

CSE 101-01 5-17-22

• mid 2: Thur 5/19

• Pa6: last ext. (Wed.)

Ex. mult. 2 ~~ts~~ of different length b=10
P=1

(1 2 3 4)
 (5 6 7)

shift

empty list = 0

() = P

	(7 14 21 28)	S.m.	0
P =	(7 14 21 28)	add	
P =	(8 6 3 8)	norm	

	(6 12 18 24 0)	S.m.	1
P =	(6 20 24 27 8)	add	
P =	(8 2 6 7 8)	norm	

$(5 \ 10 \ 15 \ 20 \ 0 \ 0) \text{ s.m.}$
 $(5 \ 18 \ 17 \ 26 \ 7 \ 8) \text{ add}$
 $(6 \ 9 \ 9 \ 6 \ 7 \ 8) \text{ norm}$

2

2

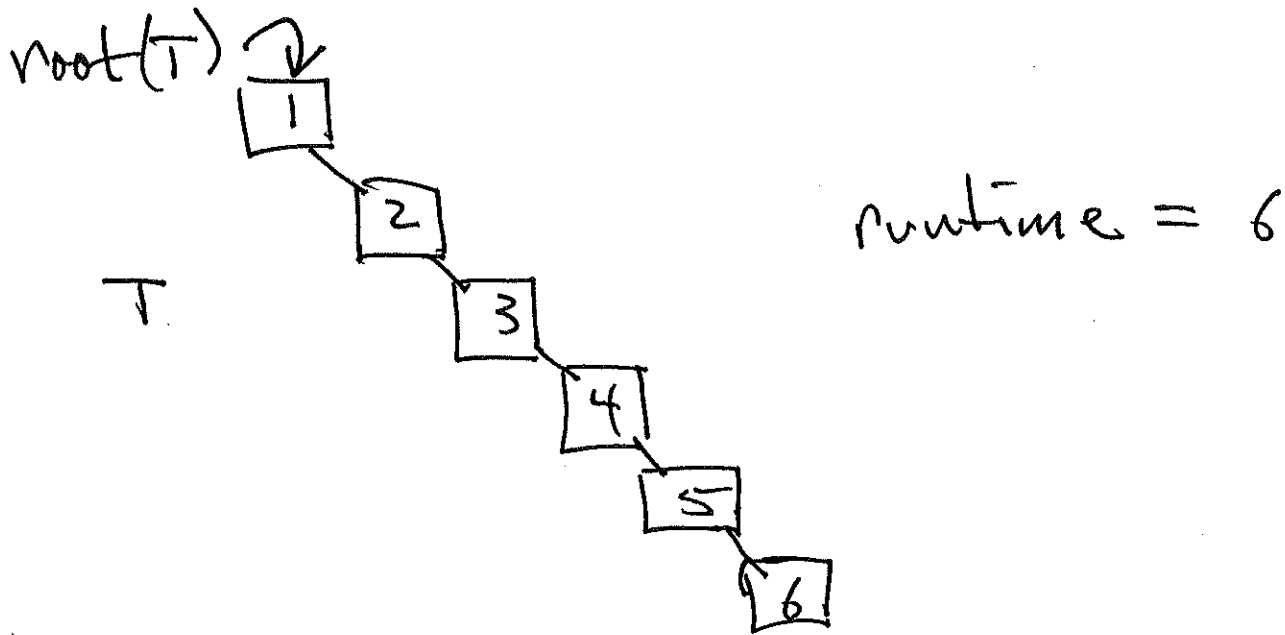
Dictionary: BST

Runtime:

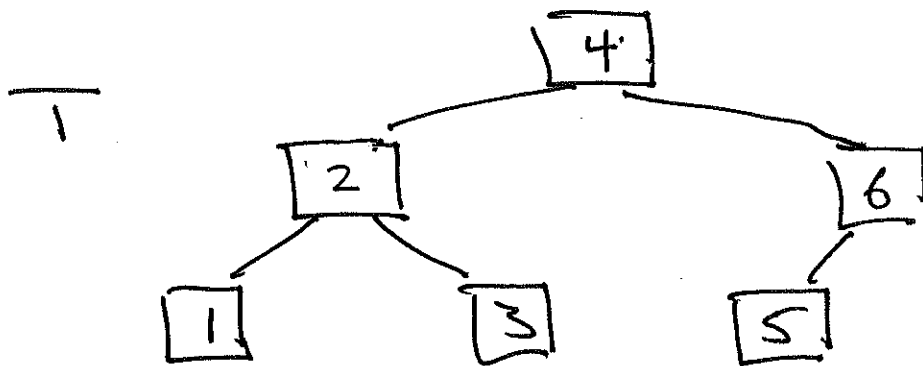
• traversal: $\Theta(n)$

• Queries: $\Theta(\text{height}(T))$

Ex. Worst possible for search



Ex. best possible for search



$$\text{runtime} = \text{height}(T) = 2$$

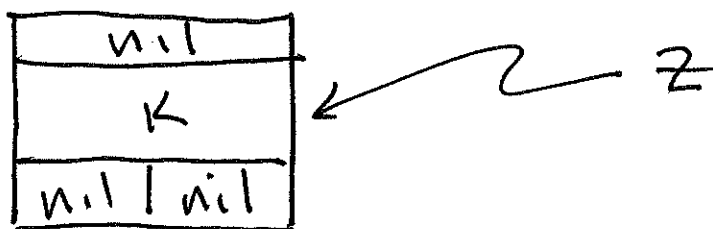
In general, for n nodes

$$\log n \leq \text{height}(T) \leq n$$

(12.3) Insertions.

to insert new node z into T .

- set $key[z] = k$
- set $p[z] = left[z] = right[z] = nil$.



- find a node to adopt z as (left or right) child.

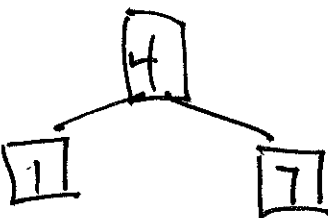
Strategy: search for key k in T ,
 find nil child where k would reside
 if it were in T .

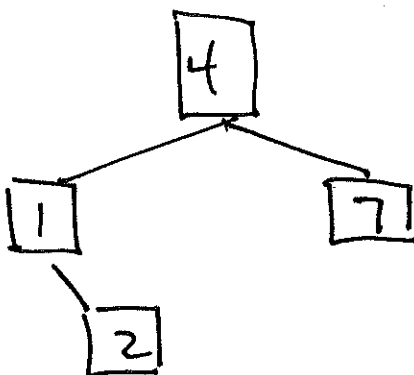
Ex. Keys: 4 1 7 2 8 3 5 6 5

empty state: $T.root = nil$

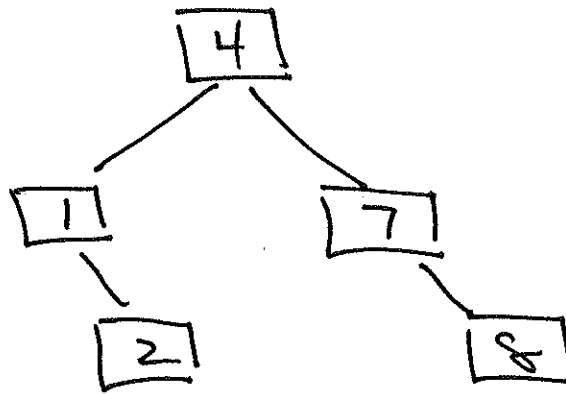
insert(4) 

insert(1) 

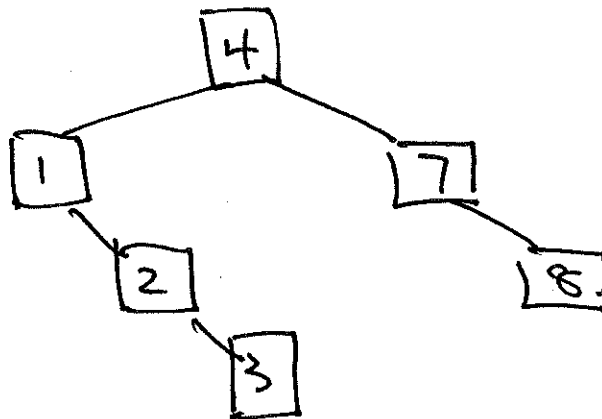
insert(7) 

insert(2) 

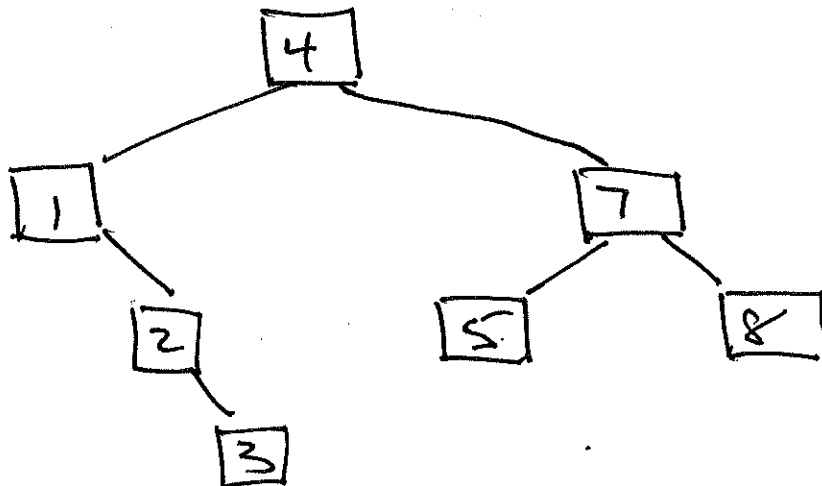
insert(8)



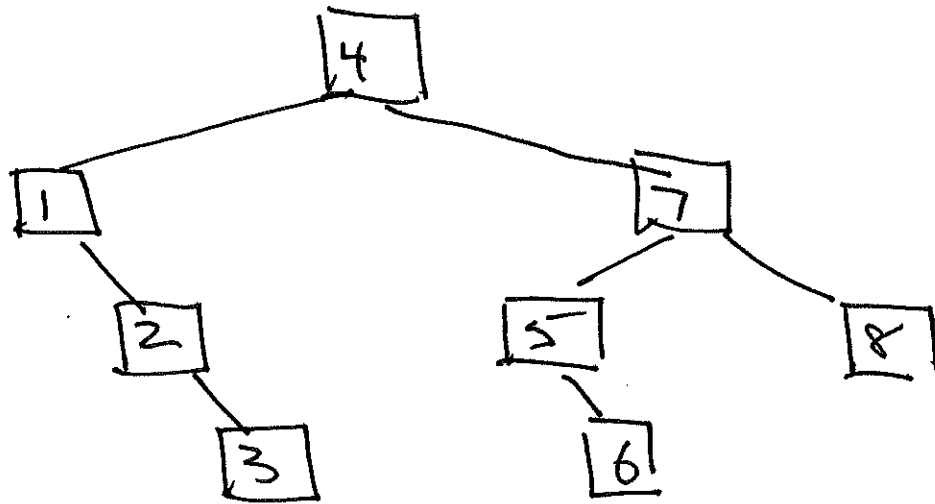
insert(3)



insert(5)



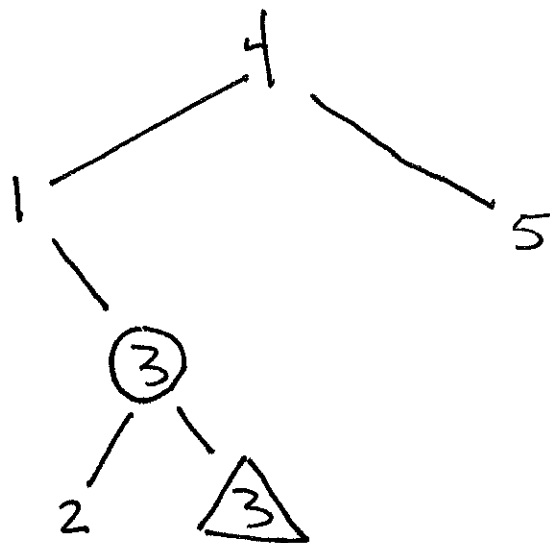
insert(6)



Runtime: $\Theta(\text{height}(T))$

what if two identical keys?

Ex. 4 1 ③ 2 △3 5



(12.4) Deletion

delete z from T

3 cases:

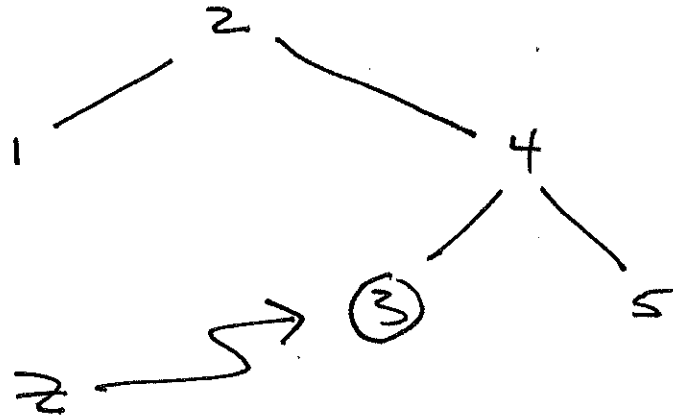
Case 1: z has no children

Case 2: z has 1 child $\begin{cases} 2.1 \text{ right no left} \\ 2.2 \text{ left no right} \end{cases}$

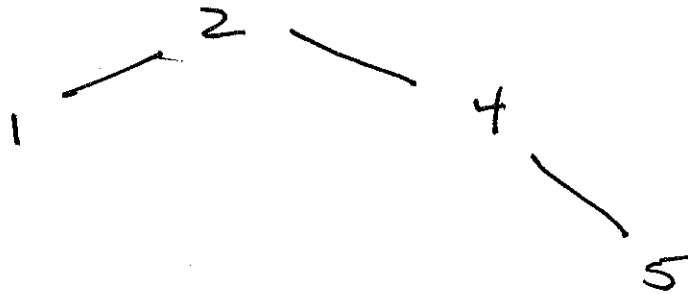
Case 3: z has 2 children

Ex Case 1 : (no children)

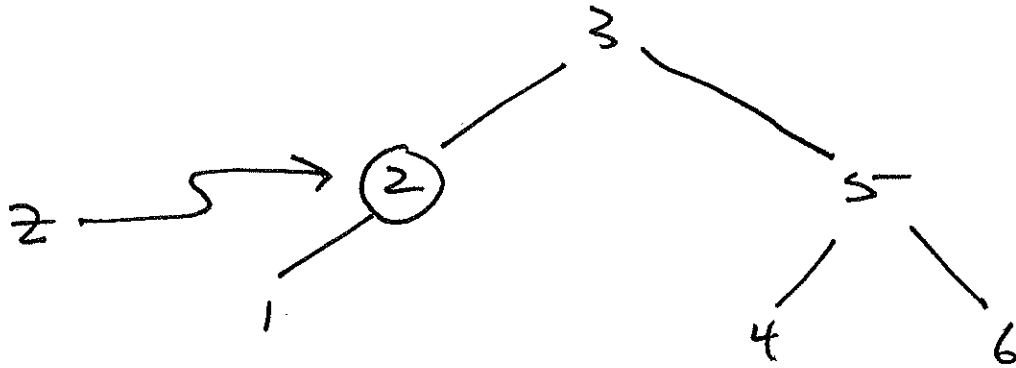
detach 2 from its Parent



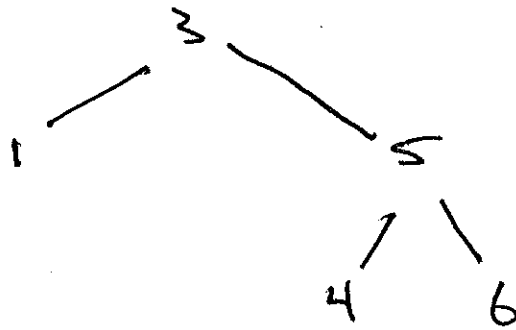
delete(3)



Ex. Case 2.2 (left but no right)
 $\Rightarrow$ splice out z .



delete(z)

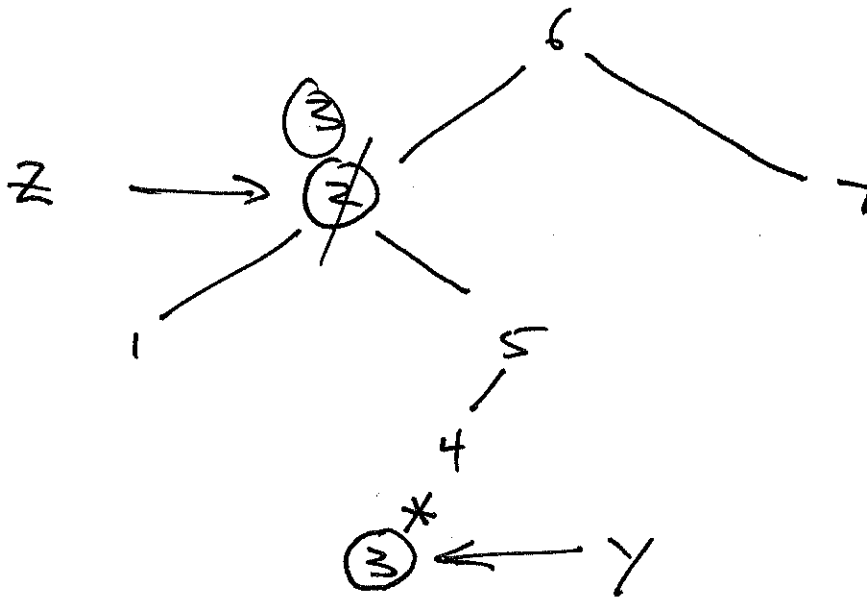


Exercise: draw an example of
 Case 2.1 (right but no left.)

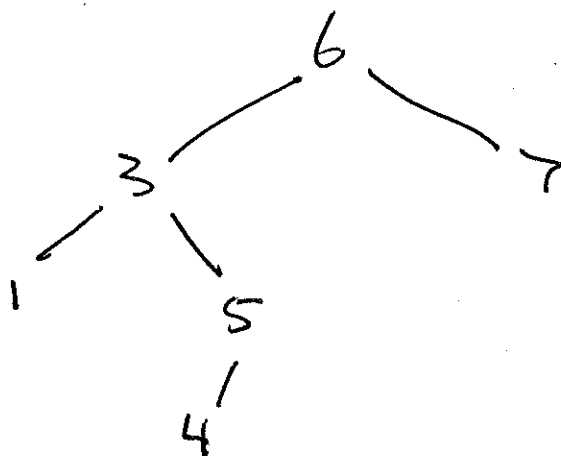
Ex. Case 3 (2 children)

replace z by its successor y

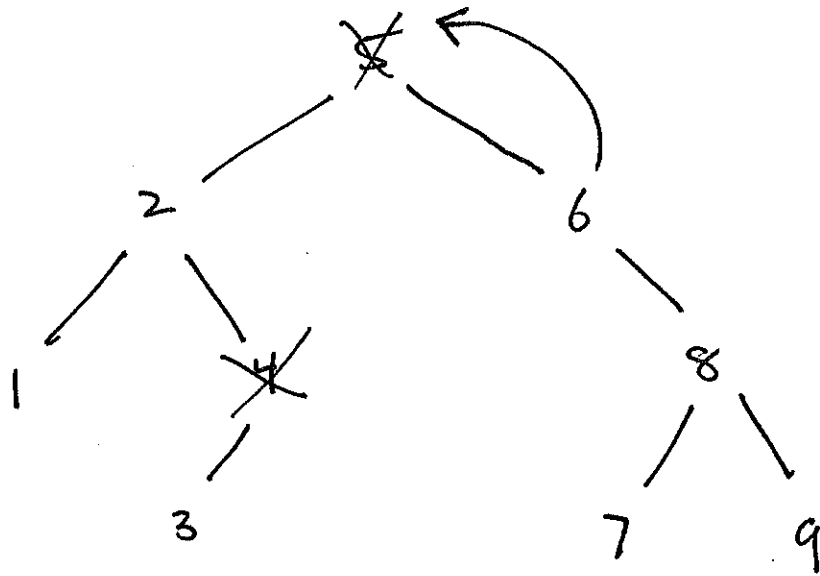
(which has no left child)



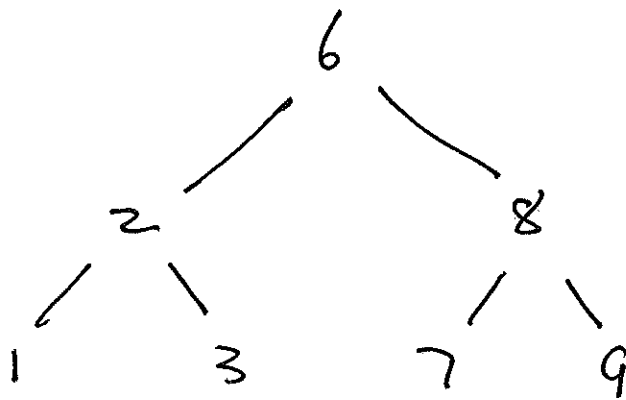
delete(z)



Ex. insert: 5 2 6 4 3 8 7 19

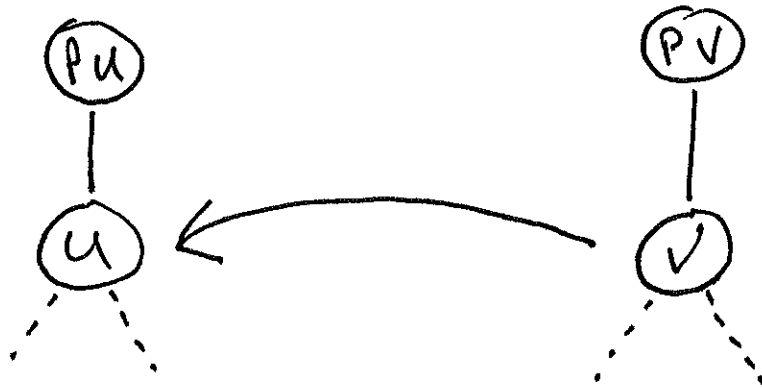


delete: 4 5



Pseudo code for delete

helper function: Transplant(T, u, v)



Ex. Case 3

