Balanced Binaries – AVL Trees

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Height of a tree node:
   1. The height of a node with no elements is 0
   2. The height of a node with 1 element is 1
   3. The height of a node with > 1 element is 1 + the height of its tallest subtree

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AVL tree:
A binary tree in which the difference between the height of the right and left subtrees of the root is never more than one.

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AVL tree:
   A binary tree in which the difference between the height of the right and left subtrees of the root is never more than one.

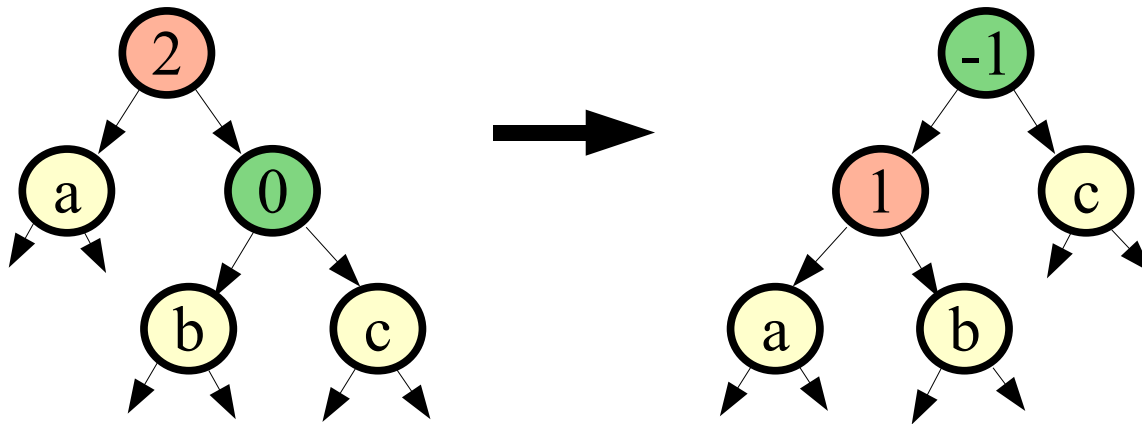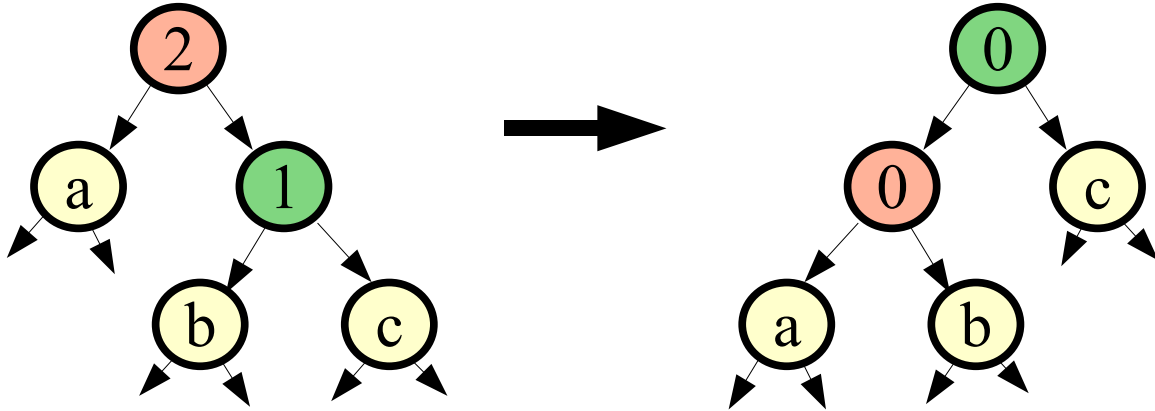   Each node keeps a balance number which is the difference in heights of its two subtrees.

   For example,
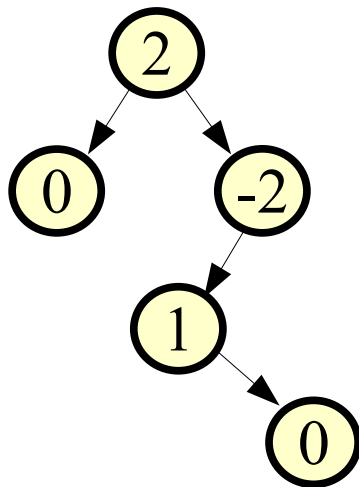
Whenever a balance number is not 0,-1,+1, perform some rotations according to some rules on following pages

Balanced Binaries – AVL Trees
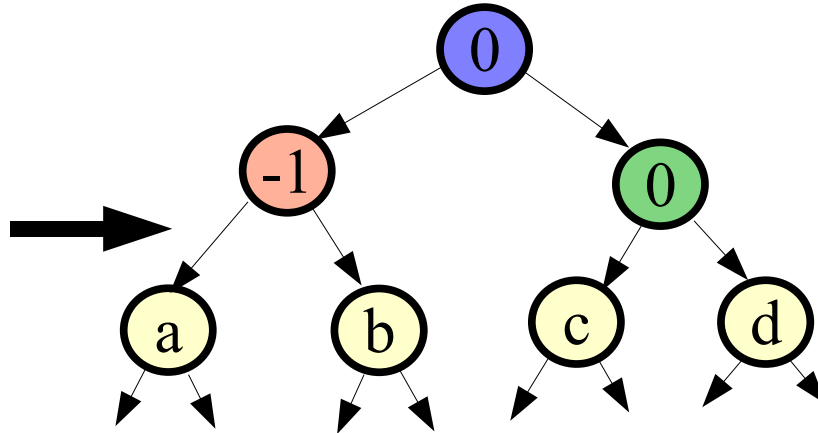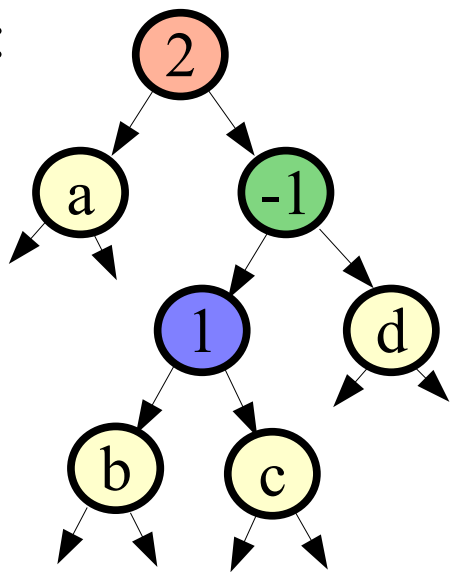
Rules for rotation:

If:

Plus mirror image of these two cases

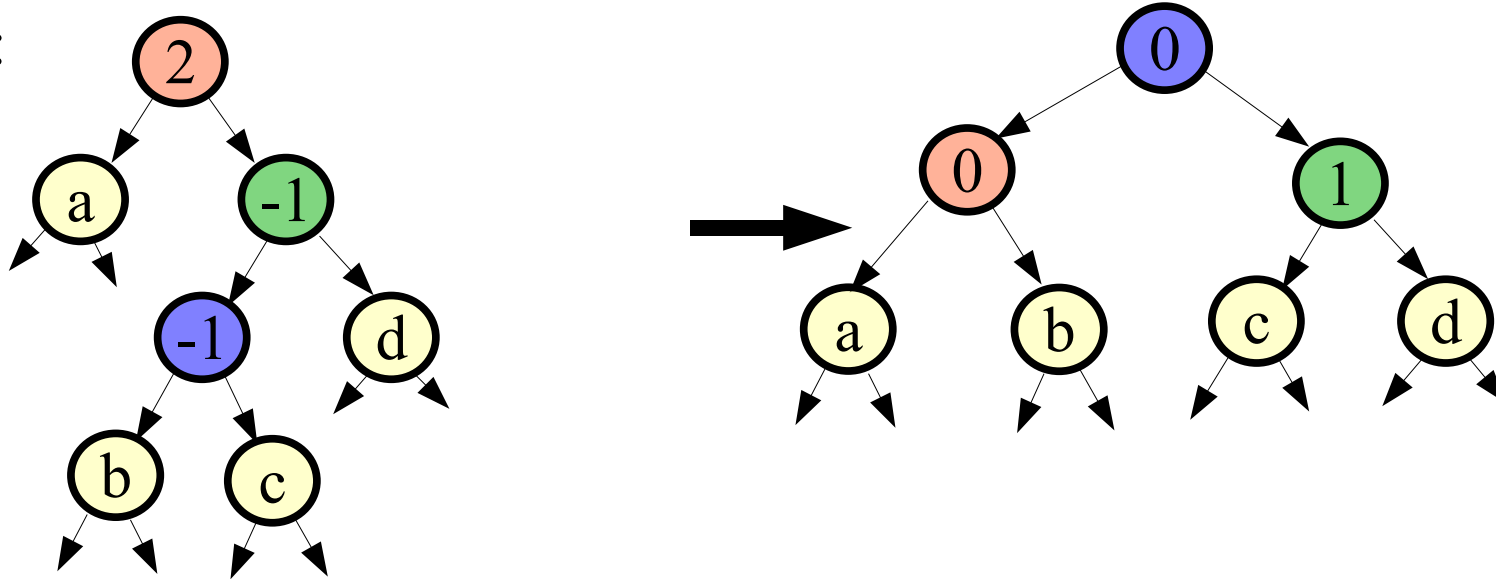# Balanced Binaries – AVL Trees

Rules for rotation:

If:

Balanced Binaries – AVL Trees
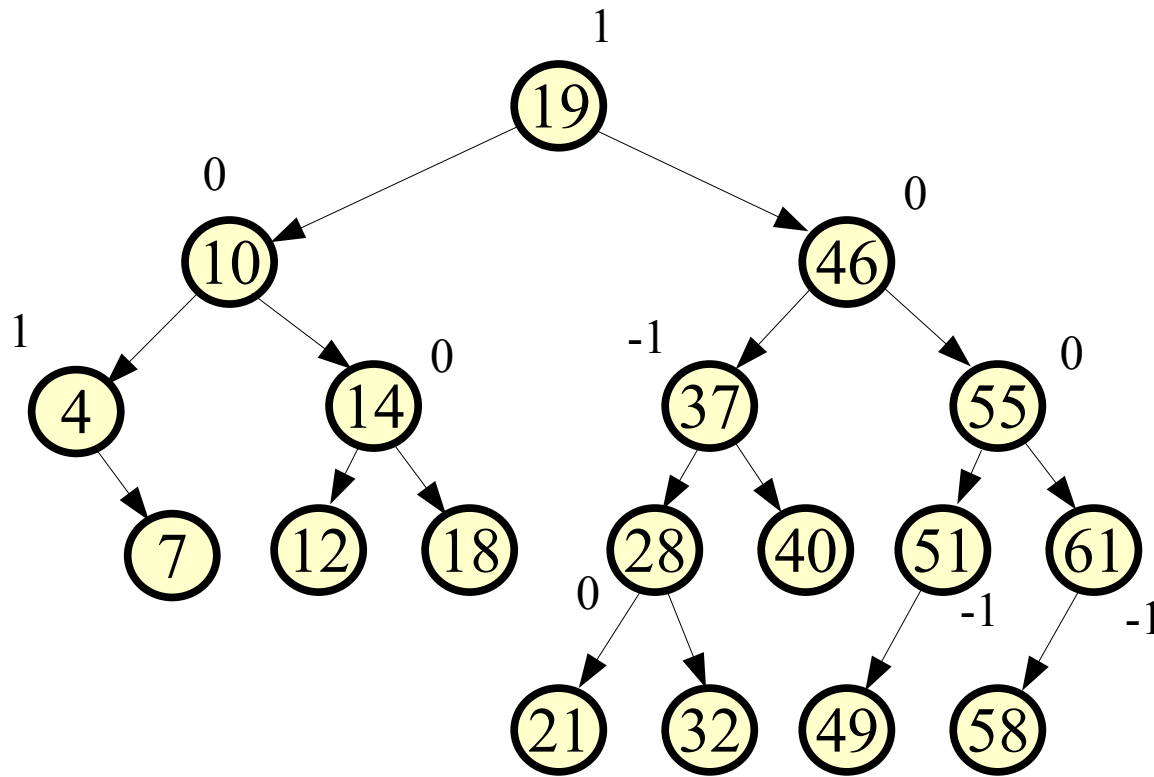
Rules for rotation:
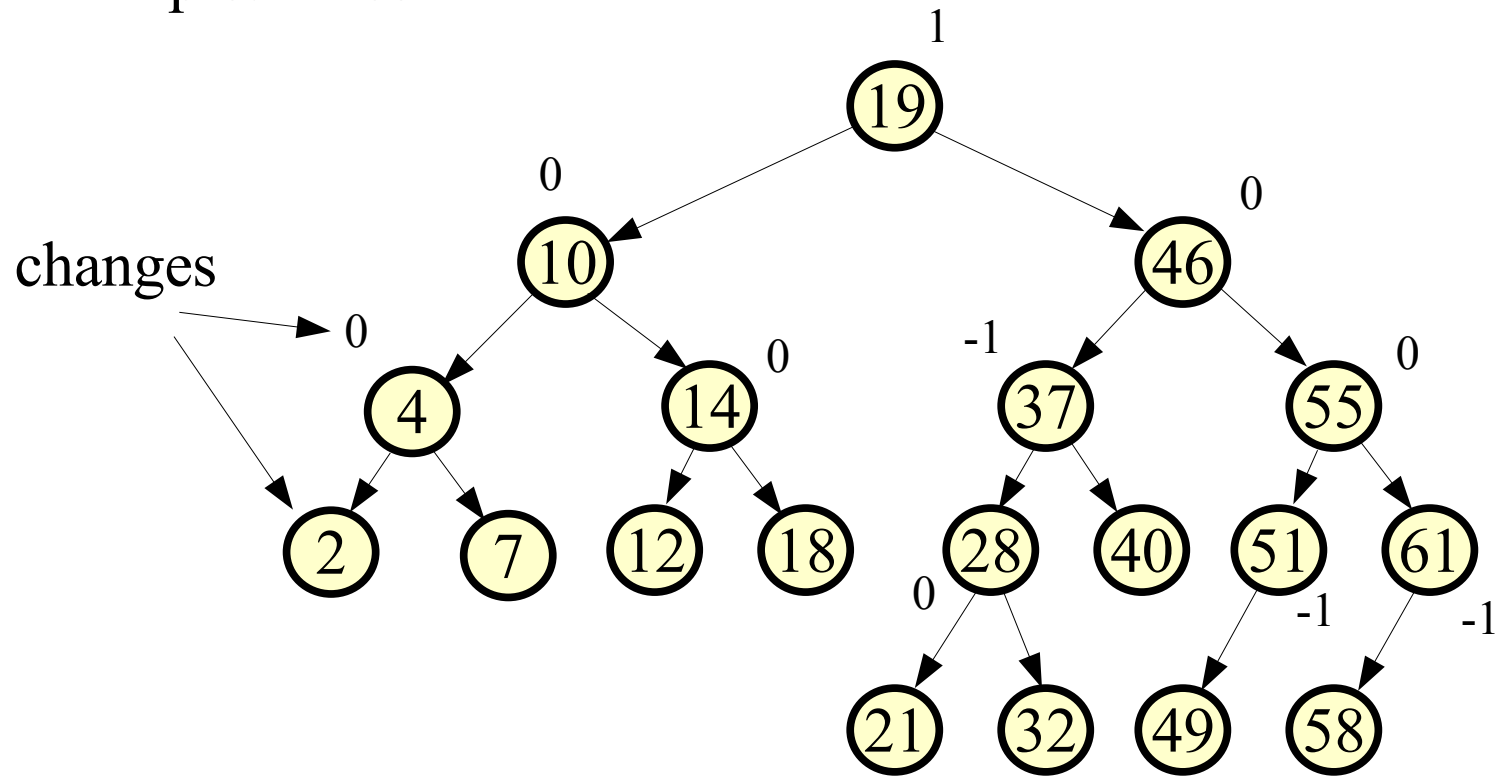

Plus mirror image of these three cases

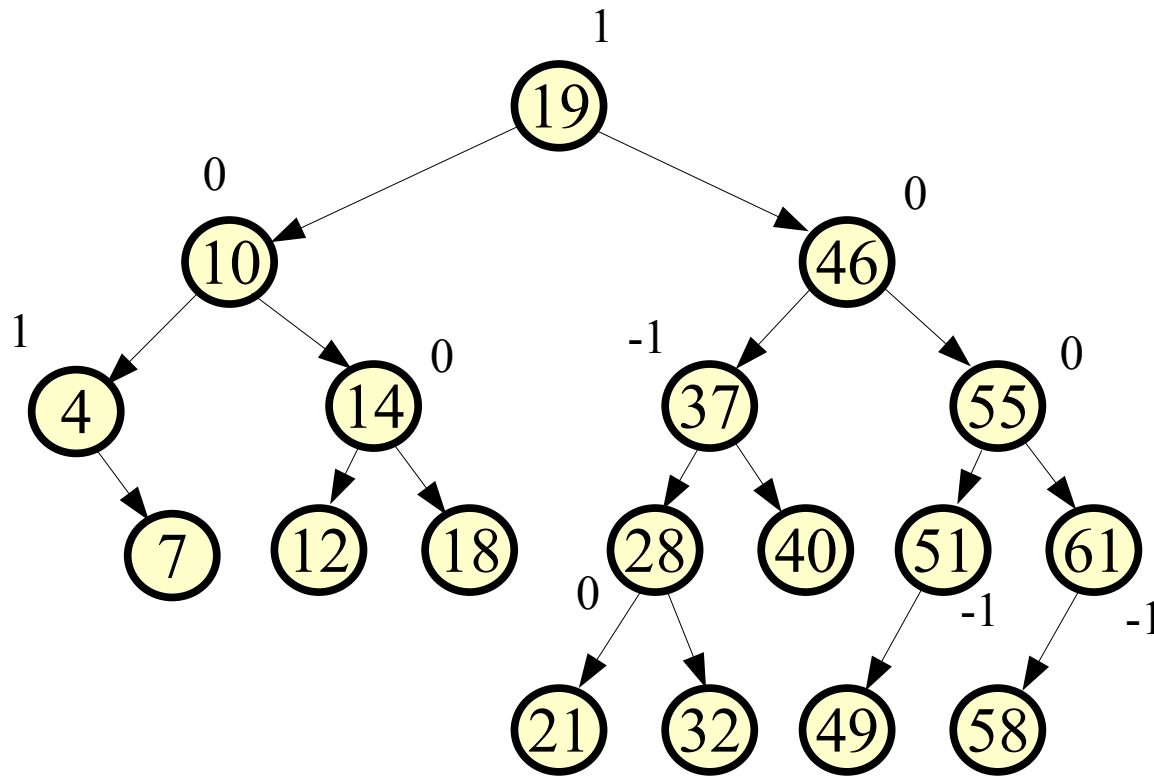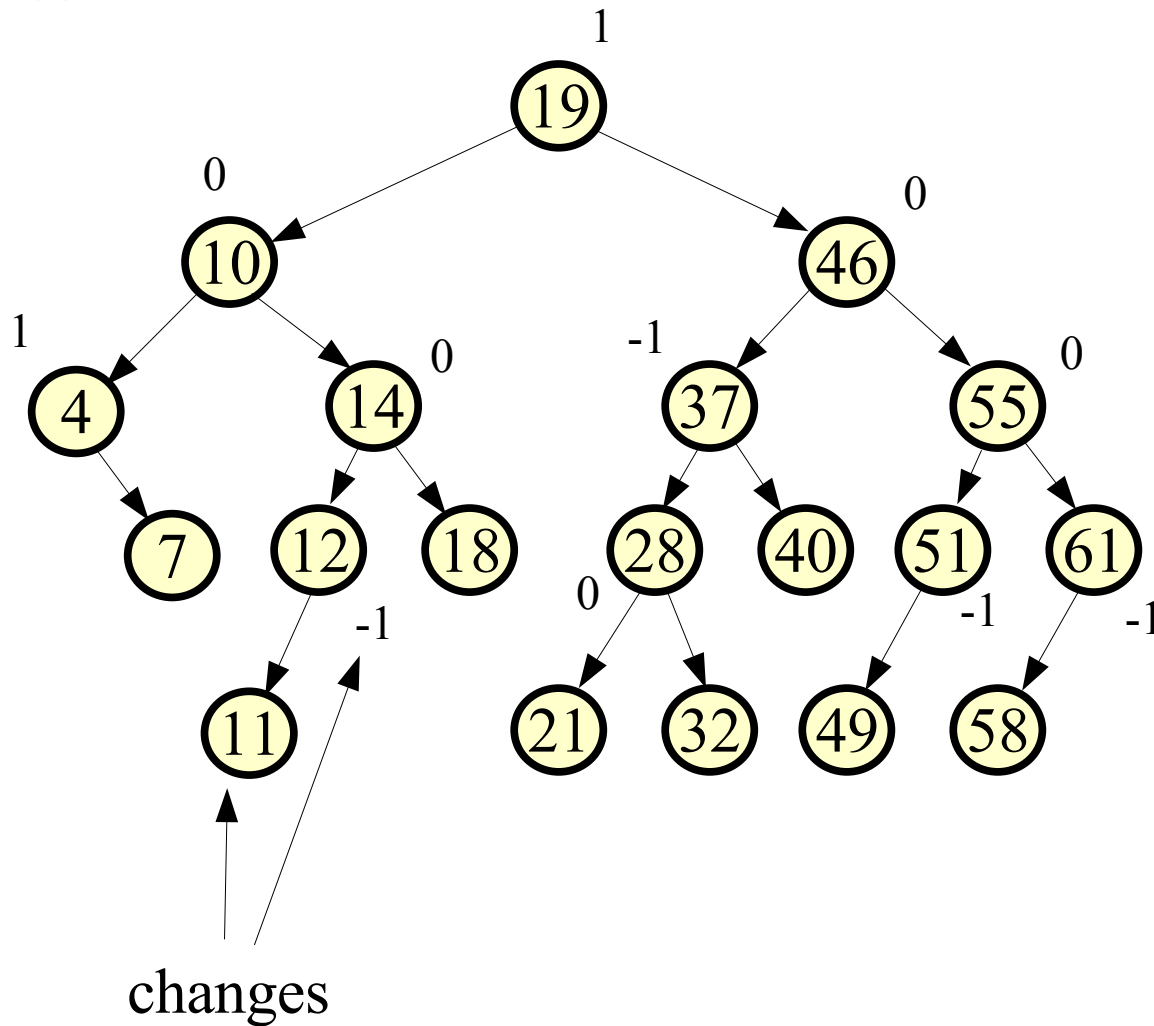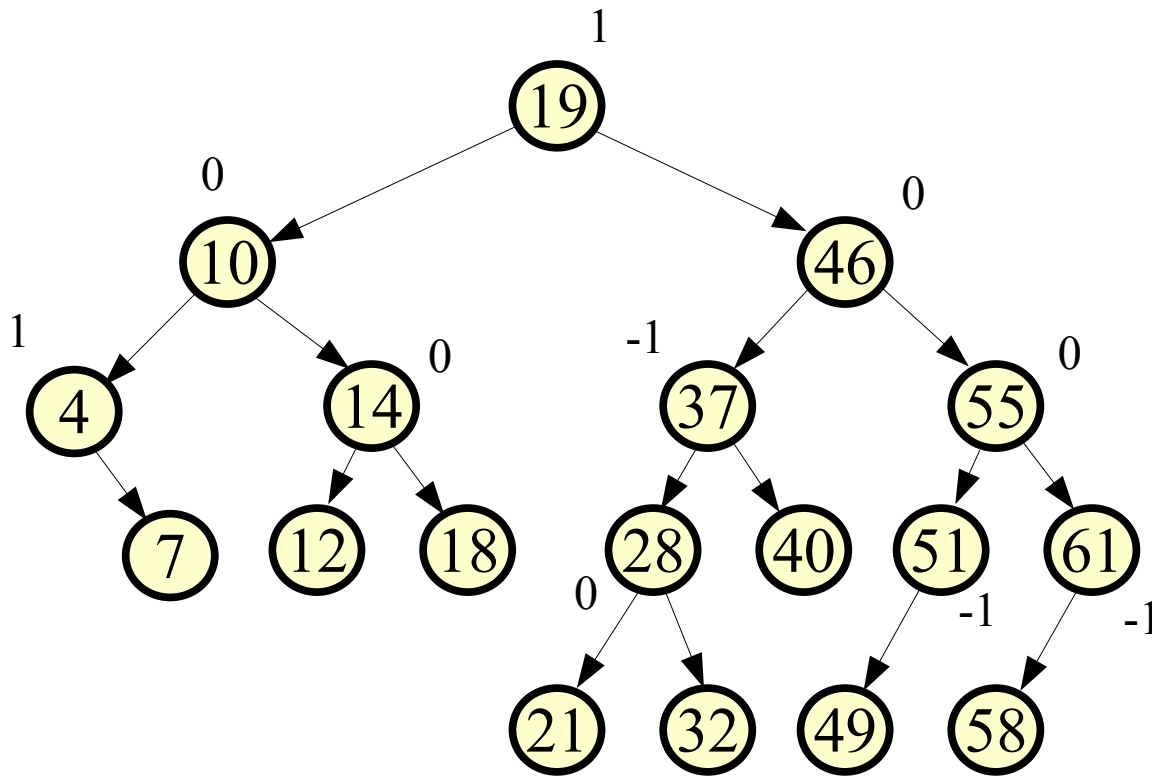# Balanced Binaries – AVL Trees

Example:

Balanced Binaries – AVL Trees

Example: Insert 2

Balanced Binaries – AVL Trees

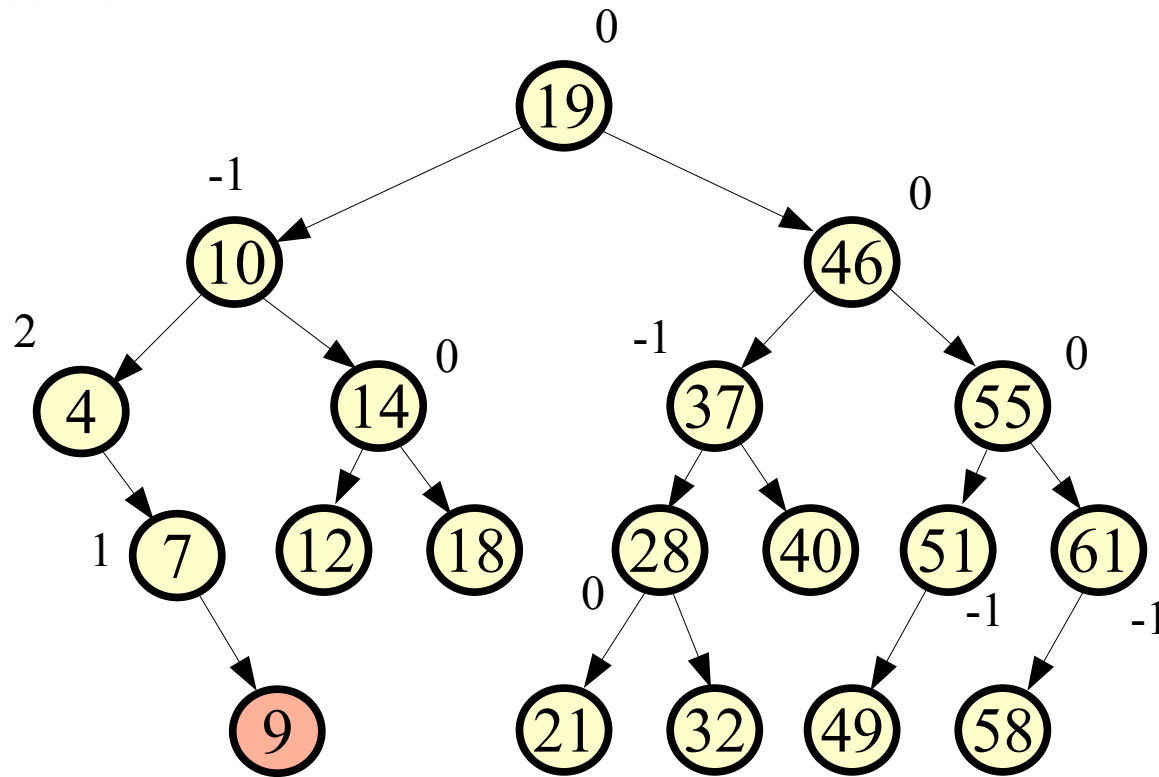Example:

Balanced Binaries – AVL Trees

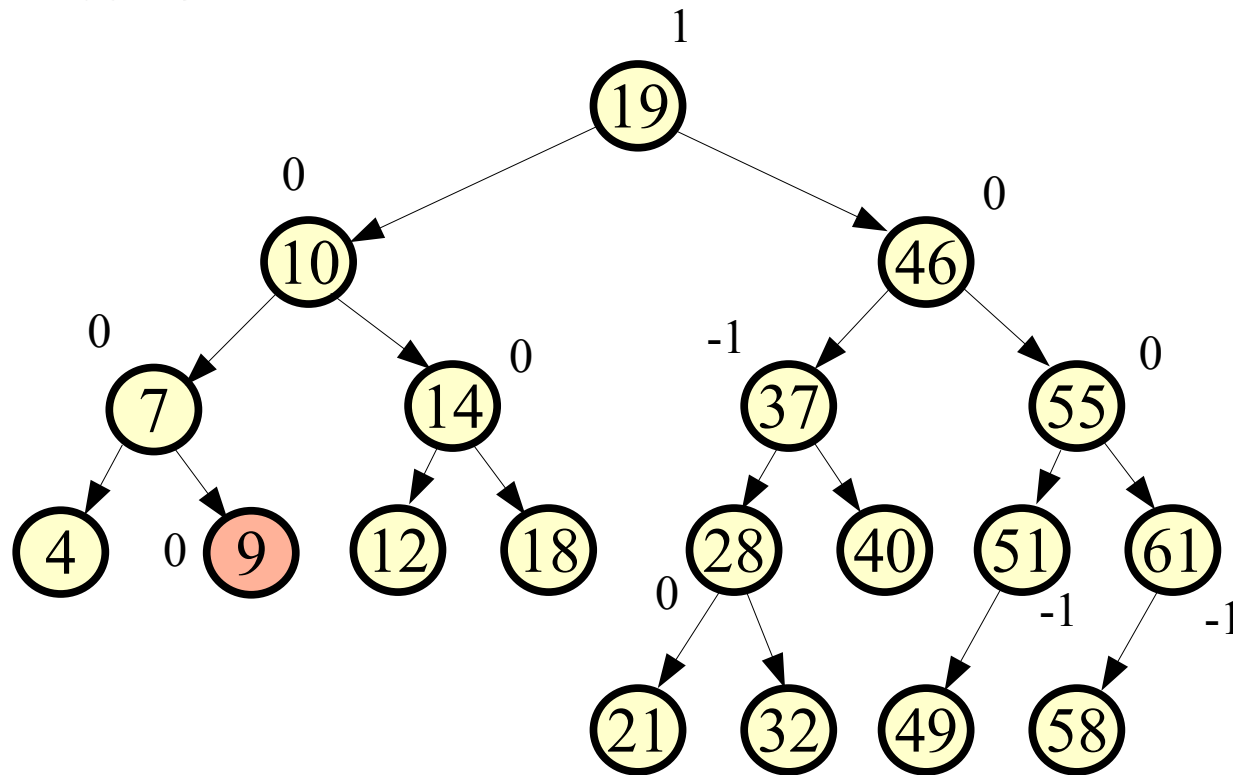Example: Insert 11

Balanced Binaries – AVL Trees

Example:

Balanced Binaries – AVL Trees
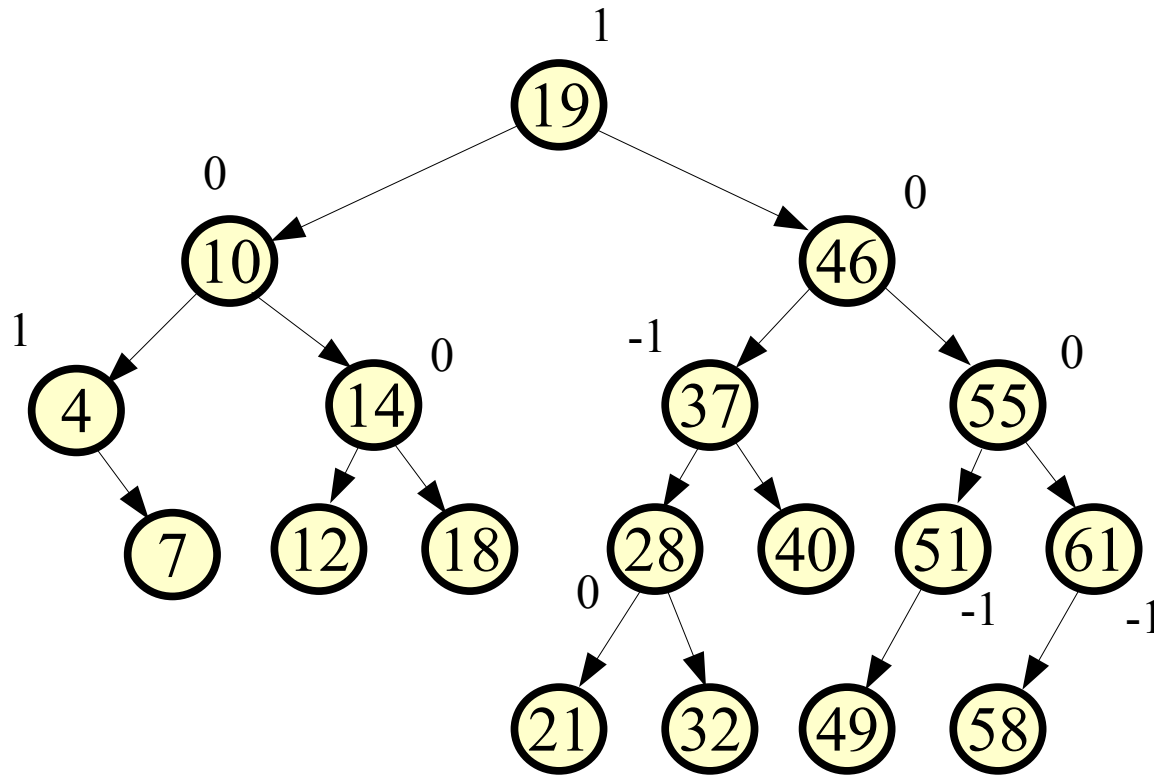
Example: Insert 9

Balanced Binaries – AVL Trees
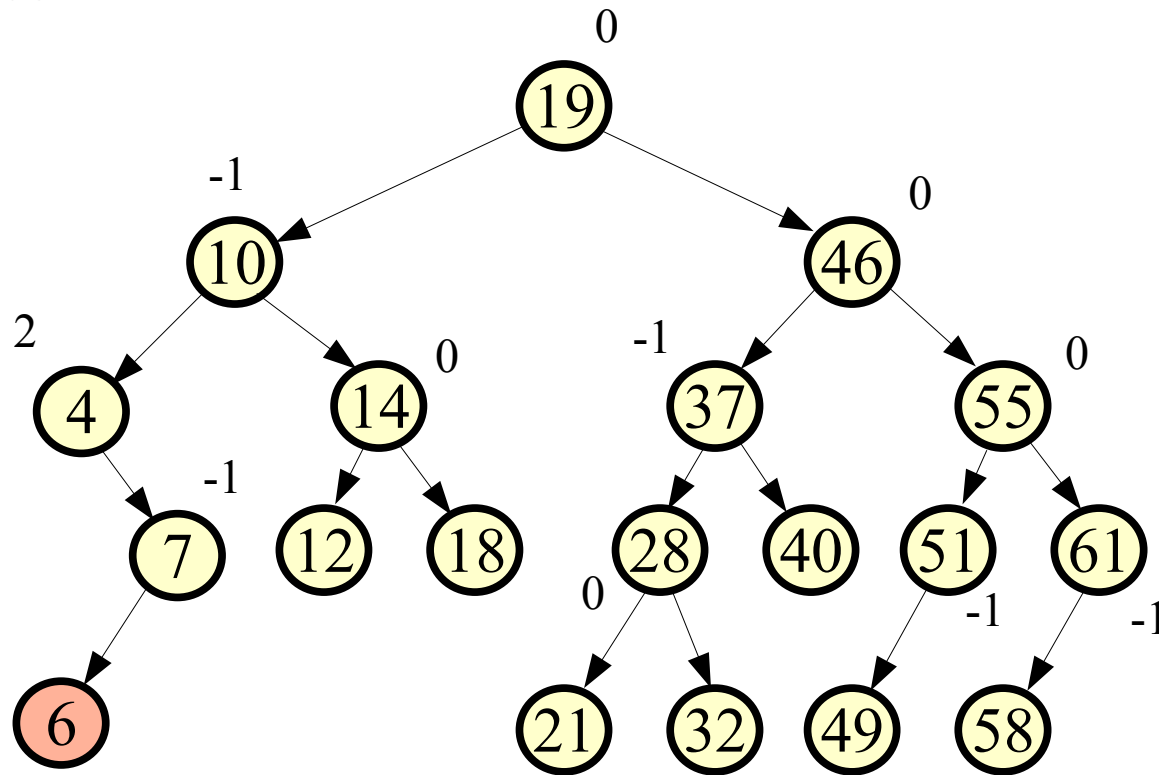
Example: Insert 9

Rotation around 7
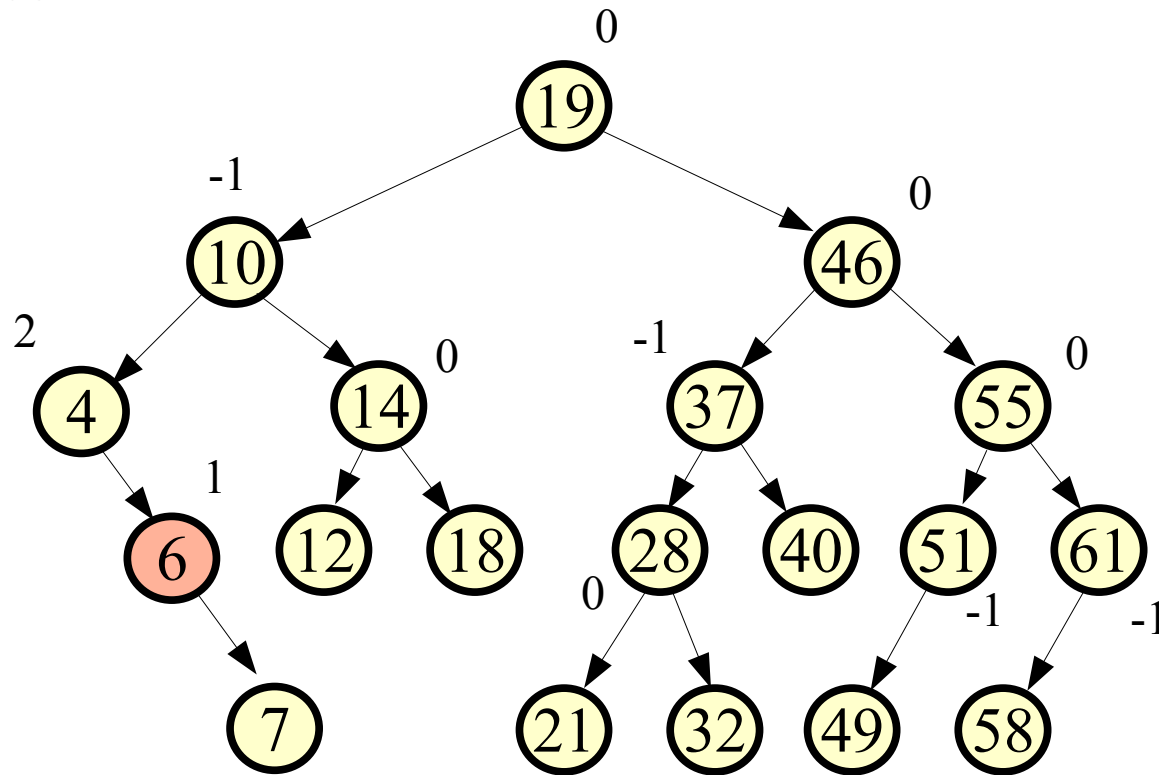
Balanced Binaries – AVL Trees

Example:

Balanced Binaries – AVL Trees

Example: Insert 6
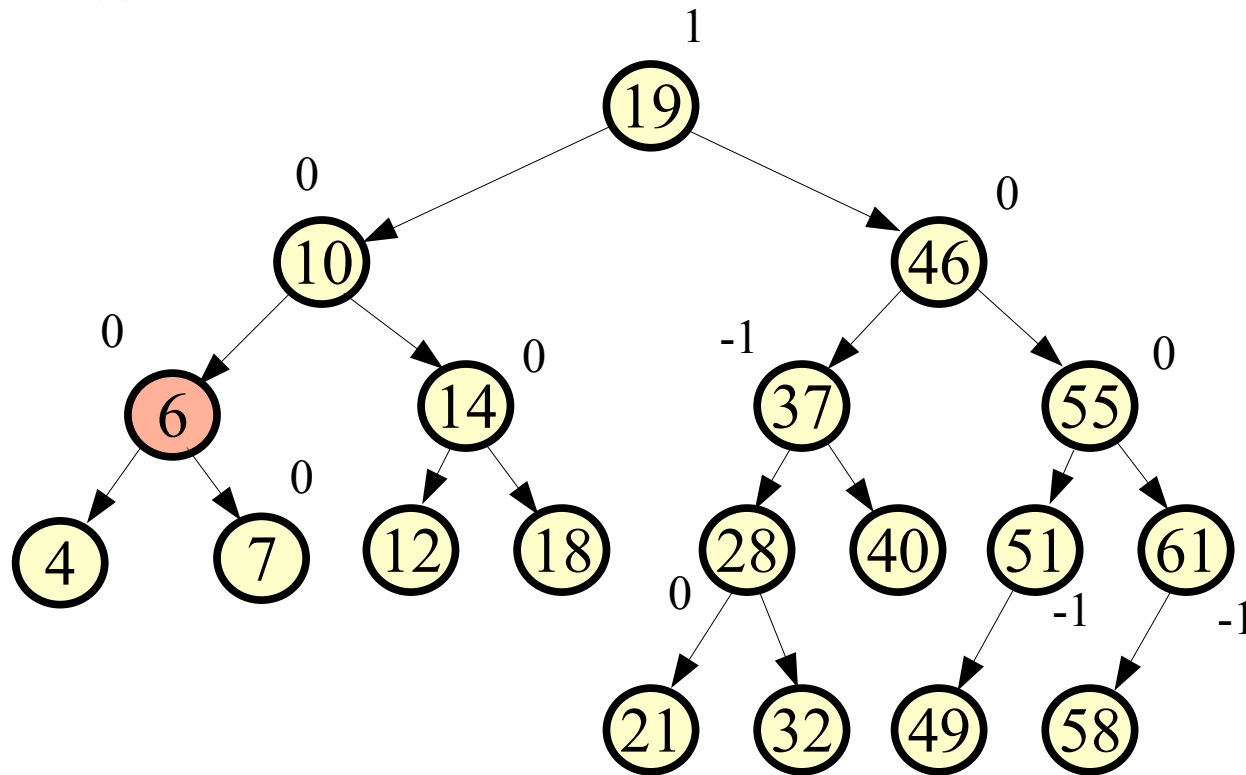
Balanced Binaries – AVL Trees

Example: Insert 6

Double rotation
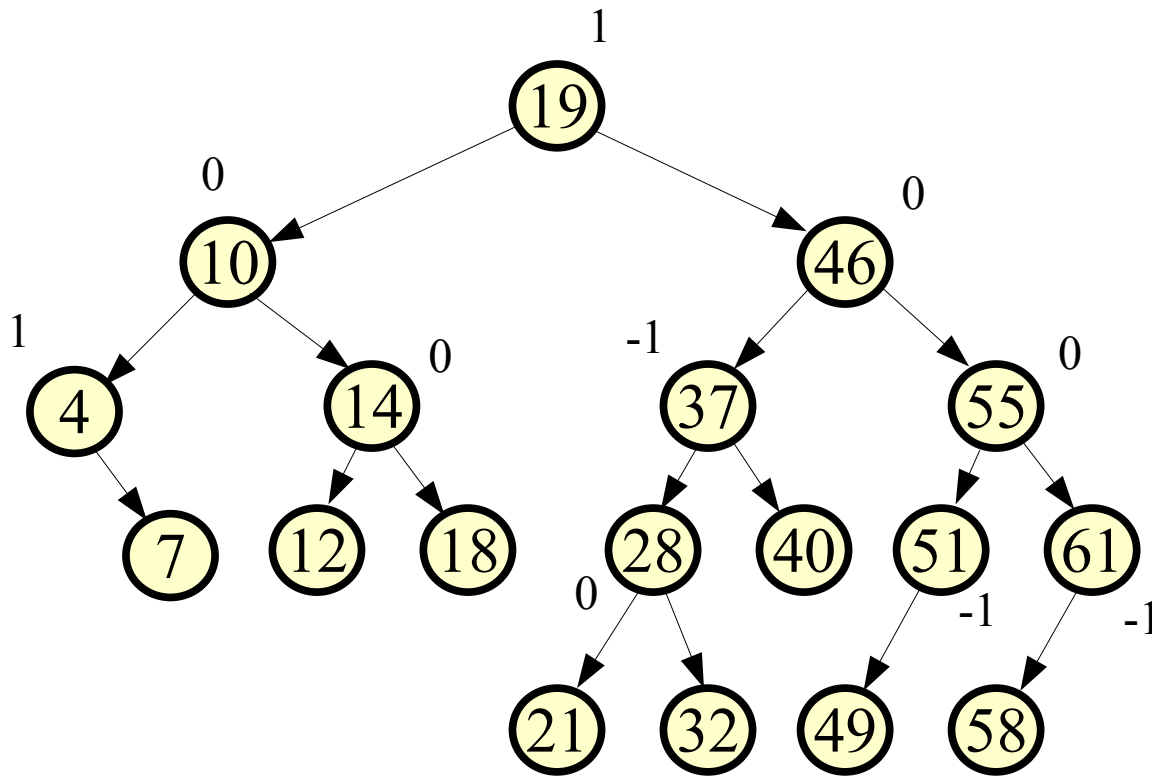
Balanced Binaries – AVL Trees
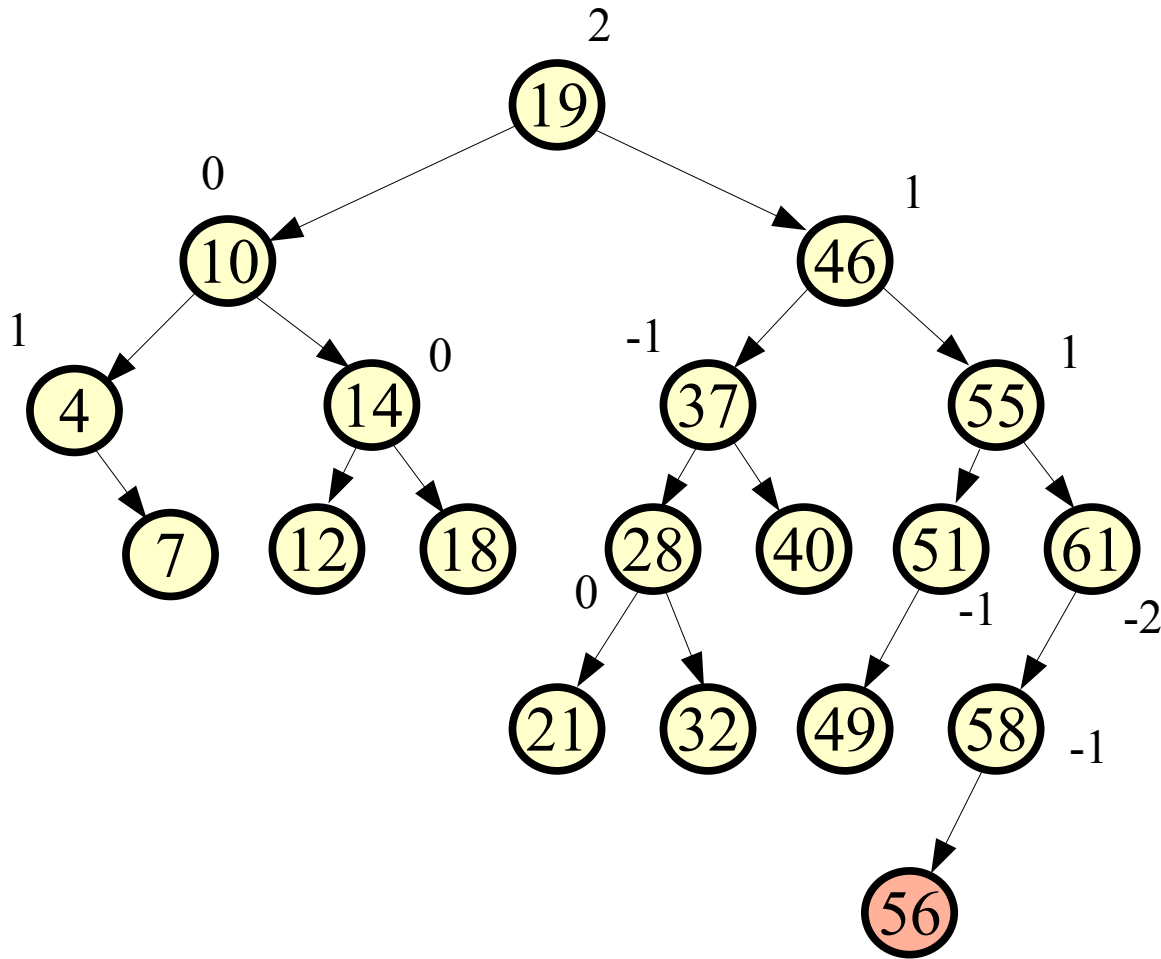
Example: Insert 6

Double rotation

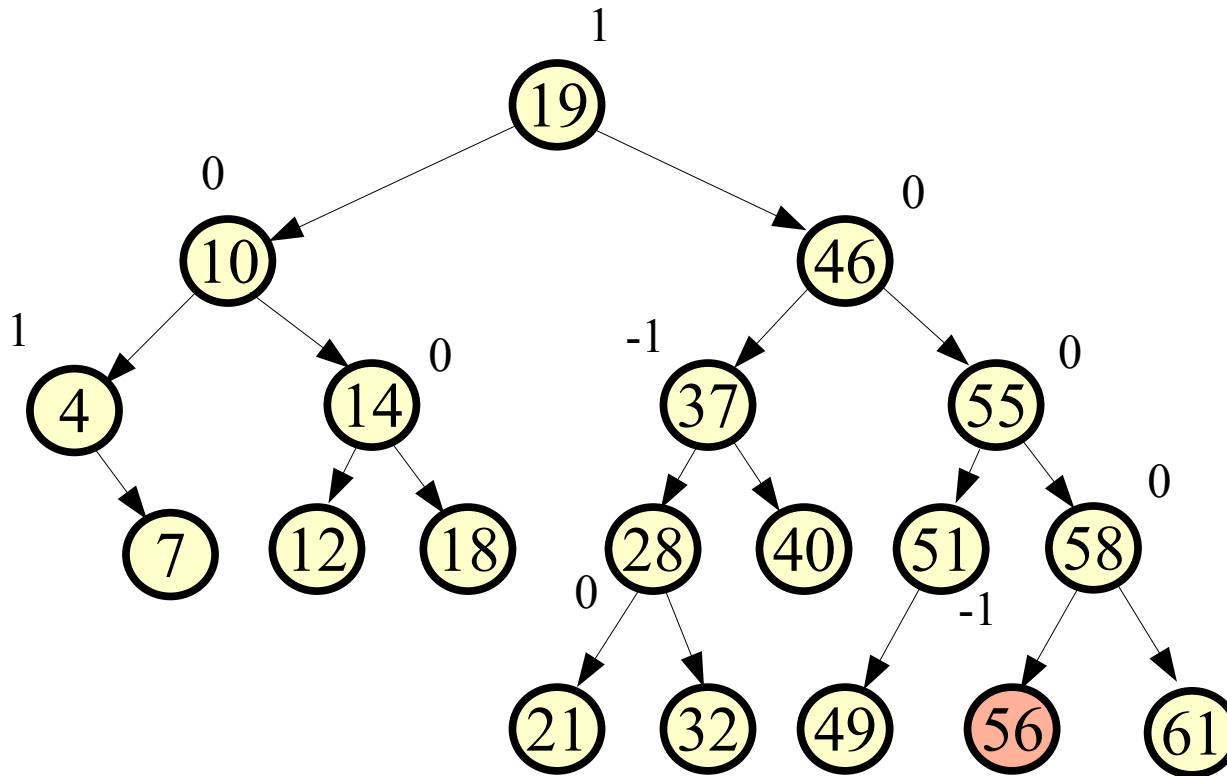# Balanced Binaries – AVL Trees

Example:

Balanced Binaries – AVL Trees

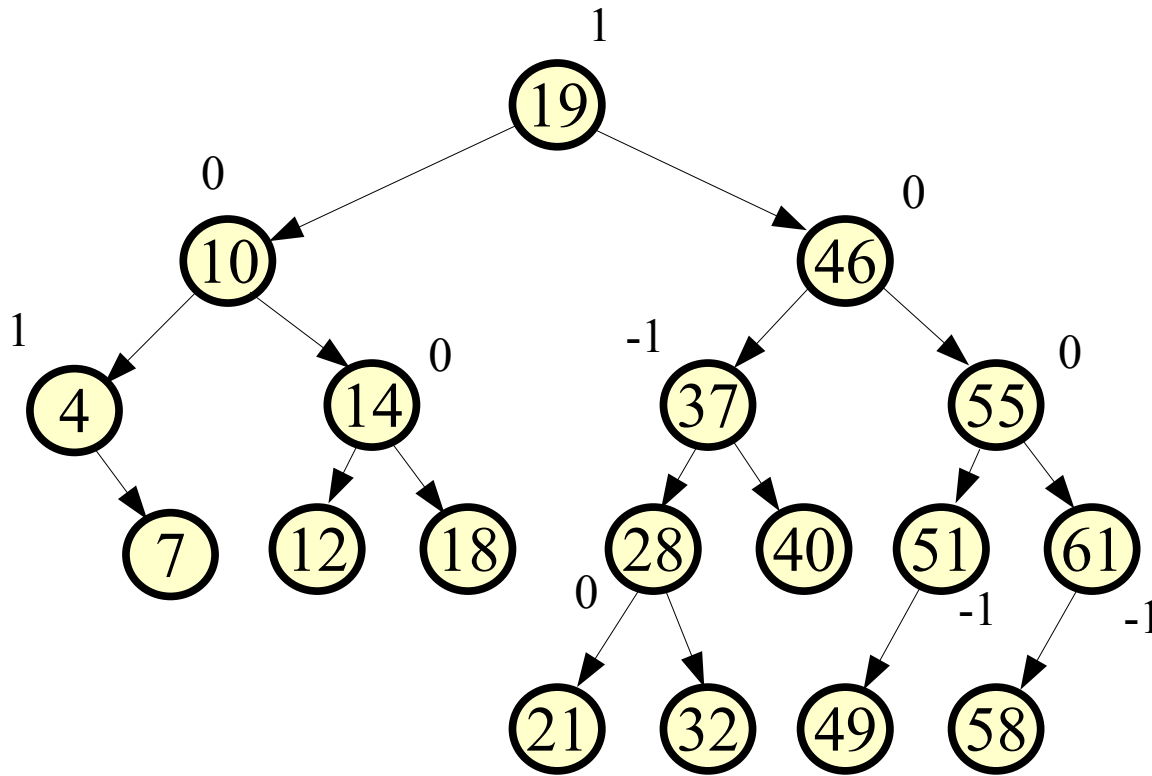Example: Insert 56

Balanced Binaries – AVL Trees

Example: Insert 56

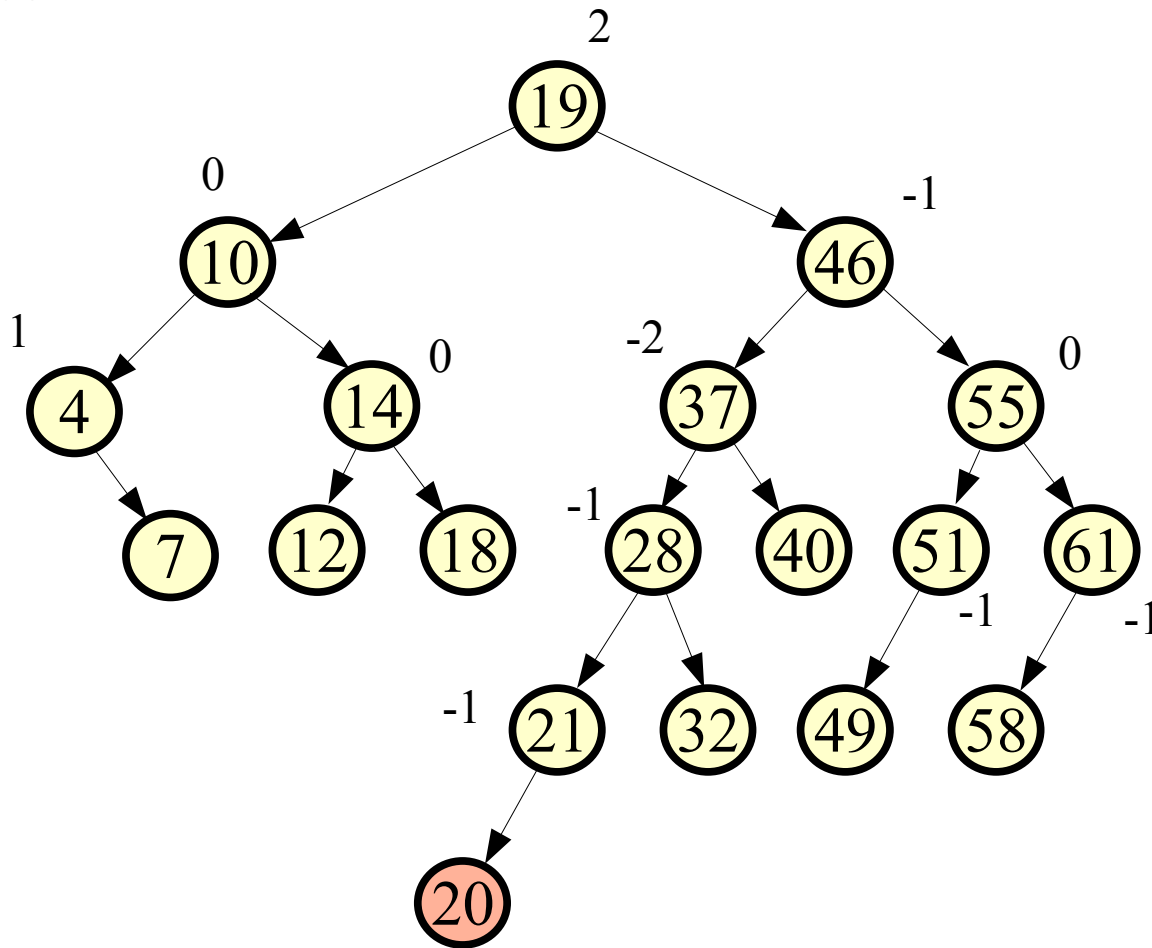

Single rotation around 58

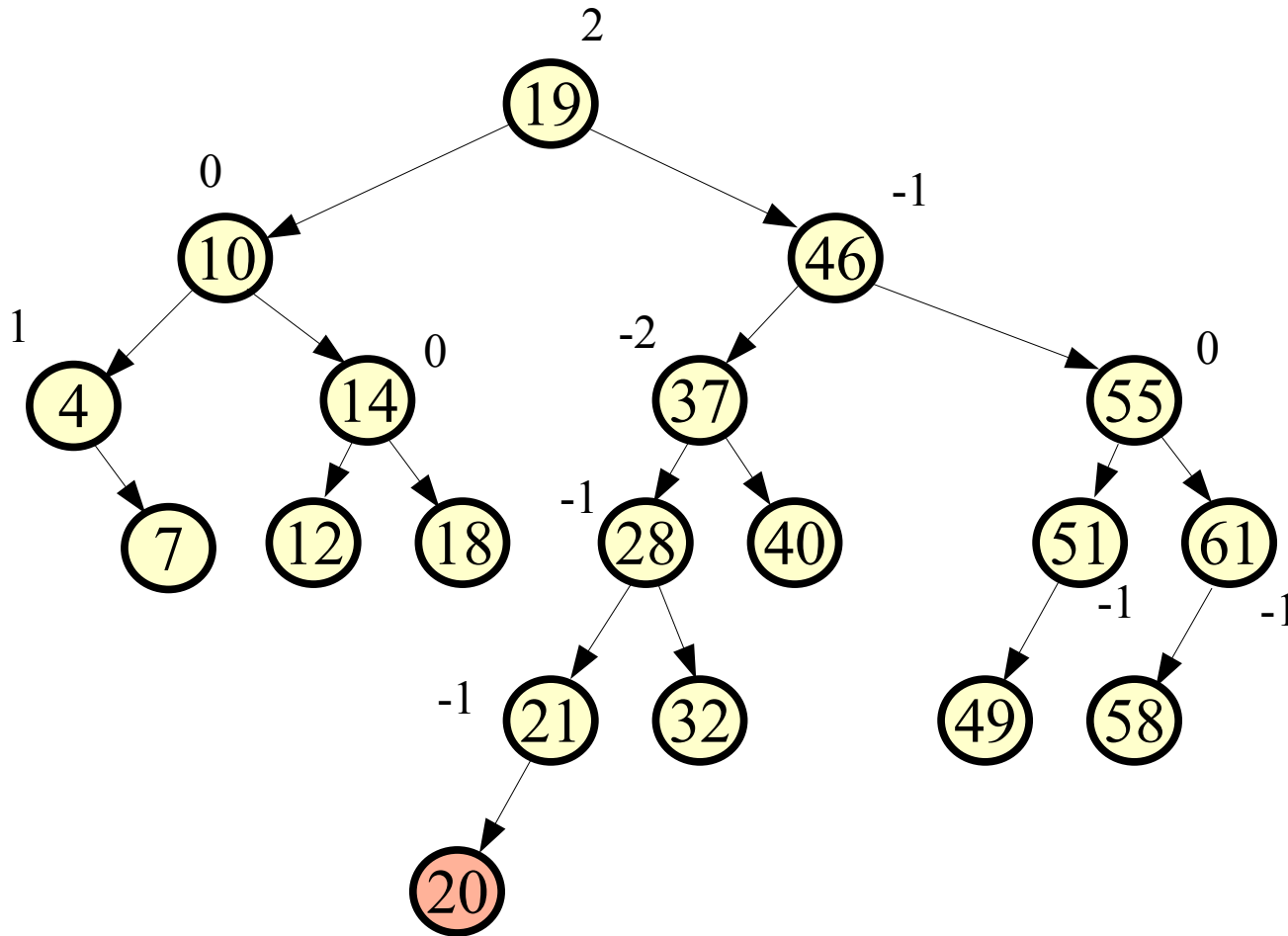# Balanced Binaries – AVL Trees

Example:

Balanced Binaries – AVL Trees

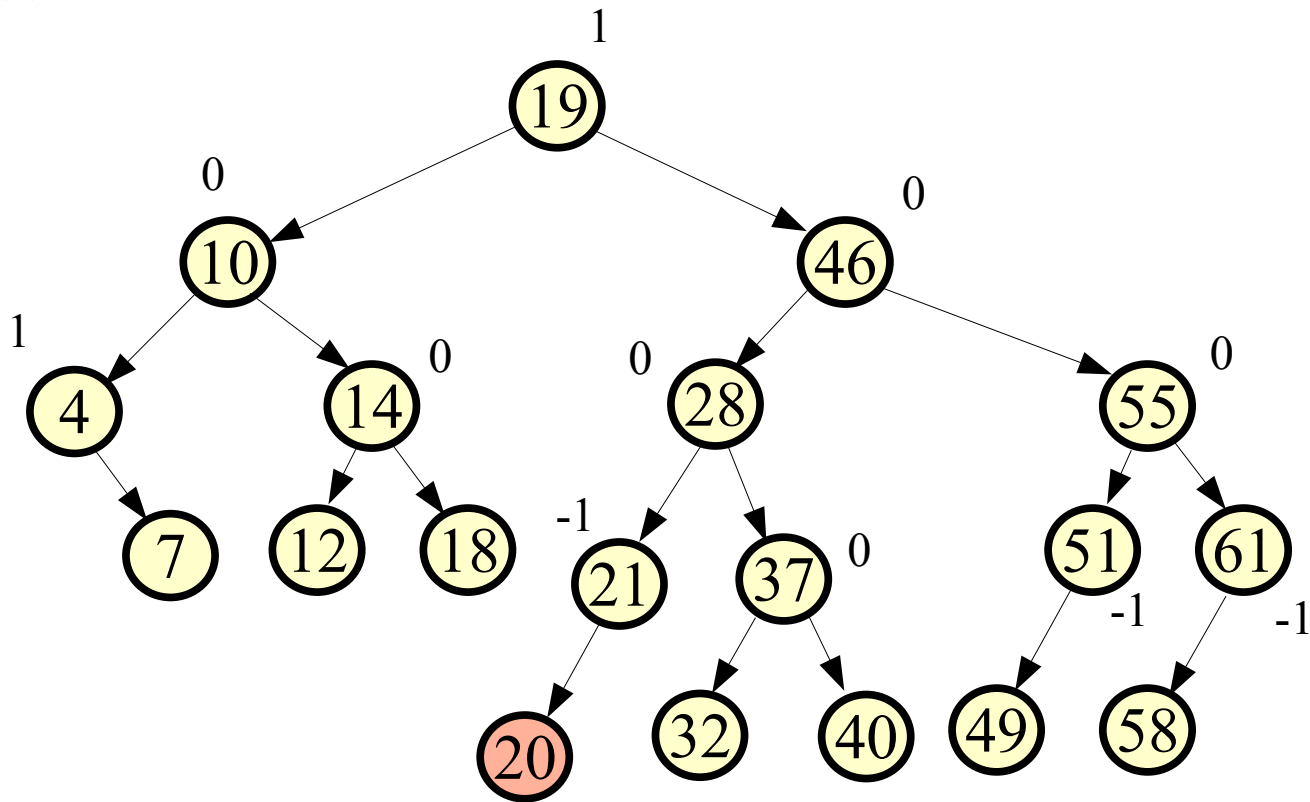Example: Insert 20

Balanced Binaries – AVL Trees

Example: Insert 20
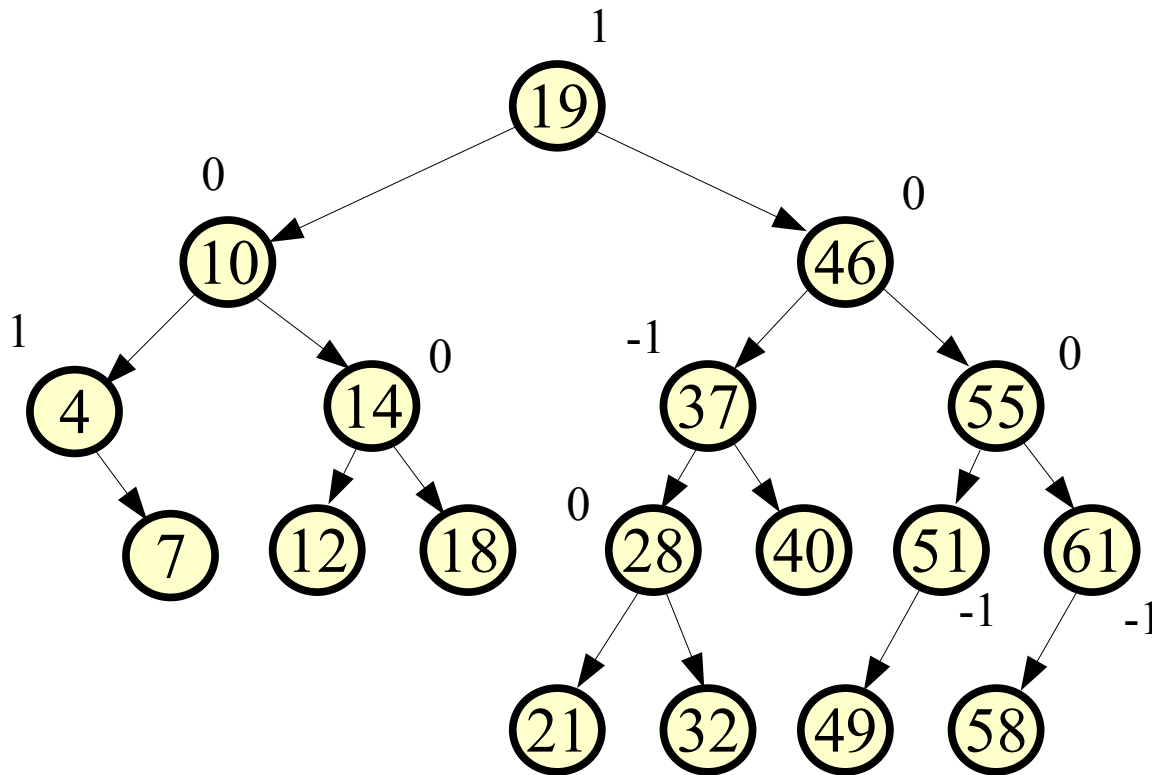

Rotate around 28

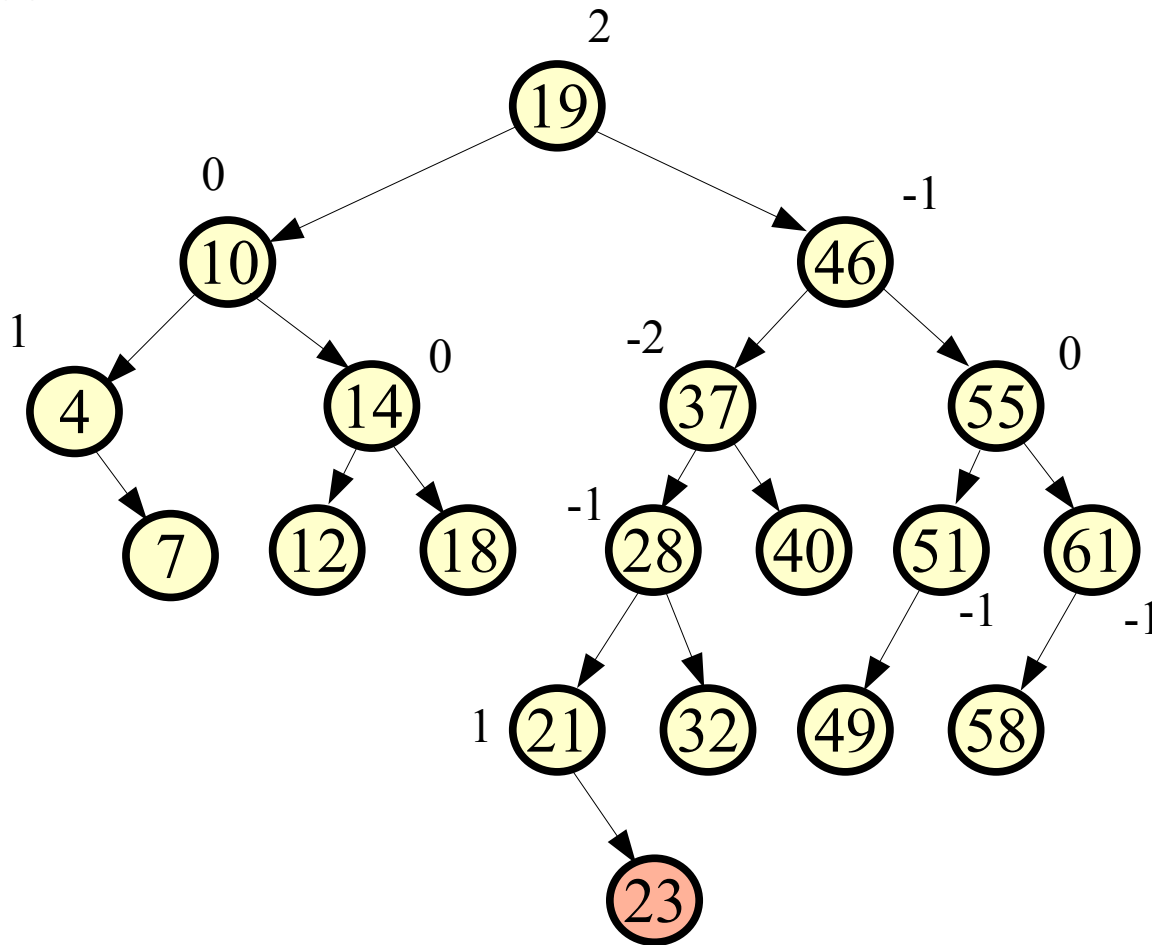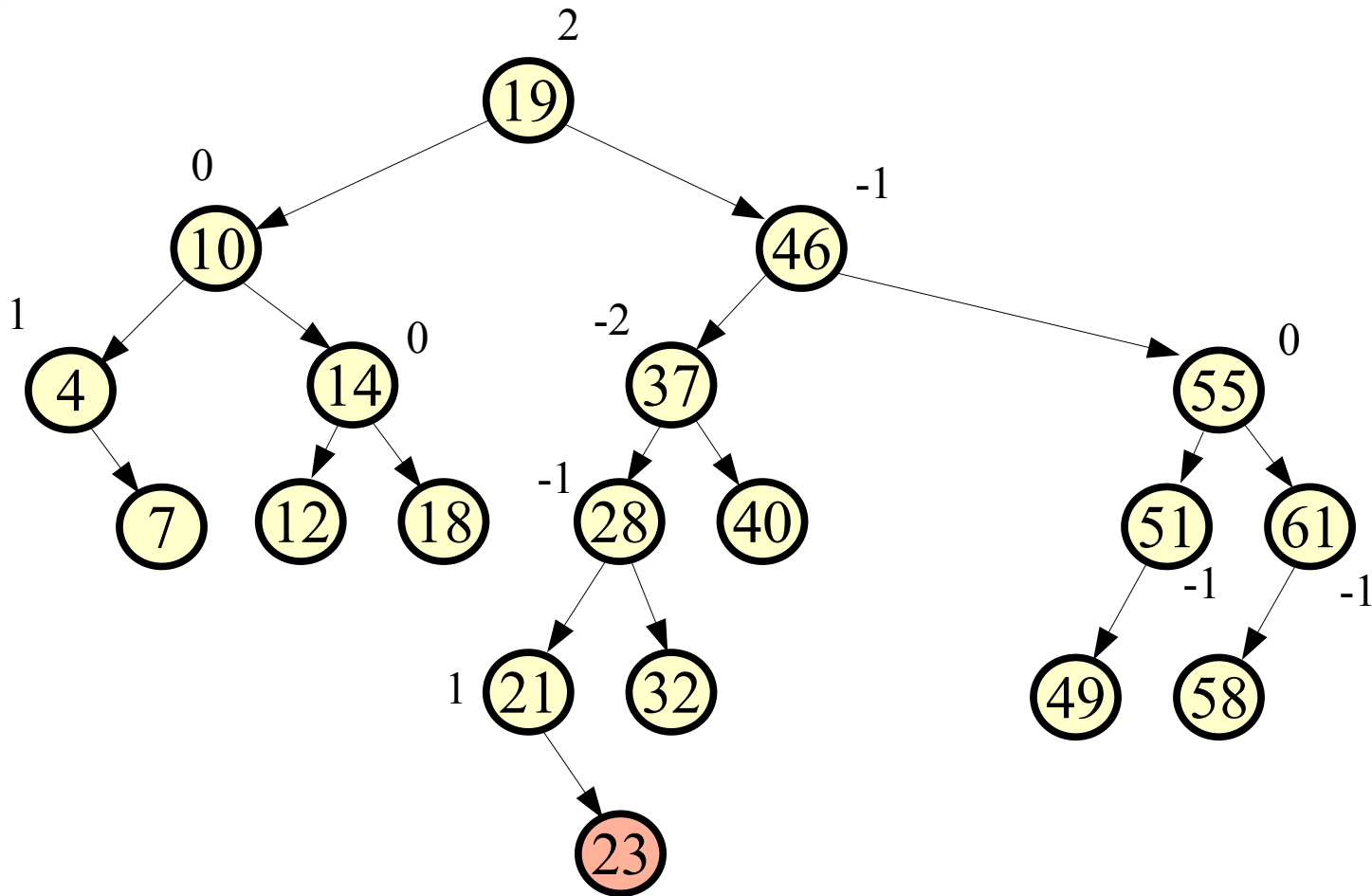# Balanced Binaries – AVL Trees

Example: Insert 20

Rotate around 28

Balanced Binaries – AVL Trees

Example:

Balanced Binaries – AVL Trees

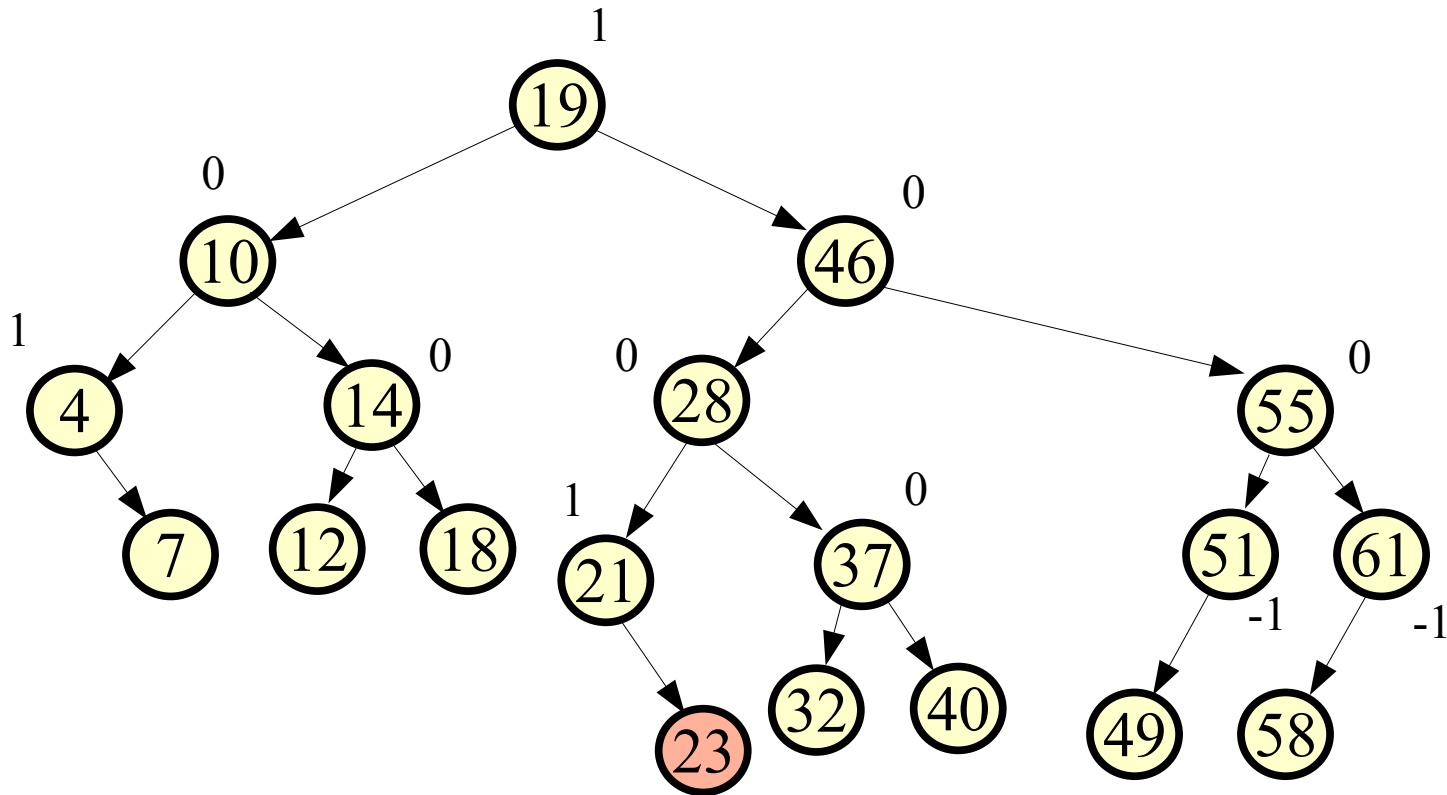Example: Insert 23

Balanced Binaries – AVL Trees

Example: Insert 23

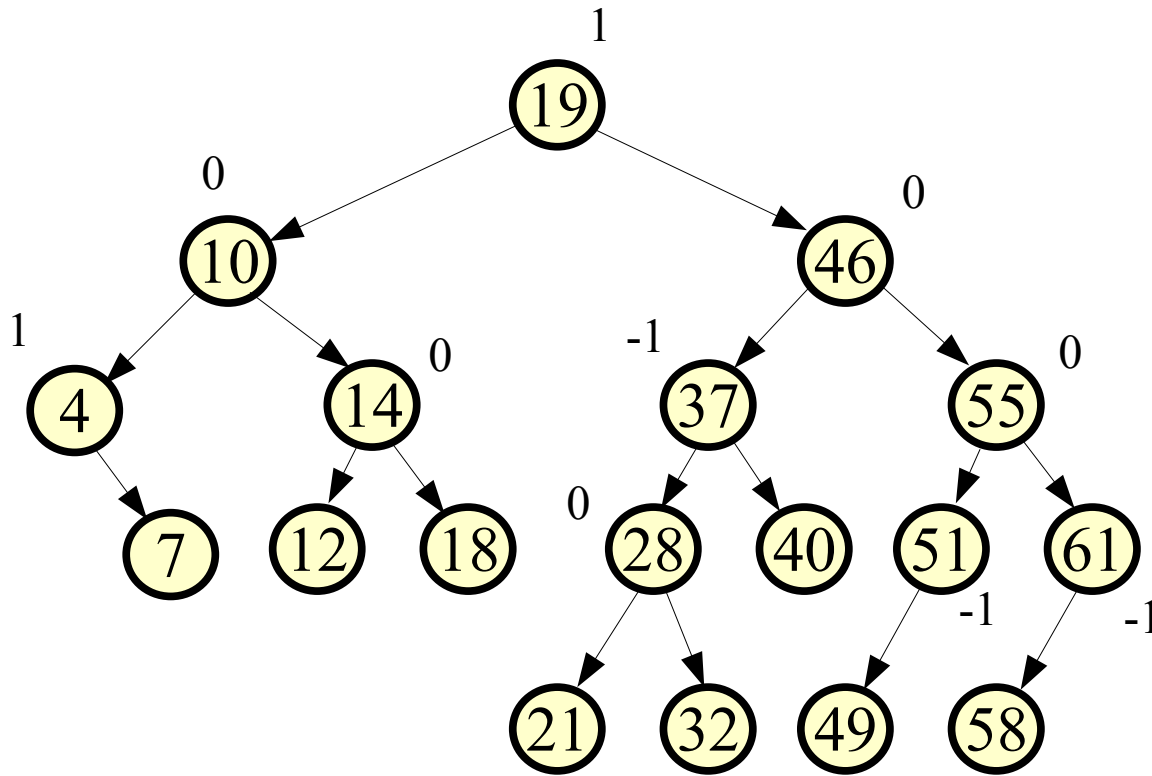Rotation around 28

Balanced Binaries – AVL Trees
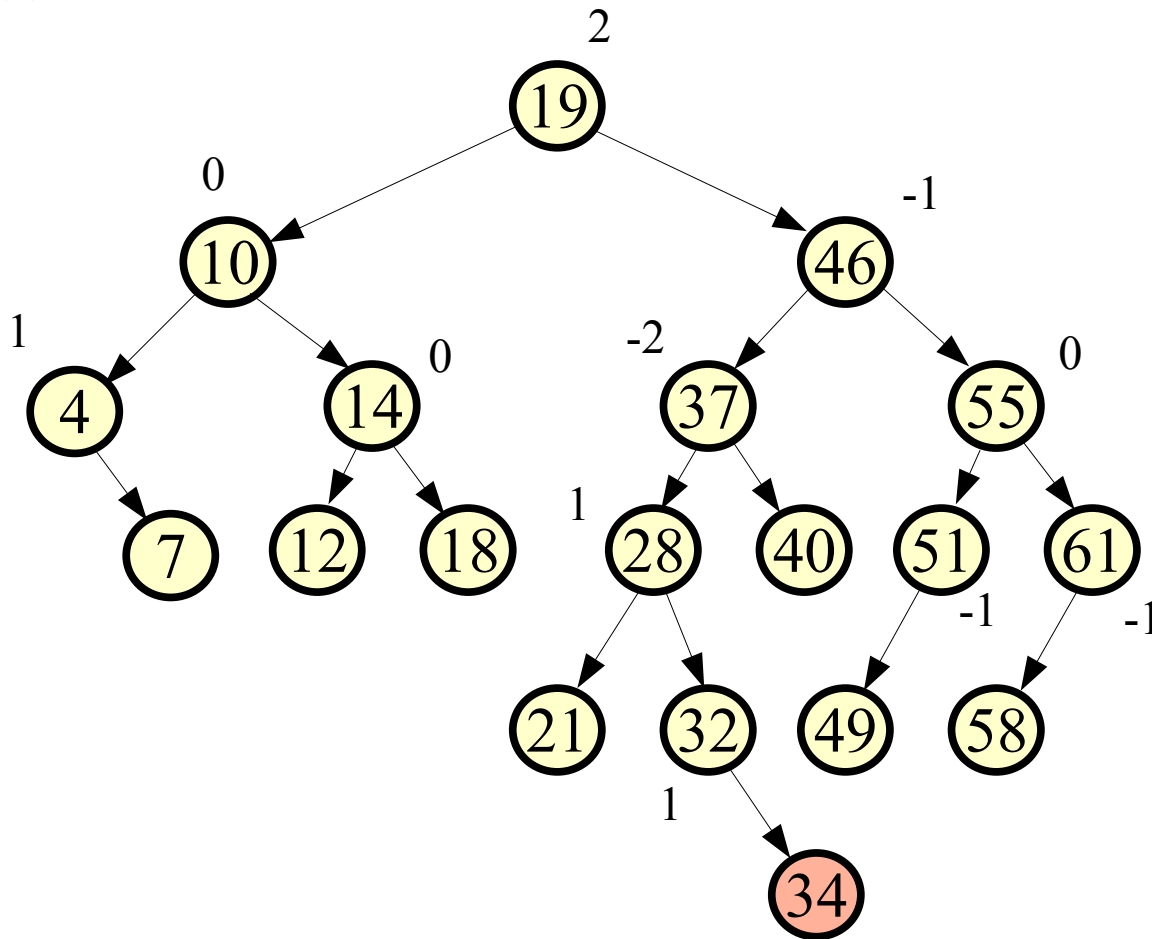
Example: Insert 23

Rotation around 28

Balanced Binaries – AVL Trees
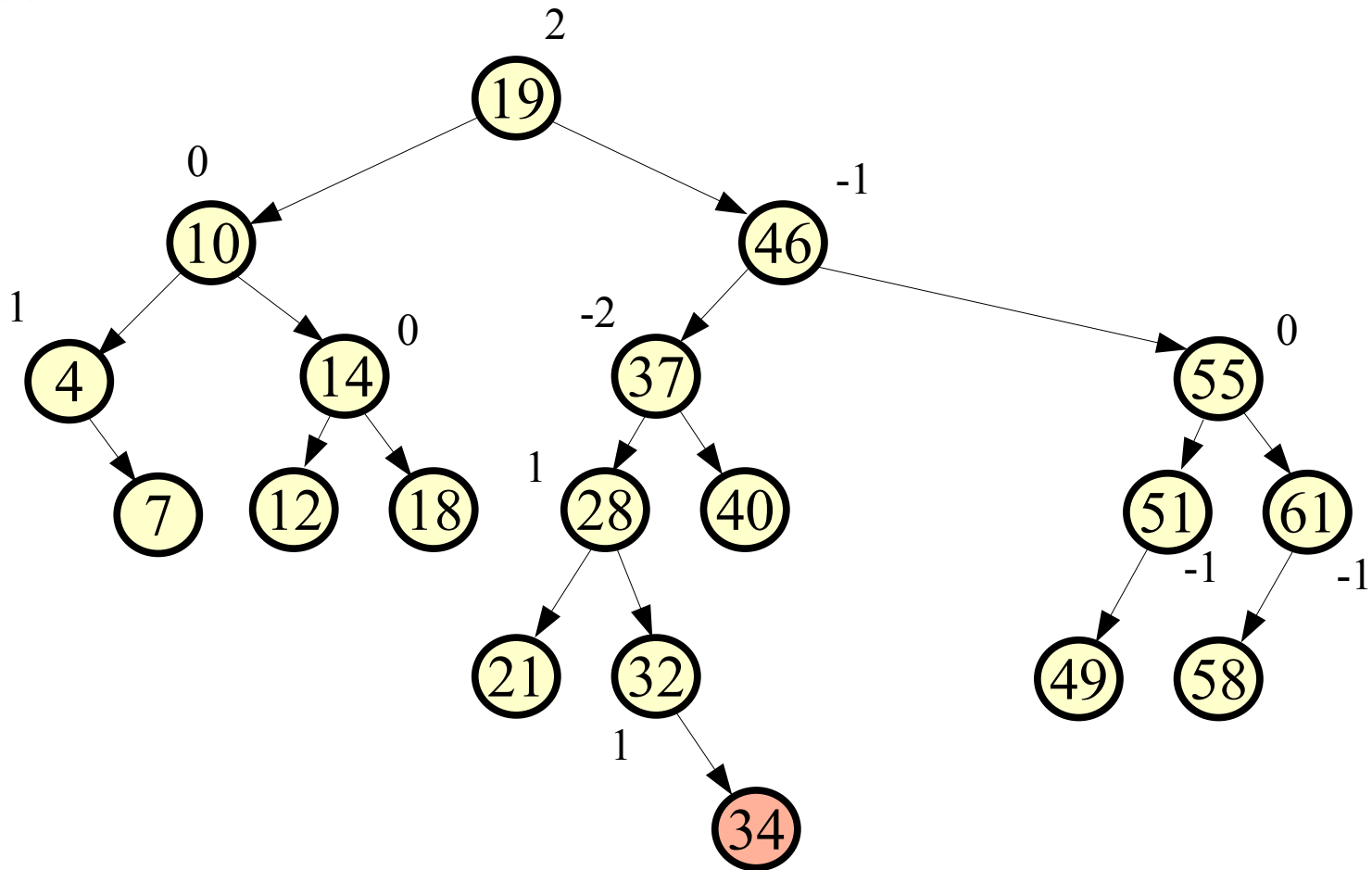
Example:

Balanced Binaries – AVL Trees

Example: Insert 34

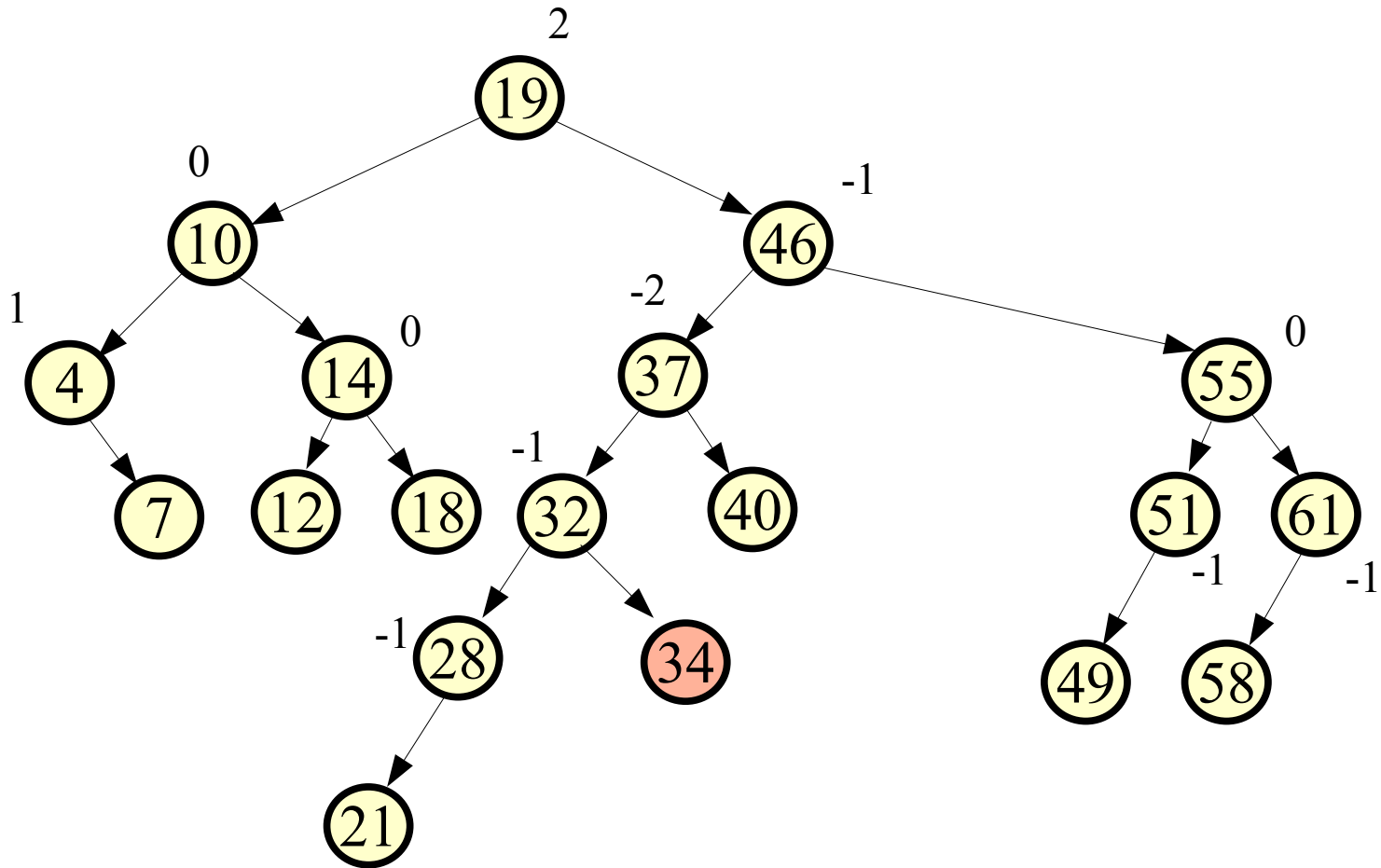# Balanced Binaries – AVL Trees

Example: Insert 34

Double rotation around 32
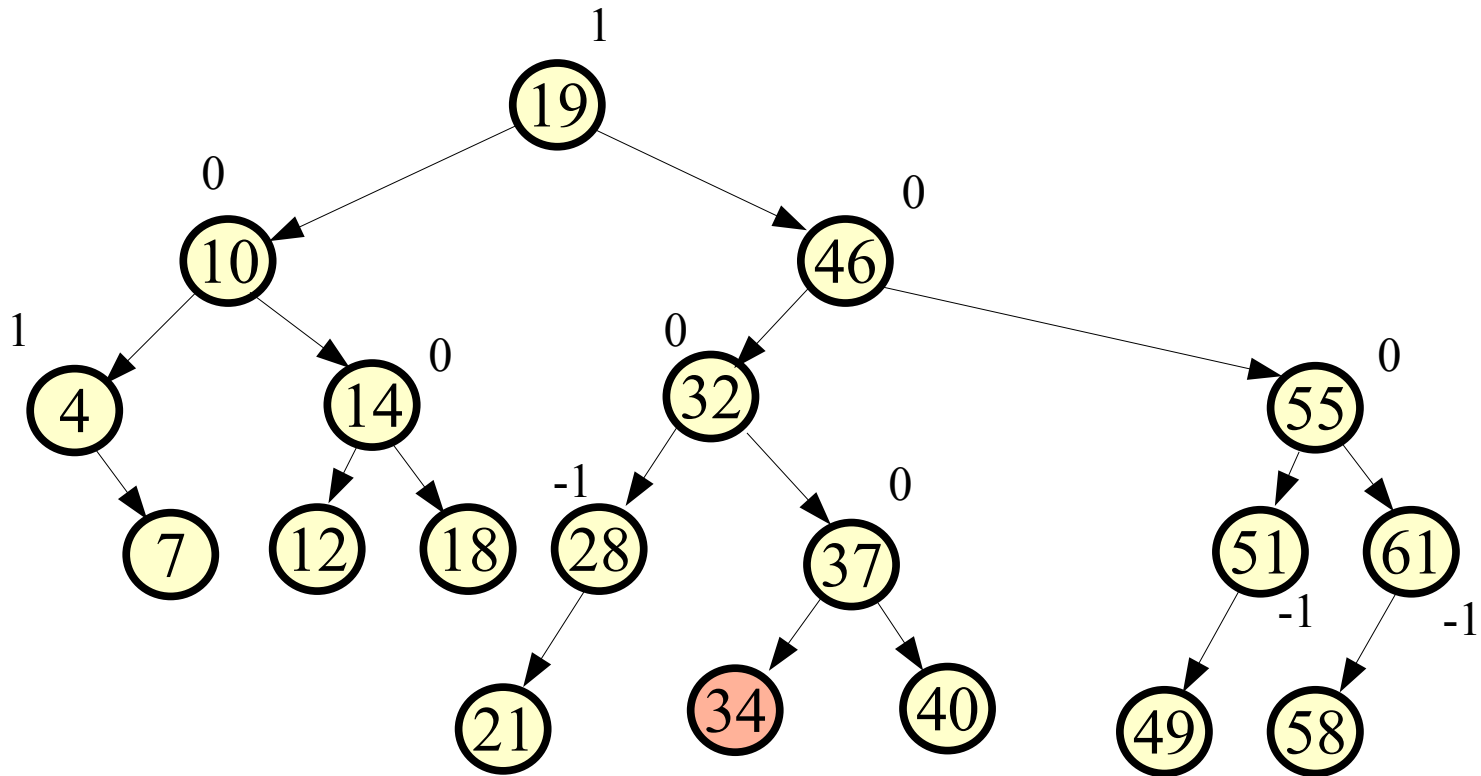
Balanced Binaries – AVL Trees

Example: Insert 34

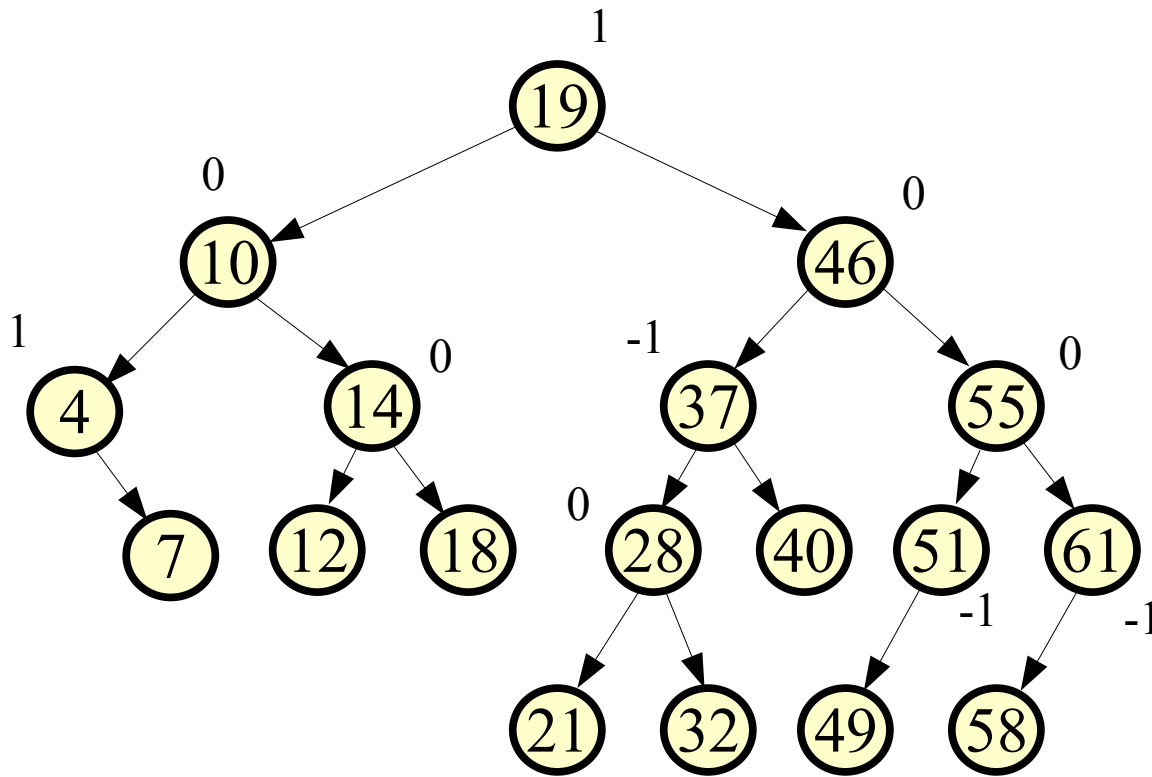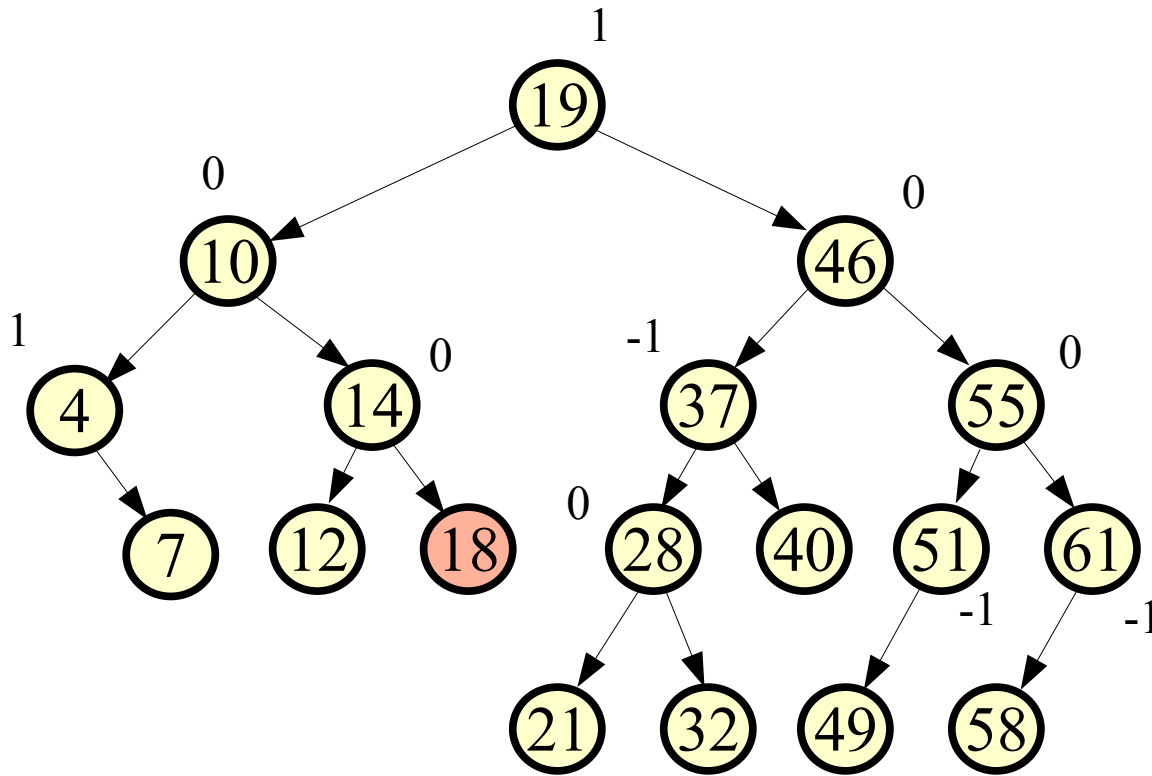Double rotation around 32
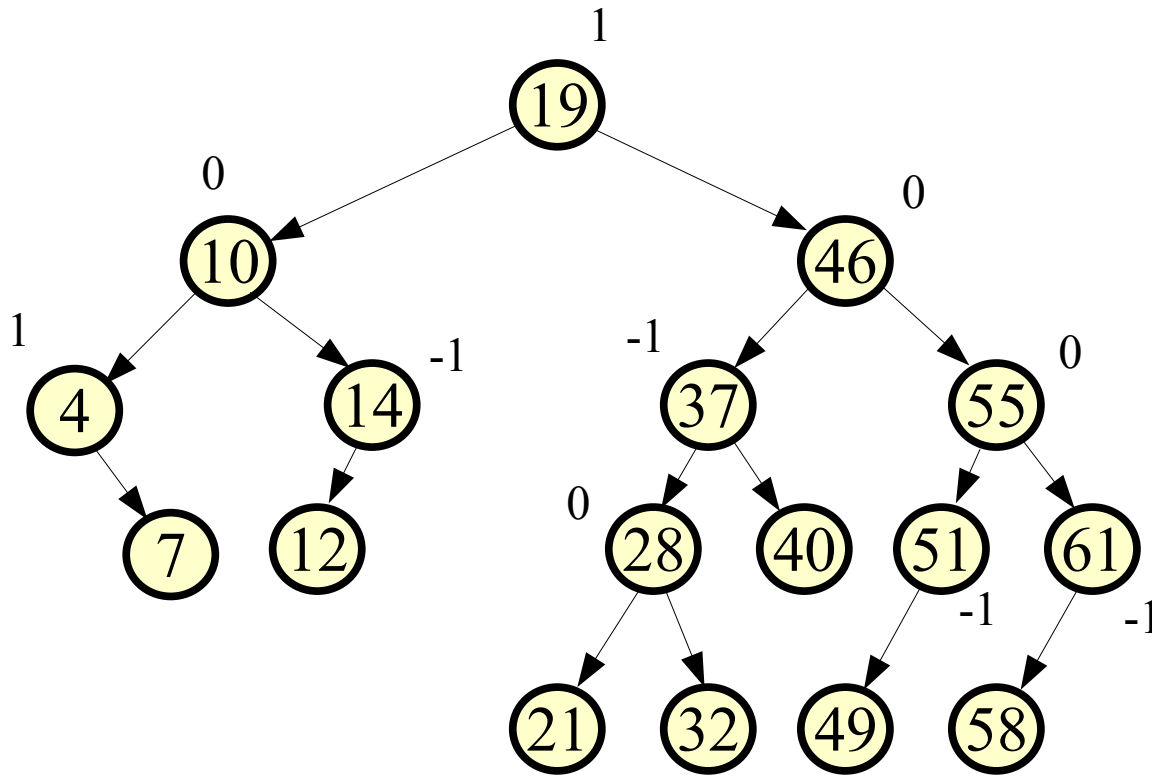
Balanced Binaries – AVL Trees

Example: Insert 34

Double rotation around 32

Balanced Binaries – AVL Trees

Example:

Balanced Binaries – AVL Trees

Example: Delete 18
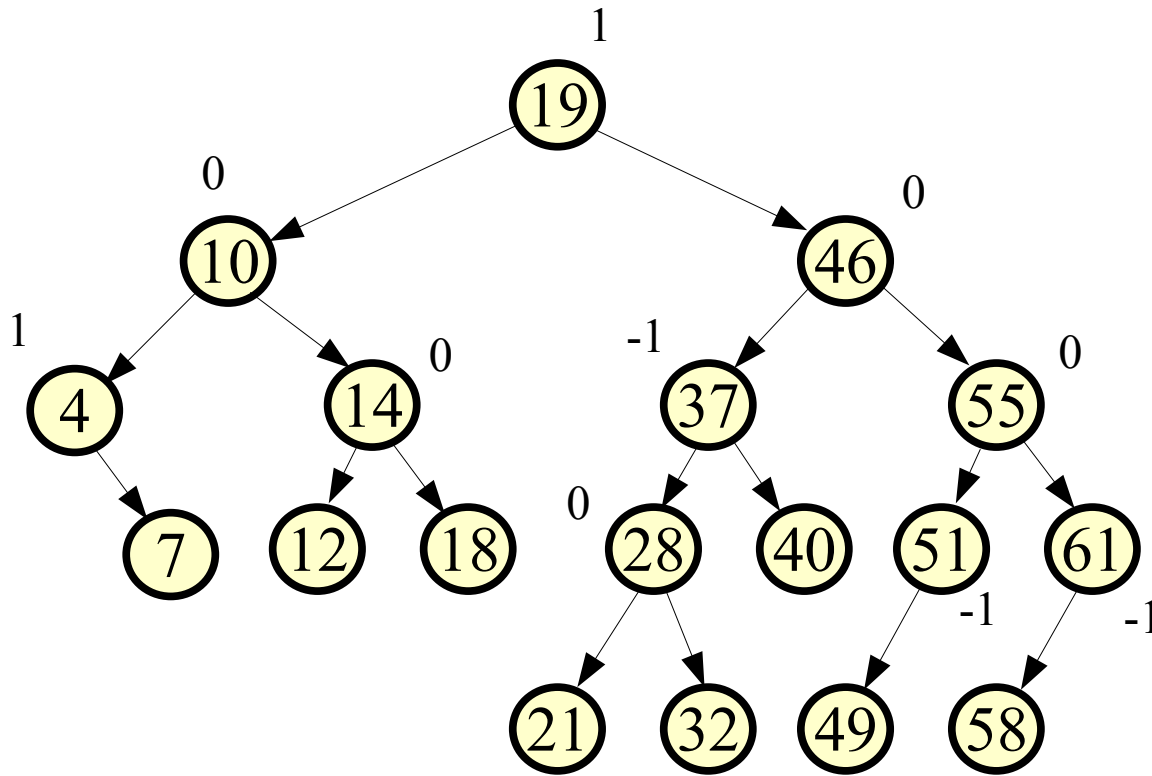
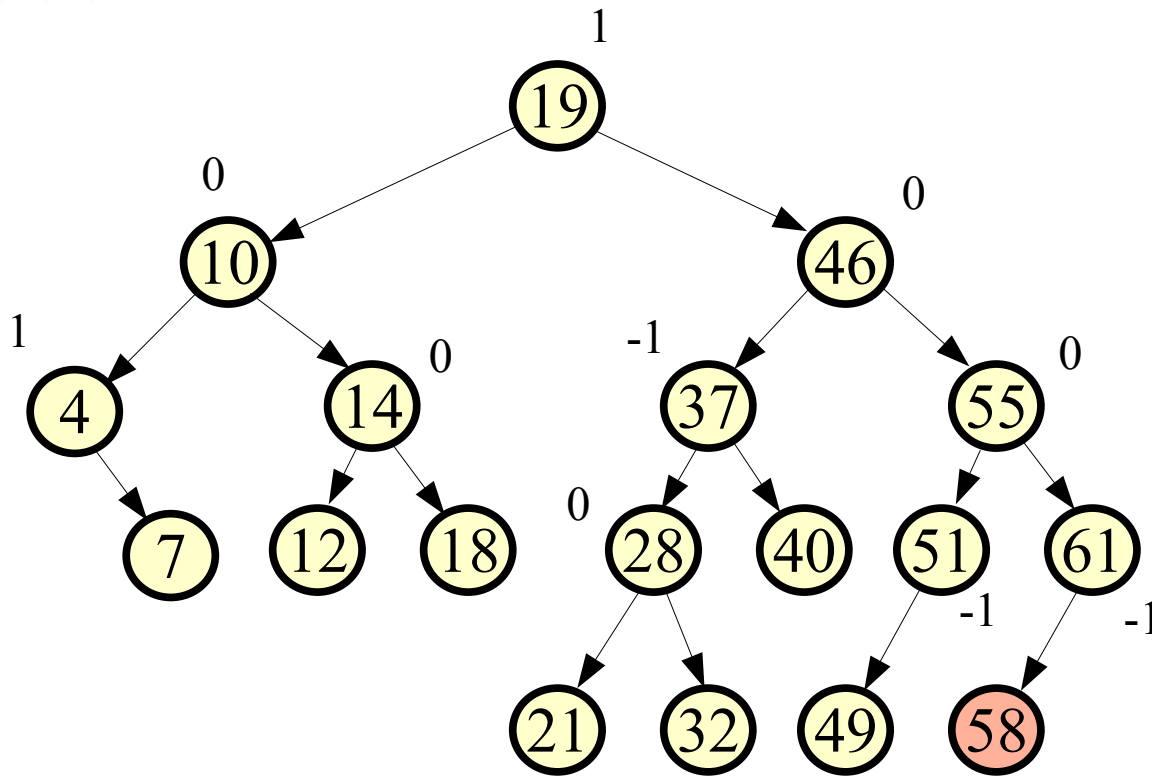# Balanced Binaries – AVL Trees

Example: Delete 18
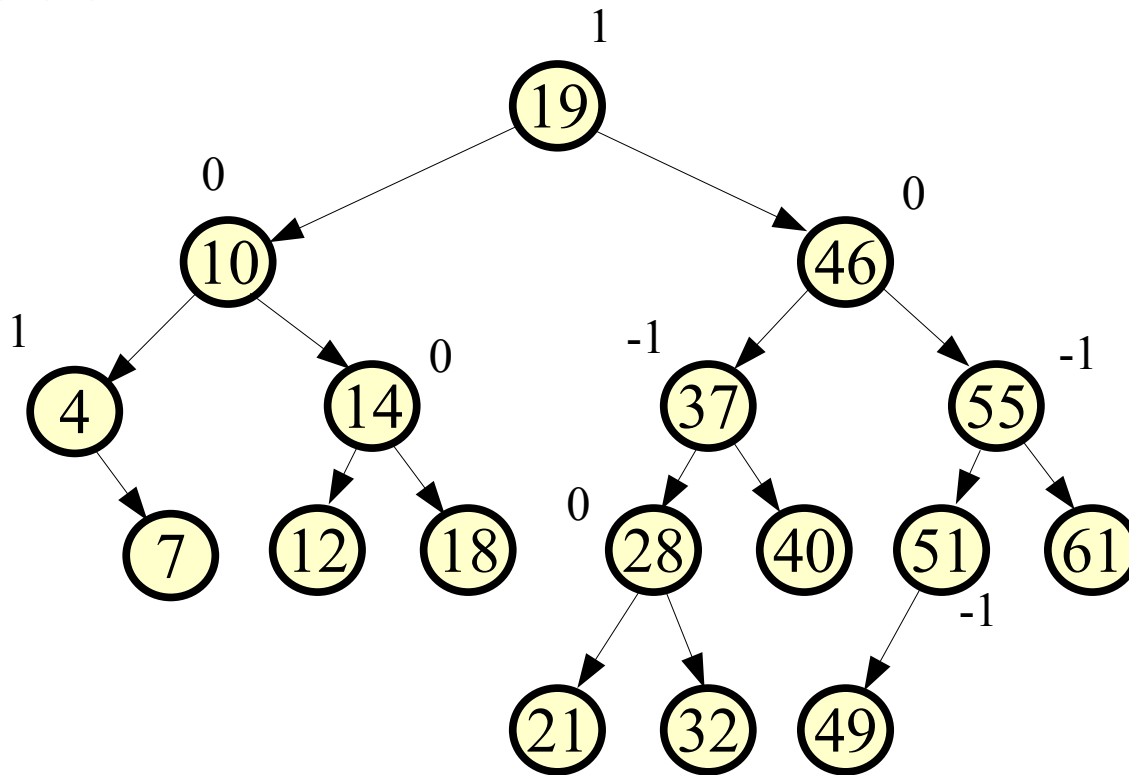

No change

Balanced Binaries – AVL Trees

Example:

Balanced Binaries – AVL Trees

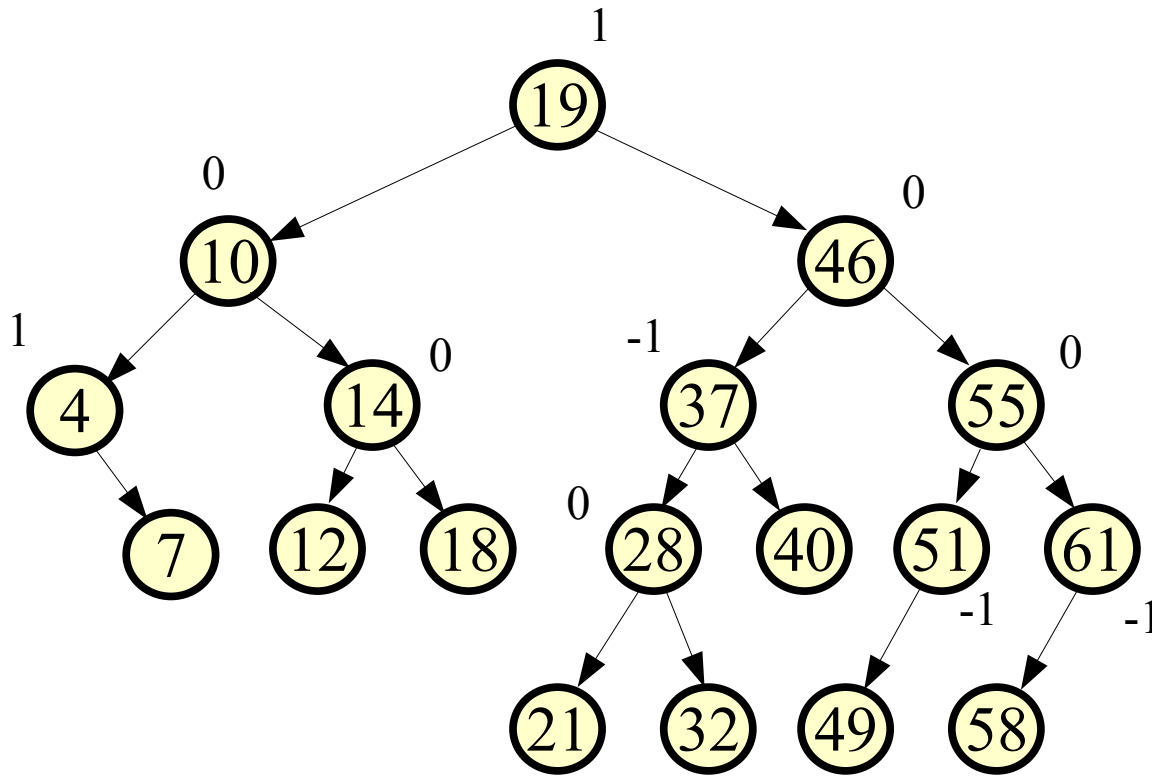Example: Delete 58

Balanced Binaries – AVL Trees
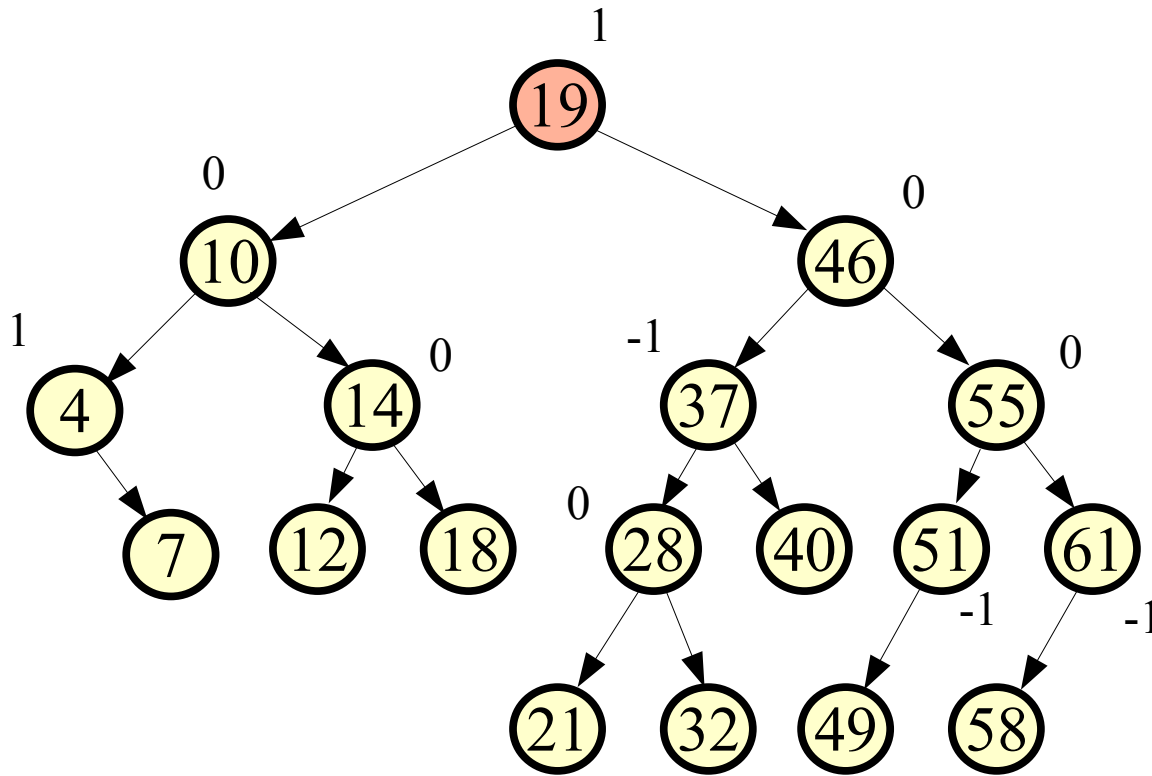
Example: Delete 58

No change

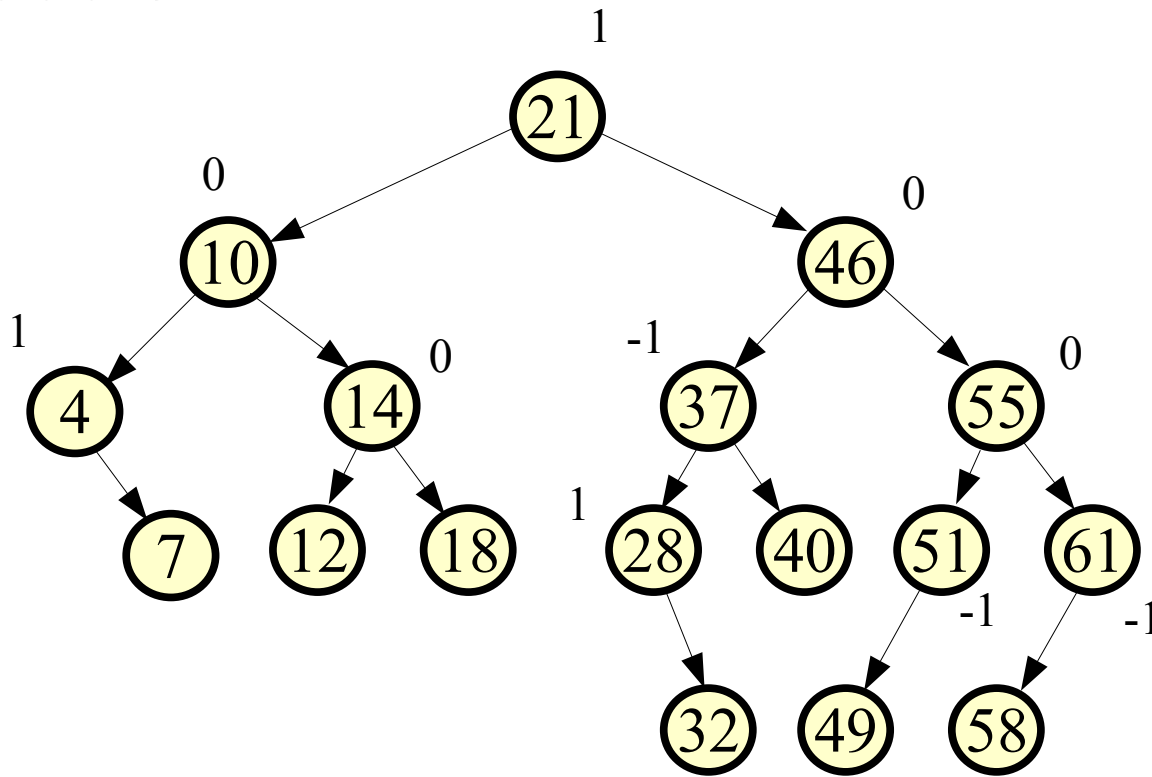# Balanced Binaries – AVL Trees

Example:

Balanced Binaries – AVL Trees
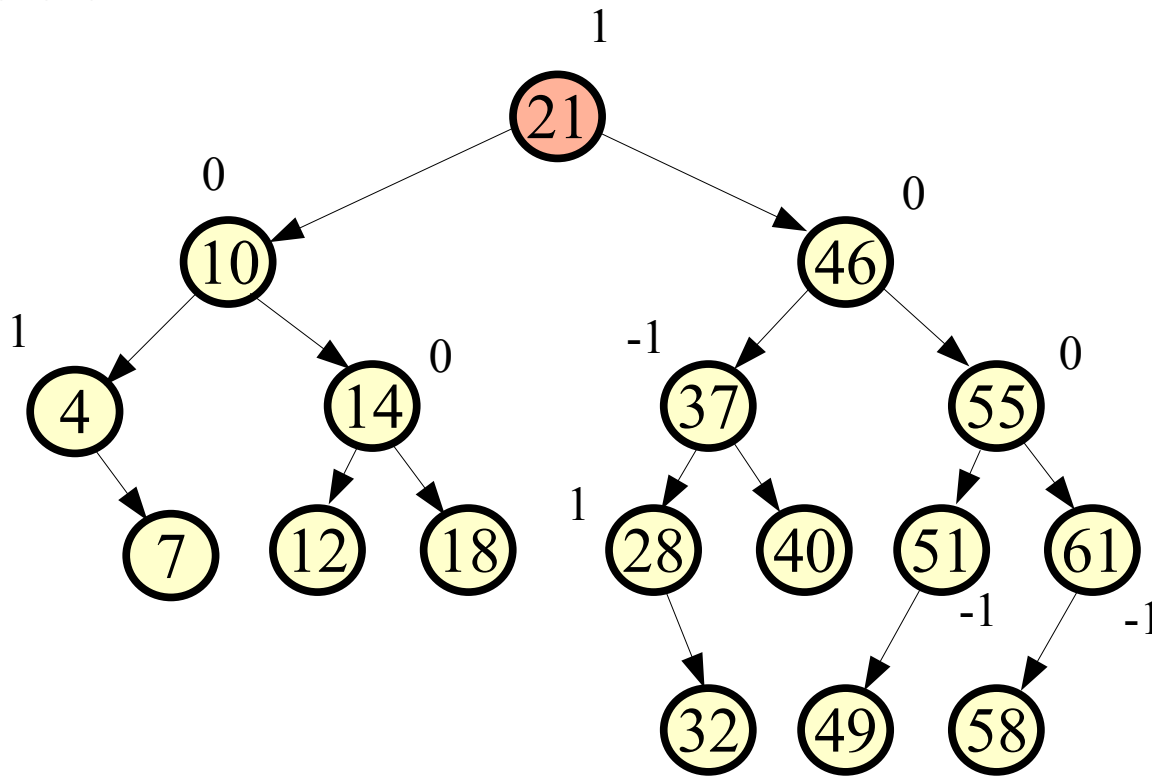
Example: Delete 19

Balanced Binaries – AVL Trees
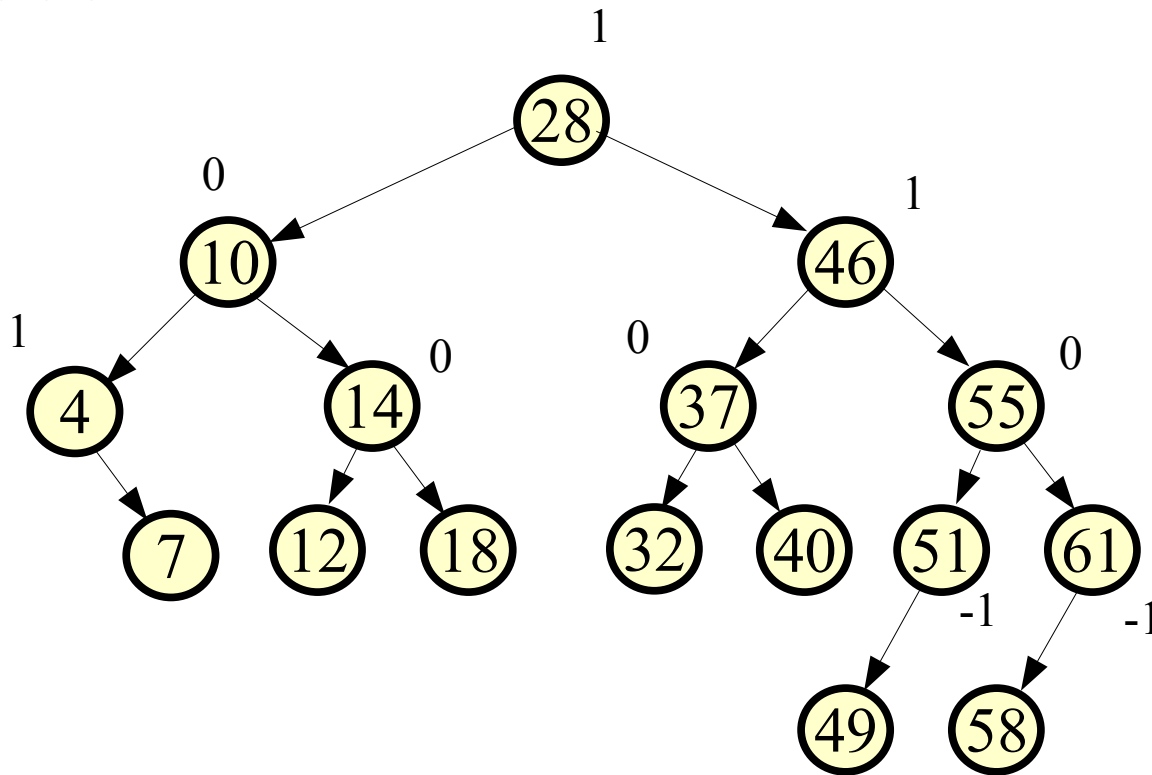
Example: Delete 19

Balanced Binaries – AVL Trees

Example: Delete 21
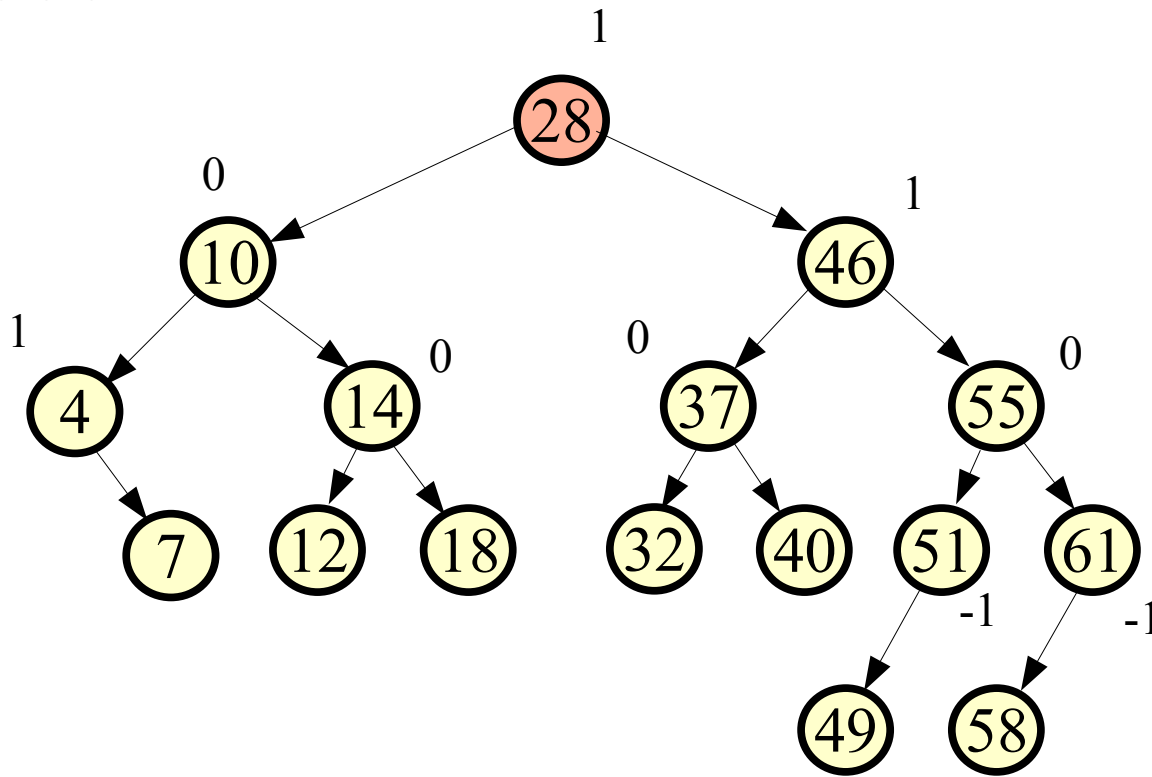
Balanced Binaries – AVL Trees
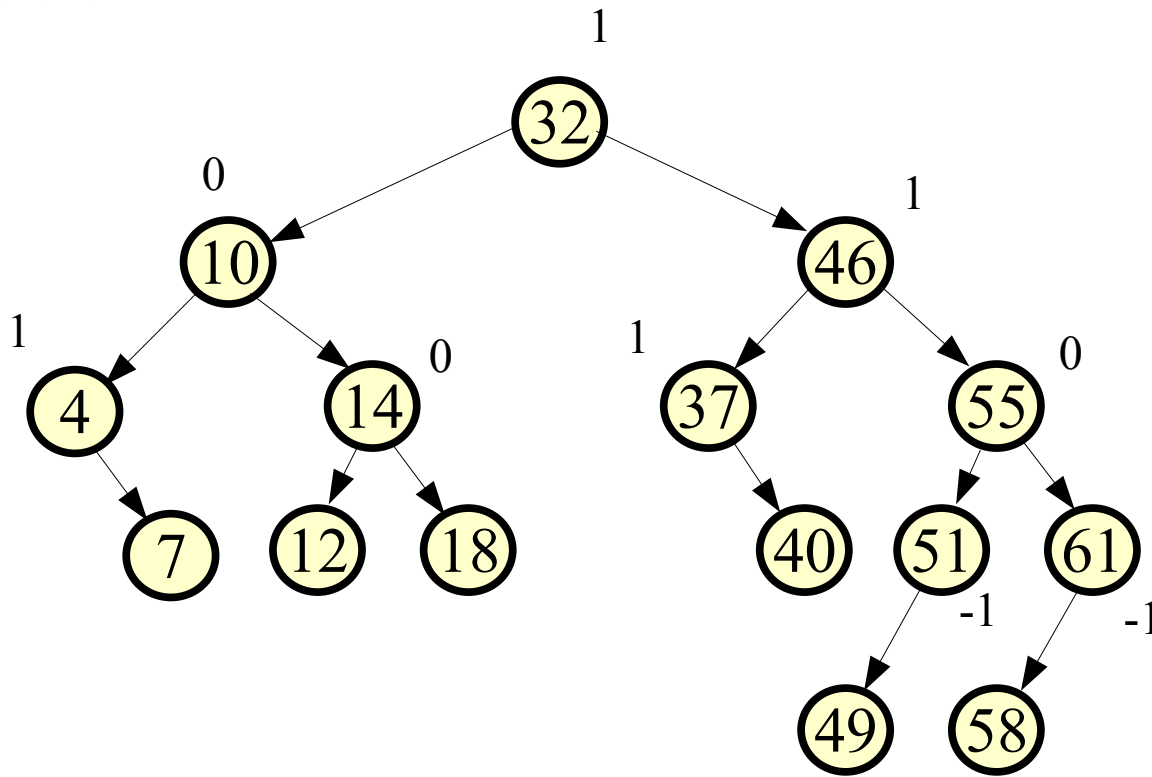
Example: Delete 21

No change

Balanced Binaries – AVL Trees

Example: Delete 28
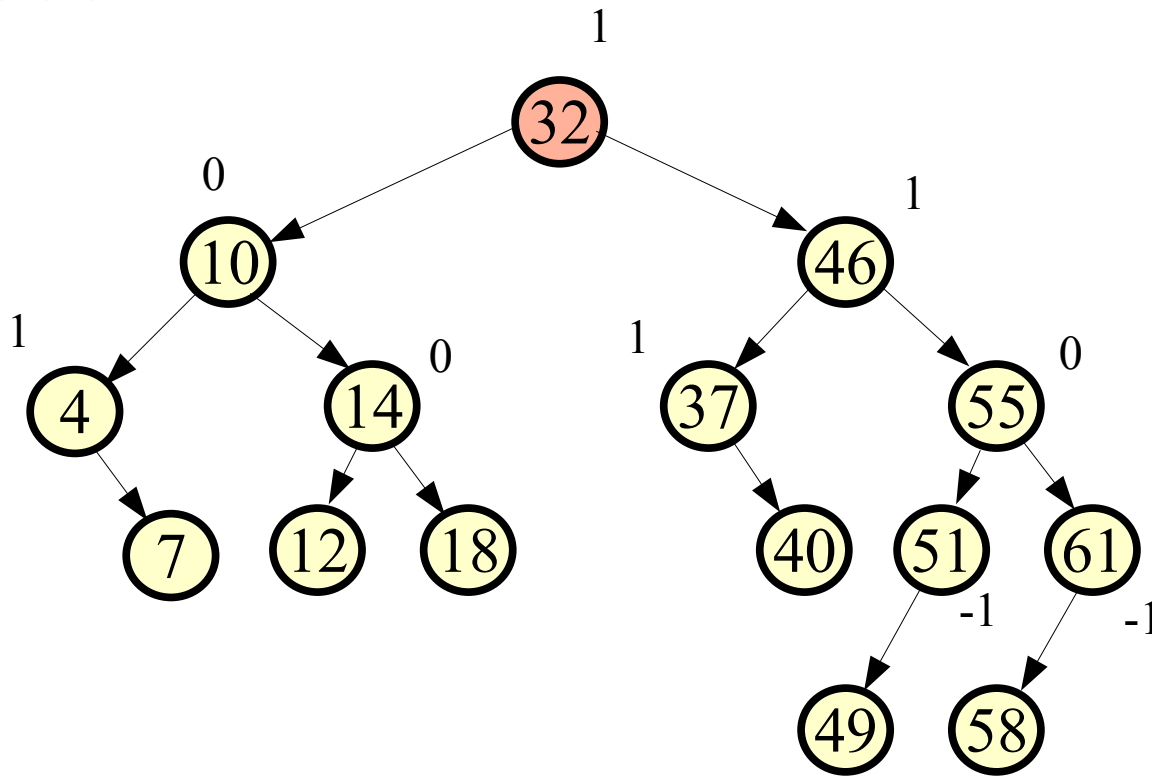
Balanced Binaries – AVL Trees
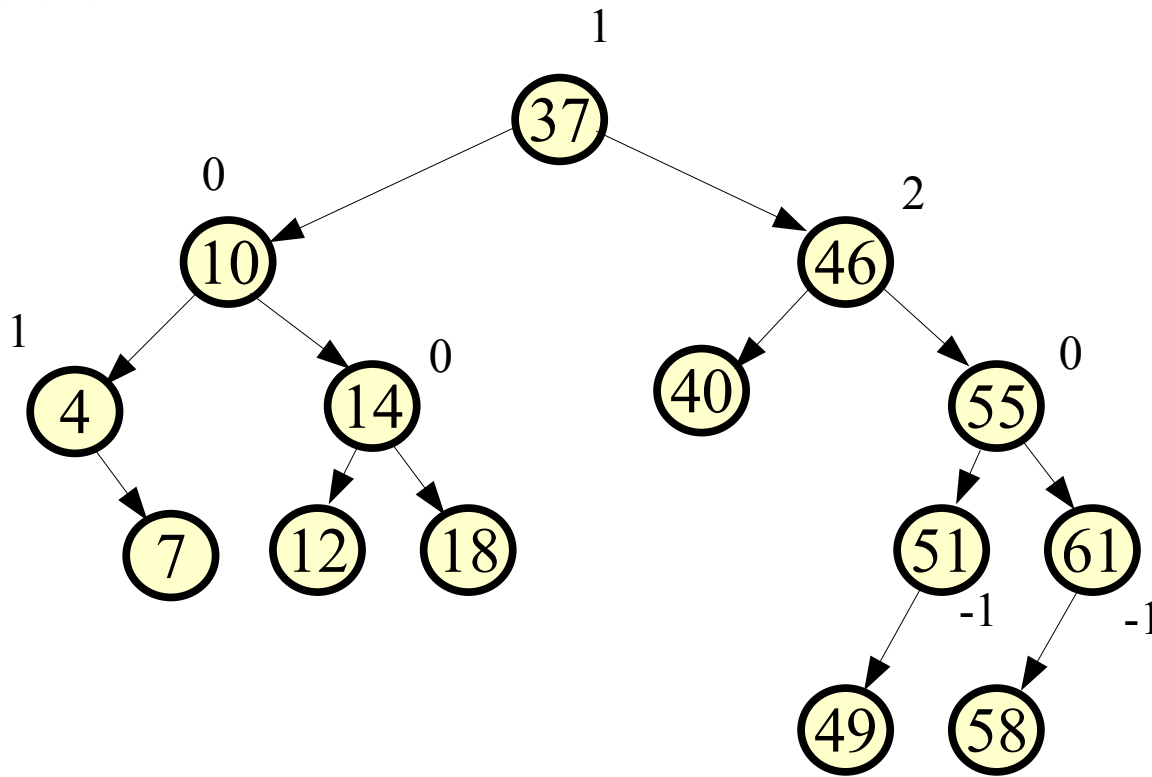
Example: Delete 28

No change

Balanced Binaries – AVL Trees

Example: Delete 32
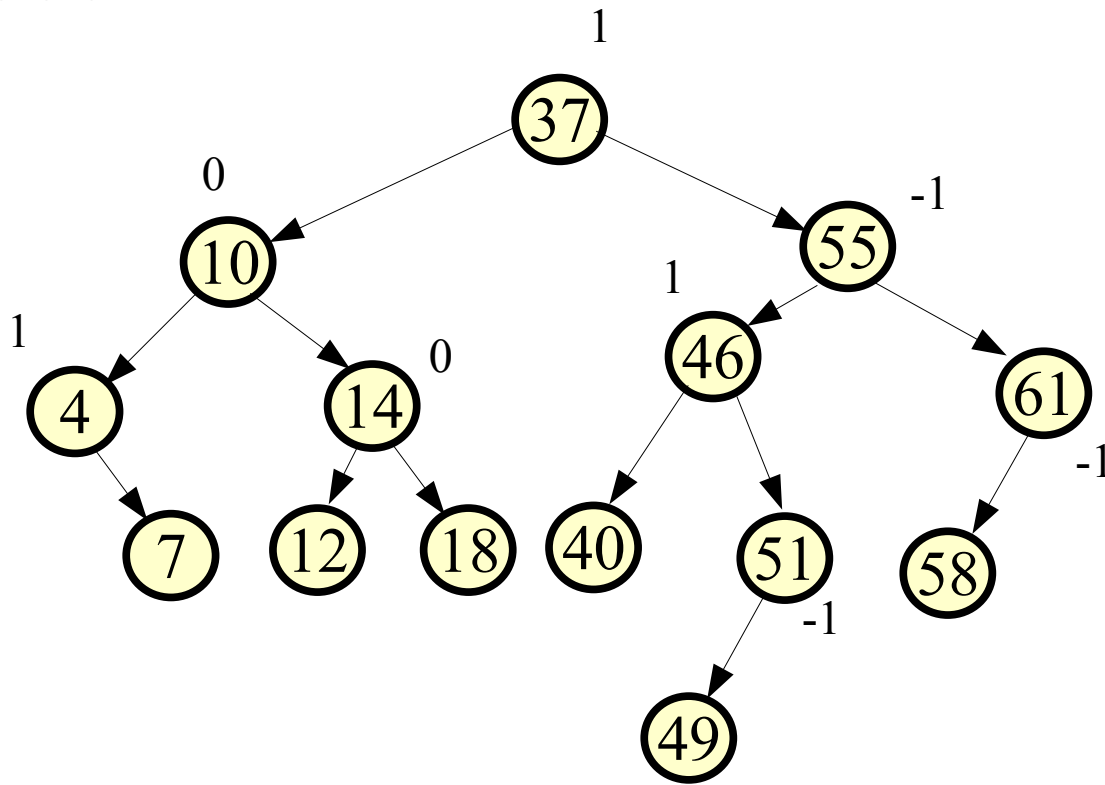
Balanced Binaries – AVL Trees

Example: Delete 32

Rotation around 55

Balanced Binaries – AVL Trees

Example: Delete 32

Rotation around 55