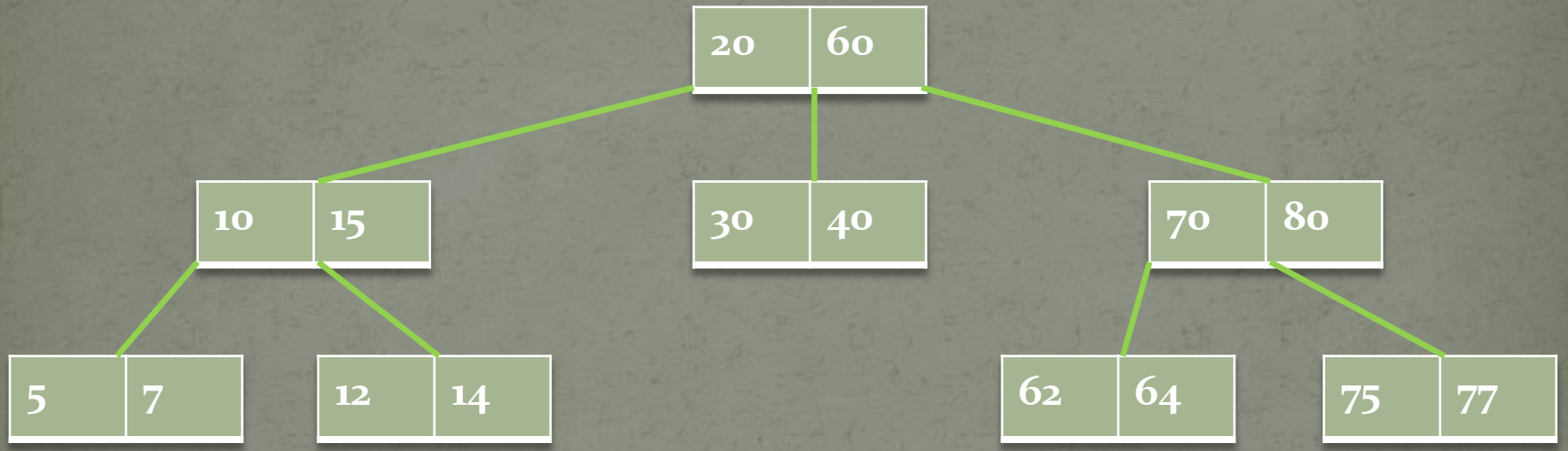
Algorithms and Data Structures

Andrzej Pisarski

Plan of the lecture

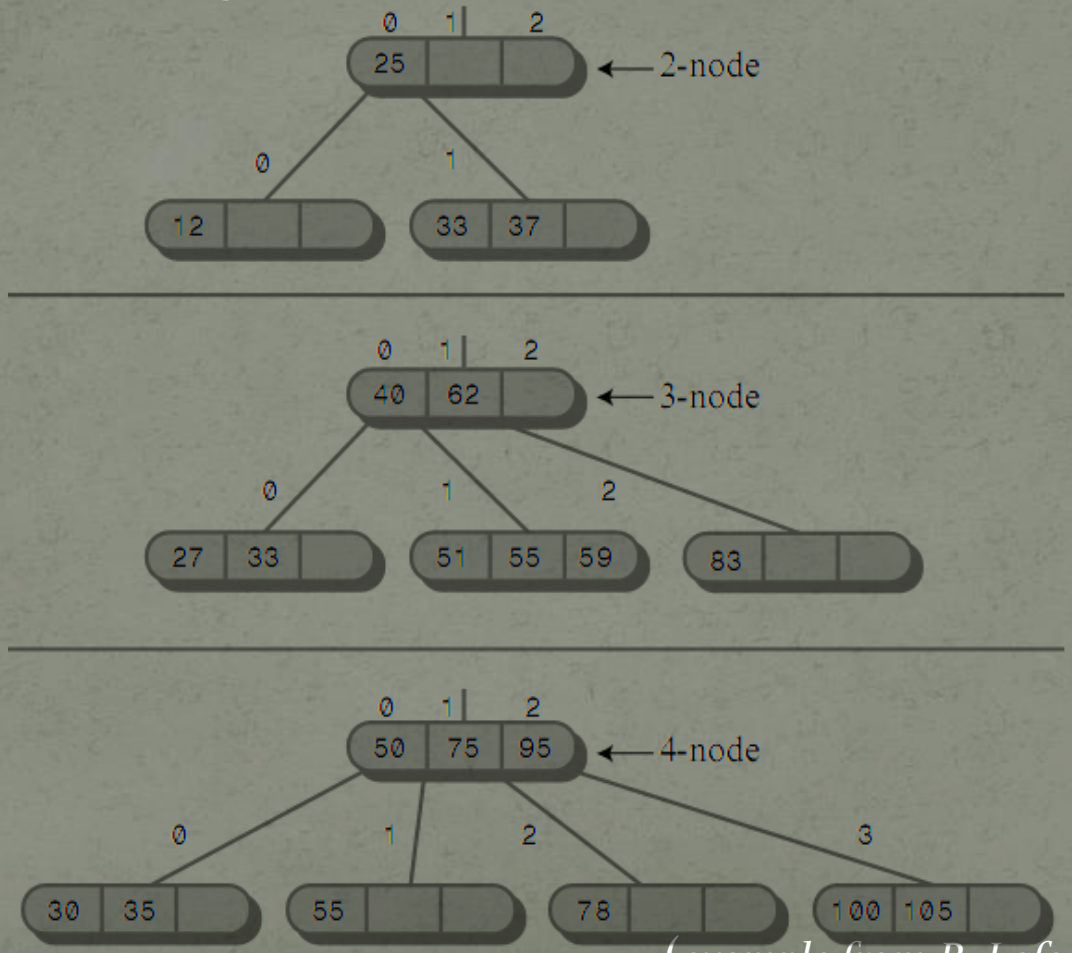
- 2-3 Tree
- 2-3-4 Tree

2-3 Tree



2-3-4 Tree

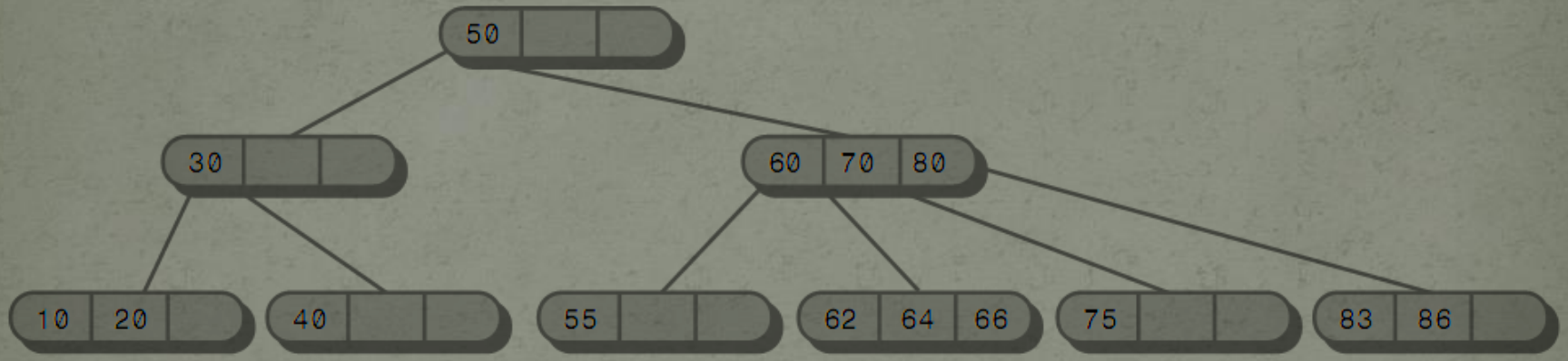
„A node must always have at least two children, unless it's a leaf"

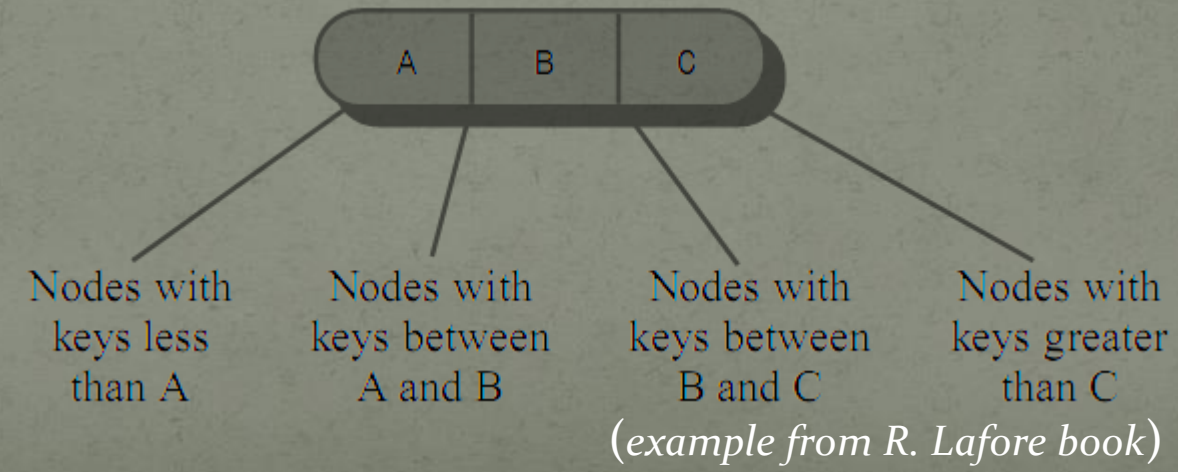


(*example from R. Lafore book*)

2-3-4 Tree

Example: searching for the data item with key (64)

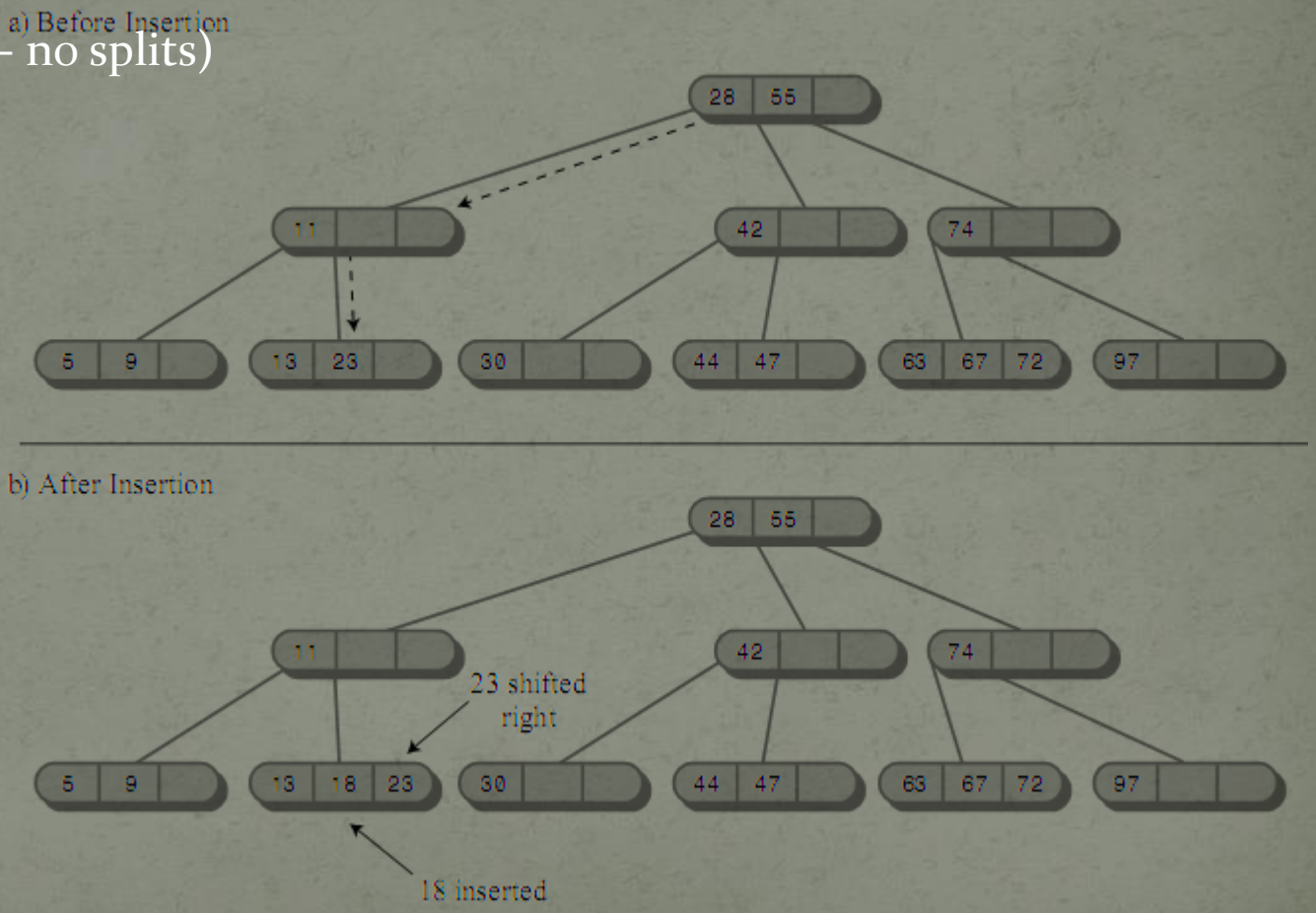




(*example from R. Lafore book*)

2-3-4 Tree

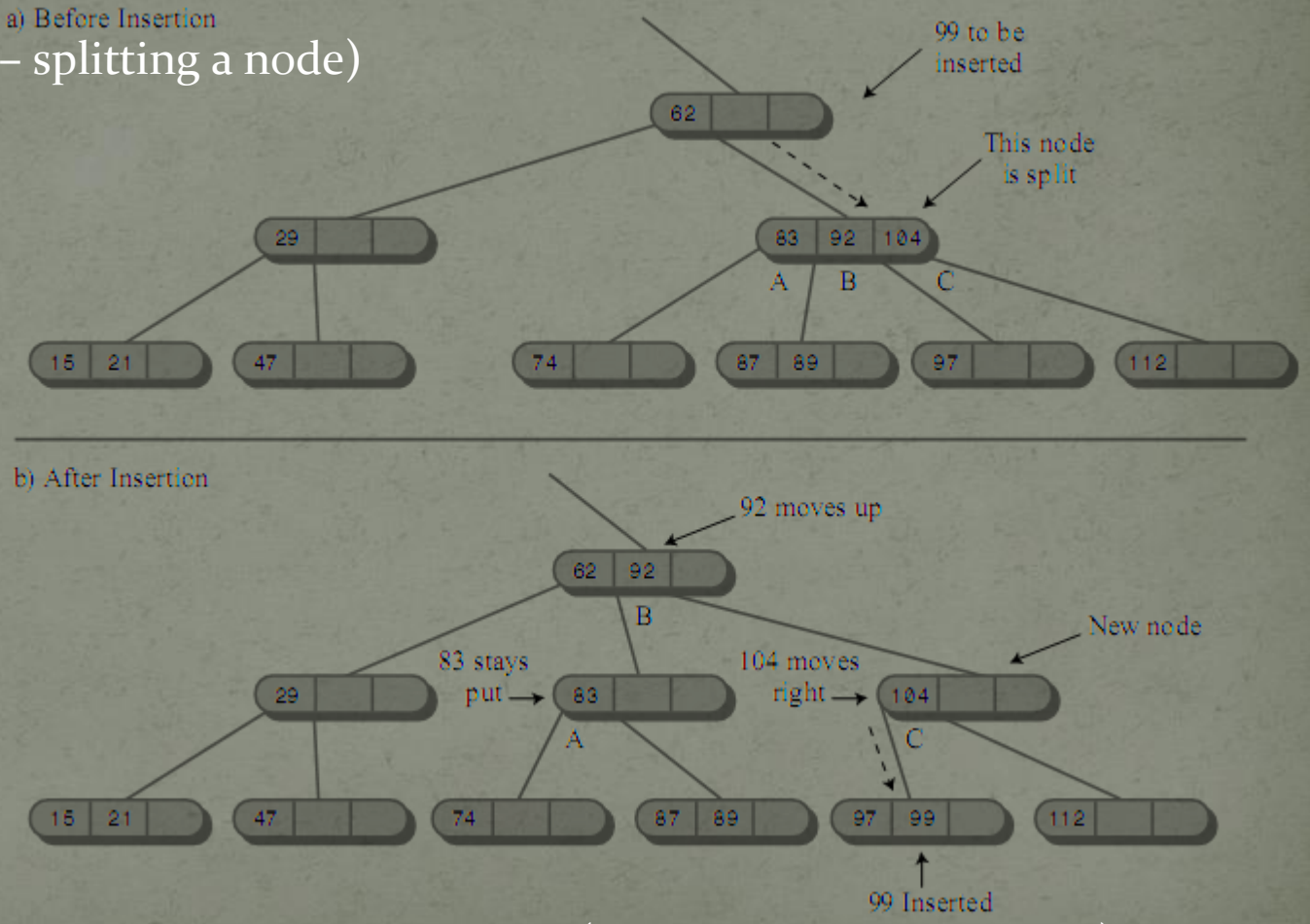
- Inserting
  a) key (18 – no splits)



(*example from R. Lafore book*)

2-3-4 Tree

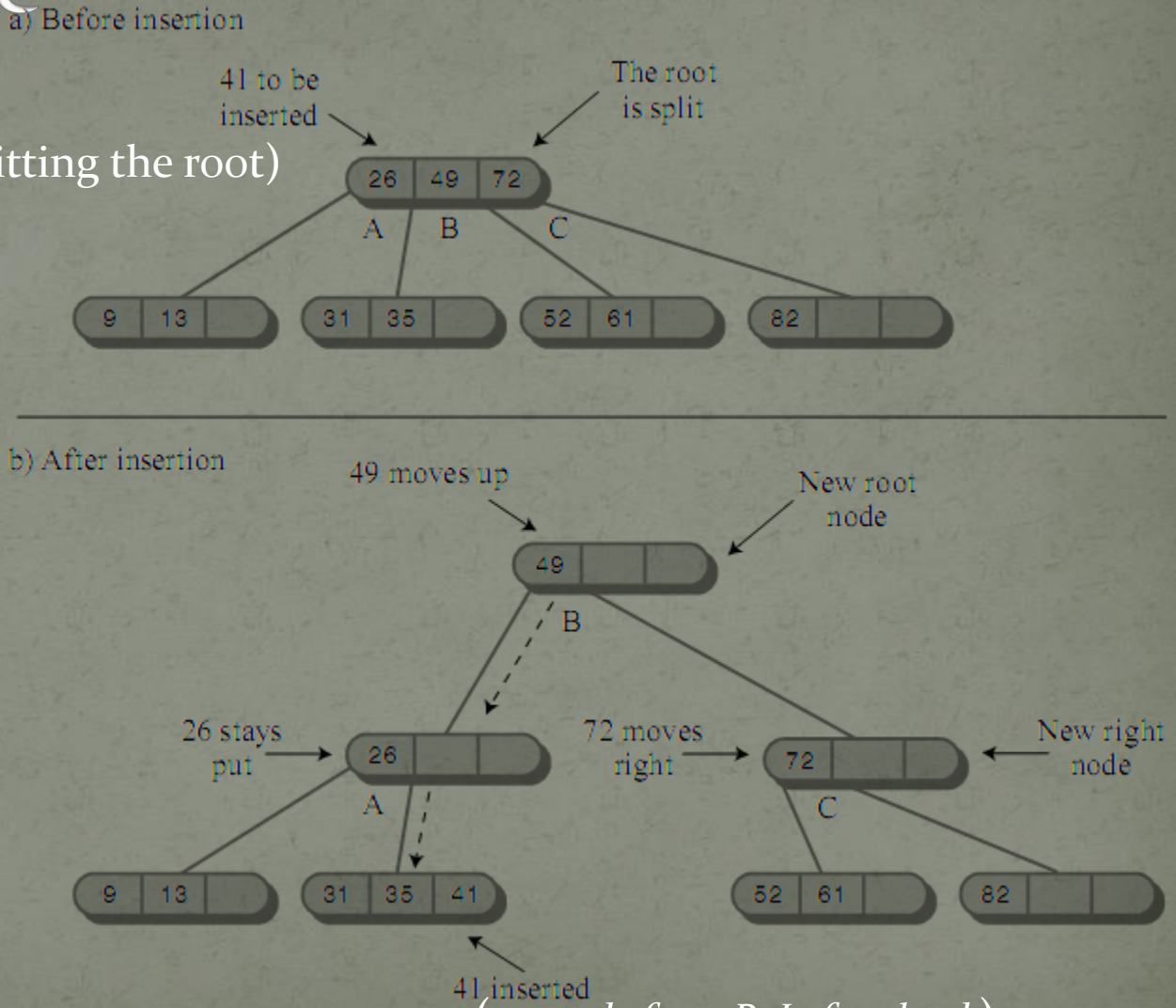
- Inserting
  b) key (99 – splitting a node)



(*example from R. Lafore book*)

2-3-4 Tree

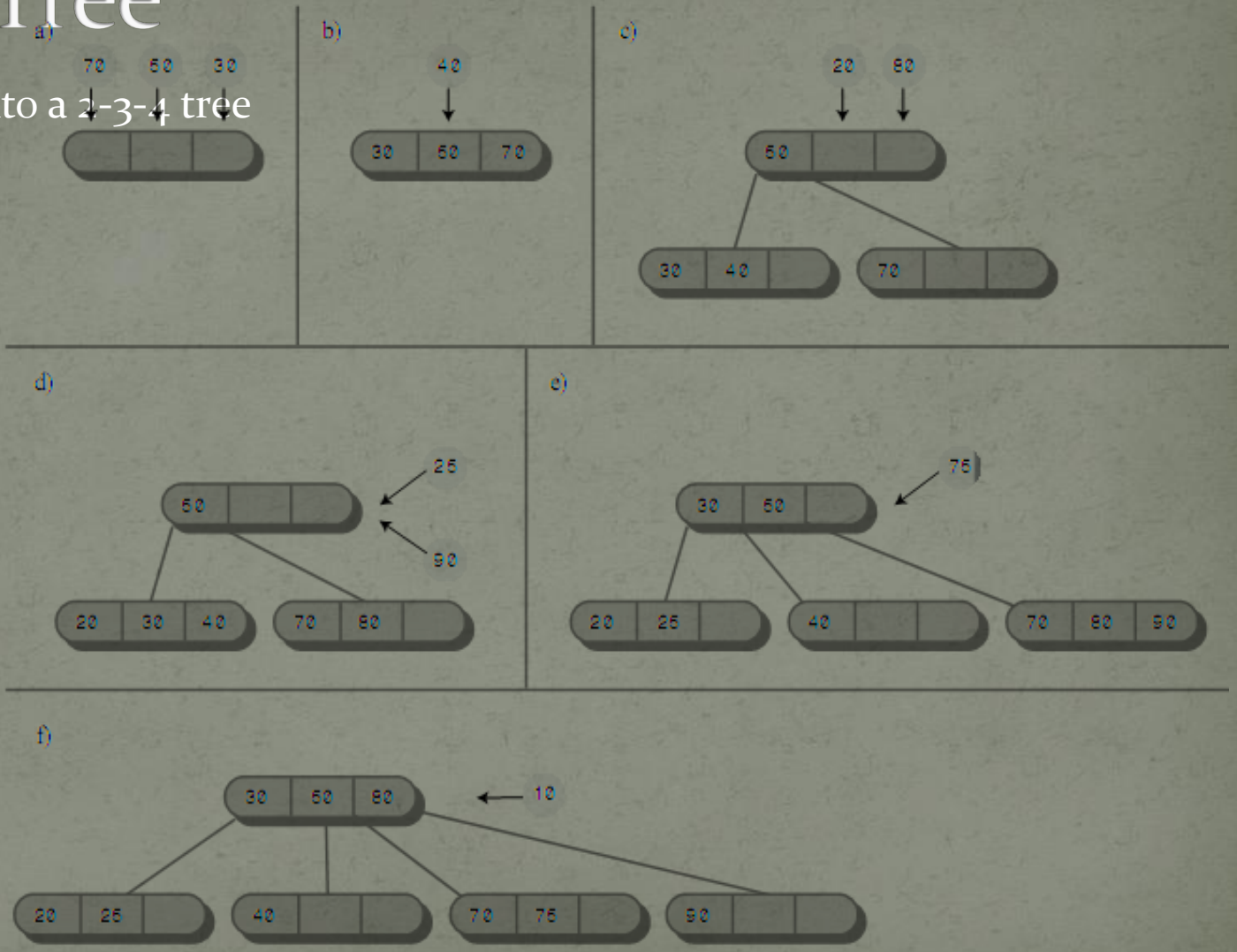
- Inserting
  - c) key (41 – splitting the root)



(*example from R. Lafore book*)

2-3-4 Tree

- Insertion into a 2-3-4 tree



(*example from R. Lafore book*)

2-3-4 Tree

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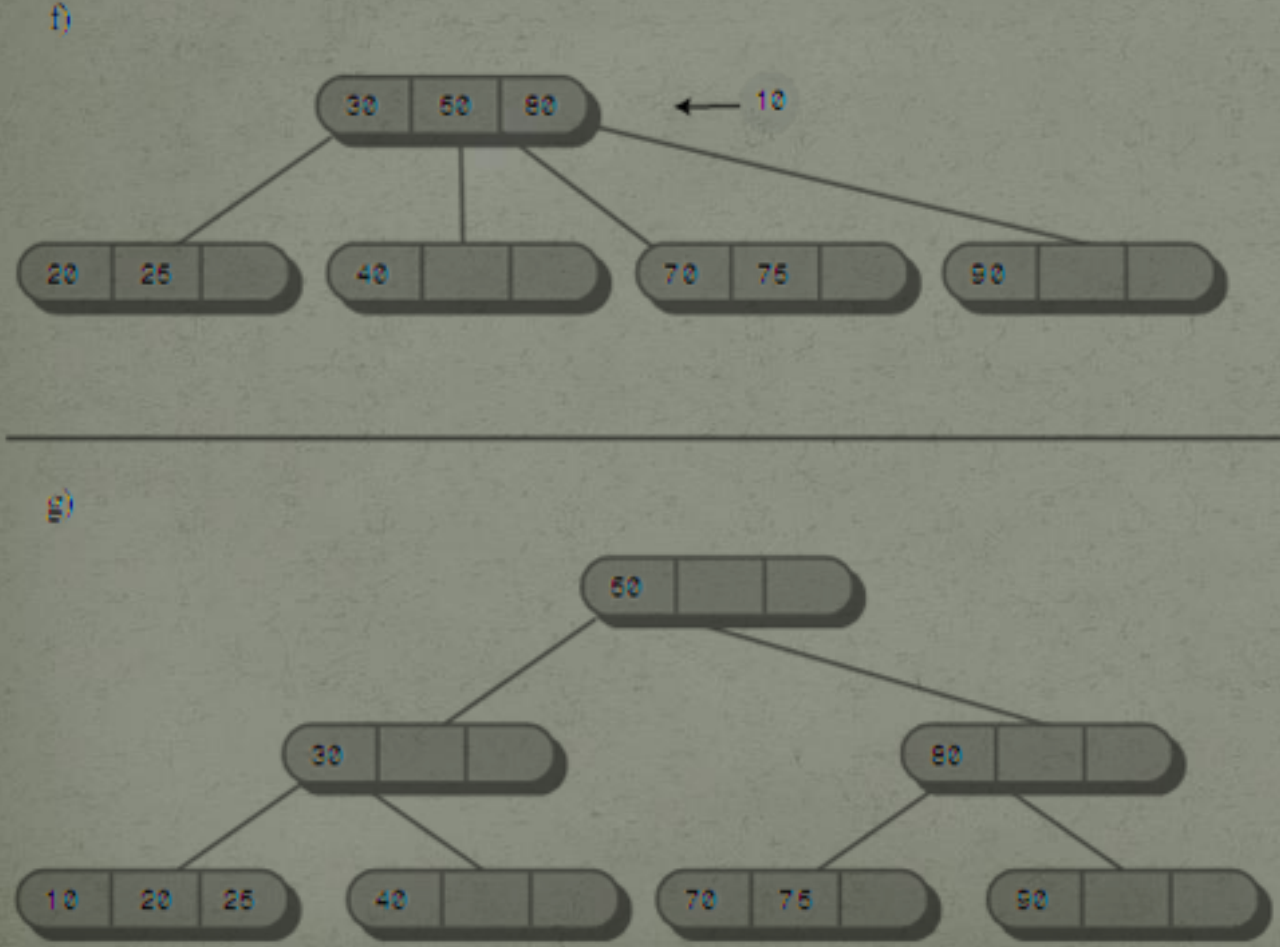
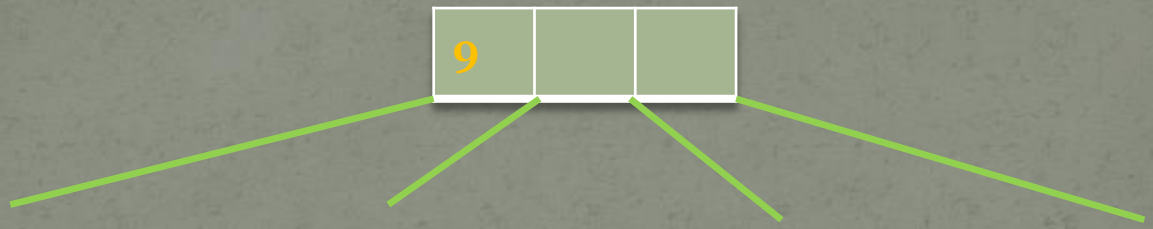


(*example from R. Lafore book*)

2-3-4 Tree

Example

Insert the following sequence of keys: 9, 7, 8, 10, 4, 12, 3, 6 ,5, 11, 16, 14



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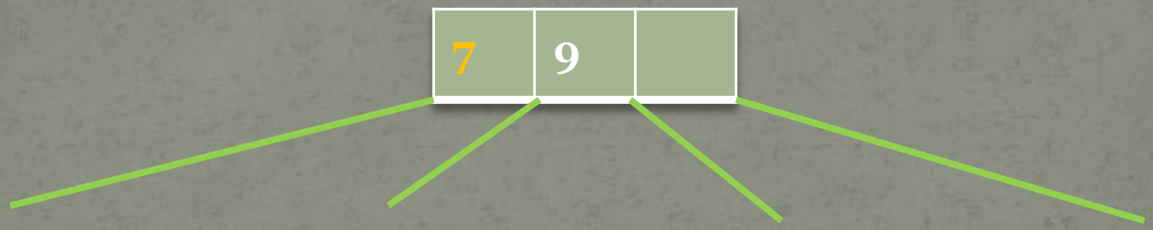

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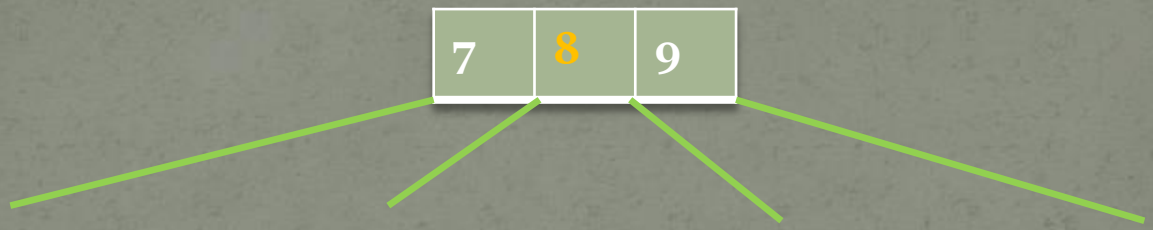

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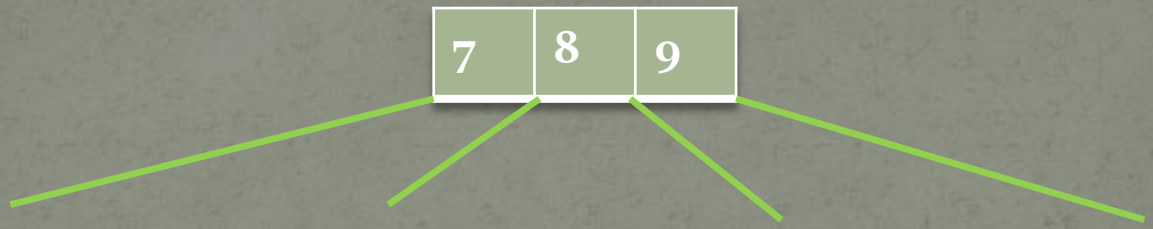

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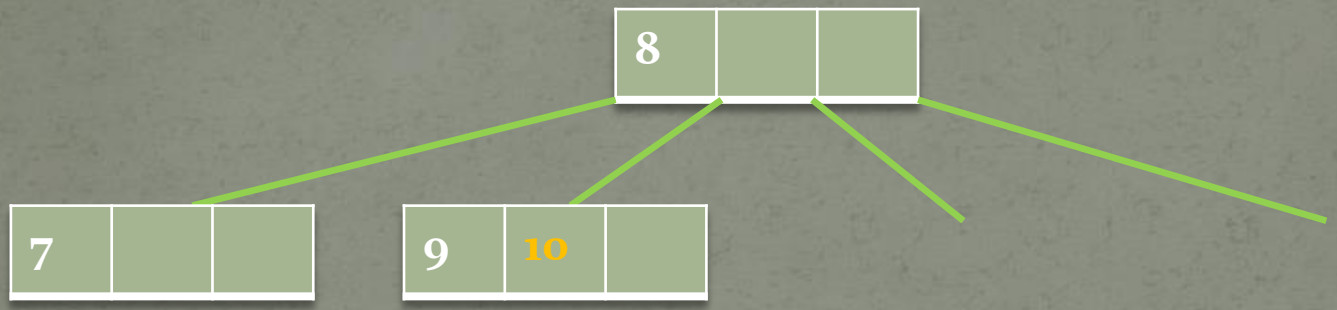

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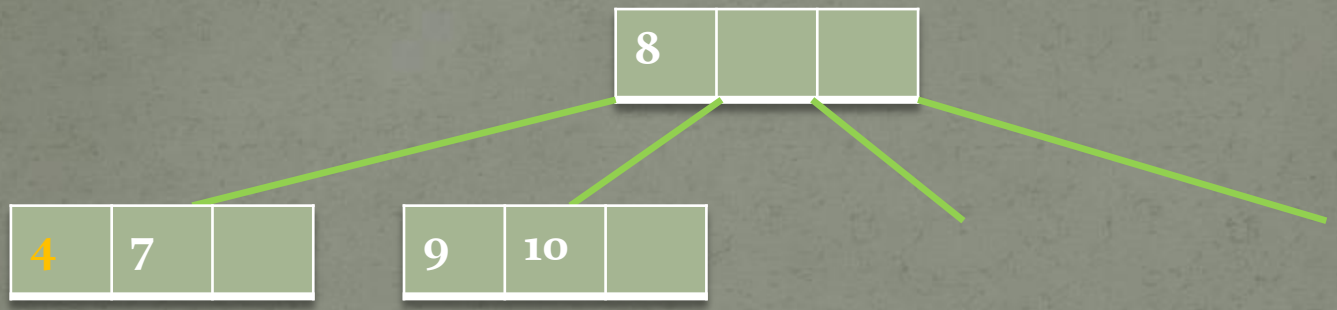

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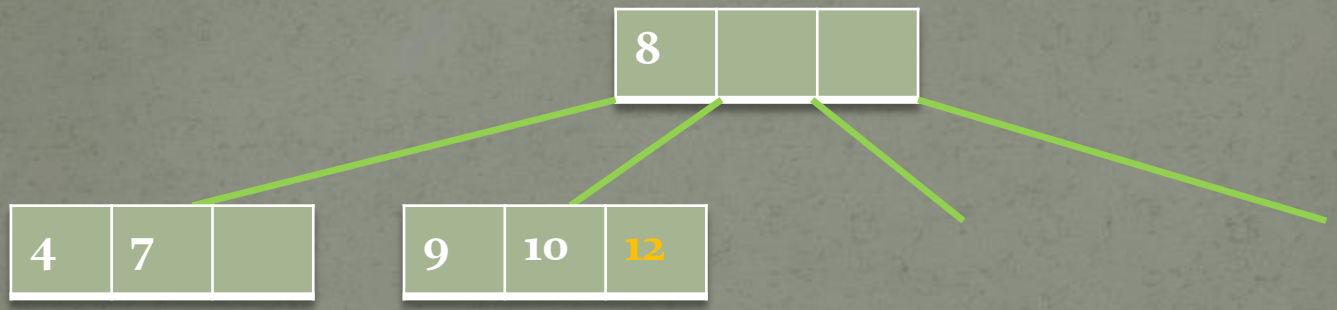

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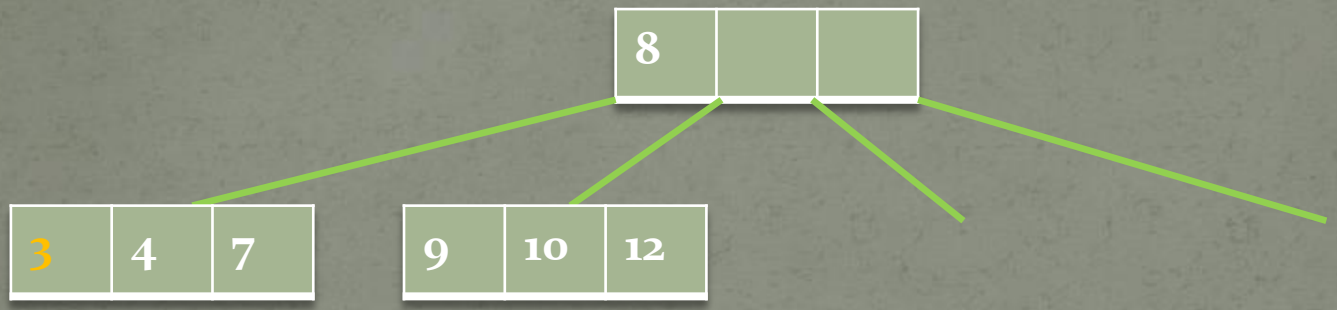

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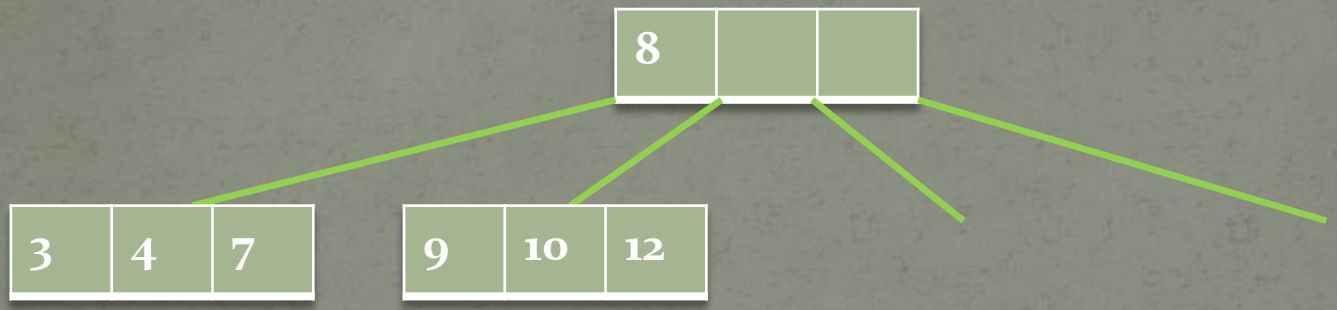

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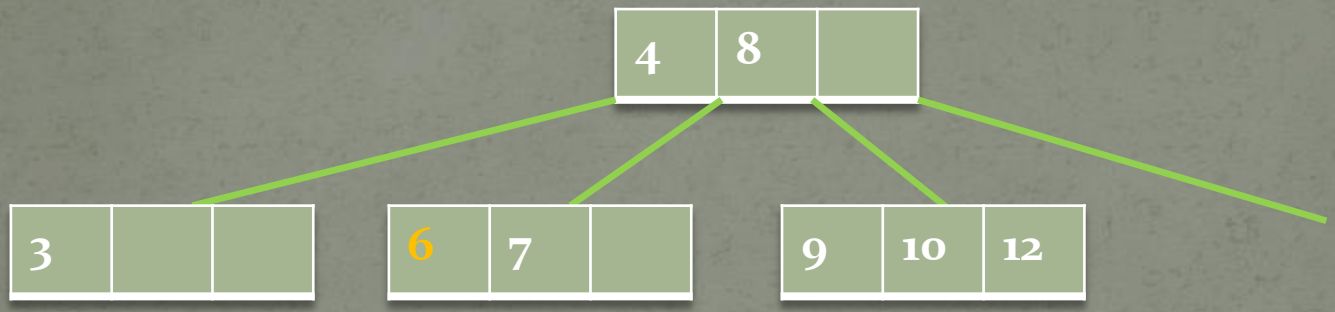

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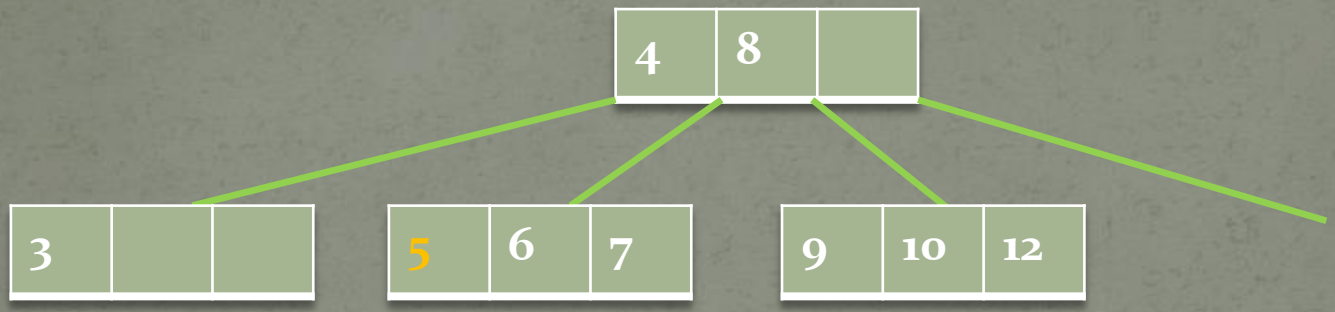

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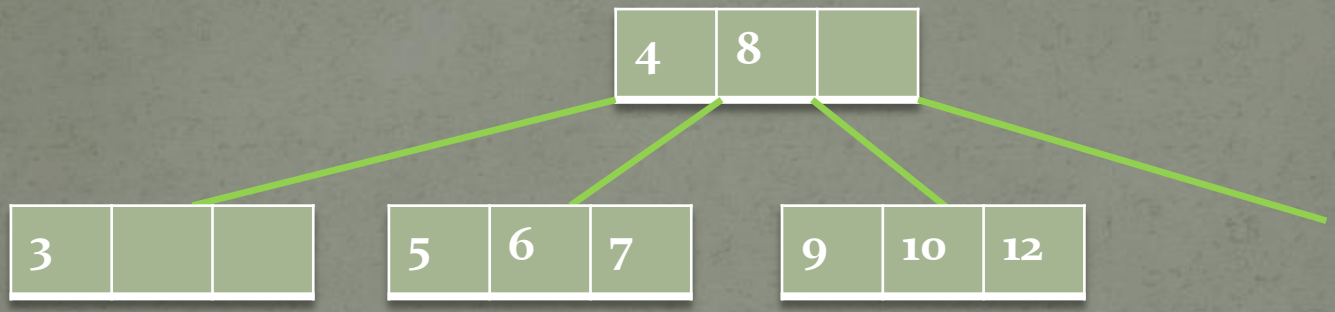

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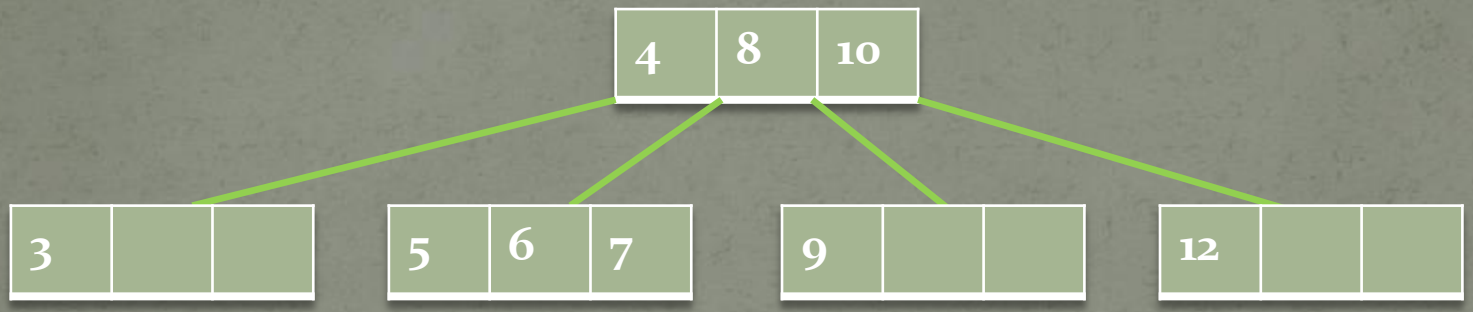

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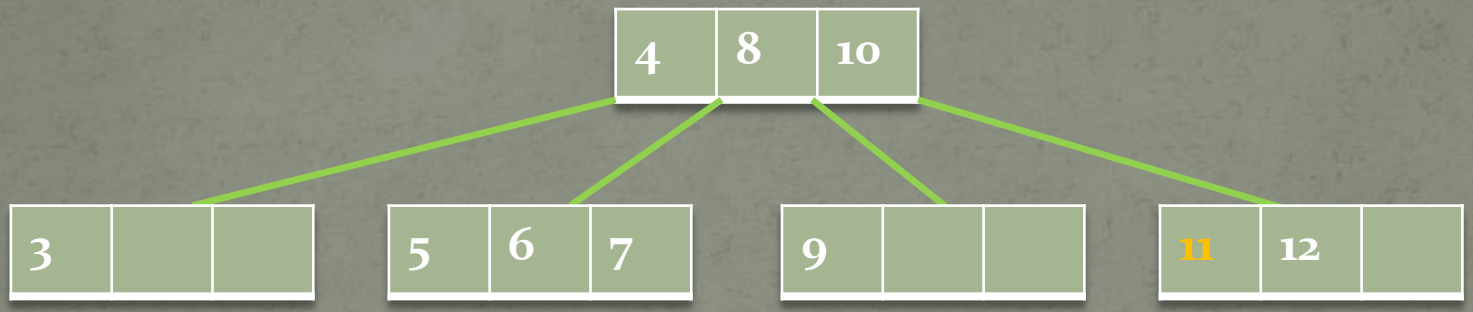

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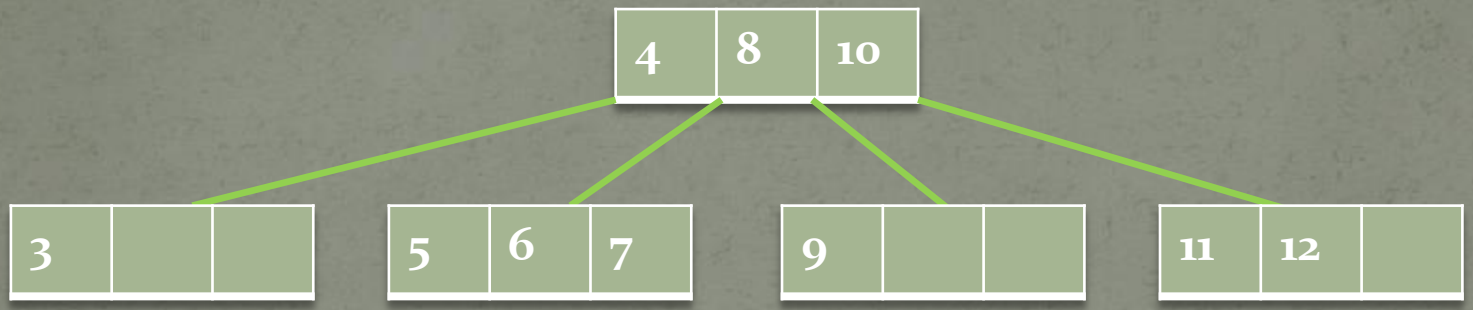

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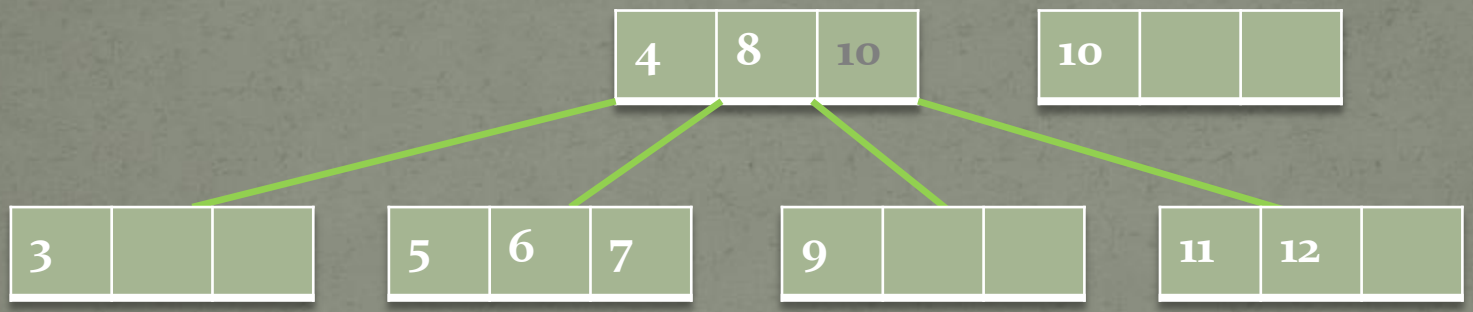

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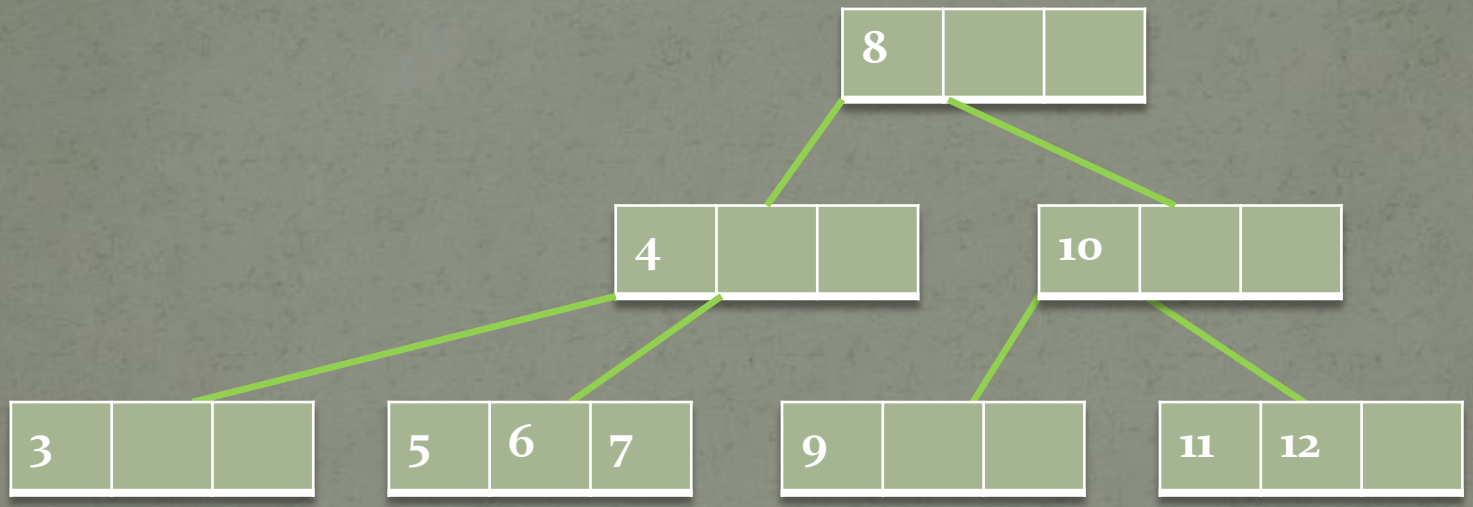

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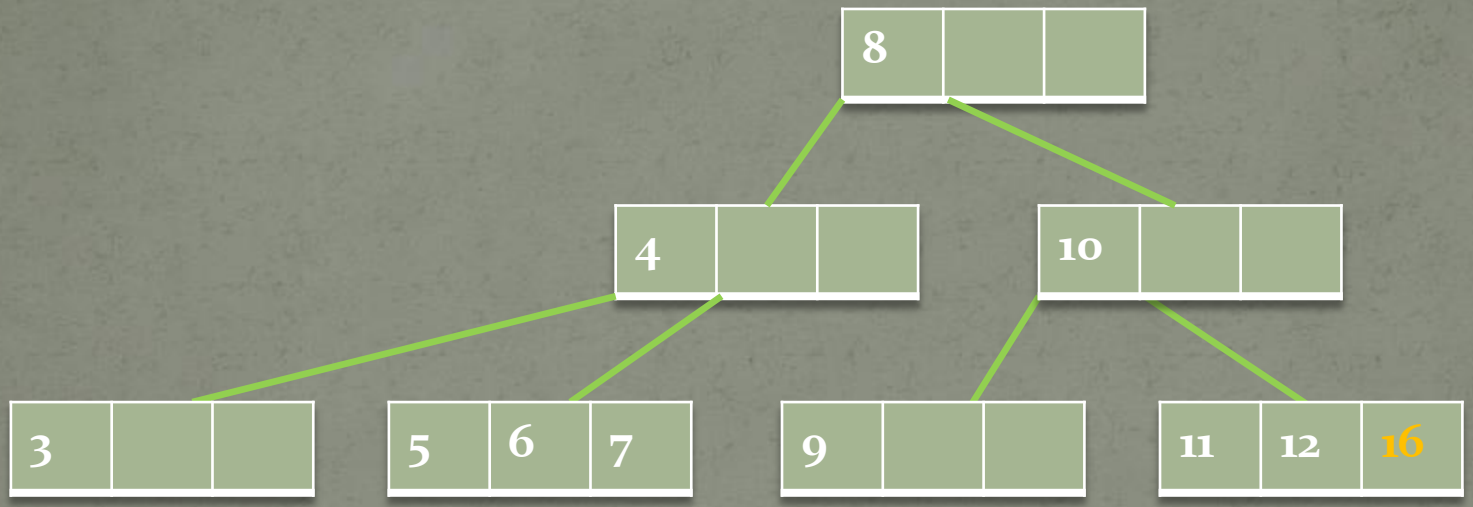

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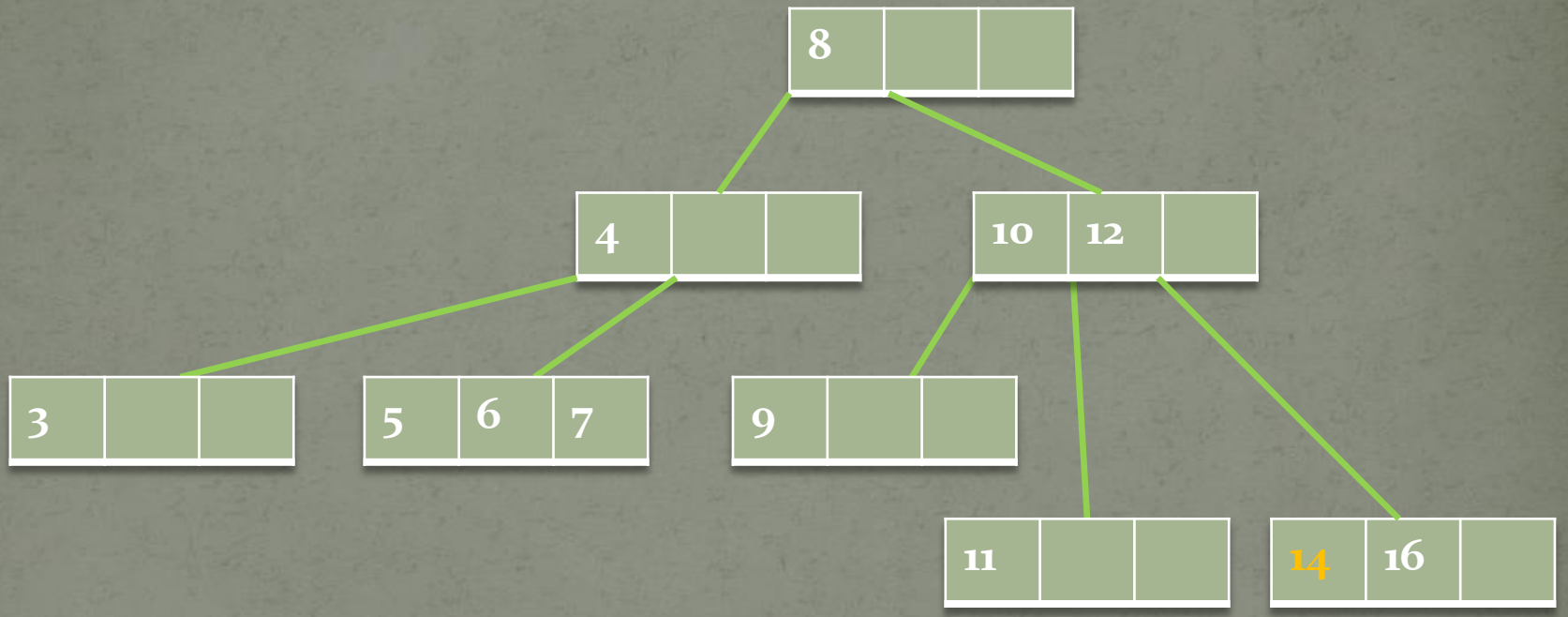


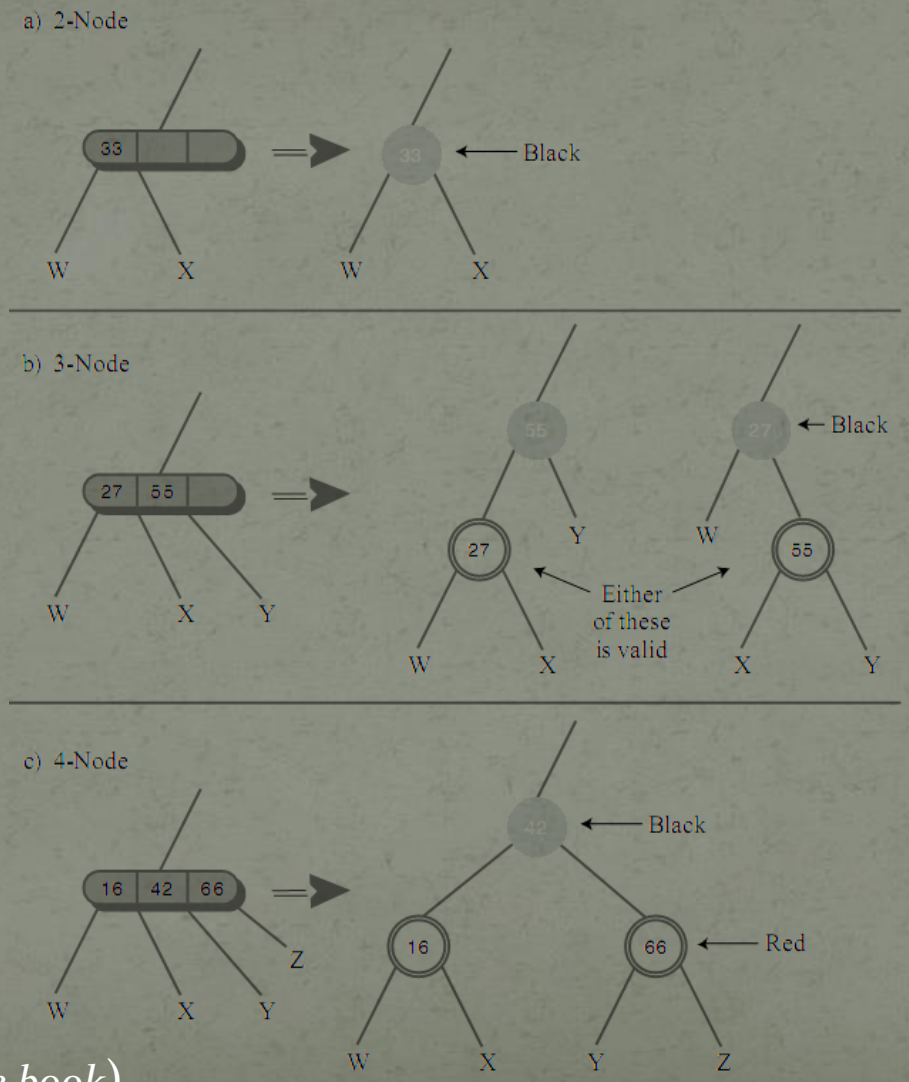
2-3-4 vs Red-Black Tree

Transformation ftrom 2-3-4 to Red-Black

- Transform 2-node into black node
- Transform any 3-node into child (red) and parent (black)
- Transform any 4-node into parent (black) and two children (red)

(*example from R. Lafore book*)

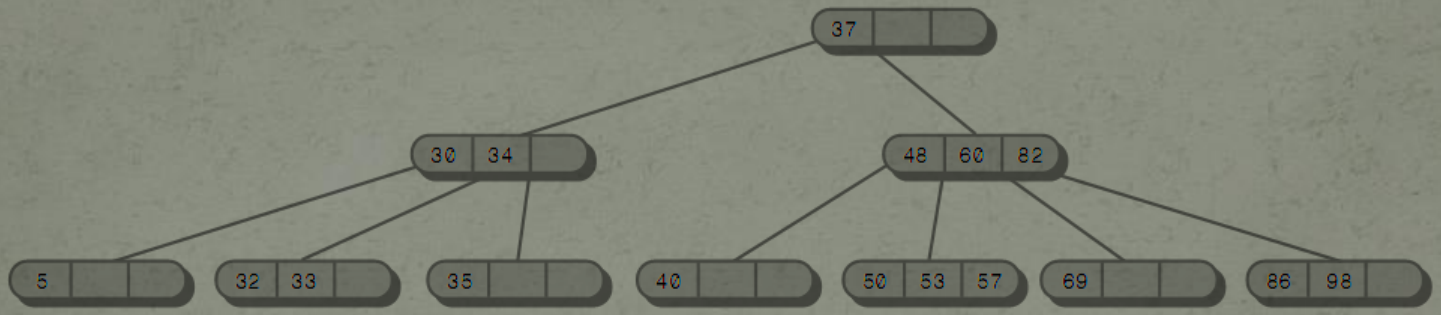
2-3-4 vs Red-Black Tree



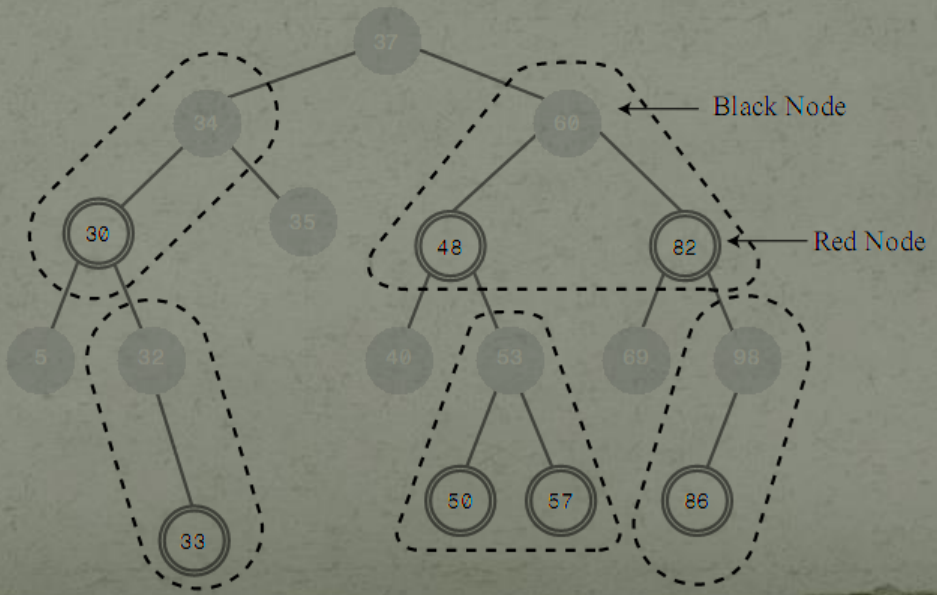
(*example from R. Lafore book*)

2-3-4 vs Red-Black Tree

a) 2-3-4 tree



b) Red-black tree



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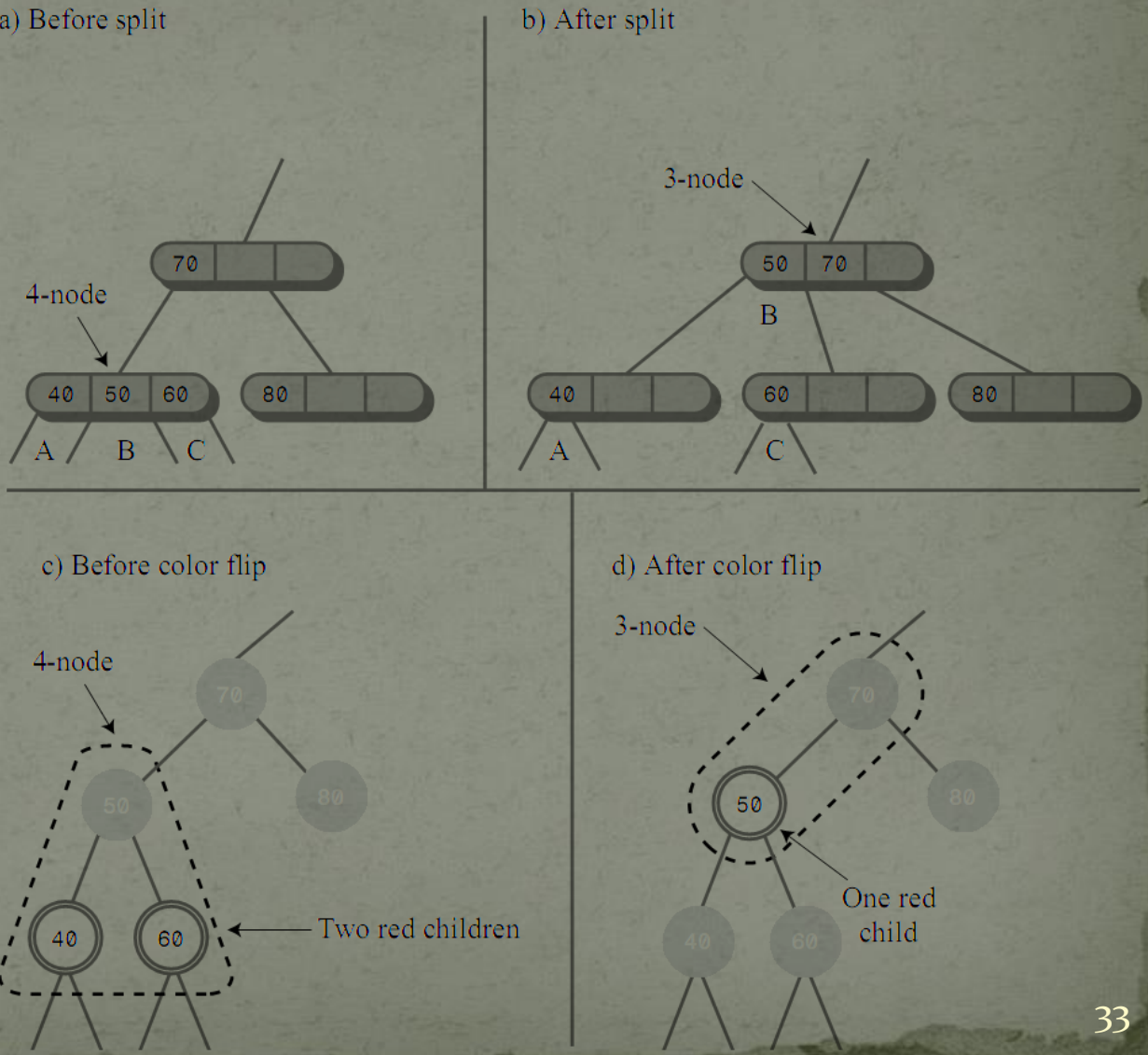
2-3-4 vs Red-Black Tree



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