11/1/16

6. Homework
Due **11/8/16** at the beginning of class

1. **Marked Root (1 point)**
   Describe what sequence of operations in a Fibonacci heap would result in a root that is marked.

2. **Fibonacci Heap Path (4 points)**

   For any $n \geq 1$, describe how to form a sequence of Fibonacci heap operations that creates a Fibonacci heap in which all n nodes form a single path of height n.

3. **Second_Smallest (5 points)**

   (a) (2 points) How fast can you compute the second smallest element in a Fibonacci heap? Justify the correctness and runtime of your answer.

   (b) (3 points) Modify the Fibonacci heap data structure to implement a procedure computing the second smallest element in constant time.

4. **MST With Distinct Edge Weights (6 points)**
   Let $G = (V, E; w)$ be an edge-weighted, undirected connected graph where the edge weights are all distinct.

   (a) (3 points) Show that the MST of G is unique.

   (b) (3 points) Show that the second-best MST of G is not unique.

5. **Adding Edges in an MST (4 points)**

   Let $G = (V, E; w)$ be an edge-weighted, undirected connected graph, and let T be an MST for G.

   Now assume that a new edge e is added between two existing vertices. Describe how to find an MST of the new graph in time proportional to $|V|$.