CIS 455 – Homework #5

Due on myCourses *before* 11:59pm on Sunday, April 29th, 2018

Instructions: There are 6 problems worth 100 points total.

Submit on myCourses: solutions to the written parts. Do **not** zip up your code, since I can't comment directly in your .doc/.pdf on myCourses.

Submitting modified versions of other people's work as your own (*or copying from websites*) is considered cheating and will result in an "F". If you feel it would help, you are encouraged to work together on homework. But remember that you must submit your own work, as the point of the homework is to learn the material. *If you do work with others on homework, you must write the names of those you worked with on your homework.*

Late Homework will be penalized until May 1st. **Homework will no longer be accepted after 11am on May 1st.**

Problem 6-1. (10 points) Jones & Pevzner, Problem 7.1, page 244.
Construct the recursion tree for MergeSort on the input (2, 5, 7, 4, 3, 6, 1, 8).

Problem 6-2. (20 points) Consider the sequences ***v=TACG*** and ***w=GGAC***.
Assume that the match premium is **+1** and that the mismatch and indel penalties are **-1**.
Use the *linear-space sequence alignment algorithm* to find a global alignment between ***v*** and ***w*** by filling out a series of dynamic programming tables, similar to Figure 7.3 on page 235. You can use the ones on the next page.

1. After correctly filling out the table (10 points) What is the score of the optimal global alignment? (5 points)
2. What alignment does this score correspond to? (5 points)

Problem 6-3. (10 points) Jones & Pevzner, Problem 8.1, page 302.
Can 99 phones be connected by wires in such a way that each phone is connected with exactly 11 others? (2 points)
Why/why not? (8 points)

Problem 6-4. (10 points) Jones & Pevzner, Problem 8.5, page 302.
Can one use **a single** 12-inch-long wire to form a cube? (each of the 12 cube edges is 1-inch long) (5 points)
If not, what is the smallest number of cuts one must make to form this cube? (5 points)

Problem 6-5. (30 points) Jones & Pevzner, Problem 8.6, page 302.
Find the shortest common superstring for eight 3-mers: {AGT, AAA, ACT, AAC, CTT, GTA, TTT, TAA} and solve the following two problems:

1. Construct the graph with 8 vertices corresponding to these 3-mers (Hamiltonian path approach) and find a Hamiltonian path (7 edges) which visits each vertex exactly once. (10 points)
    a. Does this path visit every edge of the graph? (2 points)
    b. Write the superstring corresponding to this Hamiltonian path. (3 points)
2. Construct the graph with 8 edges corresponding to these 3-mers (Eulerian path approach) and find an Eulerian path (8 edges) which visits each edge exactly once. (10 points)
    a. Does this path visit every vertex of the graph exactly once? (2 points)
    b. Write the superstring corresponding to this Eulerian path. (3 points)

Problem 6-6. (20 points) Jones & Pevzner, Problem 8.9, page 303.
Use the Eulerian path approach to solve the SBH problem for the following spectrum:
S = {ATG, GGG, GGT, GTA, GTG, TAT, TGG}
Label edges and vertices of the graph, and **give *all* possible sequences** *s* such that *Spectrum*(*s*,3) = ***S***.