

**Data Structure (CS2351) Final Exam 2006/06/12**

1. Given a graph  $G =$  
$$\begin{matrix} & \begin{matrix} 0 & 1 & 2 & 3 & 4 & 5 & 6 \end{matrix} \\ \begin{matrix} 0 \\ 1 \\ 2 \\ 3 \\ 4 \\ 5 \\ 6 \end{matrix} & \begin{bmatrix} 0 & 28 & 0 & 0 & 0 & 10 & 9 \\ 28 & 0 & 10 & 0 & 0 & 0 & 14 \\ 0 & 10 & 0 & 12 & 0 & 0 & 0 \\ 0 & 0 & 12 & 0 & 22 & 0 & 18 \\ 0 & 0 & 0 & 22 & 0 & 25 & 24 \\ 10 & 0 & 0 & 0 & 25 & 0 & 0 \\ 9 & 14 & 0 & 18 & 24 & 0 & 0 \end{bmatrix} \end{matrix}$$
, where nonzero entry represents the

weight of an edge of  $G$ .

- Use Sollin's algorithm to find a minimum-cost spanning of  $G$  step by step. (10 %)
- Find the shortest path form node 0 to all other nodes of  $G$  step by step. (5 %)
- Starting form node 0, find the BFS sequence of  $G$  (assume that the search always starts from nodes with smaller ranks). (5 %)
- Starting form node 0, find the DFS sequence of  $G$  (assume that the search always starts from nodes with smaller ranks). (5 %)

2. Given a digraph  $G =$  
$$\begin{matrix} & \begin{matrix} 0 & 1 & 2 & 3 \end{matrix} \\ \begin{matrix} 0 \\ 1 \\ 2 \\ 3 \end{matrix} & \begin{bmatrix} 0 & 4 & 11 & 7 \\ 6 & 0 & 2 & 3 \\ 3 & \infty & 0 & 6 \\ 1 & 2 & \infty & 0 \end{bmatrix} \end{matrix}$$
. Find the all-pairs shortest paths. (10 %)

- Given list  $L = (12, 2, 16, 15, 8, 28, 4, 10, 20, 6, 18)$ 
  - Write down the sorting phase step by step if quick sort algorithm is applied. (10%)
  - Write down the sorting phase step by step if recursive merge sort algorithm is applied. (10%)
  - Write down the sorting phase step by step if heap sort algorithm is applied. (10%)
- Given an input sequence as (Mar, Feb, Nov, Dec, Aug, Jan, Oct, Jun, May, Sep, Jul, Apr). Construct the corresponding AVL tree step by step. (15 %)
- Let  $n = 5$  and  $(a_1, a_2, a_3, a_4, a_5) = (\text{do}, \text{for}, \text{if}, \text{return}, \text{while})$ . Let  $(p_1, p_2, p_3, p_4, p_5) = (3, 2, 3, 1, 2)$  and  $(q_0, q_1, q_2, q_3, q_4, q_5) = (2, 1, 2, 2, 3, 1)$ . The  $p$ 's and  $q$ 's have been multiplied by 22 for convenience. What is the optimal binary search for file (do, for, if, return, while). (20 %)

6. Given 12 identifiers and their internal representation as follows:

Identifier	Internal Representation
A	1
A1	134
A2	135
A4	137
A9	144
B	2
B2	235
C	3
C4	337
G	7
DMAX	4150130
AMAX1	115013034

Assume that a Mid-Square hashing function and linear open addressing overflow handling is used to hash these 12 identifiers into a symbol table with 12 buckets and each bucket has one slot. What is the symbol table looks like after these 12 identifiers, A, ..., AMAX1 in sequence, are inserted to the symbol. (10 %)