For this tutorial, you will need to download and install Praat:
http://www.fon.hum.uva.nl/praat/

Problem 1: Exploring speech phonemes

In this problem, you are given three words ("heed", "had", "hood") uttered by three different participants:

- *m01iy.wav*, *m01ae.wav*, *m01oo.wav*: contain the words "heed", "had", "hood" uttered by a male adult

- *w01iy.wav*, *w01ae.wav*, *w01oo.wav*: contain the words "heed", "had", "hood" uttered by a female adult

- *b01iy.wav*, *b01ae.wav*, *b01oo.wav*: contain the words "heed", "had", "hood" uttered by a child

(a) Visualization of speech signal and spectrogram: Load all files on Praat (*Open → Read from file*). Using the *Play* button, listen to the files. Using the *View & Edit* button, visualize the corresponding speech signals and spectrograms.

(b) Computation of fundamental frequency: Compute the fundamental frequency F_0 of all the files. Select each file, click *View & Edit*, then click on *Pitch → Get pitch* (for the latter make sure that the cursor is close to the middle of the signal). What do you observe?

(b) Visual inspection of formants: Using the spectrograms, try to understand the regions where the first three formants F_1, F_2, F_3 of the above files lie.

(c) Computation of formants: Now use Praat to mark the formants of the above files onto the spectrogram (*Formant → Show Formants*) and get the corresponding values (*Formant → Formant listing*), making sure that the cursor is close to the middle of the signal). What do you observe? Are there differences between the three files?

(c) 2-D representation of formants: Plot the first two formants of files *m01iy.wav*, *m01ae.wav*, *m01oo.wav* on a 2-dimensional scatter plot, where the x and y axes correspond to F_1 and F_2, and connect the three points so that they form a triangle. Repeat the same for files *w01iy.wav*, *w01ae.wav*, *w01oo.wav* and files *b01iy.wav*, *b01ae.wav*, *b01oo.wav*, so that you end up with three triangles. What do you observe?