Quiz 2

Started: Oct 1 at 10:49am

Quiz Instructions

Question 1 2 pts

Let A = (a1, a2, a3, ... , a9) be 9 positive integers. Assume that the longest increasing subsequence of A is (a2, a5, a7, a8, a9). Then we have that one of the longest increasing subsequence of its first 7 numbers, i.e., A' = (a1, a2, a3, a4, a5, a6, a7), is (a2, a5, a7).

- ○ True
- ● False

Question 2 2 pts

Let G be a directed graph with n vertices. Let P be the length of the shortest path from vertex s to vertex v with at most n edges. Let Q be the length of the shortest path from vertex s to vertex v with at most (n+1) edges. If we have P = Q, then G does not contain negative cycle that can be reached from s.

- ○ True
- ● False

Question 3 2 pts

Suppose that G does not contain negative cycle. Let (u,v) be an edge of G and l(u,v) be its length. When the Bellman-Ford algorithm terminates (i.e., after |V| - 1 iterations), we must have that dist(u) + l(u,v) >= dist(v).

- ● True
- ○ False

Question 4

3 pts

Let A and B be two strings of length m and n, respectively. Let d be the edit distance between A and B; let d1 be the edit distance between A[1 ... m/2] and B, and let d2 be the edit distance between A[m/2+1 ... m] and B. Then we have

- ◯ d >= min {d1, d2}
- ◉ none of the other three is correct.
- ◯ d <= min{d1, d2}
- ◯ d <= max{d1, d2}

Question 5

3 pts

For the given instance (vector A and complex number w; shown on screen), FFT(A, w) returns:

- ◯ (1 - w, 0, w - w^2)
- ◉ (0, 1 - w^2, 1 - w)
- ◯ (1 - w^2, 0, 1 - w - w^2)
- ◯ (0, 1 - w, 1 - w^2)

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Question 1. An counter-example is $A = (10, 1, 20, 30, 2, 40, 3, 4, 5)$.

If you think this statement is true, then you did not understand why we define those subproblems in the dynamic programming algorithm (introduced in lecture).

Define $P[k]$ *as the subproblem of finding the longest increasing subsequence of* $A[1 \cdots k]$ *such that the last element is* $A[k]$ leads to an efficient dynamic problem algorithm (as we did in the lecture).

Define $P[k]$ *as the subproblem of finding the longest increasing subsequence of* $A[1 \cdots k]$ does not lead to such an efficient algorithm, and the above example explains why.

Question 2. If for a single vertex v we have $P = Q$ then it is not sufficient to guarantee that G does not contain negative cycle (that can be reached from s). It suffices if for *every* vertex we have $P = Q$.

Question 3. If G does not contain negative cycle, when Bellman-Ford algorithm terminates, we have $dist(v) = distance(s, v)$ for every $v \in V$. Therefore, we must have $dist(u) + l(u, v) \geq dist(v)$ for every $(u, v) \in E$; otherwise, for v we will have a shorter path: from s to u followed by edge (u, v).

Alternatively, we have proved that, in the algorithm to identify negative cycles within Bellman-Ford algorithm, after $(|V| - 1)$ iterations, G contain negative cycles if and only if we have $dist(u) + l(u, v) < dist(v)$ for some edge $(u, v) \in E$. Since we are told that G does contain negative cycle, then after $(|V| - 1)$ iterations, we must have $dist(u) + l(u, v) \geq dist(v)$ for every edge $(u, v) \in E$.

Question 4. This problem tests you (quickly) constructing counter-examples:

1. $d \geq \min\{d_1, d_2\}$. False. Let $A = TT$, $B = TT$.
2. $d \leq \min\{d_1, d_2\}$. False. Let $A = TT$, $B = T$.
3. $d \leq \max\{d_1, d_2\}$. False. Let $A = TT$, $B = T$.

Question 5. FFT(A, w) returns $M(w) \cdot A$.