Algorithms: Solutions 7

Problem 1
Give an algorithm that determines the number of nodes with key k in a subtree rooted at x.

TREE-COUNT(x, k)
if $x =$ NIL
  then return 0
if $k < key[x]$
  then return TREE-COUNT$(left\text{-}child[x], k)$
if $k > key[x]$
  then return TREE-COUNT$(right\text{-}child[x], k)$
return TREE-COUNT$(left\text{-}child[x], k)$ + TREE-COUNT$(right\text{-}child[x], k) + 1$

If the height of the tree is h and the number of nodes with key k is l, then the running time is $O(h + l)$.

Problem 2
Illustrate the application of CONNECTED-COMPONENTS to an undirected graph with vertices $\{a, b, c, d, e, f, g, h, i, j, k\}$ and edges $(e,g), (a,d), (i,k), (c,g), (b,f), (b,h), (f,k), (a,k), (f,h), (d,i)$.

Edge	Disjoint sets										
initial sets	$\{a\}$	$\{b\}$	$\{c\}$	$\{d\}$	$\{e\}$	$\{f\}$	$\{g\}$	$\{h\}$	$\{i\}$	$\{j\}$	$\{k\}$
(e, g)	$\{a\}$	$\{b\}$	$\{c\}$	$\{d\}$	$\{e, g\}$	$\{f\}$		$\{h\}$	$\{i\}$	$\{j\}$	$\{k\}$
(a, d)	$\{a, d\}$	$\{b\}$	$\{c\}$		$\{e, g\}$	$\{f\}$		$\{h\}$	$\{i\}$	$\{j\}$	$\{k\}$
(i, k)	$\{a, d\}$	$\{b\}$	$\{c\}$		$\{e, g\}$	$\{f\}$		$\{h\}$	$\{i, k\}$	$\{j\}$	
(c, g)	$\{a, d\}$	$\{b\}$	$\{c, e, g\}$			$\{f\}$		$\{h\}$	$\{i, k\}$	$\{j\}$	
(b, f)	$\{a, d\}$	$\{b, f\}$	$\{c, e, g\}$					$\{h\}$	$\{i, k\}$	$\{j\}$	
(b, h)	$\{a, d\}$	$\{b, f, h\}$	$\{c, e, g\}$						$\{i, k\}$	$\{j\}$	
(f, k)	$\{a, d\}$	$\{b, f, h, i, k\}$	$\{c, e, g\}$							$\{j\}$	
(a, k)	$\{a, b, d, f, h, i, k\}$		$\{c, e, g\}$							$\{j\}$	
(f, h)	$\{a, b, d, f, h, i, k\}$		$\{c, e, g\}$							$\{j\}$	
(d, i)	$\{a, b, d, f, h, i, k\}$		$\{c, e, g\}$							$\{j\}$	