

Introduction to Linguistics:

Phonetics: realising sounds

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B.A. British And American Studies
Basic Module 2

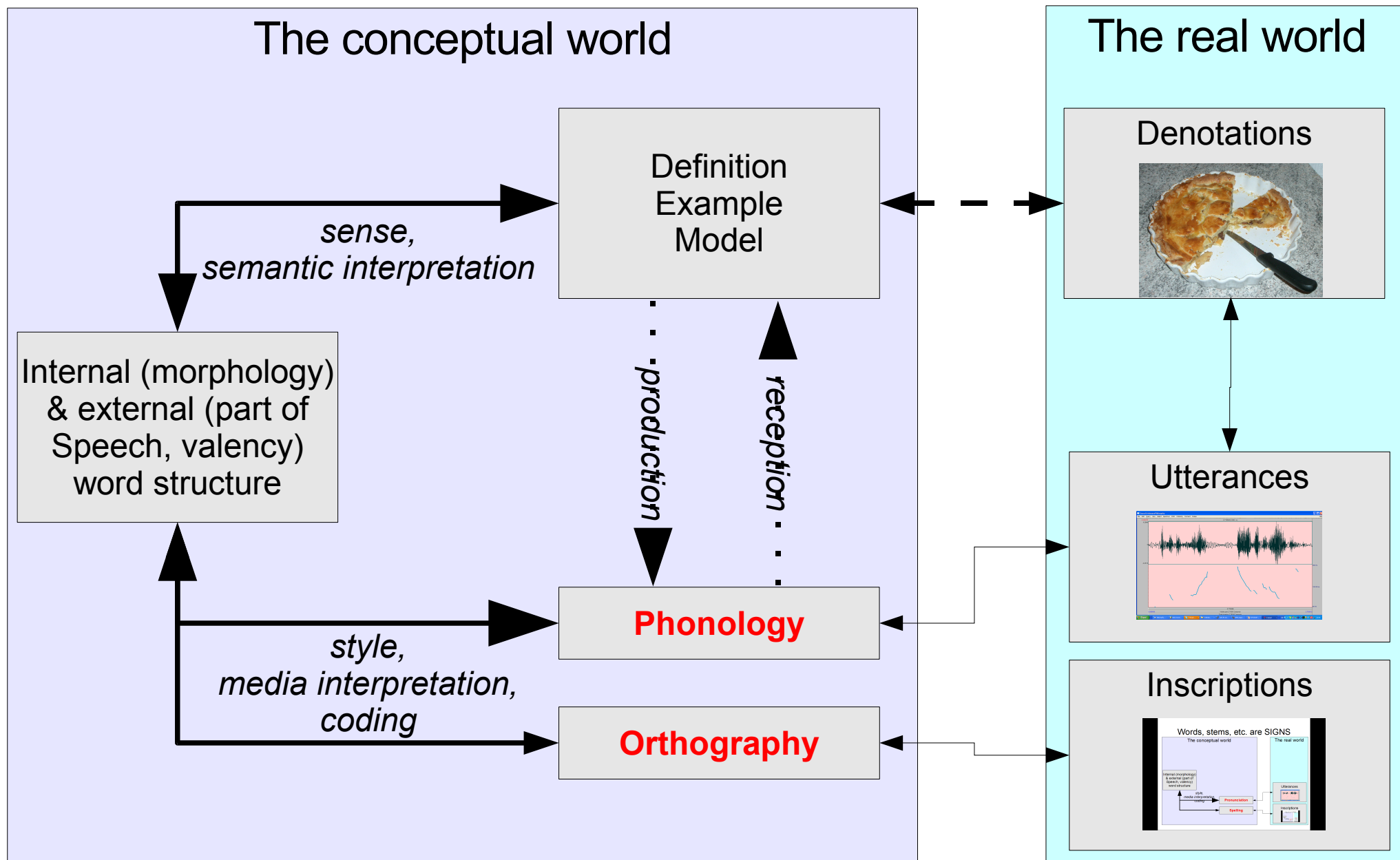
Winter Semester 2006/2007

[Class Website](#)

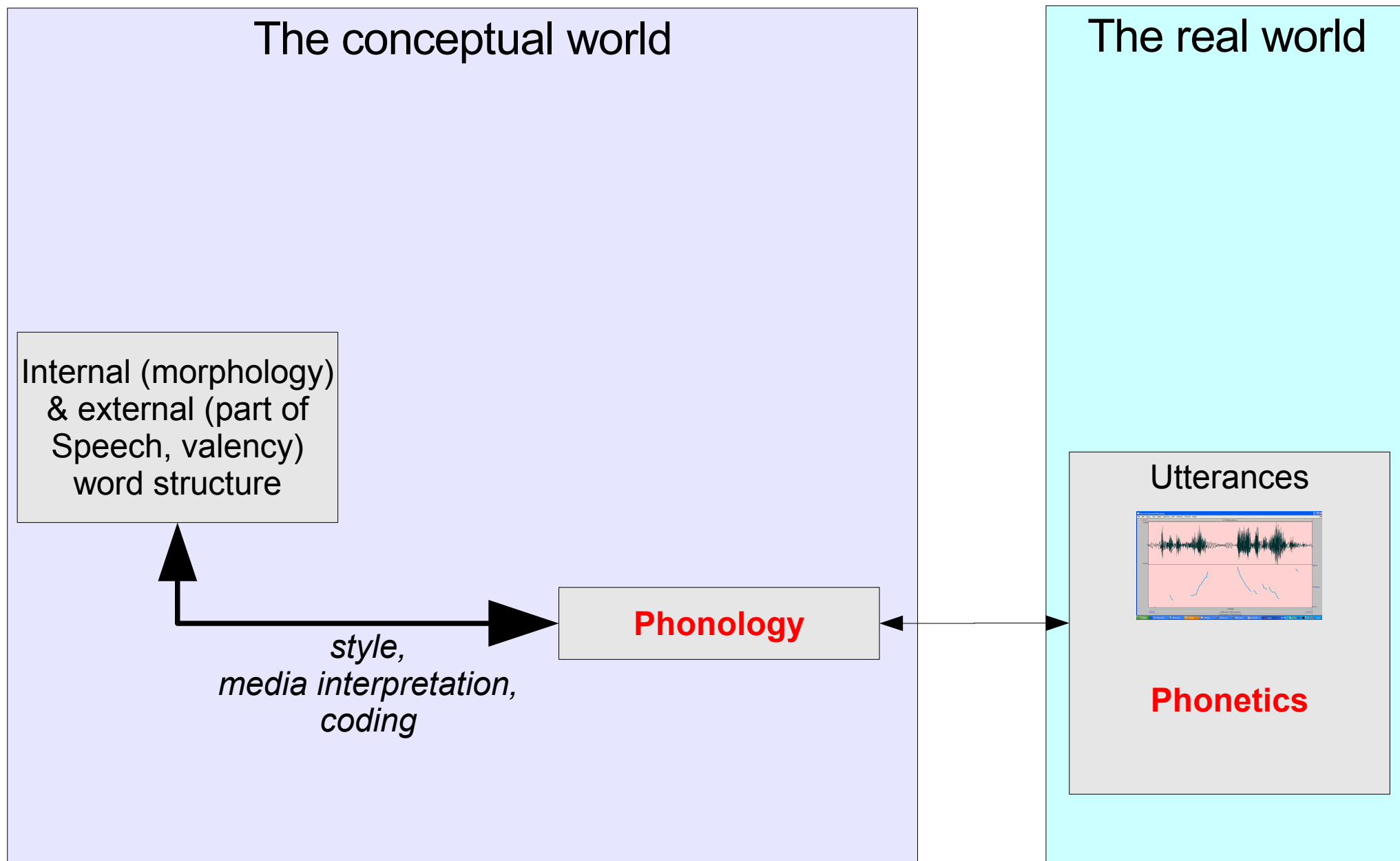
PHONETICS:

THE WORLD OF SPEECH SOUNDS

Words, stems, etc. are SIGNS



Words, stems, etc. are SIGNS



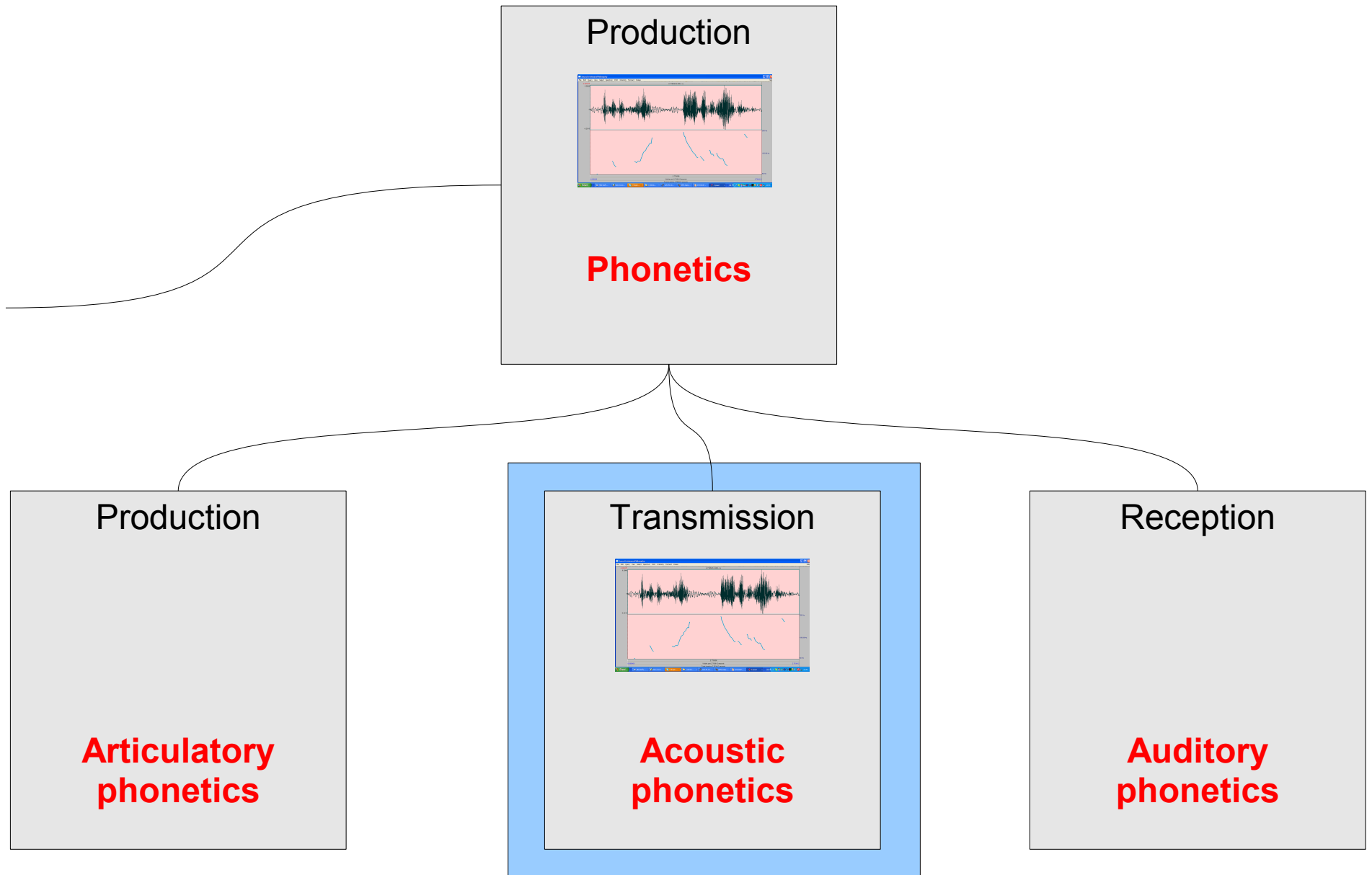
SPEECH

production

transmission

perception

The domains of phonetics



Phonetic domains: the acoustic domain

- The Articulatory Domain
 - The IPA (A = Alphabet / Association)
 - The Source-Filter Model of Speech Production
- **The Acoustic Domain**
 - **The Speech Wave-Form**
 - **Basic Speech Signal Parameters**
 - **The Time Domain: the Speech Wave-Form**
 - **The Frequency Domain: simple & complex signals**
 - **Fourier Analysis: the Spectrum**
 - **Pitch extraction**
 - **Analog-to-Digital (A/D) Conversion**
- The Auditory Domain: Anatomy of the Ear

SPEECH

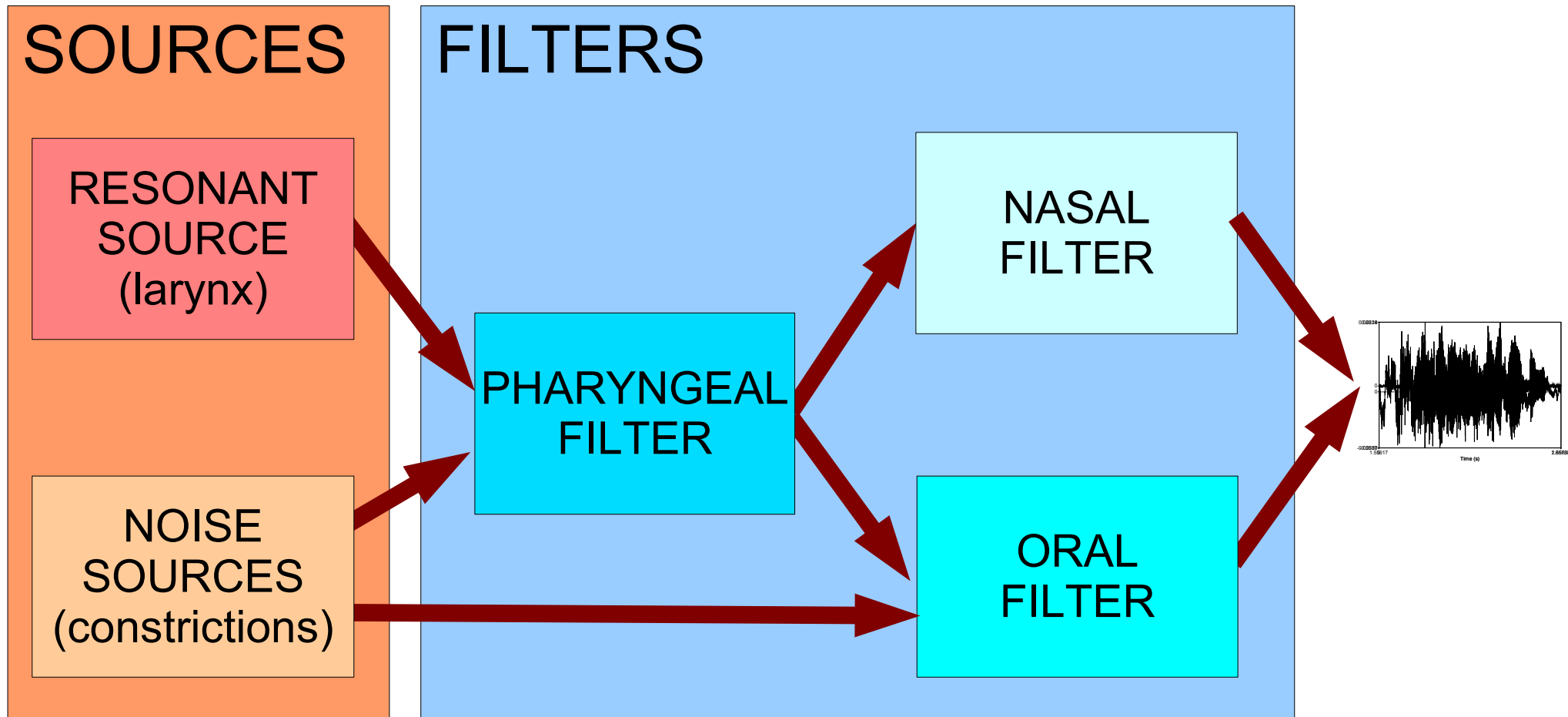
production

transmission

perception

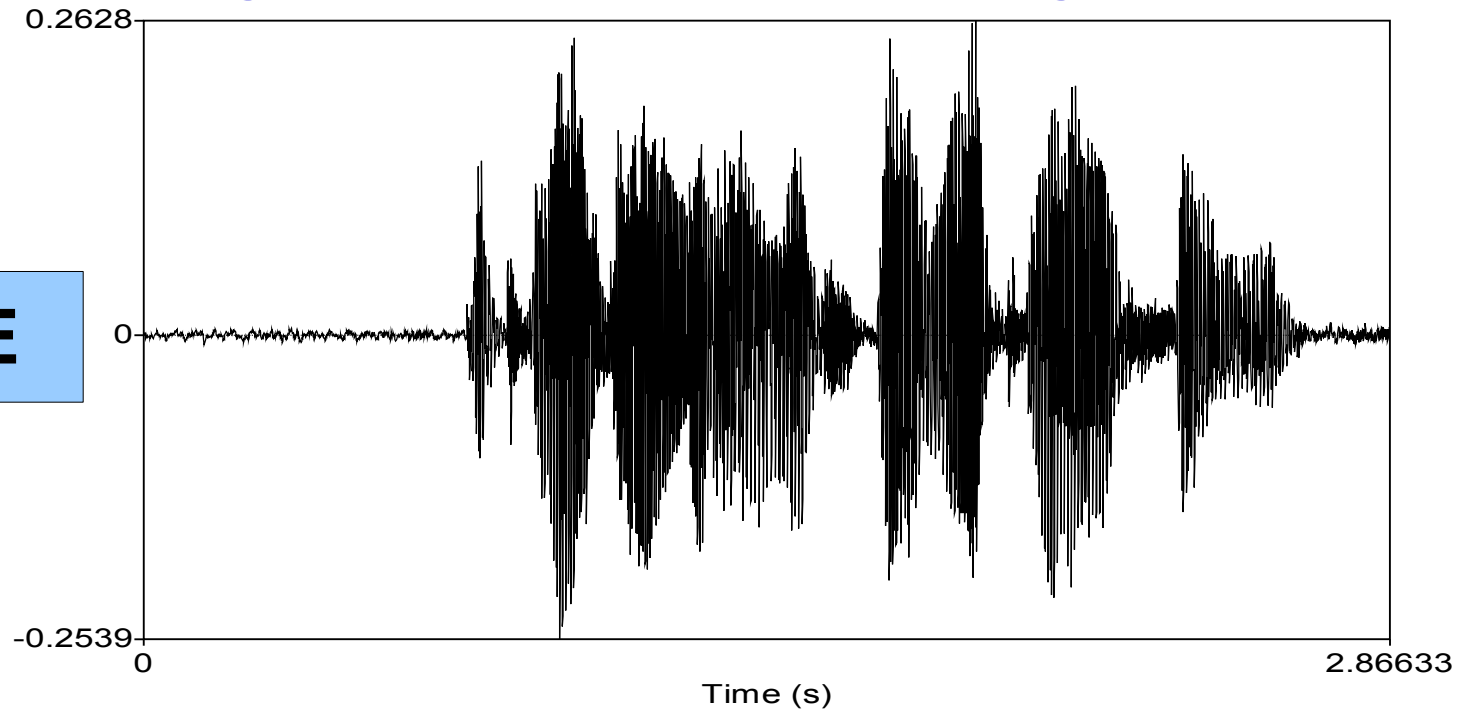
ACOUSTIC PHONETICS

Speech Production: Source-Filter Model



The speech waveform

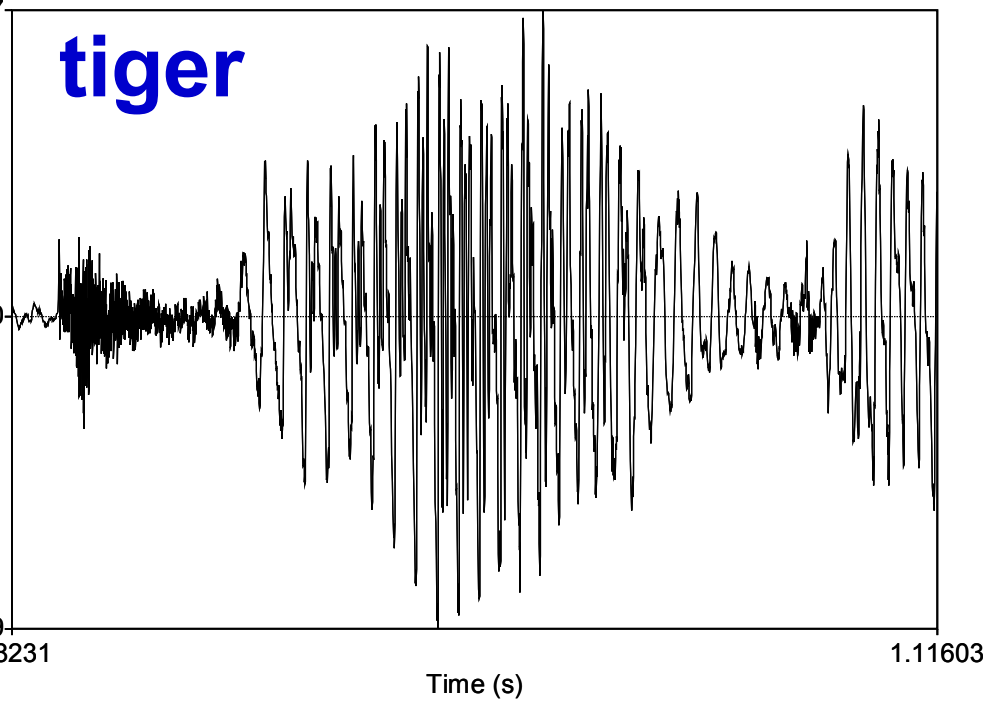
A tiger and a mouse were walking in a field...



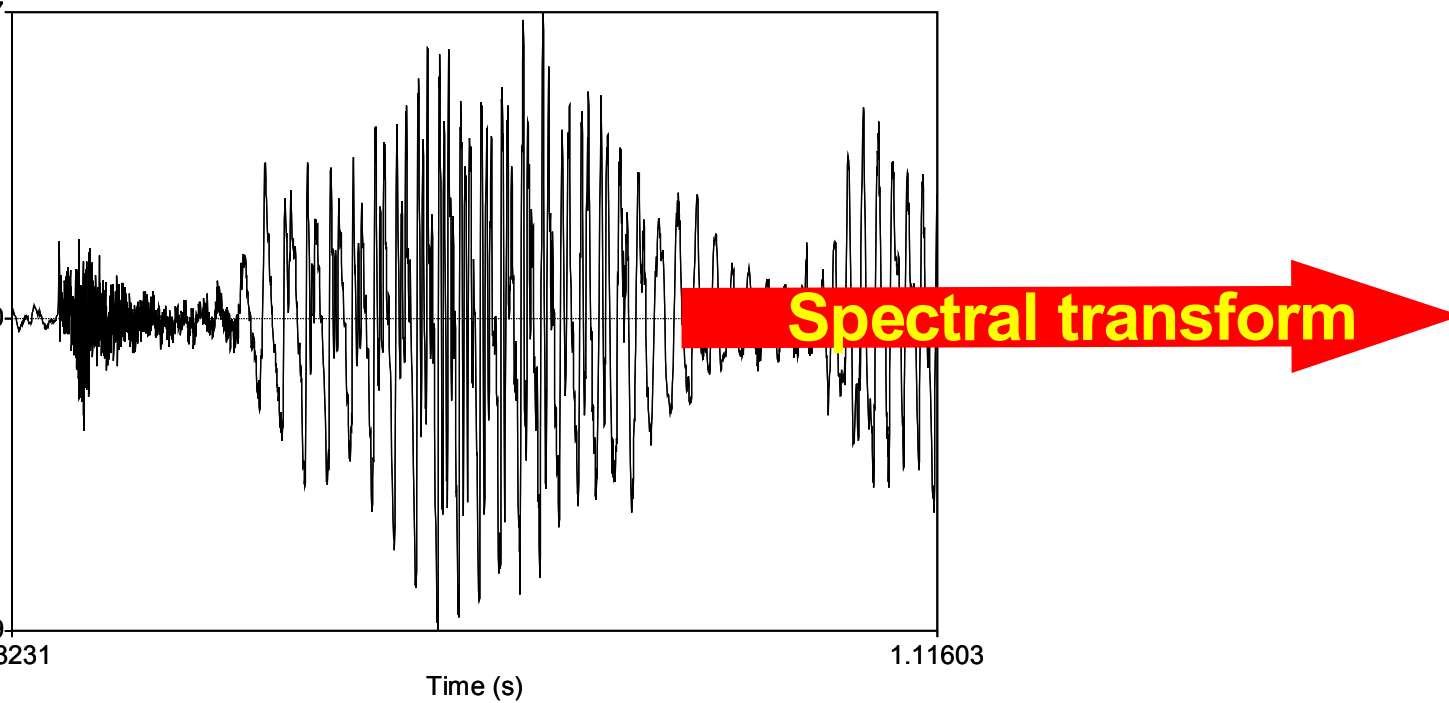
AMPLITUDE

TIME

Spectral transform

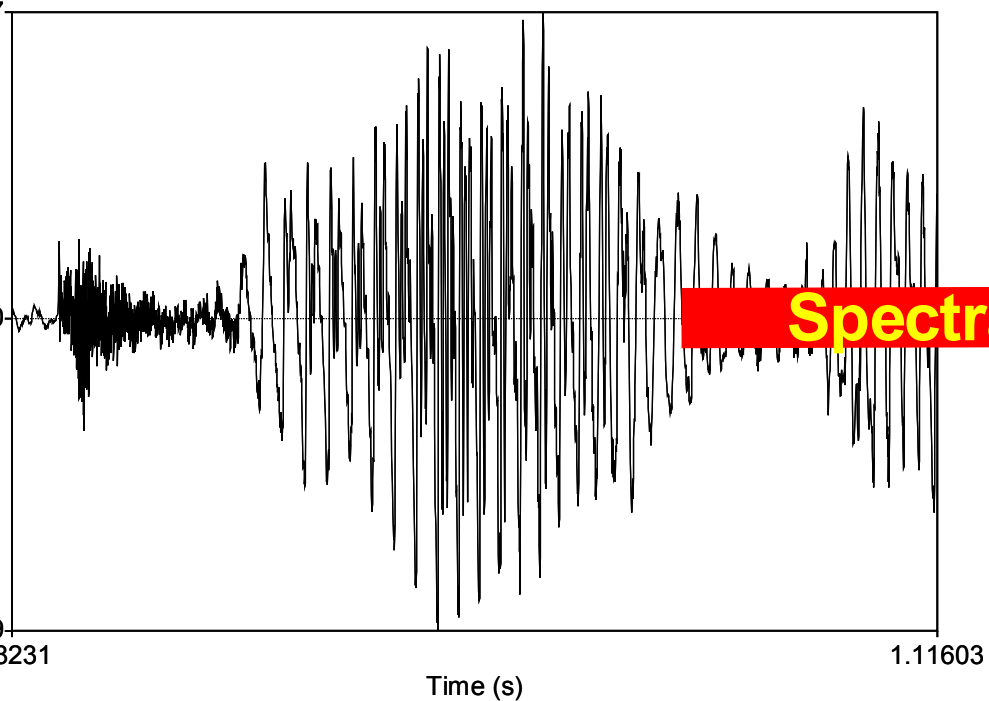


Spectral transform

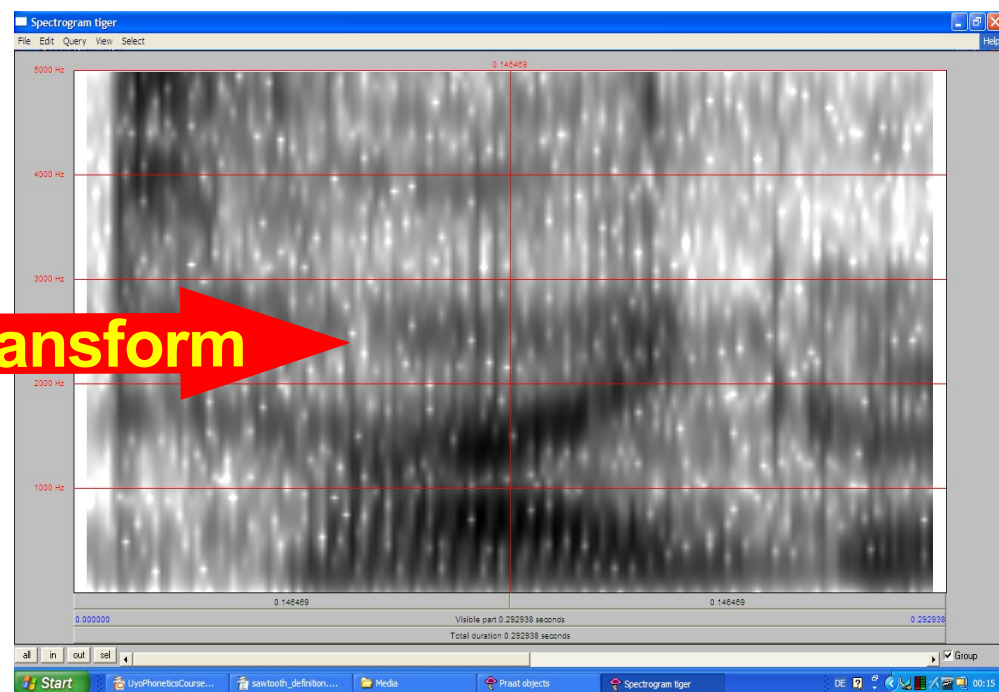


tiger

Spectral transform



Spectral transform



tiger

HOW IS THIS DONE?

Phonetics software: “Praat”

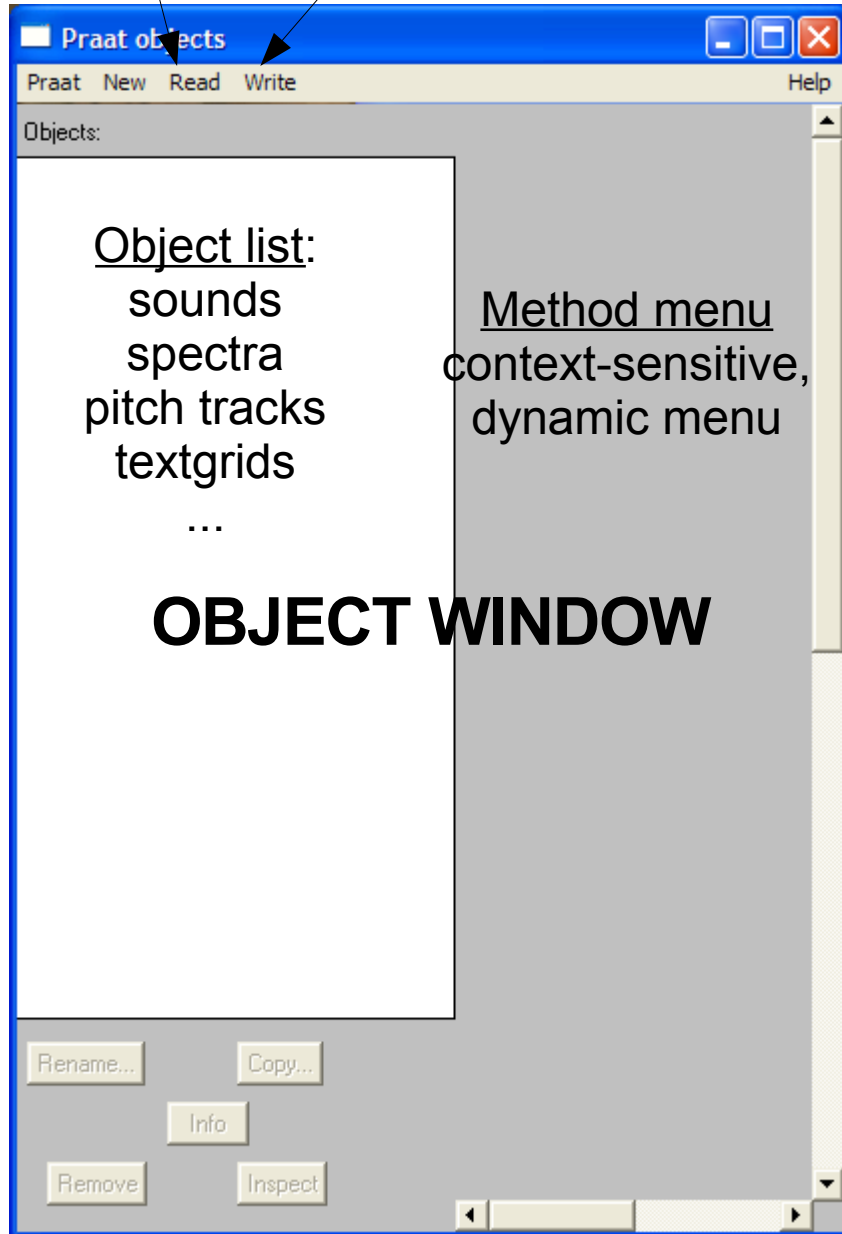
- Acoustic phonetics requires special equipment
- This used to be mechanical and electrical equipment
- Now acoustic phonetics can be done on a laptop or desktop PC
 - install software
 - Audacity
 - Praat
 - WaveSurfer
 - Transcriber
 - ...

PRAAT

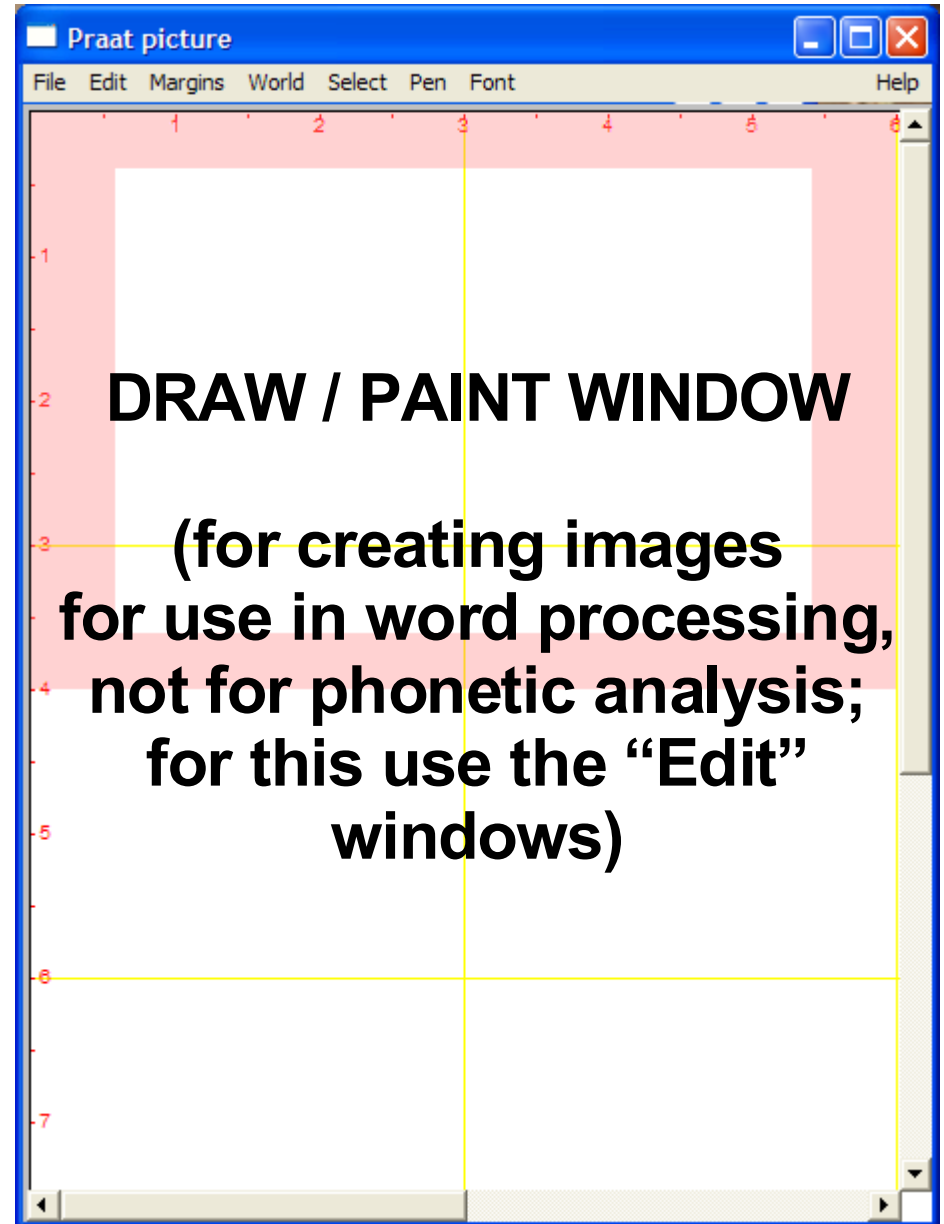
Praat windows

Load file

Save file

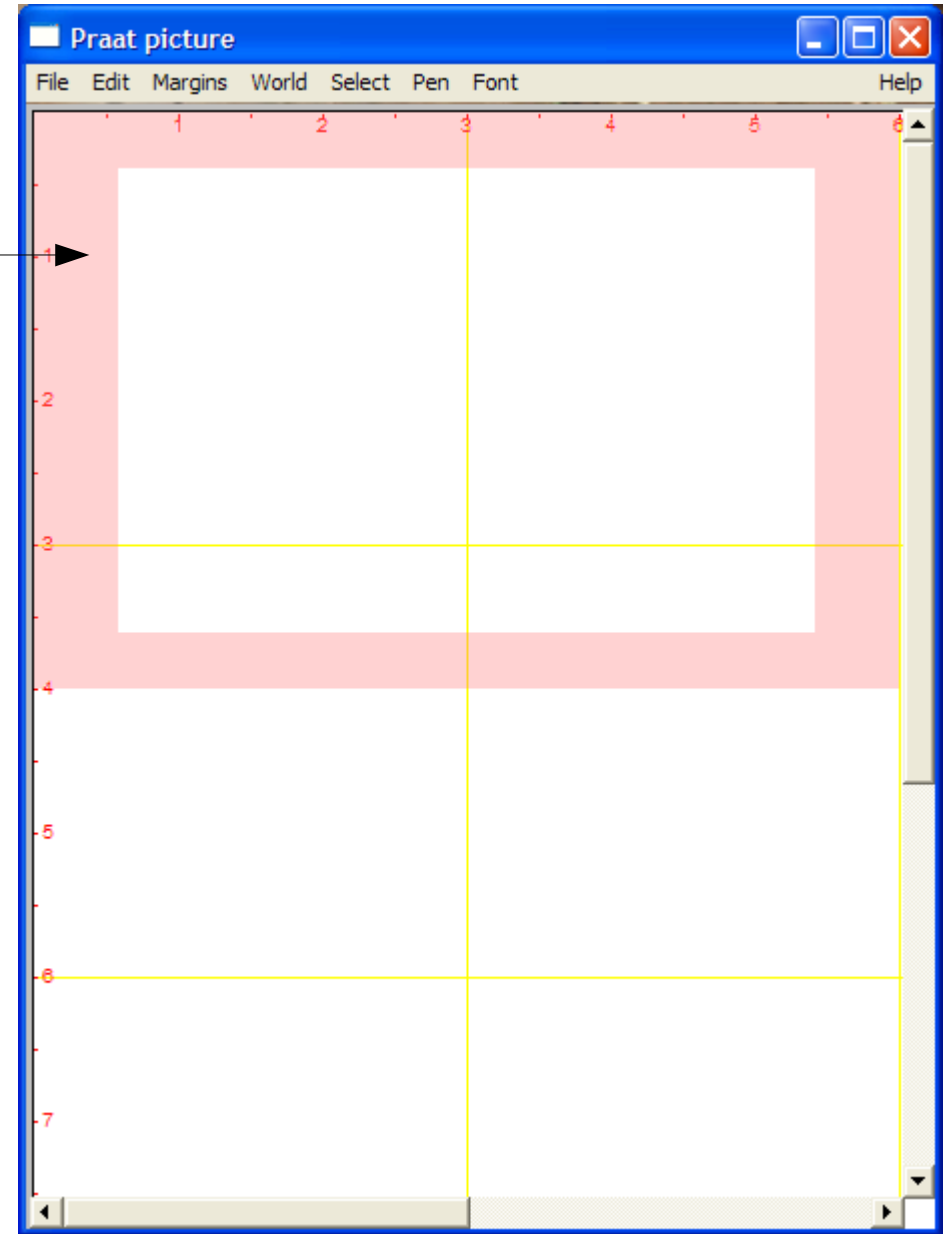
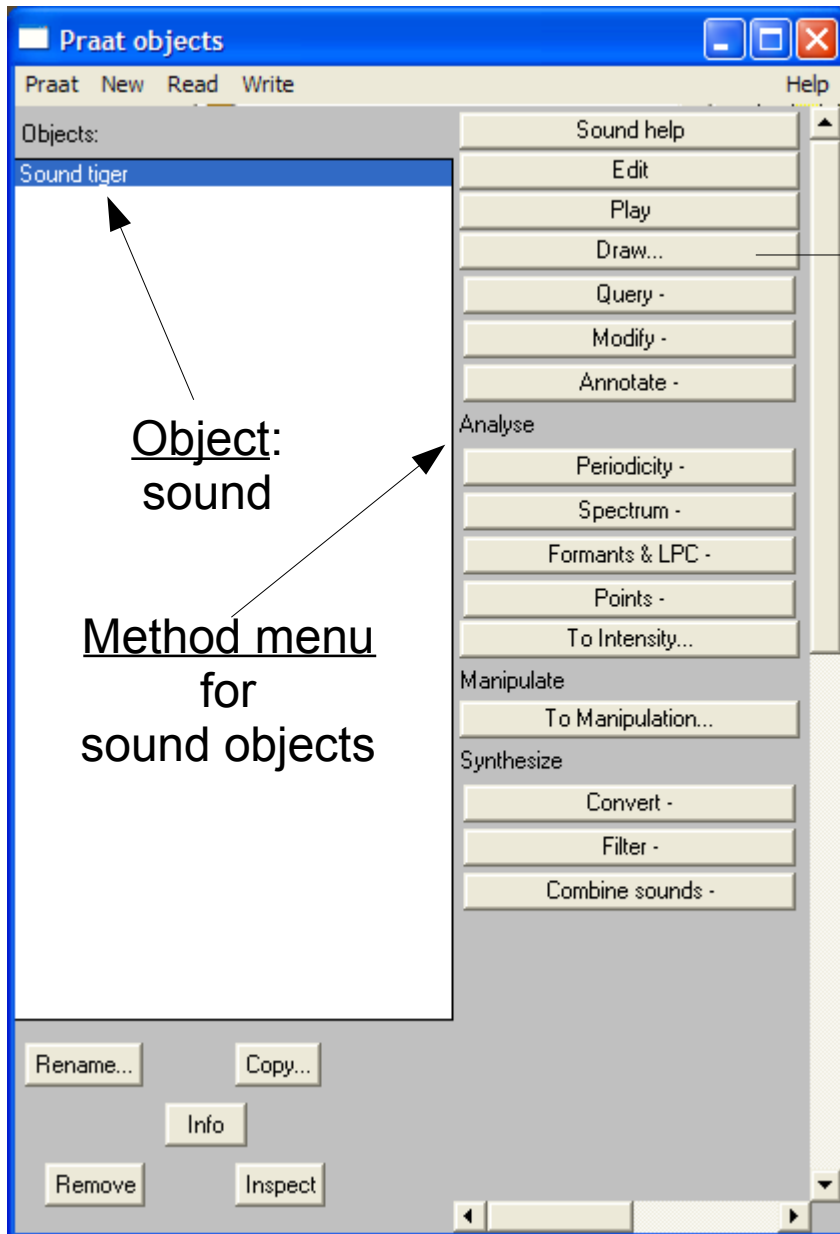


OBJECT WINDOW



DRAW / PAINT WINDOW
**(for creating images
for use in word processing,
not for phonetic analysis;
for this use the "Edit"
windows)**

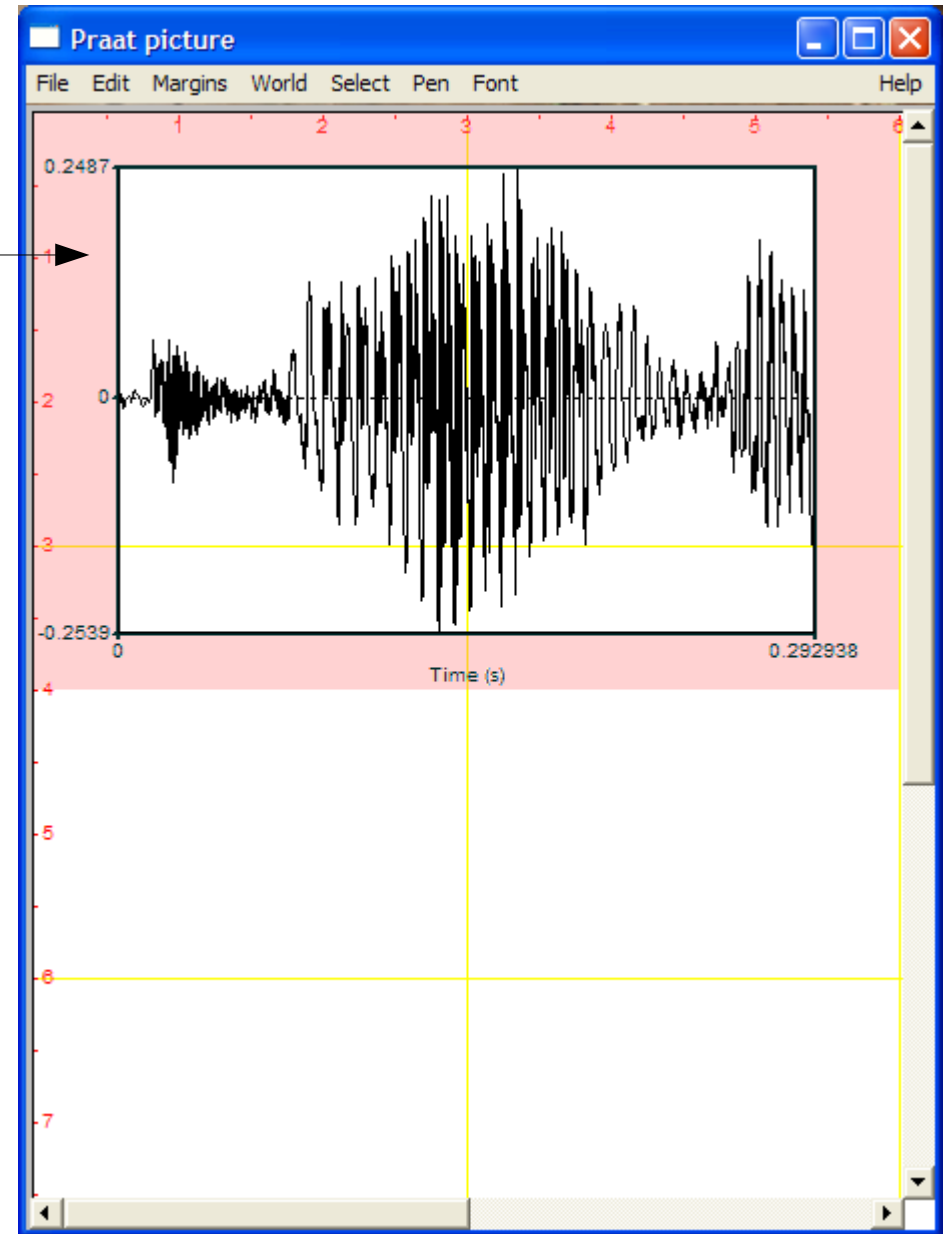
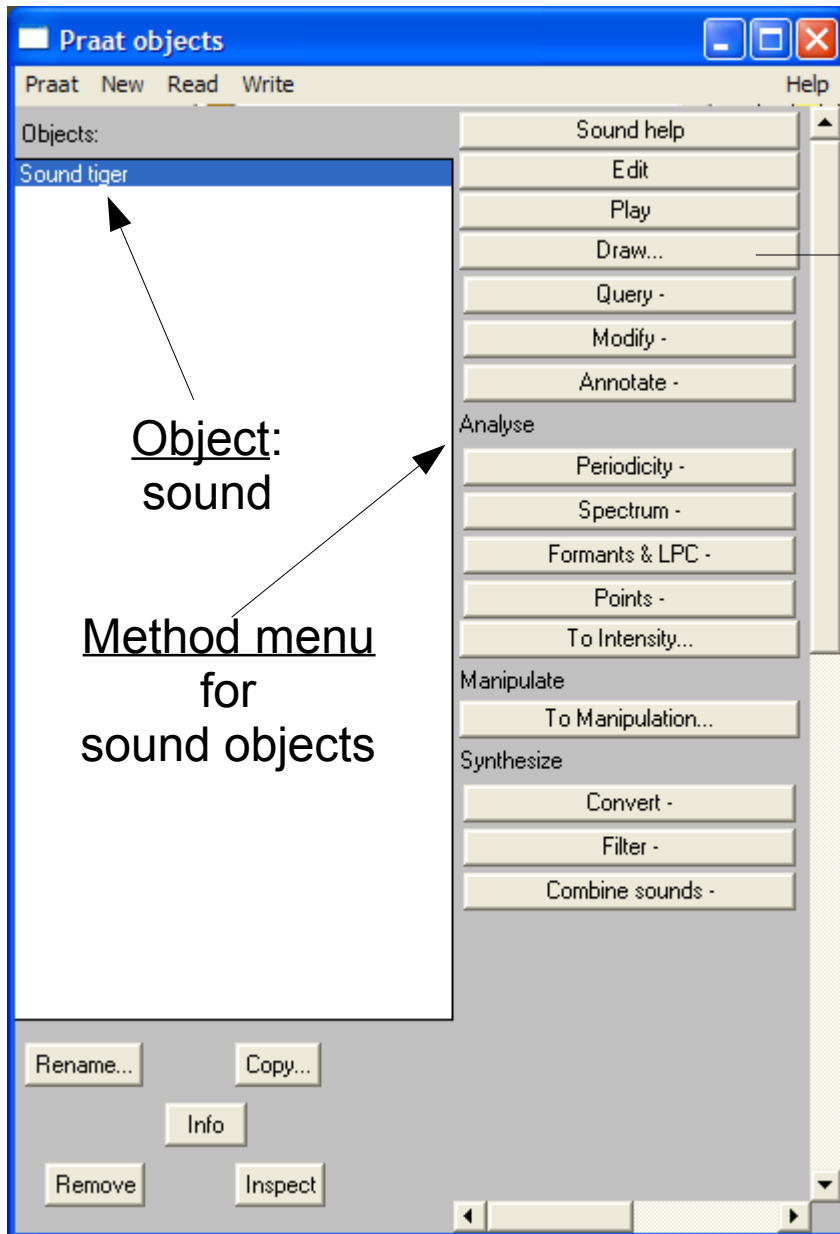
Objects and methods



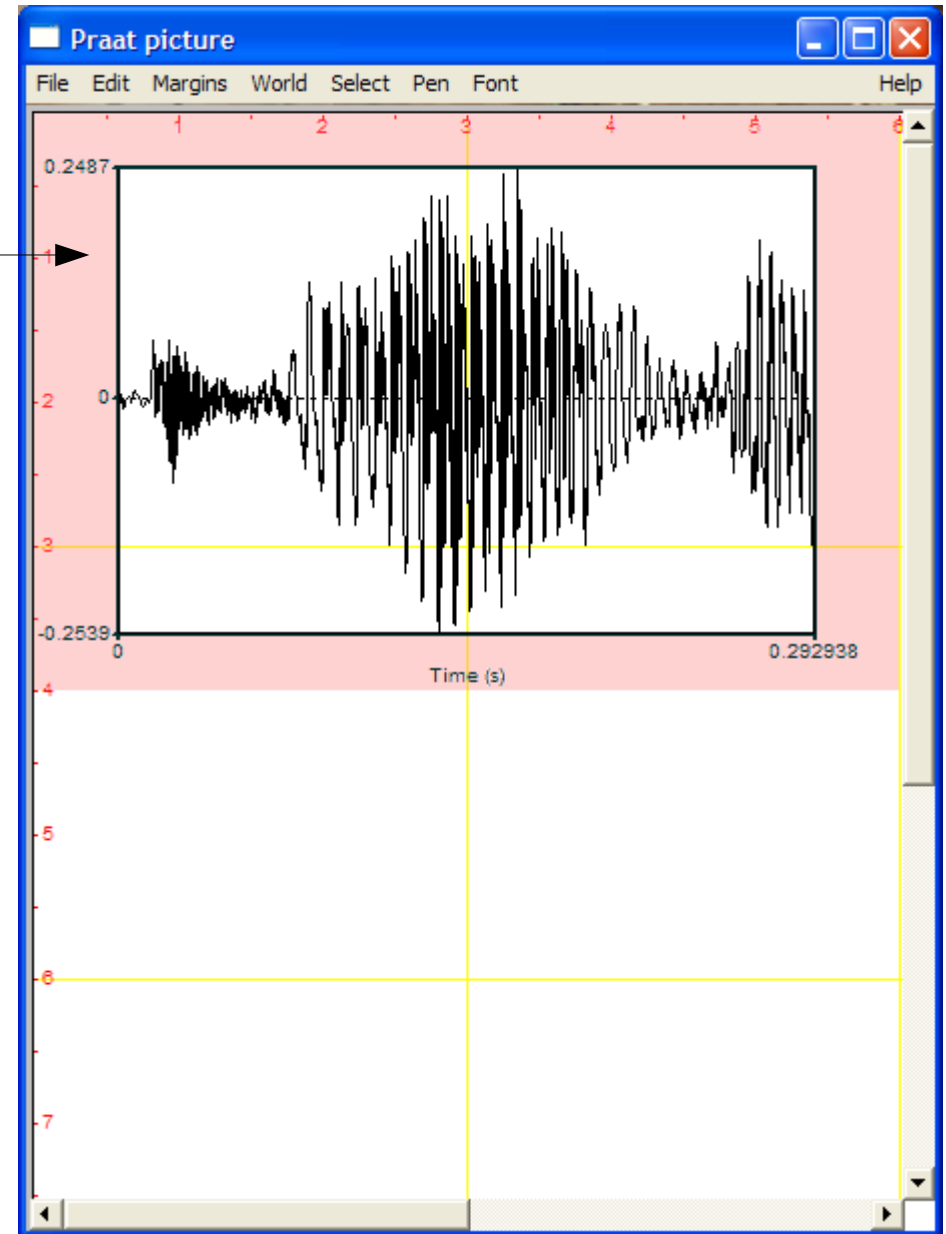
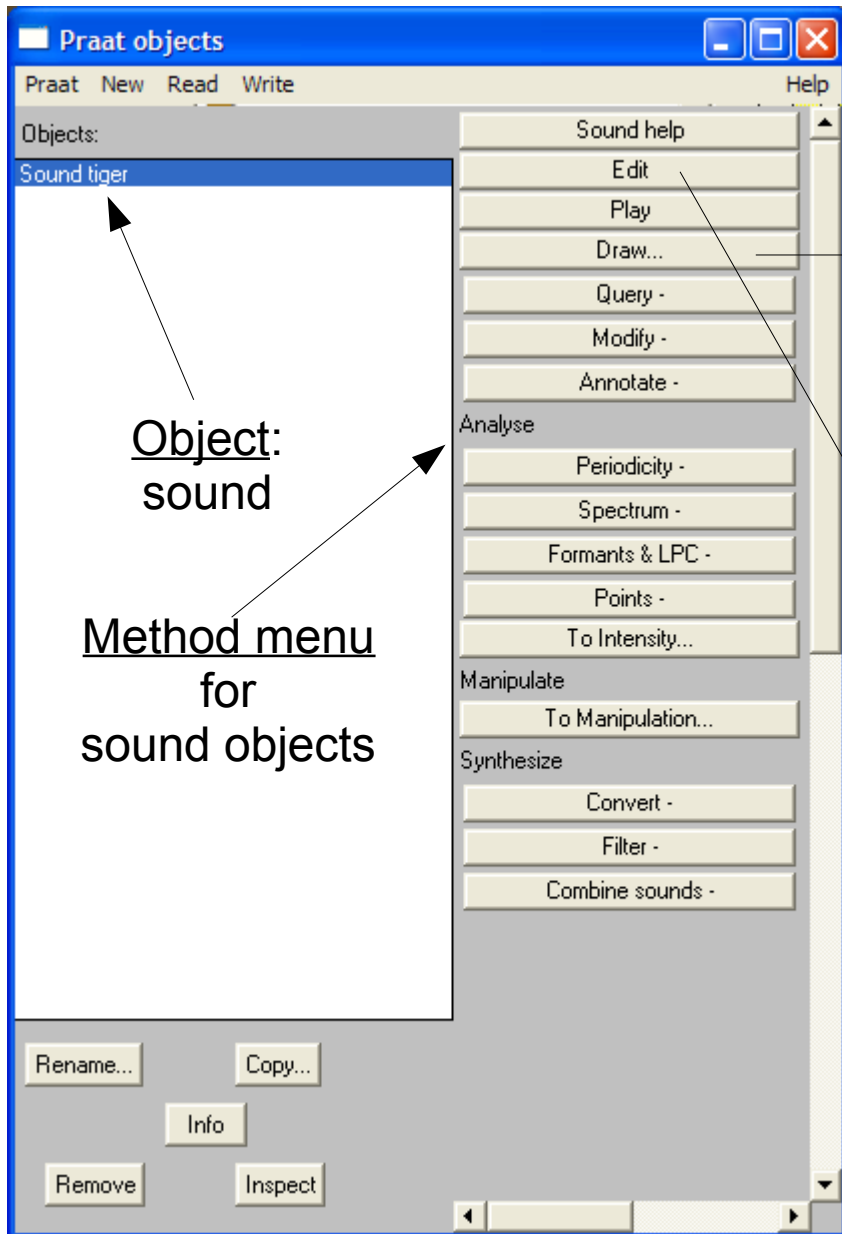
Object:
sound

Method menu
for
sound objects

Objects and methods



Objects and methods



Editing a waveform

The image shows a screenshot of the Praat software interface. The main window, titled "Sound tiger", displays a waveform with a vertical red dashed line at 0.148469 seconds. The y-axis ranges from -0.2539 to 0.2487. The x-axis shows a visible part of 0.292938 seconds and a total duration of 0.292938 seconds. The menu bar includes File, Edit, Query, View, Select, Spectrum, Pitch, Intensity, Formant, and Pulses. The "Praat objects" window is open, showing a list of objects with "Sound tiger" selected. A context menu is visible over the "Sound tiger" object, with options: Sound help, Edit, Play, and Draw... Arrows point from the "Edit" option in the context menu to the waveform in the "Sound tiger" window. Another arrow points from the "Sound tiger" object in the "Praat objects" window to the "Edit" option in the context menu. A third arrow points from the "Draw..." option in the context menu to the "Praat picture" window, which shows a zoomed-in view of the waveform. The "Praat picture" window has a menu bar with File, Edit, Margins, World, Select, Pen, and Font. The "Sound tiger" window has a toolbar at the bottom with buttons for "all", "in", "out", "sel", and a "Group" checkbox.

Object: sound

Method menu for sound objects

0.148469

0.2487

0.01224

-0.2539

0.148469

0.148469

0.000000

Visible part 0.292938 seconds

0.292938

Total duration 0.292938 seconds

all in out sel Group

Editing a waveform

Praat objects

Praat New Read Write Help

Objects:

Sound tiger

Sound help
Edit
Play
Draw...

Sound tiger

File Edit Query View Select Spectrum Pitch Intensity Formant Pulses Help

0.2487
0.148469
0.01224
-0.2539

0.148469 0.148469

0.000000 Visible part 0.292938 seconds 0.292938
Total duration 0.292938 seconds

all in out sel Group

Object: sound

Method menu for sound objects

Rename... Copy...
Info
Remove Inspect

Selecting a segment of a waveform

The image shows two windows from the Praat software. The top window, titled "Praat objects", has a menu bar with "Praat", "New", "Read", "Write", and "Help". Below the menu is a list of objects, with "Sound tiger" selected. A context menu is open over "Sound tiger", showing options: "Sound help", "Edit", "Play", and "Draw...". An arrow points from the text "Object: sound" to the "Sound tiger" entry. The bottom window, titled "Sound tiger", has a menu bar with "File", "Edit", "Query", "View", "Select", "Spectrum", "Pitch", "Intensity", "Formant", "Pulses", and "Help". The main area displays a waveform with a red shaded selection region. The selection boundaries are marked with vertical dashed red lines at time 0.071819 and 0.233795. The duration of the selection is shown as 0.161977 (6.174 / s). The visible part of the waveform is 0.292938 seconds, and the total duration is also 0.292938 seconds. The waveform amplitude ranges from -0.2539 to 0.2487. At the bottom, there are buttons for "all", "in", "out", "sel", and a "Group" checkbox.

Object: sound

Method menu for sound objects

0.071819 0.161977 (6.174 / s) 0.233795

0.2487

0

-0.2539

0.071819 0.161977 0.059142

0.000000 Visible part 0.292938 seconds 0.292938

Total duration 0.292938 seconds

all in out sel Group

Properties of sounds: spectrogramme

The image shows two windows from the Praat software. The top window, titled 'Praat objects', has a menu bar with 'Praat', 'New', 'Read', 'Write', and 'Help'. Below the menu is a list of objects with 'Sound tiger' selected. A context menu is open over 'Sound tiger', showing options: 'Sound help', 'Edit', 'Play', and 'Draw...'. An arrow points from the text 'Object: sound' to the 'Sound tiger' entry. Below this, another arrow points from the text 'Method menu for sound objects' to the context menu.

The bottom window, titled 'Sound tiger', has a menu bar with 'File', 'Edit', 'Query', 'View', 'Select', 'Spectrum', 'Pitch', 'Intensity', 'Formant', 'Pulses', and 'Help'. The main area displays a waveform and a spectrogram. The waveform is a black line on a white background, and the spectrogram is a grayscale image below it. A red shaded region highlights a portion of the waveform and spectrogram. The time axis is marked with values: 0.071819, 0.161977 (6.174 / s), and 0.233795. The frequency axis is marked with 0 Hz, 5000 Hz, and 0.2487. At the bottom, there are buttons for 'Rename...', 'Copy...', 'Info', 'Remove', and 'Inspect'. The status bar at the bottom shows 'all in out sel' and a 'Group' checkbox.

Properties of sounds: formants

The image shows two windows from the Praat software. The top window, titled 'Praat objects', has a menu bar with 'Praat', 'New', 'Read', 'Write', and 'Help'. Below the menu is a list of objects with 'Sound tiger' selected. To the right of the list is a context menu with options: 'Sound help', 'Edit', 'Play', and 'Draw...'. An arrow points from the text 'Object: sound' to the 'Sound tiger' entry. Below this, another arrow points from the text 'Method menu for sound objects' to a set of buttons: 'Rename...', 'Copy...', 'Info', 'Remove', and 'Inspect'. The bottom window, titled 'Sound tiger', has a menu bar with 'File', 'Edit', 'Query', 'View', 'Select', 'Spectrum', 'Pitch', 'Intensity', 'Formant', and 'Pulses'. The main area displays a waveform and a spectrogram. The waveform is a black line on a white background, with a red shaded region highlighting a segment. The spectrogram is a grayscale image with red diamonds marking formants. Time markers are shown at the top and bottom of the spectrogram: 0.071819, 0.161977 (6.174 / s), and 0.233795. The bottom status bar shows 'Visible part 0.292938 seconds' and 'Total duration 0.292938 seconds'. At the very bottom, there are navigation buttons: 'all', 'in', 'out', 'sel', and a 'Group' checkbox.

Object: sound

Method menu for sound objects

0.071819 0.161977 (6.174 / s) 0.233795

0.2487 0 -0.2539 5000 Hz 0 Hz

0.071819 0.161977 0.059142

0.000000 Visible part 0.292938 seconds 0.292938

Total duration 0.292938 seconds

all in out sel Group

Properties of sounds: pitch track

The image shows the Praat software interface. The top window is titled "Praat objects" and contains a list of objects with "Sound tiger" selected. A menu is open over "Sound tiger" with options: "Sound help", "Edit", "Play", and "Draw...". An arrow points from the text "Object: sound" to "Sound tiger".

The bottom window is titled "Sound tiger" and displays a waveform and a spectrogram. The waveform is at the top, and the spectrogram is below it. A red shaded region highlights a portion of the waveform. A blue line represents the pitch track, overlaid on the spectrogram. The x-axis shows time in seconds, with markers at 0.071819, 0.161977, and 0.233795. The y-axis shows frequency in Hz, with markers at 0 Hz, 155.34 Hz, and 500 Hz. The bottom status bar shows "Visible part 0.292938 seconds" and "Total duration 0.292938 seconds".

Annotations on the left side of the image:

- Object: sound
- Method menu for sound objects

Buttons at the bottom left of the "Sound tiger" window include: Rename..., Copy..., Info, Remove, and Inspect.

Copying the segment

The image shows two overlapping windows from the Praat software. The top window is titled 'Praat objects' and contains a list of objects with 'Sound tiger' selected. A context menu is open over 'Sound tiger', showing options: 'Sound help', 'Edit', 'Play', and 'Draw...'. An arrow points from the text 'Extract sound selection' to the 'Draw...' option. The bottom window is titled 'Sound tiger' and displays a waveform and spectrogram. A red shaded region highlights a segment of the waveform between time markers 0.071819 and 0.233795. Below the spectrogram, a blue line represents the pitch contour. The bottom status bar shows 'Visible part 0.292938 seconds' and 'Total duration 0.292938 seconds'. On the left side, there are several text annotations: 'Object: sound' with an arrow pointing to the 'Sound tiger' object in the top window; 'Method menu for sound objects' with an arrow pointing to the context menu in the top window; and 'Method menu for sound objects' with an arrow pointing to the 'Copy...' button in the bottom window's control panel.

Object: sound

Method menu for sound objects

Method menu for sound objects

Extract sound selection

Creation of a new waveform object

The image shows two overlapping windows from the Praat software. The top window, titled "Praat objects", has a menu bar with "Praat", "New", "Read", "Write", and "Help". Below the menu is a list of objects: "Sound tiger" and "Sound untitled". A context menu is open over "Sound untitled", showing options: "Sound help", "Edit", "Play", and "Draw...". An arrow points from the "Edit" option to the "Sound tiger" window. The "Sound tiger" window has a menu bar with "File", "Edit", "Query", "View", "Select", "Spectrum", "Pitch", "Intensity", "Formant", "Pulses", and "Help". The main area displays a waveform and a spectrogram. The waveform is a black line on a white background, with a red shaded region indicating a selected segment. The spectrogram shows frequency components over time, with a blue line representing the pitch contour. The selected segment is bounded by time markers: 0.071819, 0.161977 (6.174 / s), and 0.233795. The spectrogram shows a formant structure with red diamonds and a blue line. The bottom of the window shows a status bar with "all", "in", "out", "sel", and "Group" buttons. The bottom left of the "Praat objects" window has buttons for "Rename...", "Copy...", "Info", "Remove", and "Inspect".

Object: sound

Method menu for sound objects

Extract sound selection

Save file Saving the new object

Praat objects

Praat New Read Write Help

Objects:

Sound tiger
Sound untitled

Sound help
Edit
Play
Draw...
Query -
Modify -
Annotate -

Analyse

Periodicity -
Spectrum -
Formants & LPC -
Points -
To Intensity...

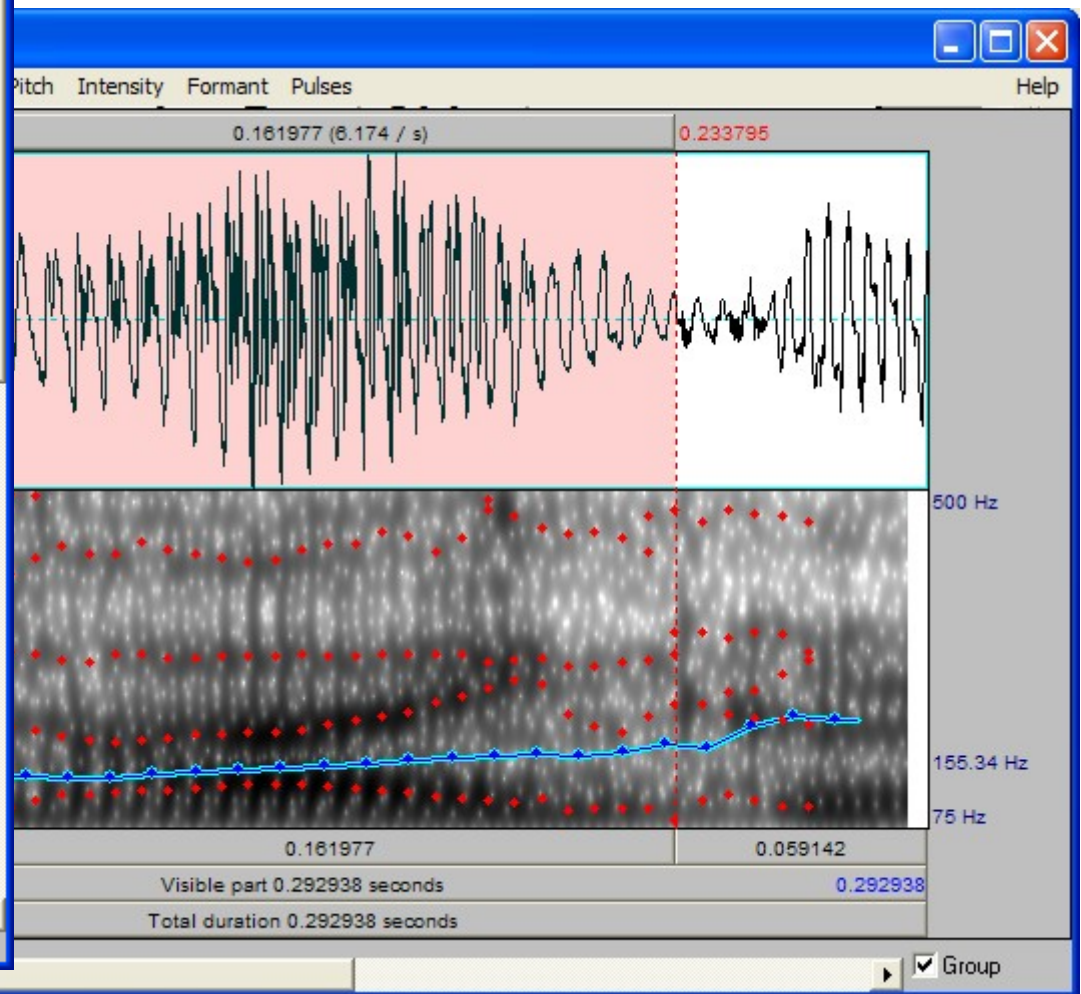
Manipulate

To Manipulation...

Synthesize

Convert -
Filter -
Combine sounds -

Rename... Copy...
Info
Remove Inspect



Live demo of Praat

Praat live demo

SPEECH

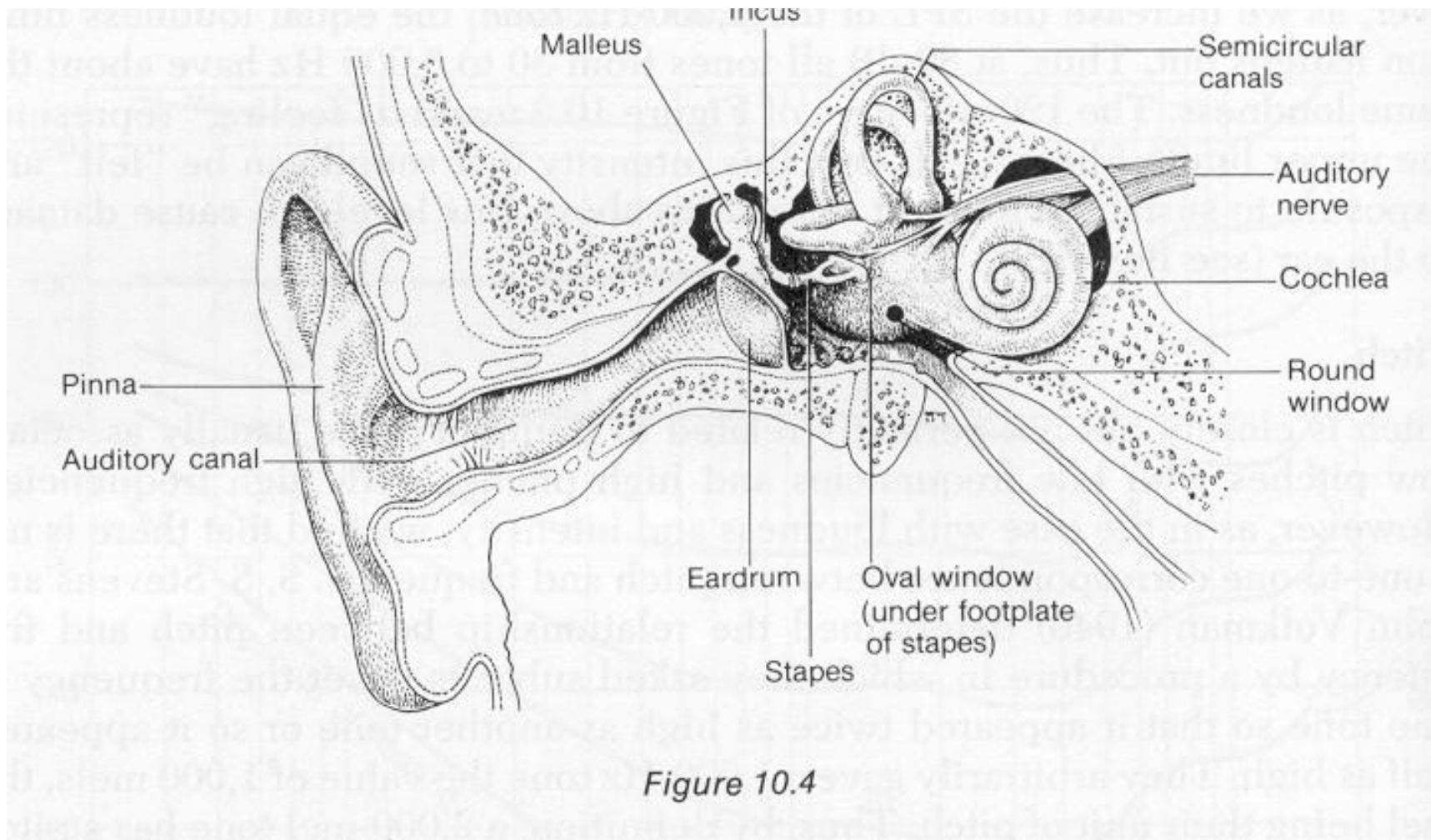
production
transmission
perception

AUDITORY PHONETICS

The ear



The ear



The ear

outer ear

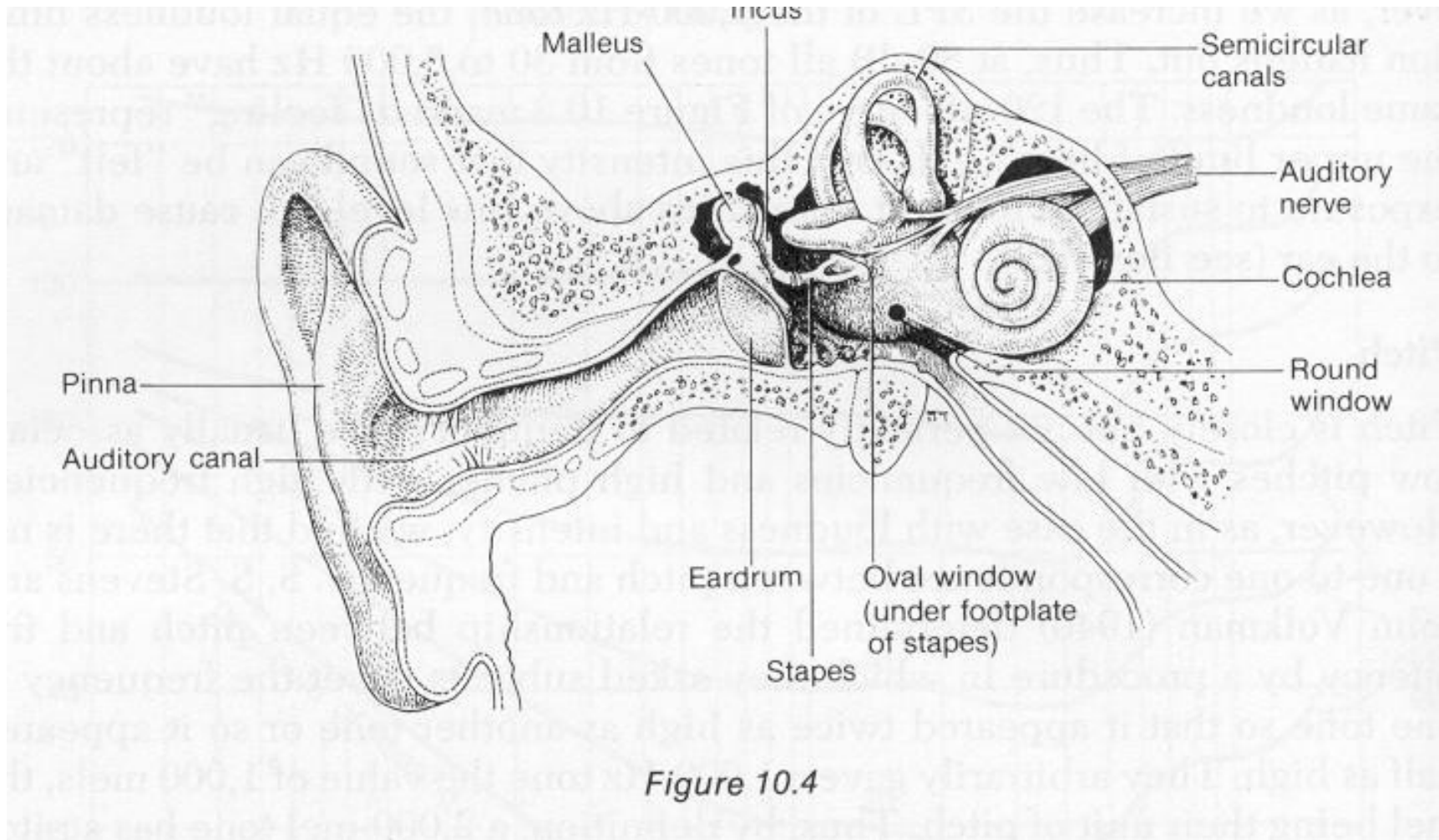


Figure 10.4

The ear

outer ear

middle ear

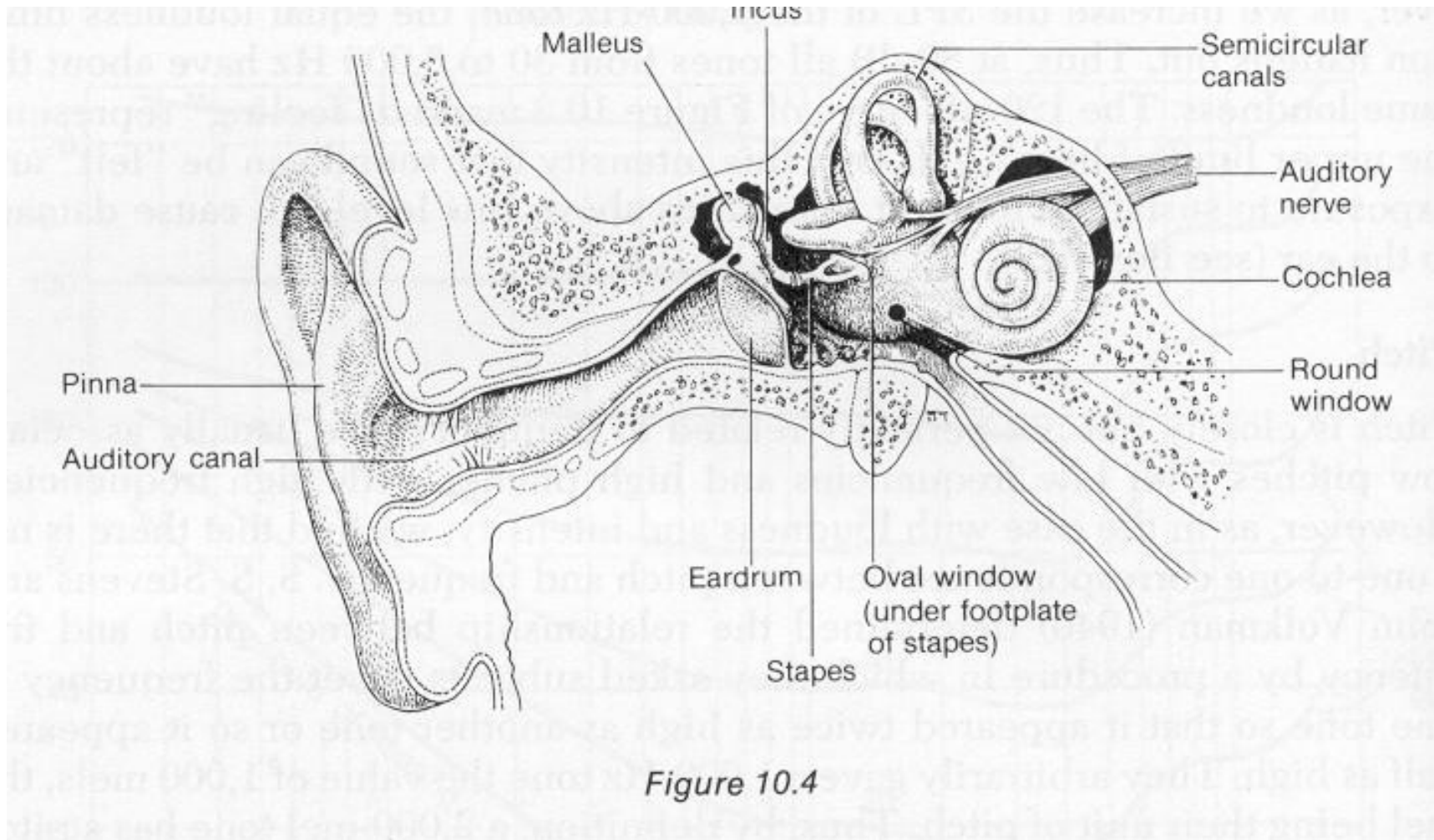


Figure 10.4

The ear

outer ear

middle ear

inner ear

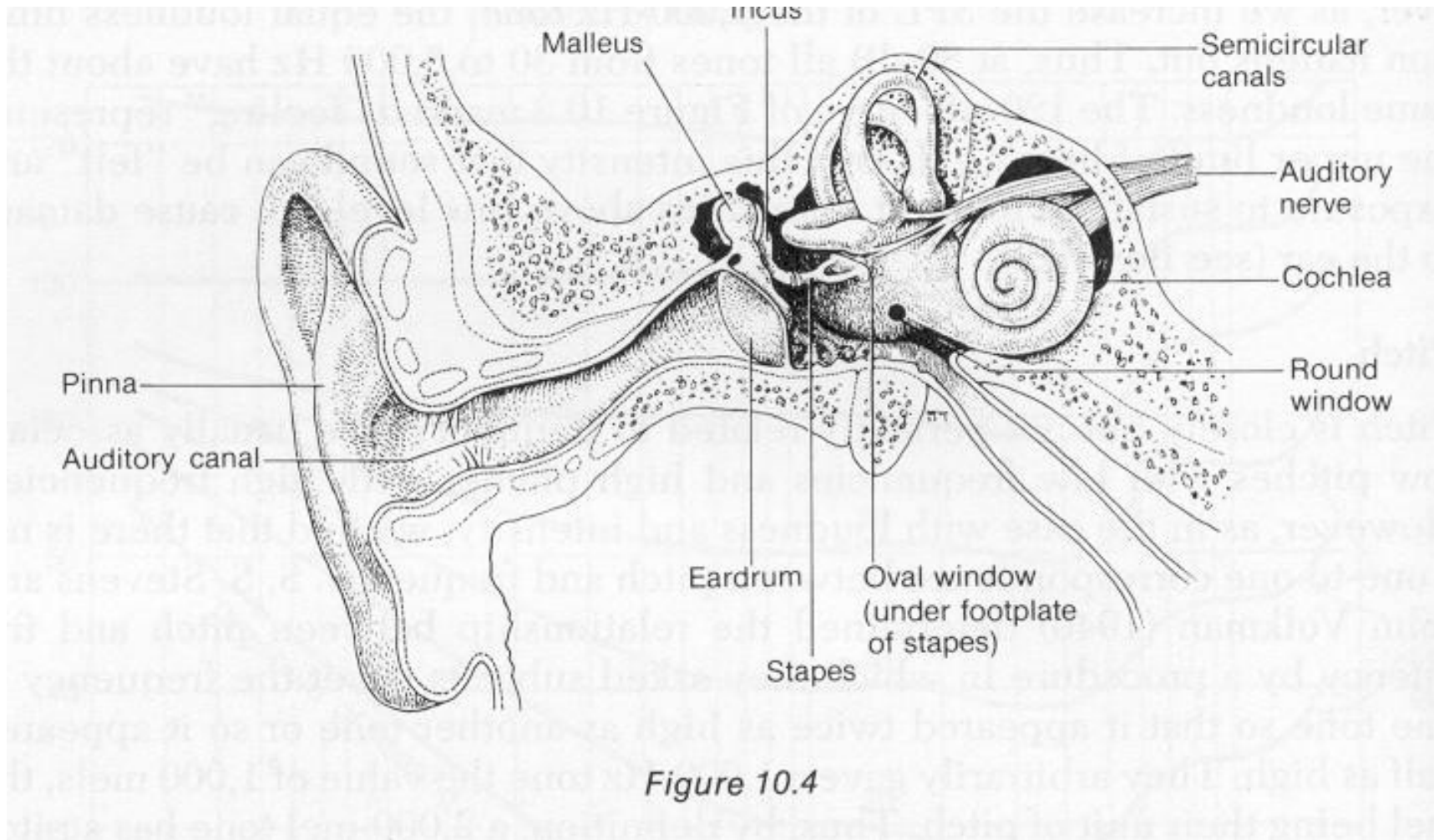
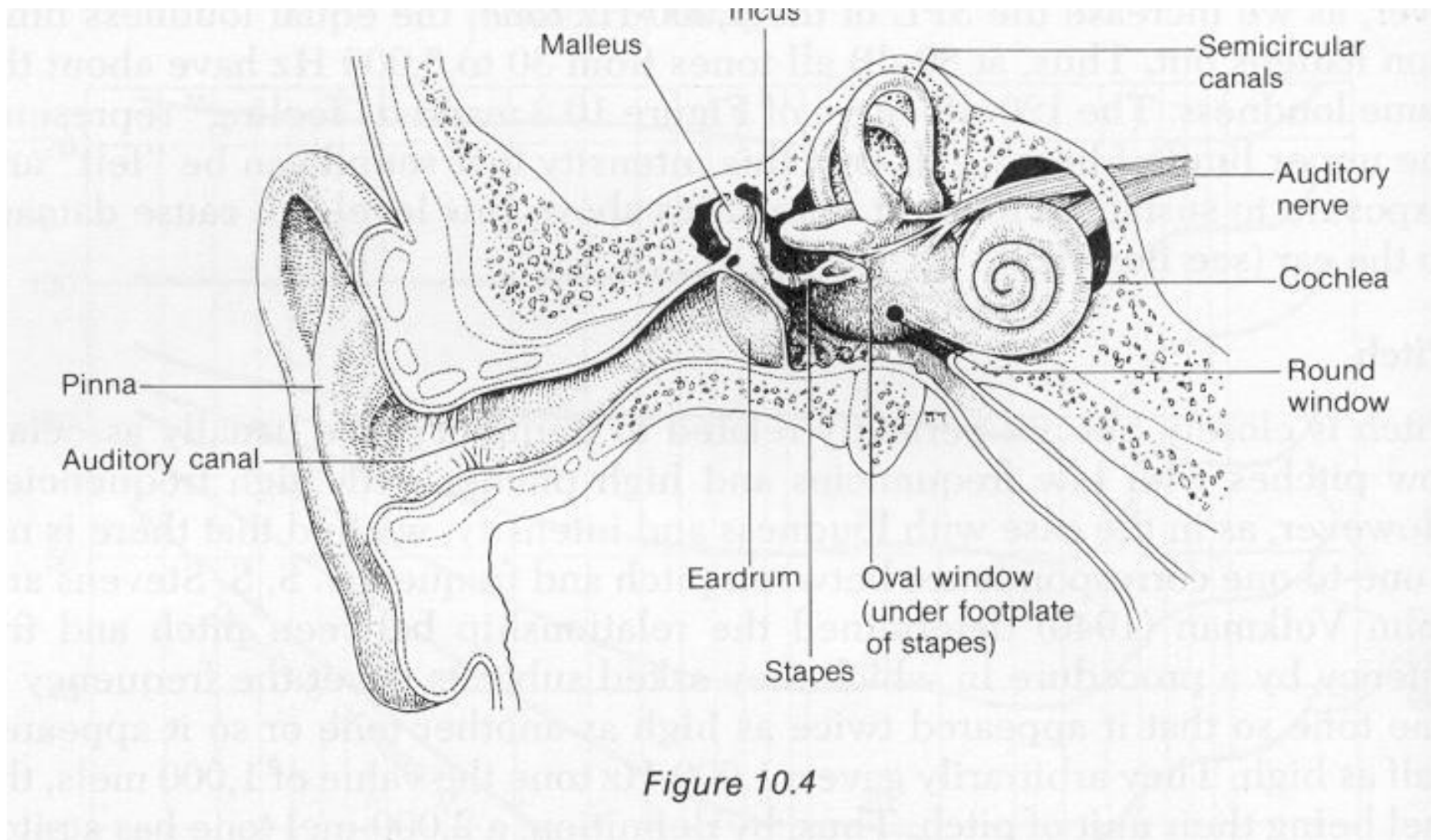


Figure 10.4

The ear

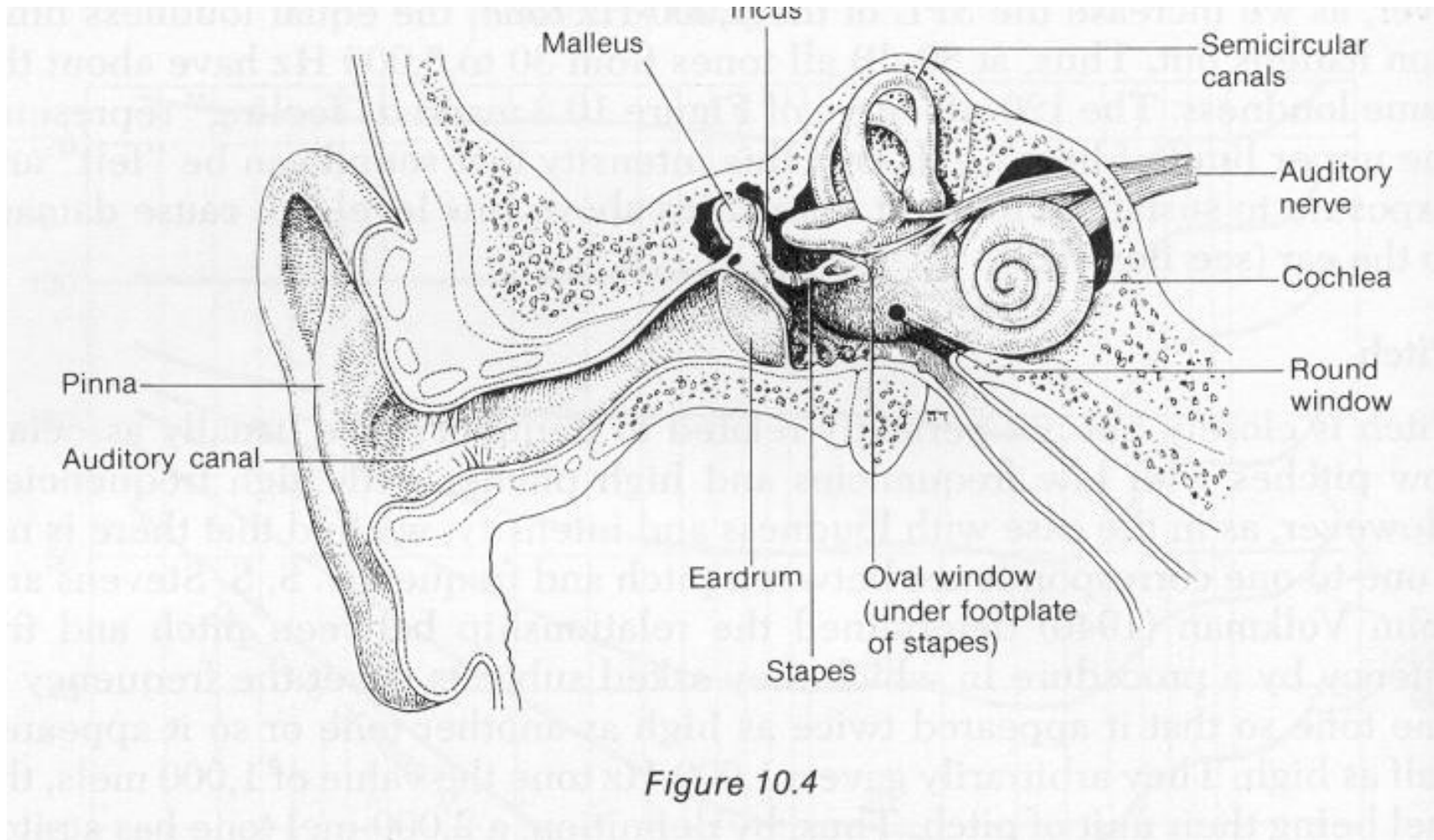
microphone



The ear

microphone

amplifier

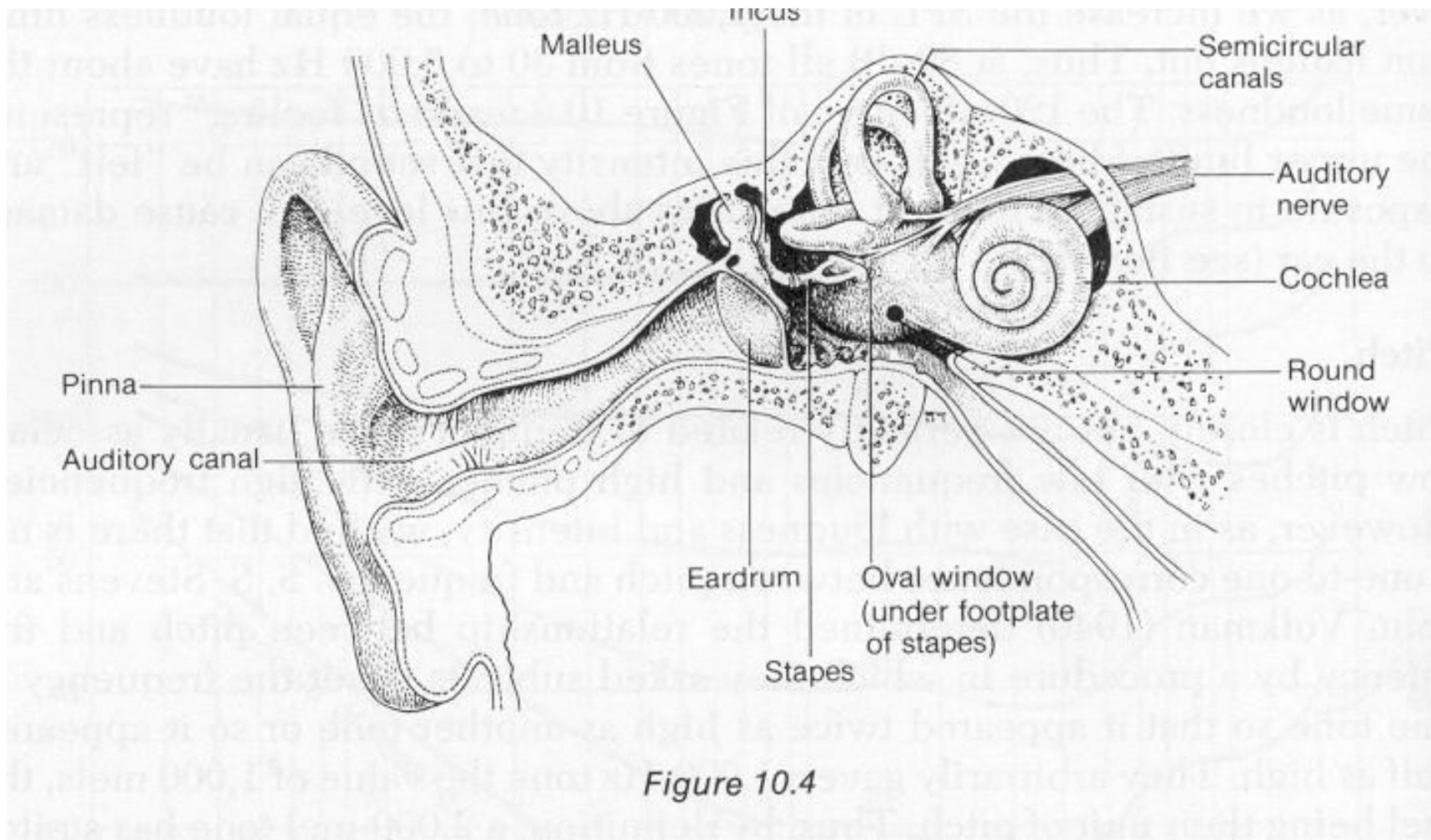


The ear

microphone

amplifier

spectral transform



HOMework

Phonetics tasks

- Take a look at the model on the Interactive Sagittal Section website and
 - practice with it to get used to the different combinations of active and passive articulators
 - pronounce all the sounds you form with the website, observing the movements of your articulatory organs
- **Download the Praat software on to your computer:**
 - **install it**
 - **read an audio file**
 - **experiment with the software**
 - **consult the help files**
- **Take a look at models of the ear: summarise the functions of the outer ear, the middle ear, the inner ear**

See you next week!