EC 504
Spring, 2021
HW 7

Due Friday, April 16, 8PM on Gradescope.

1. (15 pts) Consider the two words: *perplex* and *peruse*. Consider them as a sequence of letters. We would like to find the best alignment of the two letter sequences, with the following costs:

   - Incur a penalty of 1 for any skipped letter.
   - Incur a penalty of 3 for matching a consonant to a vowel.
   - Incur a penalty of 2 for mismatching a consonant to another consonant or a vowel to another vowel.
   - Incur a reward of 1 for correctly matching two letters.

   Using this reward structure, find the minimum cost alignment. State the cost of the alignment.

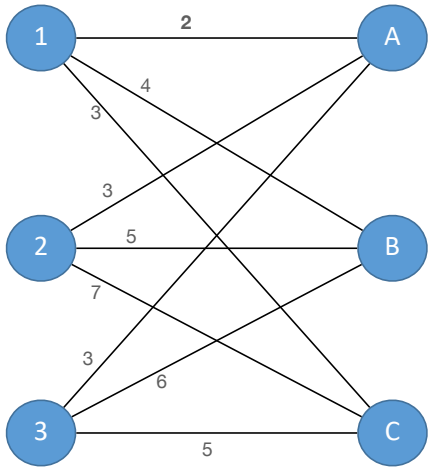
2. (20 pts) Consider the assignment problem illustrated in the figure on the right, where the costs are indicated on each of the edges. We are going to perform several steps of the successive shortest paths algorithm for solving this problem.

   (a) As initialization, what are the initial prices of vertices A, B, C and vertices $1, 2, 3$?

   (b) Let S be an added start node, and let T be an added destination node. Compute a shortest augmenting path consisting of vertices $S - 1 - A - T$, including the distance to all vertices. What are the adjusted prices of the vertices A, B, C and the vertices $1, 2, 3$ after computing the distances and modifying the prices?

   (c) Perform the augmentation on path $S-1-A-T$. Compute and show the residual graph with the modified distances.

   (d) Compute a new shortest augmenting path on this residual network, and compute the distances in the reduced graph to every node, and modify the prices for vertices $A, B, C, 1, 2, 3$.



3. (10 pts) Consider the following pairs of coordinates: (7,2), (2,3), (4,6), (5,9), (8,1), (10,4), (13,5) (6,7), (9,8). Arrange them in a quadtree, using the maximum range 0-15 for each of the coordinates.

4. (10 pts) Consider the following pairs of coordinates: (7,2), (2,3), (4,6), (5,9), (8,1), (10,4), (13,5) (6,7), (9,8). Show the 2-d binary search tree which results from inserting these elements in the order given, with no attempt to balance them.

5. (15 pts) Consider the following pairs of coordinates: (7,2), (2,3), (4,6), (5,9), (8,1), (10,4), (13,5) (6,7), (9,8). Form a balanced 2-d binary search tree using the median of the elements to split, with all the keys at the leaves of the tree. To make things unique, when you have to find a median of a list with an even number of entries, choose the smaller of the two entries as the median. Assume also that when a key is equal to the navigation key, it is added to the left subtree (that is, less than or equal).

6. (20 pts) Consider the following pairs of coordinates: (7,2), (2,3), (4,6), (5,9), (8,1), (10,4), (13,5) (6,7), (9,8). Insert them as points into a 3-1 R tree, using increase in perimeter as the rule for navigation when selecting which leaf to insert. Consider a point as a rectangle with zero area and zero perimeter (i.e. the two corner points are the same.) Use the linear splitting rule to select seeds for splitting. Show the sequence of R trees that result from each insertion.