Math 572
Winter 2010

Project 1

Instructions: This project is worth a total of 10 points. You may use any notes or books that you wish but you must work individually. The only computation aid which you may use is MATLAB, unless otherwise indicated. The primary reference for this project is the notes on Fourier series, DFT and FFT which can be found at: `http://www.math.ohio-state.edu/~husen/teaching/572/fft.pdf` Make sure to write clearly and justify your answers.

(1.) Let $\mathbf{y} = (1, 2, 3, 4, 5, 6, 7, 8)^T$. Find the discrete Fourier transform of $\mathbf{y}$ using the fast Fourier transform algorithm of Cooley and Tukey in the following manner WITHOUT using Matlab.

(a.) Find the Fourier matrix F_8, the permutation matrix P_8 and the matrix D_4 as in the notes.

(b.) Decompose F_8P_8 into blocks involving F_4 and D_4F_4.

(c.) Continue with a second decomposition stage by decomposing the F_4 matrices in part (b.) into blocks involving F_2 and D_2F_2.

(d.) Use the decomposition in part (c.) to calculate the discrete Fourier transform of $\mathbf{y}$ - make sure to indicate what needs to be done to $\mathbf{y}$ to carry out this calculation.

(e.) Check your result using the Matlab command: `fft(y)`.