CIS 455 – Homework #5

Due on myCourses *before* 11:59pm on Monday, November 30th, 2015

Instructions: There are 6 problems worth a total of **100** points.
Submit on myCourses: solutions to all written parts. *Document and indent your pseudocode properly*. You will be graded on both your solutions and your ability to show their correctness.

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, please write the names of those you worked with on your homework.*

Late Homework will be penalized!

Problem 5-1. (20 points) Jones & Pevzner, Problem 6.56, page 224.
Consider the Exon Chaining problem in the case when *all intervals have the same weight*.

1. (15 points) Design a greedy algorithm that finds an optimal solution for this limited case of the problem, and describe your algorithm in pseudocode format.
2. (5 points) Show how your algorithm would solve the example in Figure 6.26 (page 202) if all 9 intervals had the same weight.

Problem 5-2. (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 5-3. (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 5-4. (10 points) Jones & Pevzner, Problem 8.5, page 302.
Can one use a 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 5-5. (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 5-6. (20 points) Jones & Pevzner, Problem 8.9, page 303.
Use the Eulerian path approach to solve the SBH problem for the following spectrum:
$\boldsymbol{S}$ = {ATG, GGG, GGT, GTA, GTG, TAT, TGG}
Label edges and vertices of the graph, and **give *all* possible sequences** s such that $Spectrum(s,3) = \boldsymbol{S}$.