ESO207: July-Nov 2017

Programming Assignment *1* *Due: August 30, 2017, 11:59pm*

Problem 1. Implement FFT and its inverse

The problem asks you to write code to implement the recursive FFT algorithm and FFT inverse algorithm discussed in the class. Your program should start by taking an input 0 or 1. If input is 0, this means that the FFT algorithm has to be run, and the input that follows is of the form
$n\ a_0\ b_0\ a_1\ b_1\ \ldots\ a_{n-1}\ b_{n-1}$
where n is the degree bound of the input polynomial and the pair $a_j\ b_j$, each a floating point number, specifies the complex number $c_j = a_j + ib_j$ as the coefficient of x^j of the input polynomial. Assume that n is a power of 2. Thus, the input polynomial is $A(x) = \sum_{j=0}^{n-1} c_j x^j$.
If the first input is 1, this means that the inverse FFT has to be computed. The input that follows is n, the degree-bound of the polynomial to be computed and assumed to be a power of 2, followed by the values of the *DFT* of the polynomial. The format is the same as before:
$n\ y_0\ z_0\ y_1\ z_1\ \ldots\ y_{n-1}\ z_{n-1}$
Here, the pair $y_j\ z_j$ specifies the complex number $y_j + iz_j = A(\omega_n^j)$, for some polynomial A, that is, it is the jth coordinate of a given DFT. Once the input is specified, your program should compute the FFT or the inverse FFT as requested and present the output in vector form.

Example:
Input:
0 4 0 0 1.0 0 2.0 0 3.0 0
Output:
4 6.0 0 -2.0 -2.0 -2.0 0 -2.0 2.0

That is, the DFT of $x + 2x^2 + 3x^3$ is the vector $[6, -2 - 2i, -2, -2 + 2i]$

Example:
Input:
1 4 6.0 0 -2.0 -2.0 -2.0 0 -2.0 2.0
Output:
4 0 0 1.0 0 2.0 0 3.0 0

That is, the DFT^{-1} of the vector $[6, -2 - 2i, -2, -2 + 2i]$ is the polynomial $x + 2x^2 + 3x^3$.