After Lecture 21 & 22 & 23
Practice Problems (all taken from previous exams)

1. The number of trees in a binomial heap with n nodes is

   a) $\log n$
   b) n
   c) $n \log n$
   d) $\frac{n}{2}$

2. Which two Fibonacci heap functions have the same complexity?

   a) Insertion, Union
   b) Insertion, Deletion
   c) ExtractMin, Insertion
   d) Union, Delete

3. If V is the total number of elements, in the worst case, how many leader pointer updates are needed when fusing two groups in the union method:

   a) $O(1)$
   b) $O(\log |V|)$
   c) $O(|V|)$
   d) $O\left(|V|^2\right)$

4. Consider the following program:

```
for i in range(1, 13): # 1 to 12
        MakeSet(i)
Union(2,10)
Union(7,5)
Union(6,1)
Union(3,4)
Union(5,11)
Union(7,8)
Union(7,3)
Union(2,12)
Union(9,6)
Print(Find(6))
Print(Find(3))
Print(Find(11))
Print(Find(9))
```

   Assume the disjoint set data structure is implemented so after a union, the smallest valued element in the set is the label of the set. What is the output?

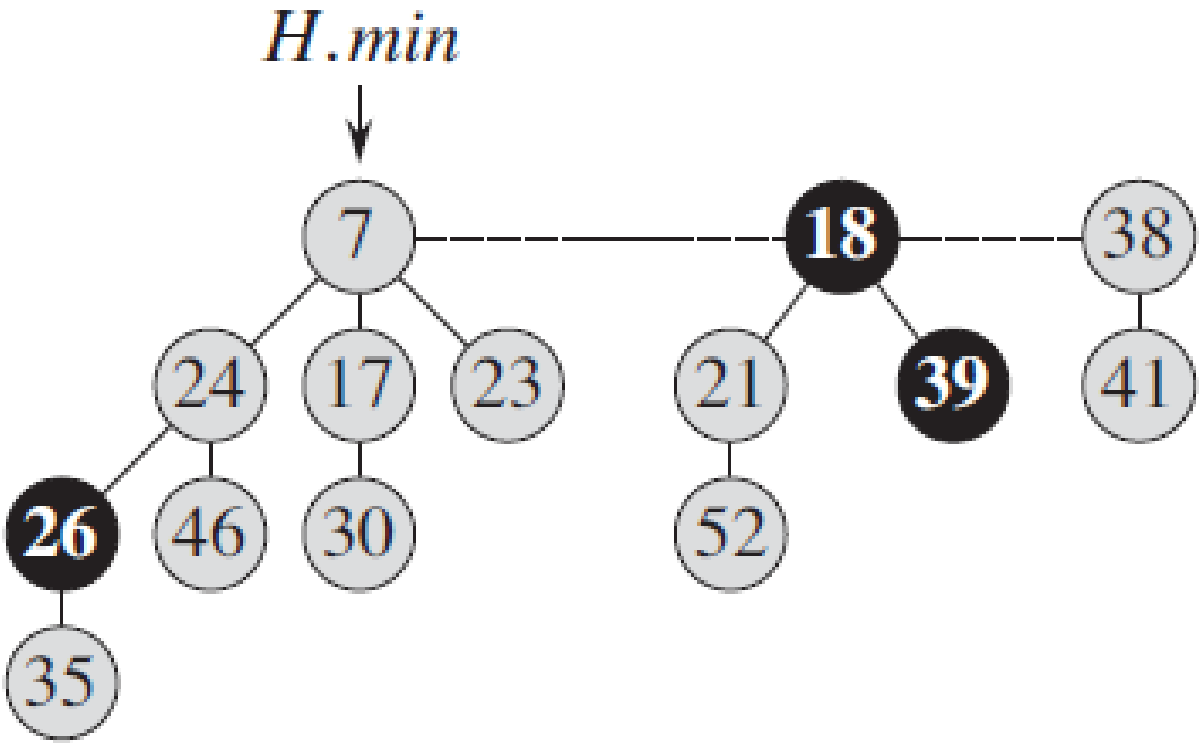
   a) 6 3 11 9

b) 3 1 1 3

c) 1 3 3 1

d) 9 11 11 9

5. Show the Fibonacci heap that results from calling FIB-HEAP-EXTRACT-MIN on the Fibonacci heap shown



6. We have students $1, 2, \ldots, n$ who need to be assigned to dormitories at a university that has an arbitrarily large number of dorms. There are m same dormitory requests $(s_1, t_1), (s_2, t_2), \ldots, (s_m, t_m)$ meaning students s_i and t_i must be assigned to the same dorm. There are also k different dormitory requests $(u_1, v_1), (u_2, v_2), \ldots, (u_k, v_k)$ meaning students u_i and t_i must be assigned to different dorms. Give an algorithm using the UNION-FIND structure to determine whether it is possible to assign students to forms so that all constraints are satisfied.