Math 320 Programming Project I - Fall 2018

Please submit all project parts on the Moodle page for MAT320. You should include all necessary files to recompile, a working executable, and a README.txt, all in a zipped folder (one file for upload). The README should contain: C++ version information if necessary, suggested command line compile and run commands, any other information needed to compile or run. Time-stamp determines the submit time, due by midnight on the due-date.

Part I: Complex Numbers

Due: Friday, 9/28

For each part below, you will need to write a command line program in C++ with text input and output. Programs should compile with g++ on Linux and with Clang on the Mac, so no Windows specific code is allowed. Parts can also be combined into one program with a clearly defined interface to run separate parts.

Input files of complex numbers should be one number per line of the form: $-1.23 + 4.56789i$ or $-1.23 - 4.56789i$ but not $-1.23 + -4.56789i$.

1. • input: command line args: N (number of complex values), x (angle multiplier), input.txt (text file of N complex numbers)

   • output: the complex numbers rotated by $2\pi x$ (counterclockwise for $x > 0$ and clockwise for $x < 0$)

2. • input: command line args: positive integers N and k

   • output: complex number sum of the first k powers of the Nth root of unity $e^{i2\pi/N}$

$$1 + e^{i2\pi/N} + (e^{i2\pi/N})^2 + \cdots + (e^{i2\pi/N})^{k-1}$$

3. • input: command line arg N, and two text files of N complex numbers each

   • output: the complex inner product of the two vectors given by the text files

4. • input: command line arg N, and text file of N complex numbers

   • output: the complex inner product of the vector given by the text file with the complex vector of roots of unity:

$$(1, e^{i2\pi/N}, (e^{i2\pi/N})^2, \cdots, (e^{i2\pi/N})^{N-1})$$

Note: The complex inner product of two vectors is given by:

$$(z_1, z_2, \ldots, z_n) \bullet (w_1, w_2, \ldots, w_n) = z_1\bar{w}_1 + z_2\bar{w}_2 + \cdots + z_n\bar{w}_n.$$