Advanced Programming, II Semester, 2014–2015 Quiz 5, 30 March 2015

Answer all questions in the space provided. Use the reverse for rough work, if any.

- 1. Recall that Dijkstra's algorithm to compute the shortest path from a source vertex s to every other vertex keeps track of two quantities: the time at which each already visited vertex was "burnt" and the expected burning time for all as yet unburnt vertices. The main loop of the algorithm repeats the following steps till all the vertices are burnt:
 - Burn the unburnt vertex with minimum expected burning time.
 - Update the expected burning time of all neighbours of the vertext just burnt.

Let G = (V, E) with |V| = n and |E| = m. What is the complexity of Dijkstra's algorithm in each of the following implementations, in terms of n and m?

Representation of G	Data structure for expected burning time	Worst-case Complexity
Adjacency Matrix	Array	$O(n^2)$
Adjacency List	Array	$O(n^2)$
Adjacency Matrix	Heap	$O(n^2 + m \log n)$ or $O(n^2 \log n)$
Adjacency List	Heap	$O((m+n)\log n)$

(5 marks)

- 2. We have a connected graph with edge weights with n vertices and m edges. We execute the following algorithm. Start with the original graph. Consider each edge e_j in decreasing order of cost. If this edge is part of a cycle delete it.
 - (a) What does the algorithm achieve?

Constructs a minimum-cost spanning tree.

(b) How many edges will the algorithm delete?

The final tree has n-1 edges, so m-(n-1) edges will be deleted.

(5 marks)