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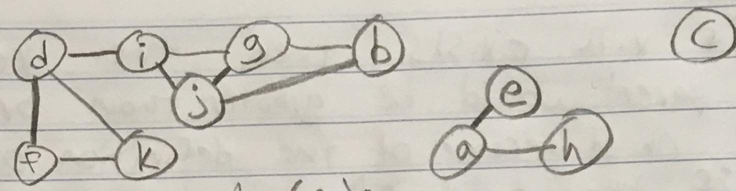
Homework #6

1\. a.



Connected_Components(G):

$\{a, e, h\}, \{b, d, f, g, i, j, k\}, \{c\}$

b. SAME_Component(a, h): true

SAME_Component(a, b): false

2\. $m = 2n - 1 = O(n)$

$O(m + n\lg n) = O(n + n\lg n) = O(n\lg n)$

3\. Instead of using the tail, you could use the head to add in each element of the smaller list into the beginning of the longer list. each insert takes $O(1)$ and with n elements in the shorter list it takes $O(n)$, which is the same as appending.

4\. $|V| - K$, this is correct because each connected component has $|v| - 1$ unions where v = verticies in the component. Since, $|V| = \sum_{1}^{k} |V| = K|V|$, then

$\sum_{1}^{k}(|v| - 1) = K|v| - K = |V| - K$

5\. 6: $d = 0$, $\pi = NIL$

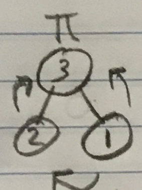
4: $d = 1$, $\pi = 6$

3: $d = 2$, $\pi = 4$

5: $d = 2$, $\pi = 4$

2: $d = 3$, $\pi = 3$

1: $d = 3$, $\pi = 5$



6. a. if $v.\pi$ exists then the key of the parent would be greater than or equal to the child because of the definition of a max-heap

b. if the root of a max-heap has a value of 3, and its two children have values of 2 and 1, both have $\pi.key = 3$ but $2 \geq 1$ and they are not predecesors

c. The height of the max-heap because each level represents a parent, so at most there would be a distance of the height of the tree on any path

7. Because of the FIFO property of the Queue, each element with the same distance will be discovered before the elements of larger distances. Therefore, by returning the distance of only the last element to leave the queue, it adds only $O(1)$ and would be the longest path.