# Lesson 2: Multiple Signal Sources

In this activity you will construct a program that is a signal generator comprised of multiple sine waveforms with the ability to control their amplitudes and frequencies. These are added together to create a more complex output.

Build a Two Waveform Signal Generator

- Open your signal source frequency file from Lesson 1.

- **Save as . . .** using a new file name.

- We will be working with sine waveforms. In the **Signal Source** block, change the **Waveform** type to "Sine".

- Also change the name of *Frequency* to "freq1" and *Amplitude* to "amplitude1".

- In the **QT GUI Range** block for "freq", change the *ID* to "freq1", and in the **QT GUI Range** block for "amplitude", change the *ID* to "amplitude1".

- Add a second signal source by completing the following:

  ◦ Copy the freq1 **QT GUI Range** block, and paste it on the canvas. Then change the *ID* to "freq2".

  ◦ Copy the amplitude1 **QT GUI Range** block, and paste it on the canvas. Open this block, and change *ID* to "amplitude2".

  ◦ Click on the **Signal Source** block and copy it (right-click Copy, or ctrl-c) and paste it on the canvas.
  [Alternately, import a **Signal Source** block from the library on the right. Be sure to change the **Waveform** type to "Sine".]
  In this new **Signal Source** block change the *Frequency* to "freq2" and *Amplitude* to "amplitude2".

  ◦ Delete the connections from the original **Signal Source** block. (Highlight and hit "Delete".)

  ◦ Add an **Add** block to the canvas. Make sure its **IO Type** is set to "float".

  ◦ Connect both **Signal Source** blocks to the inputs of the **Add** block, one to each input.

  ◦ Connect the output of the **Add** block to the **Audio Sink** and **QT GUI Sink**.

  ◦ Your canvas should look like the following:
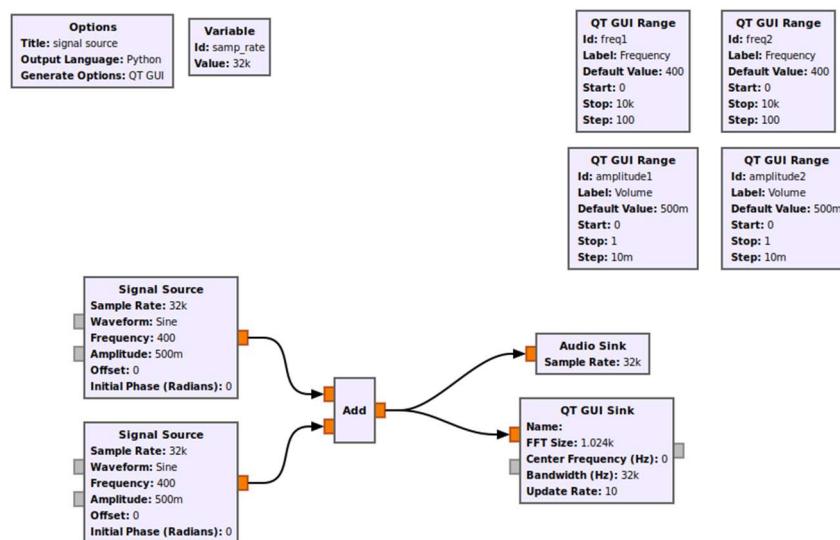
- Run the program.

- Explore the graphical displays and audio output while changing the frequencies and amplitudes.

Build a Three Waveform Signal Generator

- Add a third signal source:

  - Repeat the steps above to add a third ***Signal Source***. Be sure to add the appropriate frequency and amplitude variables by adding additional ***QT GUI Range*** blocks.

  - Change the ***Num Inputs*** in the ***Add*** block to "3".

  - Run the program and explore the output audio and the displays by the changing the frequencies and amplitudes of each input.

Build a six Waveform Signal Generator

- Add 3 more signal sources to make a signal generator comprised of 6 sine waveforms.

- In each ***QT GUI Range*** block, set the *Label* to match the *ID* value. For instance, for the ***QT GUI Range*** block with *ID* "freq1", set the *Label* to "frequency1". Set the corresponding "amplitude1" *Label* to "volume1".

- We will be using this in Lessons 3 and 4.