Computational Physics Problem Set 8

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GitHub: https://github.com/jferrante25/physga-2000

1 Problem 2 (Newman 7.3)

Part A: The Fourier transform has peaks at whole number multiples of the same frequency (about 1170 Hz). The sound for each instruments consists of multiple harmonics, with the contribution decreasing for higher frequencies. The contribution of the higher frequency harmonics to the sound of the trumpet seems to be greater than that for the piano sound based on the height of the peaks. See Figure 1-4

Part B: The note played is a D natural two octaves above middle C (D6). (Using middle C (261 Hz), the interval between the notes can be found by $log_{2^{1/12}}(1170/261) \approx 26$. An interval of 24 half-steps gives two octaves from C6, and additional two half-steps from C6 is D6)

2 Problem 3 (Newman 7.4)

Part A: See Figure 5 Part D: The plot produced by inverting the FT with the last 90% of the coefficients set to 0 resembles the original curve but with the fine detail (small fluctuations along the curve) smoothed out. The higher Fourier series terms are contributing these features of the curve, and when their coefficients are suppressed, they disappear while those from lower terms remain, preserving the basic shape of the curve. See Figure 5 Part E: This produces an even smoother curve. See Figure 6

3 Problem 1

My code gives a message about NaNs being encountered when performing the minimization, I think because my method of computing negative log-likelihood involves taking logs of 0 somehow. See code, Figures 7, 8.

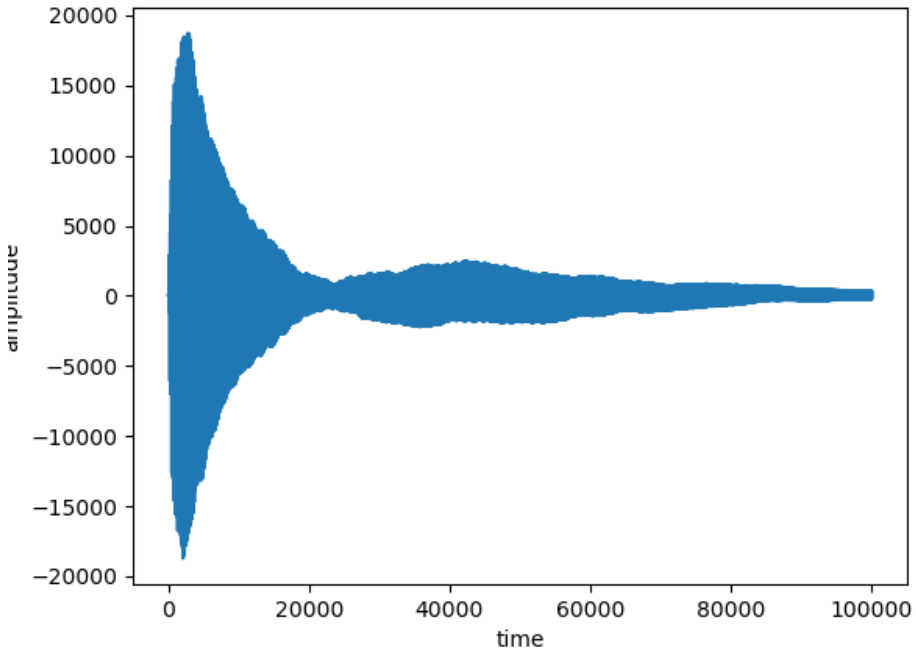

Figure 1: piano waveform

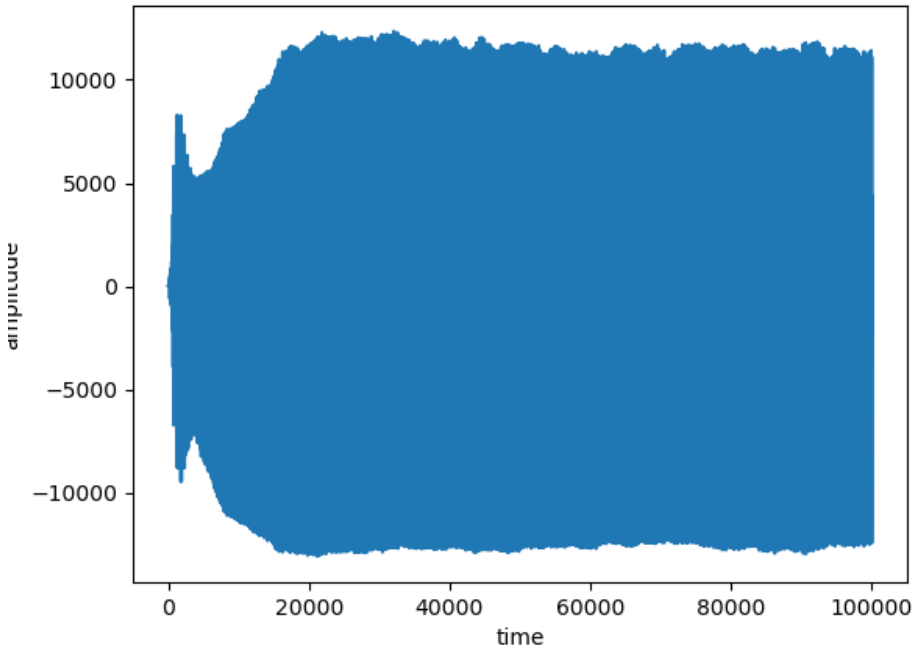

Figure 2: trumpet waveform

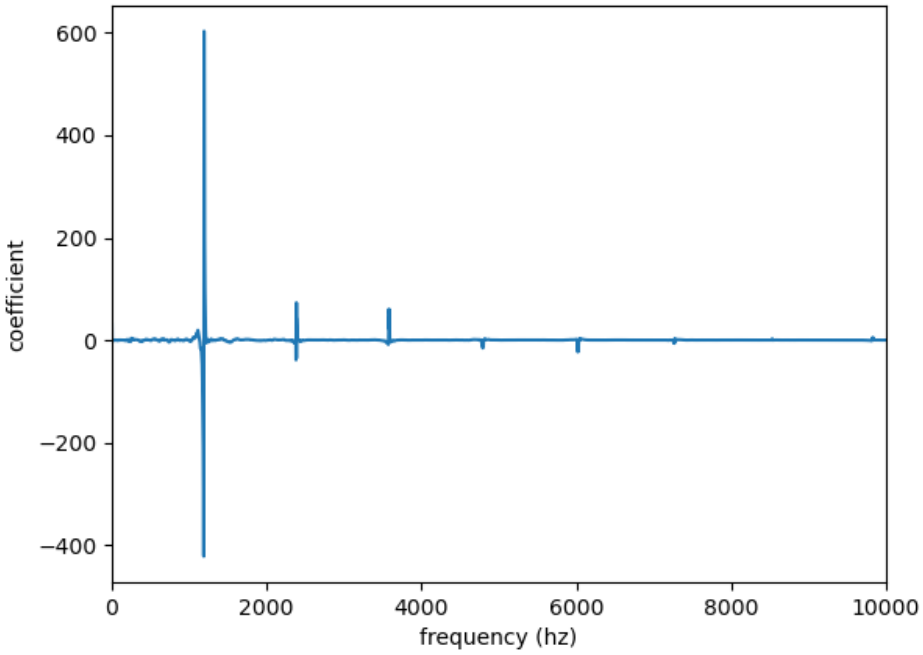

Figure 3: piano Fourier transform

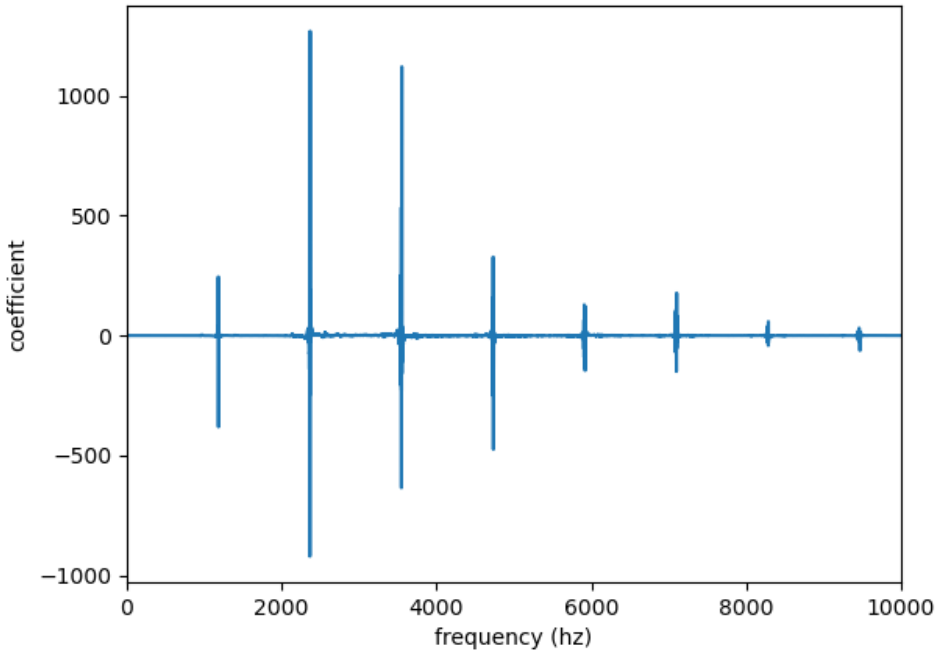

Figure 4: trumpet Fourier transform

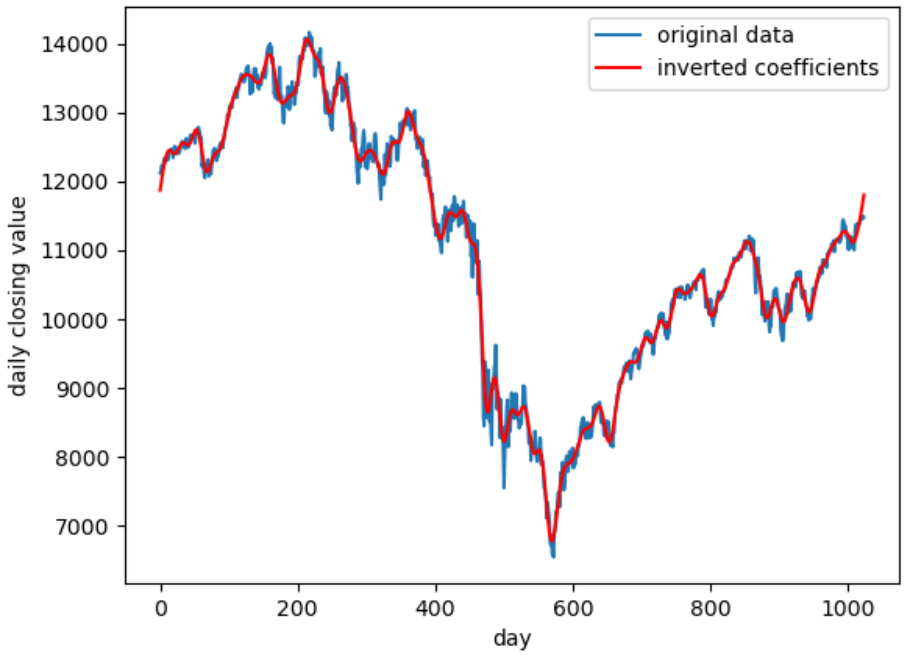

Figure 5: Comparison of original data for Dow Jones with inversion of Fourier coefficients with only first 10% of the coefficients used

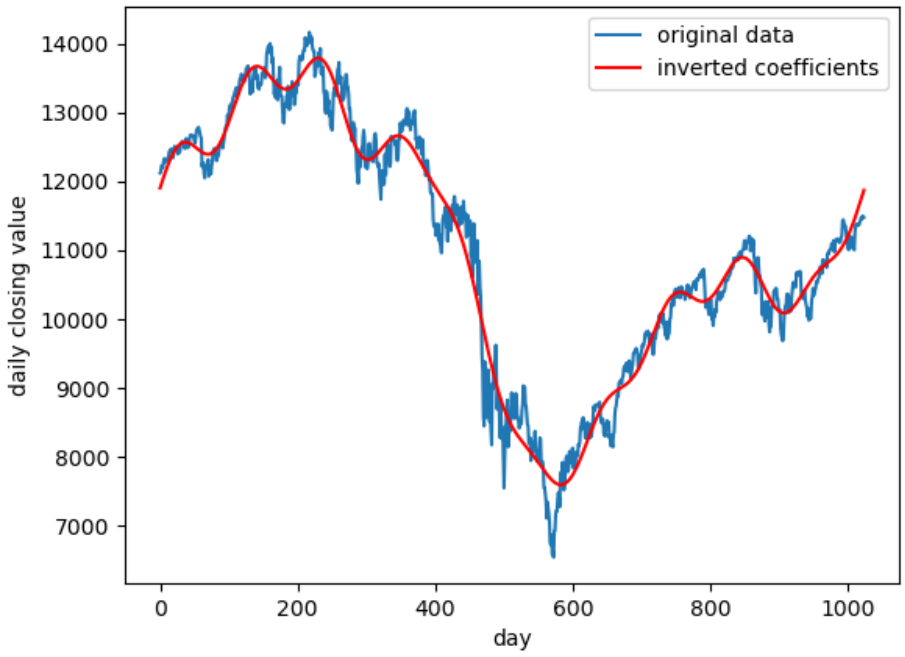

Figure 6: Comparison of original data for Dow Jones with inversion of Fourier coefficients with only first 2% of the coefficients used

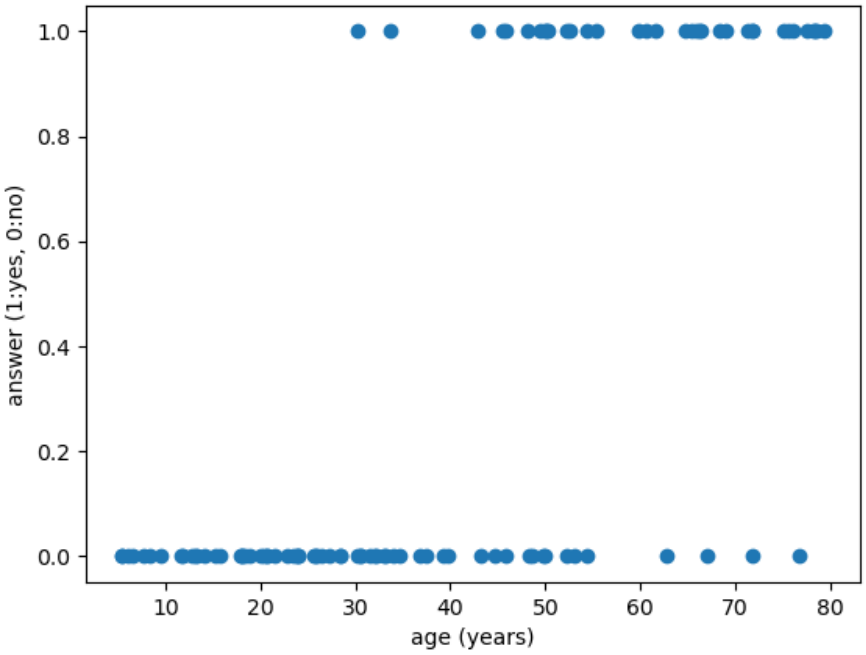

Figure 7: Plot of answers to survey by age

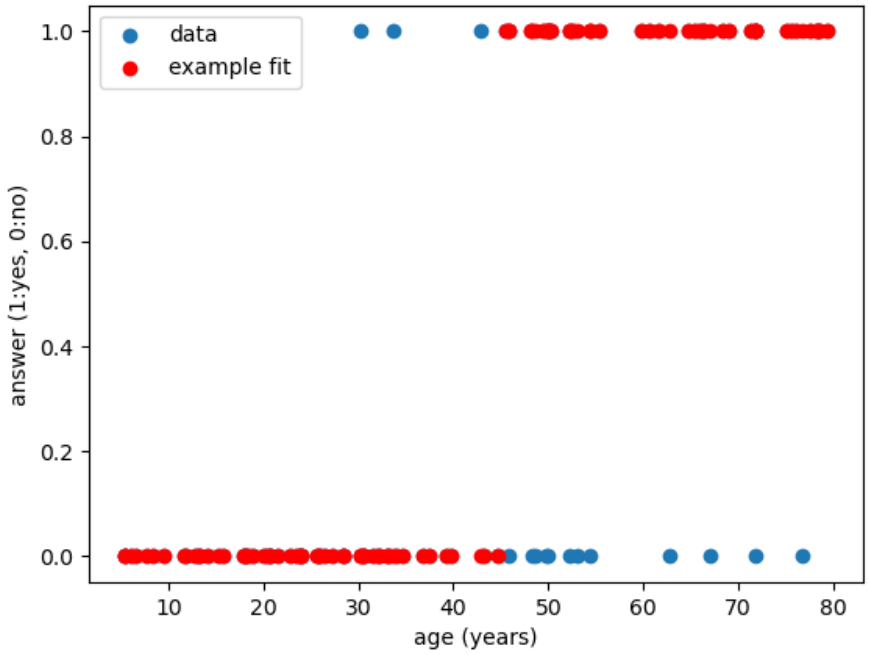

Figure 8: Plot of answers to survey by age compared with example fit, B0=-4500, B1=100