

1. Let  $G = (V; E)$  be an undirected graph such that  $m = O(n^{1.99})$ , where  $n = |V|$  and  $m = |E|$ . Suppose you want to find a minimum cost spanning tree of  $G$ . Which algorithm would you choose: Kruskal's or Prim's? Explain. (15%)
2. Write an algorithm to reverse a linked list pointed by the pointer "ptr". (10%)
3. (a) Please declare the data structure you use to represent a graph (4%).  
(b) Using the data structure defined in (a), write a program to visit the graph in depth first search order. Let  $n$  and  $e$  denote the number of vertices and edges in a graph, respectively. Please "analyze" the time complexity of your program. (12%)
4. Please write the quick sort algorithm. What is the worst case and average case time complexity of quick sort. (14%)
5. (a) What is a max heap? (5%)  
(b) Please write a program for data insertion into a max heap. Please "analyze" the time complexity (in terms of  $O$ ) of your program. (10%)  
(c) Please write the program to construct a max heap from an array, moreover, the time complexity of your program should not exceed  $O(n)$  (You should justify your answer). (15%)
6. Write a program to convert a 2-3-4 tree into its red-black representation. What is the time complexity of your program. (15%)