In-class assignment #14

PHY-905-005
Computational Astrophysics and Astrostatistics
Spring 2023

Instructions: The file `functions.py` includes two versions of the function

$$f(t) = 4\sin(30\pi t) + 1.5\cos(60\pi t) + 3\cos(120\pi t) \tag{1}$$

given to you in an array that spans the time range t= $[0, 4\pi]$ s. By inspection, you can see that there are oscillations at frequencies of 15, 30, and 60 Hz. **Write a function** based on your pre-class assignment that takes in the array of values of $f(t)$ (and any other necessary information) and returns a new array containing $g(t)$, which is $f(t)$ containing only oscillations that have frequencies between f_{min} and f_{max}, and verify that it is behaving correctly by plotting both $f(t)$ and $g(t)$ together. This is what is known as a band-pass filter. The special case with $f_{min} = 0, f_{max} \neq \infty$ is a low-pass filter, and $f_{min} \neq 0, f_{max} = \infty$ is a high-pass filter. Answer the following questions in the file `ANSWERS.md`:

1. How does the plot change as you increase/decrease the range $f_{min} - f_{max}$? Why do you think that is?
2. Do you see any unexpected features? What do you think is going on?
3. Try using the noisy version of the function. Does this behave differently? What happens as you increase the level of noise?
4. How might this type of filter be used in astronomical observations?

Hand in plots, code, and answers using the usual mechanism!