Learning Objective 2.3: I can install GNU Radio and use GNU Radio Companion (GRC) to build, inspect, and run a basic flowgraph.

Learning Objective 2.4: I can capture a real RF signal using an SDR and interpret its time- and frequency-domain representations.

Show your work. Write a **Documentation** line at the end (**None** if you did not collaborate).

1. **Reading a flowgraph.** A classmate's flowgraph has a Signal Source, a Throttle, and a QT GUI Frequency Sink. GRC draws the arrow from the Throttle to the sink in red and will not run.

    (a) The source and throttle ports are blue and the sink's input is orange. What is wrong, and what are two ways to fix it?

    (b) The classmate then replaces the Signal Source with a PlutoSDR Source and keeps the Throttle. Explain why the Throttle should come out.

2. **Complex sampling and aliasing.** A complex signal source runs at $f_s = 32$ kHz.

   (a) What range of frequencies can the samples represent?

   (b) Where does the frequency sink show a 40 kHz tone, and a -20 kHz tone?

   40 kHz:

   -20 kHz:

   (c) A PlutoSDR samples at 2.4 MS/s centered on 100.1 MHz. What band does the display show? Suppose a strong station at 102.1 MHz leaks past the Pluto's filters unattenuated. Where does it appear?

   band:

   alias:

   (d) Explain why complex samples show twice the bandwidth of real samples at the same rate.

3. **Recording and reading IQ.** A File Sink records complex samples.

   (a) Find the size of a 5 s capture at 2.4 MS/s.

   (b) You play the capture back through a File Source into a QT GUI Sink, with no other blocks. The flowgraph uses a whole processor core and the display races. What block is missing, and what do you set it to?

   (c) A teammate sends only the file `capture.cfile`. Name the two numbers you need before the file is useful, and explain why.

4. **Gain and the DC spike.** A PlutoSDR runs the L5 FM flowgraph, with the gain set to Manual.

   (a) With the gain at 0 dB, only the strongest station shows, and the noise floor does not move when you raise the gain a little. What is happening, and what do you change?

   (b) With the gain at maximum, copies of a strong station appear at frequencies where nothing transmits. Name the problem and the fix.

   (c) A student tunes the PlutoSDR exactly onto a weak narrowband signal. With DC tracking off, the signal hides in a spike at the center of the display; with DC tracking on, it looks weakened and distorted. Explain both, and the fix.

Documentation: _____