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Program Structure and Algorithms (INFO 6205)
Quiz #6 – 30 points

Student NAME:

Student ID:

Question 1 (10 points). *Please say if the following statements are* ***True*** *or* ***False.*** *No need to provide any explanations.*

(a) *(2 points) If a problem has optimal substructure, then dynamic programming can be used to solve it.*

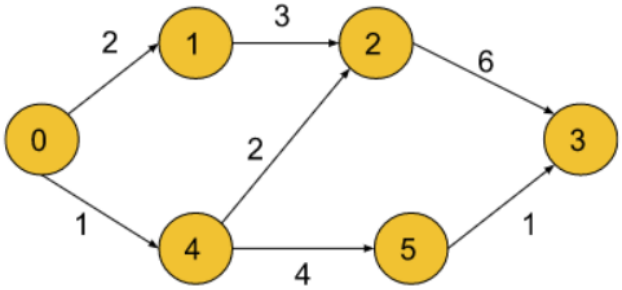
(b) *(2 points) Memoization is an effective strategy to reduce how often a subproblem is computed / solved.*

(c) *(2 points) Any dynamic programming algorithm that solves n subproblems must run in $\Omega(n)$ time.*

(d) *(2 points) Given a graph $G = (V, E)$ with positive edge weights, the Bellman-Ford algorithm and Dijkstra's algorithm will always produce the same shortest-paths besides always producing the same shortest-path cost.*

(e) *(2 points) Then Bellman-Ford algorithm can be extended to detect whether the graph has negative weight cycles.*

Question 2 (20 points). *Consider the graph $G = (V, E, w)$ below for which you need to calculate the shortest path from vertex 0 to all other vertices in the graph using* **dynamic programming**. *w are real-valued edge weights.*



(a) *(5 points) Please describe your subproblems succinctly.*

(b) *(5 points) Please describe your decisions to solve one subproblem, and the recursion to solve all subproblems.*

(c) *(3 points) Please state the number of subproblems, running time per subproblem and the overall running time of your algorithm.*

(d) *(7 points) Please fill the table below and precisely describe all the computations required to calculate the shortest path given by* $\delta(u), \forall u \in V$*. "Order" is the computation order, will be 0 for the base-case, 1 for the first subproblem and so on.*

$\delta(\cdot)$	*Order*	*Computations*
$\delta(0)$		
$\delta(1)$		
$\delta(2)$		
$\delta(3)$		
$\delta(4)$		
$\delta(5)$		