http://algs4.cs.princeton.edu

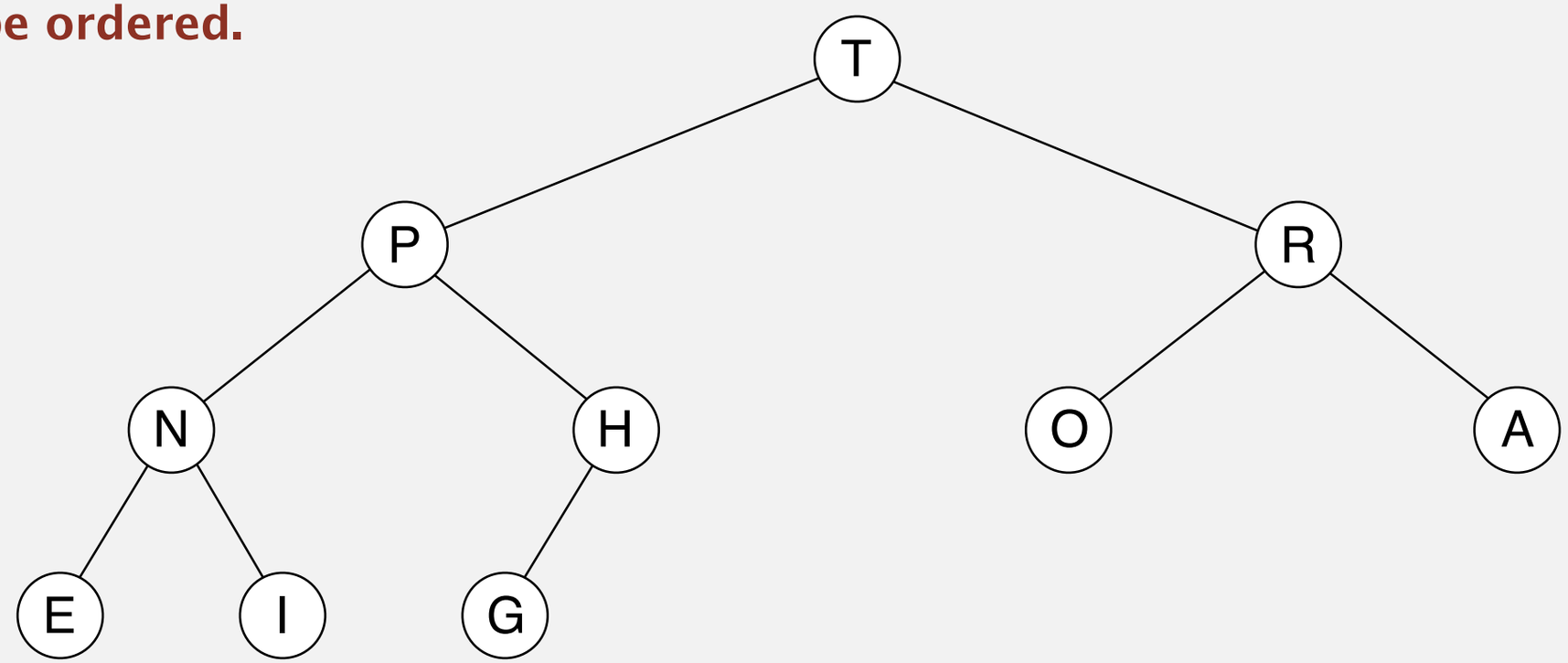
2.4 BINARY HEAP DEMO

Binary heap demo

Insert. Add node at end, then “swim" it up.

Remove the maximum. Exchange root with node at end, then “sink” it down.

Heap starts out ordered:
Recall that layers don’t have to be ordered.



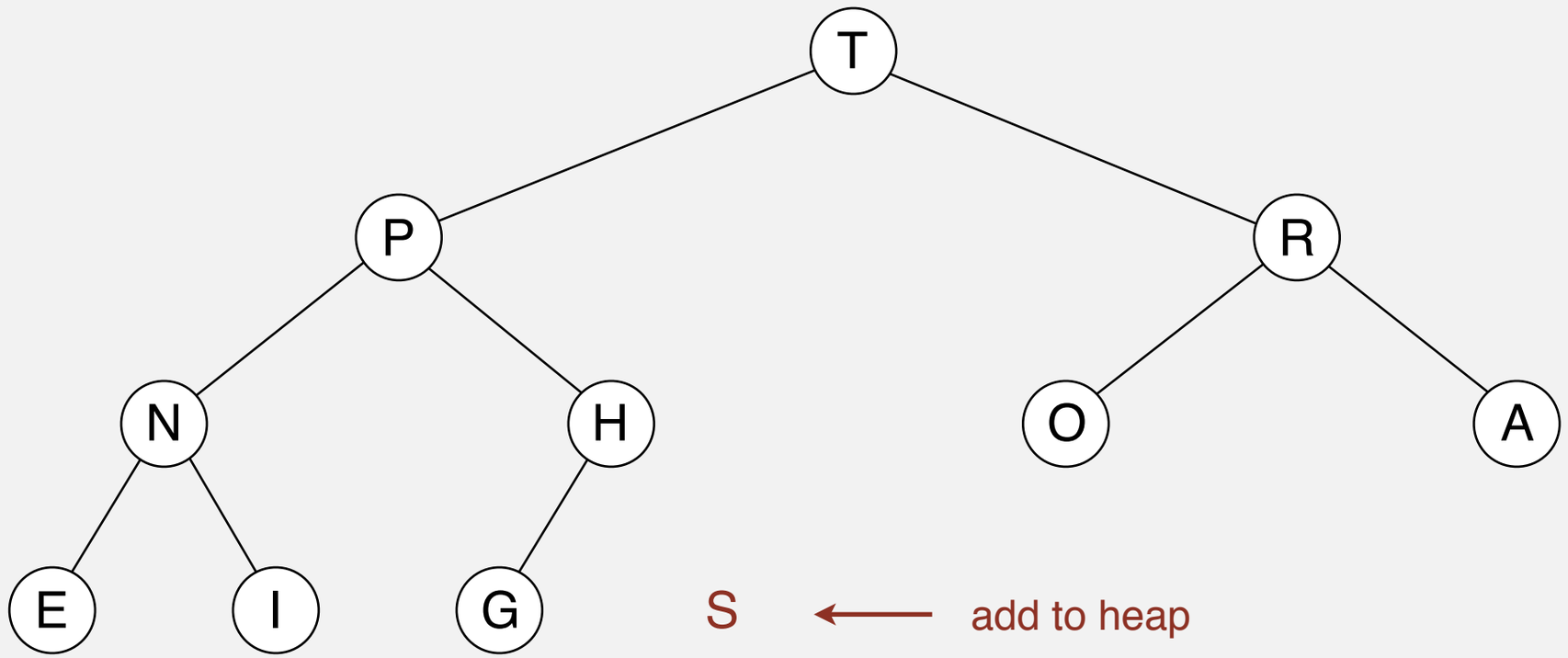
T	P	R	N	H	O	A	E	I	G	

Binary heap demo

Insert. Add node at end, then swim it up.

Remove the maximum. Exchange root with node at end, then sink it down.

Insert S: add it to last place.



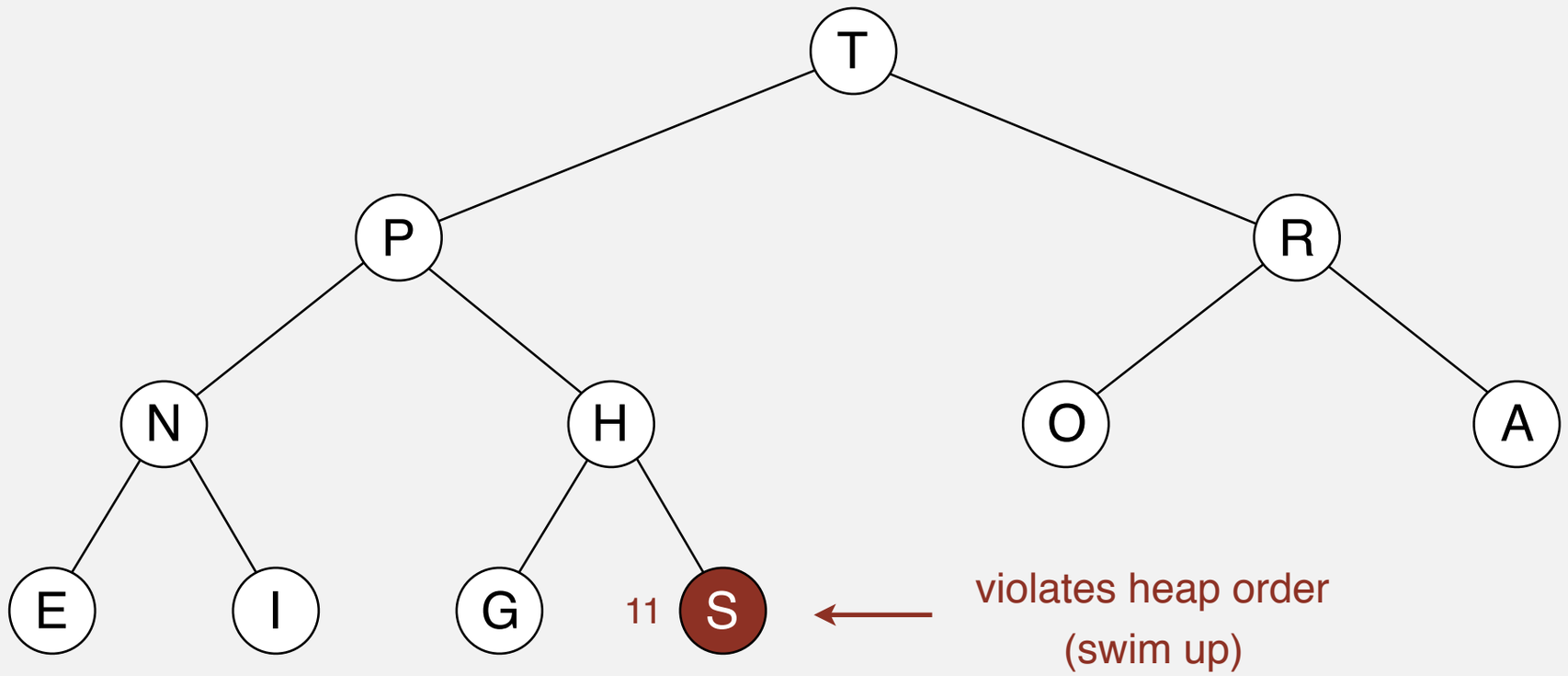
T	P	R	N	H	O	A	E	I	G	

Binary heap demo

Insert. Add node at end, then swim it up.

Remove the maximum. Exchange root with node at end, then sink it down.

Insert S: swim it up.



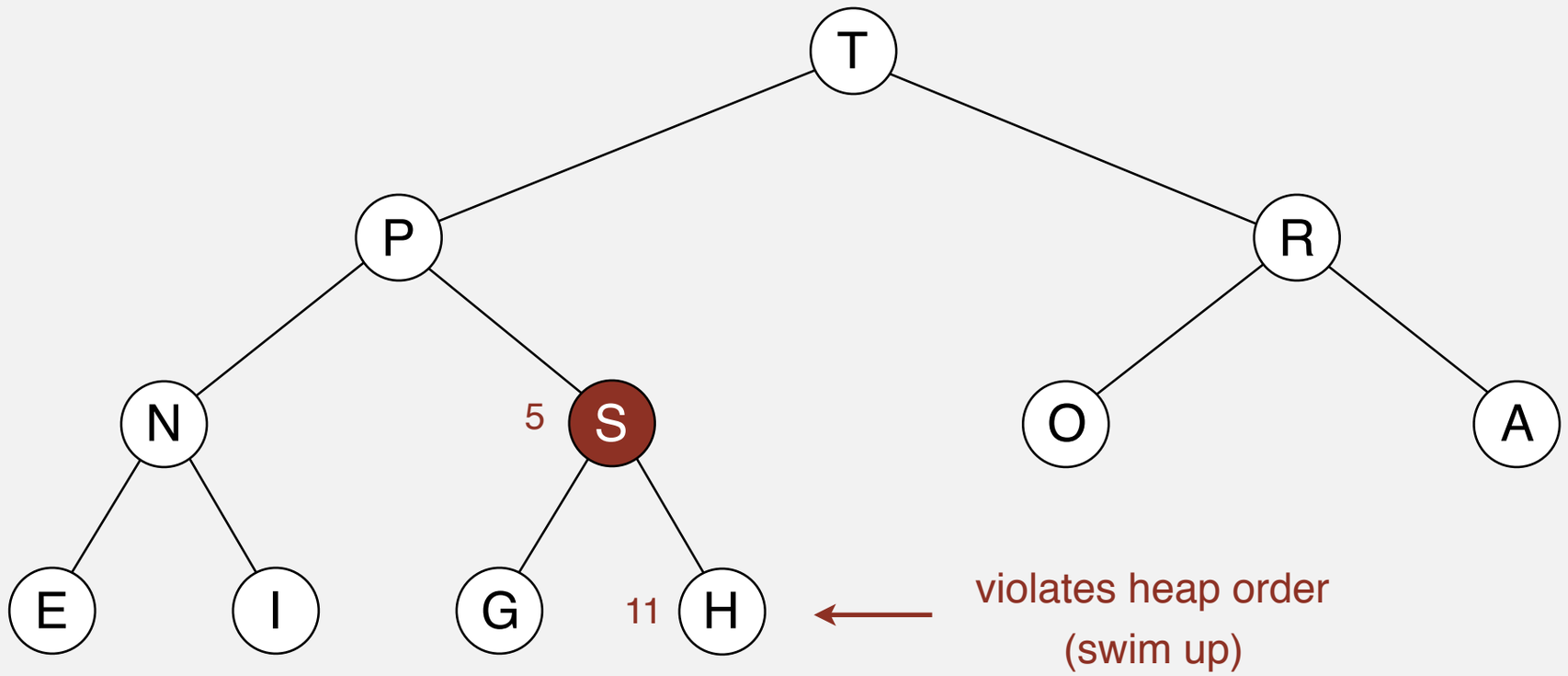
T	P	R	N	H	O	A	E	I	G	S
										11

Binary heap demo

Insert. Add node at end, then swim it up.

Remove the maximum. Exchange root with node at end, then sink it down.

Insert S: swim it up.



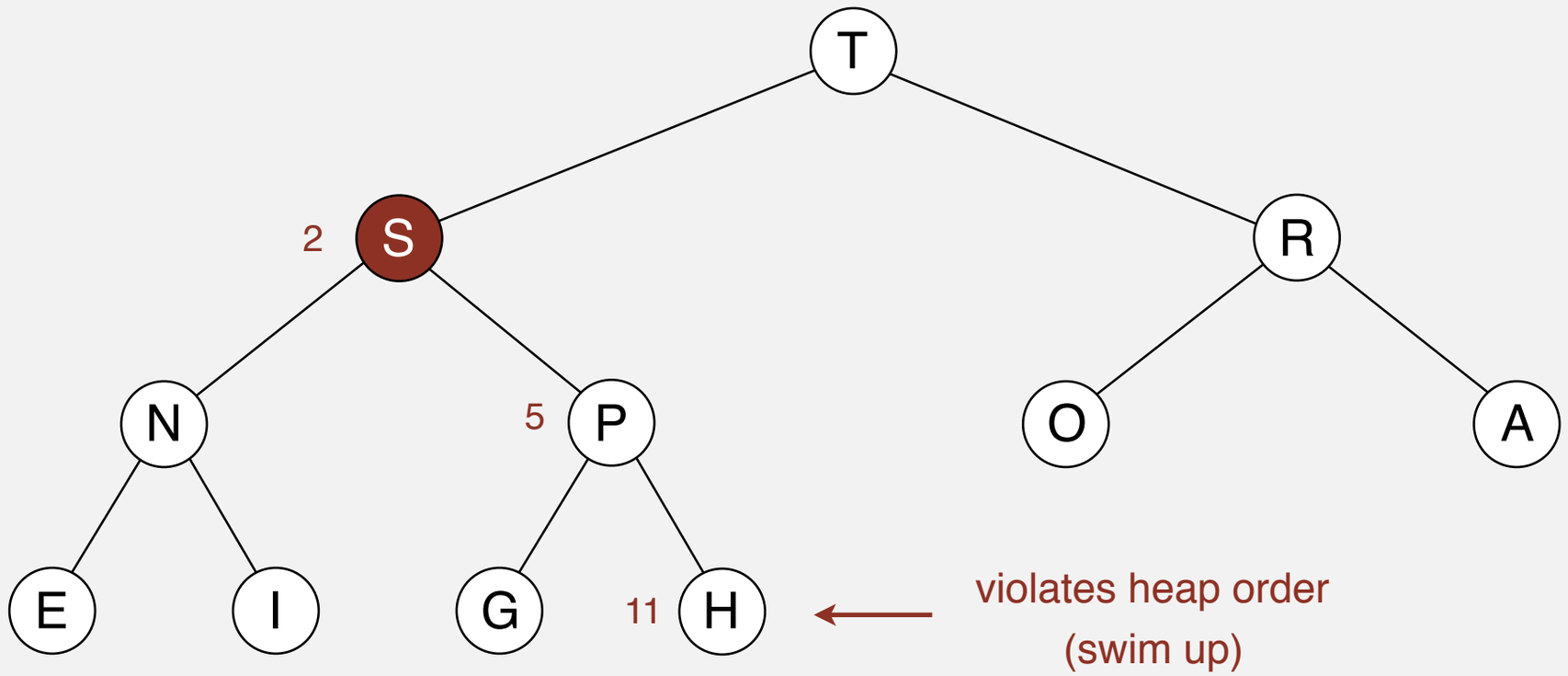
T	P	R	N	S	O	A	E	I	G	H
				5						11

Binary heap demo

Insert. Add node at end, then swim it up.

Remove the maximum. Exchange root with node at end, then sink it down.

Insert S: swim it up.



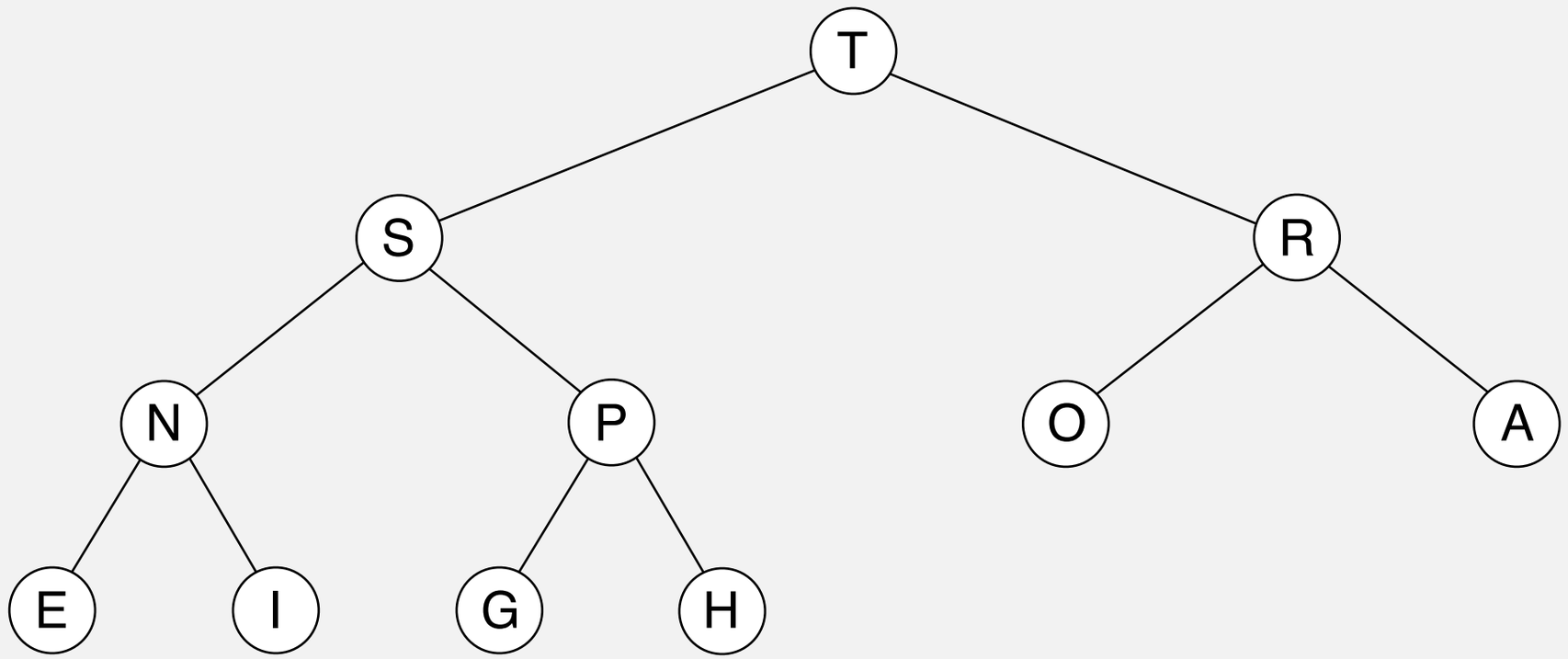
T	S	R	N	P	O	A	E	I	G	H
	2			5						11

Binary heap demo

Insert. Add node at end, then swim it up.

Remove the maximum. Exchange root with node at end, then sink it down.

Heap re-ordered



T	S	R	N	P	O	A	E	I	G	H

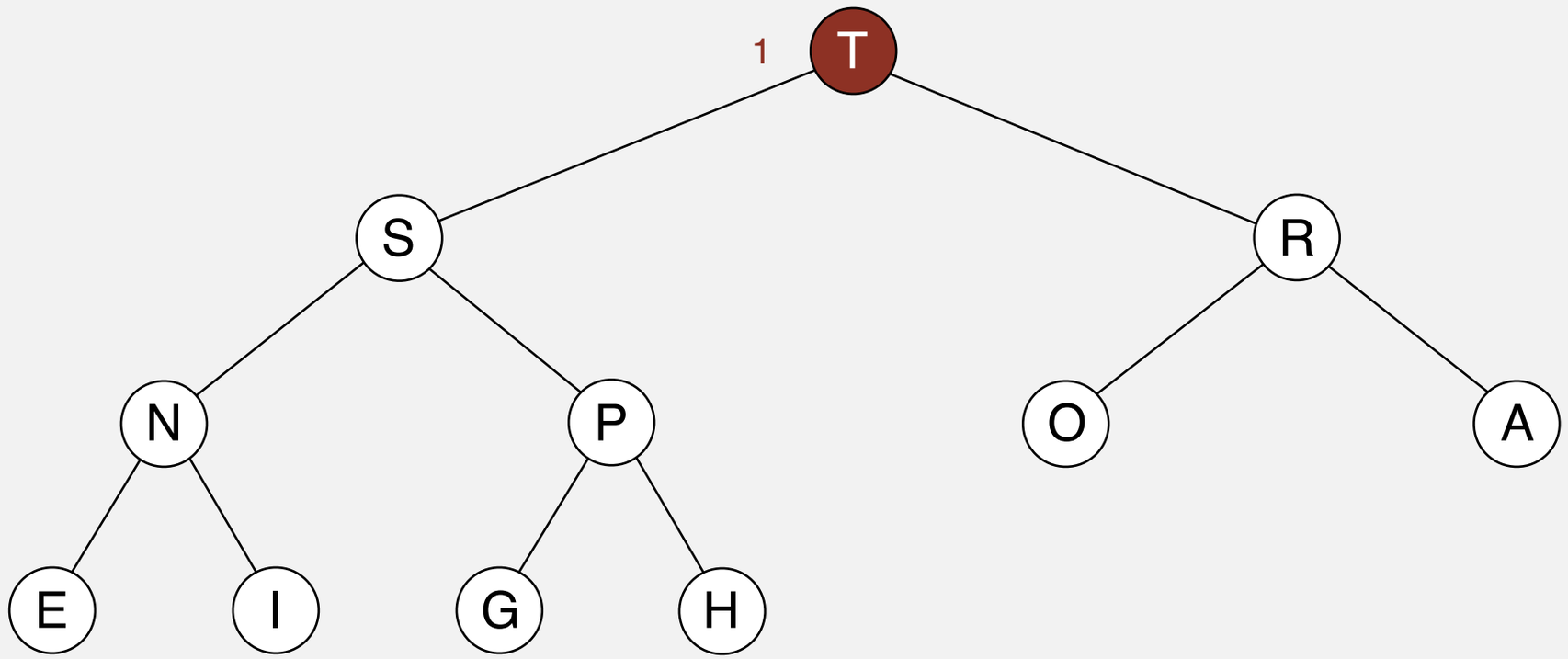
Binary heap demo

Insert. Add node at end, then swim it up.

Remove the maximum. Exchange root with node at end, then sink it down.

Remove the maximum:

Swap it with the last place.



T	S	R	N	P	O	A	E	I	G	H
1										

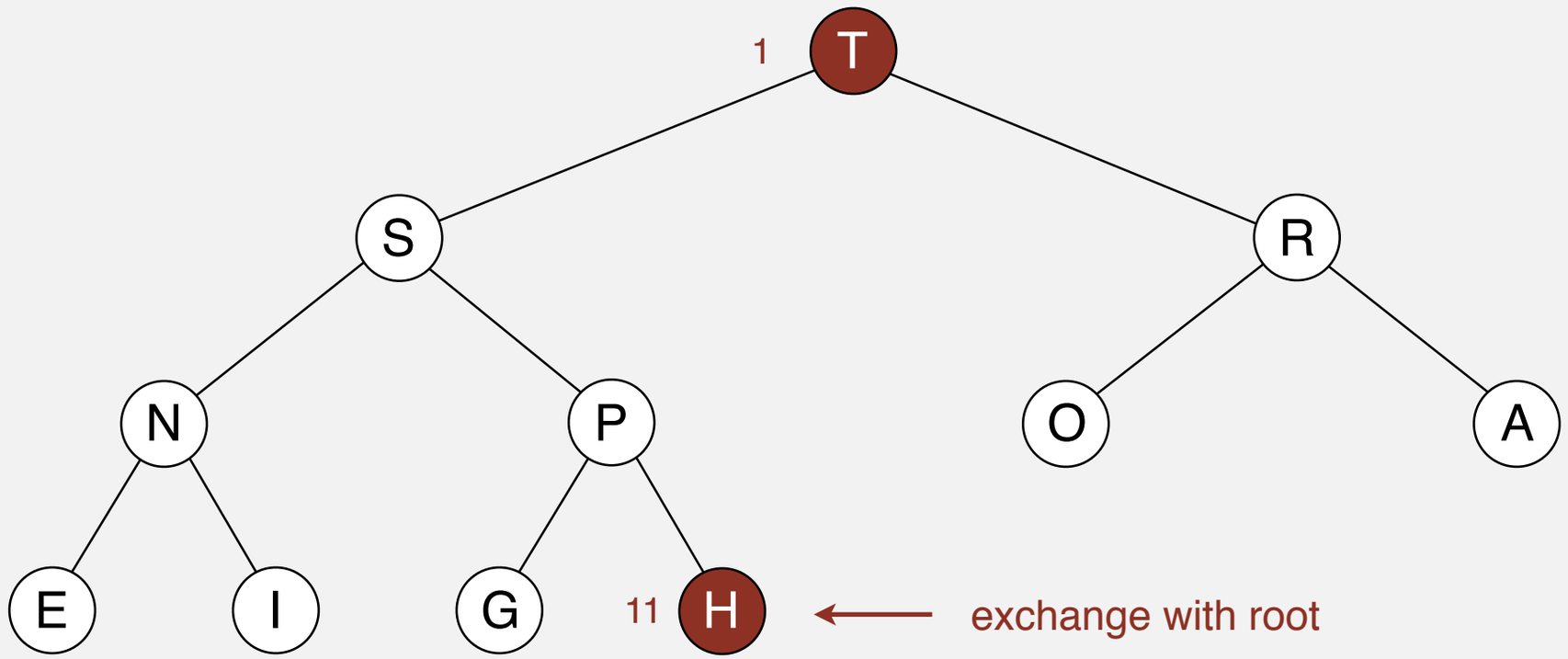
Binary heap demo

Insert. Add node at end, then swim it up.

Remove the maximum. Exchange root with node at end, then sink it down.

Remove the maximum:

Swap it with the last place.



T	S	R	N	P	O	A	E	I	G	H
1										11

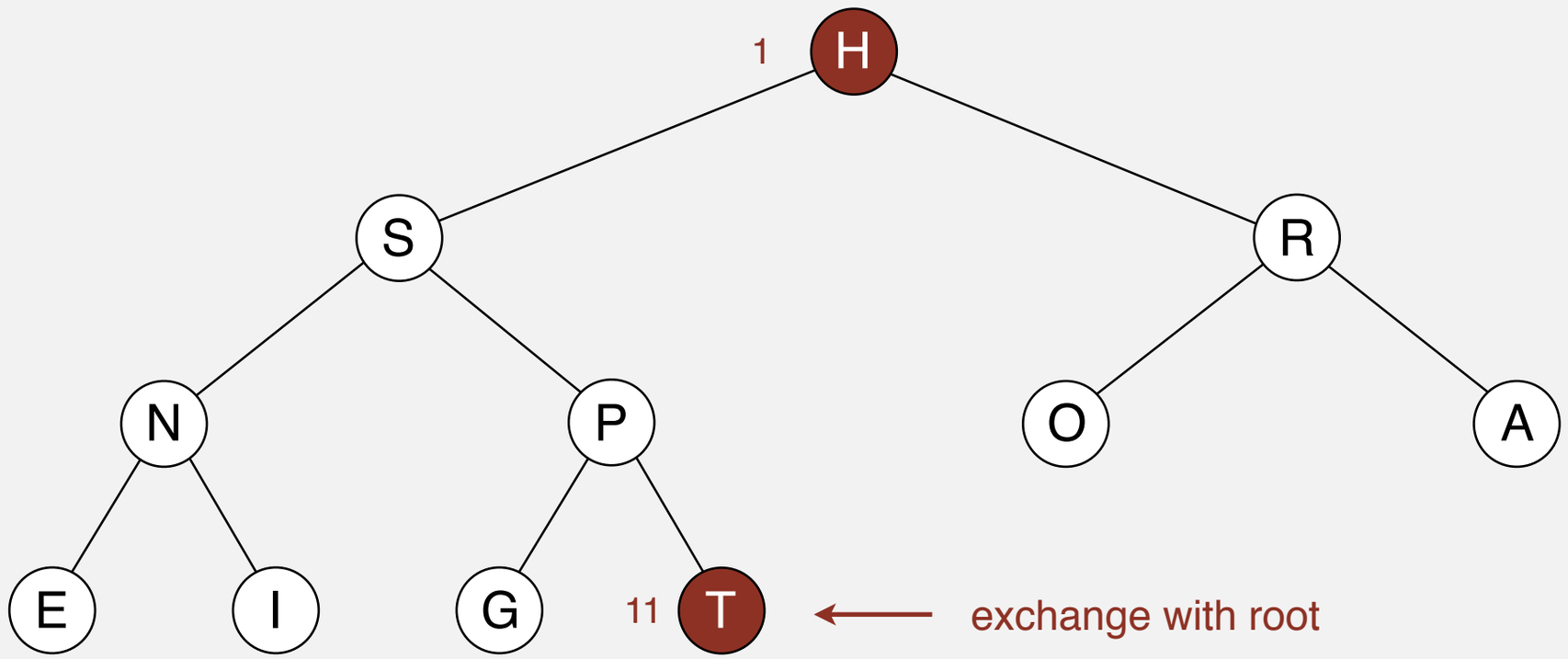
Binary heap demo

Insert. Add node at end, then swim it up.

Remove the maximum. Exchange root with node at end, then sink it down.

Remove the maximum:

Swapped with last place.



H	S	R	N	P	O	A	E	I	G	T
1										11

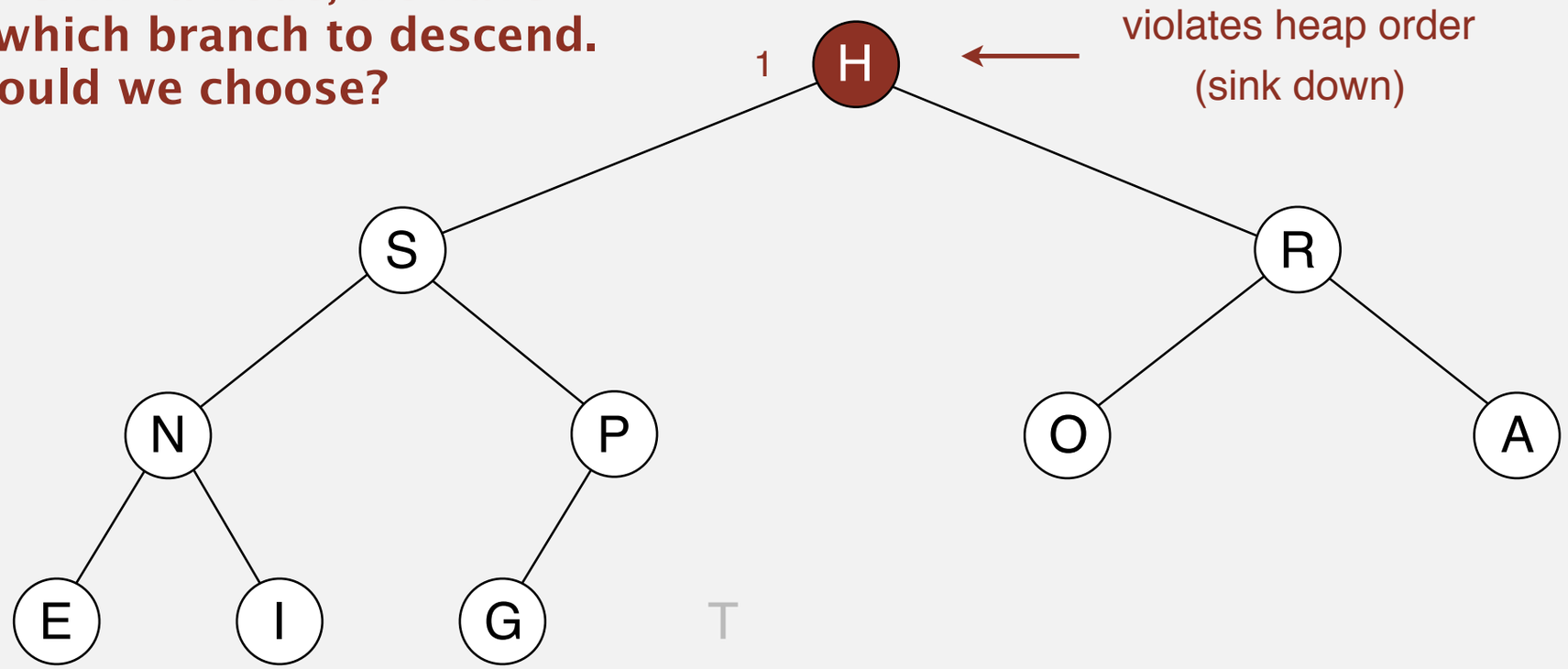
Binary heap demo

Insert. Add node at end, then swim it up.

Remove the maximum. Exchange root with node at end, then sink it down.

Remove the maximum:

When we "sink" a node, we have a choice which branch to descend. Which should we choose?



H	S	R	N	P	O	A	E	I	G	T
1										

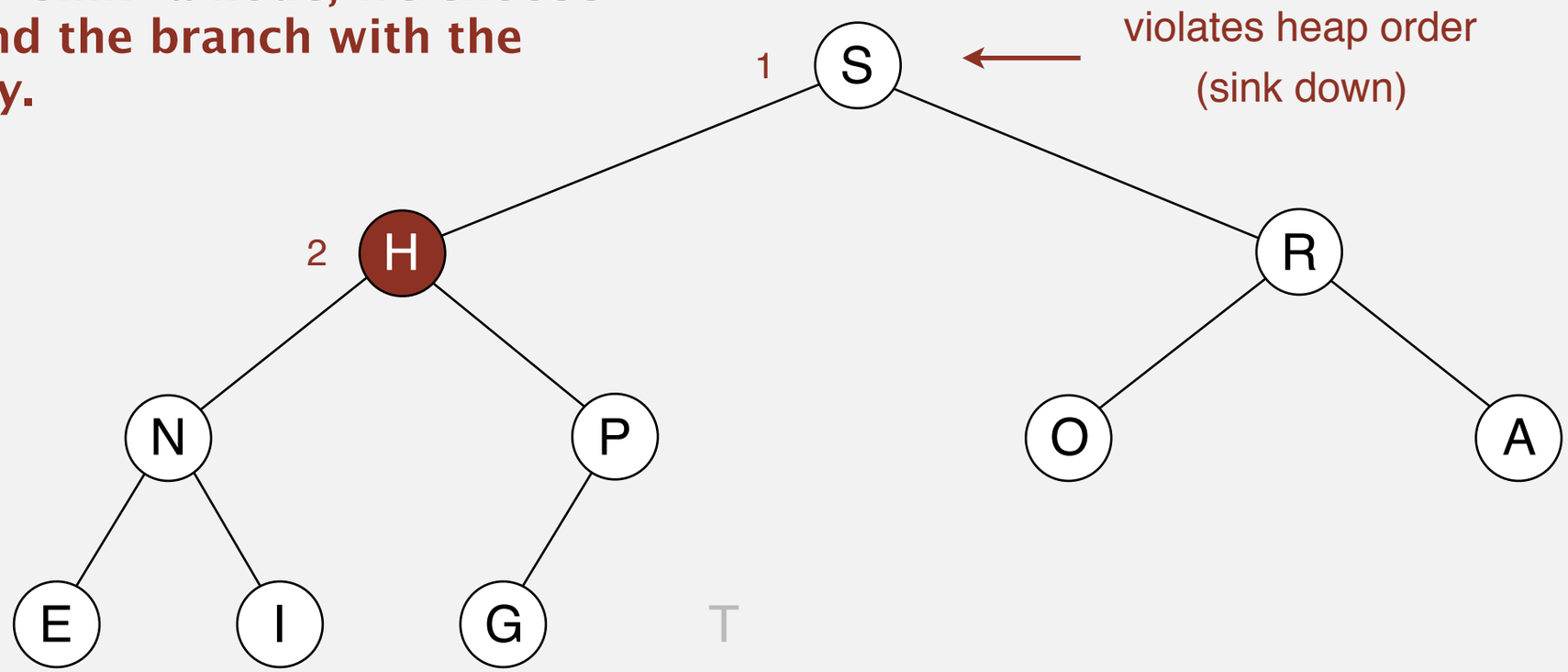
Binary heap demo

Insert. Add node at end, then swim it up.

Remove the maximum. Exchange root with node at end, then sink it down.

Remove the maximum:

When we "sink" a node, we choose to descend the branch with the larger key.
Why?



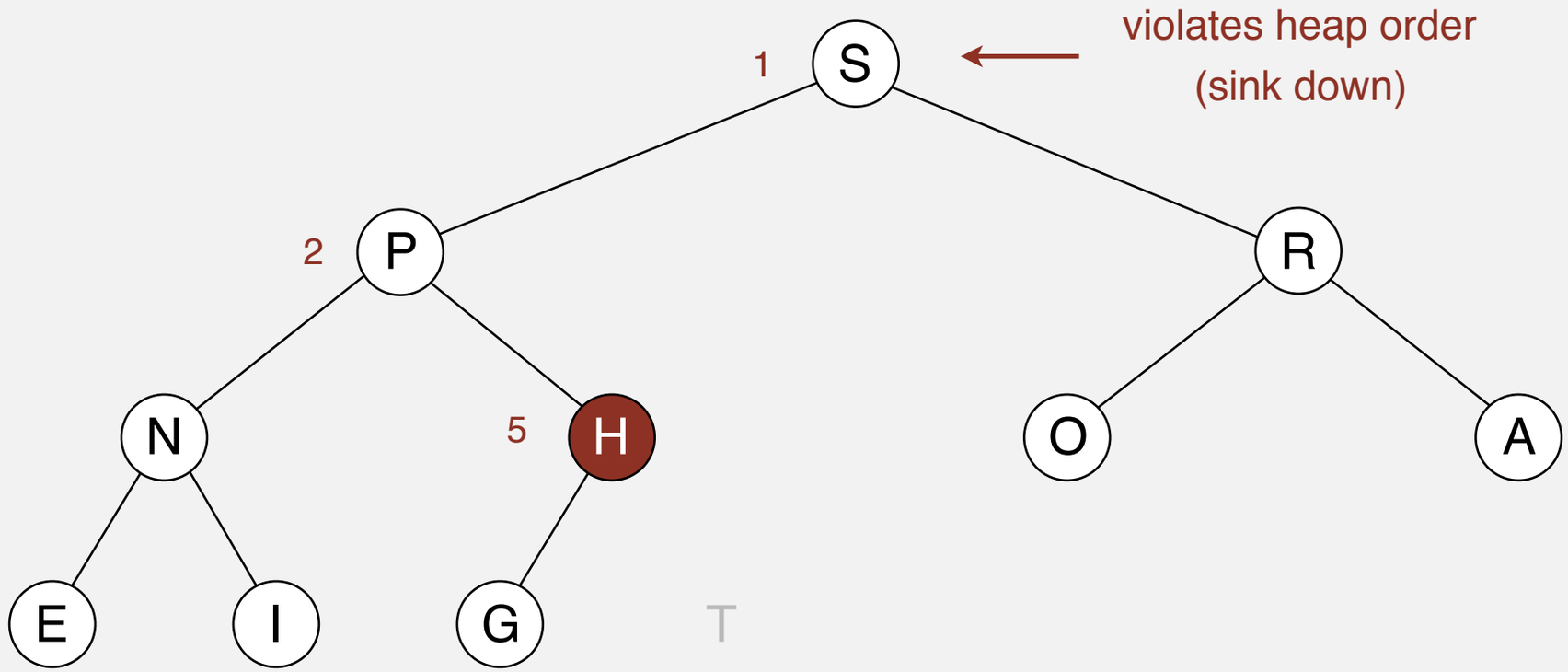
S	H	R	N	P	O	A	E	I	G	T
1	2									

Binary heap demo

Insert. Add node at end, then swim it up.

Remove the maximum. Exchange root with node at end, then sink it down.

Sinking... and sinking



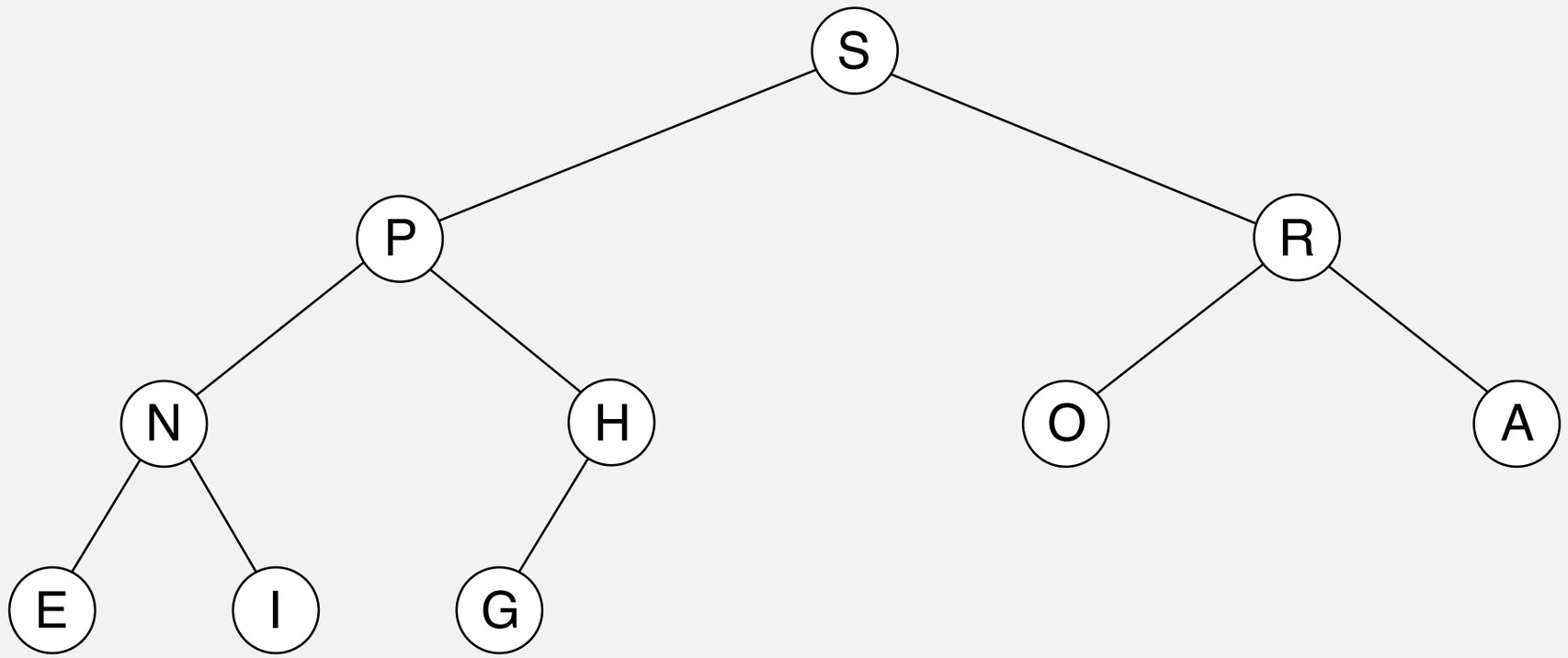
S	P	R	N	H	O	A	E	I	G	T
1	2			5						

Binary heap demo

Insert. Add node at end, then swim it up.

Remove the maximum. Exchange root with node at end, then sink it down.

Heap re-ordered



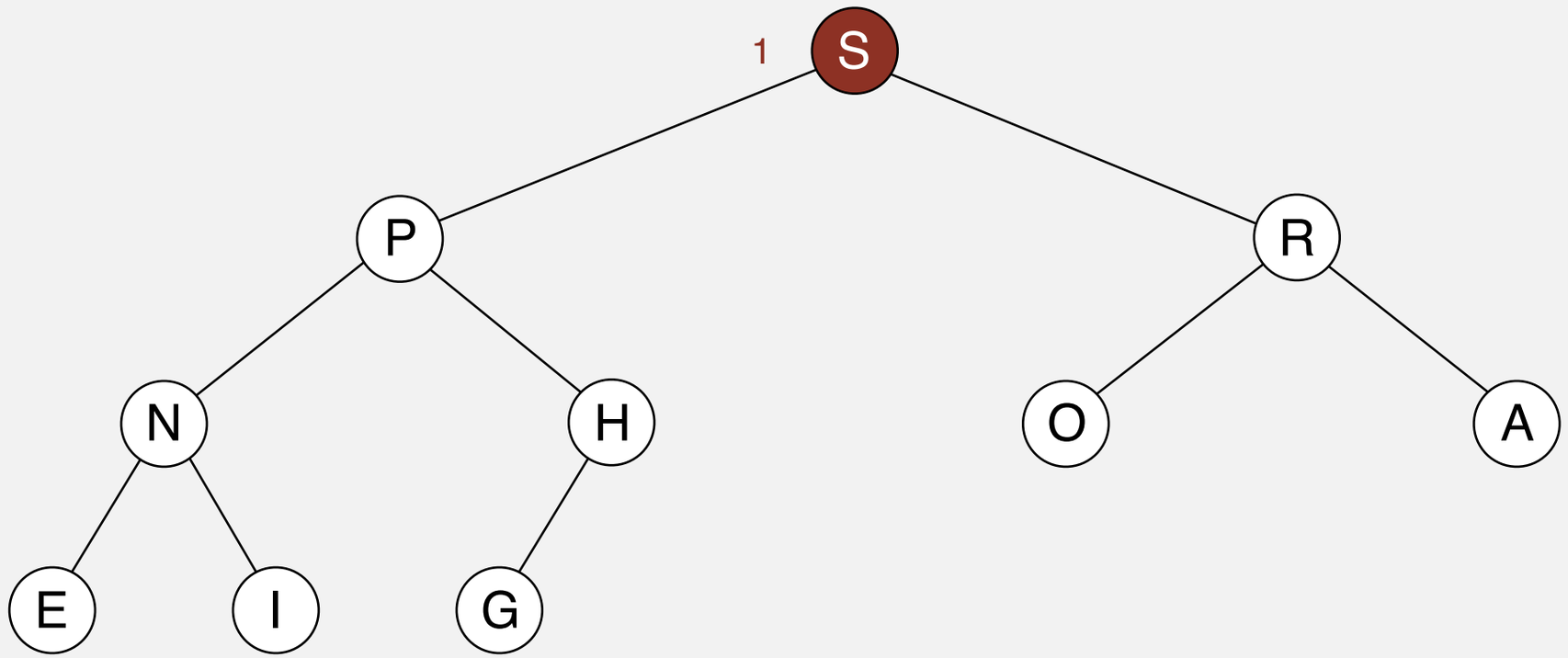
S	P	R	N	H	O	A	E	I	G	

Binary heap demo

Insert. Add node at end, then swim it up.

Remove the maximum. Exchange root with node at end, then sink it down.

Remove the maximum



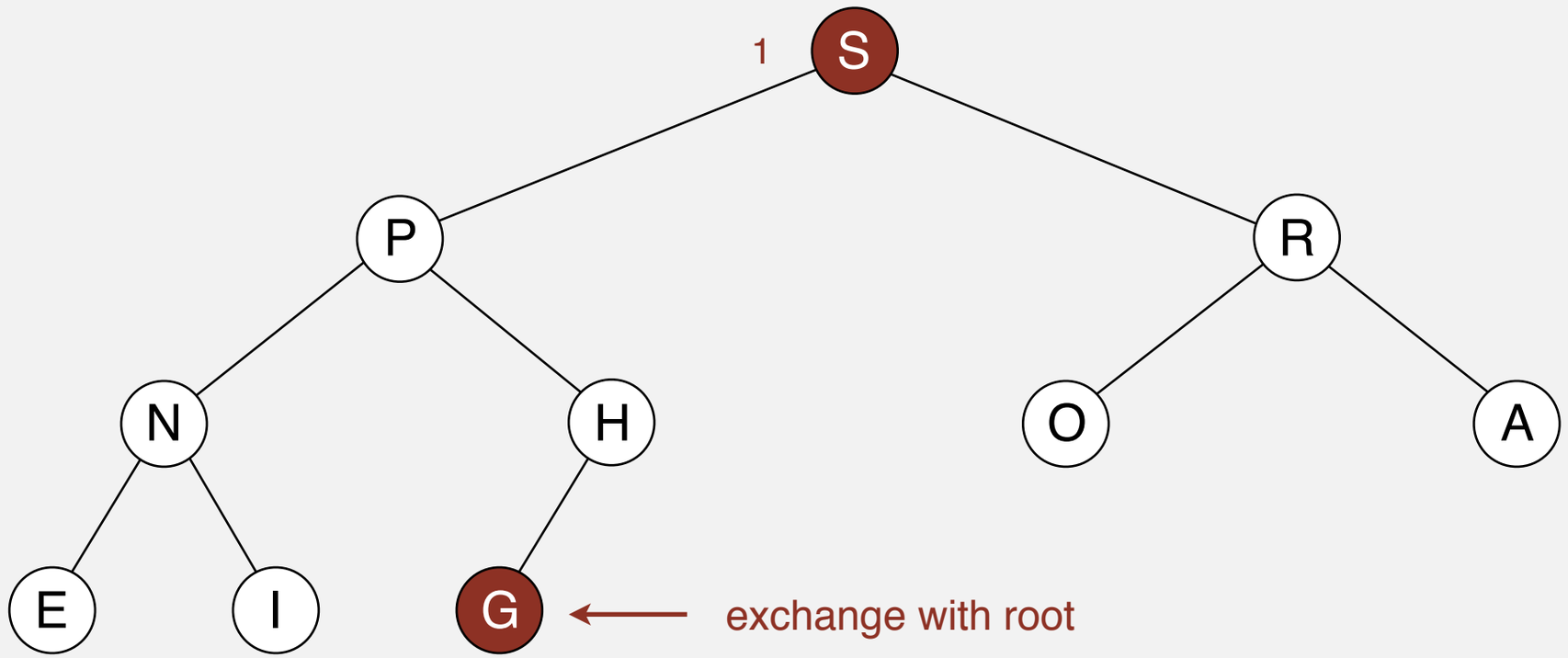
S	P	R	N	H	O	A	E	I	G	
1										

Binary heap demo

Insert. Add node at end, then swim it up.

Remove the maximum. Exchange root with node at end, then sink it down.

Remove the maximum:
Exchange last with root



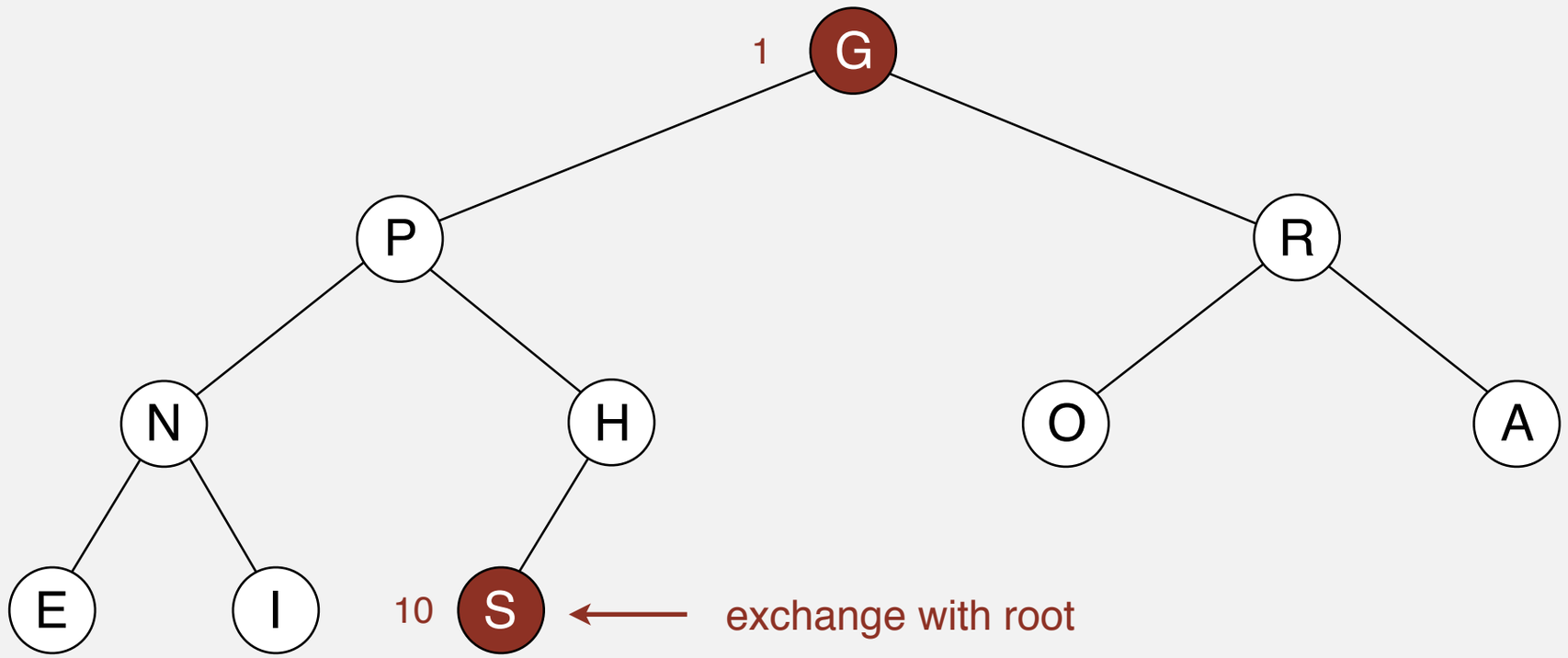
S	P	R	N	H	O	A	E	I	G	
1										

Binary heap demo

Insert. Add node at end, then swim it up.

Remove the maximum. Exchange root with node at end, then sink it down.

Remove the maximum



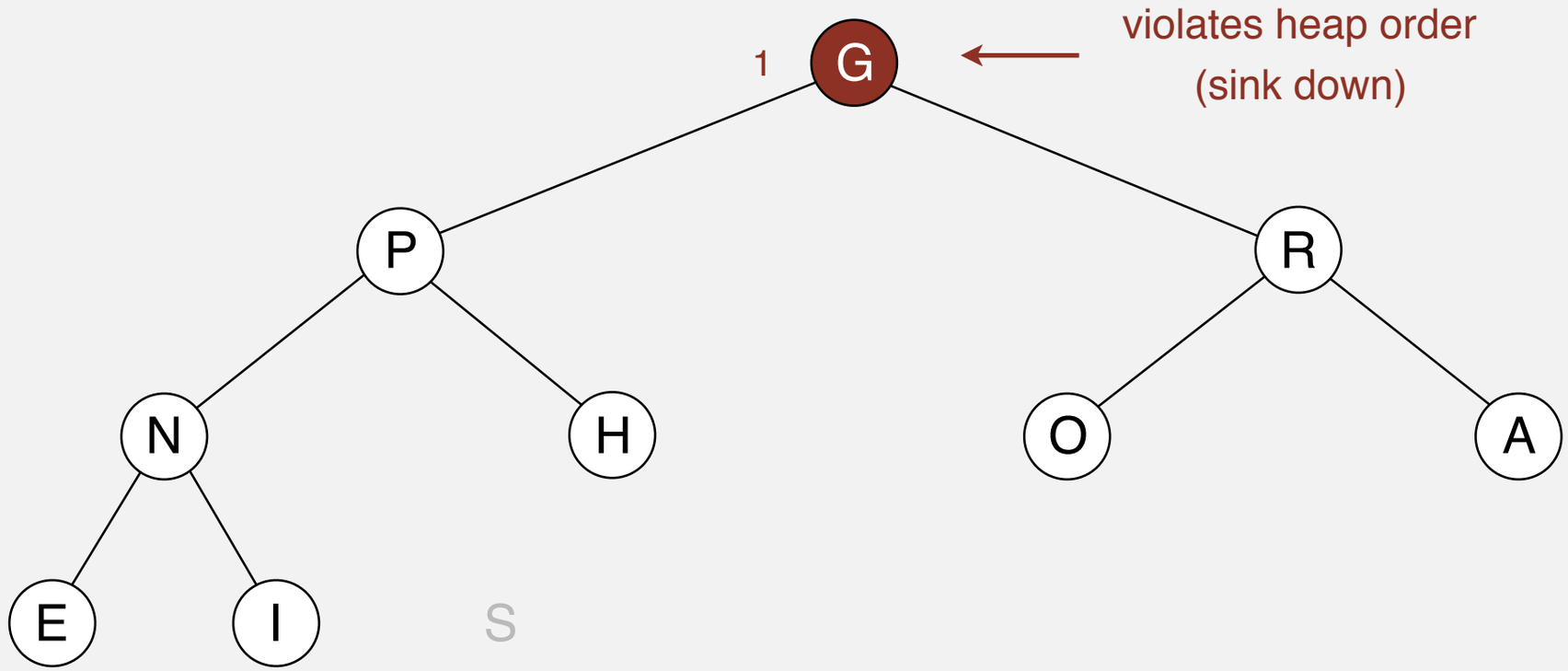
G	P	R	N	H	O	A	E	I	S	
1									10	

Binary heap demo

Insert. Add node at end, then swim it up.

Remove the maximum. Exchange root with node at end, then sink it down.

Remove the maximum:
Sink G



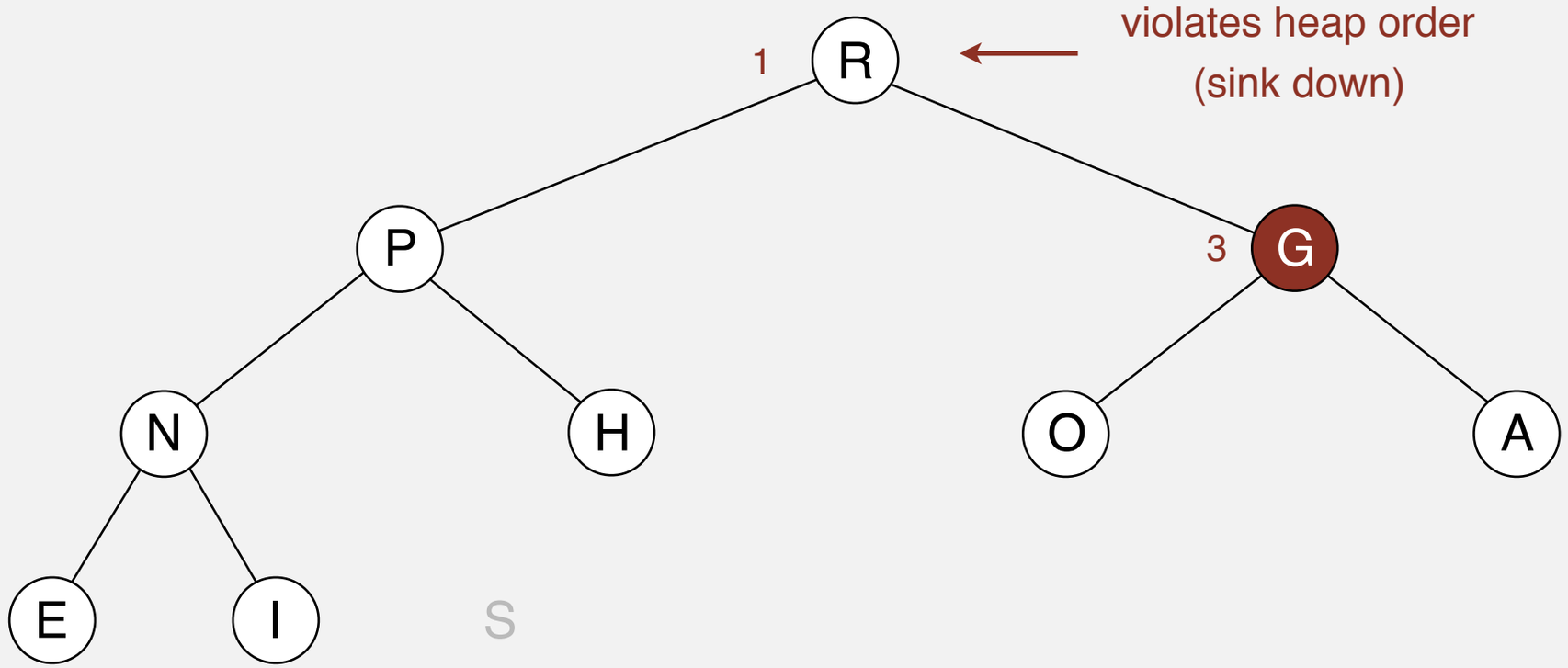
G	P	R	N	H	O	A	E	I	S	
1										

Binary heap demo

Insert. Add node at end, then swim it up.

Remove the maximum. Exchange root with node at end, then sink it down.

Remove the maximum: Sink G



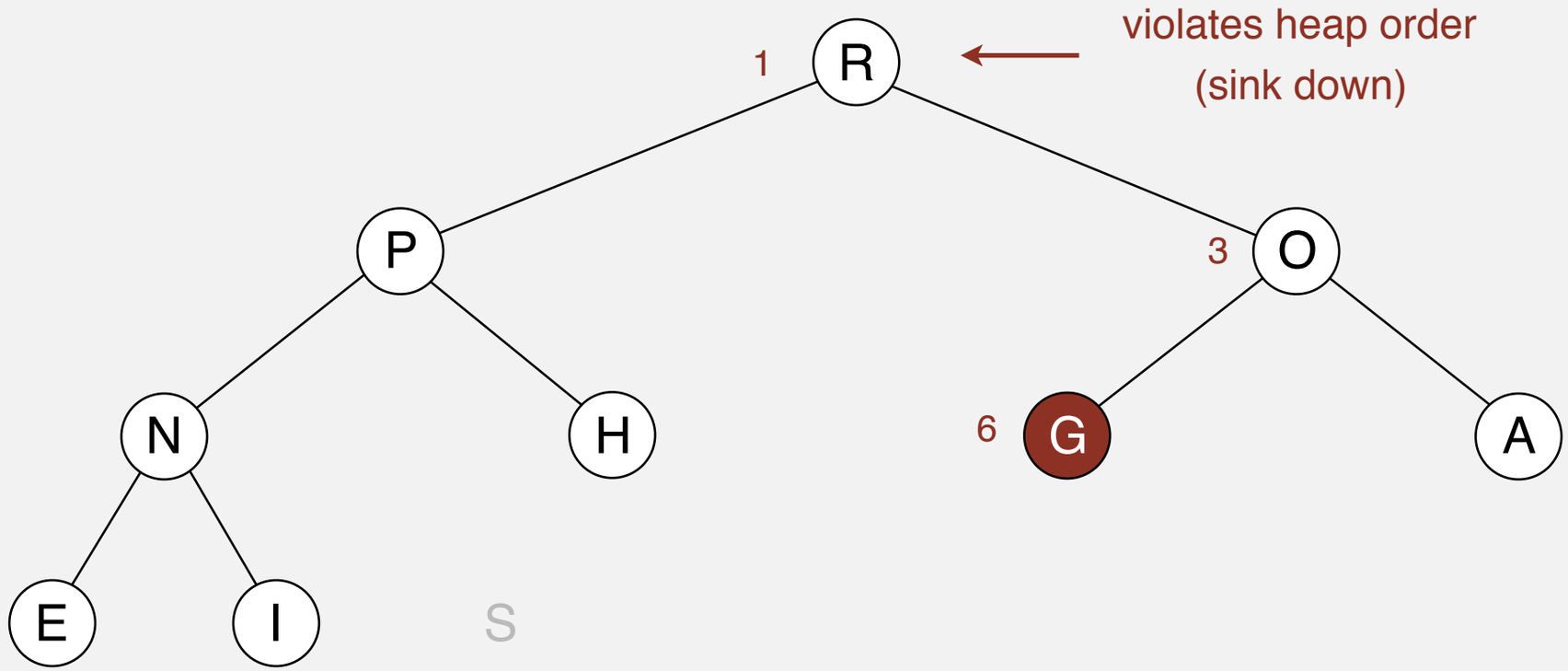
R	P	G	N	H	O	A	E	I	S	
1		3								

Binary heap demo

Insert. Add node at end, then swim it up.

Remove the maximum. Exchange root with node at end, then sink it down.

Remove the maximum:
G is sunk.



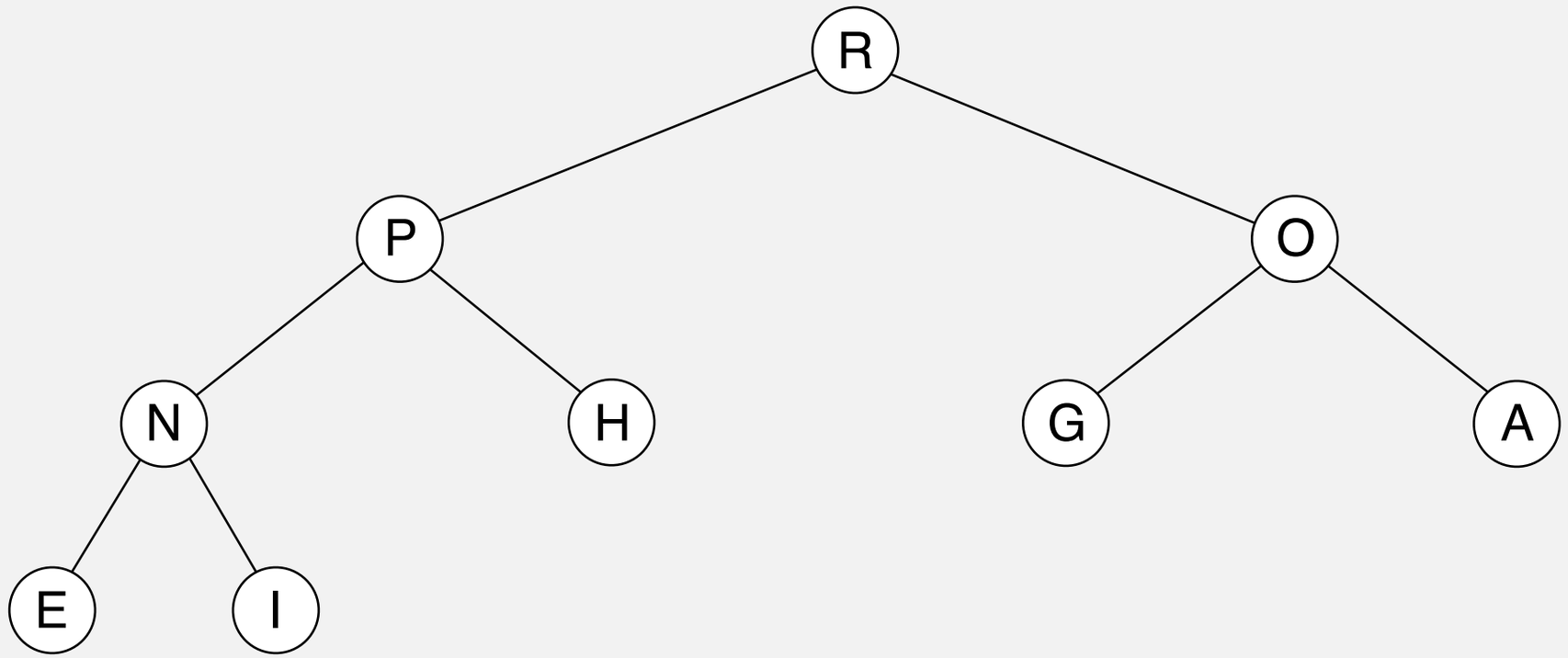
R	P	O	N	H	G	A	E	I	S	
1		3			6					

Binary heap demo

Insert. Add node at end, then swim it up.

Remove the maximum. Exchange root with node at end, then sink it down.

Heap re-ordered



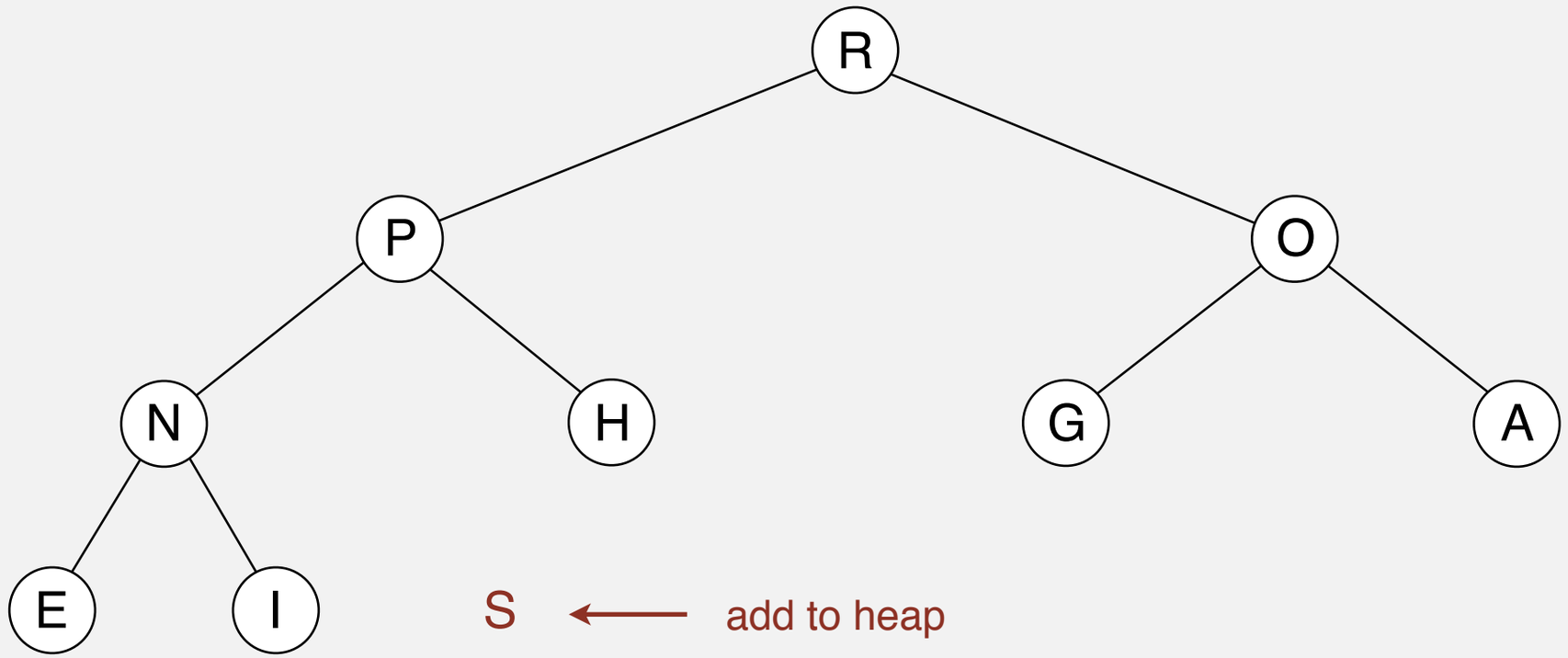
R	P	O	N	H	G	A	E	I		

Binary heap demo

Insert. Add node at end, then swim it up.

Remove the maximum. Exchange root with node at end, then sink it down.

Insert S: add in last place.



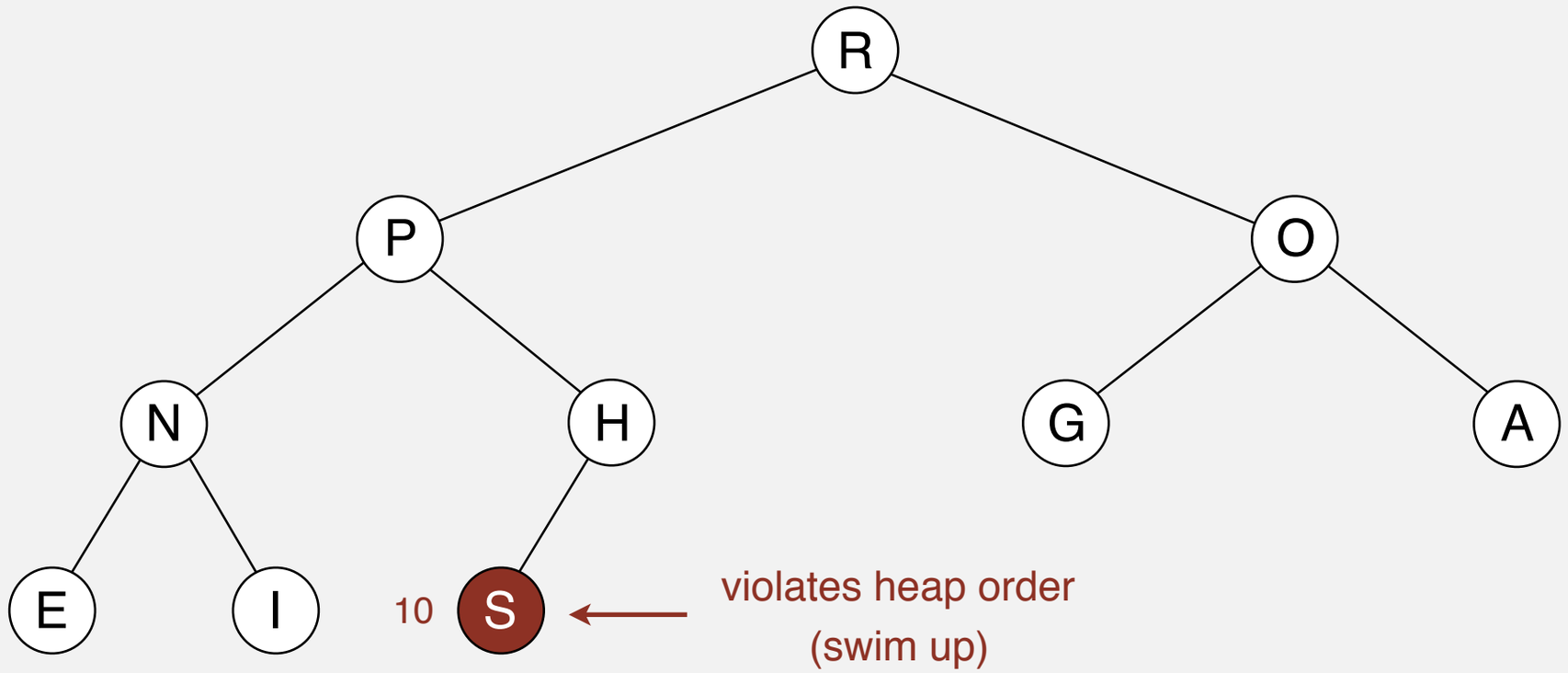
R	P	O	N	H	G	A	E	I	S	

Binary heap demo

Insert. Add node at end, then swim it up.

Remove the maximum. Exchange root with node at end, then sink it down.

Insert S: swim it up



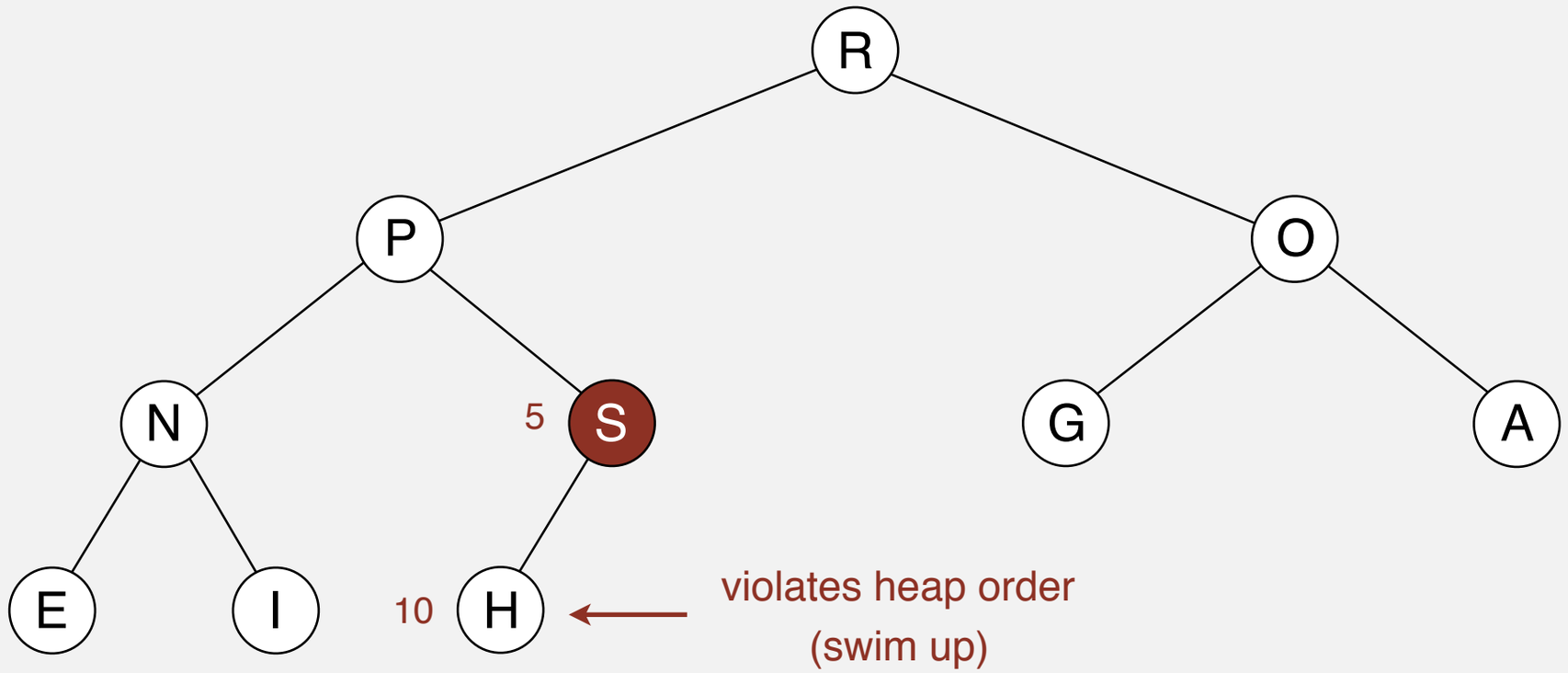
R	P	O	N	H	G	A	E	I	S	
									10	

Binary heap demo

Insert. Add node at end, then swim it up.

Remove the maximum. Exchange root with node at end, then sink it down.

Insert S: swim it up



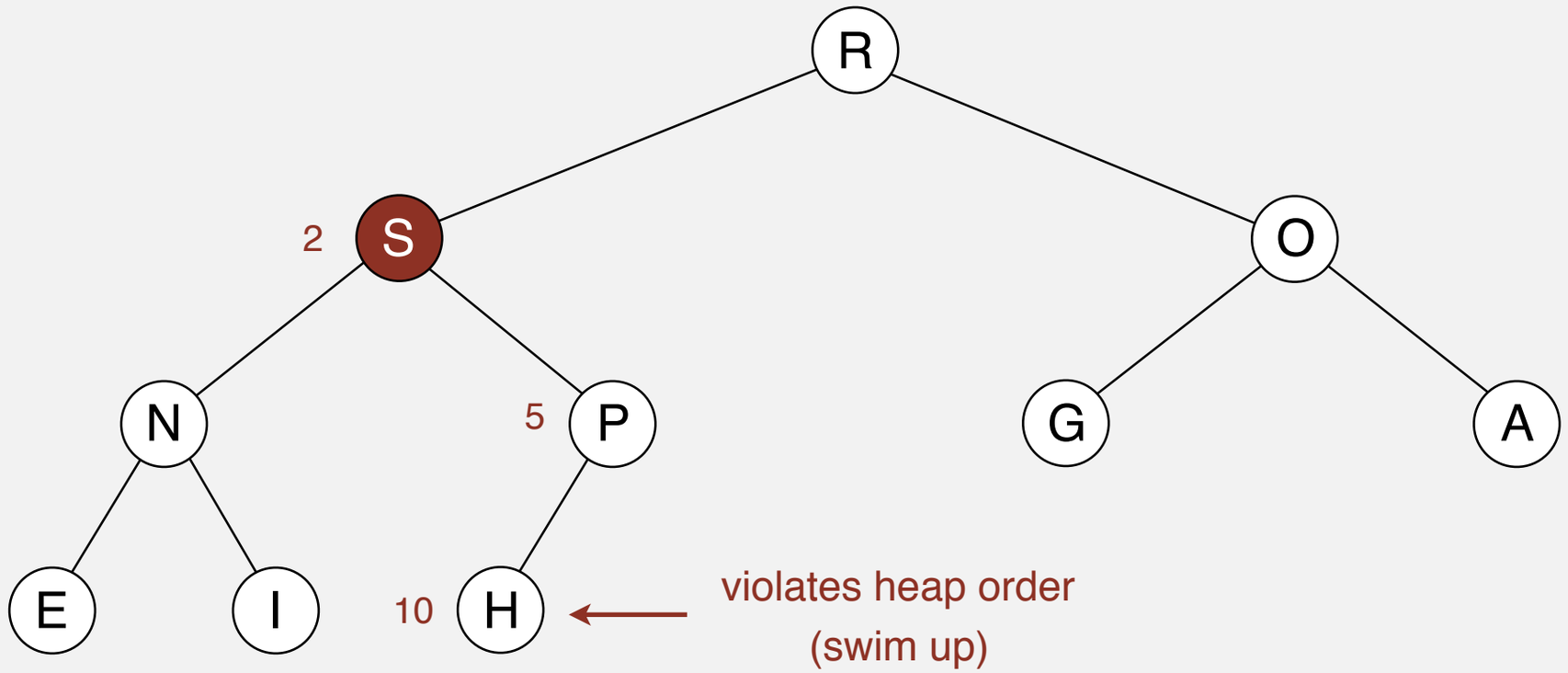
R	P	O	N	S	G	A	E	I	H	
				5					10	

Binary heap demo

Insert. Add node at end, then swim it up.

Remove the maximum. Exchange root with node at end, then sink it down.

Insert S: swim it up



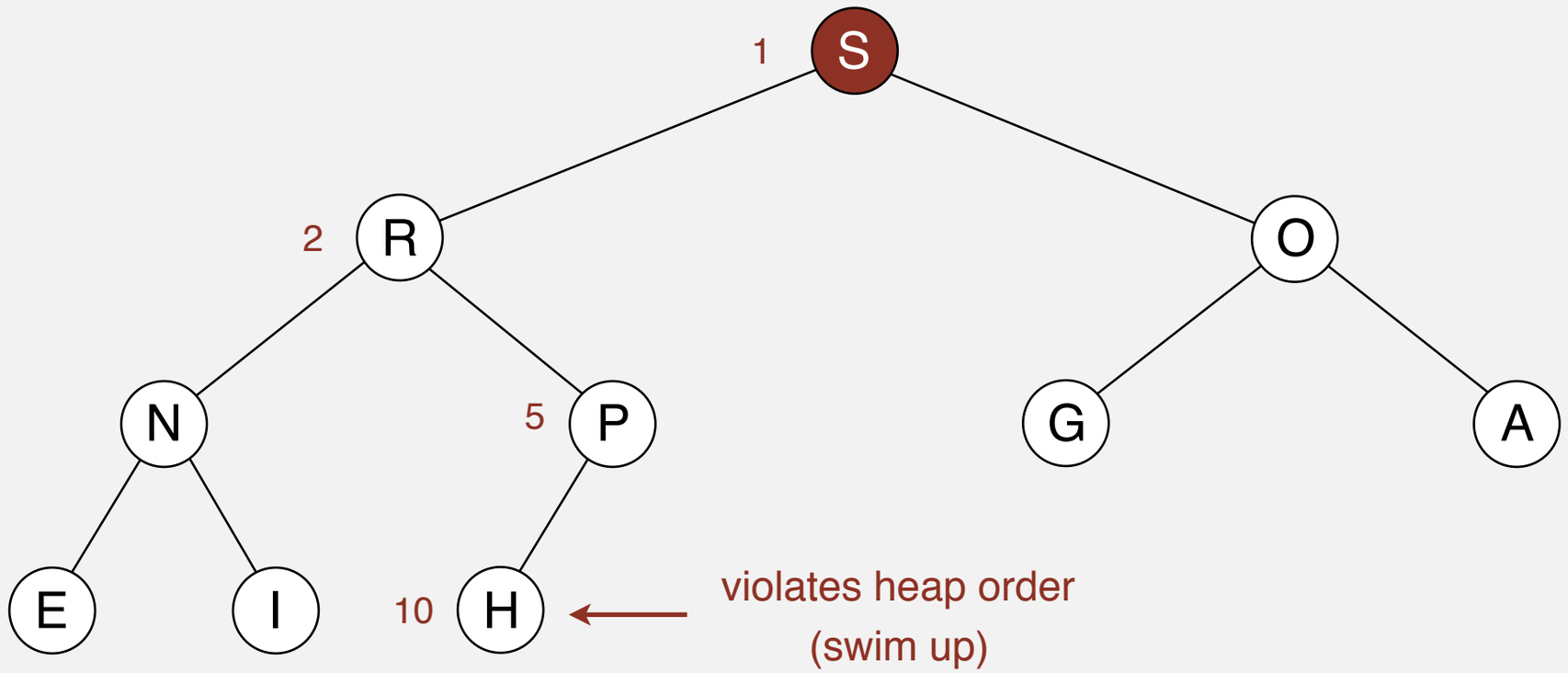
R	S	O	N	P	G	A	E	I	H	
	2			5					10	

Binary heap demo

Insert. Add node at end, then swim it up.

Remove the maximum. Exchange root with node at end, then sink it down.

Insert S: it's now at the top



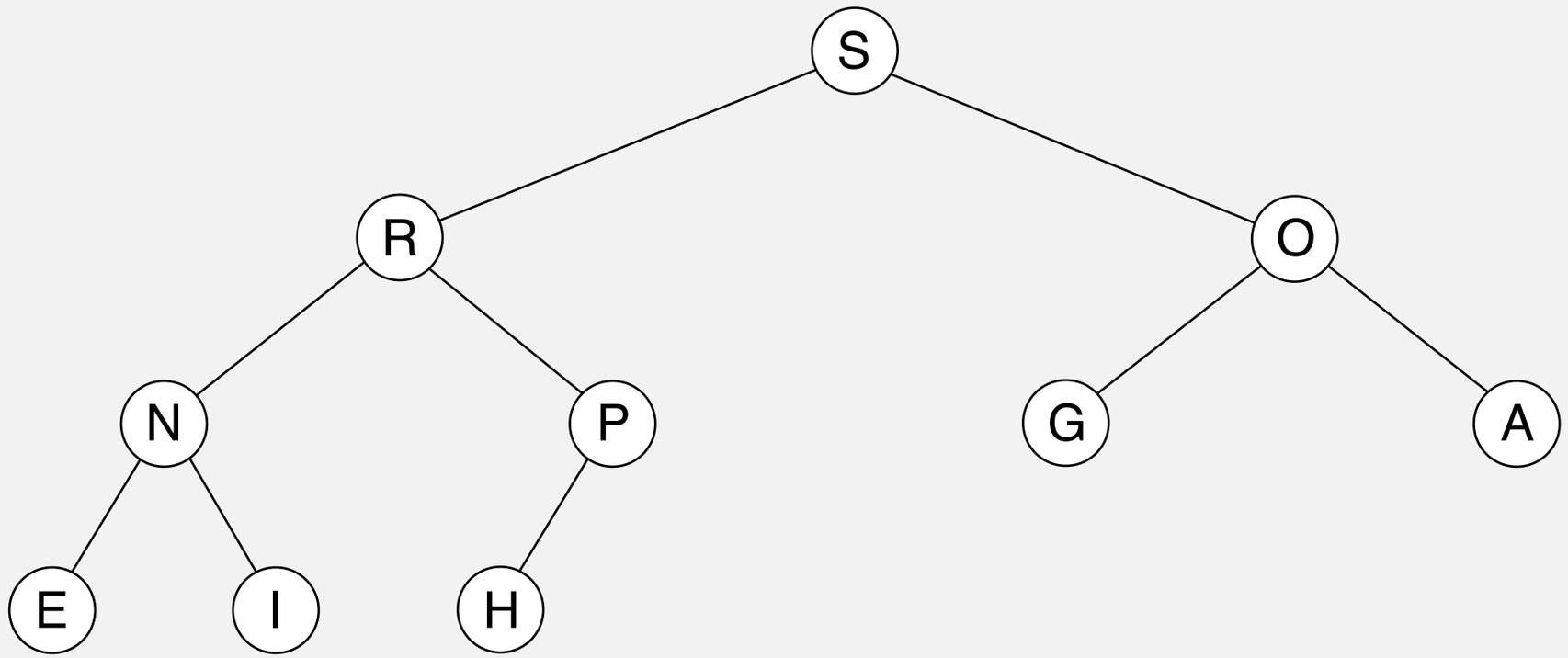
S	R	O	N	P	G	A	E	I	H	
1	2			5					10	

Binary heap demo

Insert. Add node at end, then swim it up.

Remove the maximum. Exchange root with node at end, then sink it down.

Heap re-ordered



S	R	O	N	P	G	A	E	I	H	