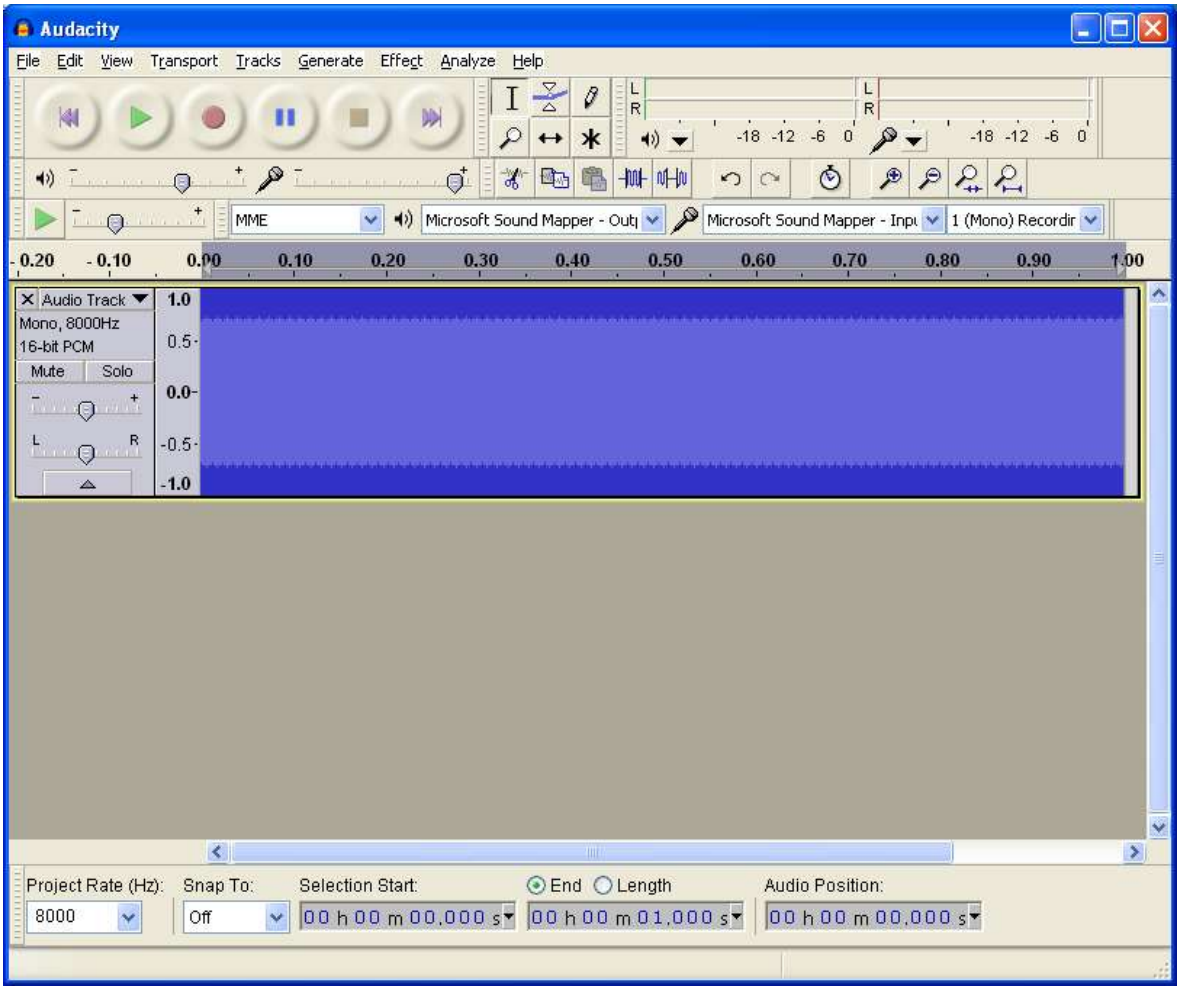
CSCU9N5: Multimedia & HCI
Sound Practical

The aims and objectives of this practical are for you to investigate the aural and spectral properties of different sound clips using the **Audacity** software package. You will need headphones – you can either use your own or we will supply them.

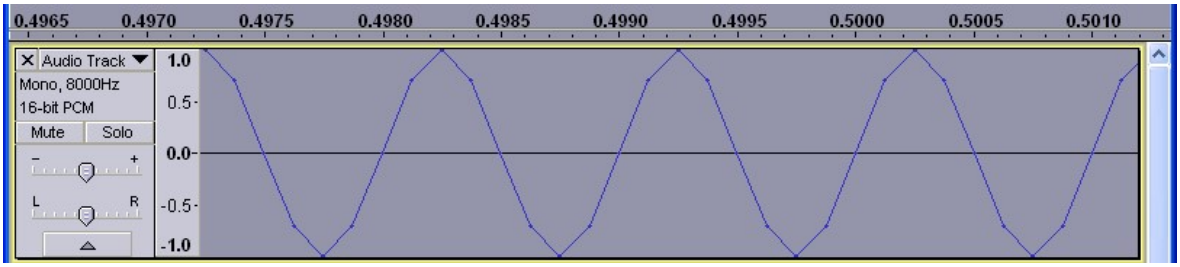
Simple Tones

1. Put your headphones on, making sure the headphone labelled L is on your left ear.
2. Start **Audacity** via the **Start** menu.
3. First off we will create a 1 second long 1KHz pure sinusoidal tone.
4. Make sure the "Project Rate (Hz):" is set to 8000 (bottom left-hand corner of window).
5. Select the menu item "Generate->Tone…" and set the waveform to "Sine", the frequency to 1000 Hz, the amplitude to 1.0 and the duration to 1 second (to change this, first click on the little down arrowhead and select "seconds" for the format).



6. Note at the left hand side of the blueish box it shows that this tone has been produced as a digital waveform at a sample rate of 8000 Hz and with a sample size of 16 or 32 bits (depending on how your version of Audacity has been configured).
7. Press the big play button (green arrow) to hear what the tone sounds like.

8. The bluish box is actually displaying the sound waveform, which is a bit difficult to distinguish at the moment. Keep clicking the **zoom button** (magnifying glass with a plus symbol on it) on the toolbar and the sine wave will appear. Keep clicking until it looks something like the following, in which the blue dots show the actual **sample times**. How many sample times are there per cycle of the sine wave? (You should be able to work this out, rather than have to count the dots!)



9. To explore the effect of the sample rate on the sound quality, first change the "Project Rate (Hz)" to 32000 Hz. Then create a new audio track by selecting "Tracks->Add New-> Audio Track" from the menus. Generate a 1KHz sinusoidal tone (as you did above) at this new sample rate and have a listen to it (select Solo for this audio track and make sure Solo is not selected in your original track, otherwise you will hear both together). Does it sound any different to the original tone? Probably not, but you should see that the sampled waveform is a much smoother sine wave than before.

10. Repeating the steps above, create a third audio track with a a sample rate of 2500Hz (you can type this rate into the "Project Rate" box, rather than select from the drop-down menu. Generate and listen to your tone now. It may still sound similar, but perhaps a bit quieter. However, the sampled waveform does not look very much like a sine wave anymore!

11. Try some even lower sample rates. Before choosing a rate, try to predict what the sampled waveform should look like. Were you right?

12. Finally, delete all your audio tracks apart from your original one (select track by clicking on it then select Tracks->Remove Tracks from the menu). Zoom out the waveform in this track until you can see the full 1 second again. Click-and-drag along the waveform to select a portion, say 0.2 seconds long. Now select "Analyze->Plot Spectrum" from the menus. A new window pops up showing you a frequency analysis of the waveform. Basically you should see a peak at 1KHz, indicating this is the dominant frequency present in the sound clip. This frequency spectrum will get more interesting when we play with more complex sound clips later on in this practical. Close this window.

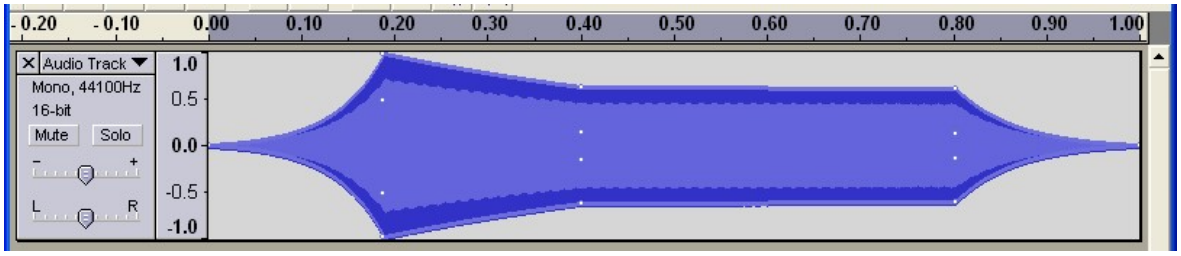
13. [OPTIONAL] The range of human hearing is approximately from 20Hz to 20KHz, but this varies considerably between people. You could try generating tones of different frequencies within this range to determine your hearing range. You can alter the amplitude of the tone using the -/+ slider in the audio track window. You can also pan the sound to be purely in the left ear or purely in the right ear, using the L/R slider. In this way you can find out if your ears have different frequency ranges.

Amplitude Envelopes

You may have noticed that the simple tones you have been playing with seem to start and end with a click (play it again if you have not noticed this). This is because the tone starts and stops instantaneously. Real sounds are not like this – it takes time for a physical object, like a guitar string, to start to vibrate. We can emulate this by putting our simple tone inside an **amplitude envelope**.

14. The button to the right of the selection button in the central toolbar (just to the right of the large playback buttons) is the **Envelope tool**. First make sure your entire 1Khz tone clip is selected (you may need to regenerate this clip if you have deleted it), then click on the Envelope tool button.

15. To create the envelope, click on the waveform at a particular time – 4 white dots will appear that can be used to adjust the amplitude of the waveform at that time by clicking-and-dragging. The amplitudes at all times to the previous and next set of dots will be adjusted automatically. Click at times 0.00, 0.20, 0.40, 0.80 and 1.00 and adjust the amplitudes at these times by clicking-and-dragging on the topmost dot at each time until you have produced a waveform that looks something like this:



16. Play this waveform. It should sound more natural. This is an example of an Attack / Decay / Sustain / Release (ADSR) envelope. You can make the tone come on faster or slower by clicking-and-dragging the dots at time 0.20 to the left or right. Try this and see how it sounds in each case.

More Complex Sounds

There are a number of more complex sound clips available on the module's **"Sound Resources"** page on Canvas. Download a few of these clips to your own file space by right-clicking on a link and selecting "Save Link As…". You should choose at least one from each category: **everyday sounds, musical sounds, speech, binaural sounds**.

Repeat the following two steps for each of your clips.

17. Load a clip into Audacity via the "File->Open" menu item. Some sounds are mono and some are stereo. For the stereo sounds, your audio track window will show two waveforms, for the left and right channels (they may look similar or quite different, depending on the clip). Play your clip.

18. Select the entire waveform of your clip by clicking-and-dragging in the waveform window, then choose "Analyze->Plot Spectrum" from the menus. The frequency spectrum will probably be much more complex than for the simple tone, with many peaks at different frequencies, instead of just a single peak.

Did you notice any consistent differences between the frequency spectrums of sounds from the different categories? You might notice that musical sounds are a bit more "peaky" than the other

sounds. That is, there are frequencies that have identifiable peaks in the frequency spectrum. Everyday sounds tend to contain a broad range of frequencies of similar power, and show only occasional peaks.

Compressing Sounds

19. Save, load and play the two clips under the heading "Raw versus MP3 Recordings" on the sounds web page. Can you hear any difference?

20. Try selecting the first 15 seconds or so of both recordings and analysing their frequency spectrums. What differences can you see (if any)?

That's all.