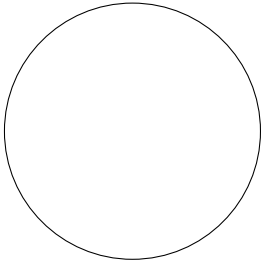
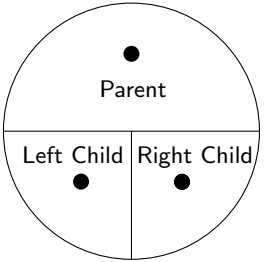
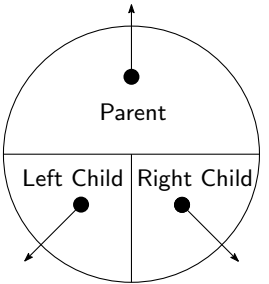
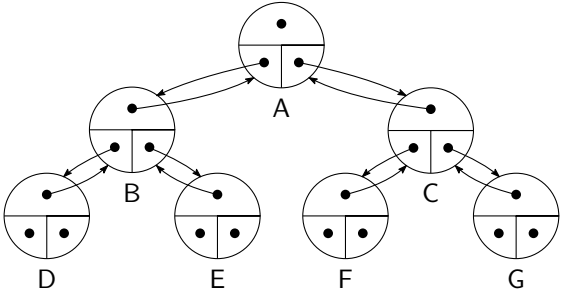
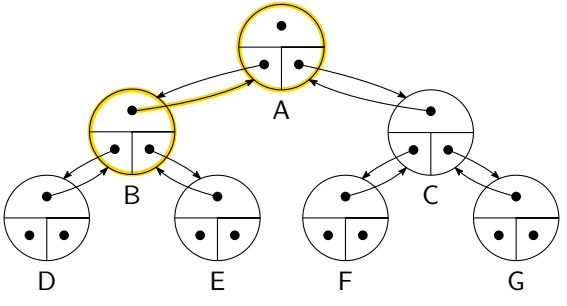
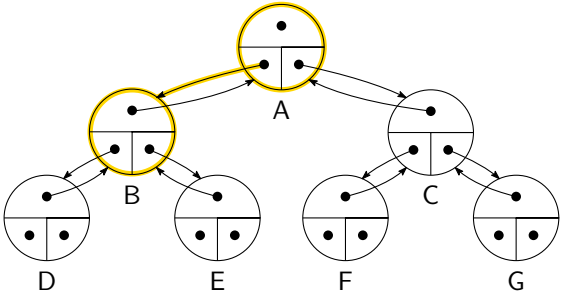

Node

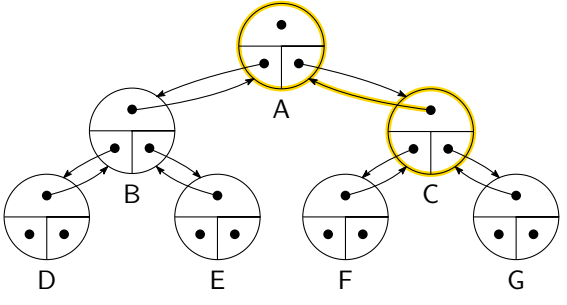

Parent
Left Child
Right Child
Node

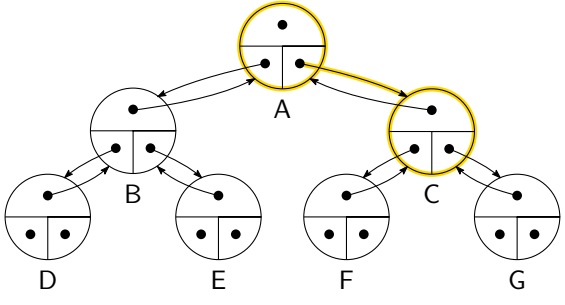

Parent
Left Child
Right Child
Node

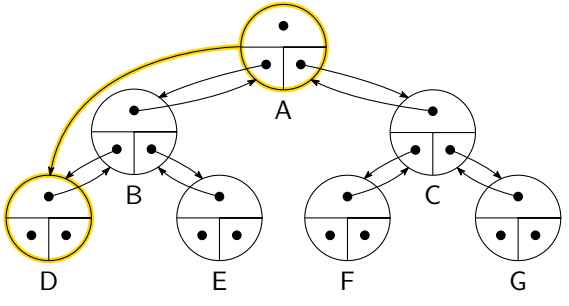

A
B
C
D
E
F
G

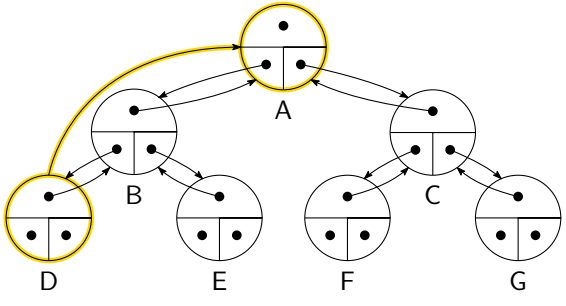

A
B
C
D
E
F
G

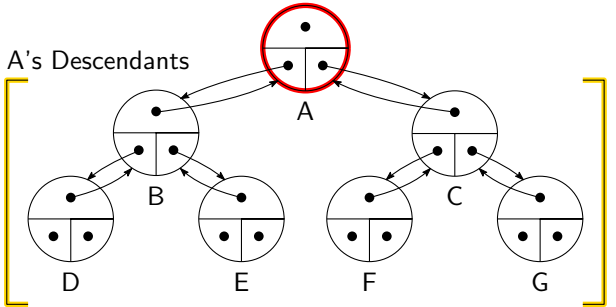

A
B
C
D
E
F
G

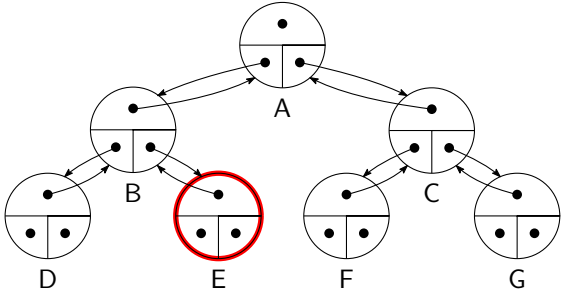

A
B
C
D
E
F
G

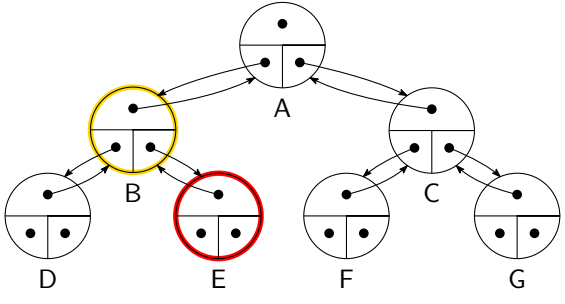

A
B
C
D
E
F
G

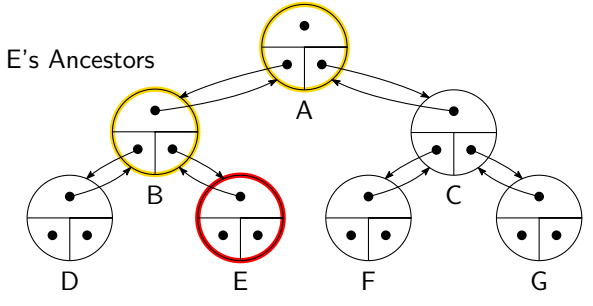

A
B
C
D
E
F
G

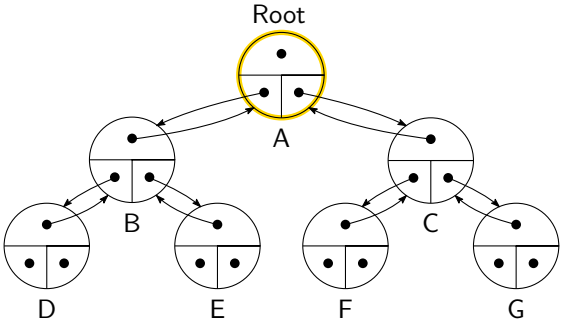

A
B
C
D
E
F
G

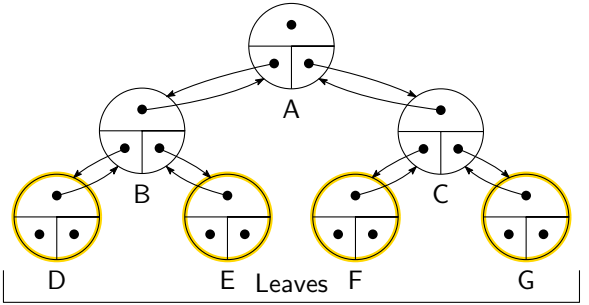

A's Descendants
A
B
C
D
E
F
G

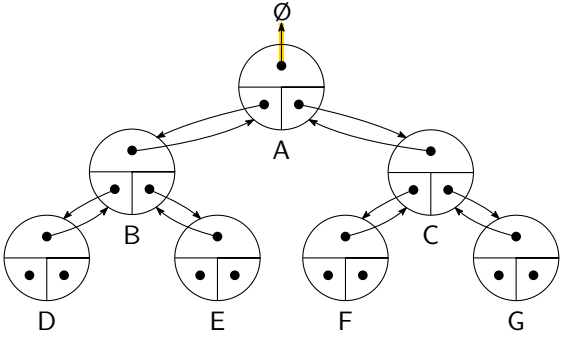

A
B
C
D
E
F
G

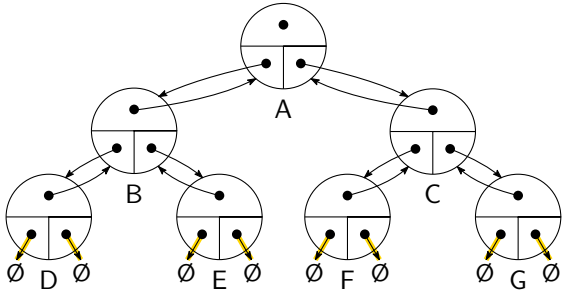

A
B
C
D
E
F
G

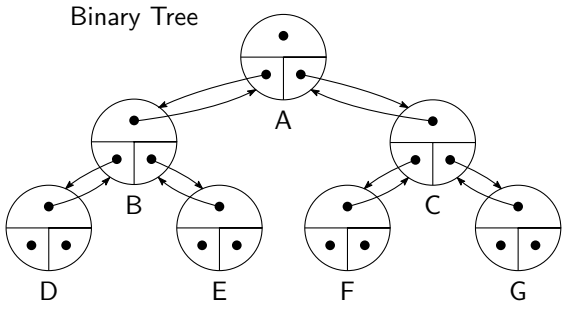

E's Ancestors
A
B
C
D
E
F
G

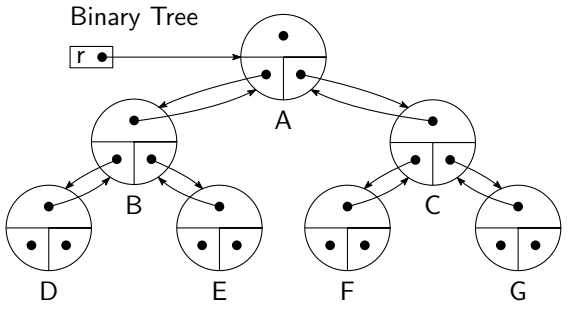

Root
A
B
C
D
E
F
G

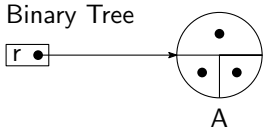

A
B
C
D
E
Leaves
F
G

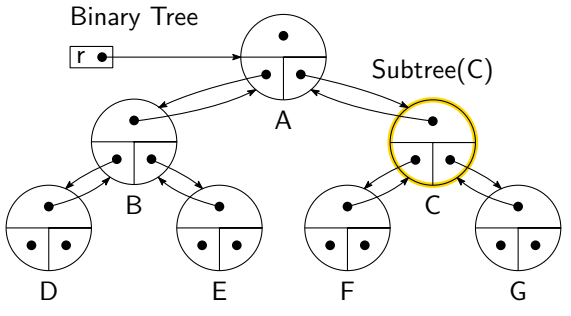

Ø
A
B
C
D
E
F
G

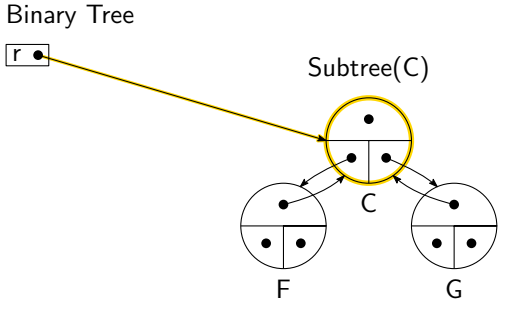

A
B
C
Ø
D
Ø
Ø
E
Ø
Ø
F
Ø
Ø
G
Ø

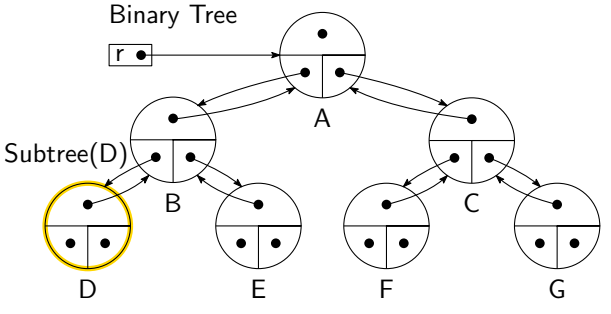

Binary Tree
A
B
C
D
E
F
G

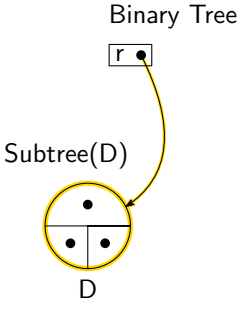

Binary Tree
r
A
B
C
D
E
F
G


Binary Tree
r
A

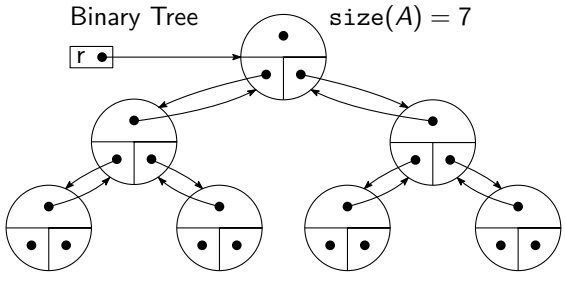

Binary Tree
r
A
Subtree(C)
B
C
D
E
F
G

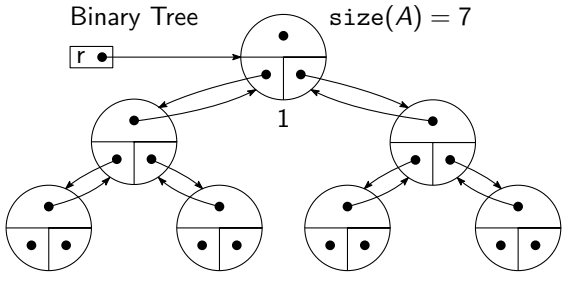

Binary Tree
r
Subtree(C)
C
F
G

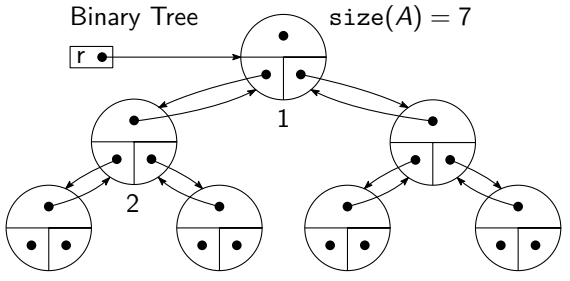

Binary Tree
r
A
Subtree(D)
B
C
D
E
F
G

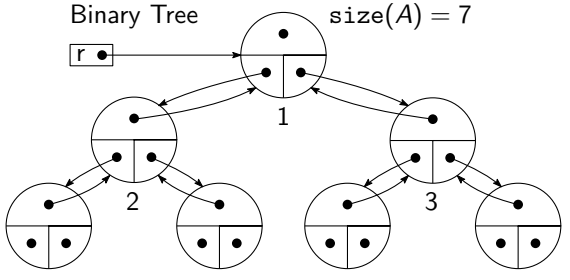

Binary Tree
r
Subtree(D)
D

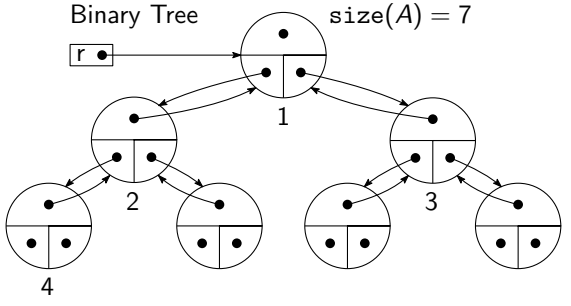
$$\texttt{size(r)} = \begin{cases} 0 & \textit{if } r = \textit{null} \\ \texttt{size}(r\textit{'s left child}) + \texttt{size}(r\textit{'s right child}) + 1 & \textit{otherwise} \end{cases}$$

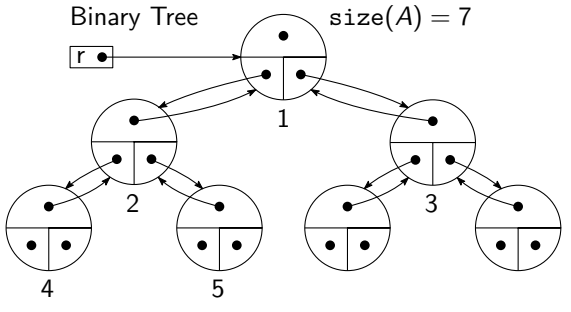

Binary Tree
size(A) = 7
r

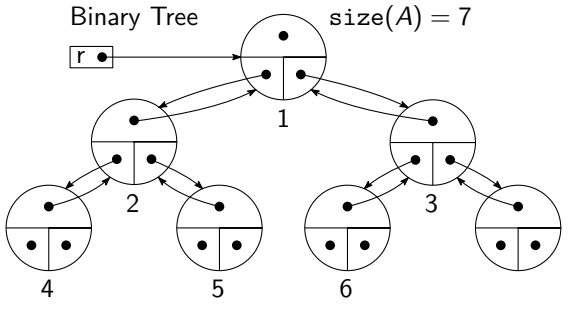

Binary Tree
size(A) = 7
r
1

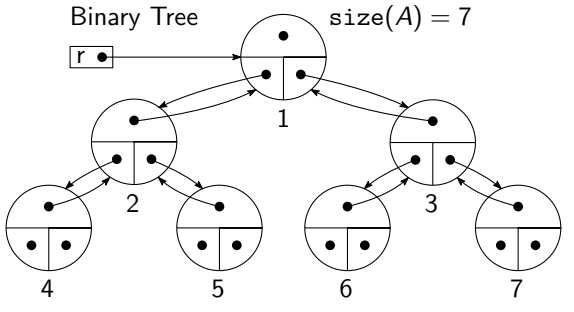

Binary Tree
size(A) = 7
r
1
2

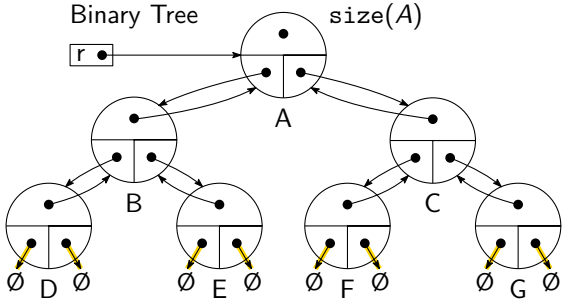

Binary Tree
size(A) = 7
r
1
2
3

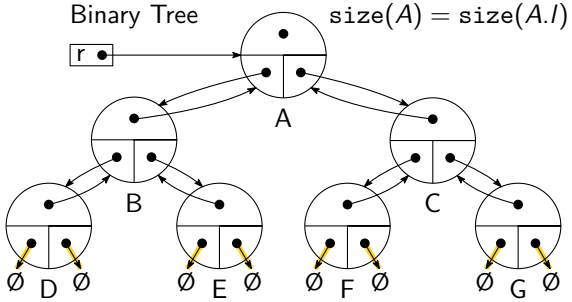

Binary Tree
size(A) = 7
r
1
2
3
4

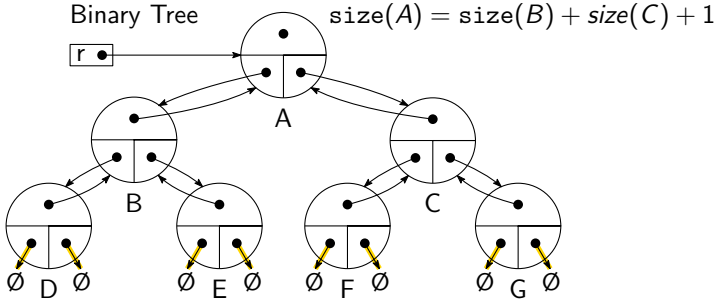

Binary Tree
size(A) = 7
r
1
2
3
4
5

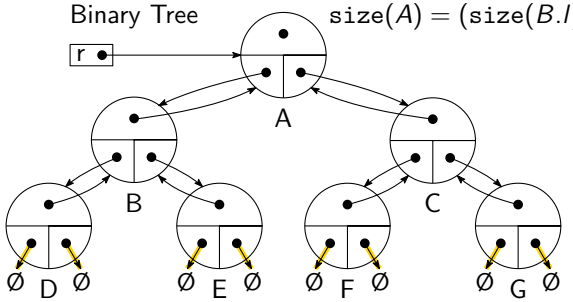

Binary Tree
size(A) = 7
r
1
2
3
4
5
6


Binary Tree
size(A) = 7
r
1
2
3
4
5
6
7

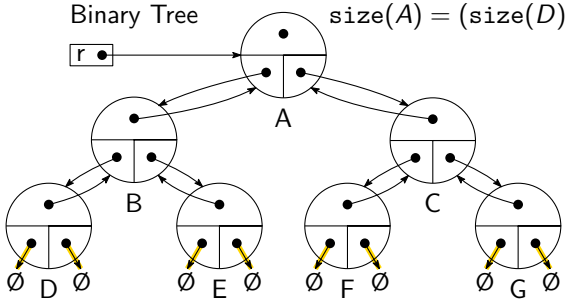

Binary Tree
size(A)
r
A
B
C
Ø
D
Ø
Ø
E
Ø
Ø
F
Ø
Ø
G
Ø


Binary Tree
size(A) = size(A.l) + size(A.r) + 1
r
A
B
C
Ø
D
Ø
Ø
E
Ø
Ø
F
Ø
Ø
G
Ø

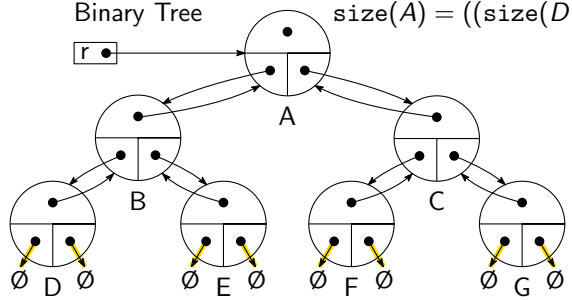

Binary Tree
size(A) = size(B) + size(C) + 1
r
A
B
C
Ø
D
Ø
Ø
E
Ø
Ø
F
Ø
Ø
G
Ø



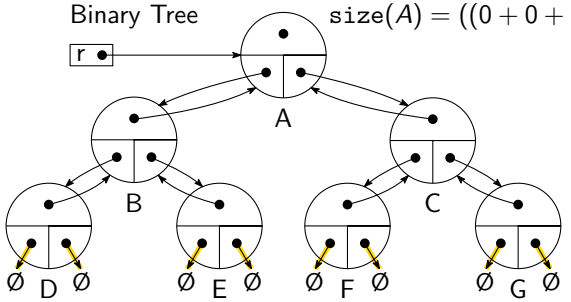
$\texttt{size}(A) = (\texttt{size}(B.l) + \texttt{size}(B.r) + 1) + \mathit{size}(C) + 1$



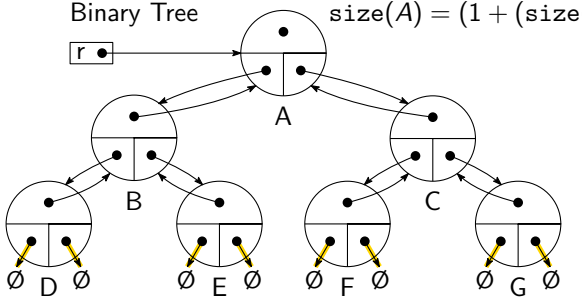
$\texttt{size}(A) = (\texttt{size}(D) + \texttt{size}(E) + 1) + \mathit{size}(C) + 1$



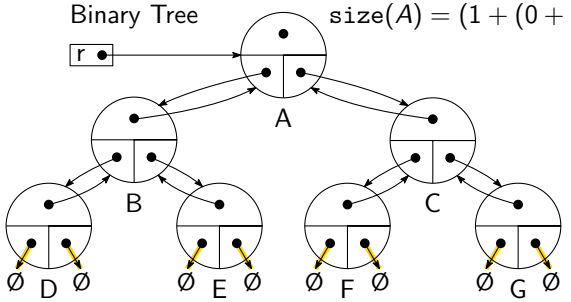
$\texttt{size}(A) = ((\texttt{size}(D.l) + \texttt{size}(D.r) + 1) + \texttt{size}(E) + 1) + \mathit{size}(C) + 1$



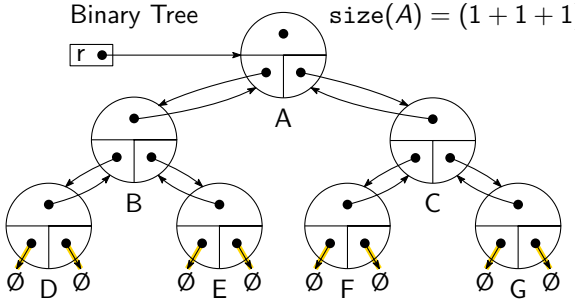
$\texttt{size}(A) = ((0 + 0 + 1) + \texttt{size}(E) + 1) + \mathit{size}(C) + 1$

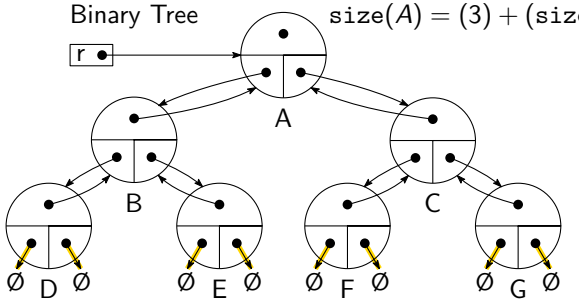


$\texttt{size}(A) = (1 + (\texttt{size}(E.l) + \texttt{size}(E.r) + 1) + 1) + \mathit{size}(C) + 1$

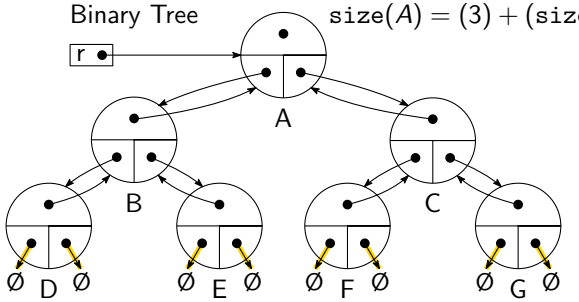


$\texttt{size}(A) = (1 + (0 + 0 + 1) + 1) + \mathit{size}(C) + 1$

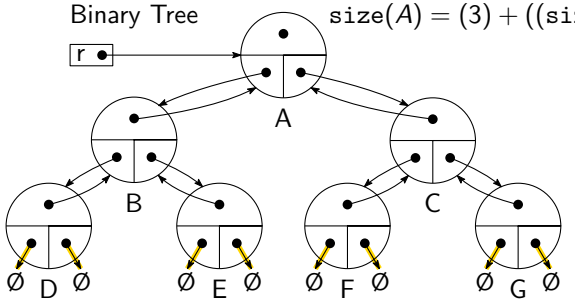

Binary Tree
size(A) = (1 + 1 + 1) + size(C) + 1
r
A
B
C
Ø
D
Ø
Ø
E
Ø
Ø
F
Ø
Ø
G
Ø



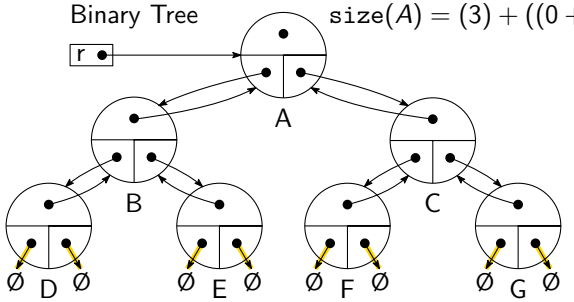
$\texttt{size}(A) = (3) + (\texttt{size}(C.l) + \texttt{size}(C.r) + 1) + 1$



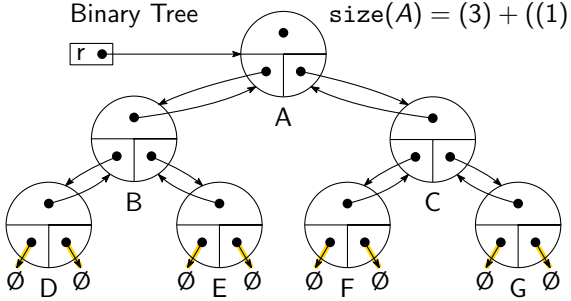
$\texttt{size}(A) = (3) + (\texttt{size}(F) + \texttt{size}(G) + 1) + 1$



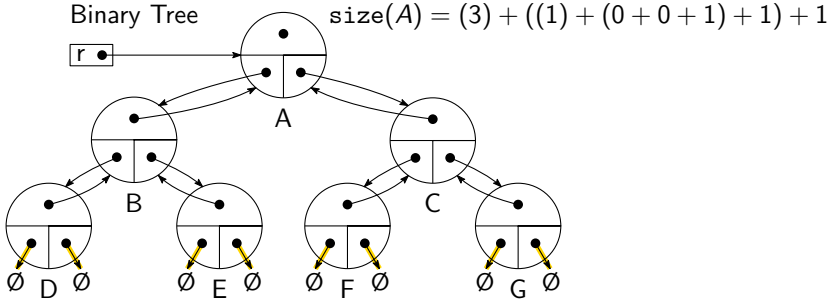
$\texttt{size}(A) = (3) + ((\texttt{size}(F.l) + \texttt{size}(F.r) + 1) + \texttt{size}(G) + 1) + 1$

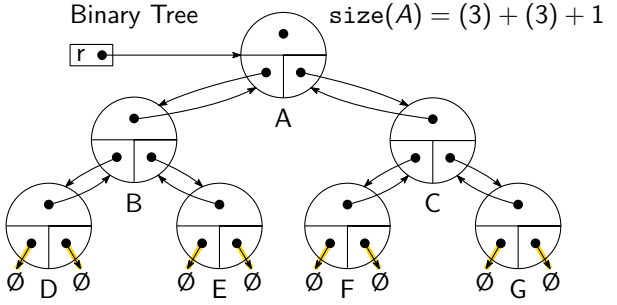


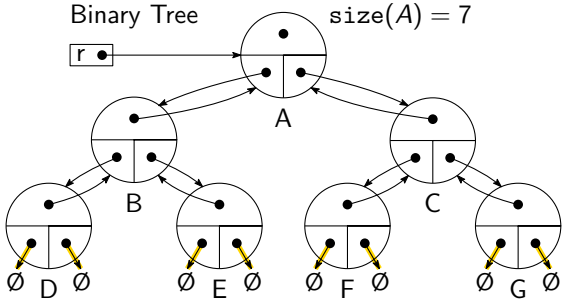
$\texttt{size}(A) = (3) + ((0 + 0 + 1) + \texttt{size}(G) + 1) + 1$

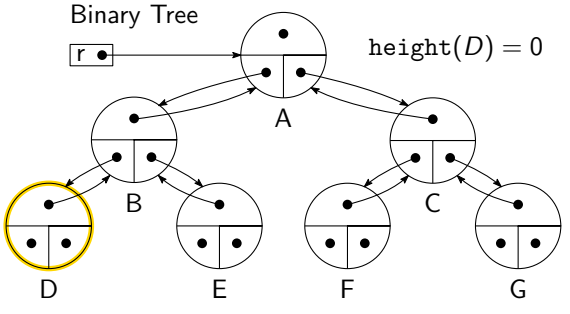


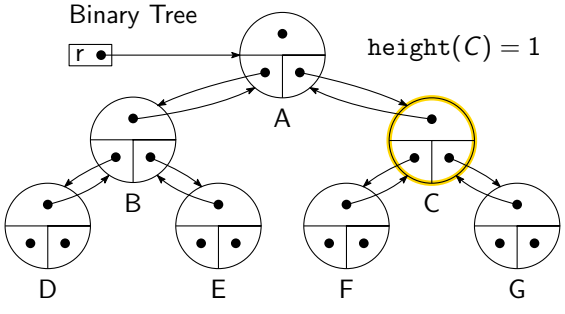
$\texttt{size}(A) = (3) + ((1) + (\texttt{size}(G.l) + \texttt{size}(G.r) + 1) + 1) + 1$

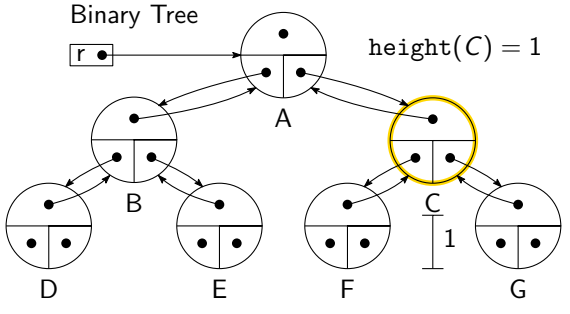

Binary Tree
size(A) = (3) + ((1) + (0 + 0 + 1) + 1) + 1
r
A
B
C
Ø D Ø
Ø E Ø
Ø F Ø
Ø G Ø

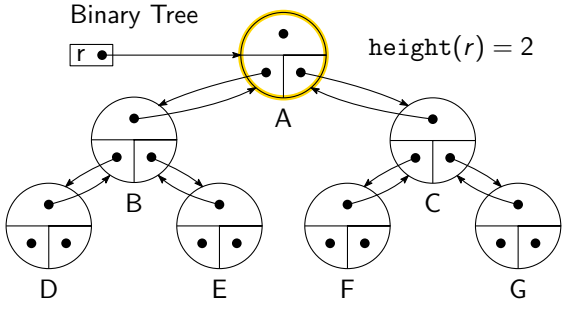

Binary Tree
size(A) = (3) + (3) + 1
r
A
B
C
Ø
D
Ø
Ø
E
Ø
Ø
F
Ø
Ø
G
Ø

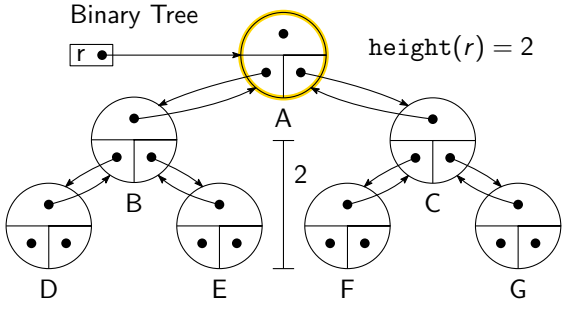

Binary Tree
size(A) = 7
r
A
B
C
Ø
D
Ø
Ø
E
Ø
Ø
F
Ø
Ø
G
Ø

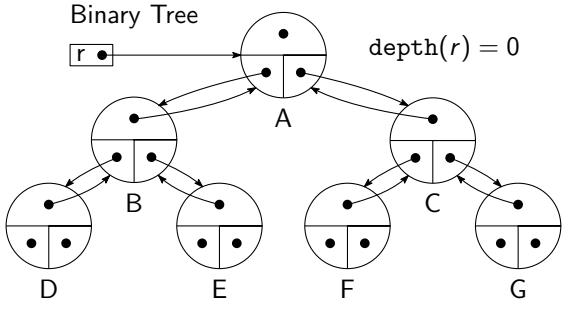

Binary Tree
r
height(D) = 0
A
B
C
D
E
F
G

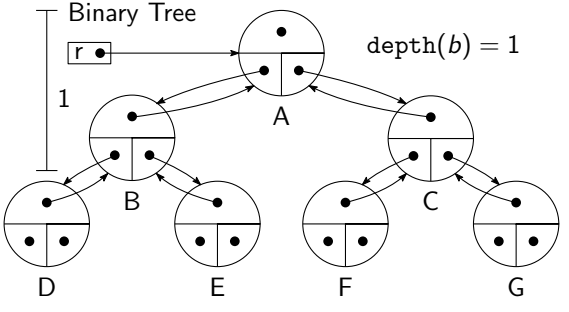

Binary Tree
r
height(C) = 1
A
B
C
D
E
F
G


Binary Tree
r
height(C) = 1
A
B
C
1
D
E
F
G


Binary Tree
r
height(r) = 2
A
B
C
D
E
F
G


Binary Tree
r
height(r) = 2
A
B
C
D
E
F
G
2


Binary Tree
r
depth(r) = 0
A
B
C
D
E
F
G


Binary Tree
r
1
depth(b) = 1
A
B
C
D
E
F
G