

AMath390

Math & Music

Fall 2016

Assignment # 5 Due: noon Nov. 3 in dropbox 6 slot 3 (s.1) or slot 4 (s. 2)

1. (a) Find the period T , and coefficients in the complex Fourier series for

$$f(t) = 6 + 4 \cos(\pi t) - 3 \sin(4\pi t).$$

(Hint: You do not need to compute any integrals to find the Fourier series.)

2. (a) Find the Fourier transform \hat{f} of $\sin(\omega_0 t)$ and also of $\cos(\omega_0 t)$. (Recall that the Fourier transform of $e^{2\pi i \omega t}$ is $\delta(\nu - \omega)$.)
- (b) Suppose $f(t) = \cos(16\pi t)$ is sampled at 10 times per second. Sketch $f(t)$ and the sampled signal f_s on $[0,1]$.
- (c) Calculate the Fourier transform \hat{f}_s of the sampled signal in (b). Sketch $\hat{f}(\nu)$ and $\hat{f}_s(\nu)$ for $|\nu| < 20$.
- (d) Repeat part (c), but with a sampled signal obtained with sample rate of 20 samples/second.
3. Look at the spectra in Figures 1 and 2.
- (a) In each figure, what is the fundamental frequency? How many overtones can you identify?
- (b) One sound was produced by my blowing into the open end of a tube, the other was produced with the same tube, but with one end closed. Which is which? Explain your answer briefly with a sentence.

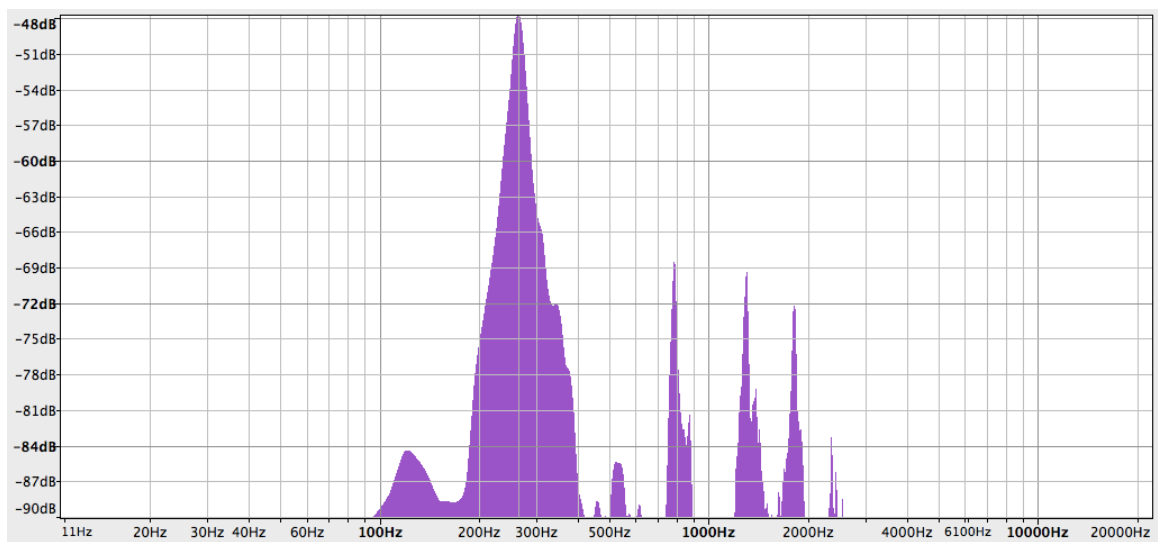


Figure 1: Sound sample (a)

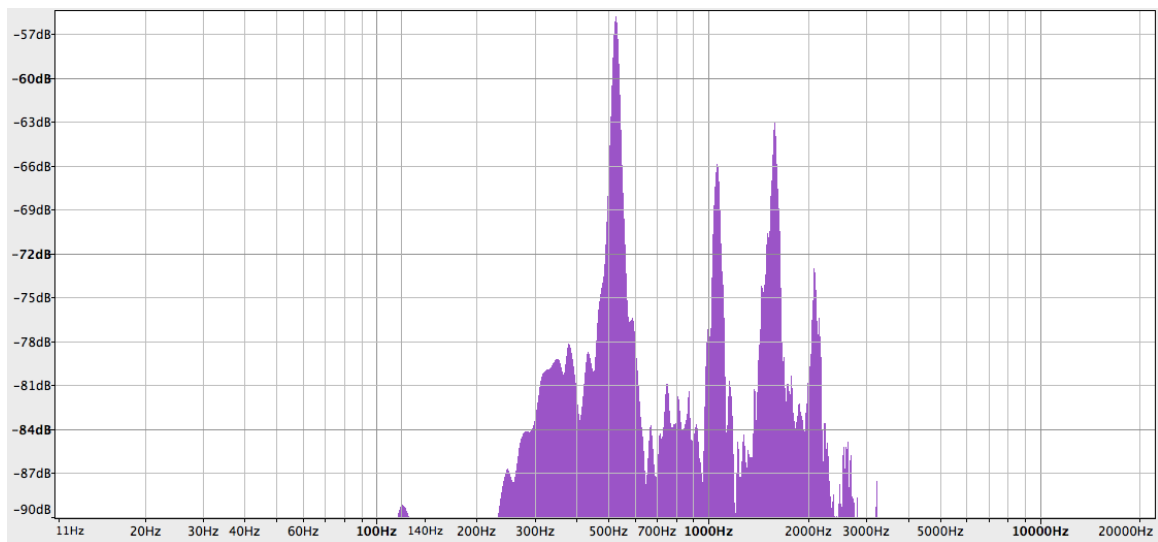


Figure 2: Sound sample (b)