Masters Exam, Algorithms: Spring 2001

Answer all problems; the first problem is the most important.

1. Let $P_1, P_2, \ldots, P_n$ be $n$ programs to be stored on a single disk. Program $P_i$ requires $s_i$ kilobytes of storage, and the capacity of the disk is $D$ kilobytes, where $D < \sum_{i=1}^{n} s_i$. We want to maximize the number of programs held on the disk; give an optimal greedy algorithm to do this, and prove that the algorithm is correct.

Now, suppose we want to maximize the amount of space used on the disk (maximize $\sum_{i=1}^{n} s_i$). Can we do this? Why, or why not?

2. Give a definition and draw a graph to illustrate each of the following.
   - $O(f(n))$
   - $\Theta(f(n))$
   - $\Omega(f(n))$

3. Sketch code for minimum spanning tree (either Prim’s or Dijkstra’s).

4. For the tree shown, give the order of vertices visited in infix, prefix, and postfix order.

![Figure 1: A tree (assume that the root is vertex R).](image-url)