Quiz #3 CS361 Spring 2017 Name: Alexander Mahdyh

I. True or False (1 point each, best 6, answer all)

T 1. If $p = \langle v_1, v_2, \ldots, v_k \rangle$ is a shortest path from v_1 to v_k, $1 \le i \le j \le k$, and $p_{ij} = \langle v_i, v_{i+1}, \ldots, v_j \rangle$ is a sub-path of p from v_i to v_j, then, p_{ij} is a shortest path from v_i to v_j.

T 2. A relaxation step may decrease the value of the shortest-path cost d[v], and update v's predecessor π[v] if decrease step happens.

F 3. The single source shortest path of a graph forms a tree, and the tree is always unique.

F 4. In class we introduced at least two algorithms to find the single-source shortest-paths, and The Bellman-Ford one is faster.

F 5. Neither Bellman-Ford's nor Dijkstra's SSSP algorithm allows negative edges.

F 6. We cannot use Radix sort to sort strings.

F 7. Since Merge sort is the best comparison based algorithm and is O(n*log n), Radix sort cannot be faster than that.

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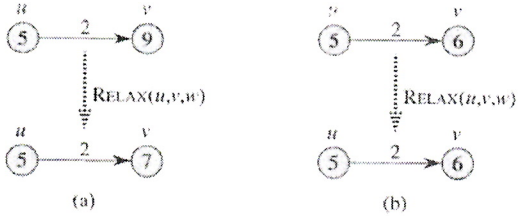
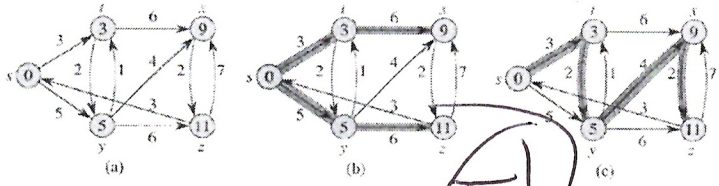
II. Multiple choice, circle the best answer (2 points each, best five, answer all)



1. For the charts above, the d[v] in (b) does not change because
   a. uv is not an edge
   b. d[u] + the weight of uv > d[v]
   c. d[u] < d[v] already
   d. d[v] can only be defined once.



2. The charts above shows that
   a. Bellman-Ford and Dijkstra algorithms may not find the same tree.
   b. Dijkstra algorithm can handle graphs with cycles
   c. Bellman-Ford algorithm can handle graphs with cycles
   d. Only the tree in (c) shows single-source shortest-paths

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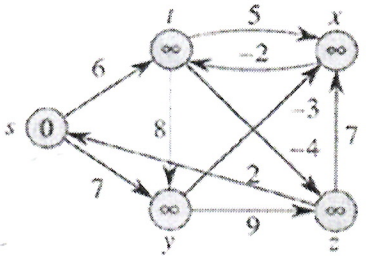
3. I have 10,000,000 positive integers stored in an array of integers (32-bit). To sort them using Radix sort, I need
   a. O(n) steps, which is exactly 10,000,000 steps.
   b. O(n log n) steps, which is about 70,000,000 steps.
   c. about 32*(10,000,000 + 10) steps.
   d. about 32*(10,000,000 + 2) steps.

4. Regarding the chart given on the right, which of the following statement is true
   a. It does not have a SSSP because it has edges with negative weight.
   b. We cannot use Dijkstra's algorithm on it because it has edges with negative weight.
   c. We cannot use Bellman-Ford's algorithm on it because it has edges with negative weight.
   d. We cannot use Dijkstra's algorithm on it NOT because it has edges with negative weight. because the graph has negative cycles/cycles



5. Regarding the properties of relaxation, which of the following statements is false
   a. d[v], not is equal to infinity, is the length of some part from s to v.
   b. d[v] may decrease, but never increases.
   c. Once d[v] is the length of the shortest path, then it stays unchanged.
   d. If there is a direct edge from s to v, then its weight should be the value for d[v]. There could be many vertices between uv.

6. I need to sort 1,800,000 numbers range from -999,999 to 1,000,000, which of the following approaches is the best?
   a. I should use the radix sort.
   b. I should use merge sort or quick soft.
   c. I can have an array of 1,800,000 bits, initialize to false, and offset a number with 999,999 as an index.
   d. I can have an array of 2,000,000 bits, initialize to false, and offset a number with 999,999 as an index.

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III. Show how to sort the following numbers (left most column) using radix sort by relisting them in the later columns. You may not need to use all the column provided (4 points).

Original numbers	Pass 1	Pass 2	Pass 3	Pass 4	Pass 5
432	0	0	0		
777	1	1	1		
0	432	5	5		
1	123	9	4		
666	333	123	88		
88	5	333	123		
123	666	432	333		
9	777	666	432		
5	88	777	666		
333	9	88	777		

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