Homework Set 6

Due: Thursday Dec. 11

Instructions:

1. This homework is *optional*, in the sense that I will count your five highest homework grades, so if you want to replace one grade and are in good enough shape on your project, it makes sense to do it. But given the relative weight in the grading scheme of one homework vs. the project, I would not encourage you to do this if you really need to put the time into your project instead.

2. You are welcome to work together on homework problems, but you should each turn your own work, for which you are individually responsible.

3. The Proakis-Manolakis book is designated by \textit{PM}, and the Ingle-Proakis book by \textit{IP}.

Reading covered by this homework assignment:

1. \textbf{PM}: Chapter 6, sections 6.1, 6.2, 6.4. Chapter 7, sections 7.1, 7.2 (except 7.2.4), 7.3 (except 7.3.5), 7.4, 7.5, 7.6, and 7.7

2. \textbf{IP}: Chapter 5, the last section on the Fast Fourier Transform. Chapter 6, except for the last section on Lattice Filter Structures

Reading assignment for upcoming classes (Nov. 24 through Dec. 1:)

1. \textbf{PM}: Chapter 4, sections 4.2.9 through 4.2.12, Chapter 9 (read quickly to get the main ideas), Chapter 10, with emphasis on sections 10.1 through 10.3, 10.5.1 and 10.5.2, 10.9

Problems:

1. From \textbf{PM} Chapter 6, problem 6.13. For part (c), the goal is to write down exactly what gets calculated, in terms of \(x(n)\), to compute \(X(7)\), by following the paths in the flow graph. Of course you know what the correct answer should be so you should verify that it is indeed the same as the DFT formula.

2. From \textbf{IP} Chapter 6, problem 6.3, parts (a) through (d) only. Note that you can use Matlab to do all the algebra if you wish. You just need to represent the polynomial coefficients as vectors, keep careful track of the resulting powers of \(z^{-1}\), and use the \texttt{conv} function in Matlab to do polynomial multiplication and the \texttt{roots} function to factor the polynomials into first order terms. Once you have the first order terms you can use the \texttt{poly} function to compute the coefficients of second order terms from the roots as needed.
3. From PM Chapter 7, problem 7.24. After you solve the problem, look at the resulting F matrix. What should its eigenvalues be (keeping in mind the relationship between eigenvalues of F and poles of the corresponding system)? Illustrate that this is true for \( M = 3 \).

4. From PM Chapter 7, problem 7.45. To make parts (c) and (e) more specific, consider the case where you have 3 bits of precision and use a rounding rule that rounds to the next largest (in algebraic value) legal number. (Check \( \text{ceil} \) in Matlab for an implementation of this rule for integers. Note that \( \text{ceil}(-5.6) = -5 \) and \( \text{ceil}(5.6) = 6 \). For this example use the same rule but to 3 binary digits, that is, the smallest unit of precision is \( 2^{-3} = 1/8 \).) Let \( a = 11/16 \) for this example and answer parts (c) and (e) in terms of this specific value of \( a \), precision, and rounding rule.