Praat Scripting Tutorial

Eleanor Chodroff

Newcastle University

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Praat

Acoustic analysis program

Best known for its ability to:

- Visualize, label, and segment audio files
- Perform spectral and temporal analyses
- Synthesize and manipulate speech

Praat Scripting

Praat: not only a program, but also a language

Why do I want to know Praat the language?

AUTOMATE ALL THE THINGS

Praat Scripting

Why can’t I just modify others’ scripts?

Honestly: power, flexibility, control

Insert: all the gifs of ‘you can do it’ and ‘you got this’ and thumbs up

Praat Scripting Goals

~*~Script first for yourself, then for others~*~

- Write Praat scripts quickly, effectively, and “from scratch”
- Learn syntax and structure of the language
- Handle various input/output combinations

Tutorial Overview

1) Praat: Big Picture
2) Getting started
3) Basic syntax
4) Script types + Practice
    - Wav files
    - Measurements
    - TextGrids
    - Other?

Praat: Big Picture

1) Similar to other languages you may (or may not) have used before

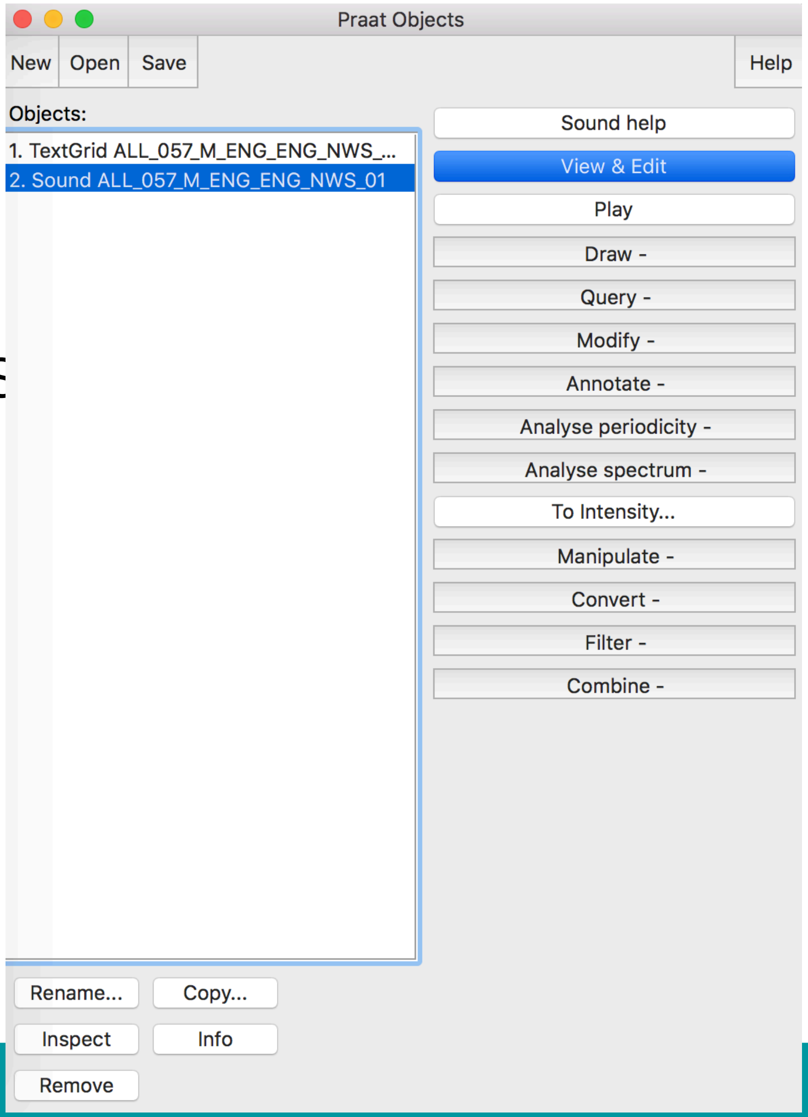
- String and numeric variables
- For-loops, if else statements, while loops
- Regular expression matching
- Interpreted language (not compiled)

Praat: Big Picture

2) Almost everything is a mouse click!

i.e., Praat is a GUI scripting language
GUI = Graphical User Interface, i.e., the Objects window

If you ever get lost while writing a Praat script, click through the steps using the GUI



Getting Started

Open a Praat script

From the toolbar, select Praat → New Praat script

Save immediately!
Save frequently!

Script Goals and Input/Output

- Consider what you want the script to accomplish
- Identify what you'll need to read in (input) and what you'll need to write out (output)

Input:	Output:
Audio file	Audio file
TextGrid	TextGrid
Text file	Text file

- Write summary and pseudo code

Some Basics

Variables
Selecting objects
String concatenation
Comments
Whitespace
For-loops + if else statements
Syntax
Regex

Variables

```
dir$ = "/Users/Eleanor/mydir/data/"
filename$ = Get string: i
nFiles = Get number of strings
myTotal = 20
```

All variables must start with a lower-case letter
Define variables with equal sign (=)
Refer to variables as arguments directly

String Variables

```
dir$ = "/Users/Eleanor/mydir/data/"
filename$ = Get string: i
nFiles = Get number of strings
myTotal = 20
```

- Name ends with $
- Defined by quotes or the output of a command

Numeric Variables

```
dir$ = "/Users/Eleanor/mydir/data/"
filename$ = Get string: i
nFiles = Get number of strings
myTotal = 20
```

- Name does not have $

Literals

```
dir$ = "/Users/Eleanor/mydir/data/"
filename$ = Get string: i
nFiles = Get number of strings
myTotal = 20
```

- String literals go in quotes
- Numbers are numbers

Selecting objects

```
selectObject: “Strings files”
plusObject: “TextGrid “ + basename$
minusObject: “Sound “ + basename$
select all
Remove
```

- Recall that Praat scripts simulate the user actions!
- You’ll need to instruct the script to select and remove objects from the Objects window

String concatenation

```
basename$ = filename$ - ".wav"
Read from file: dir$ + basename$ + ".wav"
```

- Concatenate strings with +
- Remove part of string with -

Comments

```
# my comment – path to files
dir$ = "/Users/Eleanor/mydir/data/”
```

- Hash symbol (#) at the beginning of a line
- Cannot use # symbol midline

This will not work:

```
dir$ = "/Users/Eleanor/mydir/data/" #"/Users/Mary/mydir/data"
```

Whitespace

Praat is NOT whitespace sensitive

- At one point, it was sensitive to trailing spaces or tabs at the end of a line
- Doesn’t look like this is the case with the new syntax

Convention and your eyes call for standard use of whitespace

- Code-block indentation
- Spaces around equal signs and after punctuation such as colons and commas

for-loops

```
for i from 1 to nFiles
     mycode
endfor
```

```
for integerVariable from 1 to integerVariable2
    writeSomeCode
endfor
```

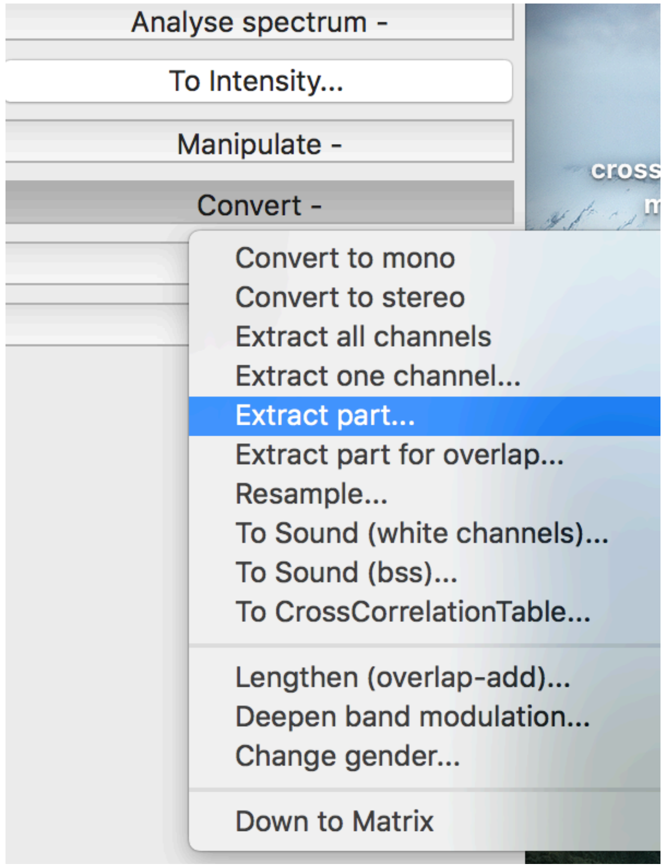
if else statements

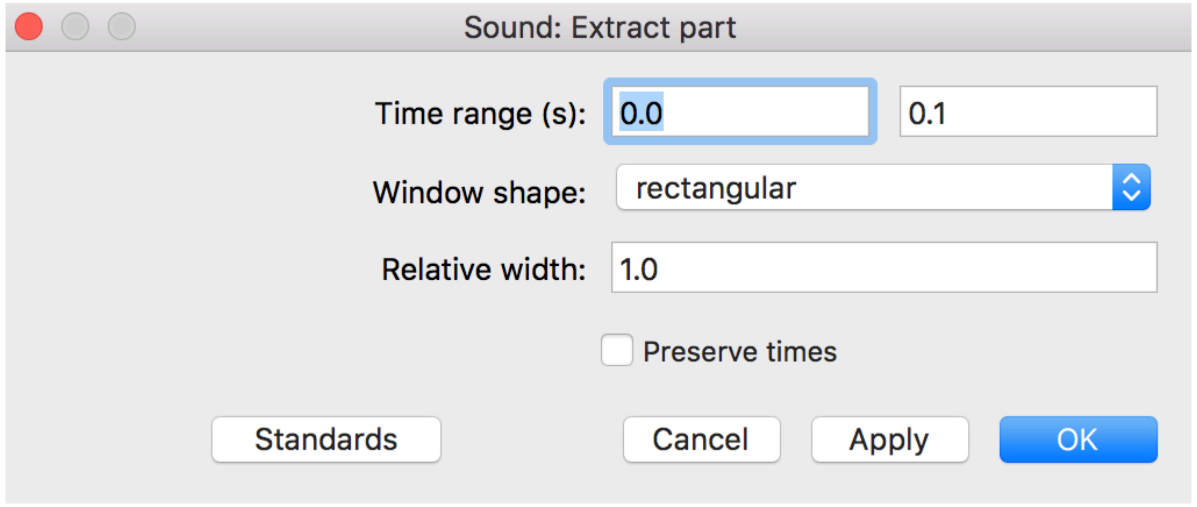
```
if i < 20 and word$ = “STIM”
     do this
elsif i = 20 and not word$ = “STIM”
     do that
else
     do this
endif
```

For more logical operators: http://www.fon.hum.uva.nl/praat/manual/Formulas_2__Operators.html

Basic Syntax

- Almost every command and its argument structure are in the Objects window → just click through it
- … becomes :

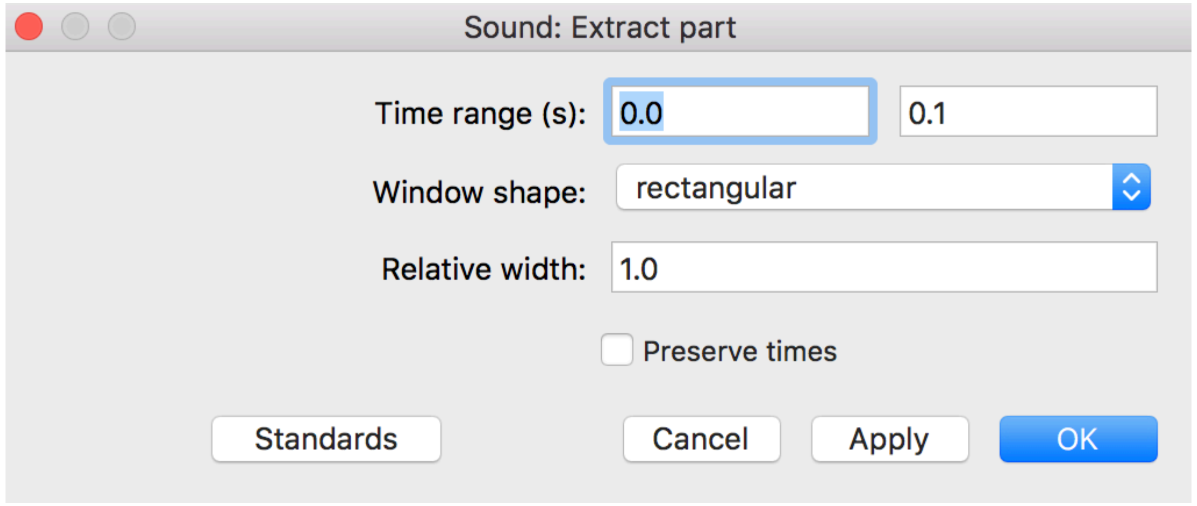



Sound: Extract part

Time range (s): 0.0 0.1
Window shape: rectangular
Relative width: 1.0
Preserve times

```
Extract part: 0.01, 1.1, “rectangular”, 1.0, “no”
```

Basic Syntax


Sound: Extract part

Time range (s): 0.0 0.1

Window shape: rectangular

Relative width: 1.0

☐ Preserve times

- Arguments are separated by commas
- Any string input must be surrounded by quotes
- Multiple choice input: Must specify one of the given options
- Checkbox input: “yes” or “no”

```
Extract part: 0.01, 1.1, “rectangular”, 1.0, “no”
```

Basic Syntax

Cheat with this trick!

Within a Praat script, you can use `Edit → Paste History` to reveal everything you've just clicked through

Regex

```
"files", dir$ + "*.wav"
```

- Praat uses fairly standard regex (regular expressions) for matching strings
- For complete list, check out http://www.fon.hum.uva.nl/praat/manual/Regular_expressions_1__Special_characters.html
- We'll go over more of these throughout the tutorial
- See also the appendix for a thorough (but probably not complete) list

Boilerplate Code

Most Praat scripts can be written with a formulaic structure

It’s not necessarily the most concise code, but it is very effective, especially for beginners

Boilerplate

- Header for inputs/outputs
- for-loop to process files

Boilerplate Code

```
dir$ = "/Users/Eleanor/mydir/data/"

Create Strings as file list: "files", dir$ + "*.wav"
nFiles = Get number of strings

for i from 1 to nFiles
     selectObject: "Strings files"
     filename$ = Get string: i
     basename$ = filename$ - ".wav"
     Read from file: dir$ + basename$ + ".wav"
     …
endfor
```

Boilerplate Code

```
dir$ = "/Users/Eleanor/mydir/data/"

Create Strings as file list: "files", dir$ + "*.wav"
nFiles = Get number of strings

for i from 1 to nFiles
     selectObject: "Strings files"
     filename$ = Get string: i
     basename$ = filename$ - ".wav"
     Read from file: dir$ + basename$ + ".wav"
     …
endfor
```

Place all paths, input and output files, and global variables at the top of the file

Boilerplate Code

Set up the for-loop

```
dir$ = "/Users/Eleanor/mydir/data/"

Create Strings as file list: "files", dir$ + "*.wav"
nFiles = Get number of strings

for i from 1 to nFiles
     selectObject: "Strings files"
     filename$ = Get string: i
     basename$ = filename$ - ".wav"
     Read from file: dir$ + basename$ + ".wav"
     …
endfor
```

Boilerplate Code

```
dir$ = "/Users/Eleanor/mydir/data/"

Create Strings as file list: "files", dir$ + "*.wav"
nFiles = Get number of strings

for i from 1 to nFiles
     selectObject: "Strings files"
     filename$ = Get string: i
     basename$ = filename$ - ".wav"
     Read from file: dir$ + basename$ + ".wav"
     …
endfor
```

Read in each file

Let’s start Praat scripting

Core types of Praat scripts

Modifying audio files
Taking temporal measurements
Taking spectral measurements
Creating TextGrids
Modifying TextGrids
Miscellaneous

Modifying audio files

Why start here?

Input = audio
Output = audio

In most cases, getting the audio is easy

Modifying audio files

Common procedures:

Scaling intensity
Resampling
Bandpass filtering
Extract one channel (convert to mono)

Scale intensity script

```
dir$ = "/Users/Eleanor/mydir/data/"

Create Strings as file list: "files", dir$ + "*.wav"
nFiles = Get number of strings

for i from 1 to nFiles
     selectObject: "Strings files"
     filename$ = Get string: i
     basename$ = filename$ - ".wav"
     Read from file: dir$ + basename$ + ".wav"
     …
endfor
```

Scale intensity script

```
dir$ = "/Users/Eleanor/Dropbox/PraatScriptingTutorial/allsstar/"

Create Strings as file list: "files", dir$ + "*.wav"
nFiles = Get number of strings

for i from 1 to nFiles
     selectObject: "Strings files"
     filename$ = Get string: i
     basename$ = filename$ - ".wav"
     Read from file: dir$ + basename$ + ".wav"
     pauseScript: "let’s take a look"
endfor
```

Scale intensity script

```
for i from 1 to nFiles
     selectObject: "Strings files"
     filename$ = Get string: i
     basename$ = filename$ - ".wav"
     Read from file: dir$ + basename$ + ".wav"
     pauseScript: "let’s take a look”
     Scale intensity: 70
endfor
```

Scale intensity script

```
for i from 1 to nFiles
     selectObject: "Strings files"
     filename$ = Get string: i
     basename$ = filename$ - ".wav"
     Read from file: dir$ + basename$ + ".wav"
     #pauseScript: "let’s take a look”
     Scale intensity: 70
     Save as WAV file: dir$ + basename$ + "_scaled.wav"
endfor
```

Scale intensity script

```
for i from 1 to nFiles
     selectObject: "Strings files"
     filename$ = Get string: i
     basename$ = filename$ - ".wav"
     Read from file: dir$ + basename$ + ".wav"
     #pauseScript: "let’s take a look”
     Scale intensity: 70
     Save as WAV file: dir$ + basename$ + "_scaled.wav"
     Remove
endfor
```

Modifying audio files

Do another or move on?

Scaling intensity

Resampling

Bandpass filtering

Extract one channel (convert to mono)

Let’s start Praat scripting

Core types of Praat scripts

Modifying audio files
Taking temporal measurements
Taking spectral measurements
Creating TextGrids
Modifying TextGrids
Miscellaneous

Temporal Measurements

Input: TextGrid
No audio – woo this will be super fast!
*Whenever possible, avoid loading audio files

Output: Text file

Temporal Measurements

Key concepts:

Looping through intervals in a TextGrid

If else statements

Writing a text file

Temporal Measurements

First script: get duration of file

You can get this directly from an audio file’s TextGrid

Script outline:
Read in TextGrid
Get duration
Write filename and duration to text file

Temporal Measurements

```
dir$ = "/Users/Eleanor/mydir/data/"

Create Strings as file list: "files", dir$ + "*fave.TextGrid"
nFiles = Get number of strings

for i from 1 to nFiles
     selectObject: "Strings files"
     filename$ = Get string: i
     basename$ = filename$ - ".TextGrid"
     Read from file: dir$ + basename$ + ".TextGrid"
     …
endfor
```

Temporal Measurements

```
dir$ = "/Users/Eleanor/mydir/data/"
outfile$ = "/Users/Eleanor/mydir/data/durations.txt”

Create Strings as file list: "files", dir$ + “fave.TextGrid"
nFiles = Get number of strings
```

Temporal Measurements

```
for i from 1 to nFiles
     selectObject: "Strings files"
     filename$ = Get string: i
     basename$ = filename$ - ".TextGrid"
     Read from file: dir$ + basename$ + ".TextGrid"
     dur = Get total duration
     pauseScript: dur
endfor
```

Temporal Measurements

```
for i from 1 to nFiles
     selectObject: "Strings files"
     filename$ = Get string: i
     basename$ = filename$ - ".TextGrid"
     Read from file: dir$ + basename$ + ".TextGrid"
     dur = Get total duration
     appendFileLine: outfile$, filename$, tab$, dur
     Remove
endfor
```

Temporal Measurements

Success! You read in a TextGrid and wrote to a Text File using `appendFileLine:`

Next script: get durations of all intervals of every instance of some word (you choose – make it relatively frequent)

Temporal Measurements

Script outline:
Read in TextGrid with word tier (called “Speaker – word”)
Loop through each word interval
Stop when interval label matches critical word
Get start time of interval
Get end time of interval
Calculate duration
Write to filename, duration to text file

Temporal Measurements

```
dir$ = "/Users/Eleanor/mydir/data/"

Create Strings as file list: "files", dir$ + "*fave.TextGrid"
nFiles = Get number of strings

for i from 1 to nFiles
     selectObject: "Strings files"
     filename$ = Get string: i
     basename$ = filename$ - ".TextGrid"
     Read from file: dir$ + basename$ + ".TextGrid"
     …
endfor
```

Temporal Measurements

```
dir$ = "/Users/Eleanor/mydir/data/"
outfile$ = "/Users/Eleanor/mydir/data/thatDurations.txt”

Create Strings as file list: "files", dir$ + “fave.TextGrid"
nFiles = Get number of strings
```

Temporal Measurements

```
for i from 1 to nFiles
     selectObject: "Strings files"
     filename$ = Get string: i
     basename$ = filename$ - ".TextGrid"
     Read from file: dir$ + basename$ + ".TextGrid”
     # get number of intervals on word tier
     nInt = Get number of intervals: 2
     for j from 1 to nInt
          …
     endfor
endfor
```

Temporal Measurements

```
for i from 1 to nFiles
     selectObject: "Strings files"
     filename$ = Get string: i
     basename$ = filename$ - ".TextGrid"
     Read from file: dir$ + basename$ + ".TextGrid”
     # get number of intervals on word tier
     nInt = Get number of intervals: 2
     for j from 1 to nInt
          label$ = Get label of interval: 2, j

     endfor
endfor
```

Temporal Measurements

```
# get number of intervals on word tier
nInt = Get number of intervals: 2
for j from 1 to nInt
     label$ = Get label of interval: 2, j
     if index_regex(label$, “THAT”)
          # get duration
          # write duration to file
     endif
endfor
```

Temporal Measurements

```
# get number of intervals on word tier
nInt = Get number of intervals: 2
for j from 1 to nInt
     label$ = Get label of interval: 2, j
     if index_regex(label$, “THAT”)
          pauseScript: label$
          start = Get starting point: 2, j
          end = Get end point: 2, j
          dur = end – start

     endif
endfor
```

Temporal Measurements

```
# get number of intervals on word tier
nInt = Get number of intervals: 2
for j from 1 to nInt
     label$ = Get label of interval: 2, j
     if index_regex(label$, “THAT”)
          pauseScript: label$
          start = Get starting point: 2, j
          end = Get end point: 2, j
          dur = end – start
          appendFileLine: outfile$, filename$, tab$, dur
     endif
endfor
Remove
```

Temporal Measurements

Looped through text file
Used if else statement
Used regex matching

Intensity Measurements

Input: Audio file and TextGrid
Output: Text file

Processes
Get intensity (dB)
Get root-mean-square

Spectral Measurements

Input: Audio file and TextGrid
Output: Text file

Common measures
Formants
f0
Spectral peak

Creating TextGrids (simple)

Input: audio file
Output: empty or almost empty TextGrid

Create Empty TextGrid

Input: audio file

Output: empty or almost empty TextGrid

Create TextGrid with highly predictable boundaries

Maybe you know the structure of the sound

For instance: each sound is flanked by 20 ms of silence and the critical (middle) interval can be labeled with the filename

Modify TextGrid (simple)

View and Edit the TextGrid by looking for highly predictable words

-or-

Delete boundaries or change text in a very predictable way

Input: Audio file and TextGrid

Output: modified TextGrid

Modify TextGrid (simple)

Working with the TextGrid overview
More boilerplate: loop through intervals

Modify TextGrid (simple)

code

Create/modify TextGrids (v2)

Input: Text file and possibly TextGrid
Output: TextGrid

Example scenario:
You have a text file of start and end times for each condition and want to add a tier with those labels

Spectral Measurements

```
To Formant (burg): 0.01, 5, 5500, 0.025, 50
selectObject: “Formant ” + basename$
f1_0 = Get value at time: 1, start, “Hertz”, “Linear”
f2_0 = Get value at time: 2, start, “Hertz”, “Linear”
f3_0 = Get value at time: 3, start, “Hertz”, “Linear”
f1_5 = Get value at time: 1, start + 0.005, “Hertz”, “Linear”
f2_5 = Get value at time: 2, start + 0.005, “Hertz”, “Linear”
f3_5 = Get value at time: 3, start + 0.005, “Hertz”, “Linear”
f1_10 = Get value at time: 1, start + 0.01, “Hertz”, “Linear”
f2_10 = Get value at time: 2, start + 0.01, “Hertz”, “Linear”
f3_10 = Get value at time: 3, start + 0.01, “Hertz”, “Linear”
```

Extract Sounds

Input: Audio file and TextGrid
Output: Audio file (and TextGrid)

Create Sounds

Input: nothing! Or existing audio file
Output: Audio file

Other loops

Repeat loop

```
repeat
     word$ = Get label of interval: 1, i
     i = i + 1
until word$ = ”STIMULUS”
```

While loop

```
while i < 20
     do this
endwhile
```

Regex Appendix

```
if label$ == “THE”
```

Matches “THE” and only “THE” (not “OTHER”, “THEN”, etc.)
== evaluates equality

```
if label$ != “THE”
```

Matches anything that is not an exact match to “THE”

```
if index_regex(label$, “THE”)
```

Matches strings that *contain* the string “THE” (matches “THEN”, ”OTHER”, etc.)

Regex Appendix

```
if index_regex(label$, “^THE”)
```

Matches strings that *start with* “THE”

```
if index_regex(label$, “NG$”)
```

Matches strings that *end with* “NG”

```
if index_regex(label$, “(THE|NORTH)”)
```

Matches strings that contain *either* the string “THE” *or* “NORTH”

Regex Appendix

```
if index_regex(label$, “AH[0-9]*”)
```

Matches strings that *contain* the string “AH” followed by zero or more numbers

```
if index_regex(label$, “AH[0-9]+”)
```

Matches strings that *contain* the string “AH” followed by one or more numbers

Regex Appendix

```
if index_regex(label$, “^[PTK][AEIOU][MN][A–Z]+”)
```

Matches strings that *start* with either P, T, or K,
followed by either A, E, I, O, U,
followed by either M or N,
followed by at least one or more letters (+)

```
if index_regex(label$, “^[PTKCBDG][^AEIOUHW]”)
```

Matches strings that *start* with P, T, K, C, B, D, G
and are *not* followed by A, E, I, O, U, W, or H
This might match English words that begin with a consonant cluster
(CLOAK, TRAVELER) – note there are many equivalent ways to writing these

Regex Appendix

```
if index_regex(label$, “AH[0-9]”) or index_regex(label$, “Y$”)
```

Matches strings that *contain* the string “AH” followed by exactly one number
Or strings that end in “Y”

```
if index_regex(label$, “THE”) & !index_regex(label$, “Y$”)
```

Matches strings that *contain* the string “THE” but do not end in “Y”
(This would exclude words like “THEY” or “APOTHECARY”)