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-child*$[x], k$)
if $k > key[x]$
  then return TREE-COUNT(*right-child*$[x], k$)
return TREE-COUNT(*left-child*$[x], k$) + TREE-COUNT(*right-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)	$\{a,b,d,f,h,i,k\}$		$\{c,e,g\}$							$\{j\}$	