Fall 2006 **CMSC 451: Homework 3** William Gasarch

Due Sep 27, at Beginning of class

1. (10 points). Write your name clearly. Staple your HW. READ Chap 4.5-4.8

2. (40 points) Dr. Hcrasag has a way of sorting m elements in $O(m)$ steps. He also has a data structure for UNION-FIND which does the following: if the structure never has more than n elements in it, then m UNIONs take $O(mf(n))$ steps, and m FINDs take $O(mg(n))$ steps. You have to implement Kruskal's algorithm using ALL of his packages — his sorting algorithm and his UNION-FIND Data structure. The resulting program is called *Hcrasag's Program For MST*

   (a) How many steps does Hcrasag's program take (f and g may appear in the answer)?

   (b) Give values for f and g where Hcrasag's program is WORSE THAN Prim's algorithm.

   (c) Give values for f and g where Hcrasag's program is AS GOOD AS Prim's algorithm.

   (d) Give values for f and g where Hcrasag's program is BETTER THAN Prim's algorithm.

3. (30 points) Dijkstra's algorithm used the common definition of the cost of a path as being the SUM of the edge weights. We define the cost of a path as being the MAX of the weights on it. Write pseudo code for an algorithm for Single Source Shortest Path with this definition of distance.

4. (30 points) Consider the OFF-KILTER data structure. Show that, for all n, there exists a sequence of operations that results in an element being at depth ROUGHLY $\log n$. (NOTE- when doing UNION you put the SMALLER set under the BIGGER set.)