

21.3-2

FIND-SET( $x$ )

visited = Stack()

while  $x \neq x.p$ :

visited.push( $x$ )

$x = x.p$

while visited  $\neq \emptyset$ :

visited.pop().  $p = x$

return  $x$

END

22.1-1

Out-degree:  $O(V + E)$

In-degree:  $O(V + E)$

22.1-3

List: Clone the list of vertices,  $v_1, v_2, \dots, v_n$ . Traverse the entirety of the old adjacency list, and for each  $(v, u)$  edge pair, append a  $\text{Node}(v)$  onto the list found at index  $u$  on the new vertex list. Time complexity:  $O(V + E)$

Matrix: Assuming you don't need a new, separate object, you can simply write an accessor function that switches the order of  $v$  and  $u$ . For example, when a user asks for  $G^T[v][u]$ , this function returns  $G[u][v]$ . Time complexity:  $O(1)$