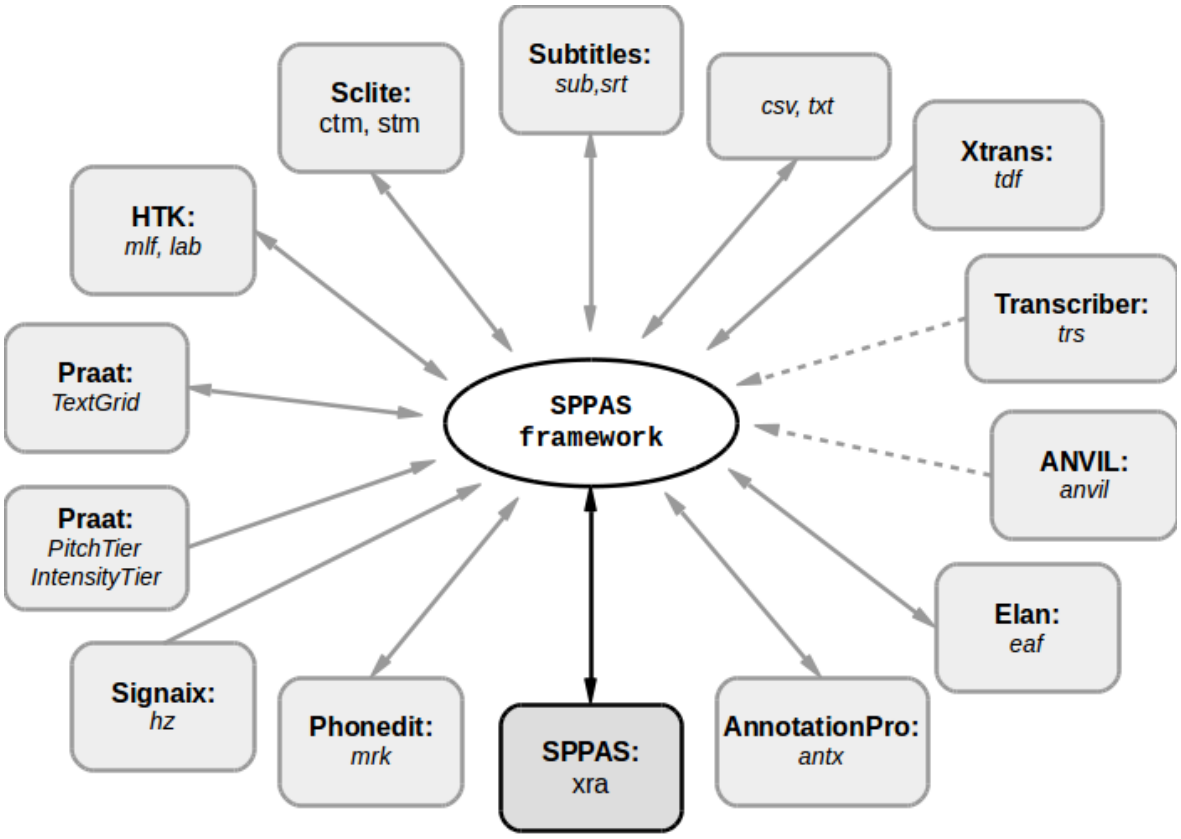

Figure 1.6: SPPAS conversion method and formats

SPPAS makes use of its internal data representation to convert files. A conversion then consists of two steps: First, the incoming file is loaded and mapped to the SPPAS data framework; and second, such data is saved to the expected format. These two steps are applied whatever the organization structure of annotations in the original or in the destination file format. This process allows SPPAS to import from and export to a variety of file formats. This is illustrated by the next Figure which includes the list of file formats and the corresponding software that are supported. Arrows are representing the following actions:

- import from, represented by a continued line with an arrow from the file format to the SPPAS framework;
- partially import from, represented by a dash line with an arrow from the file format to the SPPAS framework;
- export to, represented by an arrow from the SPPAS framework to the file format.

To summarize, SPPAS supports the following software with their file extensions:

- Praat: TextGrid, PitchTier, IntensityTier
- Elan: eaf
- Annotation Pro: antx
- Phonedit: mrk
- Sclite: ctm, stm
- HTK: lab, mlf
- Subtitles: srt, sub
- Signaix: hz

- Spreadsheets, R,…: csv
- Audacity, notepads: txt

And the followings can be imported:

- ANVIL: anvil
- Transcriber: trs
- Xtrans: tdf

The support of external formats is regularly extended to new formats by the author on-demand from the users and distributed to the community in the SPPAS regular updates.

1.6 About this documentation

This documentation is governed by GNU Free Documentation License, version 1.3. It will assume that you are using a relatively recent version of SPPAS. There's no reason not to download the latest version whenever released: it's easy and fast!

Any and all constructive comments are welcome.

2

User interfaces

2.1 Introduction

The current chapter describes how to manage workspaces, i.e a set of files and thier description. Then it describes how to use the Graphical User Interface (GUI) and the Command-line User Interface (CLI).

2.2 Workspaces

2.2.1 Overview

Since version 2.3, a workspace manager was introduced into SPPAS. It allows to manage the files and references. All the automatic annotations are using the workspaces.

2.2.2 Create and save workspace

A workspace is described in a configuration file into the folder “workspaces” of the SPPAS package. This file is made of the name of the workspace followed by the extension “.json”. It includes all properties of a workspace that are described in this chapter.

This configuration file can be copied into any other directory and re-imported into SPPAS.

2.2.3 File management

A workspace can manage a set of files. Each time a file is added into the workspace, its “root” and its “path” are extracted and stored into a tree-like architecture. Data are strutured as follow:

- a workspace contains a list of paths,
- each path contains the list of roots sharing this path,
- each root contains the list of file names sharing this root.

For example, if the file "/sppas/samples/samples-eng/oriana1.wav" is added into the workspace, the following next actions will be performed: - the path "/sppas/samples/samples-eng/" is created, - the root "/sppas/samples/samples-eng/oriana1" is created and added into the path, - the filename "/sppas/samples/samples-eng/oriana1.wav" is created and added into the root. Several properties of the file are also stored like its size and the date of modification. Then, when the file "/sppas/samples/samples-eng/oriana1.txt" is added into the workspace, its filename is created and inserted into the already existing root. The same is done each time a new annotation is creating a new file: oriana1.TextGrid, oriana1-token.TextGrid, etc.

The annotation manager is automatically searching for a given input pattern in the filename and is creating a file with a different output pattern. Notice that a pattern:

- must start by the character "-",
- must contain at least 2 characters.

Thanks to this new management of files, from version 2.4, the input and output patterns of the annotations can be modified. The second advantage of such management of files into a workspace is to add all files of a corpus only once into a workspace and to save it so that it is ready-to-use each time SPPAS is started.

To summarize, if we consider the file "/sppas/samples/samples-eng/oriana1-token.TextGrid", we have:

1. "/sppas/samples/samples-eng/" is the *path*
2. "/sppas/samples/samples-eng/oriana1" is the *root*
3. "/sppas/samples/samples-eng/oriana1-token.TextGrid" is the *filename*, in which: - "-token" is the *pattern*, - ".TextGrid" is the *extension*.

2.3 The graphical user interface

2.3.1 Launch SPPAS

The program will first check the version of wxpython and eventually ask to update. It will then check if the julius/hvite program can be accessed.

The main windows will open automatically. It is made of a menu (left), a title (top), the tips (middle), the list of files (left-middle), and the action buttons (right).

Windows

Once the SPPAS package is opened in the File Explorer, double-click on the `sppas.bat` file. In recent versions of Windows (e.g. 10), the first time you try to run SPPAS you may get a window with title "Windows protected your PC" and the following message: "Windows SmartScreen prevented an unrecognized app from starting. Running this app might put your PC at risk. More info". Click `More info` message and then `Run anyway` button. The file will now run SPPAS, and you will now no longer get a Windows protected your PC prompt when you run this specific file next time. This warning message comes from the fact that SPPAS is a free software and we did not paid to Microsoft commercial fees which would remove the "Unknown Publisher" warnings.

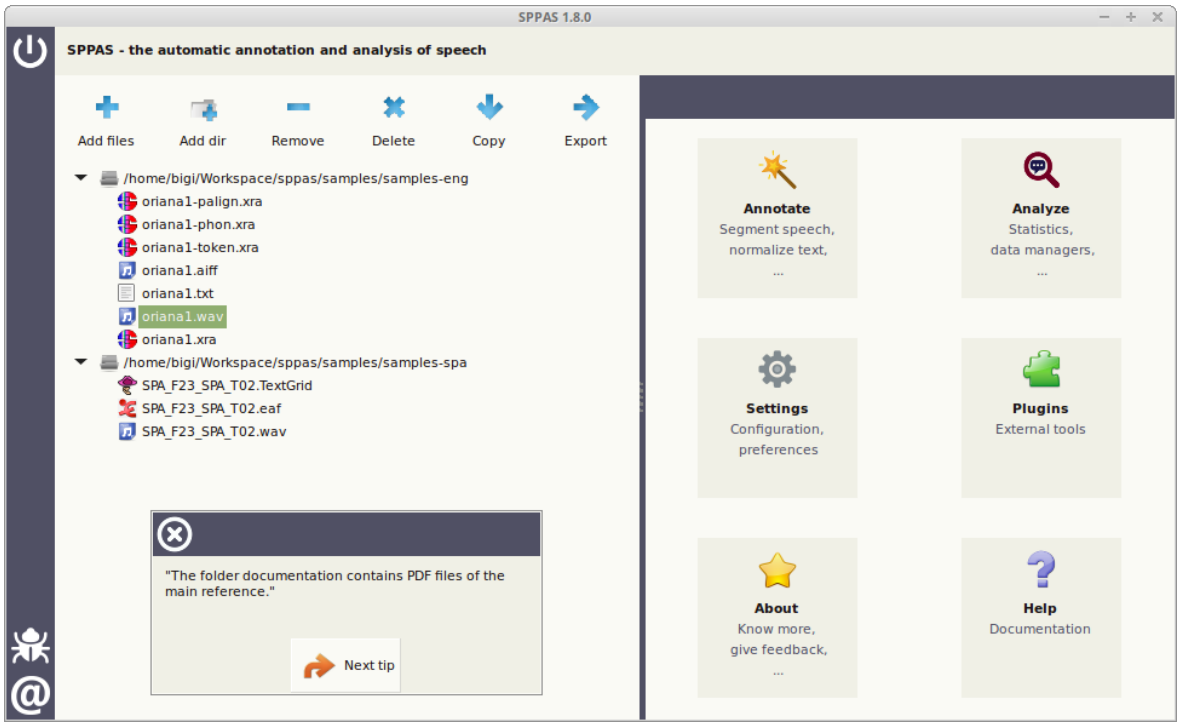

Figure 2.1: Main Frame of version 1.8.0

MacOS

Once the SPPAS package is opened in the Finder, double-click on the `sppas.command` file. In recent versions of MacOs X (e.g. from 10.11 El Capitan), the first time you try to run SPPAS you may get a message: "sppas.command can't be opened because it is from an unidentified developer.". This warning message comes from the fact that SPPAS is a free software and we did not paid to Apple commercial fees. The solution is to run SPPAS with a right click (alt-click) on sppas.command file. This time you will get a message: "sppas.command is from an unidentified developer. Are you sure you want to open it?" Then click on `Open`. It will also now work each time you run it.

Linux

Once the SPPAS package is opened in the Finder/File Explorer, double-click on the `sppas.command` file.

2.3.2 The tips

The frame includes message tips that are picked up randomly and printed to help users. Click on the button `Next Tip` to read another message, or click on the top-left button to close the tips frame. The `Settings` allows to show/hide tips at start-up. Anyone can suggest new tips to help other users. They have to be sent to the author by e-mail so that they will be included in the next version.

2.3.3 The menu

The menu is located at the left-side of the window. At top, a button allows to exit the program, and at bottom you can declare an issue or contact the author.

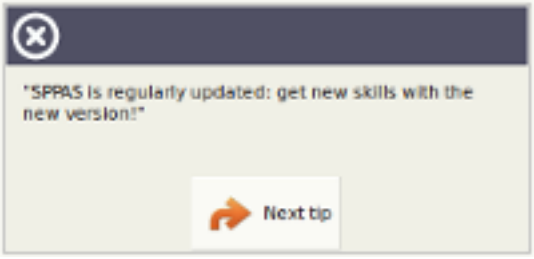

Figure 2.2: The tips included in the main frame

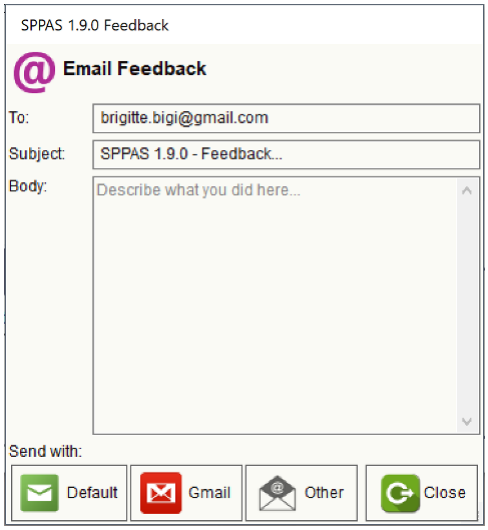

Figure 2.3: The Feedback Frame

The `Exit` button closes all SPPAS frames properly.

To declare an issue, click on the bug button of the menu, then your default web browser will be opened at the appropriate URL. Take a quick look at the list of already declared issues and if any, click on the green button “New Issue”.

To contact the author, replace the text “Describe what you did here…” by your own comment, question or suggestion and choose how to send the e-mail: with your own default mailer, with gmail opened in your web browser, or by another e-mail client. Then, close the frame by clicking on the “Close” button.

2.3.4 The file explorer

The list contains directories and files the user added. However, only files that SPPAS can deal with, e.g. depending on the file extension, can be appended to the list. Files with an unknown extension are rejected.

Remark: The files are added in the list, but they are not opened.

Select file(s)

To select a single file, all files of a directory or several files:

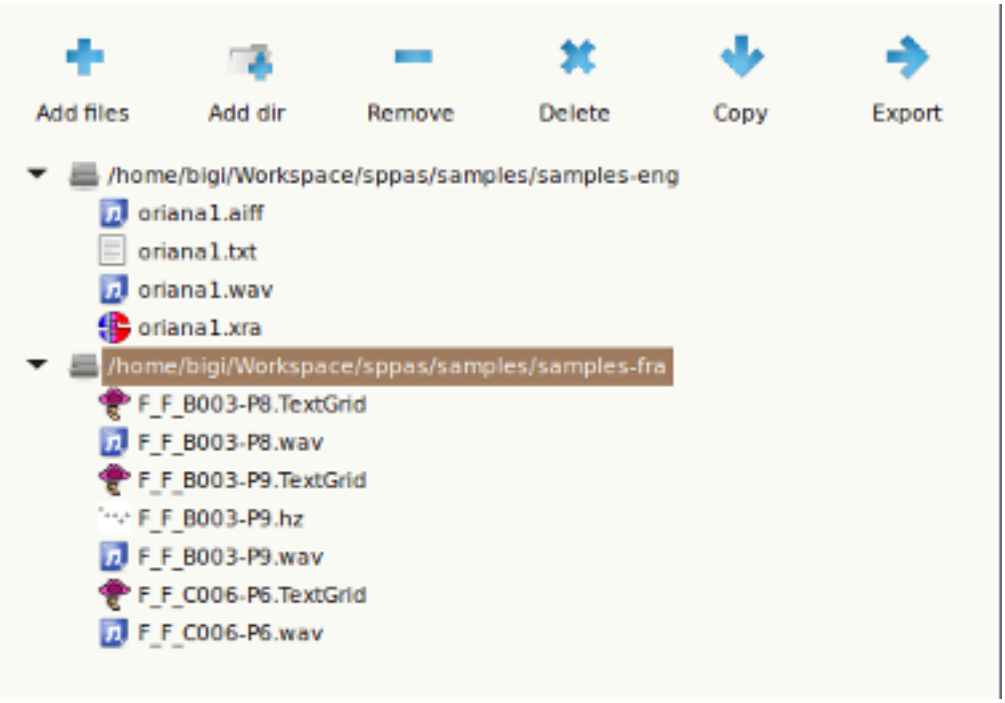

Figure 2.4: File explorer

- a single click on a file name highlights and selects the chosen file. If other files or directories were previously selected, they are deselected.
- a single click on a directory name highlights the chosen directory and selects all files. If other files or directories were previously selected, they are deselected.
- to select several files or directories, the `ctrl` key (Linux/Windows) or `CMD` key (Apple) must be pressed while clicking each file or directory.
- to select several files or directories, the `shift` key can be pressed while clicking two files or directories.

Add file(s)

A single-click on the `Add files` button opens a window that allows to select the files to get. By default, only files with ".wav" extensions are proposed. When audio file(s) is/are selected, all files with the same name are automatically added into the file explorer.

The wildcard of this window can be changed to some other specific file extensions and then other files can be selected.

In both cases, only files with an appropriate extension will be added in the file explorer.

Add a directory

A single-click on the `Add dir` button opens a window that allows to select the directory to get. Each audio file, and all related files - i.e. with the same name and with an appropriate extension, will be added into the file explorer.

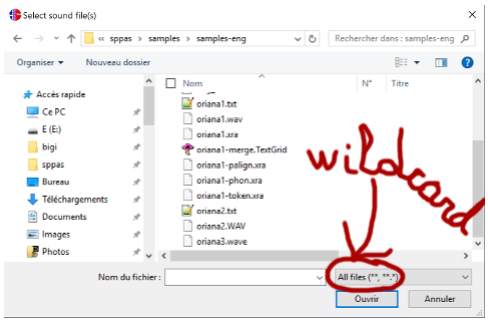

Figure 2.5: Adding specific files

Remove file(s)

A single-click on the `Remove` button removes the selected files/directories of the list. Notice that files are not deleted from the disk.

Delete file(s)

A single-click on the `Delete` button deletes *definitively* the selected files/directories of your computer, and remove them of the list. Notice that there is no way to get them back!

A dialogue window will open, and you have to confirm or cancel the definitive file(s) deletion.

Copy file(s)

A single-click on the `Copy` button allows to copy the selected file(s), change their name and/or change the location. It is also possible to change the file format by assigning the appropriate file extension.

Export file(s)

Export annotated files in an other format (csv, txt, …):

After the export, a new window opens to report whether the file(s) were exported successfully or not. Actually, an export fails if: - the given file is not in UTF-8 encoding; - the given file contains several tiers and the output format supports only one; - the given file contains corrupted annotations.

2.3.5 Settings

To change user preferences, click on the `Settings` icon, then choose your preferred options in the tabs:

- General: fix background color, font color and font of the GUI, and enable/disable tips at start-up.
- Theme: fix how the icons of the GUI will look like.
- Annotations: fix automatic annotations parameters.

These preferences can be saved in a file to be used each time SPPAS is executed. Finally, to close the settings window, click on:

- “Cancel” button to ignore changes;
- “Close” to apply changes then close the window.

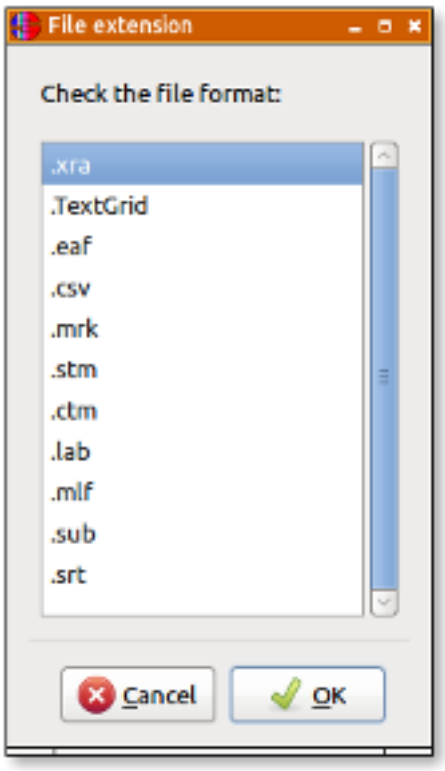

Figure 2.6: Export: Check the expected format in the list

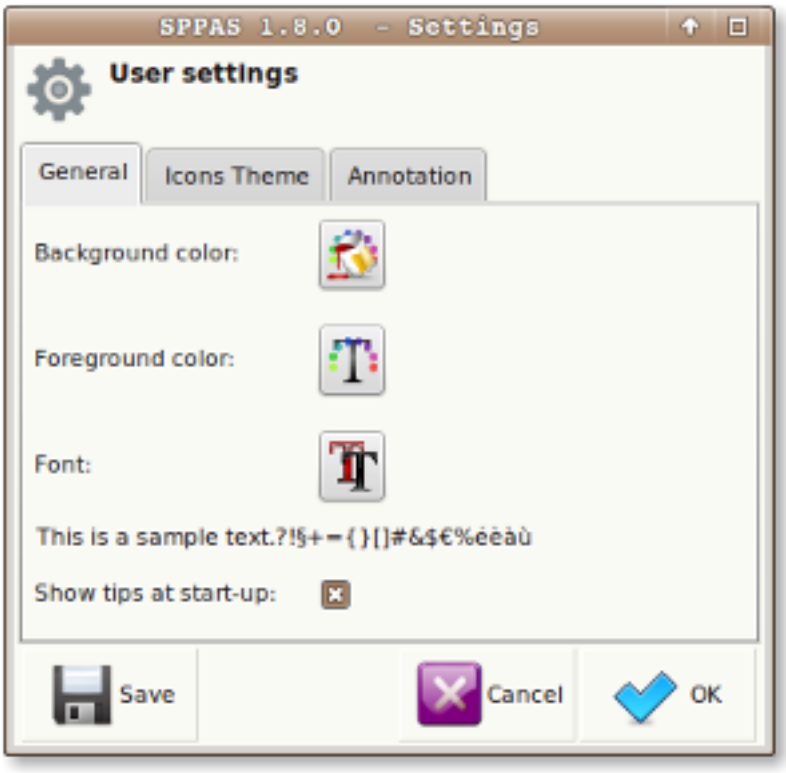

Figure 2.7: Settings is used to manage user preferences

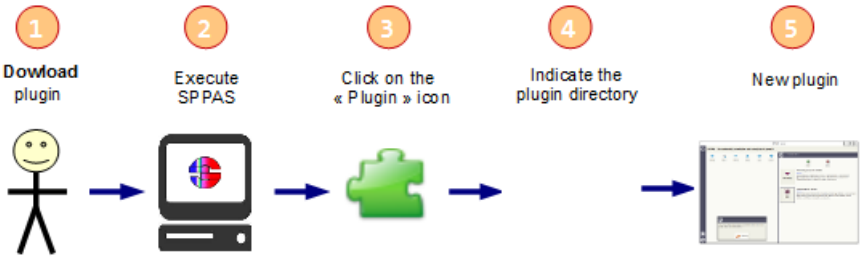

Figure 2.8: Installing a new Plugin

2.3.6 About

The `About` action button allows to display the main information about SPPAS: author, license, a link to the web site, etc.

2.3.7 Help

No longer available. Use this documentation instead.

2.3.8 Plugins

Installing plugins is a very useful solution to extend the features of SPPAS. Several plugins are available for download in the main site of SPPAS. The plugins of SPPAS are installed in a folder with name “plugins” in the main directory of SPPAS.

> The plugin system of SPPAS was fully changed at version 1.8.2; and plugins were all updated at version 1.9.0. Old plugins and new ones are not compatibles.

Installing a plugin

To install a plugin, simply follow this workflow:

1. Download the plugin package - e.g. a zip file.
2. Execute SPPAS.
3. Click on the ‘Plugin’ icon then click on the ‘Install’ button of the toolbar.
4. Browse to indicate the plugin package.
5. See the new plugin icon in the plugins list.

Deleting a plugin

To delete a plugin, click on the “Delete” button of the toolbar. Choose the plugin in the given list then click on the “OK” button. Notice that the plugin is definitively deleted of the disk.

Using a plugin

To execute a plug-in, select file(s) in the File explorer, click on the icon of the plug-in and follow instructions of the plugged program.

2.4 The command-line user interface

A command-line user interface (CLI) is a means of interacting with a computer program where the user issues commands to the program in the form of successive lines of text (command lines). Command-line interfaces provide a more concise and powerful means to control the program than the GUI.

Operating system command line interfaces are called a command-line interpreter, command processor or shell. It displays a prompt, accept a "command line" typed by the user terminated by the Enter key, then execute the specified command and provide textual display of results or error messages. When a shell is active a program is typically invoked by typing its name followed by command-line arguments (if any).

Such programs are located in the `bin` folder of the `sppas` directory of the package. All these programs are written with the programming language Python and are both compatible with version 2.7 and 3.4+. They do not use a GUI so that installing wxPython is not required. The `alignment.py` program also requires Julius or HVite.

2.4.1 Usage

It is usual for a program to be able to display a brief summary of its parameters. Each program included in SPPAS provides its usage by using the option `--help`, as for example:

```
prompt> python .\sppas\bin\trsconvert.py --help
usage: trsconvert.py [files] [options]

... a program to export annotated files.

optional arguments:
  -h, --help   show this help message and exit
  --quiet      Disable the verbosity
  --debug      Highest level of verbosity

Files:
  -i file      Input annotated file name.
  -o file      Output annotated file name.

Options:
  -n value     Number of a tier (use as many -n options as wanted). Positive
               or negative value: 1=first tier, -1=last tier.
  -t tiername  Name of a tier (use as many -t options as wanted).

This program is part of SPPAS version 2.0. Copyright (C) 2011-2019 Brigitte
Bigi. Contact the author at: contact@sppas.org
```

2.4.2 Arguments for input/output

In most of the programs, there is an option '-i' for the input file. There's no specific constraint on this file name. For example, the following program will execute the Momel automatic annotation:

```
python .\sppas\bin\momel.py -i .\samples\samples-eng\ENG_M15_ENG_T02.PitchTier
```

With this option '-i', a name of an output file can be given with the option '-o'; if not, the main part of the result is printed on the standard output.

In several programs, an option '-I' can also be available to execute the program, and several files can be processed with this option. Moreover, there is some flexibility in file names with this option. SPPAS will search for the appropriate file from the given file name. For example, the next commands will proccess the same:

```
python .\sppas\bin\intsint.py -I .\samples\samples-eng\ENG_M15_ENG_T02.wav
python .\sppas\bin\intsint.py -I .\samples\samples-eng\ENG_M15_ENG_T02.PitchTier
python .\sppas\bin\intsint.py -I .\samples\samples-eng\ENG_M15_ENG_T02-momel.xra
```

With the option '-I', the name of the output file is fixed and can't be changed. For example, the previous example will create a file with name `.\samples\samples-eng\ENG_M15_ENG_T02-intsint.xra`. An option '-e' allows to choose the extension of the file, *.xra* is the default one.

The options to manage input/output files can be summarized as follow:

```
Files (manual mode):
  -i file               An input file.
  -o file               Output file name (optionnal).

Files (auto mode):
  -I file               Input file (append).
  -e .ext               Output file extension. One of: .xra .TextGrid .eaf
                        .csv .mrk .txt .stm .ctm .lab .mlf .sub .srt .antx
                        .arff .xrff
```

3

Automatic Annotations

3.1 Introduction

3.1.1 About this chapter

This chapter is not a description on how each automatic annotation is implemented and how it's working: references are available for that in chapter 7.

Instead, this chapter describes how each automatic annotation can be used in SPPAS, i.e. what is the goal of the annotation, what are the requirements, what kind of resources are used, what is the expected result and how to perform it within SPPAS.

Each automatic annotation process is illustrated as a workflow schema, where:

- blue boxes represent the name of the automatic annotation;
- red boxes represent tiers, with their name in white;
- green boxes indicate the resource;
- yellow boxes indicate the annotated file either given as input or produced as result.

3.1.2 Annotations methodology

The kind of process to implement in the perspective of obtaining rich and broad-coverage multimodal/multi-levels annotations of a corpus is illustrated in next Figure. It describes each step of the annotation workflow. This Figure must be read from top to bottom and from left to right, starting by the recordings and ending to the analysis of annotated files. Yellow boxes represent manual annotations, blue boxes represent automatic ones.

After the recording, the first annotation to perform is IPUs segmentation. Indeed, at a first stage, the audio signal must be automatically segmented into Inter-Pausal Units (IPUs) which are blocks of speech bounded by silent pauses of more than X ms, and time-aligned on the speech signal. **An orthographic transcription has to be performed manually inside the IPUs**. Then text normalization automatic annotation will normalize the orthographic transcription. The phonetization process will convert the normalized text in a set of pronunciations using X-SAMPA standard. Alignment will perform segmentation at phonemes and tokens levels, etc.

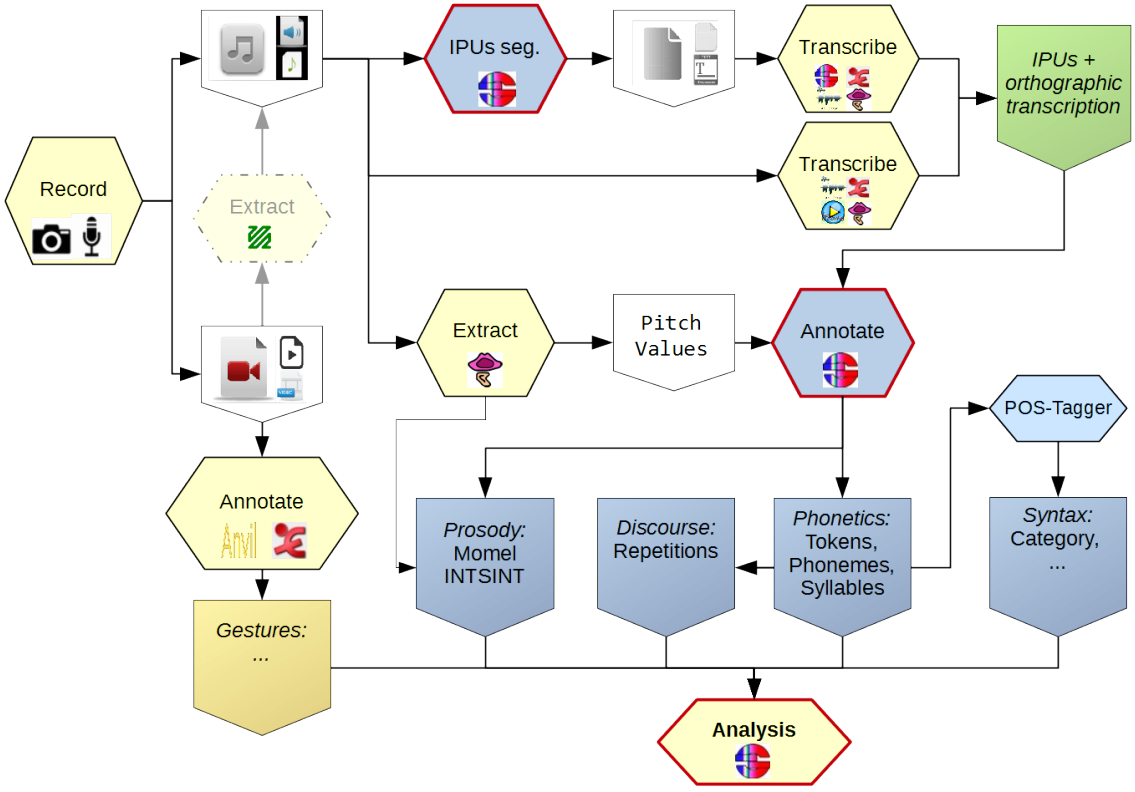

Figure 3.1: Annotation methodology

At the end of each automatic annotation process, SPPAS produces a *Procedure Outcome Report* that contains important information about the annotations. This window opens in the scope to be read by users (!) and can be saved with the annotated corpus. It mentions all parameters and eventually warnings and errors that occurred during the annotation process.

Among others, SPPAS is able to produce automatically annotations from a recorded speech sound and its orthographic transcription. Let us first introduce what is required in terms of files, and what is the exactly meaning of "recorded speech" and "orthographic transcription".

3.1.3 File formats and tier names

When using the Graphical User Interface, the file format for input and output can be fixed in the Settings and is applied to all annotations. However, while using the GUI to annotate, the file names of each annotation is already fixed. It is made of the root of the file, followed by a pattern then the file extension. For example "oriana1-palign.TextGrid" is made of the root "oriana1", the pattern "-palign" and the extension ".TextGrid". Each annotation allows to fix manually the pattern and to choose the extension among the list of the supported ones. Notice that the pattern should start with the "-" (minus) character.

However, **the name of the tiers the annotations are using and producing are fixed and can't be changed**!

3.1.4 Recorded speech

Only `wav` and `au` audio file formats are supported by SPPAS.

Only mono audio files are supported by SPPAS.

SPPAS verifies if the audio file is 16 bits sample rate and 16000 Hz frame rate. Otherwise it automatically create a copy of the audio file converted to this configuration. For very long files, this process may take time. So, the following 2 options are possible:

1. be patient;
2. prepare by your own the required wav/mono/16000Hz/16bits files to be used in SPPAS.

Secondly, a relatively good recording quality is expected. Providing a guideline or recommendation for that is impossible, because it depends on many factors. For example, "IPU segmentation" requires a better quality compared to what is expected by "Alignment", and for that latter, it depends on the language. The quality of the result of automatic annotations highly depends on the quality of the audio file. SPPAS simply performs automatic annotations: It does not make sense to hope for miracles but you can expect good enough results that will allow you to save your precious time! And it begins by taking care of the recordings…

3.1.5 Automatic Annotations with GUI

To perform automatic annotations with SPPAS Graphical User Interface, select first the list of audio files and/or a directory, then click on the "Annotate" button.

1. Enable each annotation to perform by clicking on the button in red. It will be turned green.
2. Select options and configure each annotation by clicking on the "Configure…" link text in blue.

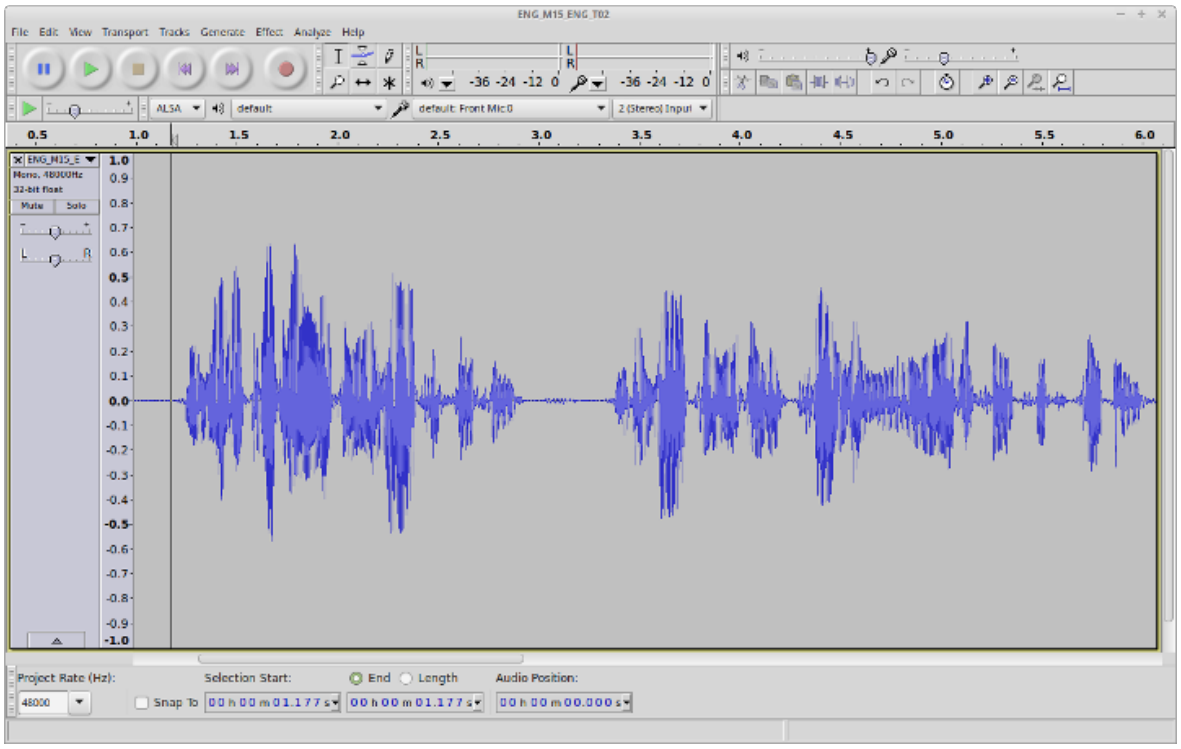

Figure 3.2: Example of expected recorded speech

3. Select the language for all annotations in one; or for each annotation independently by clicking on the "chains" button first then selecting each language.

4. Click on the *Perform annotations* button, and wait. Be patient! Particularly for Text Normalization or Phonetization: loading resources (lexicons or dictionaries) can be very long. Sometimes, the progress bar does not really show the progress… it depends on the operating system and the power of the computer. So, just wait!

5. It is important to read the Procedure Outcome report to check that everything happened normally during the automatic annotations. This report is saved in the ".logs" folder of the SPPAS package.

3.1.6 Automatic Annotations with CLI

To perform automatic annotations with SPPAS Command-line User Interface, there is a main program `annotation.py`. Each annotation has also its own program with more options than the previous one.

This main program performs automatic annotations on a given file or on all files of a directory. It strictly corresponds to the button `Perform annotations` of the GUI. All annotations are pre-configured: no specific option can be specified. Such options of annotations are stored in files with extension `.json` in `sppas/etc` folder.

```
usage: python .\sppas\bin\annotation.py -I file|folder [options]


optional arguments:
  -h, --help        show this help message and exit
  --log file        File name for a Procedure Outcome Report (default: None)
```

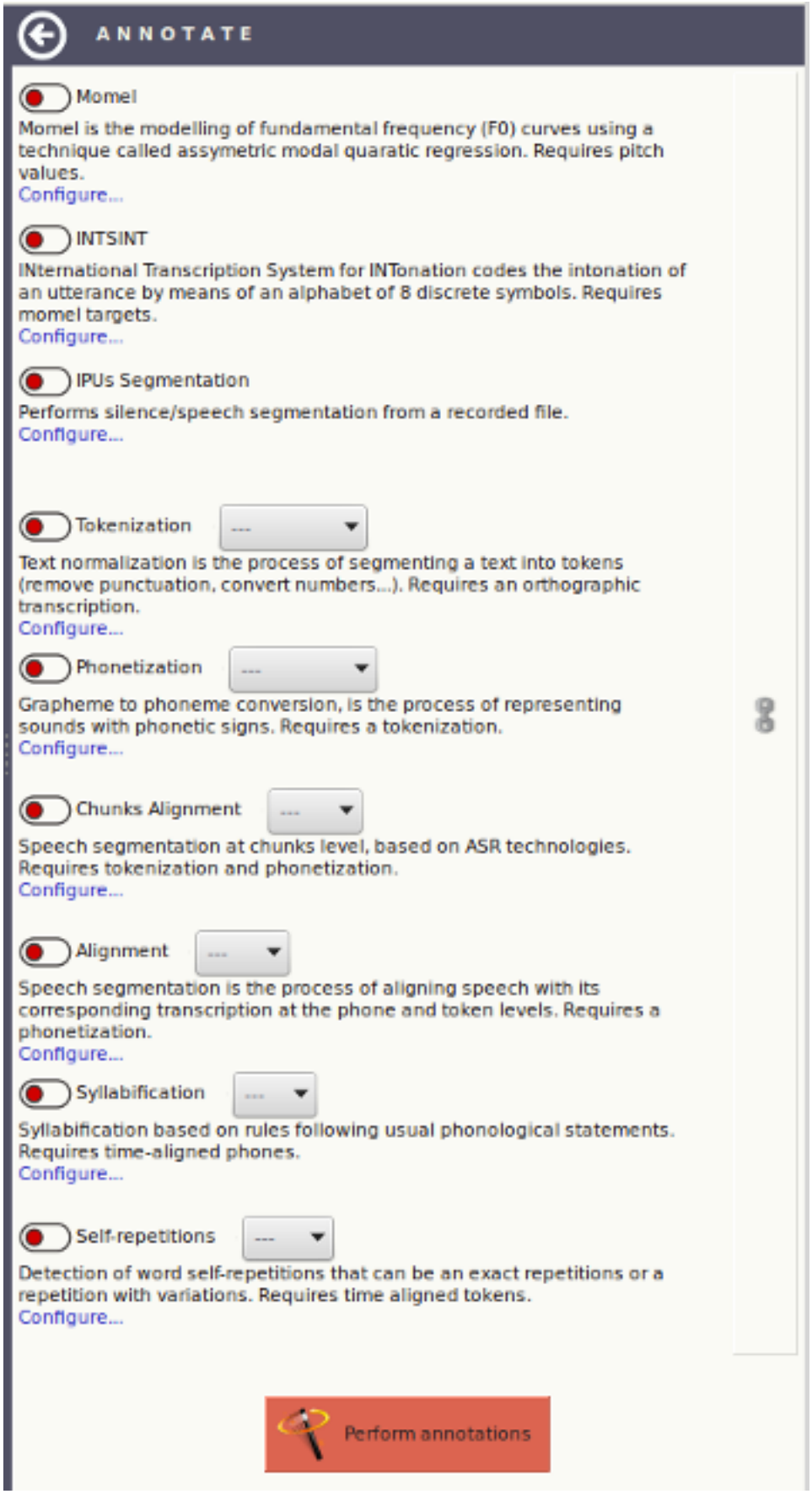

Figure 3.3: The annotate panel

```
  --momel          Activate Momel
  --intsint        Activate INTSINT
  --fillipus       Activate Fill in IPUs
  --searchipus     Activate Search for IPUs
  --textnorm       Activate Text Normalization
  --phonetize      Activate Phonetization
  --alignment      Activate Alignment
  --syllabify      Activate Syllabification
  --tga            Activate Time Group Analysis
  --activity       Activate Activity
  --selfrepet      Activate Self-Repetitions
  --otherrepet     Activate Other-Repetitions
  --reoccurrences  Activate Re-Occurrences
  --merge          Create a merged file with all the annotations

Files:
  -I file|folder   Input transcription file name (append).
  -l lang          Language code (iso8859-3). One of: por eng ita kor deu nan
                   vie und hun spa cat pol yue fra pcm yue_chars cmn jpn.
  -e .ext          Output file extension. One of: .xra .TextGrid .eaf .csv
                   .mrk .txt .stm .ctm .lab .mlf .sub .srt .antx .arff .xrff
```

Examples of use:

```
./sppas/bin/annotation.py -I .\samples\samples-eng
                          -l eng
                          -e .TextGrid
                          --fillipus --textnorm --phonetize --alignment
```

A progress bar is displayed for each annotation if the Terminal is supporting it (`bash` for example). Instead, the progress is indicated line-by-line (Windows PowerShell for example).

3.1.7 The procedure outcome report

It is very important to read conscientiously this report: it mentions exactly what happened during the automatic annotation process. This text can be saved: it is recommended to be kept it with the related data because it contains information that are interesting to know for anyone using the annotations.

All reports are stored in the ".logs" folder of the SPPAS package.

The text first indicates the version of SPPAS that was used. This information is very important. Annotations in SPPAS and their related resources are regularly improved and then, the result of the automatic process can change from one version to the other one.

Example:

```
SPPAS version 1.9.0
Copyright (C) 2011-2017 Brigitte Bigi
Site web: http://www.sppas.org/
Contact: Brigitte Bigi(brigite.bigi@gmail.com)
```

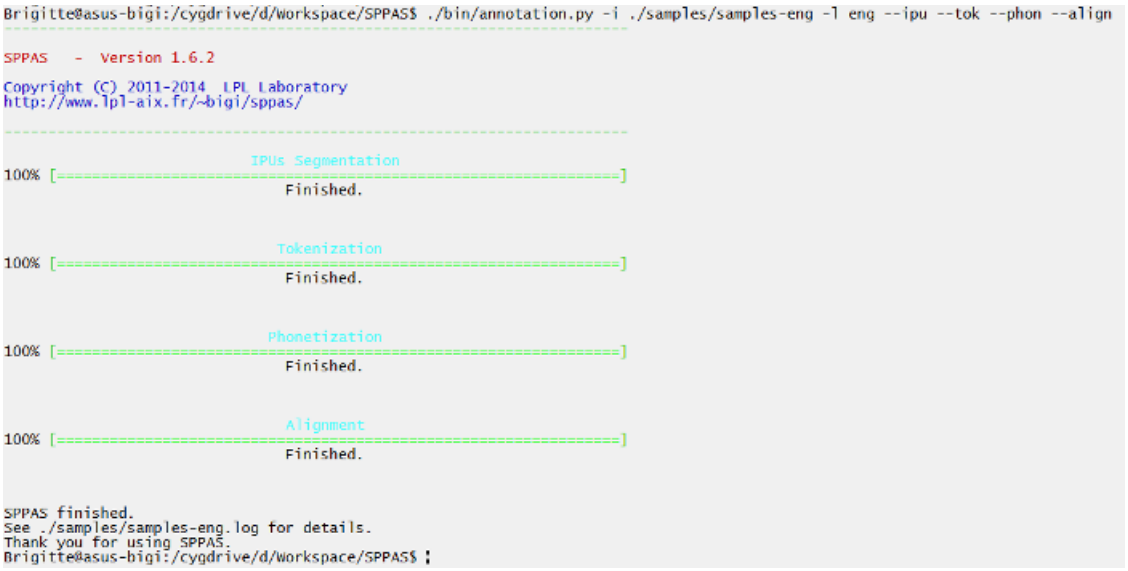

Figure 3.4: CLI: annotation.py output example

Secondly, the text mentions information related to the given input:

1. the selected language of each annotation, only if the annotation is language-dependent). For some language-dependent annotations, SPPAS can still perform the annotation even if the resources for a given language are not available: in that case, select “und”, which is the iso639-3 code for “undetermined”.
2. the list of files to be annotated.
3. the list of annotations and if each annotation was activated or disabled. In that case, activated means that the checkbox of the AAP was checked by the user and that the resources are available for the given language. On the contrary, disabled means that either the checkbox of the AAP was not checked or the required resources are not available.
4. the file format of the resulting files.

Example:

```
Date: 2017-07-05 12:15:40.637000
Langages selectionnés:
  - Momel:
  - INTSINT:
  - IPUs Segmentation:
  - Text Normalization: eng
  - Phonetization: eng
  - Alignment: eng
  - Syllabification: und
  - Self-repetitions: eng
--------------------------------------------------------------------------------
Fichiers sélectionnés:
  - oriana1.wav
--------------------------------------------------------------------------------
Annotations sélectionnées:
  - Momel: désactivé
  - INTSINT: désactivé
```

```
  - IPUs Segmentation: sélectionné
  - Text Normalization: sélectionné
  - Phonetization: sélectionné
  - Alignment: sélectionné
  - Syllabification: désactivé
  - Self-repetitions: désactivé
--------------------------------------------------------------------------------
Extension de fichiers: .xra
```

Thirdly, each automatic annotation is described in details, for each annotated file. At a first stage, the list of options and their value is summarized. Example:

```
... Text Normalization du fichier oriana1.wav
...  ... Options:
...  ...  ...  - faked: True
...  ...  ...  - std: False
...  ...  ...  - custom: False
```

Then, a diagnosis of the given file is printed. This latter can be: 1. “Valid”: the file is relevant 2. “Admit”: the file is not as expected but SPPAS will convert it in a copy and work on it. 3. “Invalid”: SPPAS can’t work with that file. The annotation of this file is disabled. In case 2 and 3, a message indicates the origin of the problem.

Example of “Valid” diagnosis:

```
...  ... Diagnostic:
...  ...  ...  - oriana1.xra: Valide.
```

Example of “Admit” diagnosis:

```
...  ... Diagnostic:
...  ...  ...  - M_3.wav: Admis. La taux d’échantillonage d’un fichier audio est
 de préférence 16000 Hz. Ce fichier est échantilloné à 44100 Hz, SPPAS créera une
 copie et travaillera sur celle-ci.
...  ...  ...  - M_3-phon.xra: Valide.
...  ...  ...  - M_3-token.xra: Valide.
```

Then, if any, the annotation procedure prints message. Four levels of information must draw your attention:

1. “[OK]” means that everything happened normally. The annotation was performed successfully.
2. “[IGNORE]” means that SPPAS ignored the file and didn’t do anything.
3. “[WARNING]” means that something happened abnormally, but SPPAS found a solution, and the annotation was still performed successfully.
4. “[ERROR]” means that something happened abnormally and SPPAS failed to found a solution. The annotation was either not performed, or performed with a bad result.

Example of “Warning” message:

```
...  ... Export AP_track_0711.TextGrid
...  ... into AP_track_0711.xra
...  ... [ IGNORE  ] because a previous segmentation is existing.
```

Example of “Warning” message:

```
...  ...  ... [ WARNING  ] chort- est absent du dictionnaire et a été phonétisé
 automatiquement S-o-R-t
```

At the end of the report, the “Result statistics” section mentions the number of files that was annotated for each step, or -1 if the annotation was disabled.

3.2 New language support

Some of the annotations are requiring linguistic resources in order to work efficiently on a given language: text normalization requires a lexicon, phonetization requires a pronunciation dictionary, etc. Each section of this chapter which is describing an annotation is also including *the way to create the related resource*. The next chapter contains details about the existing resources - list of phonemes, authors, licenses, etc.

While starting SPPAS, the Graphical User Interface dynamically creates the list of available languages of each annotation by exploring the related folder. This means that:

- appended resources are automatically taken into account (ie. there’s no need to modify the program itself);
- SPPAS needs to be re-started if new resources are appended while it was already being running.

3.3 Orthographic Transcription

An orthographic transcription is often the minimum requirement for a speech corpus so it is at the top of the annotation procedure, and it is the entry point for most of the automatic annotations. *Transcription conventions* are then designed to provide rules for writing speech corpora. These conventions establish which are the phenomena to transcribe and also how to mention them in the orthography.

In speech, many phonetic variations occur. Some of these phonologically known variants are predictable and can be included in the pronunciation dictionary but many others are still unpredictable like invented words, regional words or words borrowed from another language. These specifics have a direct consequence on the automatic phonetization procedure (Bigi 2012). As a consequence, from the beginning of its development it was considered to be essential for SPPAS to deal with an **Enriched Orthographic Transcription**.

The transcription convention is summarized below. Notice that all the symbols must be surrounded by whitespace. The file `TOE-SPPAS.pdf` available in the `documentation` folder gives details of the convention, including examples of what is recommended.

Convention overview:

- truncated words, noted as a ‘-’ at the end of the token string (an ex- example);
- noises, noted by a ’*’ (not available for some languages);

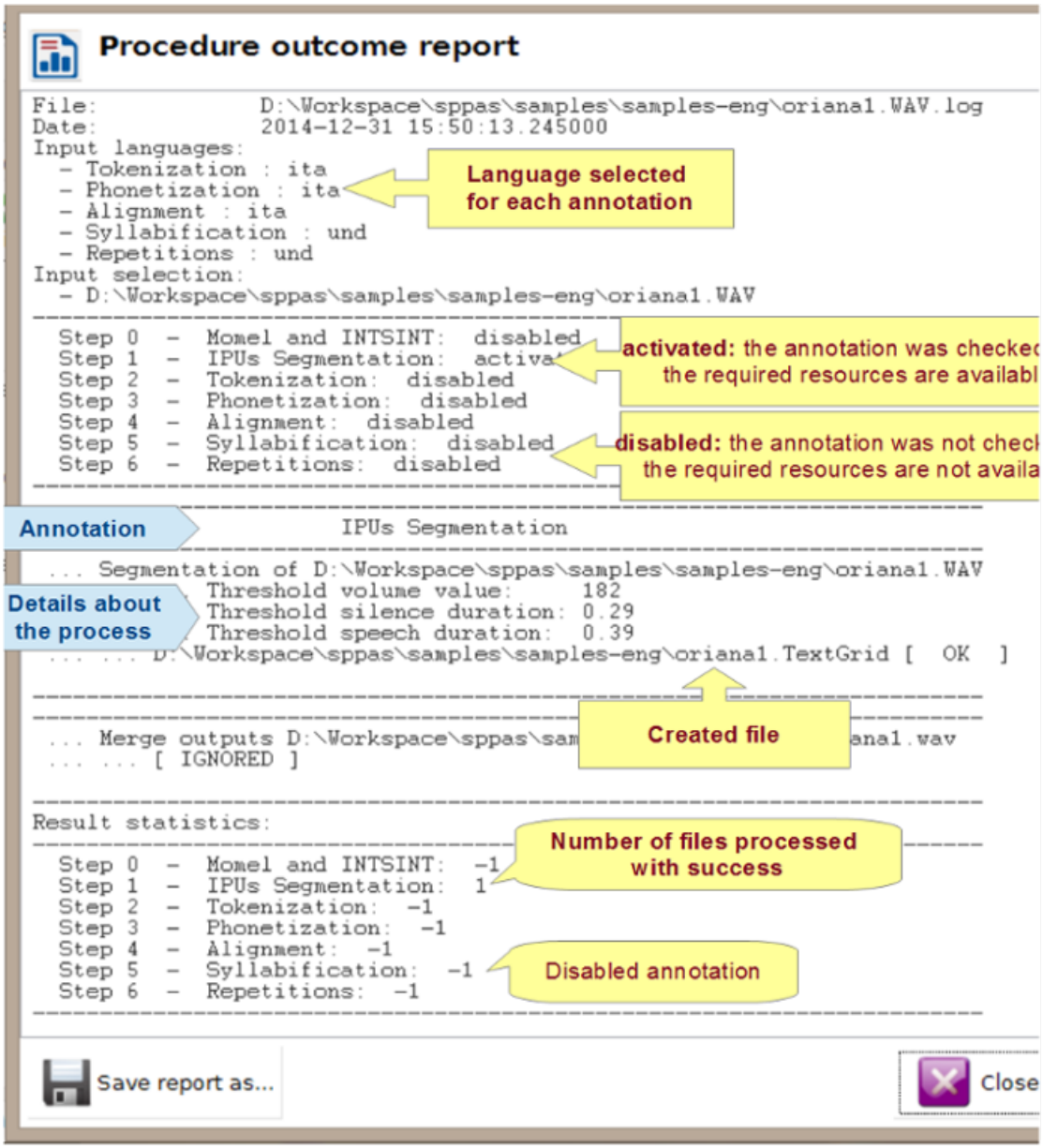

Figure 3.5: Procedure outcome report

- laughter, noted by a '@' (not available for some languages);
- short pauses, noted by a '+';
- elisions, mentioned in parenthesis;
- specific pronunciations, noted with brackets [example,eczap];
- comments are preferably noted inside braces {this is a comment!};
- comments can be noted inside brackets without using comma [this and this];
- liaisons, noted between '=' (this =n= example);
- morphological variants with <ice scream,I scream>,
- proper name annotation, like $ John S. Doe $.

SPPAS also allows to include in the transcription the regular punctuations, and numbers (not available for some languages). Numbers will be automatically converted to their written form during Text Normalization process.

From this Enriched Orthographic construction, several derived transcriptions can be generated automatically, including the followings:

1. the standard transcription is the list of orthographic tokens
2. a specific transcription from which the phonetic tokens are obtained to be used by the grapheme-phoneme converter that is named faked transcription.

As for example with the transcribed sentence: *This [is,iz] + hum… an enrich(ed) transcription {loud} number 1!*. The derived transcriptions are:

- standard: *this is + hum an enriched transcription number one*
- faked: *this iz + hum an enrich transcription number one*

The convention then allows to include a large scale of phenomena, for which most of them are optional. As a minimum, the orthographic **transcription must include**:

- filled pauses;
- short pauses;
- repeats;
- noises and laugh items (not available for: English, Japanese and Cantonese).

Finally, it has to be noticed that this convention is not software-dependent. The orthographic transcription can be performed with IPUscriber tool of SPPAS, Praat, Annotation Pro, Audacity, …

3.4 Search for Inter-Pausal Units (IPUs)

3.4.1 Overview

The Search for IPUs is a semi-automatic annotation process. It performs a silence detection from a recorded file. This segmentation provides an annotated file with one tier named "IPUs". The silence intervals are labelled with the "#" symbol, and IPUs intervals are labelled with "ipu_" followed by the IPU number. This annotation is semi-automatic: **it should be verified manually**. Notice that the better recording quality, thus the better IPUs segmentation.

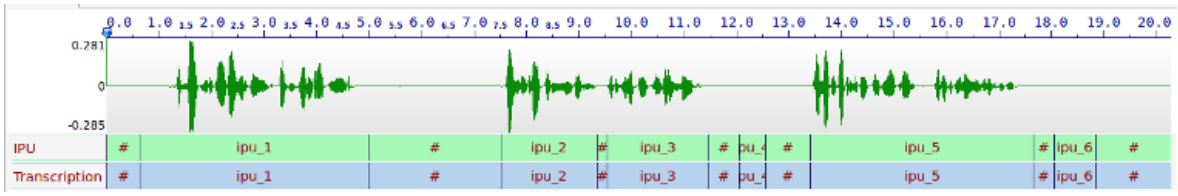

Figure 3.6: Example of result

3.4.2 How does it work

The following parameters must be properly fixed:

- Minimum volume value (in seconds): If this value is set to zero, the minimum volume is automatically adjusted for each sound file. Try with it first, then if the automatic value is not correct, set it manually. The Procedure Outcome Report indicates the value the system choose. The AudioRoamer component can also be of great help: it indicates min, max and mean volume values of the sound.
- Minimum silence duration (in seconds): By default, this is fixed to 0.2 sec. This duration mostly depends on the language. It is commonly fixed to at least 0.2 sec for French and at least 0.25 seconds for English language.
- Minimum speech duration (in seconds): By default, this value is fixed to 0.3 sec. A relevant value depends on the speech style: for isolated sentences, probably 0.5 sec should be better, but it should be about 0.1 sec for spontaneous speech.
- IPUs boundary shift (in seconds) for start or end: a duration which is systematically added to IPUs boundaries, to enlarge the IPUs interval, and as a consequence, the neighboring silences are reduced.

The procedure outcome report indicates the values (volume, minimum durations) that were used by the system for each sound file.

3.4.3 Perform “Search for IPUs” with the GUI

Click on the “Search IPUs” activation button and on the “Configure…” blue text to fix options.

In case the option values were not relevant enough, it is possible to delete the newly created file, to change such values and to re-annotate.

Notice that the speech segments can be transcribed using the “IPUScriber” analysis tool.

3.4.4 Perform “Search for IPUs” with the CLI

`searchipus.py` is the program to perform this semi-automatic annotation, i.e. silence/IPUs segmentation, either on a single file (-i and optionnally -o) or on a set of files (by using -I and optionnally -e).

Usage

```
searchipus.py [files] [options]
```

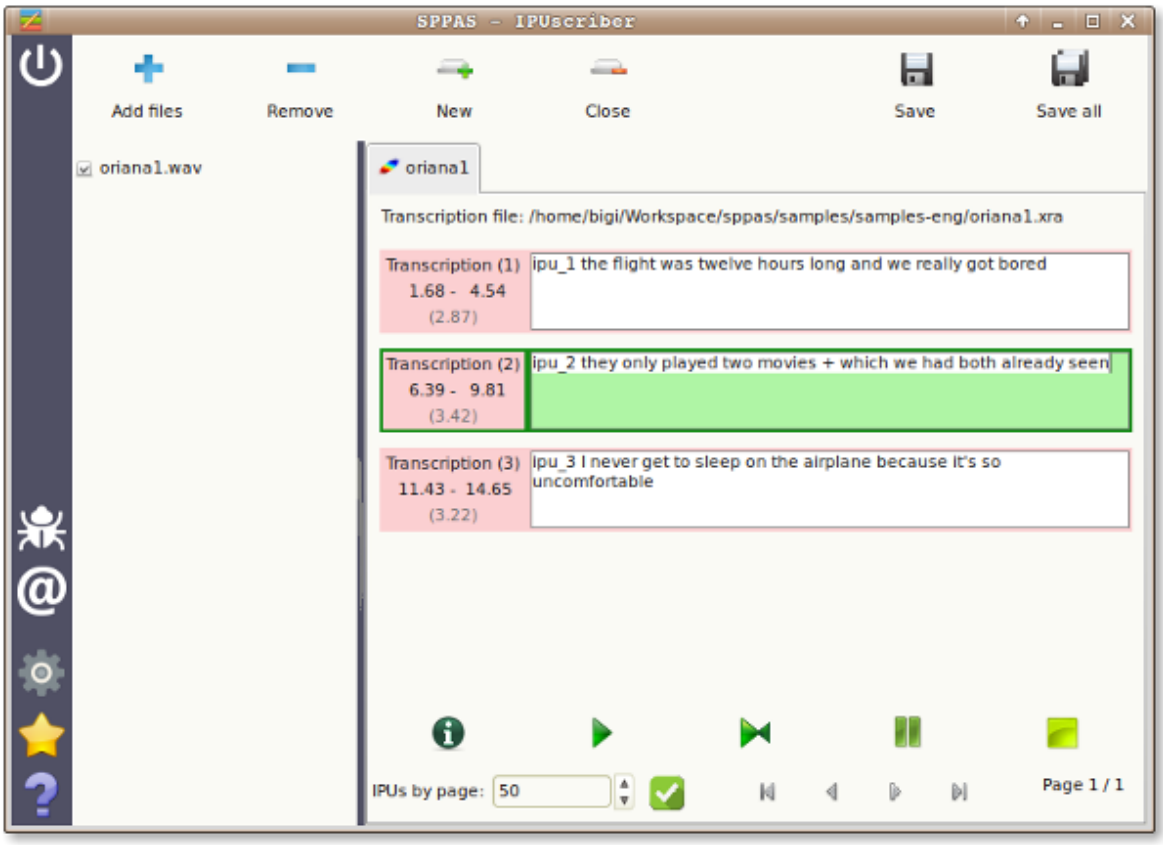

Figure 3.7: Orthographic transcription based on IPUs

```
Search for IPUs: Search for Inter-Pausal Units in an audio file.

optional arguments:
  -h, --help            show this help message and exit
  --quiet               Disable the verbosity
  --log file            File name for a Procedure Outcome Report (default: None)

Files (manual mode):
  -i file               Input wav file name.
  -o file               Annotated file with silences/units segmentation
                        (default: None)

Files (auto mode):
  -I file               Input wav file name (append).
  -e .ext               Output file extension. One of: .xra .TextGrid .eaf
                        .csv .mrk .txt .stm .ctm .lab .mlf .sub .srt .antx
                        .arff .xrff

Options:
  --outputpattern OUTPUTPATTERN
                        Output file pattern (default: )
  --win_length WIN_LENGTH
                        Window size to estimate rms (in seconds) (default:
                        0.020)
  --threshold THRESHOLD
                        Threshold of the volume value (rms) for the detection
                        of silences, 0=automatic (default: 0)
  --min_ipu MIN_IPU     Minimum duration of an IPU (in seconds) (default:
                        0.300)
  --min_sil MIN_SIL     Minimum duration of a silence (in seconds) (default:
                        0.200)
  --shift_start SHIFT_START
                        Systematically move at left the boundary of the
                        beginning of an IPU (in seconds) (default: 0.01)
  --shift_end SHIFT_END
                        Systematically move at right the boundary of the end
                        of an IPU (in seconds) (default: 0.02)

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Bigi. Contact the author at: contact@sppas.org
```

Examples of use

A single input file and output on stdout:

```
python .\sppas\bin\searchipus.py -i .\samples\samples-eng\oriana1.wav
    2018-12-19 10:49:32,782 [INFO] Logging set up level=15
    2018-12-19 10:49:32,790 [INFO]  ... Information:
    2018-12-19 10:49:32,792 [INFO]  ... ... Number of IPUs found:       3
    2018-12-19 10:49:32,792 [INFO]  ... ... Threshold volume value:     0
    2018-12-19 10:49:32,792 [INFO]  ... ... Threshold silence duration: 0.200
    2018-12-19 10:49:32,792 [INFO]  ... ... Threshold speech duration:  0.300
    0.000000 1.675000 #
    1.675000 4.580000 ipu_1
```

```
    4.580000 6.390000 #
    6.390000 9.880000 ipu_2
    9.880000 11.430000 #
    11.430000 14.740000 ipu_3
    14.740000 17.792000 #
```

Idem without logs:

```
python .\sppas\bin\searchipus.py -i .\samples\samples-eng\oriana1.wav --quiet
    0.000000 1.675000 #
    1.675000 4.580000 ipu_1
    4.580000 6.390000 #
    6.390000 9.880000 ipu_2
    9.880000 11.430000 #
    11.430000 14.740000 ipu_3
    14.740000 17.792000 #
```

Several input files, output in Praat-TextGrid file format:

```
python .\sppas\bin\searchipus.py -I .\samples\samples-eng\oriana1.wav \
 -I .\samples\samples-eng\oriana3.wave -e .TextGrid
    2018-12-19 10:48:16,520 [INFO] Logging set up level=15
    2018-12-19 10:48:16,522 [INFO] File oriana1.wav: Valid.
    2018-12-19 10:48:16,532 [INFO]  ... Information:
    2018-12-19 10:48:16,532 [INFO]  ... ... Number of IPUs found:       3
    2018-12-19 10:48:16,532 [INFO]  ... ... Threshold volume value:     0
    2018-12-19 10:48:16,532 [INFO]  ... ... Threshold silence duration: 0.200
    2018-12-19 10:48:16,533 [INFO]  ... ... Threshold speech duration:  0.300
    2018-12-19 10:48:16,538 [INFO]  ... E:\bigi\Projets\sppas\samples\samples-eng\oriana1.T
    2018-12-19 10:48:16,538 [INFO] File oriana3.wave: Invalid.
    2018-12-19 10:48:16,539 [ERROR]  ... ... An audio file with only one channel is expecte
    2018-12-19 10:48:16,540 [INFO]  ... No file was created.
```

3.5 Fill in Inter-Pausal Units (IPUs)

3.5.1 Overview

This automatic annotation consists in aligning macro-units of a document with the corresponding sound.

IPUs are blocks of speech bounded by silent pauses of more than X ms. This annotation searches for a silences/IPUs segmentation of a recorded file (see previous section) and fill in the IPUs with the transcription given in a `txt` file.

3.5.2 How does it work

SPPAS identifies silent pauses in the signal and attempts to align them with the units proposed in the transcription file, under the assumption that each such unit is separated by a silent pause. It is based on the

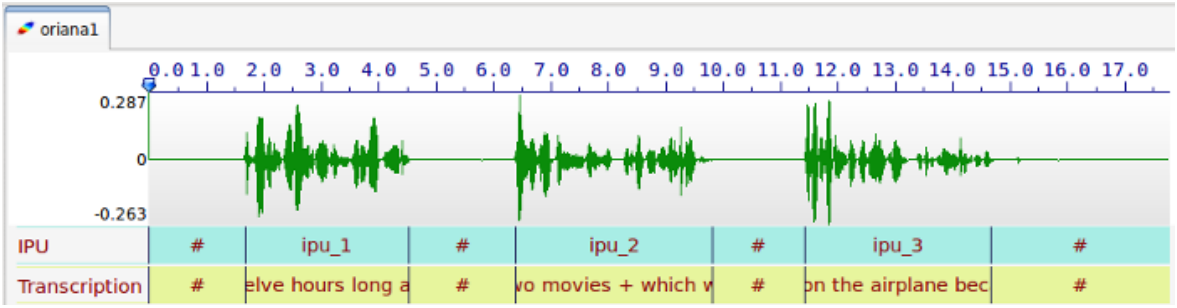

Figure 3.8: Fill in IPUs

search of silences described in the previous section, but in this case, the number of units to find is known. The system adjusts automatically the volume threshold and the minimum durations of silences/IPUs to get the right number of units. The content of the units has no regard, because SPPAS does not interpret them: it can be the orthographic transcription, a translation, numbers, … This algorithm is language-independent: it can work on any language.

In the transcription file, **silent pauses must be indicated** using both solutions, which can be combined:

- with the symbol '#';
- with newlines.

A recorded speech file must strictly correspond to a `txt` file of the transcription. The annotation provides an annotated file with one tier named "Transcription". The silence intervals are labelled with the "#" symbol, as IPUs are labelled with "ipu_" followed by the IPU number then the corresponding transcription.

The same parameters than those indicated in the previous section must be fixed.

> Remark: This annotation was tested on read speech no longer than a few sentences (about 1 minute speech) and on recordings of very good quality.

3.5.3 Perform "Fill in IPUs" with the GUI

Click on the "Fill in IPUs" activation button and on the "Configure…" blue text to fix options.

3.5.4 Perform "Fill in IPUs" with the CLI

`fillipus.py` is the program to perform this IPUs segmentation, i.e. silence/ipus segmentation, either on a single file (-i and optionnally -o) or on a set of files (by using -I and optionnally -e).

Usage

```
fillipus.py [files] [options]

Fill in IPUs: Search for Inter-Pausal Units and fill in with a transcription.
Requires an audio file and a .txt file with the transcription.
```

```
optional arguments:
  -h, --help         show this help message and exit
  --quiet            Disable the verbosity
  --log file         File name for a Procedure Outcome Report (default: None)

Files (manual mode):
  -i file            Input wav file name.
  -t file            Input transcription file name.
  -o file            Annotated file with filled IPUs

Files (auto mode):
  -I file            Input wav file name (append).
  -e .ext            Output file extension. One of: .xra .TextGrid .eaf .csv
                     .mrk .txt .stm .ctm .lab .mlf .sub .srt .antx .arff .xrff

Options:
  --outputpattern OUTPUTPATTERN
                        Output file pattern (default: )
  --min_ipu MIN_IPU  Initial minimum duration of an IPU (in seconds) (default:
                     0.300)
  --min_sil MIN_SIL  Initial minimum duration of a silence (in seconds)
                     (default: 0.200)

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Bigi. Contact the author at: contact@sppas.org
```

Examples of use

A single input file with an input in manual mode:

```
python .\sppas\bin\fillipus.py -i .\samples\samples-eng\oriana1.wav -t .\samples\samples-en
    2018-12-19 11:03:15,614 [INFO] Logging set up level=15
    2018-12-19 11:03:15,628 [INFO]  ... Information:
    2018-12-19 11:03:15,628 [INFO]  ... ... Threshold volume value:     122
    2018-12-19 11:03:15,630 [INFO]  ... ... Threshold silence duration: 0.200
    2018-12-19 11:03:15,630 [INFO]  ... ... Threshold speech duration:  0.300
    0.000000 1.675000 #
    1.675000 4.570000 the flight was 12 hours long and we really got bored
    4.570000 6.390000 #
    6.390000 9.870000 they only played two movies + which we had both already seen
    9.870000 11.430000 #
    11.430000 14.730000 I never get to sleep on the airplane because it’s so uncomfortable
    14.730000 17.792000 #
```

A single input file in automatic mode:

```
python .\sppas\bin\fillipus.py -I .\samples\samples-eng\oriana1
python .\sppas\bin\fillipus.py -I .\samples\samples-eng\oriana1.wav
python .\sppas\bin\fillipus.py -I .\samples\samples-eng\oriana1.txt
```

3.6 Text normalization

3.6.1 Overview

In principle, any system that deals with unrestricted text need the text to be normalized. Texts contain a variety of "non-standard" token types such as digit sequences, words, acronyms and letter sequences in all capitals, mixed case words, abbreviations, roman numerals, URL's and e-mail addresses… Normalizing or rewriting such texts using ordinary words is then an important issue. The main steps of the text normalization implemented in SPPAS (Bigi 2011) are:

- Replace symbols by their written form, thanks to a "replacement" dictionary, located into the folder "repl" in the "resources" directory.
- Word segmentation based on the content of a lexicon.
- Convert numbers to their written form.
- Remove punctuation.
- Lower the text.

3.6.2 Adapt Text normalization

Word segmentation of SPPAS is mainly based on the use of a lexicon. If a segmentation is not as expected, it is up to the user to modify the lexicon: Lexicons of all supported languages are all located in the folder "vocab" of the "resources" directory. They are in the form of "one word at a line" with UTF-8 encoding and "LF" for newline.

3.6.3 Support of a new language

Adding a new language in Text Normalization consists in the following steps:

1. Create a lexicon. Fix properly its encoding (utf-8), its newlines (LF), and fix the name and extension of the file as follow:
   - language name with iso639-3 standard
   - extension ".vocab"
2. Put this lexicon in the `resources/vocab` folder
3. Create a replacement dictionary for that language (take a look on the ones of the other language!)
4. Optionally, the language can be added into the num2letter.py program

That's it for most of the languages! If the language requires more steps, simply write to the author to collaborate, find some funding, etc. like it was already done for Cantonese (Bigi & Fung 2015) for example.

3.6.4 Perform Text Normalization with the GUI

The SPPAS Text normalization system takes as input a file (or a list of files) for which the name strictly match the name of the audio file except the extension. For example, if a file with name "oriana1.wav" is given, SPPAS will search for a file with name "oriana1.xra" at a first stage if ".xra" is set as the default extension, then it will search for other supported extensions until a file is found.

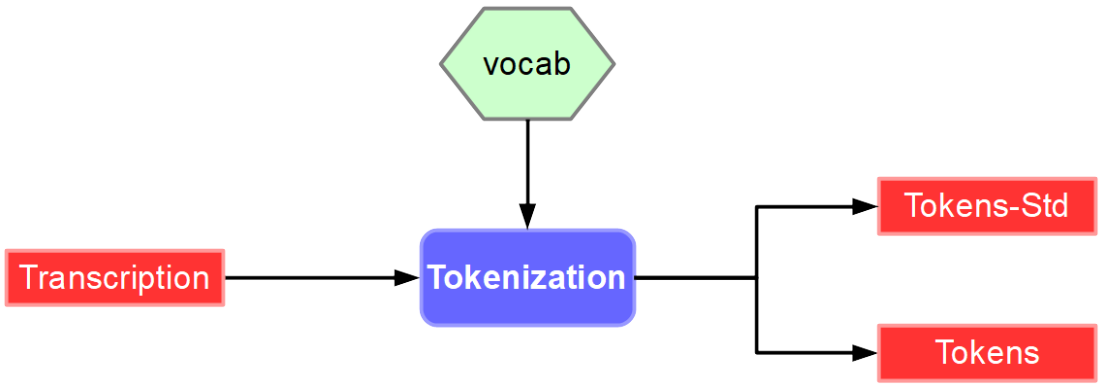

Figure 3.9: Text normalization workflow

This file must include a tier with an orthographic transcription. At a first stage, SPPAS tries to find a tier with `transcription` as name. If such a tier does not exist, the first tier that is matching one of the following strings is used (case-insensitive search):

1. `trans`
2. `trs`
3. `ipu`
4. `ortho`
5. `toe`

Text normalization produces a file with "-token" appended to its name, i.e. "oriana1-token.xra" for the previous example. By default, this file is including only one tier with the resulting normalization and with name "Tokens". To get other versions of the normalized transcription, click on the "Configure" text then check the expected tiers.

Read the "Introduction" of this chapter for a better understanding of the difference between "standard" and "faked" results.

To perform the text normalization process, click on the Text Normalization activation button, select the language and click on the "Configure…" blue text to fix options.

3.6.5 Perform Text Normalization with the CLI

`normalize.py` is the program to perform Text Normalization, i.e. the text normalization of a given file or a raw text.

Usage

```
normalize.py [files] [options]

Text Normalization: Text normalization segments the orthographic transcription
into tokens and remove punctuation, convert numbers, etc. Requires an
orthographic transcription into IPUs.

optional arguments:
  -h, --help       show this help message and exit
```

```
  --quiet          Disable the verbosity
  --log file       File name for a Procedure Outcome Report (default: None)

Files (manual mode):
  -i file          Input transcription file name.
  -o file          Annotated file with normalized tokens.

Files (auto mode):
  -I file          Input transcription file name (append).
  -l lang          Language code (iso8859-3). One of: cat cmn deu eng fra hun
                   ita jpn kor nan pcm pol por spa vie yue yue_chars.
  -e .ext          Output file extension. One of: .xra .TextGrid .eaf .csv
                   .mrk .txt .stm .ctm .lab .mlf .sub .srt .antx .arff .xrff

Resources:
  -r vocab         Vocabulary file name

Options:
  --inputpattern INPUTPATTERN
                        Input file pattern (orthographic transcription)
                        (default: )
  --outputpattern OUTPUTPATTERN
                        Output file pattern (default: -token)
  --faked FAKED    Create a tier with the faked tokens (required for
                   phonetization) (default: True)
  --std STD        Create a tier with the standard tokens (useful if EOT)
                   (default: False)
  --custom CUSTOM  Create a customized tier (default: False)
  --occ_dur OCC_DUR     Create tiers with number of tokens and duration of
                        each IPU (default: True)

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Bigi. Contact the author at: contact@sppas.org
```

Examples of use

A single input file with a raw transcription input in manual mode:

```
python .\sppas\bin\normalize.py -r .\resources\vocab\eng.vocab -i .\samples\samples-eng\oriana
    2018-12-19 11:48:34,151 [INFO] Logging set up level=15
    2018-12-19 11:48:34,473 [INFO]  ... ... Intervalle numéro 1.
    2018-12-19 11:48:34,477 [INFO]  ... ... Intervalle numéro 2.
    2018-12-19 11:48:34,480 [INFO]  ... ... Intervalle numéro 3.
    Tokens
    1, the flight was twelve hours long and we really got bored
    2, they only played two movies + which we had both already seen
    3, i never get to sleep on the airplane because it’s so uncomfortable
```

A single input file with a transcription time-aligned into the IPUS, in manual mode and no logs:

```
python .\sppas\bin\normalize.py -r .\resources\vocab\eng.vocab
-i .\samples\samples-eng\oriana1.xra --quiet
```

```
Tokens
0.000000, 1.675000 #
1.675000, 4.570000 the flight was twelve hours long and we really got bored
4.570000, 6.390000 #
6.390000, 9.870000 they only played two movies + which we had both already seen
9.870000, 11.430000 #
11.430000, 14.730000 i never get to sleep on the airplane because it's so uncomfortable
14.730000, 17.792000 #
```

The same file in automatic mode can be annotated with one of the following commands:

```
python .\sppas\bin\normalize.py -I .\samples\samples-eng\oriana1.xra -l eng
python .\sppas\bin\normalize.py -I .\samples\samples-eng\oriana1.txt -l eng
python .\sppas\bin\normalize.py -I .\samples\samples-eng\oriana1.wav -l eng
python .\sppas\bin\normalize.py -I .\samples\samples-eng\oriana1 -l eng
```

This program can also normalize data from the standard input. Example of use, using stdin/stdout under Windows:

```
Write-Output "The flight was 12 HOURS {toto} long." |
python .\sppas\bin\normalize.py -r .\resources\vocab\eng.vocab --quiet
    the
    flight
    was
    twelve
    hours
    long
```

In that case, the comment mentioned with the braces is removed and the number is converted to its written form. The character "_" is used for compound words (it replaces the whitespace).

3.7 Phonetization

3.7.1 Overview

Phonetization, also called grapheme-phoneme conversion, is the process of representing sounds with phonetic signs. However, converting from written text into actual sounds, for any language, cause several problems that have their origins in the relative lack of correspondence between the spelling of the lexical items and their sound contents. As a consequence, SPPAS implements a dictionary based-solution which consists in storing a maximum of phonological knowledge in a lexicon. This approach is then language-independent. SPPAS phonetization process is the equivalent of a sequence of dictionary look-ups.

Most of the other systems assume that all words of the speech transcription are mentioned in the pronunciation dictionary. On the contrary, SPPAS includes a language-independent algorithm which is able to phonetize unknown words of any language as long as a (minimum) dictionary is available (Bigi 2013). The Procedure Outcome Report reports on such cases with a WARNING message.

3.7.2 Adapt Phonetization

Since Phonetization is only based on the use of a pronunciation dictionary, the quality of the result only depends on this resource. If a pronunciation is not as expected, it is up to the user to change it in the dictionary: Dictionaries are located in the folder "dict" of the "resources" directory. They are all with UTF-8 encoding and "LF" for newline. The format of the dictionaries is HTK-like. As example, below is a piece of the `eng.dict` file:

```
THE             [THE]           D @
THE(2)          [THE]           D V
THE(3)          [THE]           D i:
THEA            [THEA]          T i: @
THEALL          [THEALL]        T i: l
THEANO          [THEANO]        T i: n @U
THEATER         [THEATER]       T i: @ 4 3:r
THEATER'S       [THEATER'S]     T i: @ 4 3:r z
```

The first column indicates the word, followed by the variant number (except for the first one). The second column indicates the word between brackets. The last columns are the succession of phones, separated by a whitespace. SPPAS is relatively compliant with the format and accept empty brackets or missing brackets.

The phoneset of the languages are mainly based on X-SAMPA international standard. See the chapter "Resources" of this documentation to know the list of accepted phones for a given language. This list can't be extended nor modified by users. However, new phones can be added: Send an e-mail to the author to collaborate in that way.

Actually, some words can correspond to several entries in the dictionary with various pronunciations. These pronunciation variants are stored in the phonetization result. By convention, whitespace separate words, minus characters separate phones and pipe character separate phonetic variants of a word. For example, the transcription utterance:

- Transcription: `The flight was 12 hours long.`
- Text Normalization: `the flight was twelve hours long`
- Phonetization: `D-@|D-V|D-i: f-l-aI-t w-A-z|w-V-z|w-@-z|w-O:-z t-w-E-l-v aU-3:r-z|aU-r-z l-O:-N`

3.7.3 Support of a new language

The support of a new language in Phonetization only consists in: 1. creating the pronunciation dictionary. The following constraints on the file must be respected: - its format (HTK-like), - its encoding (UTF-8), - its newlines (LF), - its phone set (X-SAMPA), - its file name (iso639-3 of the language and ".dict" extension). 2. adding the dictionary in the "dict" folder of the "resources" directory.

3.7.4 Perform Phonetization with the GUI

The Phonetization process takes as input a file that strictly match the audio file name except for the extension and that "-token" is appended. For example, if the audio file name is "oriana1.wav", the expected input file name is "oriana1-token.xra" if .xra is the default extension for annotations. This file must include a **normalized** orthographic transcription. The name of such tier must contains one of the following strings:

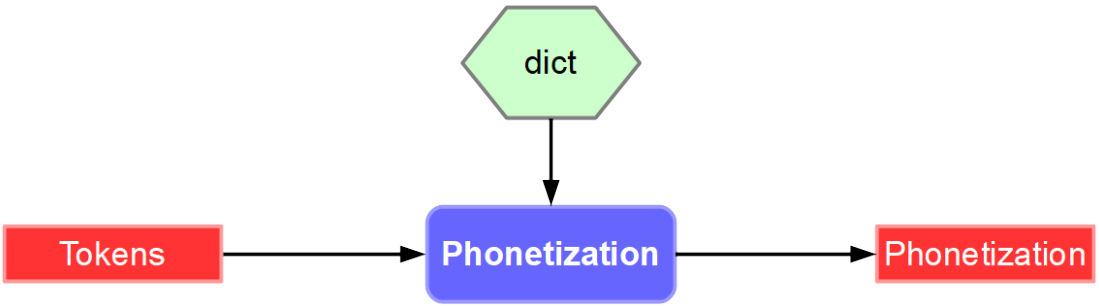

Figure 3.10: Phonetization workflow

1. “tok”
2. “trans”

The first tier that matches one of these requirements is used (this match is case-insensitive).

Phonetization produces a file with “-phon” appended to its name, i.e. “oriana1-phon.xra” for the previous example. This file contains only one tier with the resulting phonetization and with name “Phones”.

To perform the annotation, click on the Phonetization activation button, select the language and click on the “Configure…” blue text to fix options.

3.7.5 Perform Phonetization with the CLI

`phonetize.py` is the program to perform Phonetization on a given file, i.e. the grapheme-conversion of a file or a raw text.

Usage

```
phonetize.py [files] [options]

Phonetization: Grapheme to phoneme conversion represents sounds with phonetic
signs. Requires a Text Normalization.

optional arguments:
  -h, --help            show this help message and exit
  --quiet               Disable the verbosity
  --log file            File name for a Procedure Outcome Report (default: None)

Files (manual mode):
  -i file               Input tokenization file name.
  -o file               Annotated file with phonetization.

Files (auto mode):
  -I file               Input transcription file name (append).
  -l lang               Language code (iso8859-3). One of: cat cmn deu eng fra
                        ita jpn kor nan pcm pol por spa yue yue_chars.
  -e .ext               Output file extension. One of: .xra .TextGrid .eaf
                        .csv .mrk .txt .stm .ctm .lab .mlf .sub .srt .antx
                        .arff .xrff
```

```
Resources:
  -r dict               Pronunciation dictionary (HTK-ASCII format).
  -m map_file           Pronunciation mapping table. It is used to generate
                        new pronunciations by mapping phonemes of the
                        dictionary.

Options:
  --inputpattern INPUTPATTERN
                        Input file pattern (tokenization) (default: -token)
  --outputpattern OUTPUTPATTERN
                        Output file pattern (default: -phon)
  --unk UNK             Try to phonetize unknown words (default: True)
  --usestdtokens USESTDTOKENS
                        Phonetize from standard spelling (default: False)

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Bigi. Contact the author at: contact@sppas.org
```

Examples of use

A single input file with a normalized text in manual mode:

```
python .\sppas\bin\phonetize.py -r .\resources\dict\eng.dict
  -i .\samples\samples-eng\oriana1-token.xra --quiet
    Phones
    0.000000, 1.675000, sil
    1.675000, 4.570000, {D-@|D-i:|D-V} f-l-aI-t {w-@-z|w-V-z|w-O:-z|w-A-z} t-w-E-l-v
    {aU-3:r-z|aU-r\-z} l-O:-N {{-n-d|@-n-d} w-i: {r\-I-l-i:|r\-i:-l-i:} g-A-t b-O:-r\-d
    4.570000, 6.390000, sil
    6.390000, 9.870000, D-eI @U-n-l-i: p-l-eI-d t-u m-u-v-i:-z sil {h-w-I-tS|w-I-tS}
    w-i: h-{-d b-@U-T {O:-l-r\-E-4-i:|O:-r\-E-4-i:} s-i:-n
    9.870000, 11.430000, sil
    11.430000, 14.730000, aI n-E-v-3:r {g-I-t|g-E-t} {t-@|t-i|t-u} s-l-i:-p
    {O:-n|A-n} {D-@|D-i:|D-V} E-r\-p-l-eI-n {b-i-k-O:-z|b-i-k-V-z} {i-t-s|I-t-s}
    s-@U @-n-k-V-m-f-3:r-4-@-b-@-l
    14.730000, 17.792000, sil
```

The same file in automatic mode can be annotated with one of the following commands:

```
python .\sppas\bin\phonetize.py -l eng -I .\samples\samples-eng\oriana1-token.xra
python .\sppas\bin\phonetize.py -l eng -I .\samples\samples-eng\oriana1.xra
python .\sppas\bin\phonetize.py -l eng -I .\samples\samples-eng\oriana1.txt
python .\sppas\bin\phonetize.py -l eng -I .\samples\samples-eng\oriana1.wav
python .\sppas\bin\phonetize.py -l eng -I .\samples\samples-eng\oriana1
```

This program can also phonetize data from the standard input. Example of use, using stdin/stdout under Windows:

```
Write-Output ”The flight was 12 HOURS {toto} long.” |
```

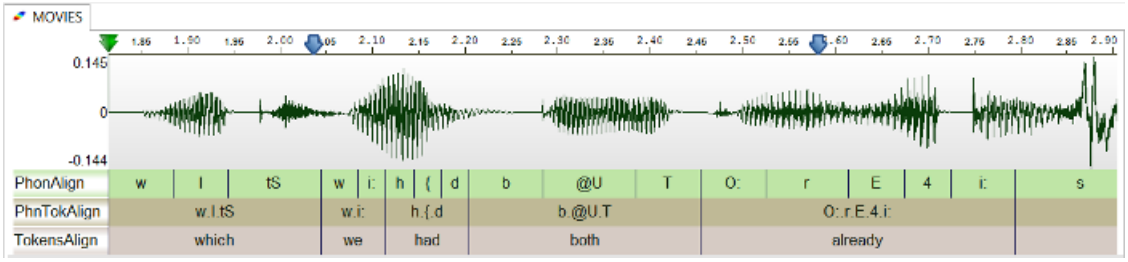

Figure 3.11: SPPAS alignment output example

```
python .\sppas\bin\normalize.py -r .\resources\vocab\eng.vocab --quiet |
python .\sppas\bin\phonetize.py -r .\resources\dict\eng.dict --quiet
    D-@|D-V|D-i:
    f-l-aI-t
    w-A-z|w-V-z|w-@-z|w-O:-z
    t-w-E-l-v
    aU-3:r-z|aU-r\-z
    l-O:-N
```

3.8 Alignment

3.8.1 Overview

Alignment, also called phonetic segmentation, is the process of aligning speech with its corresponding transcription at the phone level. The alignment problem consists in a time-matching between a given speech unit along with a phonetic representation of the unit.

SPPAS Alignment does not perform the segmentation itself. It is a wrapper either for the `Julius` Speech Recognition Engine (SRE) or for the `HVite` command of HTK-Toolkit. In addition, SPPAS can perform a "basic" alignment, assigning the same duration to each sound.

Speech Alignment requires an Acoustic Model in order to align speech. An acoustic model is a file that contains statistical representations of each of the distinct sounds of one language. Each sound is represented by one of these statistical representations. The quality of the alignment result only depends on both this resource and on the aligner. From our past experiences, we got better results with Julius. See the chapter 4 "Resources for Automatic Annotations" to get the list of sounds of each language.

Notice that SPPAS allows to time-align automatically laugh, noises, or filled pauses (depending on the language): No other system is able to achieves this task!

3.8.2 Adapt Alignment

The better Acoustic Model, the better alignment results. Any user can append or replace the acoustic models included in the "models" folder of the "resources" directory. Be aware that SPPAS only supports HTK-ASCII acoustic models, trained from 16 bits, 16000 Hz wave files.

The existing models can be improved if they are re-trained with more data. To get a better alignment result, any new data is then welcome: send an e-mail to the author to share your recordings and transcripts.

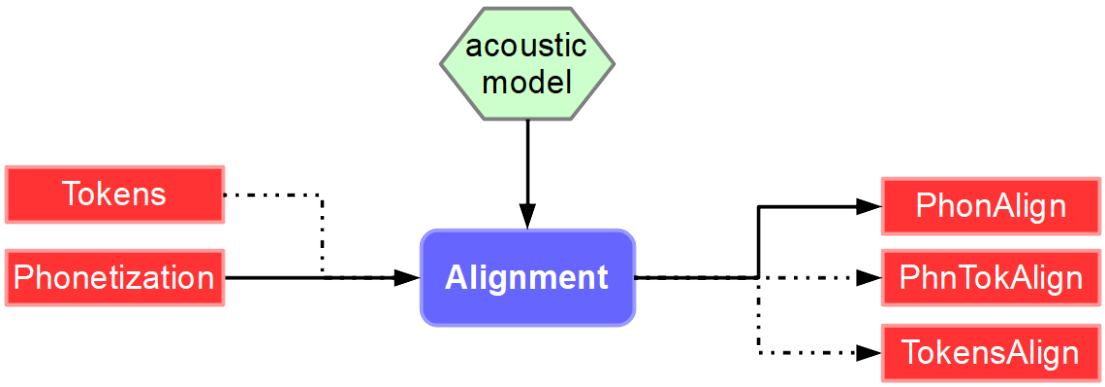

Figure 3.12: Alignment workflow

3.8.3 Support of a new language

The support of a new language in Alignment only consists in adding a new acoustic model of the appropriate format, in the appropriate directory, with the appropriate phone set.

The articulatory representations of phonemes are so similar across languages that phonemes can be considered as units which are independent from the underlying language (Schultz et al. 2001). In SPPAS package, 9 acoustic models of the same type - i.e. same HMMs definition and acoustic parameters, are already available so that the phoneme prototypes can be extracted and reused to create an initial model for a new language.

Any new model can also be trained by the author, as soon as enough data is available. It is difficult to estimate exactly the amount of data a given language requires. That is said, we can approximate the minimum as follow:

- 3 minutes altogether of various speakers, manually time-aligned at the phoneme level.
- 10 minutes altogether of various speakers, time-aligned at the ipus level with the enriched orthographic transcription.
- more data is good data.

3.8.4 Perform Alignment with the GUI

The Alignment process takes as input one or two files that strictly match the audio file name except for the extension and that "-phon" is appended for the first one and "-token" for the optional second one. For example, if the audio file name is "oriana1.wav", the expected input file name is "oriana1-phon.xra" with phonetization and optionally "oriana1-token.xra" with text normalization, if .xra is the default extension for annotations.

The speech segmentation process provides one file with name "-palign" appended to its name, i.e. "oriana1-palign.xra" for the previous example. This file includes one or two tiers:

- "PhonAlign" is the segmentation at the phone level;
- "TokensAlign" is the segmentation at the word level (if a file with tokenization was found).

The following options are available to configure Alignment:

- choose the speech segmentation system. It can be either: julius, hvite or basic

- perform basic alignment if the aligner failed, instead such intervals are empty.
- remove working directory will keep only alignment result: it will remove working files. Working directory includes one wav file per unit and a set of text files per unit.
- create the PhnTokAlign will append anoter tier with intervals of the phonetization of each word.

To perform the annotation, click on the Alignment activation button, select the language and click on the "Configure…" blue text to fix options.

3.8.5 Perform Alignment with the CLI

`alignment.py` is the program to perform automatic speech segmentation of a given phonetized file.

Usage

```
alignment.py [files] [options]

Alignment: Time-alignment of speech audio with its corresponding transcription
at the phone and token levels. Requires a Phonetization.

optional arguments:
  -h, --help            show this help message and exit
  --quiet               Disable the verbosity
  --log file            File name for a Procedure Outcome Report (default: None)

Files (manual mode):
  -i file               Input wav file name.
  -p file               Input file name with the phonetization.
  -t file               Input file name with the tokenization.
  -o file               Output file name with estimated alignments.

Files (auto mode):
  -I file               Input transcription file name (append).
  -l lang               Language code (iso8859-3). One of: cat cmn deu eng
                        eng-cd fra ita jpn kor nan pcm pol por spa yue.
  -e .ext               Output file extension. One of: .xra .TextGrid .eaf
                        .csv .mrk .txt .stm .ctm .lab .mlf .sub .srt .antx
                        .arff .xrff

Resources:
  -r model              Directory of the acoustic model of the language of the
                        text
  -R model              Directory of the acoustic model of the mother language
                        of the speaker (under development)

Options:
  --inputpattern INPUTPATTERN
                        Input file pattern (phonetization) (default: -phon)
  --inputoptpattern INPUTOPTPATTERN
                        Optional input file pattern (tokenization) (default:
                        -token)
  --outputpattern OUTPUTPATTERN
                        Output file pattern (default: -palign)
  --aligner ALIGNER     Speech automatic aligner system (julius, hvite,
```

```
                        basic): (default: julius)
  --basic BASIC         Perform basic alignment if the aligner fails (default:
                        False)
  --clean CLEAN         Remove working directory (default: True)
  --activity ACTIVITY   Create the Activity tier (default: True)
  --activityduration ACTIVITYDURATION
                        Create the ActivityDuration tier (default: False)

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Bigi. Contact the author at: contact@sppas.org
```

Example of use

```
python .\sppas\bin\alignment.py -I .\samples\samples-eng\oriana1.wav -l eng
    2018-12-19 18:33:38,842 [INFO] Logging set up level=15
    2018-12-19 18:33:38,844 [INFO] Options
    2018-12-19 18:33:38,844 [INFO]  ... activityduration: False
    2018-12-19 18:33:38,845 [INFO]  ... activity: True
    2018-12-19 18:33:38,845 [INFO]  ... aligner: julius
    2018-12-19 18:33:38,845 [INFO]  ... clean: True
    2018-12-19 18:33:38,845 [INFO]  ... basic: False
    2018-12-19 18:33:38,845 [INFO] File oriana1.wav: Valid.
    2018-12-19 18:33:38,845 [INFO] File oriana1-phon.xra: Valid.
    2018-12-19 18:33:38,846 [INFO] File oriana1-token.xra: Valid.
    2018-12-19 18:33:38,846 [WARNING]  ... ... A file with name E:\bigi\Projets\sppas\samples\
    2018-12-19 18:33:38,855 [INFO]  ... Découpage en intervalles.
    2018-12-19 18:33:38,901 [INFO]  ... Intervalle numéro 1.
    2018-12-19 18:33:38,904 [INFO]  ... Intervalle numéro 2.
    2018-12-19 18:33:38,908 [INFO]  ... Intervalle numéro 3.
    2018-12-19 18:33:38,913 [INFO]  ... Intervalle numéro 4.
    2018-12-19 18:33:38,917 [INFO]  ... Intervalle numéro 5.
    2018-12-19 18:33:38,921 [INFO]  ... Intervalle numéro 6.
    2018-12-19 18:33:38,926 [INFO]  ... Intervalle numéro 7.
    2018-12-19 18:33:38,928 [INFO]  ... Fusion des alignements des intervalles.
    2018-12-19 18:33:38,969 [INFO]  ... Création de la tier des activités.
    2018-12-19 18:33:38,993 [INFO]  ... E:\bigi\Projets\sppas\samples\samples-eng\oriana1-pali
```

3.9 Syllabification

3.9.1 Overview

The syllabification of phonemes is performed with a rule-based system from time-aligned phonemes. This phoneme-to-syllable segmentation system is based on 2 main principles:

- a syllable contains a vowel, and only one;
- a pause is a syllable boundary.

These two principles focus the problem of the task of finding a syllabic boundary between two vowels. Phonemes were grouped into classes and rules are established to deal with these classes.

Figure 3.13: Syllabification example

For each language, the automatic syllabification requires a configuration file to fix phonemes, classes and rules.

3.9.2 Adapt Syllabification

Any user can change the set of rules by editing and modifying the configuration file of a given language. Such files are located in the folder "syll" of the "resources" directory. Files are all with UTF-8 encoding and "LF" for newline.

At first, the list of phonemes and the class symbol associated with each of the phonemes are described as, for example:

- `PHONCLASS e V`
- `PHONCLASS p P`

Each association phoneme/class definition is made of 3 columns: the first one is the key-word PHONCLASS, the second is the phoneme symbol (like defined in the tier with the phonemes, commonly X-SAMPA), the last column is the class symbol. The constraints on this definition are that a class-symbol is only one upper-case character, and that the character X if forbidden, and the characters V and W are reserved for vowels.

The second part of the configuration file contains the rules. The first column is a keyword, the second one describes the classes between two vowels and the third column is the boundary location. The first column can be:

- `GENRULE`
- `EXCRULE`
- `OTHRULE`.

In the third column, a "0" means the boundary is just after the first vowel, "1" means the boundary is one phoneme after the first vowel, etc. Here are some examples of the file for French language:

- `GENRULE VXV 0`
- `GENRULE VXXV 1`
- `EXCRULE VFLV 0`
- `EXCRULE VOLGV 0`

Finally, to adapt the rules to specific situations that the rules failed to model, we introduced some phoneme sequences and the boundary definition. Specific rules contain only phonemes or the symbol "ANY" which means any phoneme. It consists of 7 columns: the first one is the key-word OTHRULE, the 5 following columns are a phoneme sequence where the boundary should be applied to the third one by the rules, the last column is the shift to apply to this boundary. In the following example:

```
OTHRULE ANY ANY p s k -2
```

More information are available in (Bigi et al. 2010).

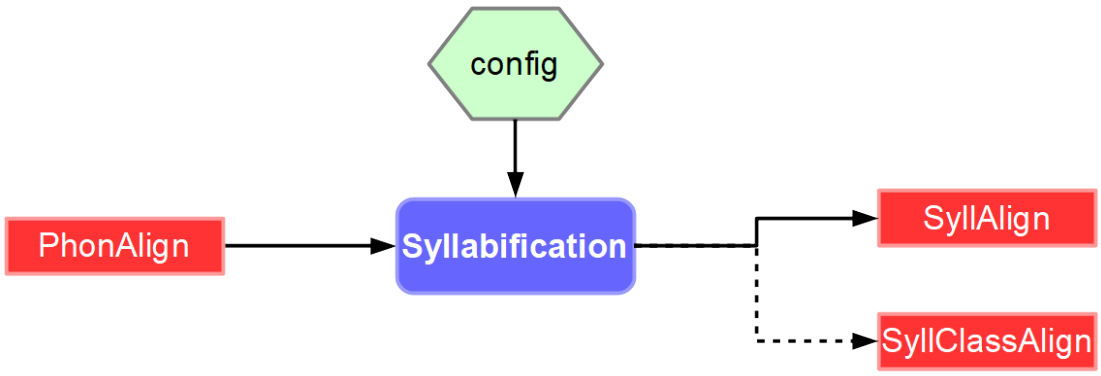

Figure 3.14: Syllabification workflow

3.9.3 Support of a new language

The support of a new language in this automatic syllabification only consists in adding a configuration file (see previous section). Fix properly the encoding (utf-8) and newlines (LF) of this file; then fix the name and extension of the file as follow:

- "syllConfig-" followed by language name with iso639-3 standard,
- with extension ".txt".

3.9.4 Perform Syllabification with the GUI

The Syllabification process takes as input a file that strictly match the audio file name except for the extension and that "-palign" is appended. For example, if the audio file name is "oriana1.wav", the expected input file name is "oriana1-palign.xra" if .xra is the default extension for annotations. This file must include time-aligned phonemes in a tier with name "PhonAlign".

The annotation provides an annotated file with "-salign" appended to its name, i.e. "oriana1-salign.xra" for the previous example. This file is including 2 tiers: SyllAlign, SyllClassAlign.

To perform the annotation, click on the Syllabification activation button, select the language and click on the "Configure…" blue text to fix options.

3.9.5 Perform Syllabification with the CLI

`syllabify.py` is the program to perform automatic syllabification of a given file with time-aligned phones.

Usage

```
syllabify.py [files] [options]

Syllabification: Syllabification is based on a set of rules to convert
phonemes into classes and to group them. Requires time-aligned phones.

optional arguments:
  -h, --help            show this help message and exit
```

```
  --quiet               Disable the verbosity
  --log file            File name for a Procedure Outcome Report (default: None)

Files (manual mode):
  -i file               Input time-aligned phonemes file name.
  -o file               Output file name with syllables.

Files (auto mode):
  -I file               Input transcription file name (append).
  -l lang               Language code (iso8859-3). One of: fra ita pol.
  -e .ext               Output file extension. One of: .xra .TextGrid .eaf
                        .csv .mrk .txt .stm .ctm .lab .mlf .sub .srt .antx
                        .arff .xrff

Resources:
  -r rules              Configuration file with syllabification rules

Options:
  --inputpattern INPUTPATTERN
                        Input file pattern (time-aligned phonemes) (default:
                        -palign)
  --outputpattern OUTPUTPATTERN
                        Output file pattern (default: -syll)
  --usesphons USESPHONS
                        Syllabify inside the IPU intervals (default: True)
  --usesintervals USESINTERVALS
                        Syllabify inside an interval tier (default: False)
  --tiername TIERNAME   Tier name for such interval tier: (default:
                        TokensAlign)
  --createclasses CREATECLASSES
                        Create a tier with syllable classes (default: True)

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Bigi. Contact the author at: contact@sppas.org
```

Examples of use

```
python .\sppas\bin\syllabify.py -i .\samples\samples-fra\F_F_B003-P8-palign.xra
  -r .\resources\syll\syllConfig-fra.txt --quiet
    SyllAlign
    2.497101 2.717101 j-E-R
    2.717101 2.997101 s-w-A/-R
    ...
    19.412000 19.692000 P-L-V-P
    19.692000 20.010000 P-V-L-P
```

All the following commands will produce the same result:

```
python .\sppas\bin\syllabify.py -I .\samples\samples-fra\F_F_B003-P8-palign.xra -l fra
python .\sppas\bin\syllabify.py -I .\samples\samples-fra\F_F_B003-P8.TextGrid -l fra
python .\sppas\bin\syllabify.py -I .\samples\samples-fra\F_F_B003-P8.wav -l fra
python .\sppas\bin\syllabify.py -I .\samples\samples-fra\F_F_B003-P8 -l fra
```

3.10 TGA - Time Groups Analyzer

3.10.1 Overview

TGA is originally available at http://wwwhomes.uni-bielefeld.de/gibbon/TGA/. It's a tool developed by Dafydd Gibbon, emeritus professor of English and General Linguistics at Bielefeld University.

> *Dafydd Gibbon* (2013). **TGA: a web tool for Time Group Analysis**, Tools ans Resources for the Analysis of Speech Prosody, Aix-en-Provence, France, pp. 66-69.

The original TGA is an online batch processing tool which provides a parametrised mapping from time-stamps in speech annotation files in various formats to a detailed analysis report with statistics and visualisations. TGA software calculates, inter alia, mean, median, rPVI, nPVI, slope and intercept functions within inter-pausal groups, provides visualizations of timing patterns, as well as correlations between these, and parses inter-pausal groups into hierarchies based on duration relations. Linear regression is selected mainly for the slope function, as a first approximation to examining acceleration and deceleration over large data sets.

The TGA online tool was designed to support phoneticians in basic statistical analysis of annotated speech data. In practice, the tool provides not only rapid analyses but also the ability to handle larger data sets than can be handled manually.

In addition to the original one, a second version of TGA was implemented in the AnnotationPro software:

> *Katarzyna Klessa, Dafydd Gibbon* (2014). **Annotation Pro + TGA: automation of speech timing analysis**, 9th International conference on Language Resources and Evaluation (LREC), Reykjavik (Iceland). pp. 1499-1505, ISBN: 978-2-9517408-8-4.

The integrated Annotation Pro + TGA tool incorporates some TGA features and is intended to support the development of more robust and versatile timing models for a greater variety of data. The integration of TGA statistical and visualisation functions into Annotation Pro+TGA results in a powerful computational enhancement of the
existing AnnotationPro phonetic workbench, for supporting experimental analysis and modeling of speech timing.

So, what's the novelty into the third version implemented into SPPAS…

First of all, it has to be noticed that TGA is only partly implemented into SPPAS. The statistics analyses tool of SPPAS allows to estimates TGA within the SPPAS framework; and it results in the following advantages:

- it can read either TextGrid, csv, Elan, or any other file format supported by SPPAS,
- it can save TGA results in any of the annotation file supported by SPPAS,
- it estimates the two versions of the linear regression estimators: the original one and the one implemented into AnnotationPro:

  1. in the original TGA, the x-axis is based on positions of syllables,
  2. in the AnnotationPro+TGA, the x-axis is based on time-stamps.

3.10.2 Result of TGA into SPPAS

The annotation provides an annotated file with "-tga" appended to its name, i.e. "oriana1-tga.xra" for the example. This file is including 10 tiers:

1. TGA-TimeGroups: intervals with the time groups
2. TGA-TimeSegments: same intervals, indicate the syllables separated by whitespace
3. TGA-Occurrences: same intervals, indicate the number of syllables
4. TGA-Total: same intervals, indicate interval duration
5. TGA-Mean: same intervals, indicate mean duration of syllables
6. TGA-Median: same intervals, indicate median duration of syllables
7. TGA-Stdev: same intervals, indicate stdev of duration of syllables
8. TGA-nPVI: same intervals, indicate nPVI of syllables
9. TGA-Intercept: same intervals, indicate the intercept
10. TGA-Slope: same intervals, indicate the slope

Both tiers 9 and 10 can be estimated in 2 ways (so 2 more tiers can be generated).

3.10.3 Perform TAG with the GUI

The TGA process takes as input a file that strictly match the audio file name except for the extension and that "-salign" is appended. For example, if the audio file name is "oriana1.wav", the expected input file name is "oriana1-salign.xra" if .xra is the default extension for annotations. This file must include time-aligned syllables in a tier with name "SyllAlign".

To perform the annotation, click on the TGA activation button and click on the "Configure…" blue text to fix options.

3.10.4 Perform TGA with the CLI

`tga.py` is the program to perform TGA of a given file with time-aligned syllables.

Usage

```
tga.py [files] [options]

TimeGroupAnalysis: Proposed by D. Gibbon, Time Group Analyzer calculates mean,
median, nPVI, slope and intercept functions within inter-pausal groups.
Requires time aligned syllables.

optional arguments:
  -h, --help            show this help message and exit
  --quiet               Disable the verbosity
  --log file            File name for a Procedure Outcome Report (default: None)

Files (manual mode):
  -i file               An input time-aligned syllables file.
  -o file               Output file name with TGA.

Files (auto mode):
```

```
  -I file               Input time-aligned syllables file (append).
  -e .ext               Output file extension. One of: .xra .TextGrid .eaf
                        .csv .mrk .txt .stm .ctm .lab .mlf .sub .srt .antx
                        .arff .xrff

Options:
  --original ORIGINAL   Use the original estimation of intercept and slope
                        (default: False)
  --annotationpro ANNOTATIONPRO
                        Use the estimation of intercept and slope proposed in
                        AnnotationPro (default: True)
  --tg_prefix_label TG_PREFIX_LABEL
                        Prefix of each time group label: (default: tg_)
  --with_radius WITH_RADIUS
                        Duration estimation: Use 0 to estimate syllable
                        durations with midpoint values, use -1 for Radius-, or
                        1 for Radius+. (default: 0)

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Bigi. Contact the author at: contact@sppas.org
```

Example of use

```
python .\sppas\bin\tga.py -i .\samples\samples-fra\F_F_B003-P8-syll.xra
    2018-12-20 08:35:21,219 [INFO] Logging set up level=15
    TGA-TimeGroups
    2.497101 5.683888 tg_1
    5.743603 8.460596 tg_2
    9.145000 11.948531 tg_3
    12.494000 13.704000 tg_4
    13.784000 15.036000 tg_5
    16.602000 20.010000 tg_6
    TGA-TimeSegments
    ...
    13.784000 15.036000 -0.03063
    16.602000 20.010000 0.00468
```

Other commands:

```
python .\sppas\bin\tga.py -I .\samples\samples-fra\F_F_B003-P8-syll.xra
python .\sppas\bin\tga.py -I .\samples\samples-fra\F_F_B003-P8.TextGrid
python .\sppas\bin\tga.py -I .\samples\samples-fra\F_F_B003-P8.wav
```

3.11 Activity

3.11.1 Overview

Activity tier represents speech activities, i.e. speech, silences, laughter, noises… It is based on the analysis of the time-aligned tokens.

3.11.2 Perform Activity with the GUI

The Activity process takes as input a file that strictly match the audio file name except for the extension and that "-palign" is appended. For example, if the audio file name is "oriana1.wav", the expected input file name is "oriana1-palign.xra" if .xra is the default extension for annotations. This file must include time-aligned phonemes in a tier with name "PhonAlign".

The annotation provides an annotated file with "-activity" appended to its name, i.e. "oriana1-activity.xra" for the previous example. This file is including 1 or 2 tiers: Activity, ActivityDuration.

To perform the annotation, click on the Activity activation button and click on the "Configure…" blue text to fix options.

3.11.3 Perform Alignment with the CLI

No CLI is available for this anntation.

3.12 Self-Repetitions

3.12.1 Overview

This automatic detection focus on word self-repetitions which can be exact repetitions (named strict echos) or repetitions with variations (named non-strict echos). The system is based only on lexical criteria. The algorithm is focusing on the detection of the source.

This system can use a list of stop-words of a given language. This is a list of very frequent words like adjectives, pronouns, etc. Obviously, the result of the automatic detection is significantly better if such list of stop-words is available.

Optionnaly, SPPAS can add new stop-words in the list: they are deduced from the given data. These new entries in the stop-list are then different for each file (Bigi et al. 2014).

The annotation provides one annotated file with 2 to 4 tiers:

1. TokenStrain: if a replacement file was available, it's the entry used by the system
2. StopWord: if a stop-list was used, it indicates if the token is a stop-word (True or False)
3. SR-Sources: tags of the annotations are prefixed by "S" followed an index
4. SR-Repetitions: tags of the annotations are prefixed by "R" followed an index

3.12.2 Adapt to a new language

The list of stop-words of a given language must be located in the "vocab" folder of the "resources" directory with ".stp" extension. This file is with UTF-8 encoding and "LF" for newline.

3.12.3 Perform Self-Repetitions with the GUI

The automatic annotation takes as input a file with (at least) one tier containing the time-aligned tokens of the main speaker, and another file/tier for other-repetitions. The annotation provides one annotated file with 2 tiers: Sources and Repetitions.

Click on the Self-Repetitions activation button, select the language and click on the "Configure…" blue text to fix options.

3.12.4 Perform SelfRepetitions with the CLI

`selfrepetition.py` is the program to perform automatic detection of self-repetitions.

Usage

```
selfrepetition.py [files] [options]

Self-repetitions: Self-repetitions searches for sources and echos of a
speaker. Requires time-aligned tokens.

optional arguments:
  -h, --help            show this help message and exit
  --quiet               Disable the verbosity
  --log file            File name for a Procedure Outcome Report (default: None)

Files (manual mode):
  -i file               Input time-aligned tokens file name.
  -o file               Output file name with syllables.

Files (auto mode):
  -I file               Input transcription file name (append).
  -e .ext               Output file extension. One of: .xra .TextGrid .eaf
                        .csv .mrk .txt .stm .ctm .lab .mlf .sub .srt .antx
                        .arff .xrff

Resources:
  -r file               List of stop-words

Options:
  --inputpattern INPUTPATTERN
                        Input file pattern (time-aligned words or lemmas)
                        (default: -palign)
  --outputpattern OUTPUTPATTERN
                        Output file pattern (default: -srepet)
  --span SPAN           Span window length in number of IPUs (default: 3)
  --stopwords STOPWORDS
                        Add stop-words estimated from the given data (default:
                        True)
  --alpha ALPHA         Coefficient to add data-specific stop-words (default:
                        0.5)

This program is part of SPPAS version 2.0. Copyright (C) 2011-2019 Brigitte
Bigi. Contact the author at: contact@sppas.org
```

Examples of use

```
python .\sppas\bin\selfrepetition.py -i .\samples\samples-fra\F_F_B003-P8-palign.xra
   -r .\resources\vocab\fra.stp
```

```
python .\sppas\bin\selfrepetition.py -I .\samples\samples-fra\F_F_B003-P8.wav -l fra
```

3.13 Other-Repetitions

3.13.1 Overview

This automatic detection focus on other-repetitions, which can be either exact repetitions (named strict echos) or repetitions with variations (named non-strict echos). The system is based only on lexical criteria (Bigi et al. 2014). Notice that the algorithm is focusing on the detection of the source.

This system can use a list of stop-words of a given language. This is a list of very frequent words like adjectives, pronouns, etc. Obviously, the result of the automatic detection is significantly better if such list of stop-words is available.

Optionnaly, SPPAS can add new stop-words in the list: they are deduced from the given data. These new entries in the stop-list are then different for each file.

3.13.2 Adapt to a language and support of a new one

This system can use a list of stop-words of a given language. This is a list of very frequent words like adjectives, pronouns, etc. Obviously, the result of the automatic detection is significantly better if such list of stop-words is available. It must be located in the “vocab” folder of the “resources” directory with “.stp” extension. This file is with UTF-8 encoding and “LF” for newline.

3.13.3 Perform Other-Repetitions with the CLI

```
usage: otherrepetition.py -r stopwords [files] [options]
```

Files:

```
-i file               Input file name with time-aligned tokens of the main
                      speaker.
-s file               Input file name with time-aligned tokens of the
                      echoing speaker
-o file               Output file name with ORs.
```

Options:

```
--inputpattern INPUTPATTERN
                      Input file pattern (time-aligned words or lemmas)
                      (default: -palign)
--outputpattern OUTPUTPATTERN
                      Output file pattern (default: -orepet)
--span SPAN           Span window length in number of IPUs (default: 3)
--stopwords STOPWORDS Add stop-words estimated from the given data
                      (default: True)
--alpha ALPHA         Coefficient to add data-specific stop-words
                      (default: 0.5)
```

3.14 Re-Occurrences

This annotation is searching for re-occurrences of an annotation of a speaker in the next N annotations of the interlocutor. It is originally used for gestures in (M. Karpinski et al. 2018).

> Maciej Karpinski, Katarzyna Klessa Methods, Tools and Techniques for Multimodal Analysis of Accommodation in Intercultural Communication CMST 24(1) 29–41 (2018), DOI:10.12921/cmst.2018.0000006

3.14.1 Perform Re-Occurrences with the CLI

```
usage: reoccurrences.py [files] [options]
```

Files:

```
-i file               Input file name with time-aligned annotations of
                      the main speaker.
-s file               Input file name with time-aligned annotations of
                      the interlocutor
-o file               Output file name with re-occurrences.
```

Options:

```
--inputpattern INPUTPATTERN
                      Input file pattern (default: )
--outputpattern OUTPUTPATTERN
                      Output file pattern (default: -reocc)
--tiername TIERNAME   Tier to search for re-occurrences (default: )
--span SPAN           Span window length in number of annotations (default:
                      10)
```

This program is part of SPPAS version 2.4. Copyright (C) 2011-2019 Brigitte Bigi. Contact the author at: contact@sppas.org

3.15 RMS

3.15.1 Overview

The Root-Mean Square - RMS is a measure of the power in an audio signal. It is estimated from the amplitude values by: sqrt(sum(S_i^2)/n).

RMS automatic annotation estimates the rms value on given intervals of an audio file. Empty intervals - i.e. intervals without labels, are ignored. By default, the RMS is estimated on a tier with name “PhonAlign” of an annotated file with pattern “-palign”. Both can be modified by configuring the annotations. The annotation provides an annotated file with “-rms” appended to its name. This file is including 3 tiers:

- RMS: indicates the RMS value estimated on each non-empty interval;
- RMS-values: indicates RMS values estimated every 10 ms in each interval;
- RMS-mean: indicates the mean of the previous values.

3.15.2 Perform RMS with the GUI

To perform the annotation, click on the RMS activation button and click on the "Configure…" blue text to fix options.

3.15.3 Perform RMS with the CLI

`rms.py` is the program to perform this annotation, either on a single given file (-i and -t) or on a set of files (-I).

```
usage: rms.py [files] [options]

RMS: Estimate the Root-Mean Square values in intervals.

optional arguments:
  -h, --help            show this help message and exit
  --quiet               Disable the verbosity
  --log file            File name for a Procedure Outcome Report (default:
                        None)

Files (manual mode):
  -i file               Input wav file name.
  -t file               Input annotated file name.
  -o file               Annotated file with RMS values (default: None)

Files (auto mode):
  -I file               Input file name (append).
  -e .ext               Output file extension. One of: .xra .TextGrid .eaf
                        .csv .mrk .txt .stm .ctm .lab .mlf .sub .srt .antx
                        .arff .xrff

Options:
  --inputpattern INPUTPATTERN
                        Input file pattern (default: -palign)
  --outputpattern OUTPUTPATTERN
                        Output file pattern (default: -rms)
  --tiername TIERNAME   Tier to fix intervals in which RMS is estimated
                        (default: PhonAlign)

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Bigi. Contact the author at: contact@sppas.org
```

3.16 Momel (modelling melody)

Momel is an algorithm for the automatic modeling of fundamental frequency (F0) curves using a technique called asymetric modal quadratic regression.

This technique makes it possible by an appropriate choice of parameters to factor an F0 curve into two components:

- a macro-prosodic component represented by a a quadratic spline function defined by a sequence of target points < ms, hz >.
- a micro-prosodic component represented by the ratio of each point on the F0 curve to the corresponding point on the quadratic spline function.

For details, see the following reference:

> **Daniel Hirst and Robert Espesser** (1993). *Automatic modelling of fundamental frequency using a quadratic spline function.* Travaux de l'Institut de Phonétique d'Aix. vol. 15, pages 71-85.

The SPPAS implementation of Momel requires a file with the F0 values **sampled at 10 ms**. Two file formats are supported:

- ".PitchTier", from Praat.
- ".hz", from any tool. It is a file with one F0 value per line.

The following options can be fixed:

- Window length used in the "cible" method
- F0 threshold: Maximum F0 value
- F0 ceiling: Minimum F0 value
- Maximum error: Acceptable ratio between two F0 values
- Window length used in the "reduc" method
- Minimal distance
- Minimal frequency ratio
- Eliminate glitch option: Filter f0 values before 'cible'

3.16.1 Perform Momel

Click on the Momel activation button then click on the "Configure…" blue text to fix options.

3.16.2 Perform Momel with the CLI

`momel.py` is the program to perform Momel annotation of a given file with F0 values sampled at 10ms.

Usage

```
momel.py [files] [options]

Momel: Proposed by D. Hirst and R. Espesser, Momel - Modelling of fundamental
frequency (F0) curves is using a technique called assymetric modal quaratic
regression. Requires pitch values.
```

```
optional arguments:
  -h, --help       show this help message and exit
  --quiet          Disable the verbosity
  --log file       File name for a Procedure Outcome Report (default: None)

Files (manual mode):
  -i file          Input file name (extension: .hz or .PitchTier)
  -o file          Output file name (default: stdout)

Files (auto mode):
  -I file          Input file name with pitch (append).
  -e .ext          Output file extension. One of: .xra .TextGrid .eaf .csv
                   .mrk .txt .stm .ctm .lab .mlf .sub .srt .antx .arff .xrff

Options:
  --outputpattern OUTPUTPATTERN
                        Output file pattern (default: -momel)
  --win1 WIN1      Target window length (default: 30)
  --lo LO          F0 threshold (default: 50)
  --hi HI          F0 ceiling (default: 600)
  --maxerr MAXERR  Maximum error (default: 1.04)
  --win2 WIN2      Reduce window length (default: 20)
  --mind MIND      Minimal distance (default: 5)
  --minr MINR      Minimal frequency ratio (default: 0.05)

This program is part of SPPAS version 2.4. Copyright (C) 2011-2019 Brigitte
Bigi. Contact the author at: contact@sppas.rg
```

Examples of use

```
python .\sppas\bin\momel.py -i .\samples\samples-eng\ENG_M15_ENG_T02.PitchTier
    2018-12-19 15:44:00,437 [INFO] Logging set up level=15
    2018-12-19 15:44:00,674 [INFO]  ... ... 41 anchors found.
    1.301629 109.285503
    1.534887 126.157058
    1.639614 143.657446
    1.969234 102.911464
    2.155284 98.550759
    2.354162 108.250869
    2.595364 87.005994
    2.749773 83.577924
    2.933222 90.218382
    3.356651 119.709142
    3.502254 104.104568
    3.707747 132.055286
    4.000578 96.262109
    4.141915 93.741407
    4.383332 123.996736
    4.702203 89.152708
    4.987086 101.561180
    5.283864 87.499710
    5.538984 92.399690
    5.707147 95.411586
    5.906895 87.081095
```

```
6.705373 121.396919
7.052992 130.821479
7.218415 120.917642
7.670083 101.867028
7.841935 109.094053
8.124574 90.763267
8.455182 114.261067
8.746016 93.704705
9.575359 101.108444
9.996245 122.488120
10.265663 105.244429
10.576394 94.875460
11.730570 99.698799
12.083323 124.002313
12.411790 108.563104
12.707442 101.928297
12.963805 113.980850
13.443483 90.782781
13.921939 90.824376
14.377324 60.126506
```

Apply Momel on all files of a given folder:

```
python .\sppas\bin\momel.py -I .\samples\samples-eng
```

3.17 INTSINT: Encoding of F0 anchor points

INTSINT assumes that pitch patterns can be adequately described using a limited set of tonal symbols, T,M,B,H,S,L,U,D (standing for : Top, Mid, Bottom, Higher, Same, Lower, Up-stepped, Down-stepped respectively) each one of which characterises a point on the fundamental frequency curve.

The rationale behind the INTSINT system is that the F0 values of pitch targets are programmed in one of two ways : either as absolute tones T, M, B which are assumed to refer to the speaker's overall pitch range (within the current Intonation Unit), or as relative tones H, S, L, U, D assumed to refer only to the value of the preceding target point.

The rationale behind the INTSINT system is that the F0 values of pitch targets are programmed in one of two ways : either as absolute tones T, M, B which are assumed to refer to the speaker's overall pitch range (within the current Intonation Unit), or as relative tones H, S, L, U, D assumed to refer only to the value of the preceding target point.

A distinction is made between non-iterative H, S, L and iterative U, D relative tones since in a number of descriptions it appears that iterative raising or lowering uses a smaller F0 interval than non-iterative raising or lowering. It is further assumed that the tone S has no iterative equivalent since there would be no means of deciding where intermediate tones are located.

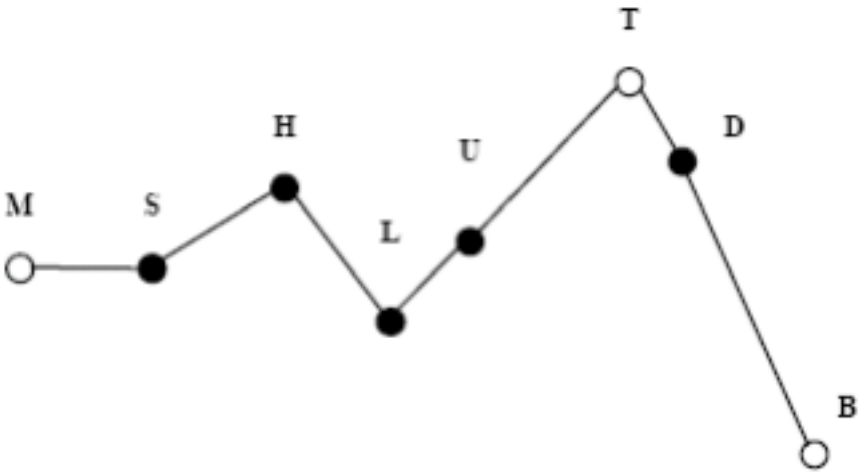
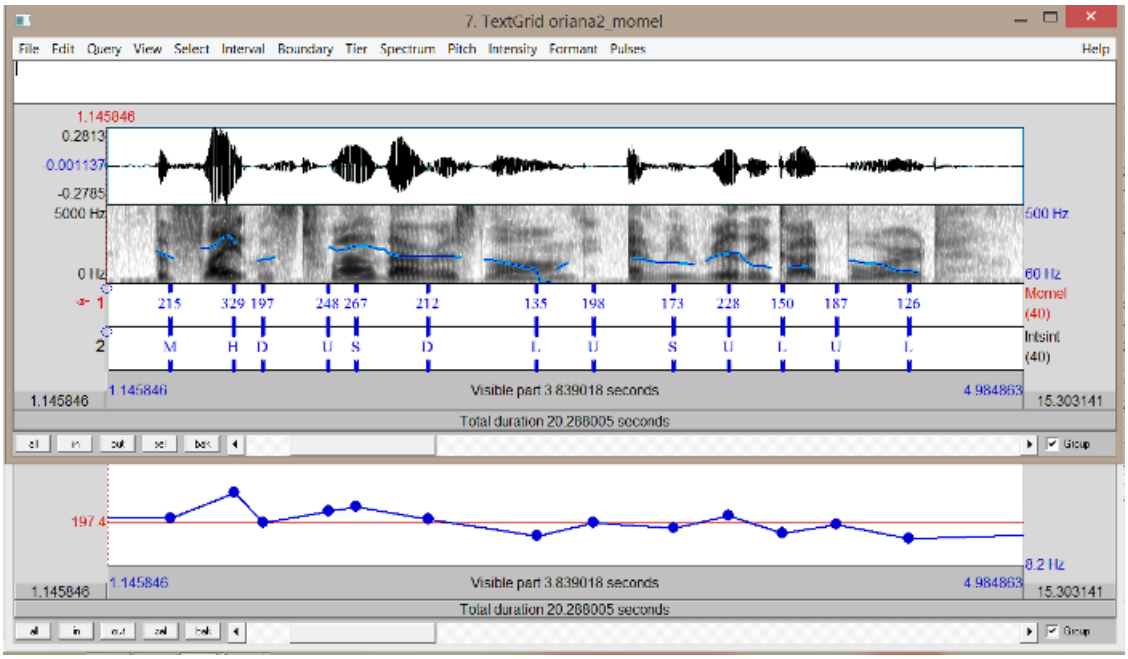


Figure 3.15: INTSINT example



D.-J. Hirst (2011). *The analysis by synthesis of speech melody: from data to models*, Journal of Speech Sciences, vol. 1(1), pages 55-83.

3.17.1 Perform INTSINT with the GUI

Click on the INTSINT activation button and click on the “Configure…” blue text to fix options.

3.17.2 Perform INTSINT with the CLI

`intsint.py` is the program to perform INTSINT annotation of a given file with momel anchors.

Usage

```
intsint.py [files] [options]

INTSINT: INternational Transcription System for INTonation codes the
intonation of an utterance by means of an alphabet of 8 discrete symbols.
Requires Momel targets.

optional arguments:
  -h, --help  show this help message and exit
  --quiet     Disable the verbosity
  --log file  File name for a Procedure Outcome Report (default: None)

Files (manual mode):
  -i file     Input file name with anchors.
  -o file     Output file name (default: stdout)

Files (auto mode):
  -I file     Input file name with anchors (append).
  -e .ext     Output file extension. One of: .xra .TextGrid .eaf .csv .mrk
              .txt .stm .ctm .lab .mlf .sub .srt .antx .arff .xrff

Options:
  --inputpattern INPUTPATTERN
                        Input file pattern (momel anchors) (default: -momel)
  --outputpattern OUTPUTPATTERN
                        Output file pattern (default: -intsint)

This program is part of SPPAS version 2.4. Copyright (C) 2011-2019 Brigitte
Bigi. Contact the author at: contact@sppas.org
```

Examples of use

Apply INTSINT on a single file and print the result on the standard output:

```
python .\sppas\bin\intsint.py -i .\samples\samples-eng\ENG_M15_ENG_T02-momel.xra --quiet
    1.301629 M
    1.534887 U
    1.639614 H
    1.969234 L
    2.155284 S
    2.354162 U
    2.595364 L
    2.749773 S
    2.933222 S
    3.356651 H
    3.502254 D
    3.707747 H
    4.000578 L
    4.141915 S
    4.383332 H
    4.702203 L
    4.987086 U
```

```
5.283864 L
5.538984 U
5.707147 D
5.906895 S
6.705373 M
7.052992 U
7.218415 S
7.670083 D
7.841935 S
8.124574 D
8.455182 U
8.746016 D
9.575359 M
9.996245 U
10.265663 D
10.576394 D
11.730570 M
12.083323 U
12.411790 D
12.707442 S
12.963805 U
13.443483 L
13.921939 S
14.377324 B
```

Apply INTSINT in auto mode:

```
python .\sppas\bin\intsint.py -I .\samples\samples-eng\ENG_M15_ENG_T02.wav
python .\sppas\bin\intsint.py -I .\samples\samples-eng\ENG_M15_ENG_T02.PitchTier
python .\sppas\bin\intsint.py -I .\samples\samples-eng\ENG_M15_ENG_T02-momel.xra
```

4

Resources for Automatic Annotations

4.1 Overview

Automatic annotations included in SPPAS are implemented with language-independent algorithms. This means that adding a new language into SPPAS only consists in adding resources related to the annotation (like lexicons, dictionaries, models, set of rules, etc).

> All resources can be edited, modified, changed or deleted by users.

To know what the resources are for and other information, refer to chapter 3 of this documentation: Each resource is used by an automatic annotation.

The resources are language dependent and the name of the files are based on the ISO639-3 international standard. See http://www-01.sil.org/iso639-3/ for the list of all languages and codes.

In the next sections, the table indicates the list of phonemes that are included in the resources required for phonetization, alignment and syllabification of a given language. The first column represents the symbols used by SPPAS and the other columns are intended to help users to better understand what it means.

The encoding of phonemes in SPPAS resources is based on a computer-readable phonetic list of 7-bit printable ASCII characters: X-SAMPA. This Extended Speech Assessment Methods Phonetic Alphabet was developed in 1995 by John C. Wells, professor of phonetics at the University of London. X-SAMPA is a language-independent notation covering the entire International Phonetic Alphabet - IPA repertoire. A plugin allows to convert time-aligned phonemes from X-SAMPA to IPA.

The acoustic models created by the author, Brigitte Bigi, were trained using the HTK toolbox, version 3.4.1. "HTK has been developed by the Machine Intelligence Laboratory (formerly know as the Speech Vision Robotics Group) at the Cambridge University Engineering Department (CUED) and Entropic Ltd. Microsoft has now licensed HTK back to CUED and is providing support so that CUED can redistribute HTK and provide development support via the HTK3 web site." (source: http://htk.eng.cam.ac.uk/) Notice that HTK is available for free download after registration and users must first agree to the license. Notice that the section 2.2 of the license terms mentions that HTK "either in whole or in part can not be distributed or sub-licensed to any third party in any form."

4.2 French

All French resources are *(c) Laboratoire Parole et Langage, Aix-en-Provence, France.*

4.2.1 List of phonemes

Consonant Plosives

SPPAS	IPA	Description	Examples
p	p	voiceless bilabial	passé, par, appris
b	b	voiced bilabial	beau, abris, baobab
t	t	voiceless alveolar	tout, thé, patte
d	d	voiced alveolar	doux, deux, addition
k	k	voiceless velar	cabas, psycho, quatre, kelvin
g	g	voiced velar	gain, guerre, second

Consonant Fricatives

SPPAS	IPA	Description	Examples
f	f	voiceless labiodental	fête, pharmacie
s	s	voiceless alveolar	sa, hausse, ce, garçon, option, scie
S	ʃ	voiceless postalveolar	choux, schème, shampooing
z	z	voiced alveolar	hasard, zéro, transit
Z	ʒ	voiced postalveolar	joue geai
v	v	voiced labiodental	vous, wagon, neuf heures

Consonant Nasals

SPPAS	IPA	Description	Examples
m	m	bilabial	mou, homme
n	n	alveolar	nous, bonne
N	ŋ	voiced velar	camping, bingo

Consonant Liquids

SPPAS	IPA	Description	Examples
l	l	alveolar lateral	lit, ville, fil
R	ʁ	voiced uvular	roue, rhume, arrive

Semivowels

SPPAS	IPA	Description	Examples
j	j	palatal	payer, fille, travail
w	w	voiced labiovelar	oui, web, whisky
H	ɥ	labial-palatal	huit, Puy

Vowels

SPPAS	IPA	Description	Examples
E	ɛ	open-mid front unrounded	crème, faite, peine, fête, maître, mètre, reine
A/	a	open front unrounded	patte, là
A/	ɑ	open back unrounded	pâte glas
9	œ	open-mid front rounded	sœur, neuf, œuf
i	i	close front unrounded	si, île, régie, y
e	e	close-mid front unrounded	clé, les, chez, aller, pied, journée
O/	ɔ	open-mid back rounded	sort, minimum
O/	o	close-mid back rounded	sot, hôtel, haut
u	u	close back rounded	cou, clown, roue
y	y	close front rounded	tu, sûr, rue
2	ø	close-mid front rounded	ceux, jeûner, deux
@	ə	schwa	le, reposer, faisons

Nasal vowels

SPPAS	IPA	Examples
a~	ɑ̃	sans, champ, vent, temps, Jean, taon
U~/	ɛ̃	vin, pain, brin, printemps
U~/	œ̃	un, parfum, brun
O~	ɔ̃	son, nom, bon

Fillers

SPPAS	Description
laugh	laughter
noise	noises, unintelligible speech
fp	filled pause (“euh”)
dummy	un-transcribed speech

4.2.2 Pronunciation dictionary

The French pronunciation dictionary was created by Brigitte Bigi by collecting and merging several free dictionaries loaded from the web. Some pronunciations were added using the LIA_Phon tool. Many words

were manually corrected and a large set of missing words and pronunciation variants were manually added.

It is distributed under the terms of the *GNU General Public License*.

4.2.3 Acoustic Model

The French acoustic model was created by Brigitte Bigi from various corpora mainly recorded at Laboratoire Parole et Langage. Special thanks are addressed to Roxane Bertrand, Béatrice Priego-Valverde, Sophie Herment, Amandine Michelas, Christine Meunier and Cristel Portes for kindly sharing their corpora.

It is distributed under the terms of the *Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International Public License*.

4.2.4 Syllabification configuration file

The syllabification configuration file corresponds to the one described in the paper (Bigi et al. 2010). It is distributed under the terms of the *GNU General Public License*.

4.3 Italian

4.3.1 List of phonemes

Consonant Plosives

SPPAS	IPA	Description	Examples
p	p	voiceless bilabial	primo, ampio, copertura
b	b	voiced bilabial	banca, cibo
t	t	voiceless alveolar	tranne, mito, Fiat
d	d	voiced alveolar	dove, idra
k	k	voiceless velar	cavolo, acuto, anche, quei
g	g	voiced velar	gatto, agro, glifo, ghetto

Consonant Fricatives

SPPAS	IPA	Description	Examples
f	f	voiceless labiodental	fatto, fosforo
s	s	voiceless alveolar	sano, scatola, presentire
S	ʃ	voiceless postalveolar	scena, sciame, pesci
z	z	voiced alveolar	sbavare, presentare, asma
v	v	voiced labiodental	vado, povero

Consonant Nasals

SPPAS	IPA	Description	Examples
m	m	bilabial	mano, amare, campo
n	n	alveolar	nano, punto, pensare, anfibio
J	ɲ	palatal	gnocco, ogni
N	ŋ	voiced velar	fango, unghia, panchina, dunque

Consonant Liquids

SPPAS	IPA	Description	Examples
l	l	alveolar lateral	lato, lievemente
L	ʎ	palatal lateral	gli, glielo, maglia
r	r	alveolar trill	Roma, quattro, morte

Semivowels

SPPAS	IPA	Description	Examples
j	j	voiced palatal	ieri, più, Jesi
w	w	voiced labiovelar	uovo, fuoco, qui

Vowels

SPPAS	IPA	Description	Examples
E	ɛ	open-mid front unrounded	elica, cioè
a	a	open front unrounded	alto, sarà
o	ɔ	open-mid back rounded	otto, posso, sarò
o	o	close-mid back rounded	ombra, come
e	e	close-mid front unrounded	vero, perché
i	i	close front unrounded	imposta, colibrì, zie
u	u	close back rounded	ultimo, caucciù, tuo

Affricates

SPPAS	IPA	Description	Examples
tS	t͡ʃ	voiceless postalveolar	Cennini, cinque, ciao
ts	t͡s	voiceless alveolar	sozzo canzone marzo
dz	d͡z	voiced alveolar	zaino zelare mezzo
dZ	d͡ʒ	voiced postalveolar	giungla, magia, fingere

Fillers

SPPAS	Description
laugh	laughter
noise	noises, unintelligible speech
dummy	un-transcribed speech
fp	filled pause (eh, ah)

4.3.2 Pronunciation dictionary

The Italian dictionary was downloaded in 2011 from the Festival synthetizer tool. A large amount of the phonetization were manually corrected by Brigitte Bigi and a large set of missing words and pronunciation variants were added manually.

It is distributed under the terms of the *GNU General Public License*.

4.3.3 Acoustic Model

The Italian acoustic model was created during the Evalita 2011 evaluation campaign, from the CLIPS Map-Task corpus (3h30), and updated during the Evalita 2014 evaluation campaign.

It is distributed under the terms of the *Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International Public License*.

4.3.4 Syllabification configuration file

The syllabification configuration file corresponds to the rules defined in the paper (Bigi and Petrone, 2014). This file is distributed under the terms of the *GNU General Public License*.

4.4 Spanish

4.4.1 List of phonemes

Consonant Plosives

SPPAS	IPA	Description	Examples
p	p	voiceless bilabial	pozo, topo, perro
b	b	voiced bilabial	bestia, embuste, vaca
t	t	voiceless alveolar	tamiz, átomo
d	d	voiced alveolar	dedo, cuando, aldaba
k	k	voiceless velar	caña, laca, quise, kilo
g	g	voiced velar	gato, lengua, gatouerra

Consonant Fricatives

SPPAS	IPA	Description	Examples
f	f	voiceless labiodental	fase, café
j\	t͡s	voiced palatal fricative	ayer, haya
s	s	voiceless alveolar	saco, zapato, cientos, espita
z	z	voiced alveolar	isla, mismo, deshuesar
S	ʃ	voiceless postalveolar	English, abacaxi, Shakira
T	θ	voiceless dental	cereal, encima, zorro, enzima, paz
x	x	voiceless velar	jamón, eje, reloj, general

Consonant Nasals

SPPAS	IPA	Description	Examples
m	m	bilabial	madre, campo, convertir
n	n	alveolar	nido, anhelo, sin, álbum
J	ɲ	palatal	ñandú, cañón, enyesar

Consonant Liquids

SPPAS	IPA	Description	Examples
l	l	alveolar lateral	lino, alhaja, principal
L	ʎ	palatal lateral	llave, pollo, roughly
r	r	alveolar trill	rumbo, carro, amor
4	ɾ	alveolar flap	caro, bravo, eterno

Semivowels

SPPAS	IPA	Description	Examples
j	j	voiced palatal	aliada, cielo, amplio
w	w	voiced labiovelar	cuadro, fuego

Vowels

SPPAS	IPA	Description	Examples
a	a	open front unrounded	azahar
o	o	close-mid back rounded	boscoso
e	e	close-mid front unrounded	vehemente
i	i	close front unrounded	dimitir, mío
u	u	close back rounded	cucurucho, dúo

Affricates

SPPAS	IPA	Description	Examples
tS	t͡ʃ	voiceless postalveolar	chubasco, acechar

Fillers

SPPAS	Description
laugh	laughter
noise	noises, unintelligible speech
dummy	un-transcribed speech

4.4.2 Pronunciation Dictionary

The pronunciation dictionary was downloaded from the CMU web page in 2013. Brigitte Bigi converted the CMU phoneset to X-SAMPA, and changed the format of the file. It is distributed under the terms of the *GNU General Public License*.

4.4.3 Acoustic Model

The acoustic model was trained from Glissando corpus. We address special thanks to Juan-Maria Garrido for giving us access to this corpus. It is distributed under the terms of the *Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International Public License*.

> **GARRIDO, J. M. - ESCUDERO, D. - AGUILAR, L. -CARDEÑOSO, V. - RODERO, E. - DE-LA-MOTA, C. - GONZÁLEZ, C. - RUSTULLET, S. - LARREA, O. - LAPLAZA, Y. - VIZCAÍNO, F. - CABRERA, M. - BONAFONTE, A.** (2013). *Glissando: a corpus for multidisciplinary prosodic studies in Spanish and Catalan*, Language Resources and Evaluation, DOI 10.1007/s10579-012-9213-0.

4.5 Catalan

4.5.1 List of phonemes

Consonant Plosives

SPPAS	IPA	Description	Examples
p	p	voiceless bilabial	pala
b	b	voiced bilabial	bala, via
t	t	voiceless alveolar	tela
d	d	voiced alveolar	donar
k	k	voiceless velar	cala
g	g	voiced velar	gala

Consonant Fricatives

SPPAS	IPA	Description	Examples
D	ð	voiced dental	cada
G	ɣ	voiceless velar	alga, mages
f	f	voiceless labiodental	fals
s	s	voiceless alveolar	si, sala
z	z	voiced alveolar	desde
S	ʃ	voiceless postalveolar	caixa
Z	ʒ	voiced postalveolar	mújol
v	v	voiced labiodental	va, vol
T	θ	voiceless dental	circus

Consonant Nasals

SPPAS	IPA	Description	Examples
m	m	bilabial	mena
n	n	alveolar	nena
J	ɲ	palatal	any
N	ŋ	voiced velar	lingot, lingual

Consonant Liquids

SPPAS	IPA	Description	Examples
l	l	alveolar lateral	líquid
L	ʎ	palatal lateral	llamp
r	r	alveolar trill	carro
4	ɾ	alveolar flap	cara

Semivowels

SPPAS	IPA	Description	Examples
j	j	voiced palatal	iaia, nacións, iogurt
w	w	voiced labiovelar	veu, veuran

Vowels

SPPAS	IPA	Description	Examples
E	ɛ	open-mid front unrounded	sec, veça
a	a	open front unrounded	sac
O	ɔ	open-mid back rounded	soc

SPPAS	IPA	Description	Examples
o	o	close-mid back rounded	sóc
e	e	close-mid front unrounded	séc, cec
i	i	close front unrounded	sic, ric
u	u	close back rounded	suc
@	ə	schwa	contra, estada
U	ʊ	near-close near-back rounded	òpols

Affricates

SPPAS	IPA	Description	Examples
dZ	d͡ʒ	voiced postalveolar	metge
tS	t͡ʃ	voiceless postalveolar	cotxe

Fillers

SPPAS	Description
laugh	laughter
noise	noises, unintelligible speech
dummy	un-transcribed speech

4.5.2 Pronunciation dictionary

The catalan pronunciation dictionary was downloaded in 2014 from the Ralf catalog of dictionaries for the Simon ASR system at http://spirit.blau.in/simon/import-pls-dictionary/. It was then converted (format and phoneset) by Brigitte Bigi. Some new words were also added and phonetized manually by Eva Bosch i Roura. New entries were then added from observed pronunciations in Glissando corpus.

It is distributed under the terms of the *GNU General Public License*.

4.5.3 Acoustic Model

The acoustic model was trained from Glissando corpus. We address special thanks to Juan-Maria Garrido for giving us access to this corpus. It is distributed under the terms of the *Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International Public License*.

Reference of Glissande corpus is:

> **GARRIDO, J. M. - ESCUDERO, D. - AGUILAR, L. -CARDEÑOSO, V. - RODERO, E. - DE-LA-MOTA, C. - GONZÁLEZ, C. - RUSTULLET, S. - LARREA, O. - LAPLAZA, Y. - VIZCAÍNO, F. - CABRERA, M. - BONAFONTE, A.** (2013). *Glissando: a corpus for multidisciplinary prosodic studies in Spanish and Catalan*, Language Resources and Evaluation, DOI 10.1007/s10579-012-9213-0.

4.6 English

4.6.1 List of phonemes

Consonant Plosives

SPPAS	IPA	Description	Examples
p	p	voiceless bilabial	pie, spy, cap
b	b	voiced bilabial	buy, cab
t	t	voiceless alveolar	tie, sty, cat, atom
d	d	voiced alveolar	dye, cad, do
k	k	voiceless velar	sky, crack, quick
g	g	voiced velar	guy, bag, luggage

Consonant Fricatives

SPPAS	IPA	Description	Examples
D	ð	voiced dental	thy, breathe, father
f	f	voiceless labiodental	phi, caff, fan
s	s	voiceless alveolar	sigh, mass
S	ʃ	voiceless postalveolar	shy, cash, emotion
z	z	voiced alveolar	zoo, has
Z	ʒ	voiced postalveolar	equation, pleasure, vision, beige
v	v	voiced labiodental	vie, have
T	θ	voiceless dental	thigh, math
h	h	voiceless glottal	high, ahead

Consonant Nasals

SPPAS	IPA	Description	Examples
m	m	bilabial	my, smile, cam
n	n	alveolar	nigh, snide, can
N	ŋ	voiced velar	sang, sink, singer

Consonant Liquids

SPPAS	IPA	Description	Examples
l	l	alveolar lateral	lie, sly, gal
4	ɾ	alveolar flap	lyda, maddy, makita
r\	ɹ	alveolar approximant	red, try, very

Semivowels

SPPAS	IPA	Description	Examples
j	j	voiced palatal	yes, yacht, william
w	w	voiced labiovelar	wye, swine, why

Vowels

SPPAS	IPA	Description	Examples
E	ɛ	open-mid front unrounded	dress, bed, fell, men
A	ɑ:	open back unrounded	palm, father, bra
A	ɒ	open back rounded	lot, pod, John
O:	ɔ:	open-mid back rounded	thought, Maud, dawn, fall
V	ʌ	open-mid back unrounded	strut, mud, dull, gun
i	i	close front unrounded	happy, serious
i:	i:	close front unrounded	fleece, seed, feel, sea
u:	u:	close back rounded	goose, food, chew, do
@	ə	schwa	a, baccus
I	ɪ	near-close near-front unrounded	kit, lid, fill, bin
U	ʊ	near-close near-back rounded	foot, full, woman
{	æ	near-open front unrounded	trap, pad, shall, ban

Affricates

SPPAS	IPA	Description	Examples
dZ	d͡ʒ	voiced postalveolar	giant, badge, jam
tS	t͡ʃ	voiceless postalveolar	China, catch

Other symbols

SPPAS	IPA	Examples
aI	aɪ	price, ride, file, pie
aU	aʊ	mouth, loud, down, how
eI	eɪ	face, fail, vein, pay
OI	ɔɪ	choice, void, foil, boy
@U	oʊ	goat, code, foal, go
3:r	ɜ:r	liner, foundered, current

Fillers

SPPAS	Description
laugh	laughter
noise	noises, unintelligible speech
dummy	un-transcribed speech

4.6.2 Pronunciation dictionary

The pronunciation dictionary is for North American English. It was downloaded in 2011 from the CMU web page. This Carnegie Mellon Pronouncing Dictionary (version 0.6) is Copyright (C) 1993-2008 by Carnegie Mellon University. We acknowledge CMU for distributing freely this resource and allowing its re-distribution.

Brigitte Bigi converted the original CMUdict encoded with ARPAbet into X-SAMPA and converted the format of the file in HTK-ASCII.

4.6.3 Acoustic Model

The acoustic model distributed in SPPAS resources was downloaded in 2014 from the VoxForge project at `http://www.voxforge.org/`.

Actually, two acoustic models are available:

- "eng-cd" is context-dependent (better accuracy) but does not contain the fillers;
- "eng" is context-independent, and contains the fillers (i.e. laugh, noise and dummy). The latter was extracted from the first one.

Both English acoustic models are under the terms of the "GNU Public License".

It has to be noticed that the first one will time-align with a better accuracy but it can't be used if the speech to align contains fillers.

4.7 Polish

4.7.1 List of phonemes

Consonant Plosives

SPPAS	IPA	Description	Examples
p	p	voiceless bilabial	pas
b	b	voiced bilabial	
t	t	voiceless alveolar	
d	d	voiced alveolar	
k	k	voiceless velar	
g	g	voiced velar	
c	c	voiceless palatal	

Consonant Fricatives

SPPAS	IPA	Description	Examples
f	f	voiceless labiodental	fac, feedback
s	s	voiceless alveolar	sabat, subaru
s\	ɕ	voiceless alveolo-palatal	świerszcz, śam
s‘	ʂ	voiceless alveolar with retroflex hook	
S	ʃ	voiceless postalveolar	
z	z	voiced alveolar	
z\	ʑ	voiced alveolo-palatal	źrebak
Z	ʒ	voiced postalveolar	
v	v	voiced labiodental	
x	x	voiceless velar	hak, chór
x	ç		
x	h		

Consonant Nasals

SPPAS	IPA	Description	Examples
m	m	bilabial	
n	n	alveolar	
N	ŋ	voiced velar	

Consonant Liquids

SPPAS	IPA	Description	Examples
l	l	alveolar lateral	
r	r	alveolar trill	krok

Semivowels

SPPAS	IPA	Description	Examples
j	j	palatal	jak
w	w	voiced labiovelar	

Vowels

SPPAS	IPA	Description	Examples
E	ɛ	open-mid front unrounded	test, ten
a	a	open front unrounded	pat, ptak
O	ɔ	open-mid back rounded	pot, kot

SPPAS	IPA	Description	Examples
i	i	close front unrounded	pit, bit, miś
i	ɨ	near-close central unrounded	ryba
u	u	close back rounded	bum
y	y	close front rounded	mysz

Nasal vowels

SPPAS	IPA	Examples
E~	ɛ̃	węże
o~	ɔ̃	wąż

Affricates

SPPAS	IPA	Description	Examples
tS	t͡ʃ	voiceless postalveolar	
ts	t͡s	voiceless alveolar	co
dz	d͡z	voiced alveolar	dzwon
dZ	d͡ʒ	voiced postalveolar	

Fillers

SPPAS	Description
laugh	laughter
noise	noises, unintelligible speech
dummy	un-transcribed speech

4.7.2 Pronunciation Dictionary

The Polish pronunciation dictionary was downloaded in 2015 from the Ralf catalog of dictionaries for the Simon ASR system at http://spirit.blau.in/simon/import-pls-dictionary/.

It was then converted (format and phoneset) and corrected by Brigitte Bigi, thanks to the help of Katarzyna Klessa http://katarzyna.klessa.pl/. An update was done in 2017 to correct systematic errors.

It is distributed under the terms of the *GNU General Public License*.

4.7.3 Acoustic Model

The acoustic model was created by Brigitte Bigi. We address special thanks to Katarzyna Klessa for giving us access to a corpus.

It is distributed under the terms of the *Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International Public License*.

4.8 Portuguese

List of phonemes

Consonant Plosives

SPPAS	IPA	Description	Examples
p	p	voiceless bilabial	pacto
b	b	voiced bilabial	bato
t	t	voiceless alveolar	tacto
d	d	voiced alveolar	dato
k	k	voiceless velar	cacto
g	g	voiced velar	gato

Consonant Fricatives

SPPAS	IPA	Description	Examples
f	f	voiceless labiodental	facto
s	s	voiceless alveolar	saca
S	ʃ	voiceless postalveolar	chato
z	z	voiced alveolar	zaca
Z	ʒ	voiced postalveolar	jacto
v	v	voiced labiodental	vaca
x	x	voiceless velar	rabão

Consonant Nasals

SPPAS	IPA	Description	Examples
m	m	bilabial	mato
n	n	alveolar	nato
N	ŋ	voiced velar	hong-kong
J	ɲ	palatal	pinha

Consonant Liquids

SPPAS	IPA	Description	Examples
l	l	alveolar lateral	galo
L	ʎ	palatal lateral	galho
r	r	alveolar trill	pira
R	ʁ	voiced uvular	rato

Semivowels

SPPAS	IPA	Description	Examples
j	j	voiced palatal	yoga
w	w	voiced labiovelar	uísque

Vowels

SPPAS	IPA	Description	Examples
E	ɛ	open-mid front unrounded	ego, eira
a	a	open front unrounded	parto
O	ɔ	open-mid back rounded	pôde
i	i	close front unrounded	hidra
e	e	close-mid front unrounded	pega, elo
o	o	close-mid back rounded	bola
u	u	close back rounded	hotel
y	y	close front rounded	emile
I	ɪ	near-close near-front unrounded	dois
U	ʊ	near-close near-back rounded	ido

Nasal vowels

SPPAS	IPA	Examples
a~	ɑ̃	anis
u~	ũ	humberto, unha

Fillers

SPPAS	Description
laugh	laughter
noise	noises, unintelligible speech
dummy	un-transcribed speech

4.8.1 Pronunciation Dictionary

The Portuguese pronunciation dictionary was downloaded from the Ralf catalog of dictionaries for the Simon ASR system at http://spirit.blau.in/simon/import-pls-dictionary/. It was then converted (format and phoneset) and corrected by Brigitte Bigi.

It is re-distributed under the terms of the *GNU General Public License*.

4.8.2 Acoustic Model

The acoustic model was *NOT* trained from data. Monophones of other models were cut and pasted to create this one, mainly from the Spanish and the French models. The Portuguese model is distributed under the terms of the *Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International Public License*.

New Portuguese data is welcome! Because data implies a better acoustic model then better alignments…

4.9 German

List of phonemes

Consonant Plosives

SPPAS	IPA	Description	Examples
p	p	voiceless bilabial	
b	b	voiced bilabial	
t	t	voiceless alveolar	
d	d	voiced alveolar	
k	k	voiceless velar	
g	g	voiced velar	

Consonant Fricatives

SPPAS	IPA	Description	Examples
f	f	voiceless labiodental	
s	s	voiceless alveolar	
S	ʃ	voiceless postalveolar	
z	z	voiced alveolar	
Z	ʒ	voiced postalveolar	
v	v	voiced labiodental	
x	x	voiceless velar	
h	h	voiceless glottal	
C	ç	voiceless palatal fricative	ich , nicht

Consonant Liquids

SPPAS	IPA	Description	Examples
l	l	alveolar lateral	
R	ʁ	voiced uvular	

Consonant Nasals

SPPAS	IPA	Description	Examples
m	m	bilabial	
n	n	alveolar	
N	ŋ	voiced velar	

Semivowels

SPPAS	IPA	Description	Examples
j	j	voiced palatal	
w	w	voiced labiovelar	software

Vowels

SPPAS	IPA	Description	Examples
E	ɛ	open-mid front unrounded	
E:	ɛː	open-mid front unrounded	
O	ɔ	open-mid back rounded	
U	ʊ	near-close near-back rounded	
i	i	close front unrounded	
i:	iː	close front unrounded	
u:	uː	close back rounded	
@	ə	schwa	
I	ɪ	near-close near-front unrounded	
a	a	open front unrounded	
a:	aː	open front unrounded	
2:	ø	close-mid front rounded	
9	œ	open-mid front rounded	
6	ɐ	near-open central vowel	besser
e	e	close-mid front unrounded	
o:	oː	close-mid back rounded	
y	y	close front rounded	
y:	yː	close front rounded	
Y	ʏ	near-close near-front rounded vowel	hübsch

Affricates

SPPAS	IPA	Description	Examples
tS	t͡ʃ	voiceless postalveolar	
ts	t͡s	voiceless alveolar	
dZ	d͡ʒ	voiced postalveolar	

Other symbols

SPPAS	IPA	Examples
?	ʔ	
aI	aɪ	
aU	aʊ	
OY	ɔʏ	

Fillers

SPPAS	Description
laugh	laughter
noise	noises, unintelligible speech
fp	filled pause (äh, eh)
dummy	un-transcribed speech

4.9.1 Pronunciation Dictionary

The German pronunciation dictionary was downloaded from the Ralf catalog of dictionaries for the Simon ASR system at http://spirit.blau.in/simon/import-pls-dictionary/. It was then converted (format and phoneset) and corrected by Brigitte Bigi.

It is re-distributed under the terms of the *GNU General Public License*.

4.10 Mandarin Chinese

4.10.1 List of phonemes

Any help is welcome to improve the quality of both Mandarin Chinese resources and of this documentation. Both are distributed without any warranty.

Consonant Plosives

SPPAS	IPA	Description	Examples
p	p	voiceless bilabial	□, □□□
p_h	p^h	voiceless bilabial aspirated	□, □, □
t	t	voiceless alveolar	□, □
t_h	t^h	voiceless alveolar aspirated	□□
k	k	voiceless velar	□, □
k_h	k^h	voiceless velar aspirated	□, □

Consonant Fricatives

SPPAS	IPA	Description	Examples
f	f	voiceless labiodental	[illegible], [illegible], [illegible]
s	s	voiceless alveolar	[illegible], [illegible]
s‘	ʂ	voiceless alveolar with retroflex hook	[illegible] [illegible]
z‘	ʐ	voiced alveolar with retroflex hook	[illegible], [illegible]
S	ʃ	voiceless postalveolar	[illegible], [illegible]
x	x	voiceless velar	[illegible], [illegible]
ss			[illegible], [illegible]

Consonant Nasals

SPPAS	IPA	Description	Examples
m	m	bilabial	[illegible], [illegible], [illegible]
n	n	alveolar	[illegible], [illegible], [illegible]
N	ŋ	voiced velar	[illegible], [illegible], [illegible]

Consonant Liquids

SPPAS	IPA	Description	Examples
l	l	alveolar lateral	[illegible], [illegible]

Vowels

SPPAS	IPA	Description	Examples
a	a	open front unrounded	[illegible], [illegible], [illegible], [illegible], [illegible]
o	o	close-mid back rounded	[illegible], [illegible]
e	e	close-mid front unrounded	A, [illegible]
i	i	close front unrounded	[illegible], [illegible], [illegible] [illegible]
i_d	i̪	close front unrounded dental	[illegible], [illegible]
i‘	ɻ	close front unrounded retroflex	[illegible][illegible], [illegible]
u	u	close back rounded	[illegible], [illegible], [illegible]
y	y	close front rounded	[illegible], [illegible], [illegible]
@‘	ə˞	schwa with retroflex hook	[illegible], [illegible]

Affricates

SPPAS	IPA	Description	Examples
ts	t͡s	voiceless alveolar	[illegible], [illegible]
tss			[illegible], [illegible]
ts_h	t͡sʰ	voiceless alveolar aspirated	[illegible], [illegible]
ts‘		voiceless alveolar retroflex hook	[illegible], [illegible]

SPPAS	IPA	Description	Examples
ts_h‘			□ □
ts_hs			□, □

Fillers

SPPAS	Description
laugh	laughter
noise	noises, unintelligible speech
dummy	un-transcribed speech

4.10.2 Pronunciation dictionary

The pronunciation dictionary was manually created for the syllables by Zhi Na. We address special thanks to her for sharing her work.

It is distributed under the terms of the *GNU General Public License*.

4.10.3 Acoustic model

The acoustic model was created by Brigitte Bigi from 2 corpora: the first one at Shanghai by Zhi Na, and another one by Hongwei Ding. We address special thanks to hers for giving us access to their corpus. Both recordings are a Chinese version of the Eurom1 corpus. See the following publication for details:

> **Daniel Hirst, Brigitte Bigi, Hyongsil Cho, Hongwei Ding, Sophie Herment, Ting Wang** (2013). *Building OMProDat: an open multilingual prosodic database*, Proceedings of Tools ans Resources for the Analysis of Speech Prosody, Aix-en-Provence, France, Eds B. Bigi and D. Hirst, ISBN: 978-2-7466-6443-2, pp. 11-14.

Notice that the current model was trained from a very small amount of data: this will impact on the results. Do not expect to get good performances for the automatic alignment.

More Mandarin Chinese data are welcome! Because more data implies a better acoustic model then better alignments…

The model is distributed under the terms of the *Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International Public License*.

4.11 Southern Min (or Min Nan)

4.11.1 List of phonemes

Consonant Plosives

SPPAS	IPA	Description
b	b	voiced bilabial
d	d	voiced alveolar
p	p	voiceless bilabial
p_h	p^h	voiceless bilabial aspirated
t	t	voiceless alveolar
t_h	t^h	voiceless alveolar aspirated
k	k	voiceless velar
k_h	k^h	voiceless velar aspirated
g	g	voiced velar

Consonant Fricatives

SPPAS	IPA	Description
f	f	voiceless labiodental
s	s	voiceless alveolar
S	ʃ	voiceless postalveolar
x	x	voiceless velar
ss		
v	v	voiced labiodental
z	z	voiced alveolar
h	h	voiceless glottal

Consonant Nasals

SPPAS	IPA	Description
m	m	bilabial
n	n	alveolar
N	ŋ	voiced velar

Consonant Liquids

SPPAS	IPA	Description
l	l	alveolar lateral

Semivowels

SPPAS	IPA	Description
w	w	voiced labiovelar

Vowels

SPPAS	IPA	Description
a	a	open front unrounded
o	o	close-mid back rounded
O	ɔ	open-mid back rounded
e	e	close-mid front unrounded
i	i	close front unrounded
u	u	close back rounded
y	y	close front rounded
@	ə	schwa

Nasal vowels

SPPAS	IPA
a~	ɑ̃
e~	ɛ̃
o~	õ
O~	ɔ̃
u~	ũ
i~	ĩ

Affricates

SPPAS	IPA	Description
ts	t͡s	voiceless alveolar
ts_h	t͡sʰ	voiceless alveolar aspirated
dz	d͡z	voiced alveolar

Fillers

SPPAS	Description
laugh	laughter
noise	noises, unintelligible speech
dummy	un-transcribed speech

4.11.2 Pronunciation Dictionary

The pronunciation dictionary was constructed from the most frequent observed pronunciations of the corpus described below.

It is distributed under the terms of the *GNU General Public License*.

4.11.3 Acoustic Model

The acoustic model was trained from a corpus of spontaneous speech. We address special thanks to Sheng-Fu Wang for giving us access to his corpus.

S-F Wang, J. Fon (2013). *A Taiwan Southern Min spontaneous speech corpus for discourse prosody*, Proceedings of Tools ans Resources for the Analysis of Speech Prosody, Aix-en-Provence, France, Eds B. Bigi and D. Hirst, ISBN: 978-2-7466-6443-2, pp. 20-23.

4.12 Cantonese

4.12.1 List of phonemes

Consonant Plosives

SPPAS	IPA	Description
p	p	voiceless bilabial
p_h	p^h	voiceless bilabial aspirated
t	t	voiceless alveolar
t_h	t^h	voiceless alveolar aspirated
k	k	voiceless velar
k_h	k^h	voiceless velar aspirated
k_w	k^w	voiceless velar labialized
k_h_w	k^{hw}	voiceless velar aspirated labialized

Consonant Fricatives

SPPAS	IPA	Description
f	f	voiceless labiodental
s	s	voiceless alveolar
S	ʃ	voiceless postalveolar
h	h	voiceless glottal

Consonant Nasals

SPPAS	IPA	Description
m	m	bilabial
n	n	alveolar
N	ŋ	voiced velar

Consonant Liquids

SPPAS	IPA	Description
l	l	alveolar lateral

Semivowels

SPPAS	IPA	Description
j	j	palatal
w	w	voiced labiovelar

Vowels

SPPAS	IPA	Description
E:	ɛ:	open-mid front unrounded
a:	a:	open front unrounded
9:	œ:	open-mid front rounded
O:	ɔ:	open-mid back rounded
o	o	close-mid back rounded
e	e	close-mid front unrounded
8	ɵ	close-mid central rounded vowel
i:	i:	close front unrounded
u:	u:	close back rounded
y:	y:	close front rounded
6	ɐ	near-open central vowel
I	ɪ	near-close near-front unrounded
U	ʊ	near-close near-back rounded
@	ə	schwa

Affricates

SPPAS	IPA	Description
ts	t͡s	voiceless alveolar
ts_h	t͡sʰ	voiceless alveolar aspirated
tS	t͡ʃ	voiceless postalveolar
tS_h	t͡ʃʰ	voiceless postalveolar aspirated

4.12.2 Acoustic Model

The Cantonese acoustic model is copyrighted: *(C) DSP and Speech Technology Laboratory, Department of Electronic Engineering, the Chinese University of Hong Kong.*

This is a monophone Cantonese acoustic model, based on Jyutping of the Linguistic Society of Hong Kong

(LSHK). Each state is trained with 32 Gaussian mixtures. The model is trained with HTK 3.4.1. The corpus for training is CUSENT, also developed in our laboratory.

Generally speaking, you may use the model for non-commercial, academic or personal use.

See COPYRIGHT for the details of the license: "Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International Public License".

We also have other well-trained Cantonese acoustic models. If you would like to use the models and/or the CUSENT corpus for commercial applications or development, please contact Professor Tan LEE for appropriate license terms.

The character pronunciation comes from Jyutping phrase box from the Linguistic Society of Hong Kong.

"The copyright of the Jyutping phrase box belongs to the Linguistic Society of Hong Kong. We would like to thank the Jyutping Group of the Linguistic Society of Hong Kong for permission to use the electronic file in our research and/or product development."

If you use this model for academic research, please cite:

> **Tan Lee, W.K. Lo, P.C. Ching, Helen Meng** (2002). *Spoken language resources for Cantonese speech processing*, Speech Communication, Volume 36, Issues 3–4, Pages 327-342

- Website: http://dsp.ee.cuhk.edu.hk
- Email: tanlee@ee.cuhk.edu.hk

4.13 Japanese

The linguistic resources for Japanese language are kindly shared by the authors of the Julius CSR engine.

For more detail, please contact csrc@astem.or.jp, or access the Julius website: http://julius.osdn.jp/en_index.php?q=index-en.html#about_models

4.14 Korean

Korean resources are under construction.

4.14.1 List of phonemes

Consonant Plosives

SPPAS	IPA	Description	Examples
b	b	voiced bilabial	□, □□
p	p	voiceless bilabial	□
p_h	p^h	voiceless bilabial aspirated	□, □□
p_>	$\ddot{p}$	voiceless bilabial ejective	□
t	t	voiceless alveolar	□
t_h	t^h	voiceless alveolar aspirated	□
t_>	$\ddot{t}$	voiceless alveolar ejective	□, □

SPPAS	IPA	Description	Examples
d	d	voiced alveolar	[illegible], [illegible], [illegible]
k	k	voiceless velar	[illegible], [illegible]
k_h	k^h	voiceless velar aspirated	[illegible]
k_>	k͈	voiceless velar ejective	[illegible], [illegible]
g	g	voiced velar	[illegible], [illegible], [illegible]

Consonant Fricatives

SPPAS	IPA	Description	Examples
s	s	voiceless alveolar	[illegible], [illegible], [illegible]
s_>	s͈	voiceless alveolar ejective	[illegible]

Consonant Nasals

SPPAS	IPA	Description	Examples
m	m	bilabial	[illegible], [illegible] , [illegible]
n	n	alveolar	[illegible], [illegible]
N	ŋ	voiced velar	[illegible], [illegible], [illegible]

Consonant Liquids

SPPAS	IPA	Description	Examples
l	l	alveolar lateral	[illegible], [illegible], [illegible]
4	ɾ	alveolar flap	[illegible], [illegible], [illegible]

Semivowels

SPPAS	IPA	Description	Examples
j	j	voiced palatal	[illegible], [illegible], [illegible], [illegible], [illegible]
w	w	voiced labiovelar	[illegible], [illegible], [illegible], [illegible], [illegible]

Vowels

SPPAS	IPA	Description	Examples
E	ɛ	open-mid front unrounded	[illegible], [illegible]
A	ɑ	open back unrounded	[illegible], [illegible]
i	i	close front unrounded	[illegible], [illegible]
e	e	close-mid front unrounded	[illegible], [illegible]
o	o	close-mid back rounded	[illegible], [illegible]

SPPAS	IPA	Description	Examples
u	u	close back rounded	[illegible], [illegible]
2	ø	close-mid front rounded	[illegible]
V	ʌ	open-mid back unrounded	[illegible], [illegible]
M	ɯ	close back unrounded	[illegible], [illegible]

Affricates

SPPAS	IPA	Description	Examples
dz	d͡z	voiced alveolar	[illegible]
dZ	d͡ʒ	voiced postalveolar	[illegible]
tS_>	t͡ʃˀ	voiceless postalveolar ejective	[illegible]
tS_h	t͡ʃʰ	voiceless postalveolar aspirated	[illegible]

Fillers

SPPAS	Description
laugh	laughter
noise	noises, unintelligible speech
dummy	un-transcribed speech

4.14.2 Pronunciation dictionary

The Korean pronunciation dictionary was manually created and is still under construction. **Any help is welcome!**

It is distributed under the terms of the *GNU General Public License*.

4.14.3 Acoustic Model

The acoustic model was *NOT* trained from data. Monophones of other models were cut and pasted to create this one, mainly the English and Taiwanese models.

Korean data are welcome! Because data implies a better acoustic model then better alignments…

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4.15 Naija

This work was financed by the French Agence Nationale pour la Recherche (ANR-16-CE27-0007), in the context of the NaijaSynCor project.

4.15.1 List of phonemes

Consonant Plosives

SPPAS	IPA	Description	Examples
p	p	voiceless bilabial	public, palaver
b	b	voiced bilabial	bye, bojuboju, boli
t	t	voiceless alveolar	two, tree, tranga
d	d	voiced alveolar	drop, duma, this
k	k	voiceless velar	ketu, cut, quick
g	g	voiced velar	gain, girl, guy

Consonant Fricatives

SPPAS	IPA	Description	Examples
f	f	voiceless labiodental	farm, phone, view
s	s	voiceless alveolar	centre, safe, zero
S	ʃ	voiceless postalveolar	cheque, sabi, ship
z	z	voiced alveolar	used, diesel, eze
v	v	voiced labiodental	visit, view
h	h	voiceless glottal	happy, hope, who
T	θ	voiceless dental	thing, ethnic, three

Consonant Nasals

SPPAS	IPA	Description	Examples
m	m	bilabial	make, milk, magaji
n	n	alveolar	knock, name, nitel
N	ŋ	voiced velar	bongo, sings

Consonant Liquids

SPPAS	IPA	Description	Examples
l	l	alveolar lateral	load, lokodan
r\	ɹ	alveolar approximant	radio, root, wrap

Semivowels

SPPAS	IPA	Description	Examples
j	j	voiced palatal	uni, yes, europe
w	w	voiced labiovelar	one, wait, wowo

Vowels

SPPAS	IPA	Description	Examples
E	ɛ	open-mid front unrounded	air, early, egg, men
a	a	open front unrounded	our, ask, above
O	ɔ	open-mid back rounded	us, onion, all, oba
i	i	close front unrounded	each, even, ile, is
e	e	close-mid front unrounded	alone, eko
o	o	close-mid back rounded	obodo, ojo
u	u	close back rounded	ugu, una, upo

Nasal vowels

SPPAS	IPA	Examples
a~	ɑ̃	auntie, african, commander
e~	ẽ	fiyen, britain, town
E~	ɛ̃	calendar, men, accent
i~	ĩ	admin, ani, benin
O~	ɔ̃	election, lokodan, million
u~	ũ	remove, segun, broken

Affricates

SPPAS	IPA	Description
tS	t͡ʃ	voiceless postalveolar
dZ	d͡ʒ	voiced postalveolar

Others

SPPAS	IPA	Examples
aI	aɪ	I, write, type
aU	aʊ	out, town
OI	ɔɪ	oil, boy
eI	eɪ	a, eight, age

Fillers

SPPAS	Description
laugh	laughter
noise	noises, unintelligible speech
dummy	un-transcribed speech

4.15.2 Pronunciation Dictionary

The dictionary was originally created by extracting the lexicon of the corpus published in annex of (Deuber 2005). New words with their orthographic variants and pronunciations were added to the dictionary by team of four transcribers, native speakers of the language.

It is distributed under the terms of the *GNU General Public License*.

4.15.3 Acoustic Model

The Naija acoustic model was created in 2017-07 by Brigitte Bigi with the SPPAS training scripts.

An initial model was created on the basis of other language prototypes. Such prototypes were mostly extracted from the English acoustic model. For the missing models of phonemes, the nasals /O~/, /a~/, /e~/, /i~/ and /u~/ were picked off Southern Min language, and /E~/ was extracted from French language using /U~/ prototype. The vowels /a/ and /e/ were extracted from the French model; and finally /O/ and /o/ from the Italian one. The fillers were also added to the model in order to be automatically time-aligned too: silence, noise, laughter.

The acoustic model was then trained with a set of 8 files (totalling 3 min 29 seconds in length.) manually phonetized and time-aligned.

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5

Analyses

5.1 Introduction

The analysis tools are useful for the analyses of annotated files: display the automatic alignments with the audio signal, estimates statistics on the annotations, filter the annotated data to get only the annotations you are interested in, etc.

To execute a specific analysis tool, select file(s) in the file explorer of the main frame, then click on the button of the tool. It will open the window of the tool, and add the file(s) in its file manager.

Six tools are available:

1. `DataRoamer` allows to explore the annotated files: cut/copy/paste/rename/duplicate tiers, move a tier from one file to another one, etc.
2. `AudioRoamer` allows to play and manage audio files: extract a channel, see clipping rates, change framerate, etc.
3. `IPUscriber` is useful to perform manual orthographic transcription.
4. `Visualizer` displays audio files and annotated files, and is very useful to take a screenshot! Easy way to zoom/scroll, change colours, choose the tiers to display, etc;
5. `DataFilter` allows to select a sub-set of annotations: fix a set of filters to create new tiers with only the annotations you are interested in!
6. `Statistics` estimates the number of occurrences, the duration, etc. of the annotations, and allows to save in CSV (for Excel, OpenOffice, R, MatLab,…).

All of such tools share the same look with:

- a menu at left
- a toolbar at top
- a list of files
- a notebook to open files in the tabs

Figure 5.1: The analysis tools

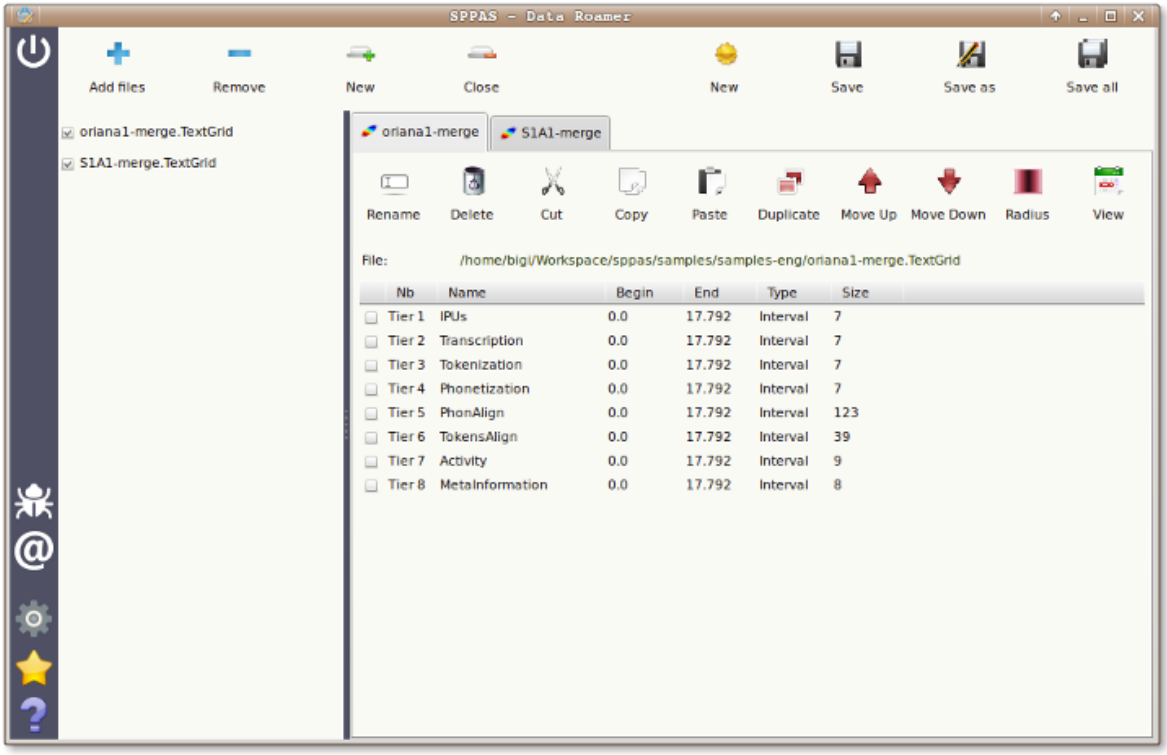


Figure 5.2: DataRoamer: explore annotated files

5.2 DataRoamer

`DataRoamer` displays detailed information about annotated files and allows to manage the tiers: cut/copy/paste/rename/duplicate tiers, move a tier from one file to another one, etc.

When an annotated file is checked in the list of files, the file is opened in a new panel of the current tab of the notebook and information about this file are displayed. At top, the name of the file is in dark green color. It is turned to blue color if some changes were applied. Below the name of the file, each tier is represented in a row of a spreadsheet:

- 1st column is a check box: select/deselect the tier;
- 2nd column indicates the number of the tier;
- 3rd column indicated the name of the tier;
- 4th column indicates the lower time value of the annotations;
- 5th column indicates the higher time values of the annotations;
- 6th column is the type of the tier: either “Interval” or “Point”;
- last column is the number of annotations in the tier.

The buttons of the toolbar can be applied on the tier(s) selected in the same tab of the notebook. For example, it is possible to copy a tier of a file and to paste it in another file only if they are both open in the same tab.

- Rename: Fix a new name to the selected tier. If the given name is already assigned to a tier in the same file, a number is automatically appended to the end of the new name.
- Delete: Definitively delete the selected tier. To recover the tier, the only way is to close the file without saving changes and to re-open it.

- Cut: Delete the tier of the file and put it in the dashboard.
- Copy: Copy the selected tier into the dashboard.
- Paste: Paste the content of the dashboard into the currently selected file.
- Duplicate: Duplicate the selected tier in the file. A number is automatically appended to the end of name of the copy.
- Move Up: Move the selected tier up in the list of tiers of the file.
- Move Down: Move the selected tier down in the list of tiers of the file.
- Radius: Fix the radius value of each localization of each annotation. A radius value indicates the vagueness around the point. It is commonly ranging from 1ms for very (very) precise annotations up to 40ms for annotations of videos for example. This value is safely saved only in XRA format. Other formats don't consider vagueness.
- View: Open a window and display the annotations of the tier.

Only the `Delete` and `Radius` actions can be applied on several selected tiers at a time. The other actions can be applied only on one selected tier.

5.3 AudioRoamer

`AudioRoamer` allows to play audio files, to display general information about a digitalized audio-PCM file and to manipulate the file.

Pulse-code modulation (PCM) is a method used to digitally represent sampled analog signals. In a PCM stream, the amplitude of the analog signal is sampled regularly at uniform intervals. A PCM stream has two basic properties that determine the stream's fidelity to the original analog signal:

1. the sampling rate, which is the number of times per second that samples are taken;
2. the bit depth, which determines the number of possible digital values that can be used to represent each sample.

Common sampling frequencies are 48 kHz as used with DVD format videos, or 44.1 kHz that was used in Compact discs. Common sample depths is 16 bits per sample: it allows values to range from -32768 to 32767.

Support for multichannel audio depends on file format and relies on interweaving or synchronization of streams.

When an audio file is checked in the list of files, a new page is opened in the notebook. The main information about the audio file are then displayed in the panel at the middle and a player is displayed at bottom. The audio file is not loaded in memory, so event very long audio files can be displayed. At the top of the page, a button "Want more?" can be clicked: the audio file will then be fully read and analyzed, then a new window will be opened to display detailed information. It will also allow to change some properties of the audio file, extract a channel, etc.

5.3.1 Properties of the audio file

The main properties of any audio file are displayed. SPPAS can open audio files of type "Waveform Audio" file format (WAVE), a Microsoft and IBM audio file format standard and "SunAu" file format, an audio file format introduced by Sun Microsystems. The following information are extracted or deducted of the header of the audio file:

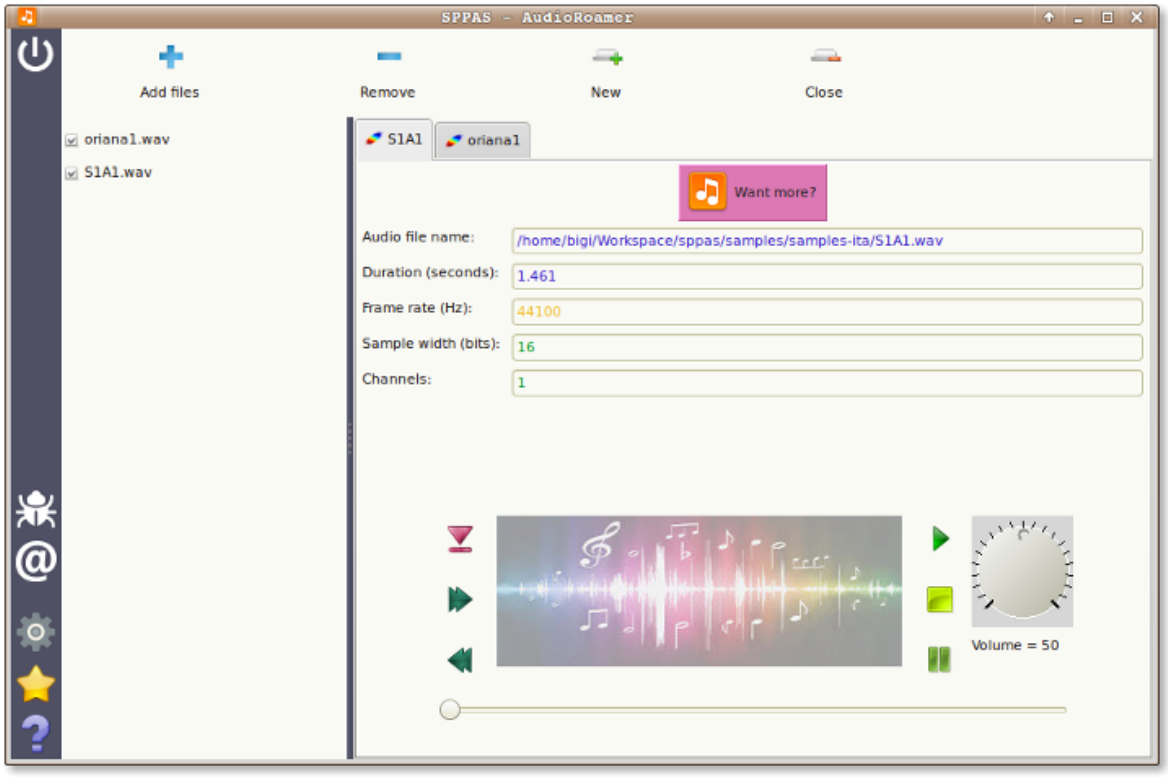


Figure 5.3: AudioRoamer: play and manage audio files

- the duration given in seconds with a maximum of 3 digits;
- the frame rate given in Hz;
- the sample width in bits (one of 8, 16, 24 or 32);
- the number of channels.

A color code is used to indicate if the file is compatible with SPPAS automatic annotations:

- Green color: the value is perfectly matching the expectations;
- Orange color: the value is not the expected one but automatic annotations will be able to convert it to the right one;
- Red color: none of the automatic annotations can work with the given value. The file must be modified.

5.3.2 Playing audio files

The following shortcuts can be used:

- TAB: Play
- ESC: Stop
- F6: Rewind
- F7: Pause
- F8: Next

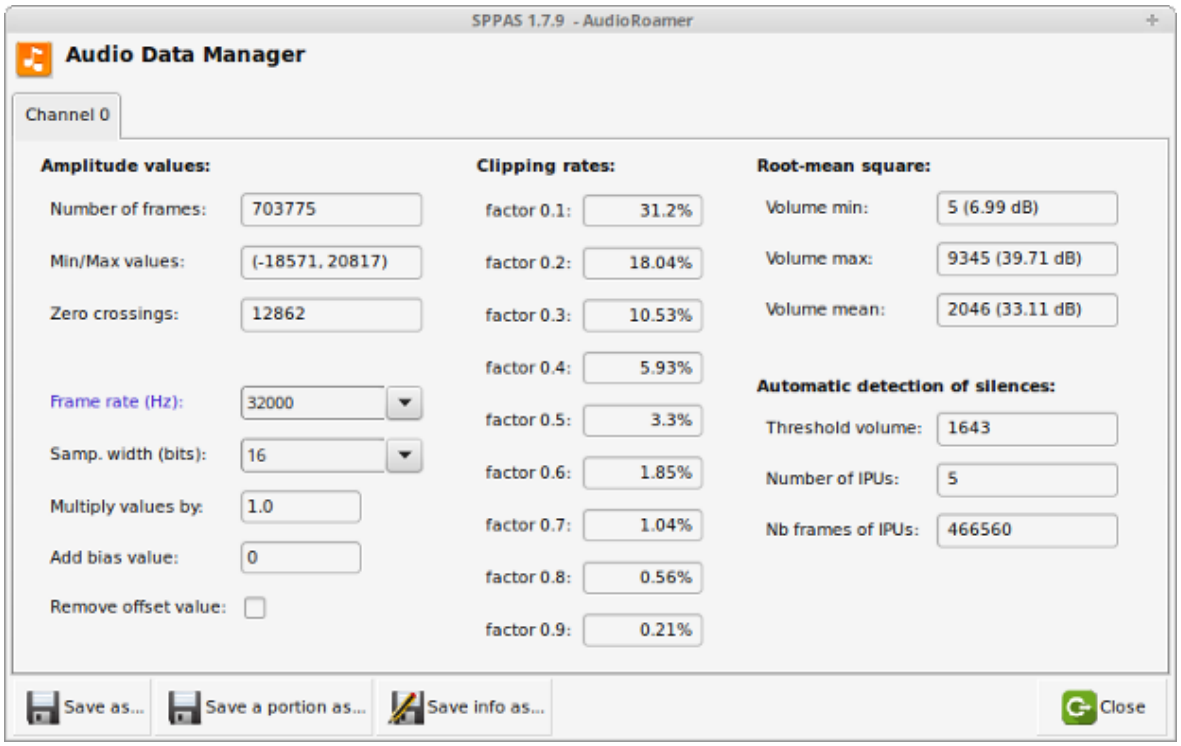


Figure 5.4: AudioRoamer if you want more

5.3.3 Want more?

`AudioRoamer` allows to display a large amount of information for each channel. For a long audio file, it can take a while to estimate such information… For example, a mono-audio file of 243 seconds (21.5Mb) is loaded in 20 seconds. **So be patient! It's worth it!**

There are 3 main columns of information, related to amplitude, clipping and volume.

At the bottom of the window, it is possible to click on buttons to:

1. Save the channel currently displayed;
2. Save a portion (from…to…) of the channel;
3. Save the displayed information in a text file;
4. Close the window.

Amplitude

The amplitude is a variable characterizing the sinusoidal oscillation of the digital-audio recording. It gives the deflection of a physical quantity from its neutral position (zero point) up to a positive or negative value. With sound waves, it is the extent to which air particles are displaced, and this amplitude of sound or sound amplitude is experienced as the loudness of sound. The loudness perception of a sound is determined by the amplitude of the sound waves – the higher the amplitude, the louder the sound or the noise.

The first column of `AudioRoamer` Data Manager gives amplitude values of each channel of the PCM file:

- Number of frames: the number of samples, i.e. the number of amplitude values;
- Min/Max values: minimum and maximum amplitude values in the channel;

- Zero crossings: number of times continuous values are crossing the 0 value.

The 5 information below can be modified and modifications can be saved separately for each channel:

- Frame rate: the sampling frequency observed in the channel is included in the default list of possible values. If it is modified, the color is changed.
- Samp. width: the bit depth observed in the channel is included in the list of possible values. If it is modified, the color is changed.
- Multiply values by: all samples in the original channel are multiplied by the floating-point value factor. Sample values are truncated in case of overflow.
- Add bias value: a bias value is added to each sample. Sample values wrap around in case of overflow.
- Remove offset value: the average over all values is deduced to each sample. Sample values wrap around in case of overflow.

Clipping

The second column displays the clipping rates of the sample values given a factor. It will consider that all values outside the interval are clipped. The clipping rate is given as a percentage related to the total number of values. For example, if factor is 0.5 and clipping rate is 10%, it means that 10% of the amplitude values are more than the half of the maximum amplitude. This value is generally an expected rate while preparing audio recordings.

Volume

RMS: Volume is estimated with root-mean-square (RMS) of the samples, i.e. sqrt(sum(S_i^2)/n). This is a measure of the power in an audio signal. Between parenthesis, the volume in dB is estimated as: 20.log10(rms). Doubling of the rms value leads to an increase of 6.02dB.

Automatic detection of silences: Finally, the result of an automatic detection of silences is given. This information is given for information only: It is estimated with default parameters which should be adapted!

5.4 IPUscriber

`IPUscriber` is useful to perform manual orthographic transcription. When an audio file is checked in the list of files, the program search for a file with the IPUs Segmentation, i.e. a file with the same name (in the same directory) with a known extension like .xra, .TextGrid, etc. If this file is not found, an error message is displayed. Otherwise, the audio file is opened and the annotated file is loaded in a new page of the notebook.

Silences are hidden and the IPUs are displayed in a list of boxes with:

- at left: the name of the tier followed by the number of the interval, then the time values of start and end of the interval, and the duration of the interval between parenthesis.
- at right: the content text of the IPU.

At the bottom of the tab, green buttons perform actions on the audio file: get information, play, auto-play, make pause and stop playing. The following keyboard shortcuts can also be used:

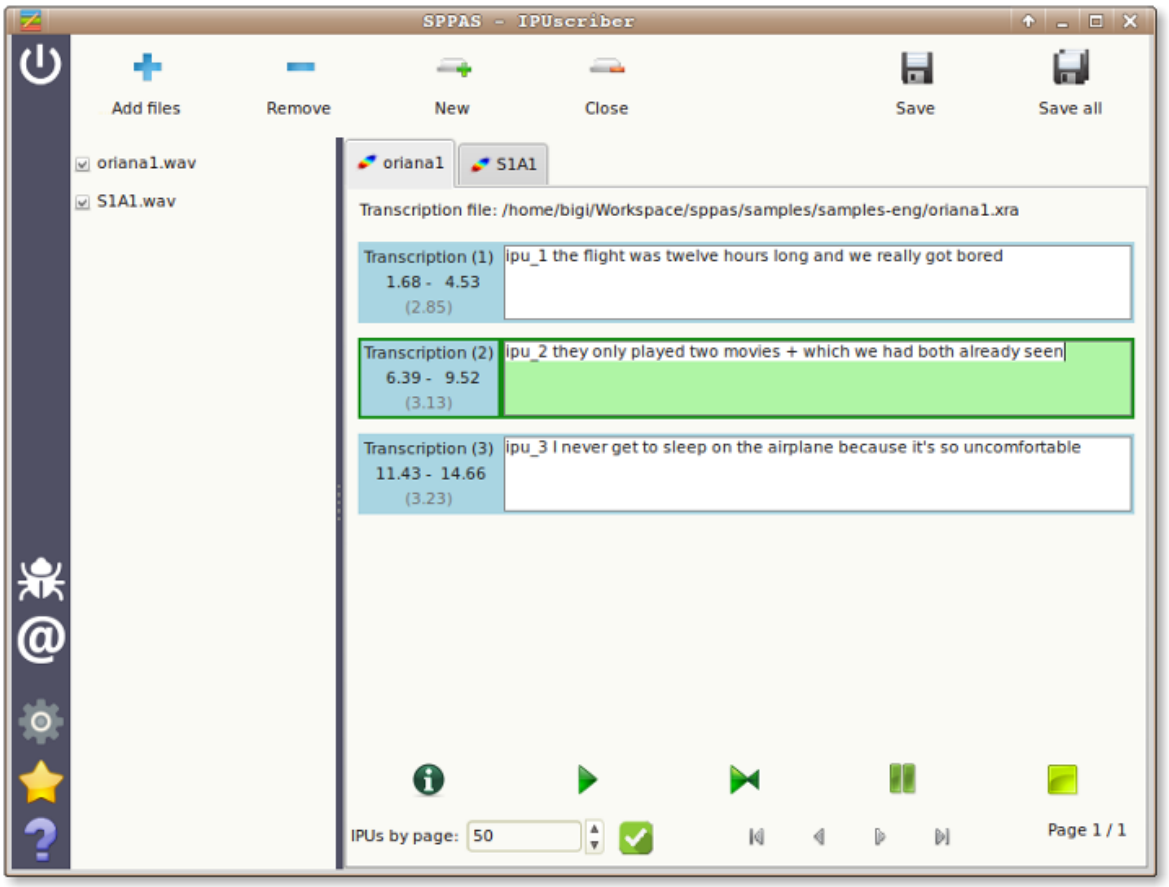


Figure 5.5: IPUscriber: for manual orthographic transcription

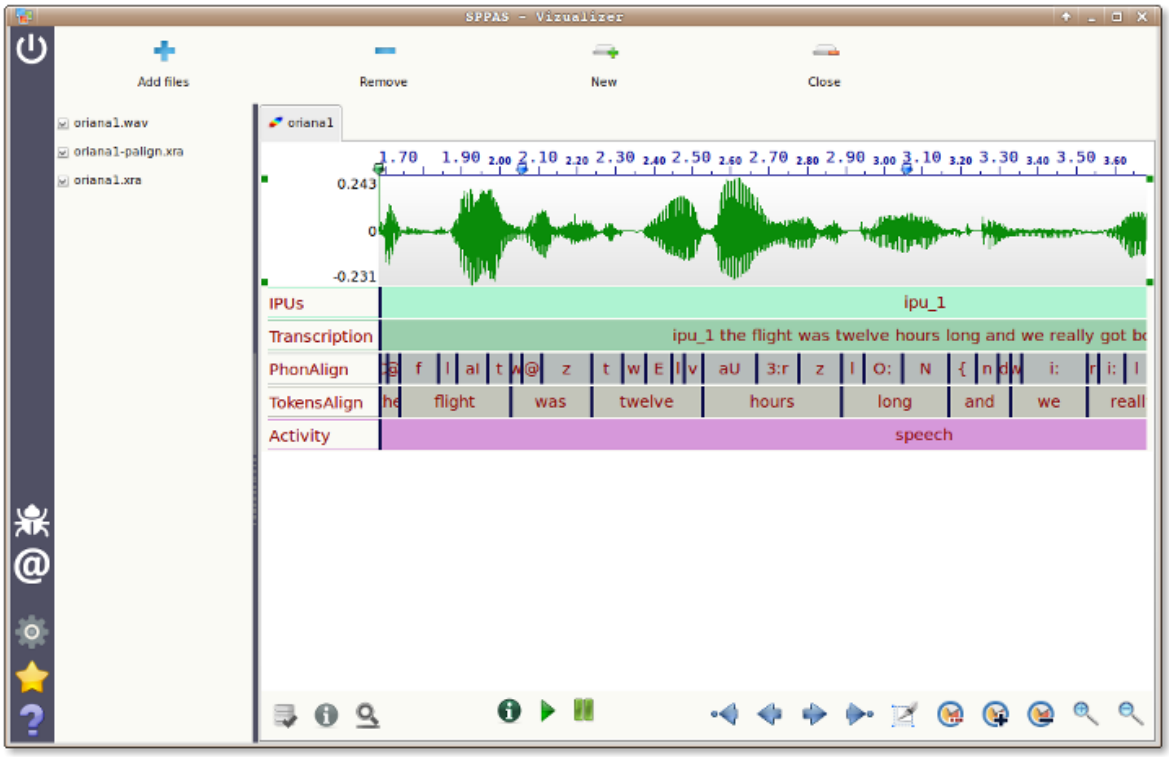


Figure 5.6: Visualizer: displays audio files and annotated files

- TAB: Play
- ESC: Stop
- F6: Rewind
- F7: Pause
- F8: Next

By default, only 50 IPUs are displayed at a time in a tab. To get access to the next/previous IPUs, 4 small buttons in gray allow to navigate in the pages.

To transcribe an IPU, click on the IPU text box, play sound and write the corresponding text: refer to the transcription convention of this document.

5.5 Visualizer

`Visualizer` displays speech files and annotated files, and is very useful to take a nice screenshot.

This tool is still under-development, some “troubles/crashes” can occur while using it… however the data will never been corrupted!

When a file is checked on the file of files, it is opened and displayed in the currently opened tab of the notebook. There is not limit on the number of audio files that can be displayed nor on the number of annotated files. To select a displayed file, click anywhere of the displayed part.

At the bottom of the tab, 3 series of buttons are available:

- at left, red buttons allow to manage the selected annotated file:

1. select to tiers to display
2. get information about the file and tiers
3. search for annotations in the tier

- at the middle, green buttons are related to an audio file

1. get information about the file
2. play sound
3. pause

- at right, blue buttons are related to zoom and scroll.

1. move at the beginning of the file
2. move at left (show previous data)
3. move at right (show next data)
4. move at the end of the file
5. show the selection. Selected part is the one between the blue arrows of the rule
6. display a specific time period (from… to…)
7. zoom in: show a smaller period
8. zoom out: show a higher period
9. vertical zoom in
10. vertical zoom out

5.6 DataFilter

`DataFilter` allows to select annotations: define a set of filters to create new tiers with only the annotations you are interested in! This system is based on the creation of 2 different types of filters:

1. single filters, i.e. search in a/several tier(s) depending on the data content, the time values or the duration of each annotation;
2. relation filters, i.e. search on annotations of a/several tier(s) in time-relation with annotations of another one.

These later are applied on tiers of many kind of input files (TextGrid, eaf, trs, csv…). The filtering process results in a new tier, that can re-filtered and so on.

5.6.1 Filtering annotations of a tier: SingleFilter

Pattern selection is an important part to extract data of a corpus and is obviously and important part of any filtering system. Thus, if the label of an annotation is a string, the following filters are proposed in DataFilter:

- exact match: an annotation is selected if its label strictly corresponds to the given pattern;
- contains: an annotation is selected if its label contains the given pattern;
- starts with: an annotation is selected if its label starts with the given pattern;
- ends with: an annotation is selected if its label ends with the given pattern.

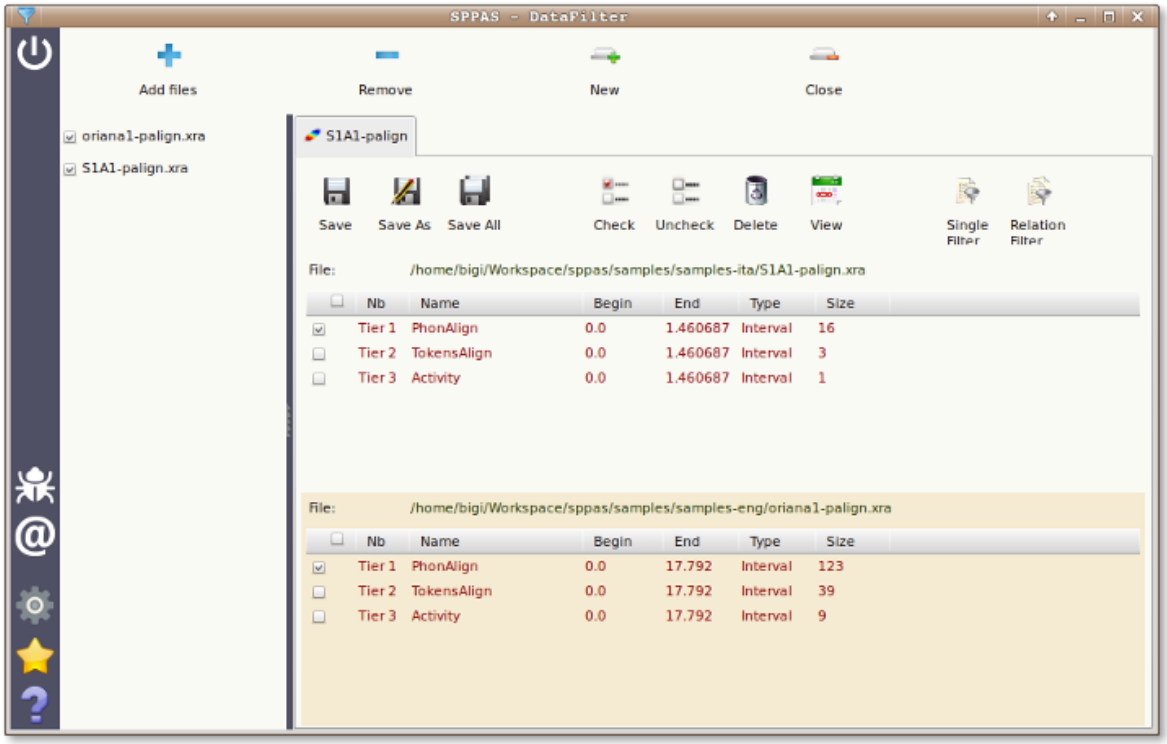


Figure 5.7: DataFilter: select annotations

All these matches can be reversed to represent respectively: does not exactly match, does not contain, does not start with or does not end with. Moreover, this pattern matching can be case sensitive or not.

For complex search, a selection based on regular expressions is available for advanced users.

A multiple pattern selection can be expressed in both ways:

- enter multiple patterns at the same time (separated by commas) to mention the system to retrieve either one pattern or the other, etc.
- enter one pattern at a time and choose the appropriate button: “Apply All” or “Apply any”.

Another important feature for a filtering system is the possibility to retrieve annotated data of a certain duration, and in a certain range of time in the timeline.

Search can also starts and/or ends at specific time values in a tier.

All the given filters are then summarized in the “SingleFilter” frame. To complete the filtering process, it must be clicked on one of the apply buttons and the new resulting tiers are added in the annotation file(s).

In the given example:

- click on “Apply All” to get either a, @ or E vowels during more than 80ms, after the 5th minute.
- click on “Apply Any” to get a, @ or E vowels, and all annotations during more than 80 ms, and all annotations after the 5th minute.

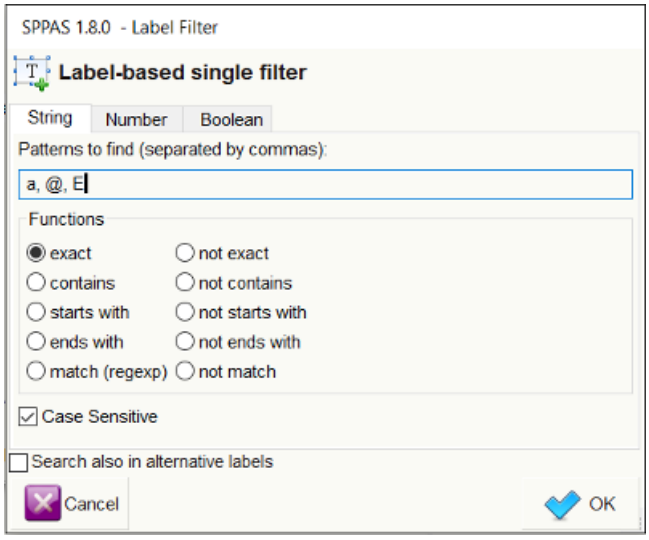


Figure 5.8: Frame to create a filter on annotation labels. In that case, filtering annotations that exactly match either a, @ or E

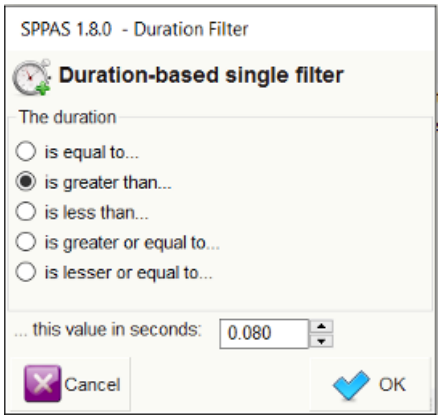


Figure 5.9: Frame to create a filter on annotation durations. In that case, filtering annotations that are during more that 80 ms

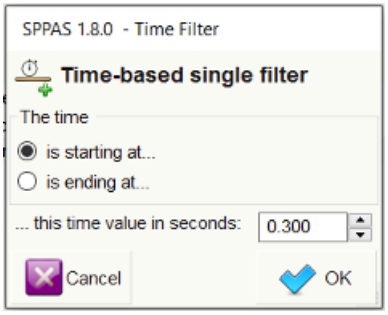


Figure 5.10: Frame to create a filter on annotation time values. In that case, filtering annotations that are starting after the 5th minute.

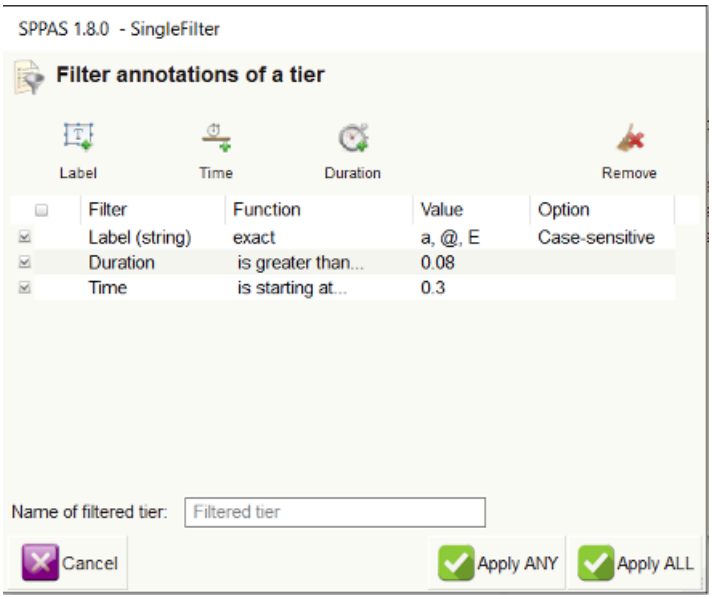


Figure 5.11: DataFilter: SingleFilter frame

5.6.2 Filtering on time-relations between two tiers

Regarding the searching problem, linguists are typically interested in locating patterns on specific tiers, with the possibility to relate different annotations a tier from another. The proposed system offers a powerful way to request/extract data, with the help of Allen's interval algebra.

In 1983 James F. Allen published a paper in which he proposed 13 basic relations between time intervals that are distinct, exhaustive, and qualitative:

- distinct because no pair of definite intervals can be related by more than one of the relationships;
- exhaustive because any pair of definite intervals are described by one of the relations;
- qualitative (rather than quantitative) because no numeric time spans are considered.

These relations and the operations on them form Allen's interval algebra. These relations were extended to Interval-Tiers as Point-Tiers to be used to find/select/filter annotations of any kind of time-aligned tiers.

For the sake of simplicity, only the 13 relations of the Allen's algebra are available in the GUI. But actually, we implemented the 25 relations proposed Pujari and al. (1999) in the INDU model. This model is fixing constraints on INtervals (with Allen's relations) and on DUration (duration are equals, one is less/greater than the other). Such relations are available while requesting with Python.

At a first stage, the user must select the tiers to be filtered and click on "RelationFilter". The second stage is to select the tier that will be used for time-relations.

The next step consists in checking the Allen's relations that will be applied. The last stage is to fix the name of the resulting tier. The above screenshots illustrates how to select the first phoneme of each token, except for tokens that are containing only one phoneme (in this later case, the "equal" relation should be checked).

To complete the filtering process, it must be clicked on the "Apply" button and the new resulting tiers are added in the annotation file(s).

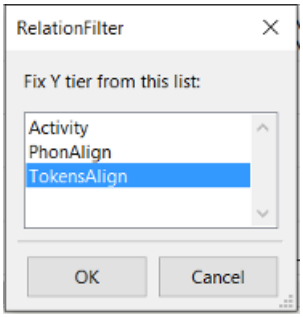


Figure 5.12: Fix time-relation tier name

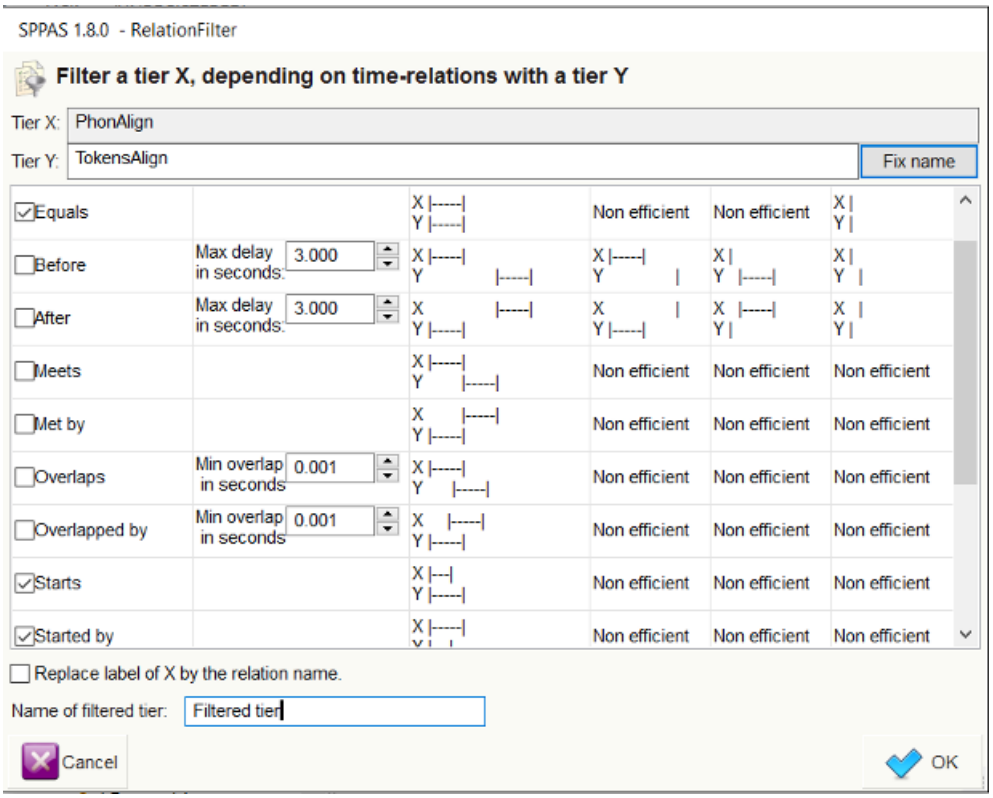


Figure 5.13: DataFilter: RelationFilter frame

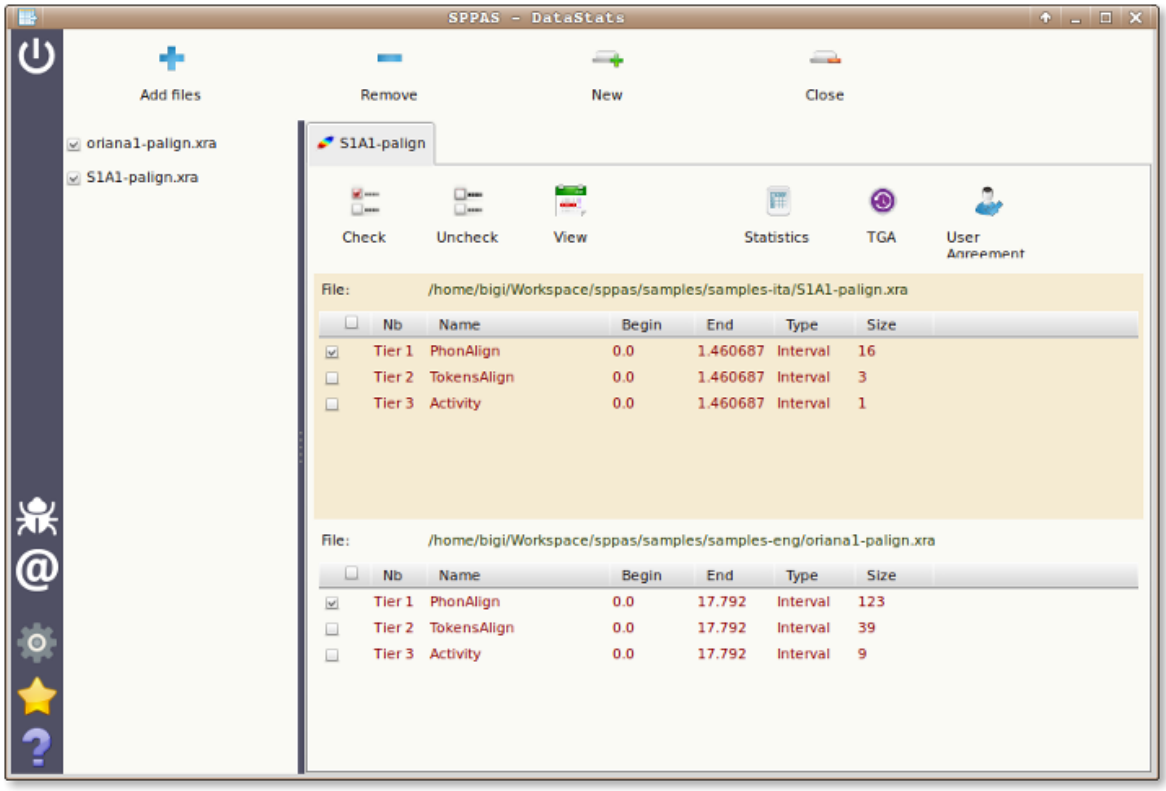


Figure 5.14: Statistics: descriptive statistics and TGA

5.7 Statistics

5.7.1 Descriptive statistics

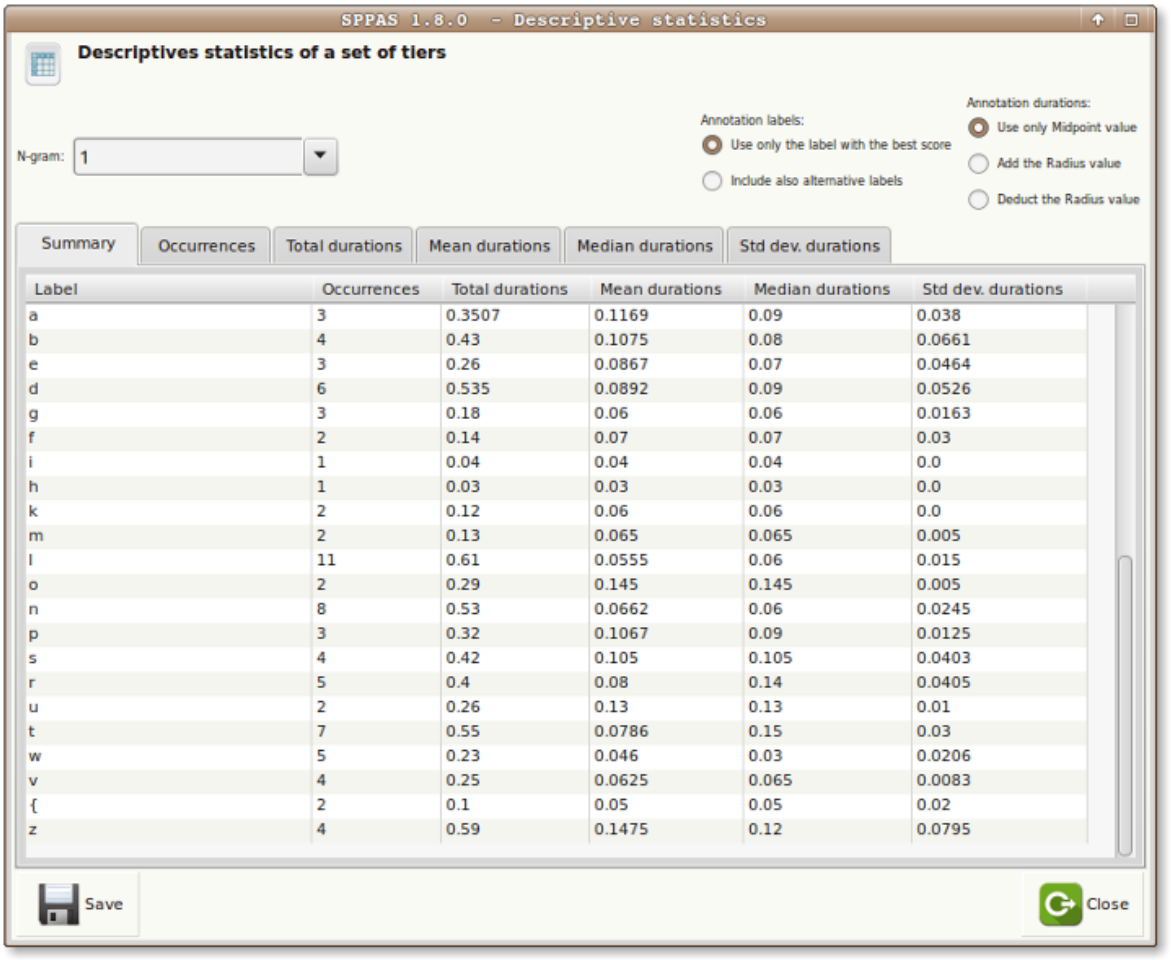
It allows to estimate the number of occurrences, the duration, etc. of the annotations of a set of selected tiers, and allows to save in CSV (for Excel, OpenOffice, R, MatLab,…). It offers a serie of sheets organized in a notebook. The first tab is displaying a summary of descriptive statistics of the set of given tiers. The other tabs are indicating one of the statistics over the given tiers. The followings are estimated:

- occurrences: the number of observations
- total durations: the sum of the durations
- mean durations: the arithmetic mean of the duration
- median durations: the median value of the distribution of durations
- std dev. durations: the standard deviation value of the distribution of durations

All of them can be estimated on a single annotation label or on a serie of them. The length of this context can be optionally changed while fixing the “N-gram” value (available from 1 to 5), just above the sheets.

Each displayed sheet can be saved as a CSV file, which is a useful file format to be read by R, Excel, OpenOffice, LibreOffice, and so… To do so, display the sheet you want to save and click on the button “Save sheet”, just below the sheets. If you plan to open this CSV file with Excel under Windows, it is recommended to change the encoding to UTF-16. For the other cases, UTF-8 is probably the most relevant.

The annotation durations are commonly estimated on the Midpoint value, without taking the radius into account; see (Bigi et al, 2012) for explanations about the Midpoint/Radius. Optionally, the duration can



Label	Occurrences	Total durations	Mean durations	Median durations	Std dev. durations
a	3	0.3507	0.1169	0.09	0.038
b	4	0.43	0.1075	0.08	0.0661
e	3	0.26	0.0867	0.07	0.0464
d	6	0.535	0.0892	0.09	0.0526
g	3	0.18	0.06	0.06	0.0163
f	2	0.14	0.07	0.07	0.03
i	1	0.04	0.04	0.04	0.0
h	1	0.03	0.03	0.03	0.0
k	2	0.12	0.06	0.06	0.0
m	2	0.13	0.065	0.065	0.005
l	11	0.61	0.0555	0.06	0.015
o	2	0.29	0.145	0.145	0.005
n	8	0.53	0.0662	0.06	0.0245
p	3	0.32	0.1067	0.09	0.0125
s	4	0.42	0.105	0.105	0.0403
r	5	0.4	0.08	0.14	0.0405
u	2	0.26	0.13	0.13	0.01
t	7	0.55	0.0786	0.15	0.03
w	5	0.23	0.046	0.03	0.0206
v	4	0.25	0.0625	0.065	0.0083
{	2	0.1	0.05	0.05	0.02
z	4	0.59	0.1475	0.12	0.0795

Figure 5.15: Descriptive statistics

either be estimated by taking the vagueness into account, then check “Add the radius value” button, or by ignoring the vagueness and estimating only on the central part of the annotation, then check “Deduct the radius value”.

For those who are estimating statistics on XRA files, you can either estimate stats only on the best label (the label with the higher score) or on all labels, i.e. the best label and all its alternatives (if any).

5.7.2 User agreement

SPPAS implements the estimation of the Cohen’s Kappa. It is currently limited to the evaluation of this user agreement between labels of 2 tiers with the same number of intervals. It is under-development…

6

Scripting with Python and SPPAS

6.1 Introduction

Since version 1.8.7, SPPAS implements an Application Programming Interface (API), named *anndata*, to deal with annotated files. Previously, SPPAS was based on another API named *annotationdata* which is still distributed in the package but no longer updated or maintained.

anndata API is a free and open source Python library to access and search data from annotated data of any of the supported formats (xra, TextGrid, eaf…). It can either be used with the Programming Language Python 2.7 or Python 3.4+. This API is PEP8 and PEP257 compliant and the internationalization of the messages is implemented (English and French are available in the "po" directory).

In this chapter, it is assumed that a version of Python is installed and configured. It is also assumed that the Python IDLE is ready-to-use. For more details about Python, see:

> The Python Website: `http://www.python.org`

This chapter firstly introduces basic programming concepts, then it gradually introduces how to write scripts with Python. Those who are familiar with programming in Python can directly go to the last section related to the description of the *anndata* API and how to use it in Python scripts.

This API can convert file formats like Elan's EAF, Praat's TextGrid and others into a `sppasTranscription` object and convert this object into any of these formats. This object allows unified access to linguistic data from a wide range sources.

```
This chapter includes exercises. The solution scripts are included in
the package directory *documentation*, folder *scripting_solutions*.
```

6.2 A gentle introduction to programming

Figure 6.1: The Python IDLE logo

6.2.1 Introduction

This section includes examples in Python programming language. You may want to try out some of the examples that come with the description. In order to do this, execute the Python IDLE - available in the Application-Menu of your operating system, and write the examples after the prompt ">>>".

To get information about the IDLE, get access to the IDLE documentation

Writing any program consists of writing statements so using a programming language. A *statement* is often known as a line of code that can be one of:

- comment,
- documentation,
- assignment,
- conditions,
- iterations, etc.

Lines of code are grouped in *blocks*. Depending on the programming language, blocks delimited by brackets, braces or by the indentation.

Each language has its own syntax to write these lines and the user has to follow strictly this syntax for the program to be able to interpret the program. However, the amount of freedom the user has to use capital letters, whitespace and so on is very high. Recommendations for Python language are available in the PEP8 - Style Guide for Python Code.

6.2.2 Variables: Assignment and Typing

A *variable* is a name to give to a piece of memory with some information inside. Assignment is then the action of setting a variable to a value. The equal sign (=) is used to assign values to variables.

```
>>>a = 1
>>>b = 1.0
>>>c = "c"
>>>hello = "Hello world!"
>>>vrai = True
```

In the previous example, `a`, `b`, `c`, `hello` and `vrai` are variables, `a = 1` is a declaration.

Assignments to variables with Python language can be performed with the following operators:

```
>>> a = 10   # simple assignment operator
>>> a += 2   # add and assignment operator, so a is 12
>>> a -= 7   # minus and assignment, so a is 5
```

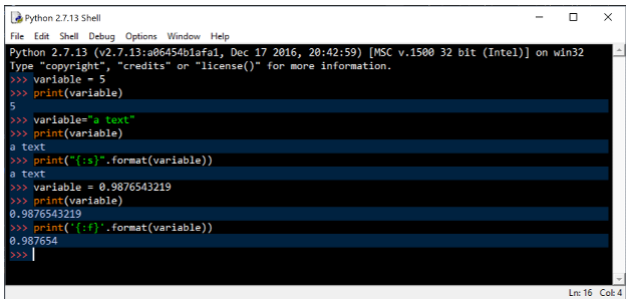


Figure 6.2: Variable declarations and print in the Python IDLE

```
>>> a *= 20  # multiply and assignment, so a is 100
>>> a /= 10  # divide and assignment, so a is 10
>>> a        # verify the value of a...
10
```

6.2.3 Basic Operators

Basic operators are used to manipulate variables. The following is the list of operators that can be used with Python, i.e. equal (assignment), plus, minus, multiply, divide:

```
>>> a = 10
>>> b = 20  # assignment
>>> a + b   # addition
>>> a - b   # subtraction
>>> a * b   # multiplication
>>> a / b   # division
```

6.2.4 Data types

The variables are of a data-type. For example, the declarations `a=1` and `a=1.0` are respectively assigning an integer and a real number. In Python, the command `type` allows to get the type of a variable, like in the following:

```
>>> type(a)
<type 'int'>
>>> type(b)
<type 'float'>
>>> type(c)
<type 'str'>
>>> type(cc)
<type 'unicode'>
>>> type(vrai)
<type 'bool'>
```

Here is a list of some fundamental data types, and their characteristics:

- *str* String of characters
- *unicode* Unicode string of characters
- *int* Integer in range from -2147483648 to 2147483647
- *bool* Boolean value, can take value `True` (=1) or `False` (=0)
- *float* Floating point number (max 15 digits)

Python is assigning data types dynamically. As a consequence, the result of the sum between an `int` and a `float` is a `float`. The next examples illustrate that the type of the variables have to be carefully managed.

```
>>> a = 10
>>> a += 0.
>>> a
10.0
>>> a += True
>>> a
11.0
>>> a += "a"
Traceback (most recent call last):
  File "<input>", line 1, in <module>
TypeError: unsupported operand type(s) for +=: 'float' and 'str'
>>> a = "a"
>>> a *= 5
>>> a
'aaaaa'
```

The type of a variable can be explicitly changed. This is called a "cast":

```
>>> a = 10
>>> b = 2
>>> a/b
5
>>> float(a) / float(b)
5.0
>>> a = 1
>>> b = 1
>>> str(a) + str(b)
'11'
```

Complex data types are often used to store variables sharing the same properties like a list of numbers, and so on. Common types in languages are lists/arrays and dictionaries. The following is the assignment of a list with name `fruits`, then the assignment of a sub-part of the list to the `to_buy` list:

```
>>> fruits = ['apples', 'tomatoes', 'peers', 'bananas', 'lemons']
>>> to_buy = fruits[1:3]
>>> to_buy
['tomatoes', 'peers']
```

6.2.5 Conditions

Conditions aim to test whether a statement is True or False. The statement of the condition can include a variable, or be a variable and is written with operators. The following shows examples of conditions/comparisons in Python. Notice that the comparison of variables of a different data-type is possible (but not recommended!).

```
>>> var = 100
>>> if var == 100:
...     print("Value of expression is 100.")
...
Value of expression is 100.

>>> if var == "100":
...     print("This message won't be printed out.")
...
```

Conditions can be expressed in a more complex way like:

```
>>> if a == b:
...     print('a and b are equals')
... elif a > b:
...    print('a is greater than b')
... else:
...    print('b is greater than a')
```

The simple operators for comparisons are summarized in the next examples:

```
>>> a == b   # check if equals
>>> a != b   # check if different
>>> a > b    # check if a is greater than b
>>> a >= b   # check if a is greater or equal to b
>>> a < b    # check if a is lesser than b
>>> a <= b   # check if a is lesser or equal to b
```

It is also possible to use the following operators:

- `and`: called "Logical AND operator". If both the operands are true then the condition becomes true.
- `or`: called "Logical OR operator". If any of the two operands are non zero then the condition becomes true.
- `not` called "Logical NOT operator". Use to reverses the logical state of its operand. If a condition is true then Logical NOT operator will make false.
- `in`: evaluates to true if it finds a variable in the specified sequence and false otherwise.

```
>>> if a == "apples" and b == "peers":
...    print("You need to buy fruits.")
```

```
>>> if a == "apples" or b == "apples":
...     print("You already have bought apples.")

>>> if "tomatoas" not in to_buy:
...     print("You don't have to buy tomatoes.")
```

6.2.6 Loops

The `for` loop statement iterates over the items of any sequence. The next Python lines of code print items of a list on the screen:

```
>>> to_buy = ['fruits', 'viande', 'poisson', 'oeufs']
>>> for item in to_buy:
...     print(item)
...
fruits
viande
poisson
oeufs
```

A `while` loop statement repeatedly executes a target statement as long as a given condition returns `True`. The following example prints exactly the same result as the previous one:

```
>>> to_buy = ['fruits', 'viande', 'poisson', 'oeufs']
>>> i = 0
>>> while i < len(to_buy):
...     print(to_buy[i])
...     i += 1
...
fruits
viande
poisson
oeufs
```

6.2.7 Dictionaries

A dictionary is a very useful data type. It consists of pairs of keys and their corresponding values.

```
>>> fruits = dict()
>>> fruits['apples'] = 3
>>> fruits['peers'] = 5
>>> fruits['tomatoas'] = 1
```

`fruits['apples']` is a way to get the value - i.e. 3, of the `apple` key. However, an error is sent if the key is unknown, like `fruits[bananas]`. Alternatively, the `get` function can be used, like `fruits.get("bananas", 0)` that returns 0 instead of an error.

The next example is showing how use a simple dictionary:

```
>>> for key in fruits:
...     value = fruits.get(key, 0)
...     if value < 3:
...         print("You have to buy new {:s}.".format(key))
...
You have to buy new tomatoes.
```

To learn more about data structures and how to manage them, get access to the Python documentation

6.3 Scripting with Python

This section describes how to create simple Python lines of code in separated files commonly called *scripts*, and run them. Some practical exercises, appropriate to the content of each action, are proposed and test exercises are suggested at the end of the section.

To practice, you have first to create a new folder in your computer - on your Desktop for example; with name "pythonscripts" for example, and to execute the python IDLE.

For an advanced use of Python, the installation of a dedicated IDE is very useful. SPPAS is developed with PyCharm: See the PyCharm Help webpage

6.3.1 Comments and documentation

Comments are not required by the program to work. But comments are necessary! Comments are expected to be appropriate, useful, relevant, adequate and always reasonable.

```
# This script is doing this and that.
# It is under the terms of a license.
# and I can continue to write what I want after the # symbol
# except that it's not the right way to tell the story of my life
```

The documentation of a program complements the comments. Both are not sharing the same goal: comments are used in all kind of programs but documentation is appended to comments for the biggest programs and/or projects. Documentation is automatically extracted and formatted thanks to dedicated tools. Documentation is required for sharing the program. See the Docstring Conventions for details. Documentation must follow a convention like for example the markup language reST - reStructured Text. Both conventions are used into SPPAS API, programs and scripts.

6.3.2 Getting started with scripting in Python

In the IDLE, create a new empty file either by clicking on "File" menu, then "New File", or with the shortcut "CTRL"+N.

Copy the following line of code in this newly created file:

```
1    print("Hello world!")
```

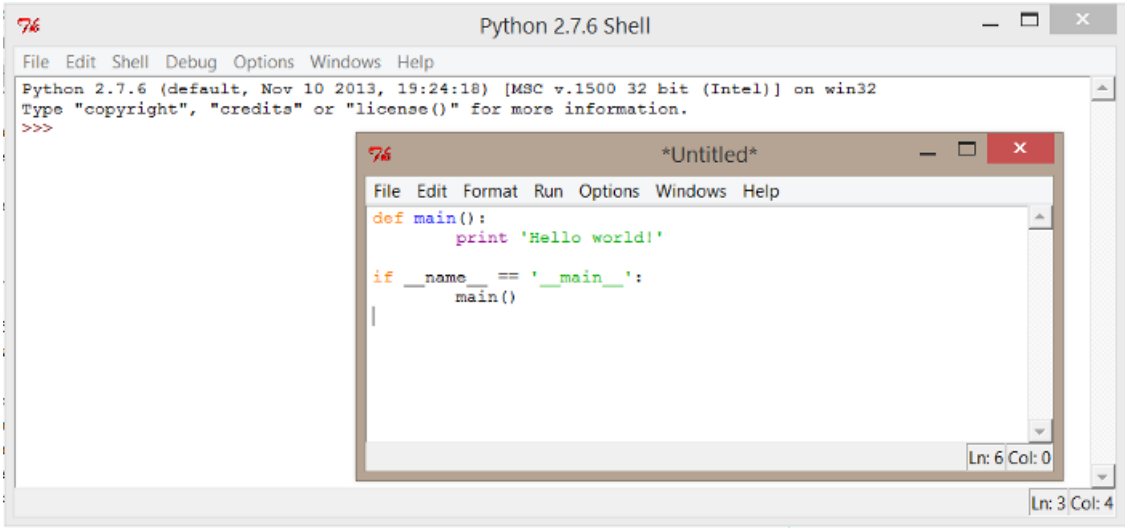


Figure 6.3: Hello world! in a Python script

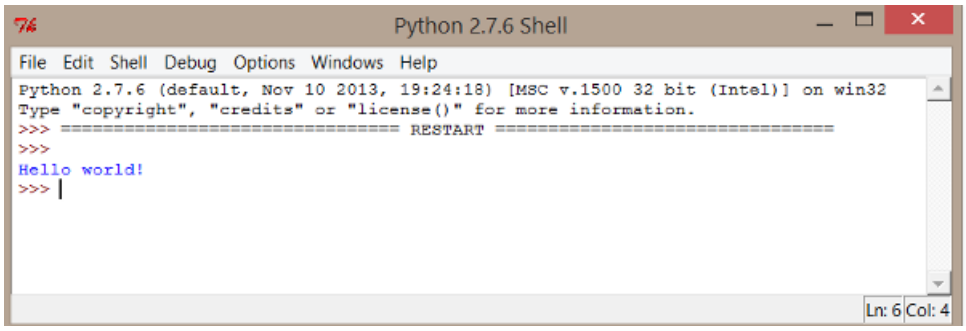


Figure 6.4: Output of the first script

Then, save the file in the "pythonscripts" folder. By convention, Python source files end with a *.py* extension, and so the name `01_helloworld.py` could be fine.

To execute the program, you can do one of:

- with the mouse: Click on the Menu "Run", then "Run module"
- with the keyboard: Press F5

The expected output is as follow:

A better practice while writing scripts is to describe by who, what and why this script was done. A nifty trick is to create a skeleton for any future script that will be written. Such ready-to-use script is available in the SPPAS package with the name `skeleton.py`.

6.3.3 Blocks

Blocks in Python are created from the indentation. Tab and spaces can be used but using spaces is recommended.

```
>>>if a == 3:
...     # this is a block using 4 spaces for indentation
...     print("a is 3")
```

6.3.4 Functions

Simple function

A function does something: it stats with its definition then is followed by its lines of code in a block.

Here is an example of function:

```
27      def print_vowels():
28          """ Print the list of French vowels on the screen. """
29
30          vowels = ['a', 'e', 'E', 'i', 'o', 'u', 'y', '@', '2', '9', 'a~', 'o~', 'U~']
31          print("List of French vowels:")
32          for v in vowels:
33              print(v)
```

What the `print_vowels()` function is doing? This function declares a list with name `vowels`. Each item of the list is a string representing a vowel in French encoded in X-SAMPA. Of course, this list can be overridden with any other set of strings. The next line prints a message. Then, a loop prints each item of the list.

At this stage, if a script with this function is executed, it will do… nothing! Actually, the function is created, but it must be invoked in the main function to be interpreted by Python. The `main` is as follow:

```
34      if __name__ == '__main__':
35          print_vowels()
```

> *Practice:* create a copy of the file `skeleton.py`, then make a function to print "Hello World!". (solution: ex01_hello_world.py).
>
> *Practice*: Create a function to print plosives and call it in the main function (solution: ex02_functions.py).

One can also create a function to print glides, another one to print affricates, and so on. Hum… this sounds a little bit fastidious!

Function with parameters

Rather than writing the same lines of code with only a minor difference over and over, we can declare *parameters* to the function to *make it more generic*. Notice that the number of parameters of a function is not limited!

In the example, we can replace the `print_vowels()` function and the `print_plosives()` function by a single function `print_list(mylist)` where `mylist` can be any list containing strings or characters. If the list contains other typed-variables like numerical values, they must be converted to string to be printed out. This can result in the following function:

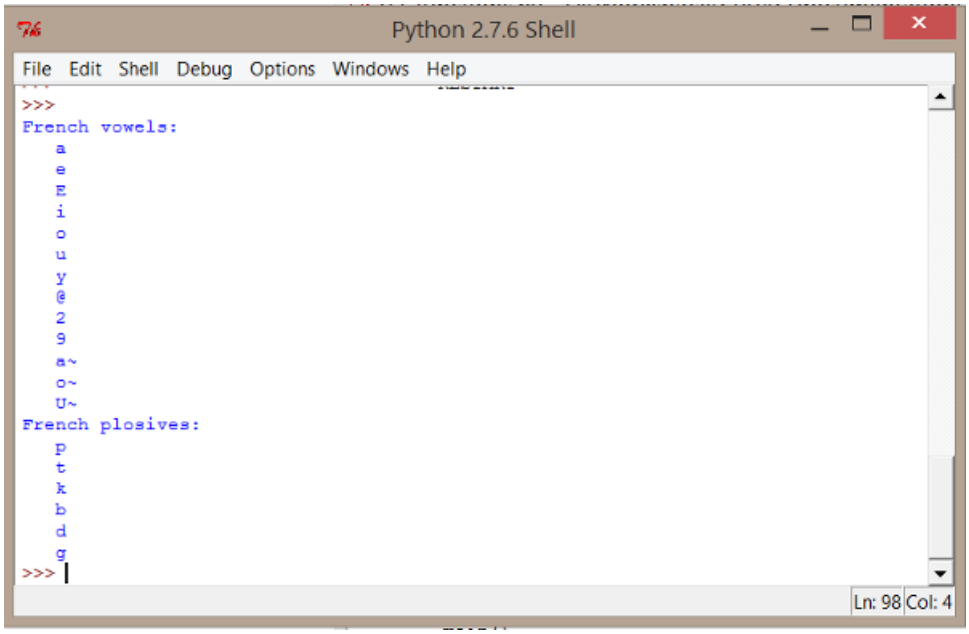


Figure 6.5: Output of the second script

```
27      def print_list(mylist, message="  -"):
28          """ Print a list on the screen.
29
30          :param mylist: (list) the list to print
31          :param message: (string) an optional message to print before each element
32
33          """
34          for item in mylist:
35              print("{:s} {:s}".format(message, item))
```

Function return values

Functions are used to do a specific job and the result of the function can be captured by the program. In the following example, the function would return a boolean value, i.e. True if the given string has no character.

```
27      def is_empty(mystr):
28          """ Return True if mystr is empty. """
29
30          return len(mystr.strip()) == 0
```

Practice: Add this function in a new script and try to print various lists (solution: ex03_functions.py)

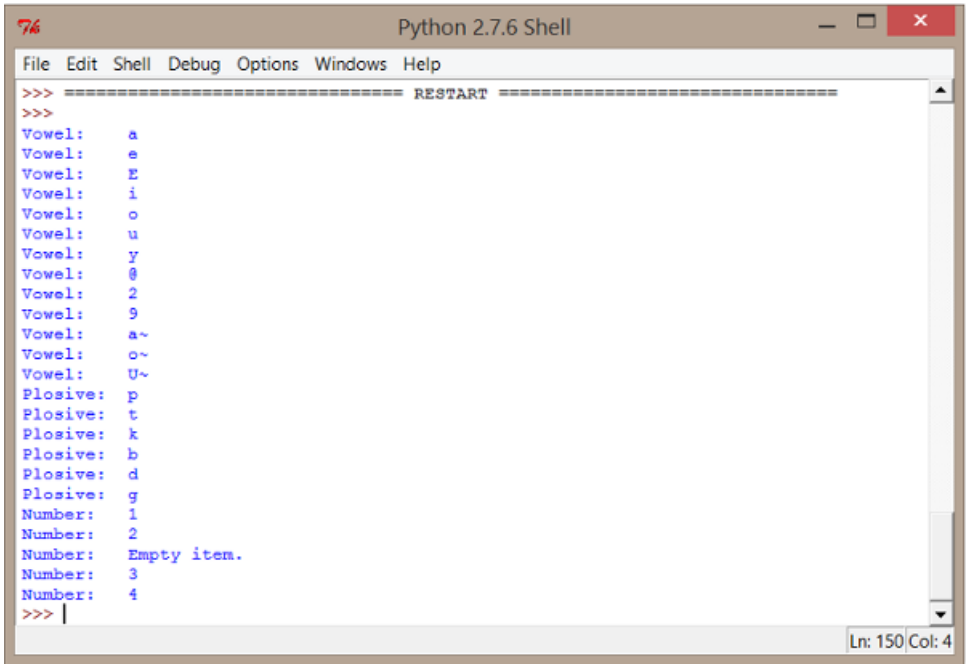


Figure 6.6: Expected output of the 3rd script

6.3.5 Reading/Writing files

Reading data from a file

Now, we'll try to get data from a file. Create a new empty file with the following lines - and add as many lines as you want; then, save it with the name "phonemes.csv" by using UTF-8 encoding:

```
occlusives ; b ; b
occlusives ; d ; d
fricatives ; f ; f
liquids ; l ; l
nasals ; m ; m
nasals ; n ; n
occlusives ; p ; p
glides ; w ; w
vowels ; a ; a
vowels ; e ; e
```

The following statements are typical statements used to read the content of a file. The first parameter of the `open` function is the name of the file, including the path (relative or absolute); and the second argument is the opening mode ('r' is the default value, used for reading).

Practice: Add these lines of code in a new script and try it (solution: ex04_reading_simple.py)

```
21  fp = open("phonemes.csv", 'r')
22  for line in fp:
23      # do something with the line stored in variable l
```

```
24          print(line.strip())
25      f.close()
```

The following is a solution with the ability to deal with various file encodings, thanks to the `codecs` library:

```
21      def read_file(filename):
22          """ Get the content of file.
23
24          :param filename: (string) Name of the file to read, including path.
25          :returns: List of lines
26
27          """
28          with codecs.open(filename, 'r', encoding="utf8") as fp:
29              return fp.readlines()
```

In the previous code, the `codecs.open` functions got 3 parameters: the name of the file, the mode to open, and the encoding. The `readlines()` function gets each line of the file and store it into a list.

Practice: Write a script to print the content of a file (solution: ex05_reading_file.py)

Notice that Python `os` module provides useful methods to perform file-processing operations, such as renaming and deleting. See Python documentation for details: https://docs.python.org/2/

Writing data to a file

Writing a file requires to open it in a writing mode:

- 'w' is the mode to write data; it will erase any existing file;
- 'a' is the mode to append data in an existing file.

A file can be opened in an encoding and saved in another one. This could be useful to write a script to convert the encoding of a set of files. The following could help to create such script:

```
10      # getting all files of a given folder:
11      path = 'C:\Users\Me\data'
12      dirs = os.listdir( path )


15      # Converting the encoding of a file:
16      file_stream = codecs.open(file_location, 'r', file_encoding)
17      file_output = codecs.open(file_location+'utf8', 'w', 'utf-8')
18
19      for line in file_stream:
20          file_output.write(line)
```

6.3.6 Python tutorials

Here is a list of web sites with tutorials, from the easiest to the most complete:

1. Learn Python, by DataCamp
2. Tutorial Points
3. The Python documentation

6.3.7 Exercises to practice

Exercise 1: How many vowels are in a list of phonemes? (solution: ex06_list.py)

Exercise 2: Write a X-SAMPA to IPA converter. (solution: ex07_dict.py)

Exercise 3: Compare 2 sets of data using NLP techniques (Zipf law, Tf.Idf) (solution: ex08_counter.py)

6.4 anndata, an API to manage annotated data

6.4.1 Overview

We are now going to write Python scripts using the *anndata* API included in SPPAS. This API is useful to read/write and manipulate files annotated from various annotation tools like SPPAS, Praat or Elan.

First of all, it is important to understand the data structure included into the API to be able to use it efficiently.

6.4.2 Why developing a new API?

In the Linguistics field, multimodal annotations contain information ranging from general linguistic to domain specific information. Some are annotated with automatic tools, and some are manually annotated. In annotation tools, annotated data are mainly represented in the form of "tiers" or "tracks" of annotations. Tiers are mostly series of intervals defined by:

- a time point to represent the beginning of the interval;
- a time point to represent the end of the interval;
- a label to represent the annotation itself.

Of course, depending on the annotation tool, the internal data representation and the file formats are different. In Praat, tiers can be represented by a time point and a label (such tiers are respectively named PointTiers and IntervalTiers). IntervalTiers are made of a succession of consecutive intervals (labelled or un-labelled). In Elan, points are not supported; and unlabelled intervals are not represented nor saved.

The *anndata* API was designed to be able to manipulate all data in the same way, regardless of the file type. It supports to merge data and annotations from a wide range of heterogeneous data sources.

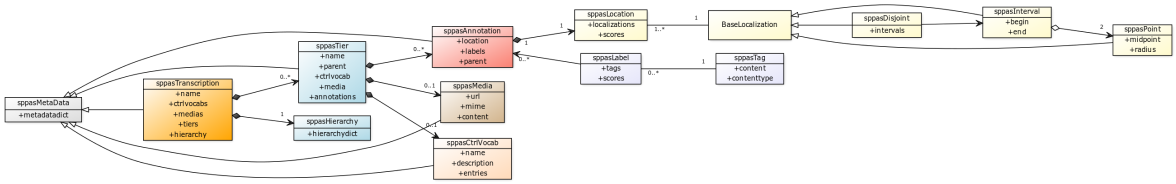


Figure 6.7: API class diagram

6.4.3 The API class diagram

After opening/loading a file, its content is stored in a `sppasTranscription` object. A `sppasTranscription` has a name, and a list of `sppasTier` objects. Tiers can't share the same name, the list of tiers can be empty, and a hierarchy between tiers can be defined. Actually, subdivision relations can be established between tiers. For example, a tier with phonemes is a subdivision reference for syllables, or for tokens; and tokens are a subdivision reference for the orthographic transcription in IPUs. Such subdivisions can be of two categories: alignment or association.

A `sppasTier` object has a name, and a list of `sppasAnnotation` objects. It can also be associated to a controlled vocabulary, or a media.

Al these objects contain a set of meta-data.

An annotation is made of 2 objects:

- a `sppasLocation` object,
- a list of `sppasLabel` objects.

A `sppasLabel` object is representing the "content" of the annotation. It is a list of `sppasTag` each one associated to a score.

A `sppasLocation` is representing where this annotation occurs in the media. Then, a `sppasLocation` is made of a list of localization each one associated with a score. A localization is one of:

- a `sppasPoint` object; or
- a `sppasInterval` object, which is made of 2 `sppasPoint` objects; or
- a `sppasDisjoint` object which is a list of `sppasInterval`.

Label representation

Each annotation holds a serie of 0..N labels, mainly represented in the form of a string, freely written by the annotator or selected from a list of categories.

Location representation

In the *anndata* API, a `sppasPoint` is considered *as an imprecise value*. It is possible to characterize a point in a space immediately allowing its vagueness by using:

- a midpoint value (center) of the point;
- a radius value.

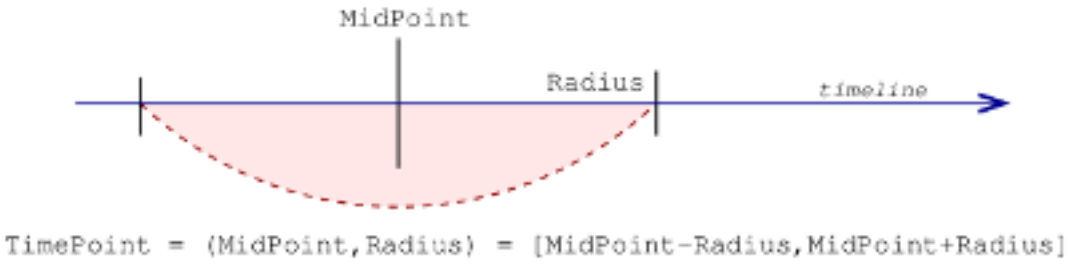


Figure 6.8: Representation of a sppasPoint

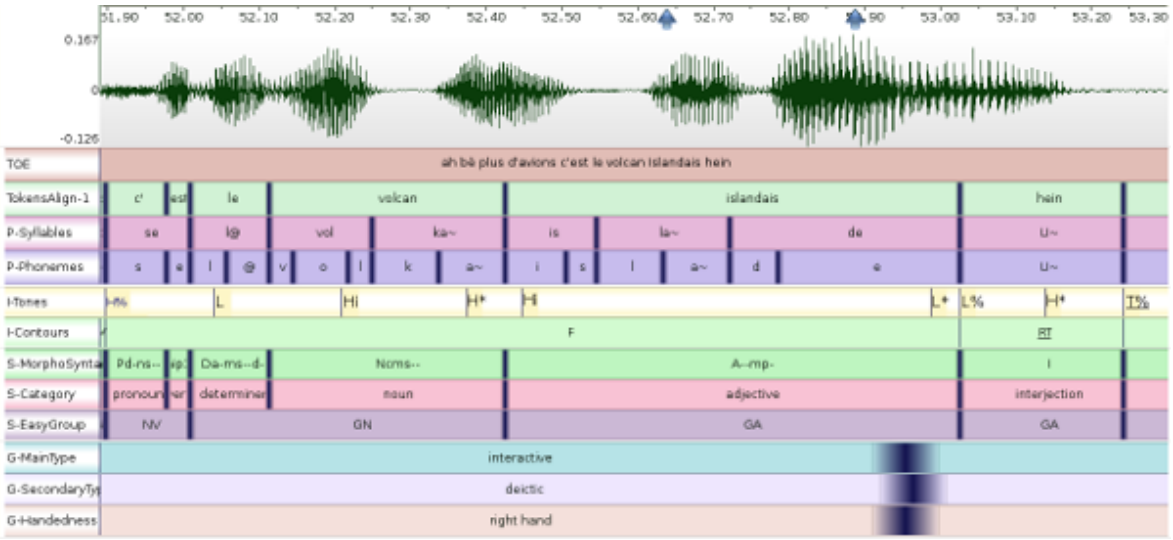


Figure 6.9: Example of multimodal data

Example

The screenshot below shows an example of multimodal annotated data, imported from 3 different annotation tools. Each `sppasPoint` is represented by a vertical dark-blue line with a gradient color to refer to the radius value.

In the screenshot the following radius values were assigned:

- 0ms for prosody,
- 5ms for phonetics, discourse and syntax
- 40ms for gestures.

6.5 Creating scripts with anndata

6.5.1 Preparing the data

To practice, you have first to create a new folder in your computer - on your Desktop for example; with name "sppasscripts" for example, and to execute the python IDLE.

Open a File Explorer window and go to the SPPAS folder location. Then, copy the `sppas` directory into the newly created "sppasscripts" folder. Then, go to the solution directory and copy/paste the files

`skeleton-sppas.py` and `F_F_B003-P9-merge.TextGrid` into your "sppasscripts" folder. Then, open the skeleton script with the python IDLE and execute it. It will do… nothing! But now, you are ready to do something with the API of SPPAS!

When using the API, if something forbidden is attempted, the object will raise an Exception. It means that the program will stop except if the script "raises" the exception.

6.5.2 Read/Write annotated files

We are being to Open/Read an annotated file of any format (XRA, TextGrid, Elan, …) and store it into a `sppasTranscription` object instance. Then, it will be saved into another file.

```
    # Create a parser object then parse the input file.
    parser = sppasRW(input_filename)
    trs = parser.read()

    # Save the sppasTranscription object into a file.
    parser.set_filename(output_filename)
    parser.write(trs)
```

Only these two lines of code are required to convert a file from a format to another one! The appropriate parsing system is extracted from the extension of file name.

To get the list of accepted extensions that the API can read, just use `aio.extensions_in`. The list of accepted extensions that the API can write is given by `aio.extensions_out`.

Practice: Write a script to convert a TextGrid file into CSV (solution: ex10_read_write.py)

6.5.3 Manipulating a sppasTranscription object

The most useful functions to manage tiers of a sppasTranscription object are:

- `create_tier()` to create an empty tier and to append it,
- `append(tier)` to add a tier into the sppasTranscription,
- `pop(index)` to remove a tier of the sppasTranscription,
- `find(name, case_sensitive=True)` to find a tier from its name.

```
    for tier in trs:
        # do something with the tier:
        print(tier.get_name())
    phons_tier = trs.find("PhonAlign")
```

Practice: Write a script to select a set of tiers of a file and save them into a new file (solution: ex11_transcription.py).

6.5.4 Manipulating a sppasTier object

A tier is made of a name, a list of annotations, and optionally a controlled vocabulary and a media. To get the name of a tier, or to fix a new name, the easier way is to use `tier.get_name()`. The following block of code allows to get a tier and change its name.

```
43      # Get the first tier, with index=0
44      tier = trs[0]
45      print(tier.get_name())
46      tier.set_name("NewName")
47      print(tier.get_name())
```

The most useful functions to manage annotations of a `sppasTier` object are:

- `create_annotation(location, labels)` to create and add a new annotation
- `append(annotation)` to add a new annotation at the end of the list
- `add(annotation)` to add a new annotation
- `pop(index)` to delete the annotation of a given index
- `remove(begin, end)` to remove annotations of a given localization range
- `is_disjoint()`, `is_interval()`, `is_point()` to know the type of location
- `is_string()`, `is_int()`, `is_float()`, `is_bool()` to know the type of labels
- `find(begin, end)` to get annotations in a given localization range
- `get_first_point()`, `get_last_point()` to get respectively the point with the lowest or highest localization
- `set_radius(radius)` to fix the same vagueness value to each localization point

Practice: Write a script to open an annotated file and print information about tiers (solution: ex12_tiers_info.py)

6.5.5 Manipulating a sppasAnnotation object

An annotation is a container for a location and optionally a list of labels. It can be used to manage the labels and tags with the following methods:

- `is_labelled()` returns True if at least a `sppasTag` exists and is not None
- `append_label(label)` to add a label at the end of the list of labels
- `get_labels_best_tag()` returns a list with the best tag of each label
- `add_tag(tag, score, label_index)` to add a tag into a label
- `remove_tag(tag, label_index)` to remove a tag of a label
- `serialize_labels()` to get a string representing the sequence of labels

An annotation object can also be copied with the method `copy()`. The location, the labels and the metadata are all copied; and the 'id' of the returned annotation is then the same. It is expected that each annotation of a tier as its own 'id', but the API doesn't check this.

Practice: Write a script to print information about annotations of a tier (solution: ex13_tiers_info.py)

6.5.6 Search in annotations: Filters

Overview

This section focuses on the problem of *searching and retrieving* data from annotated corpora.

The filter implementation can only be used together with the `sppasTier()` class. The idea is that each `sppasTier()` can contain a set of filters, that each reduce the full list of annotations to a subset.

SPPAS filtering system proposes 2 main axis to filter such data:

- with a boolean function based either on the content, the duration or on the time of annotations,
- with a relation function between annotation locations of 2 tiers.

A set of filters can be created and combined to get the expected result. To be able to apply filters to a tier, some data must be loaded first. First, a new `sppasTranscription()` has to be created when loading a file. Then, the tier(s) to apply filters on must be fixed. Finally, if the input file was NOT an XRA, it is widely recommended to fix a radius value before using a relation filter.

```
f = sppasFilter(tier)
```

When a filter is applied, it returns an instance of `sppasAnnSet` which is the set of annotations matching with the request. It also contains a 'value' which is the list of functions that are truly matching for each annotation. Finally, `sppasAnnSet` objects can be combined with the operators 'l' and '&', and expected to a `sppasTier` instance.

Filter on the tag content

The following matching names are proposed to select annotations:

- 'exact': means that a tag is valid if it strictly corresponds to the expected pattern;
- 'contains' means that a tag is valid if it contains the expected pattern;
- 'startswith' means that a tag is valid if it starts with the expected pattern;
- 'endswith' means that a tag is valid if it ends with the expected pattern.
- 'regexp' to define regular expressions.

All these matches can be reversed, to represent does not exactly match, does not contain, does not start with or does not end with. Moreover, they can be case-insensitive by adding 'i' at the beginning like 'iexact', etc. The full list of tag matching functions is obtained by invoking `sppasTagCompare().get_function_names()`.

The next examples illustrate how to work with such pattern matching filter. In this example, `f1` is a filter used to get all phonemes with the exact label 'a'. On the other side, `f2` is a filter that ignores all phonemes matching with 'a' (mentioned by the symbol '~') with a case insensitive comparison (iexact means insensitive-exact).

```
tier = trs.find("PhonAlign")
f = sppasFilter(tier)
ann_set_a = f.tag(exact='a')
ann_set_aA = f.tag(iexact='a')
```

The next example illustrates how to write a complex request. Notice that r1 is equal to r2, but getting r1 is faster:

```
tier = trs.find("TokensAlign")
f = sppasFilter(tier)
r1 = f.tag(startswith="pa", not_endswith='a', logic_bool="and")
r2 = f.tag(startswith="pa") & f.tag(not_endswith='a')
```

With this notation in hands, it is easy to formulate queries like for example: *Extract words starting by "ch" or "sh"*:

```
result = f.tag(startswith="ch") | f.tag(startswith="sh")
```

Practice:: Write a script to extract phonemes /a/ then phonemes /a/, /e/, /A/ and /E/. (solution: ex15_annotation_label_filter.py).

Filter on the duration

The following matching names are proposed to select annotations:

- 'lt' means that the duration of the annotation is lower than the given one;
- 'le' means that the duration of the annotation is lower or equal than the given one;
- 'gt' means that the duration of the annotation is greater than the given one;
- 'ge' means that the duration of the annotation is greater or equal than the given one;
- 'eq' means that the duration of the annotation is equal to the given one;
- 'ne' means that the duration of the annotation is not equal to the given one.

The full list of duration matching functions is obtained by invoking `sppasDurationCompare().get_function_names`

Next example shows how to get phonemes during between 30 ms and 70 ms. Notice that r1 and r2 are equals!

```
tier = trs.find("PhonAlign")
f = sppasFilter(tier)
r1 = f.dur(ge=0.03) & f.dur(le=0.07)
r2 = f.dur(ge=0.03, le=0.07, logic_bool="and")
```

Practice: Extract phonemes 'a' or 'e' during more than 100ms (solution: ex16_annotation_dur_filter.py).

Filter on position in time

The following matching names are proposed to select annotations:

- rangefrom allows to fix the begin time value,
- rangeto allows to fix the end time value.

Next example allows to extract phonemes 'a' of the 5 first seconds:

```
tier = trs.find("PhonAlign")
f = sppasFilter(tier)
result = f.tag(exact='a') & f.loc(rangefrom=0., rangeto=5., logic_bool="and")
```

Creating a relation function

Relations between annotations is crucial if we want to extract multimodal data. The aim here is to select intervals of a tier depending on what is represented in another tier.

James Allen, in 1983, proposed an algebraic framework named Interval Algebra (IA), for qualitative reasoning with time intervals where the binary relationship between a pair of intervals is represented by a subset of 13 atomic relation, that are:

- distinct because no pair of definite intervals can be related by more than one of the relationships;
- exhaustive because any pair of definite intervals are described by one of the relations;
- qualitative (rather than quantitative) because no numeric time spans are considered.

These relations and the operations on them form "Allen's Interval Algebra".

Pujari, Kumari and Sattar proposed INDU in 1999: an Interval & Duration network. They extended the IA to model qualitative information about intervals and durations in a single binary constraint network. Duration relations are: greater, lower and equal. INDU comprises of 25 basic relations between a pair of two intervals.

`anndata` implements the 13 Allen interval relations: before, after, meets, met by, overlaps, overlapped by, starts, started by, finishes, finished by, contains, during and equals; and it also contains the relations proposed in the INDU model. The full list of matching functions is obtained by invoking `sppasIntervalCompare().get_function_names()`.

Moreover, in the implementation of `anndata`, some functions accept options:

- `before` and `after` accept a `max_delay` value,
- `overlaps` and `overlappedby` accept an `overlap_min` value and a boolean `percent` which defines whether the value is absolute or is a percentage.

The next example returns monosyllabic tokens and tokens that are overlapping a syllable (only if the overlap is during more than 40 ms):

```
tier = trs.find("TokensAlign")
other_tier = trs.find("Syllables")
f = sppasFilter(tier)
f.rel(other_tier, "equals", "overlaps", "overlappedby", min_overlap=0.04)
```

Below is another example of implementing a request. *Which syllables stretch across 2 words?*

```
# Get tiers from a sppasTranscription object
tier_syll = trs.find("Syllables")
tier_toks = trs.find("TokensAlign")
f = sppasFilter(tier_syll)

# Apply the filter with the relation function
ann_set = f.rel(tier_toks, "overlaps", "overlappedby")

# To convert filtered data into a tier:
tier = ann_set.to_tier("SyllStretch")
```

Practice 1: Create a script to get tokens followed by a silence. (solution: ex17_annotations_relation_filter1.py).

Practice 2: Create a script to get tokens preceded by OR followed by a silence. (solution: ex17_annotations_relation_filter2.py).

Practice 3: Create a script to get tokens preceded by AND followed by a silence. (solution: ex17_annotations_relation_filter3.py).

6.6 More with SPPAS...

In addition to *anndata*, SPPAS contains several other API. They are all free and open source Python libraries, with a documentation and a set of tests.

Among others:

- *audiodata* to manage digital audio data: load, get information, extract channels, re-sample, search for silences, mix channels, etc.
- *calculus* to perform some math on data, including descriptive statistics.
- *resources* to access and manage linguistic resources like lexicons, dictionaries, etc.

7

References

7.1 References

7.1.1 How to cite SPPAS?

For a general citation of SPPAS, simply use the main reference below. A PDF version of this publication is available in the folder `documentation` of the package.

> *Brigitte Bigi (2015).* **SPPAS - Multi-lingual Approaches to the Automatic Annotation of Speech**. In "the Phonetician" - International Society of Phonetic Sciences, ISSN 0741-6164, Number 111-112 / 2015-I-II, pages 54-69.

For a specific purpose of SPPAS, like for automatic syllabification, forced-alignment, or for the request system, please refer to the related specific publication. All the papers are available on the author website, at the following URL: `http://www.lpl-aix.fr/~bigi/publications.html`

7.1.2 SPPAS software description

> *Brigitte Bigi* (2012). **SPPAS: a tool for the phonetic segmentations of Speech**, The eight international conference on Language Resources and Evaluation, Istanbul (Turkey), pages 1748-1755, ISBN 978-2-9517408-7-7.

> *Brigitte Bigi, Daniel Hirst* (2012) **SPeech Phonetization Alignment and Syllabification (SPPAS): a tool for the automatic analysis of speech prosody**, Speech Prosody, Tongji University Press, ISBN 978-7-5608-4869-3, pages 19-22, Shanghai (China).

> *Brigitte Bigi, Daniel Hirst* (2013). **What's new in SPPAS 1.5?**, Tools ans Resources for the Analysis of Speech Prosody, Aix-en-Provence, France, pp. 62-65.

7.1.3 About Text Normalization

Brigitte Bigi (2011). **A Multilingual Text Normalization Approach**, 2nd Less-Resourced Languages workshop, 5th Language & Technology Conference, Poznan (Poland).

Brigitte Bigi (2014). **A Multilingual Text Normalization Approach**, Human Language Technologies Challenges for Computer Science and Linguistics LNAI 8387, Springer, Heidelberg. ISBN: 978-3-319-14120-6. Pages 515-526.

Roxana Fung, Brigitte Bigi* (2015). **Automatic Word Segmentation for Spoken Cantonese**, The Oriental Chapter of COCOSDA (International Committee for the Co-ordination and Standardization of Speech Databases and Assessment Techniques).

7.1.4 About Phonetization

Brigitte Bigi, Pauline Péri, Roxane Bertrand (2012). **Orthographic Transcription: Which Enrichment is required for Phonetization?**, Language Resources and Evaluation Conference, Istanbul (Turkey), pages 1756-1763, ISBN 978-2-9517408-7-7.

Brigitte Bigi (2013). **A phonetization approach for the forced-alignment task**, 3rd Less-Resourced Languages workshop, 6th Language & Technology Conference, Poznan (Poland).

Brigitte Bigi (2016). **A phonetization approach for the forced-alignment task in SPPAS**, Human Language Technologies Challenges for Computer Science and Linguistics, LNAI 9561, , pp. 515–526, Springer, Heidelberg. ISBN: 978-3-319-14120-6.

7.1.5 About Forced-Alignment

Brigitte Bigi (2012). **The SPPAS participation to Evalita 2011**, Working Notes of EVALITA 2011, Rome (Italy), ISSN: 2240-5186.

Brigitte Bigi (2014). **Automatic Speech Segmentation of French: Corpus Adaptation**. 2nd Asian Pacific Corpus Linguistics Conference, p. 32, Hong Kong.

Brigitte Bigi (2014). **The SPPAS participation to Evalita 2014**, Proceedings of the First Italian Conference on Computational Linguistics CLiC-it 2014 and the Fourth International Workshop EVALITA 2014, Pisa (Italy). Editors R. Basili, A. Lenci, B. Magnini. ISBN 978-886741-472-7. Volume 2. Pages 127-130.

Brigitte Bigi, Christine Meunier (2018). **euh, rire et bruits en parole spontanée : application à l'alignement forcé**, Actes des 32èmes Journées d'études sur la Parole, Aix-en-Provence, France.

Brigitte Bigi, Christine Meunier (2018). **Automatic speech segmentation of spontaneous speech**. Revista de Estudos da Linguagem. International Thematic Issue: Speech Segmentation. Editors: Tommaso Raso, Heliana Mello, Plinio Barbosa, Volume 26, number 4, pages 1489-1530, e-ISSN 2237-2083.

7.1.6 About Syllabification

Brigitte Bigi, Christine Meunier, Irina Nesterenko, Roxane Bertrand (2010). **Automatic detection of syllable boundaries in spontaneous speech**, Language Resource and Evaluation Conference, pages 3285-3292, La Valetta, Malte.

Brigitte Bigi, Caterina Petrone, Leonardo Lancia (2014). **Automatic Syllabification of Italian: adaptation from French.** Laboratory Approaches to Romance Phonology VII, Aix-en-Provence (France).

Brigitte Bigi, Caterina Petrone (2014). **A generic tool for the automatic syllabification of Italian**, Proceedings of the First Italian Conference on Computational Linguistics CLiC-it 2014 and the Fourth International Workshop EVALITA 2014, Pisa (Italy). Editors R. Basili, A. Lenci, B. Magnini. ISBN 978-886741-472-7. Volume 1. Pages 73-77.

Brigitte Bigi, Katarzyna Klessa (2015). **Automatic Syllabification of Polish**, 7th Language and Technology Conference: Human Language Technologies as a Challenge for Computer Science and Linguistics, pp. 262–266, Poznan, Poland.

7.1.7 About Repetitions

Brigitte Bigi, Roxane Bertrand, Mathilde Guardiola (2014). **Automatic detection of other-repetition occurrences: application to French conversational speech**, 9th International conference on Language Resources and Evaluation (LREC), Reykjavik (Iceland), pp. 2648-2652. ISBN: 978-2-9517408-8-4.

7.1.8 About analyses tools

Brigitte Bigi, Jorane Saubesty (2015). **Searching and retrieving multi-levels annotated data**, Proceedings of Gesture and Speech in Interaction, Nantes (France).

7.1.9 About the API

Brigitte Bigi, Tatsuya Watanabe, Laurent Prévot (2014). **Representing Multimodal Linguistics Annotated Data**, 9th International conference on Language Resources and Evaluation (LREC), Reykjavik (Iceland), pages 3386-3392. ISBN: 978-2-9517408-8-4.

Brigitte Bigi (2017). **Annotation representation and file conversion tool**, Contributi del Centro Linceo Interdisciplinare 'Beniamino Segre' (ISSN 0394-0705), vol. –, pp. –. (TO BE PUBLISHED)

7.1.10 Related references

Some results of analyses

Marion Tellier, Gale Stam, Brigitte Bigi (2012). **Same speech, different gestures?**, 5th International Society for Gesture Studies (ISGS), Lund, Sweden.

Marion Tellier, Gale Stam, Brigitte Bigi (2013). **Gesturing While Pausing In Conversation: Self-oriented Or Partner-oriented?**, TIGER, Tillburg.

Laurent Prévot, Brigitte Bigi, Roxane Bertrand (2013). **A quantitative view of feedback lexical markers in conversational French**, 14th Annual Meeting of the Special Interest Group on Discourse and Dialogue, Metz, France.

Brigitte Bigi, Katarzyna Klessa, Laurianne Georgeton, Christine Meunier (2015). **A syllable-based analysis of speech temporal organization: a comparison between speaking styles in dysarthric and healthy populations.** Interspeech2015, Dresden (Germany), pages 2977-2981.

Laurent Prevot, Jan Gorisch, Roxane Bertrand, Emilien Gorene and Brigitte Bigi (2015). **A SIP of CoFee: A Sample of Interesting Productions of Conversational Feedback**, 16th Annual Meeting of the Special Interest Group on Discourse and Dialogue, Prague (Czech Republic), pp. 149–153.

Brigitte Bigi, Roxane Bertrand (2016). **Laughter in French Spontaneous Conversational Dialogs**, Tenth International Conference on Language Resources and Evaluation (LREC 2016), pp. 2168-2174, Portoroz, Slovenia.

Béatrice Priego-Valverde, Brigitte Bigi, Salvatore Attardo, Lucy Pickering, Elisa Gironzetti (2018). **Is smiling during humor so obvious? A cross-cultural comparison of smiling behavior in humorous sequences in American English and French interactions.** Intercultural Pragmatics. 10/2018; 15(4):563-591.

Some corpora

Sophie Herment, Anastasia Loukina, Anne Tortel, Daniel Hirst, Brigitte Bigi (2012). **AixOx, a multi-layered learners corpus: automatic annotation**, Proceedings of international conference on corpus linguistics, Jaèn (Spain).

Ellen Gurman Bard, Corine Astésano, Alice Turk, Mariapaola D'imperio, Noel Nguyen, Laurent Prévot, Brigitte Bigi (2013). **Aix MapTask: A (rather) new French resource for prosodic and discourse studies**, Proceedins of Tools ans Resources for the Analysis of Speech Prosody, Aix-en-Provence, France, Eds B. Bigi and D. Hirst, ISBN: 978-2-7466-6443-2, pp. 15-19.

Daniel Hirst, Brigitte Bigi, Hyongsil Cho, Hongwei Ding, Sophie Herment, Ting Wang (2013). **Building OMProDat: an open multilingual prosodic database**, Proceedins of Tools ans Resources for the Analysis of Speech Prosody, Aix-en-Provence, France, Eds B. Bigi and D. Hirst, ISBN: 978-2-7466-6443-2, pp. 11-14.

Jan Gorish, Corine Astésano, Ellen Gurman Bard, Brigitte Bigi, Laurent Prévot (2014). **Aix Map Task corpus: The French multimodal corpus of task-oriented dialogue**, 9th International conference on Language Resources and Evaluation (LREC), Reykjavik (Iceland), pages 2648-2652. ISBN: 978-2-9517408-8-4.

Christine Meunier, Cécile Fougeron, Corinne Fredouille, Brigitte Bigi, Lise Crevier-Buchman, Elisabeth Delais-Roussarie, Laurianne Georgeton, Alain Ghio, Imed Laaridh, Thierry Legou, Claire Pillot-Loiseau, Gilles Pouchoulin (2016). **The TYPALOC Corpus: A Collection of Various Dysarthric Speech Recordings in Read and Spontaneous Styles**, Tenth International Conference on Language Resources and Evaluation (LREC 2016), pp. 4658-4665, Portoroz, Slovenia.

Tools re-implemented into SPPAS

Daniel Hirst and Robert Espesser (1993). *Automatic modelling of fundamental frequency using a quadratic spline function.* Travaux de l'Institut de Phonétique d'Aix. vol. 15, pages 71-85.

D.-J. Hirst (2011). *The analysis by synthesis of speech melody: from data to models*, Journal of Speech Sciences, vol. 1(1), pages 55-83.

Dafydd Gibbon (2013). **TGA: a web tool for Time Group Analysis**, Tools ans Resources for the Analysis of Speech Prosody, Aix-en-Provence, France, pp. 66-69.

7.2 SPPAS in research projects

You used SPPAS into your research project? Send an e-mail to the author to append it into this section!

7.2.1 MULTIPHONIA

SPPAS was used to annotate the MULTIPHONIA corpus (MULTImodal database of PHONetics teaching methods in classroom InterActions) created by Charlotte ALAZARD, Corine ASTESANO, Michel BILLIÈRES.

This database consists of audio-video classroom recording comparing two methods of phonetic correction (the "traditional" articulatory method, and the Verbo-Tonal Method). This database is composed of 96 hours of pronunciation classes with beginners and advanced students of French as a Foreign Language. Every class lasted approximatively 90 minutes. This multimodal database constitutes an important resource for Second Language Acquisition's researchers. Hence, MULTIPHONIA will be enriched at many different levels, to allow for segmental, prosodic, morphosyntaxic, syntaxic, lexical and gestural analyses of L2 speech.

Charlotte Alazard, Corine Astésano, Michel Billières **MULTIPHONIA: a MULTImodal database of PHONetics teaching methods in classroom InterActions**, Language Resources and Evaluation Conference, Istanbul (Turkey), May 2012.

MULTIPHONIA: http://www.sldr.org/sldr000780/en

7.2.2 Amennpro

SPPAS was used for the annotation of the French part of the AixOx corpus.

- four way recordings of French and English texts;
- read by English and French speakers;
- non-native speakers were divided into advanced and beginners.

Download the AixOx corpus: http://www.sldr.fr/sldr000784/

```
Remark:
Some examples are located in the samples-fra directory (files F_F_*.*) and
in the samples-eng (files E_E*.*).
```

7.2.3 Evalita 2011: Italian phonetization and alignment

Evalita 2011 was the third evaluation campaign of Natural Language Processing and Speech tools for Italian, supported by the NLP working group of AI*IA (Associazione Italiana per l'Intelligenza Artificiale/Italian Association for Artificial Intelligence) and AISV (Associazione Italiana di Scienze della Voce/Italian Association of Speech Science).

SPPAS participated to the Forced Alignment on Spontaneous Speech for both tasks:

- Phone segmentation
- Word segmentation

The corpus was a set of Dialogues, map-tasks:

- 3h30 speech;
- 15% phones are: "sil", filled-pauses, garbage.

7.2.4 Cofee: Conversational Feedback

In a conversation, feedback is mostly performed through short utterances produced by another participant than the main current speaker. These utterances are among the most frequent in conversational data. They are also considered as crucial communicative tools for achieving coordination in dialogue. They have been the topic of various descriptive studies and often given a central role in applications such as dialogue systems. Cofee project addresses this issue from a linguistic viewpoint and combines fine-grained corpus analyses of semi- controlled data with formal and statistical modelling.

Cofee is managed by Laurent Prévot: http://cofee.hypotheses.org/

Cofee corpora and the use of SPPAS on such corpora is presented in:

> **Jan Gorish, Corine Astésano, Ellen Gurman Bard, Brigitte Bigi, Laurent Prévot** (2014). *Aix Map Task corpus: The French multimodal corpus of task-oriented dialogue*, 9th International conference on Language Resources and Evaluation (LREC), Reykjavik (Iceland).

7.2.5 Variamu: Variations in Action: a MUltilingual approach

Variamu is an international collaborative joint project co-funded by Amidex. The scientific object of the collaboration is the issue of language variation addressed from a comparative perspective. Speech and language knowledge supports a growing number of strategic domains such as Human Language Technologies (HLT), Language Learning (LL), and Clinical Linguistics (CL). A crucial issue to these domains is language variation, which can result from dysfunction, proficiency, dialectal specificities, communicative contexts or even inter-individual differences. Variation is often an important part of the question itself.

This network will be structured around 3 research axes, all centered on the variation concept:

1. Language technologies,
2. Linguistics and Phonetics,
3. Speech and Language Pathologies.

SPPAS is mainly concerned by the first axe.

The first result of this project is the participation of SPPAS at the Evalita 2014 campaign, for the FACS task: Forced-Alignment on Children Speech.

The second result of this project is the support of Cantonese into SPPAS, thanks to a collaboration with Prof. Tan Lee of the University of Hong Kong.

8

SPPAS Release notes

8.1 The early versions

Versions 1.0 to 1.3 was made only of `tcsh` and `gawk` scripts. It was developed under Linux system and was efficiently tested under Windows with Cygwin.

8.1.1 Version 1.0

(2011, 9th March)

The only feature was that it was able to perform speech segmentation of English read speech.

8.1.2 Version 1.1

(2011, 7th June)

This was mainly the debug of the previous version and some code re-organization and cleaning.

8.1.3 Version 1.2

(2011, 23th July)

The support of English, French and Italian was added: a lexicon, a pronunciation dictionary and an acoustic model of each language was created. Three annotations were implemented: Tokenization, Phonetization, Alignment.

The basis for a *multi-lingual methodology* was already there.

8.1.4 Version 1.3

(2011, 12th December)

This is a transitional version, from the scripts language to Python programming language. The main fixes and improvements were:

Development:

- MacOS support
- bugs corrected in many scripts
- check.csh -> check.py
- sppas.csh -> sppas.py
- GUI: zenity -> pyGtk
- sox limited to the use of re-sampling audio signal
- a python library to manage wav files is added.
- IPUs segmentation automatic annotation

Resources:

- Italian dictionary improved
- Italian acoustic model changed (triphones trained from map-task dialogues)
- French acoustic model changed

But the program still haven't a name and isn't distributed.

8.2 The birth of SPPAS

8.2.1 SPPAS 1.4.0

(2012, 14th June)

It's the official birth of SPPAS: the software has a name, a license, a GUI, a web-page and is freely distributed to the community.

The source code is only based on Python 2.7 language and the GUI is based on WxPython 2.8.x or 2.9.x (on MacOS, wxpython must be 32 bits). SPPAS requires also `sox` and `julius` software to be installed.

Automatic annotations:

- add Momel: Momel (MOdelling MELody) is an algorithm developed by Daniel Hirst and Robert Espesser for the analysis and synthesis of intonation patterns. Momel needs a .hz files with pitch values: ASCII file with one value each 10ms. This Momel implementation can be used directly, with a large set of options: > python $SPPAS/scripts/lib/momel.py -h

  or in SPPAS, using the GUI, or in text-mode (only with default options): > $SPPAS/sppas.py -i INPUT –momel

- add the first version of INTSINT, proposed by Daniel Hirst. INTSINT is an acronym for INternational Transcription System for INTonation. INTSINT codes the intonation of an utterance by means of an alphabet of i 8 discrete symbols constituting a surface phonological representation of the intonation.

Packaging:

- merge AUTHORS, VERSION and README files in the README file

- create packages in the lib directory (2012-03-20)
- ipu-segmentation in python (2012-02-16)
- improve ipu segmentation algorithm (2012-05-24)
- phonetization in python (2012-02-27), with an unknown word phonetization.
- alignment entirely in python (2012-03-29)
- syllabification implemented with python, and tool/syllabify.py
- add a simple terminal controller (not needed for Unix, just for "DOS")
- Momel can read PitchTier (from Praat) files
- Momel can deal with long sounds (not only one IPU)
- manage source files, comments, exceptions…
- SPPAS works as a single instance by mean of a lock file.
- SPPAS can be installed in a directory containing spaces and can deal with file names with spaces (bug fixed: 2012-06-11)

GUI:

- GUI with the wxpython library (2012-03-27)
- Manage a list of selected files
- Add a "File information"
- Add a "Wav player"
- Fix options to each annotation step with the menu
- Open the log file after each process

Resources:

- French dictionary is using UTF-8 (instead of iso8859-1 in previous versions)
- French dictionary is based on X-SAMPA phone set
- Chinese: work with chinese characters instead of pinyin.

Known Bugs:

- The wav player can not play wav files if the filename contains '#'.
- The first line of the Italian dictionary must be changed to "# [#] #".

8.2.2 SPPAS 1.4.1

(2012, 13th July)

Resources:

- Updated English acoustic model (from voxforge, 2012-06-25)
- English acoustic models converted to X-SAMPA

Automatic annotations:

- IPUs Segmentation annotation performs a simple silence detection if no transcription is available (the volume is automatically adjusted)

- A specific language can be selected for each annotation depending on available resources
- Updated transcription conventions:
  - truncated words: a '-' at the end of the token string (an ex- example)
  - liaisons: the 'letter' between '=' (an =n= example)
  - noises: * (only for FR and IT)
  - short pauses: + (a + example)
  - silences: # (a # example)

GUI:

- Create (systematically) a merged annotations TextGrid file.

Development:

- Package's management

8.2.3 SPPAS 1.4.2

(2012, 2nd August)

GUI:

- add a panel with a Transcription editor
- IPU segmentation can split a wav into tracks
- IPU segmentation can fix a shift value to boundaries
- IPU segmentation: min-volume option is removed (because the min-volume value is automatically adjusted)
- "File Information" button adds some tier manipulation tools: cut/copy/paste/rename/duplicate/move/preview/filter

Known bug:

- The filter frame is not working under Windows XP.

8.2.4 SPPAS 1.4.3

(2012, 10th October)

This is primarily a bug-fix release. The author is addressing many thanks to all users who send their comments!

GUI:

- Frames and Dialog design is more uniform.
- Users preferences changed. Themes and colors introduced.
- Help is available.

Automatic annotations:

- Bug fixed for phonetization/alignement if the input transcription contains series of silence intervals or series of speech intervals. Previous versions was supposing a **strict IPUs** input transcription.
- Tokenization is done.

Development:

- Code cleaning in the package wxGUI.
- Debug…

8.2.5 SPPAS 1.4.4

(2012, 6th December)

GUI:

- add information/options when "Request" a file
- debug Request/Filter (for Windows systems)

Automatic annotations:

- New Italian acoustic model
- New Chinese acoustic model, and some minor changes in the dictionary

Development:

- ".trs" files support (transcriptions from Transcriber)
- debug (alignment, tokenization)
- add ".lab" files export (HTK format)

Known bugs:

- Alignment: it fails under Windows, if `julius` is not installed properly.
- Syllabification: the last syllable of each file is "broken".
- Alignment error if unknown words during phonetization.

8.2.6 SPPAS 1.4.5

(2013, 15th January)

Development:

- Correct a few bugs of the previous version (phonetization, alignment, syllabification)
- ".eaf" files support (transcriptions from Elan software)
- add script tierfilter.py
- add script tiercombine.py

Automatic annotations:

- Experimental version of Vietnamese
- add Tokenization as a specific annotation level
- add Phonetization of PinYin

GUI:

- Request/Filter a tier: multiple patterns filtering
- Request: add a “New File” button

8.2.7 SPPAS 1.4.6

(2013, 12th February)

GUI:

- Improved Request/Filter a tier:
  - add new modes: not contains, not starts with, not ends with
  - add time constraints: minimum duration, maximum duration, meets
  - multiple modes selection (replace radio buttons by check buttons)
- Add Requests/Stats to obtain basic statistics
- Requests Copy/Cut/Paste/Duplicate/Save debugged

utomatic annotations:

- IPU segmentation: can take a “Name” tier to fix names of tracks (if the “Split into tracks” option is checked)

8.2.8 SPPAS 1.4.7

(2013, 25th March)

Development:

- re-organization of lib, except for the wxGUI library.
- Cancel the sppas.lock file creation when SPPAS is running.
- Requests/Filter: “Starts search at…” and “Ends search at…”
- Requests/Filter: remove negative search (because of a bug…). Replaced by a “reverse” option.

Resources:

- add experimental version of Taiwanese automatic segmentation (from romanized transcriptions)

Annotations:

- New version of INTSINT, based on the algorithm proposed in (Hirst 2011) and implemented in the last version of Momel/INTSINT Praat plugin!

8.2.9 SPPAS 1.4.8

(2013, 30th May)

Development:

- reorganization of the GUI code. SPPAS is made of:
  - automatic annotations;
  - 3 components (wavplayer, transcriber, requests).
- sppas.py removed. sppas.bat created (for Windows).
- Input/Output library entirely changed

GUI:

- components (wavplayer, transcriber, requests) in separate frames
- new design
- Help and documentation changed, expanded and improved

8.2.10 SPPAS 1.4.9

(2013, 3rd July)

SPPAS has a new and more colored logo!

Development:

- bug correction:
  - Bug fixed in IPU segmentation with option “Split into tracks”
  - Bug fixed in Momel with some rare files
  - Bug fixed to create a merged file
  - Bug fixed in align and IPU seg.
  - Bug fixed in Transcriber
- library organization revised

GUI:

- Add an export button to the File List Panel
- Migrate wav infos from the Requests component to the Wav player component
- Volume control removed in the Wav Player component
- Save As improved in the Requests component

8.2.11 SPPAS 1.5.0

(2013, 2nd August)

Development:

- bug correction

Annotation:

- Tokenization: TOE support finalized

GUI:

- Transcribe: debug of IPU player, for MacOS

Resources:

- New French acoustic model. Attention: phoneset changed.
- New French dictionary: use the new phoneset!
- New Taiwanese acoustic model. Attention: phoneset changed: accept some chinese…
- New Taiwanese dictionary: use the new phoneset + some chinese syllabes added.
- Vietnamese removed: due to the lack of data, the model can't be improved.

8.2.12 SPPAS 1.5.1

(2013, 29th August)

Development:

- bug correction in annotations
- help system debugged

Annotation:

- Phonetization of unknown words improved

Resources:

- French dict modified

8.2.13 SPPAS 1.5.2

(2013, 27th September)

All resources are moved into the "resources" directory.

Development:

- bug correction in annotations and GUI

Resources:

- French dict modified
- New resources for the tokenization

Components:

- “Statistics”: an avanced component to estimate (and save!) descriptive statistics on multiple annotated files

8.2.14 SPPAS 1.5.3

(2013, 25th October)

Resources:

- Add Spanish support

Components:

- improved Statistics component
- Add a “Filter” component, first version with a basic GUI

GUI:

- Help updated.

8.2.15 SPPAS 1.5.4

(2013, 3rd December)

Components:

- Wav Player changed.
- Information and Requests removed. Replaced by Data Roamer.
- Transcriber removed. Replaced by IPU Transcriber.
- Statistics updated.
- Filter updated.

Annotations:

- Add Repetitions (detection of sources only)

Notice that this is the first stable release.

8.2.16 SPPAS 1.5.5

(2013, 23th December)

Development:

- improved annotationdata (add methods: Find, Index; add uncertain label; debug radius).

Components:

- debug

GUI:

- Tips at start-up
- New theme: Christmast

8.2.17 SPPAS 1.5.6

(2014, 28th January)

Development:

- improved annotationdata (add methods: Near, Search).
- Package cleaning!

Components:

- debug

Resources:

- New Italian dictionary (including gemination)

8.2.18 SPPAS 1.5.7

(2014, 18th February)

Development:

- Plugins manager added.

Resources:

- Japanese support, thanks to the resources available on the Julius website.

8.2.19 SPPAS 1.5.8

(2014, 18th March)

Development:

- annotationdata: more flexibility while adding annotations, add sub-divisions, export csv modified, doc-strings, import/export in a native format (xra, version 1.0).

Documentation:

- add a PDF file of slides: “SPPAS for dummies”

8.2.20 SPPAS 1.5.9

(2014, 15th April)

Components:

- new: DataViewer, experimental version

Annotations:

- syllabification rules: accept 2 types of vowels (V and W)
- syllabification: faster!

Development:

- Export Elan
- Import/Export xra. XRA is the native format of SPPAS annotation files. See etc/xra for details.

Resources:

- New French acoustic model

8.2.21 SPPAS 1.6.0

(2014, 22th May)

Package:

- Rename folder “Doc” to “documentation”
- A documentation is created
- SPPAS-for-dummies updated

Development:

- helpsystem removed
- GUI: package re-organization, re-implementation.
- Alignment: choice of the aligner (julius, hvite or basic)

Resources:

- new acoustic model: FR-Read and FR
- new acoustic model: ZH
- new acoustic model: TW
- new acoustic model: SP

8.2.22 SPPAS 1.6.1

(2014, 26th September)

Development:

- bug correction (export, syllabification, alignment)
- DataViewer, major bugs corrected.

Resources:

- Italian: new pronunciation dictionary and new acoustic model
- add resources for Catalan

GUI:

- add a new Export button

8.2.23 SPPAS 1.6.2

(2014, 21th October)

Resources:

- language names changed. They are now corresponding to the international standard ISO639-3. See http://www-01.sil.org/iso639-3/
- Mandarin Chinese dictionary changed.
- Catalan dictionary changed.

8.2.24 SPPAS 1.6.3

(2014, 2nd November)

Resources:

- Add resources for Cantonese

Documentation:

- It's now (more or less) finished!

Development:

- Support of Elan improved (add Controlled vocabulary)

GUI:

- Change the organization of the main frame: annotations above components

This version is known to be a stable release.

8.3 The childhood of SPPAS

8.3.1 SPPAS 1.6.4

(2014, 5th December)

From this version, SPPAS requires wxpython to be updated to version 3.0, particularly for MacOS users, and they need to install the 64 bits version. It is recommended to Windows users to install Python 2.7 and wxpython in 32bits.

Development:

- Package re-organized!
- Phonetization of unknown words improved
- Support of upper/lower of the extension of speech files (wav, WAV)
- Tokenization of languages with dictionaries in upper case (eng, ita): bug fixed.

- Creates systematically a dump file of resources for a faster load at the next use
- Read TextGrid files exported by Elan: bug fixed.
- `sppas.command` checks the system and run either in 32 or 64 bits (MacOS)

Components:

- IPUscribe replaces IPUTranscriber mainly for the support of large files: tested with a file of 1 hour speech (143 Go) and 800 IPUs.
- SndRoamer replaces WavPlayer
- Dataroamer has also a new version

8.3.2 SPPAS 1.6.5

(2014, 17th December)

This is primarily a bug-fix release.

Development:

- all programs in “bin” and “scripts” sub-directories were revised and tested, or removed.

Annotation:

- Tokenization: code cleaning and re-organisation.

GUI:

- Procedure outcome report: print a warning message in the log file if no file is matching the expected extension

8.3.3 SPPAS 1.6.6

(2015, 19th January)

Web site host has changed: `http://sldr.org/sldr00800/preview/`

Documentation completed and updated. Now, only the documentation of all the components is missing.

Annotations:

- log messages more explicit and status printed with intuitive colors.
- management of input/output file format re-done: now easier for the user.

Development:

- package architecture revised: mainly “sppasgui” and “components” merged in “wxgui”, and many other changes.
- thread removed in automatic annotation process.
- debug of alignment: if too short units.
- radius value properly fixed in most of the automatic annotations.

GUI:

- GUI is more homogeneous and pretty (hope!)
- Show the date in the status bar
- New Settings frame:
  - 4 icon themes available
  - Choice of foreground and background colours
  - Choice of the font
  - Choice of the input/output file format of annotations
- New in Help menu:
  - access to the project homepage
  - access to the online documentation
- New Feedback window
- New Help browser
- Add Keyboard shortcuts:
  - ALT+F4 to exit,
  - CTRL+A to add files in FLP
  - SHIFT+CTRL+A to add a directory in FLP
  - Del to remove selected files of the FLP
  - SHIFT+Del to erase selected files of the FLP
  - CTRL+C to copy files
  - CTRL+E to export files
  - F5 to refresh the FLP
  - F1 to open the help browser
  - F2 to open the “About” frame

Components:

- GUI design unified for DataRoamer, SndPlayer, IPUscribe and SppasEdit
- New Tier Preview frame (still under development)
- SndPlayer print information about a sound file with colors:
  - Green: the information corresponds to the SPPAS requirements

  - Orange: the information does not exactly corresponds to the requirements however SPPAS is able to deal with (after conversion)
  - Red: SPPAS does not support. It must be converted before using it!

8.3.4 SPPAS-1.6.7

(2015, 16th February)

Automatic Annotations:

- By default, tokenization produces only one tier. Check an option to get TokensStd and TokensFaked, in case of EOT.
- radius value properly fixed in most of the automatic annotations.

GUI:

- Tested and debugged on MacOS (version 10.9.5, with wxpython 3.0.2)

Development:

- Tier hierarchy partly implemented: TimeAlignement and TimeAssociation are two “links” that can be fixed between tiers.

Annotations:

- Add Polish support

8.3.5 SPPAS-1.6.8

(2015, 9th April)

Resources:

- new French acoustic model
- new English acoustic model (VoxForge nightly build of March, 15th, 2015)
- add phoneset mapping tables

Development:

- Add a phoneme mapping in models, to allow both the dictionary to include real X-SAMPA symbols and the acoustic model to be compatible with Hvite requirements (only ASCII).
- annotationdata bug correction with min and max values
- IPUs Segmentation:

  - bug correction when split into tracks with a tier “Name”
  - add the ipu number in speech segments if silence/speech segmentation

- Self-repetitions debug in finding the repetition interval

GUI:

- DataRoamer: “New” button debugged
- DataRoamer: Add a button “Radius” to adjust manually the vagueness of each bounday of a tier

8.4 The development phase

8.4.1 SPPAS-1.6.9

(2015, 14th May)

The installation of dependencies is simplified: `sox` is unnecessary. Python 2.7.x, WxPython and Julius are the only remaining dependencies.

Development:

- package annotationdata.filter updated to support last changes in annotationdata: multiple labels and numerical labels.

- package annotationdata.io:

  - praat.py newly created. Support of TextGrid, PitchTier and IntensityTier files completely re-written
  - htk.py newly created to support .lab and .mlf files
  - sclite.py newly created to support .stm and .ctm files
  - signaix.py newly created to support .hz files
  - SPPAS native format XRA upgraded to version 1.1 to support improvements of the library.

- package annotationdata:

  - updated object Transcription to support more/different input data
  - updated hierarchy
  - updated meta-data

- package signal: partially re-written. As a consequence, sox won’t be neither used, but the file conversion (if required) is slower.

GUI:

- DataFilter component partially re-written to facilitate its use
- Preview frame modified

8.4.2 SPPAS-1.7.0

(2015, 3th July)

Development:

- package annotationdata.io:
  - add support of subtitles: sub, srt
  - elan.py created to replace eaf.py: allows a full support of Elan annotations
  - transcriber.py created to replace trs.py for a better support of Transcriber files
  - anvil.py allows to import anvil files
- package annotationdata:
  - updated hierarchy (simplified)
  - updated meta-data
- package signal:
  - support of audio files re-written: can open/save wav, aiff and au files
  - add a lot of possibilities to manage one channel of an audio file

GUI:

- DataFilter component finalized: can deal with alternative labels, and typed labels (string, number, boolean)
- Statistics component fully re-written to facilitate its use
- SndRoamer displays more properties of audio files (min, mean and max added)

Annotations:

- IPUs Segmentation produces 2 tiers if a transcription is given: the IPUs segmentation itself, and the Transcription time-aligned at the IPUs level.

8.4.3 SPPAS-1.7.1

(2015, 5th August)

Development:

- package re-organization:
  - package signal is now standalone
  - package resources is now standalone
  - package presenters created
- updated statistics estimations
- package annotationdata:

  - add Media object
  - add CtrlVocab object
  - add inheritance of MetaObject for Annotation

- package annotationdata.io:

  - full debug of all file formats
  - add comments and documentation
  - add also some tests
  - add Media/CtrlVocab in some file formats
  - add Annotation Pro support of antx files (in API)

Components:

- add Time Group Analyser (TGA) in Statistics
- add Kappa estimation on labels of 2 tiers with the same number of intervals

Annotations:

- New version of XRA: 1.2
- Make XRA the default input/output file format

8.4.4 SPPAS-1.7.2

(2015, 3th September)

Development:

- updated XRA reader/writer to solve problems with upper/lower cases of elements
- updated Elan reader to be compatible with format 2.8
- updated Praat reader/writer for single/double quotes
- support of AnnotationPro antx files in the GUI
- add the julius score in PhonAlign annotation (can be seen only if XRA)
- remove tk dependency

8.4.5 SPPAS-1.7.3

(2015, 9th October)

Resources:

- New word-based vocab for Cantonese
- New word-based dict for Cantonese
- New phoneme-based acoustic model for Cantonese

Development:

- Descriptive statistics debugged for detailed panels.

8.4.6 SPPAS-1.7.4

(2015, 6th November)

Resources:

- Add a vocab for Portuguese
- Add a dict for Portuguese
- Add an acoustic model for Portuguese. It has to be noticed that it was constructed from French/Spanish/Italian models, not trained from data.

Samples:

- Add Portuguese
- Change some samples in various languages

Development:

- Debug of the Tokenizer.

8.4.7 SPPAS-1.7.5

(2015, 11th December)

Development:

- Add vagueness to the annotation duration estimation
- Bug correction while saving the procedure outcome report in the GUI

GUI:

- Changed all pictures to remove the problem with colorset of some of them
- Add a christmast theme for the pictures of tips
- IPUscribe improvements:
  - add keyboard shortcuts to play/pause/stop the sound
  - add a new button to auto-play the sound

8.4.8 SPPAS-1.7.6

(2016, 28th January)

Web site host has changed: http://www.sppas.org/

Development:

- IPU segmentation:
  - bug correction with option “split into tracks”
  - new option to add or not add the IPU index of each IPU into the transcription tier
- Tokenization:
  - bug correction in input tier selection
  - bug correction for replacements

Resources:

- add a vocabulary of Korean
- add an acoustic model for Korean (made from the English and the Taiwanese ones).

GUI:

- DataRoamer: bug correction of “Duplicate”

Others:

- Add a sample in Korean
- Updated references to cite SPPAS in publications

8.4.9 SPPAS-1.7.7

(2016, 30th March)

Resources:

- Correction of errors in most of the acoustics models, for /@@/ and /dummy/ models
- New vocabulary and pronunciation dictionary for Mandarin Chinese.

GUI:

- Dialogs are customized
- DataRoamer debug and changes: save buttons moved in the main toolbar.
- HelpSystem is (welcome) back!

Development:

- Add the API and a script to train acoustic models with HTK.
- Add Kullback-Leibler distance estimator.
- Add a script to compare segmentation of 2 tiers.
- Classes of the package resources are debugged, improved and extended.
- Alignment: bug correction if input starts by an empty interval.
- `sppas.command` modified for MacOS-X (use python if python2 not available)
- GUIs in `bin` directory are updated (test of python, wxpython, and so on).

8.4.10 SPPAS-1.7.8

(2016, 5th May)

Resources:

- Add a pronunciation mapping table `eng-fra.map`: to be used for the speech segmentation for French speakers reading an English text.

Development:

- Phonetization is extended: it can take into account a mapping table of phones to generate new pronunciation variants.
- Phonetization: use of minus instead of dots to separate phones as recommended in X-SAMPA standard.
- Alignment is restructured and extended: it can take into account two acoustics models and mix them.
- Filter is extended: Relations can be based on a delay between the intervals
- annotationdata: add Xtrans reader (extension: .tdf)
- Code cleaning in several packages.

GUI:

- Automatic annotations: more explicit log messages.

8.4.11 SPPAS-1.7.9

(2016, 3th June)

GUI:

- Some debug in SppasEdit
- SndPlayer renamed AudioRoamer because new functionalities were added:
  - See detailed information about each channel of an audio file
  - Can extract/save a channel or a fragment of channel
  - Can modify the frame rate and the sample width of a channel

  - Can add a bias on amplitude values of a channel
  - Can multiply amplitude values of a channel
  - Can remove the offset of amplitude values of a channel

Automatic annotations:

- IPUs Segmentation fully re-implemented.
  - Silence/speech segmentation improved for both quality and fastness
  - Package code cleaning and re-organization.

8.5 The stabilization phase

8.5.1 SPPAS-1.8.0

(2016, 30th August)

GUI:

- Design fully revisited and tested under Linux Mint, Windows 10 and MacOS 10.9

Development:

- SLM package created: can estimate a statistical language model (without smooth method) on a small corpus

Automatic annotations:

- Add a diagnosis of files
- Tokenize extended: applied also on alternative labels
- Phonetize extended: applied also on alternative labels
- Alignment code cleaning and partly re-implemented
- Add “Chunk alignment”
- Use of a .ini file to configure each annotation instead of a sppas.conf file

8.5.2 SPPAS-1.8.1

(2016, 28th November)

A few tutorials are available on the web site.

Automatic annotations:

- Align: an ActivityDuration tier can be optionally added.
- Support of 3-columns tab-delimited files with .txt extension. It allows the compatibility with Audacity Label track files.
- Acoustic models training validated.

Resources:

- Catalan: new pronunciation dictionary and new acoustic model.

8.5.3 SPPAS-1.8.2

(2017, 18th January)

Analysis:

- debug of DataFilter

Resources:

- French vocabulary and dictionary updated

Development:

- new plugins package with a new plugin manager
- GUI integration of this new plugins system
- some unittest appended and all existing ones updated
- annotationdata.io renamed annotationdata.aio
- docstrings of some packages converted from epytext to reST syntax

GUI:

- DataStats, DataFilter and DataRoamer toolbars don't scroll anymore
- Themes management changed.
- Main font is managed by the Themes.

8.5.4 SPPAS-1.8.3

(2017, 10th March)

Development:

- Elan reader highly improved (faster reader).
- updated plugins

8.5.5 SPPAS 1.8.4

(2017, 10th April)

Development:

- Elan writer modified: create a time slot for each localization.

8.5.6 SPPAS 1.8.5

(2017, 20th April)

Development:

- Vizualizer renamed Visualizer
- AudioRoamer: bug with an icon corrected
- New Phonedit mrk format support.
- Updated AnnotationPro Antx reader/writer

8.5.7 SPPAS 1.8.6

(2017, 19th June)

Resources:

- Polish dictionary and acoustic model updated.

8.5.8 SPPAS 1.9.0

(2017, 28th July)

Programming:

- Relative imports used in the standard way for Python
- PEP 8 code style (except for wxgui/annotationdata)
- PEP 257 reST code documentation style (except for wxqui/annotationdata)
- Unittests:

```
- existing tests verified, improved, extended
- new tests added
- tests migrated into the packages
```

- Compatibility for both Python 2.7 and Python > 3.2:
  - makeunicode.py contains functions and classes to deal with strings
  - utils, term, structs, resources, presenters, plugins, calculus packages: migration is done
- Exceptions are separately managed
- Introduction of a system for the internationalization of the messages. Done in English and French for the packages: audiodata, calculus, plugins, resources, structs, term, utils
- Package re-organization:

  - new package “models”, with acm and slm
  - utils
  - resources
  - …

- meta.py is replacing sp_glob.py
- new scripts: tieraligntophon.py, dictmerge.py
- new bin: pluginbuild.py
- Robustness to read malformed HTK-ASCII pronunciation dictionaries.
- Bug corrected in the management of pronunciation variants
- re-structured package TextNormalization
- re-structured package Repetitions
- new version of the plugins: updated and debugged.

Resources:

- Add support of Naija language (pcm)
- English-French mapping table updated

Annotations:

- Tokenizer renamed into Text Normalization:
  - a lot of debug mainly for English language, and punctuation managements
  - new option: can output a customized tier.
- Repetitions:
  - some debug

Communication:

- Add a description document of the orthographic transcription convention in the package.
- Web page updated, new tutorials available
- Documentation updated
- Better information about the licenses

8.5.9 SPPAS 1.9.1

(2017, 1st September)

Programming:

- Bug correction in the ELAN reader.
- Bug correction with quotation marks of the Praat writer.

Resources:

- Add an acoustic model for English, including laughter and noises.

8.5.10 SPPAS 1.9.2

(2017, 6th October)

Programming:

- Bug correction in the diagnosis of audio files.
- Package “anndata” continued, in the scope of replacing “annotationdata”.
- Acoustic model training procedure debugged and improved, code cleaned, scripts updated, etc.

8.5.11 SPPAS 1.9.3

(2017, 18th October)

Programming:

- Critical bug correction in Alignment: error when loading the tiedlist.
- Correction of TextNormalization of broken words: “-” is now not removed.

Resources:

- Italian pronunciation dictionary updated.
- French vocabulary updated: list of compound words revised.

Known bugs:

- Spanish alignment does not work: corrupted acoustic model

8.5.12 SPPAS 1.9.4

(2018, 15th January)

Programming:

- Script to train acoustic models updated
- Script to evaluate alignments updated
- Bug corrections of the search tier system

Resources:

- Spanish:
  - new pronunciation dictionary
  - new acoustic model

8.5.13 SPPAS 1.9.5

(2018, 26th April)

Programming:

- I/O development of the package “anndata”.
- Reading and writing of annotated files is now based on the new ‘anndata’ package instead of the old ‘annotationdata’ package. This was a big issue and it allows a better support of annotated files (less bugs and the amount of lost information is drastically reduced).

8.5.14 SPPAS 1.9.6

(2018, 25th May)

Resources:

- New: support of German language for Text Normalization (except num2letter), Phonetization and Alignment.
- French: new acoustic model with an updated phoneset and a better accuracy.
- Laugh and noise are uniformly represented in all languages.
- English: context-independent model is the default, instead of context-dependent model, for Alignment.

Development

- debug of the Transcriber file reader.
- debug in the management of the hierarchy in file readers/writers.
- Resources package: add compatibility with PLS (W3C xml) pronunciation dictionaries

Known bugs:

- Syllabification of French: the configuration file is not correct.

8.5.15 SPPAS 1.9.7

(2018, 23th July)

Development

- new filter system in anndata
- IPUs segmentation: debug in fixing automatically the threshold for the search of silences (can't be negative!)
- Annotations: improved messages for the procedure outcome report
- Annotations: Text normalization is based on `anndata` API instead of `annotationdata`
  - the result is now a sequence of individual tokens (each token is a sppasLabel()), instead of a single string separating tokens with space.
- Annotations: Phonetization is based on `anndata` API instead of `annotationdata`
  - the result is now a sequence of sppasLabel() with alternative tags: each tag corresponds to a pronunciation variant
- Annotations: Syllabification re-programmed and now based on `anndata` API
  - only sequences of phonemes are syllabified (i.e. no silence, no laugh nor noise in the result)
  - `O` class name changed into `P` class name
  - do not generate the tier "structures" tier anymore
  - generating the "classes" tier is optional
- Annotations: INTSINT is based on `anndata` API instead of `annotationdata`
- IPUScriber is based on `anndata` API instead of `annotationdata`

Resources:

- French syllabification rules updated to be compliant with the new phoneset (used since version 1.9.6)

Documentation

- updated chapter 6: scripting with Python and SPPAS. It is now based on `anndata` API instead of `annotationdata`.

8.5.16 SPPAS 1.9.8

(2018, 06th September)

e-mail contact is changed to:

- *contact@sppas.org* for general questions of users
- *develop@sppas.org* for developer questions or for a bug alert

Development

- bug correction for GMT with a negative value, like GMT-4.
- most of the scripts are based on `anndata` API instead of `annotationdata`
- dependency to markdown removed
- new solution to work with global variables with the new package `config` and the new classes like `sppasGlobalSettings`, `sppasPathSettings`, ...

- translation management moved in package `config`
- better way to work with imports
- increased pep8 and pep257 compatibility (should be continued)
- `anndata` is used in DataRoamer, Visualizer, DataFilter
- new script trsshift.py to shift the transcription of a delay in time

Documentation

The API documentation is based on Sphinx `http://www.sphinx-doc.org`.

8.5.17 SPPAS 1.9.9

(2018, 23th October)

Development

- package for the 'aligment' is fully re-structured (re-implemented partially), new unittests are added, and compatibility with python 3, pep8 and pep257.
- new GUI based on python3 + phoenix: it prints an information message in case SPPAS is launched with these versions.
- package 'prensenters' updated: unittests, python 3, pep8 and pep257.

Plugins

- sampa2ipa included to the SPPAS package
- audiosegmenter included to the SPPAS package

Annotations

- IPUs Segmentation removed. It is replaced by:

  1. Search for IPUs: to find silences/tracks from an audio file
  2. Fill in IPUs: to find silences/tracks from an audio file and its transcription
  3. AudioSegmenter plugin: to segment audio files into several tracks

- annotation.py: bug correction with the default output extension

- bug correction when the phonetization was unknown

Resources

- add a file 'monophones' into each model, for the compatibility with HVite.
- errors of the acoustic models of "spa" and "nan" corrected.

8.5.18 SPPAS 2.0

(2019, 4th January)

The main change of this release is that the package `annotationdata` has been removed, so that all packages are using `anndata` instead. One of the most important consequence of this change is that all packages, except the wxGUI, are compatible with both Python 2.7 and Python 3.4+.

Annotations

- Alignment: bug correction if the last unit is empty.
- Self-Repetitions and Other-Repetitions split into two different packages
- Un-used package 'Chunks' removed
- Better management of annotations: sppasBaseAnnot, sppasParam and sppasManager revised.

UI

- All programs in `bin` folder updated. A 'manual mode' and an 'auto mode' are available in the annotations to fix input/output, and a –log option is proposed to save a report.
- Plugins: marsatagplugin added and debugged.

8.5.19 SPPAS 2.1

(2019, 28th February)

Development

- Praat TextGrid: it's now allowed to use the symbol '=' in annotation labels.
- Use of 'json' files instead of 'ini' files to configure SPPAS, the annotations and the plugins.
- New package 'analysis' with the filter and statistic systems.

Annotations

- Search for IPUs: the program has been improved and evaluated.
- Alignment: priority is given to standard tokens (if EOT).
- Alignment: problem of whitespace in filenames solved.

UI

- Plugins: new plugin to remove un-translated IPUs and to re-index the IPUs
- extended internationalization of the messages (for English and French)

8.5.20 SPPAS 2.2

(2019, 09th May)

sppas.bat and sppas.command, the two main ways to launch the GUI, were fully re-written in order to search for 'pythonw' command first. It results in the following advantages: - it increases the compatibility with MacOS systems; - it allows to not display the dark frame of 'python' under Windows.

Development

- New package 'files' for a further use.
- Increased compatibility of file formats: can read alternative tags with {|} system, whitespace vs CR, etc.

Plugins

- Debug of the plugin to clean IPUs.

Annotations

- Search for IPUs: a special threshold value is set when the audio recording has a very low median value (ie very low volume values)
- Normalization/Phonetization/Alignment/Syllabification can work without audio
- Search for IPUs and Fill in IPUs: problem with upper/lower extension solved

GUI

- "Delete" button of the "File Explorer": files are no longer definitively deleted. Instead, they are moved into an hidden folder with name '.trash' in the package of SPPAS.
- wxFrame to display log messages.
- Annotations in GUI: better compatibility to annotate written texts

Resources

- fra.dict: corrected 6 errors with a non-existing 'eu' sound

8.5.21 SPPAS 2.3

(2019, 25th June)

Development

- JSON configuration files of sppas modified.
- package "files" is used: the annotations manager is using a workspace instead of a list of files.

- the GUI based on wx4 is managing properly the workspaces and the annotations: a page with “Files” is displayed and allows to “add/remove/delete” files in the list, “import from/export to/pin&save/rename” workspaces, to “create/edit/delete” references and to “check with filters/check all/associate/dissociate” files and references.
- Workspaces are saved in “JSON” format in the “workspaces” folder.

Annotations

- New annotation “Activity”. This annotation was previously available as an option of “Alignment”.
- Text Normalization: the Num2Letter module has been fully re-programmed.
- Text Normalization: new option “occurrence & duration” to estimate the number of tokens of each IPU and the duration of this latter.
- Annotations are categorized as: STANDALONE, SPEAKER or INTERACTION. The GUI based on wx3 only shows the STANDALONE ones, but the GUI based on wx4 can deal with all of them.

Resources

- New folder “num” with dictionaries of numbers for cmn, eng, fra, ita, jpn, khm, pol, por, spa, vie.

8.5.22 SPPAS 2.4

(2019, 26th June)

Development

- the GUI based on wx4 is managing the plugins
- bug correction in ‘files’ package

Annotations

- New annotation “Re-Occurrences”, of type INTERACTION. Can only be used with the CLI or the GUI based on wx4.
- Either one or two new options in all the annotations:
  - inputpattern: to choose the pattern of the input file (like “-token” for Phonetization)
  - outputpattern: to choose the pattern of the output file (like “-token” for Tokenization)
- CLI: the script annotation.py is fully re-implemented

Resources

- New pronunciation dictionary for Iranian Persian (pes), for Phonetzation
- New acoustic model for Iranian Persian (pes), for Alignment

8.5.23 SPPAS 2.5

(2019, 30th July)

Development

- the GUI based on wx4 can convert files.

Annotations

- New annotation “RMS” to estimate the Root-mean square of an audio file in given intervals

8.5.24 SPPAS 2.6

(2019, 1st October)

Various

- New script ‘dictsampa.py’ to convert a pronunciation dictionary in IPA into SAMPA encoding
- New script ‘clippingrate.py’ to estimate the clipping rate at several factors in sub-parts of the audio file
- New plugin ‘StatGroups’ to estimate distributional statistics on sequences of numbers in annotations.

Development

- the GUI based on wx4 can convert files (debugged and extended)
- the GUI based on wx4 can display the content of a file (ListView) in the page “Analyze”
- GUI: “Save all” button debugged in DataFilter and DataRoamer

9

Appendix

9.1 List of error messages

Since version 1.9.0, SPPAS introduced a system for internationalization of the messages. In the same time, a quality and a number was assigned progressively to each of them in the packages. The following indicates the list of error messages that can occur while using SPPAS.

From "annotations" package

:ERROR 1010: Unknown option with key {key}.

:ERROR 1020: Empty input tier {name}.

:ERROR 1030: Missing input tier. Please read the documentation.

:ERROR 1040: Bad input tier type. Expected time-aligned intervals.

:ERROR 1050: Inconsistency between the number of intervals of the input tiers. Got: {:d} and {:d}.

From "utils" package

:ERROR 1210: The directory {dirname} does not exist.

:ERROR 1220: The directory {dirname} does not contain relevant data.

From "audiodata" package

:ERROR 2000: No audio file is defined.

:ERROR 2005: Audio type error: not supported file format {extension}.

:ERROR 2010: Opening, reading or writing error.

:ERROR 2015: No data or corrupted data in the audio file {filename}.

:ERROR 2020: {number} is not a right index of channel.

:ERROR 2025: From {value1} to {value2} is not a proper interval.

:ERROR 2050: No channel defined.

:ERROR 2060: Channels have not the same sample width.

:ERROR 2061: Channels have not the same frame rate.

:ERROR 2062: Channels have not the same number of frames.

:ERROR 2070: Invalid sample width {value}.

:ERROR 2080: Invalid frame rate {value}.

From “calculus” package

:ERROR 3010: Both vectors p and q must have the same length and must contain probabilities.

:ERROR 3015: Value must range between 0 and 1. Got {:f}.

:ERROR 3016: Probabilities must sum to 1. Got {:f}.

:ERROR 3025: Error while estimating Euclidian distances of rows and columns.

:ERROR 3030: The given data must be defined or must not be empty.

:ERROR 3040: Value {value} is out of range: expected value in range [{min_value},{max_value}].

From “plugins” package

:ERROR 4010: Missing plugin configuration file.

:ERROR 4014: Missing section {section_name} in the configuration file.

:ERROR 4016: Missing option {:s} in section {:s} of the configuration file.

:ERROR 4020: Unsupported plugin file type.

:ERROR 4024: Unsupported plugin file type.

:ERROR 4030: A plugin with the same name is already existing in the plugins folder.

:ERROR 4040: No plugin with identifier {plugin_id} is available.

:ERROR 4050: No such plugin folder: {:s}.

:ERROR 4060: A plugin with the same key is already existing or plugin already loaded.

:ERROR 4070: {command_name} is not a valid command on your operating system.

:ERROR 4075: No command was defined for the system: {:s}. Supported systems of this plugin are: {:s}.”””

:ERROR 4080: No option with key {:s}.

From “resources” package

:ERROR 5005: Encoding error while trying to read the file: {name}.

:ERROR 5010: Error while trying to open and read the file: {name}.

:ERROR 5015: Read file failed at line number {number}: {string}.

:ERROR 5020: The n value of n-grams pattern matching must range [1;{maximum}]. Got {observed}.

:ERROR 5022: The gap value of pattern matching must range [0;{maximum}]. Got {observed}.

:ERROR 5024: The score value of unigrams pattern matching must range [0;1]. Got {observed}.

:ERROR 5030: The dump file can't have the same extension as the ASCII file ({extension}).

:ERROR 5040: The count value must be positive. Got ({count}).

From "structs" package

:ERROR 6010: {meta} is not a known meta information.

:ERROR 6020: Unknown resource type: expected file or directory. Got: {string}.

:ERROR 6024: The resource folder {dirname} does not exists.

:ERROR 6028: The language must be "und" or one of the language list. Unknown language {lang}.

From "models" package

:ERROR 7010: Expected a {data_name} of type {expected_type}. Got {data_type} instead.

:ERROR 7500: The file {!s:s} contains non UTF-8 characters: {:s}.

:ERROR 7505: Fail formats: unrecognized file format {!s:s}.

:ERROR 7510: Fail formats: the folder {!s:s} does not contain a known model.

:ERROR 7515: No model found or empty model in {!s:s}.

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