Chapter 5, Binary search trees:

- Binary search trees intro (lab and **Today**)
- The balanced BST problem (Fri, Oct 25)
- AVL trees (Friday, Oct 25, and Monday, Oct 28)
- Traditional red-black trees (Wednesday, Oct 30)
- Left-leaning red-black trees (Friday, Nov 1)
- “Wrap-up” BST (Monday, Nov 4)

Today:

- The quest for a better map, motivation for BST
- BST definition and iterative implementation
- BST performance and the balanced BST problem
- Introduction to the code base

Coming up:

Catch up on older projects?
Do **SSSP** *project (due today, Fri, Oct 18)*

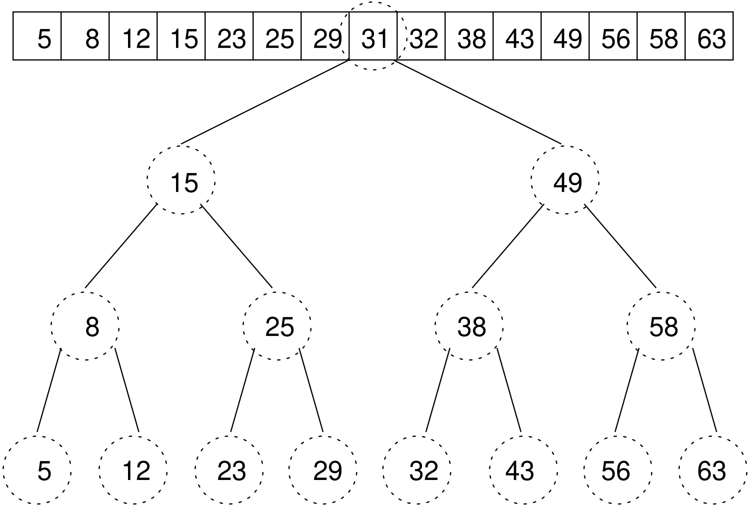
Due **Fri, Oct 25** *(end of day)*
Read Section 5.(1 & 2)
Do Exercises 5.(2 & 6)
Take quiz

Do **BST rotations** *project (due Mon, Oct 28)*

```java
public interface Map<K, V> extends Iterable<K> {
    void put(K key, V val);
    V get(K key);
    boolean containsKey(K key);
    void remove(K key);
}
```

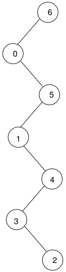
List	$\Theta(n)$
BST	$\Theta(\lg n)$
Hashtable	$\Theta(1)$

		Unsorted	Sorted
Array	Find	$\Theta(n)$	$\Theta(\lg n)$
	Insert	$\Theta(1)$ expected, $\Theta(n)$ worst	$\Theta(n)$
	Delete	$\Theta(n)$	$\Theta(n)$
Linked structure	Find	$\Theta(n)$	$\Theta(n)$
	Insert	$\Theta(1)$	$\Theta(1)$
	Delete	$\Theta(1)$	$\Theta(1)$



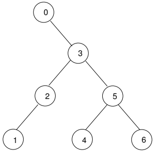
5	8	12	15	23	25	29	31	32	38	43	49	56	58	63

6, 0, 5, 1, 4, 2, 3



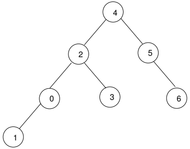
height 7
total depth 21
ANI 4

0, 3, 5, 2, 6, 1, 4



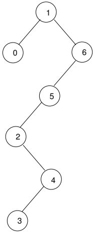
height 4
total depth 14
ANI 3

4, 2, 5, 3, 0, 1, 6



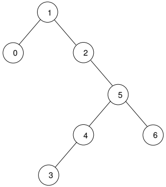
height 4
total depth 11
ANI 2.57

1, 6, 5, 2, 4, 3, 0



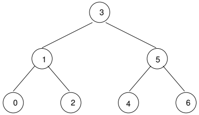
height 6
total depth 16
ANI 3.29

1, 2, 5, 4, 3, 0, 6

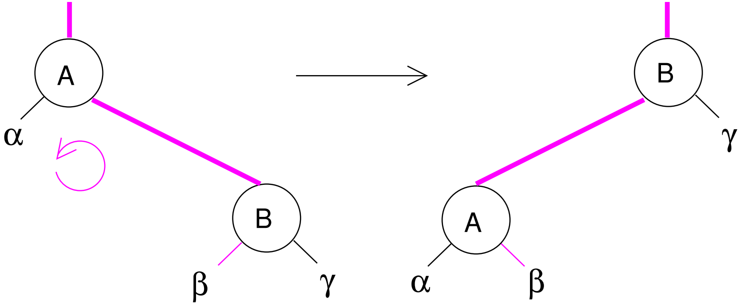


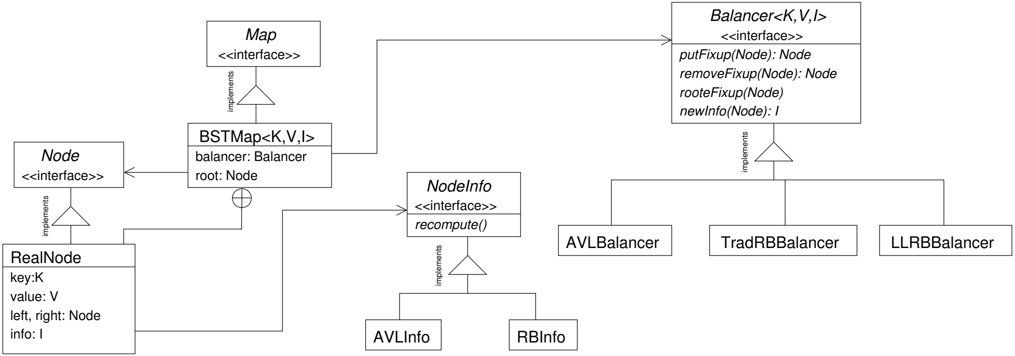
height 5
total depth 14
ANI 3

3, 1, 5, 0, 2, 4, 6



height 3
total depth 10
ANI 2.43


A
α
B
β
γ
B
γ
A
α
β


Map
<<interface>>

implements

BSTMap<K,V,I>
balancer: Balancer
root: Node

Node
<<interface>>

implements

RealNode
key:K
value: V
left, right: Node
info: I

Balancer<K,V,I>
<<interface>>
putFixup(Node): Node
removeFixup(Node): Node
rooteFixup(Node)
newInfo(Node): I

implements

AVLBalancer

TradRBBalancer

LLRBBalancer

NodeInfo
<<interface>>
recompute()

implements

AVLInfo

RBInfo

Coming up:

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