Homework #7 part_1

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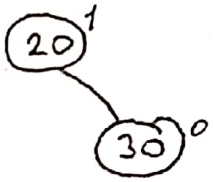
Q-1) Last four digits of my student number in two-digit format is 40 and 56, so I add 20, 30, 8, 47, 39, 18, 40 and 56 to my balanced trees, then remove them one by one in the same order (Fifo)

AVL Tree Insert

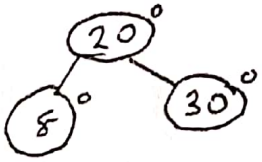
insert 20:

→ this is node balance for a balanced tree it must ≥-1 and ≤1

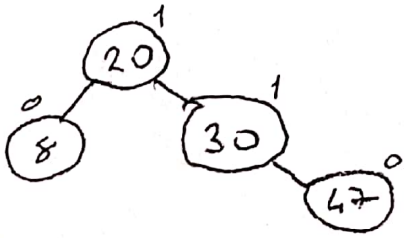
insert 30:



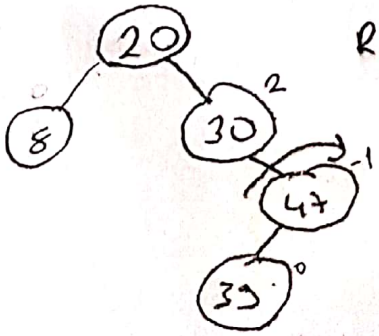
insert 8:



insert 47:

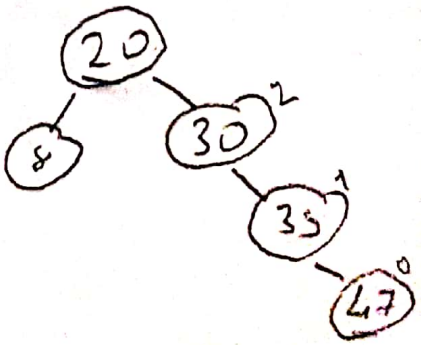


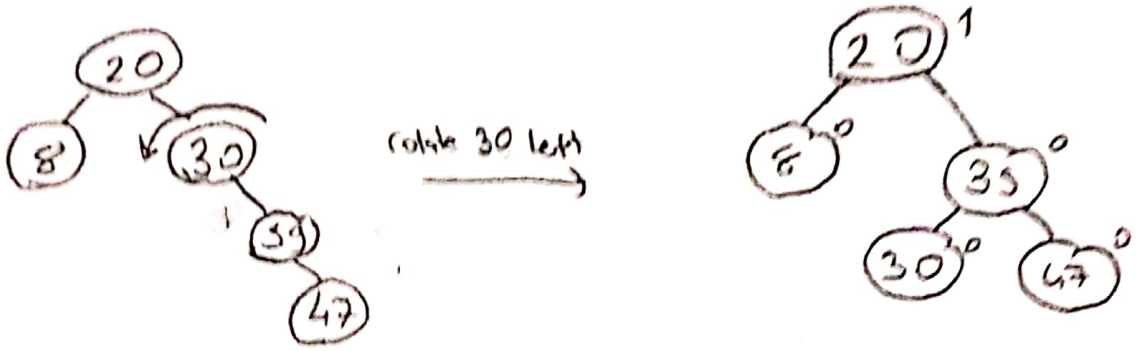
insert 39:



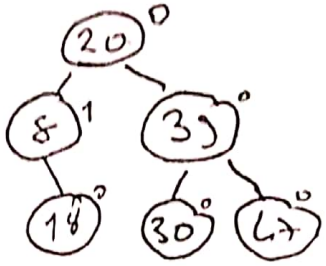
Right-Left Case

rotate 47 right

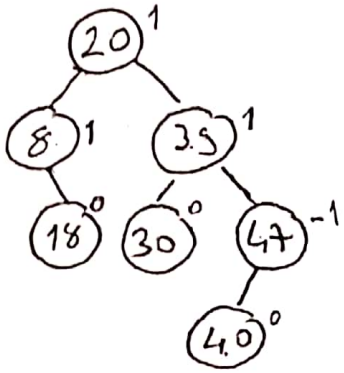




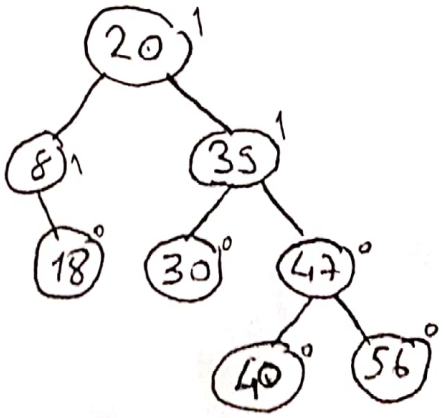
insert 18:



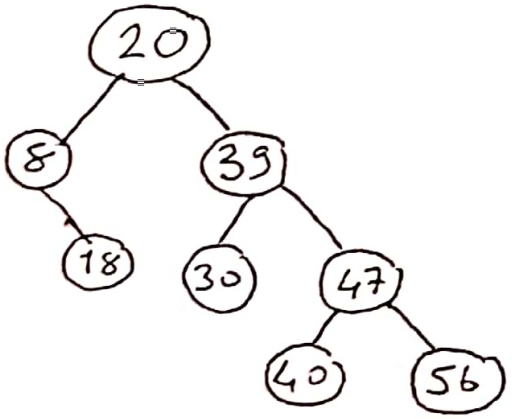
insert 40:



Insert 56:

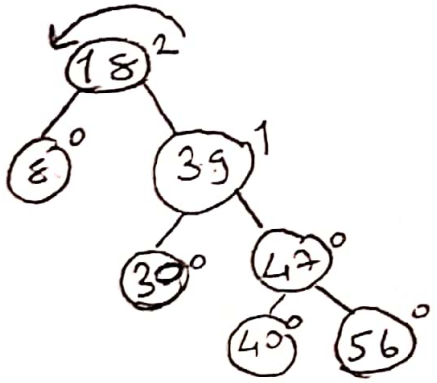


AVL Tree Remove



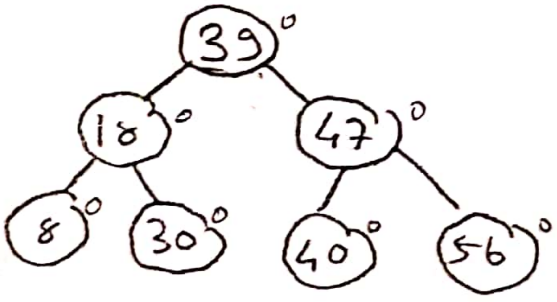
Remove 20:

After deleting 20 →



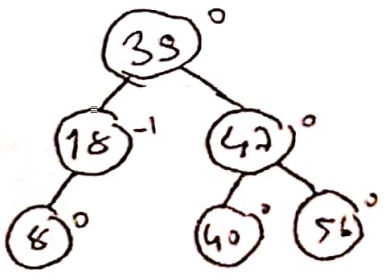
Right-Right Case

Left rotate 18 →



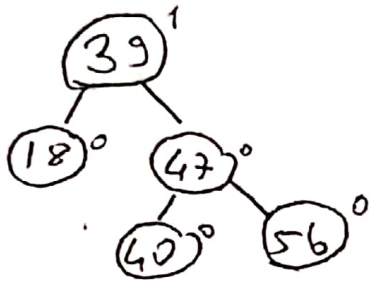
Remove 30:

After deleting 30 →



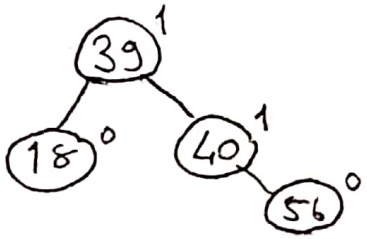
Remove 8:

After deleting 8 →



Remove 47:

After deleting 47 →

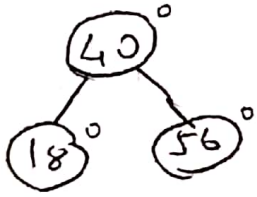


Remove 39:

After deleting 39 →

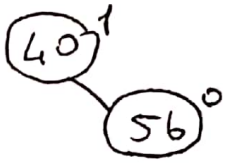
Right-Right Case

Rotate 18 left →



Remove 18:

After deleting 18 →



Remove 40:

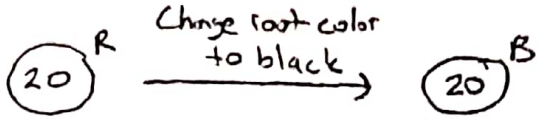
After deleting 40 →

Remove 56:

After deleting 56 → Tree is empty, All elements deleted

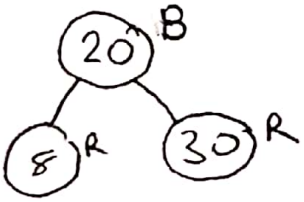
Red-Black Tree Insert

Insert 20:

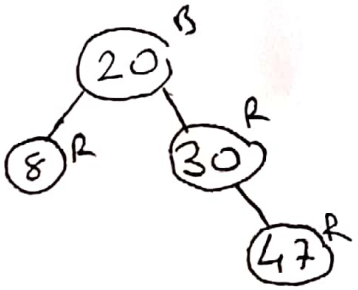


Insert 30:

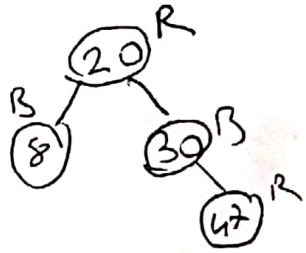
Insert 8:



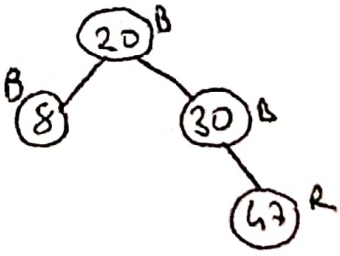
Insert 47:



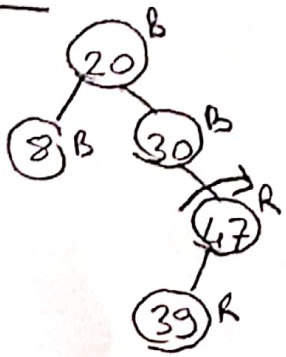
Recolor 47's parent and uncle to black and grandparent to red



Recolor parent to black

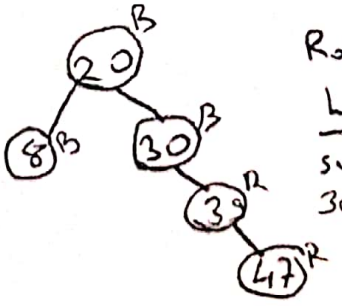


Insert 39:



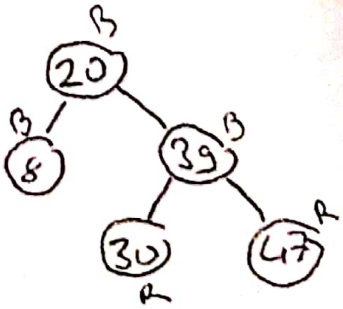
Right-Left Case

Rotate 47 right

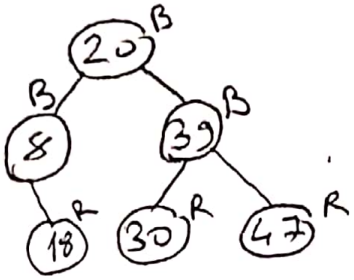


Rotate 30 Left

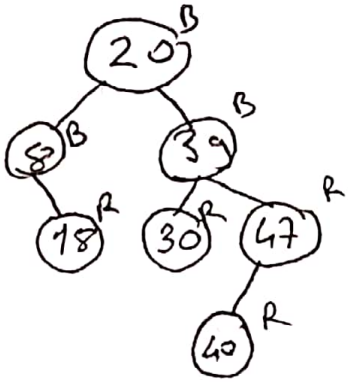
swap colors 30 and 39



Insert 18:

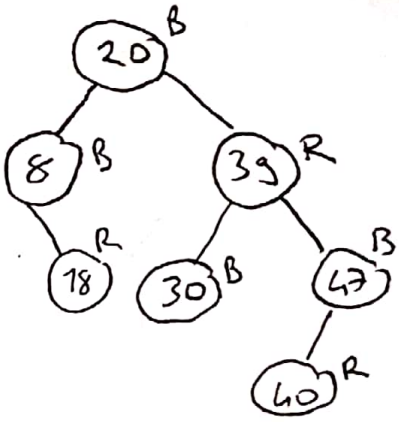


Insert 40:

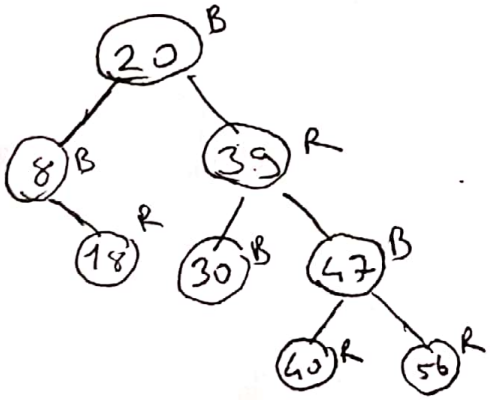


40's parent and uncle red

Recolor
40's parent and uncle
to black and
40's grandparent to red

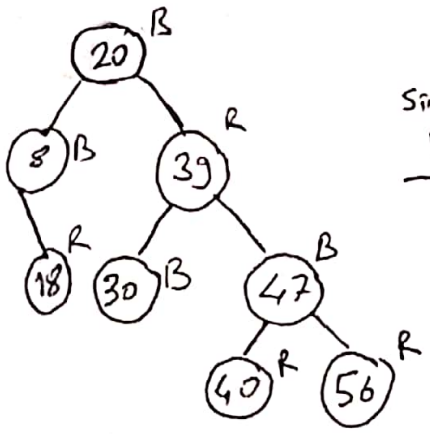


Insert 56:

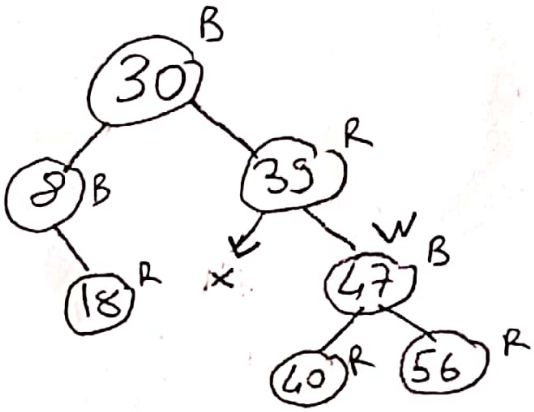


Red-Black Tree Remove

Remove 20:

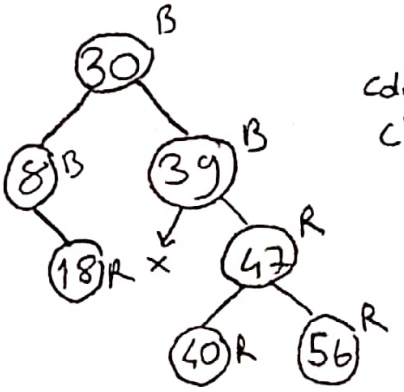


Simple BST Deletion →

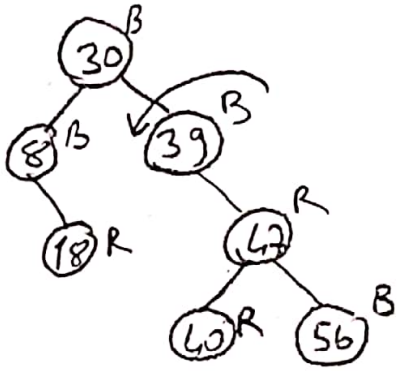


Color w the same color as x prent →

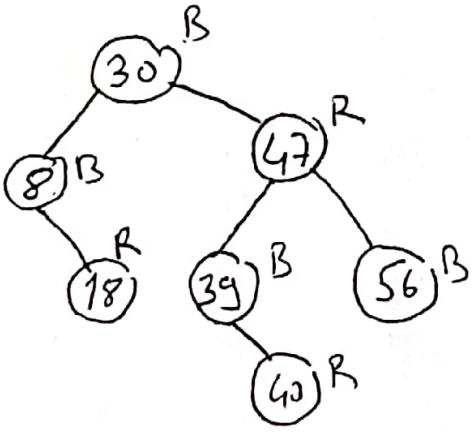
Color x parent black



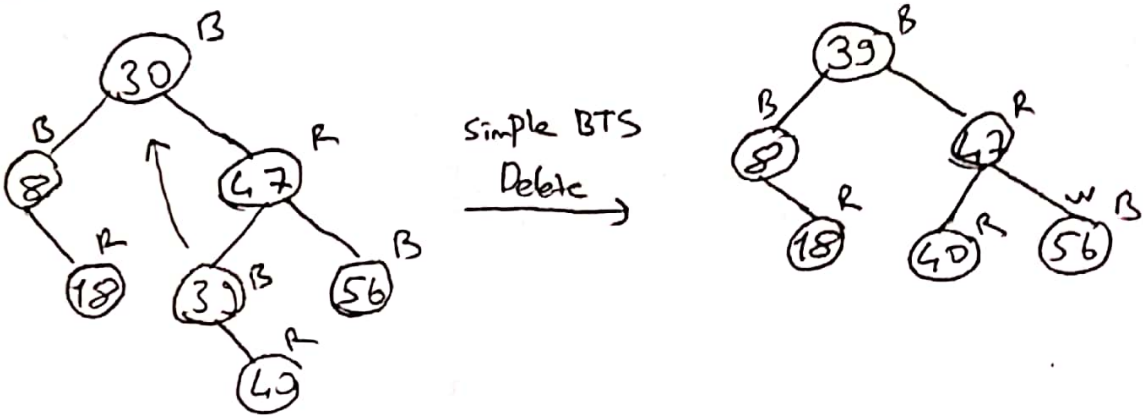
Color 47 right child black →



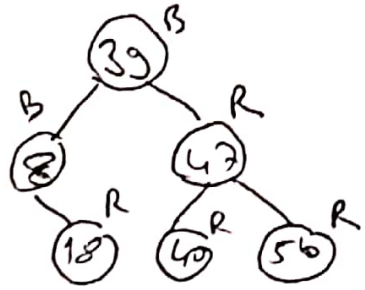
Rotate 39 left →



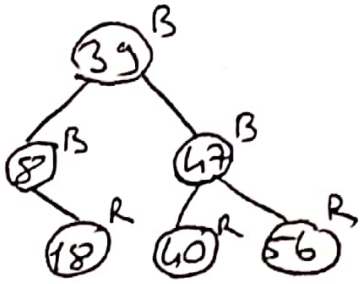
Remove 30:



Color 56 red →

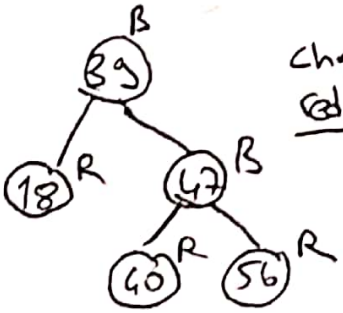


Change 47 red to black →

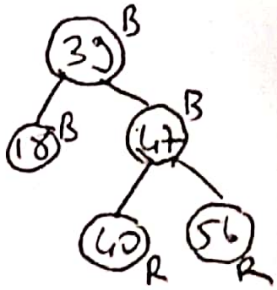


Remove 8:

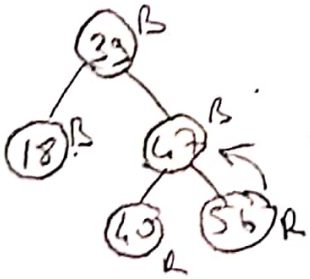
Simple BTS Delete →



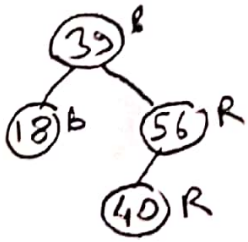
Change 18 color red to black →



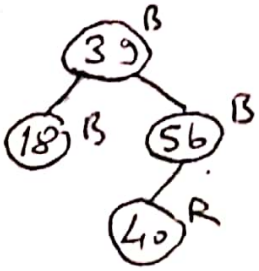
Remove 47:



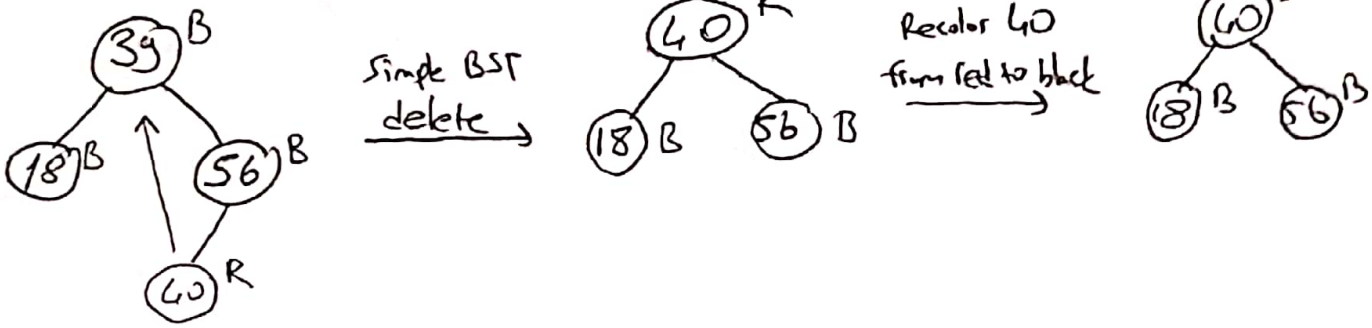
Simple BTS delete →



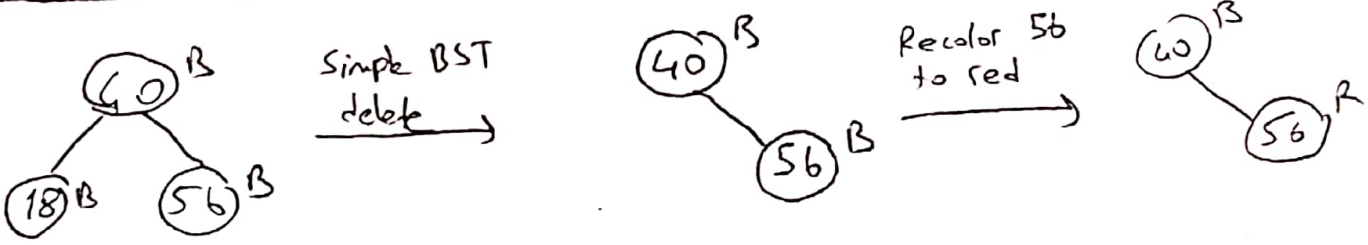
Change 56 color red to black



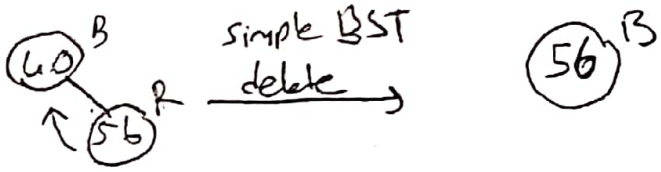
Remove 39:



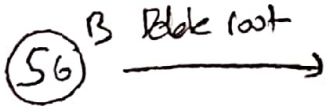
Remove 18:



Remove 40:



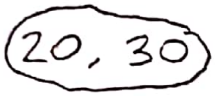
Remove 56:



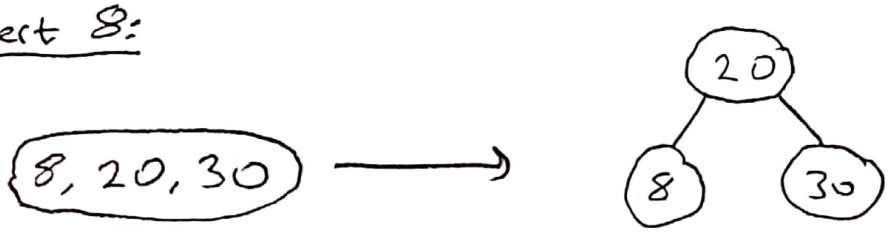
2-3 Tree Insert

Insert 20:

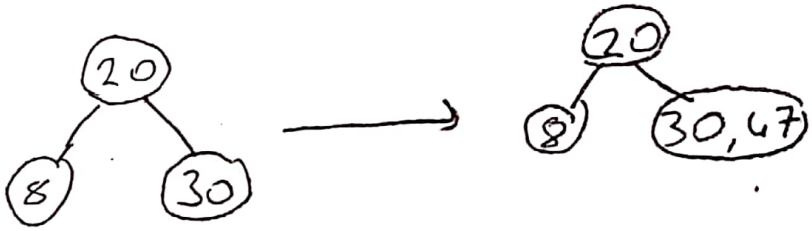
Insert 30:



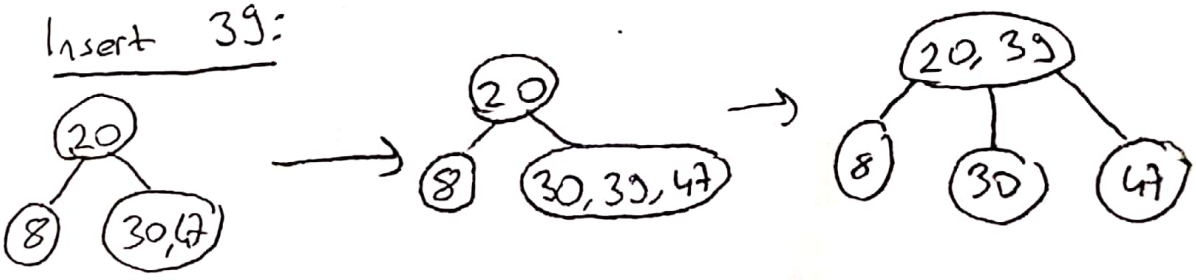
Insert 8:



Insert 47:



Insert 39:



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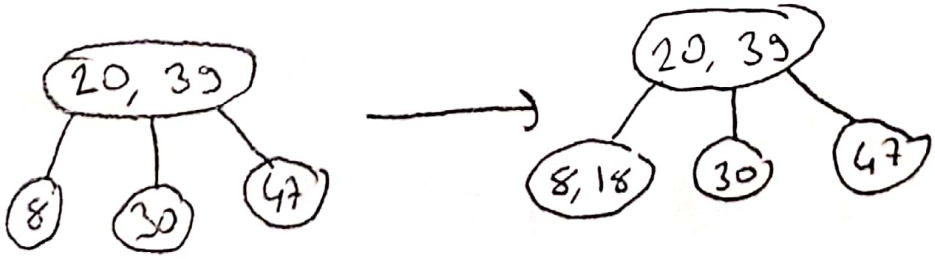

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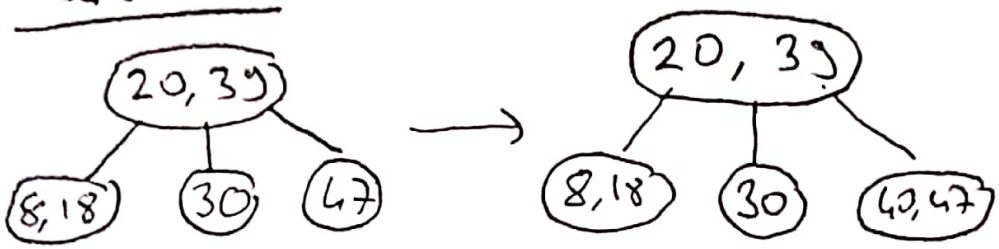

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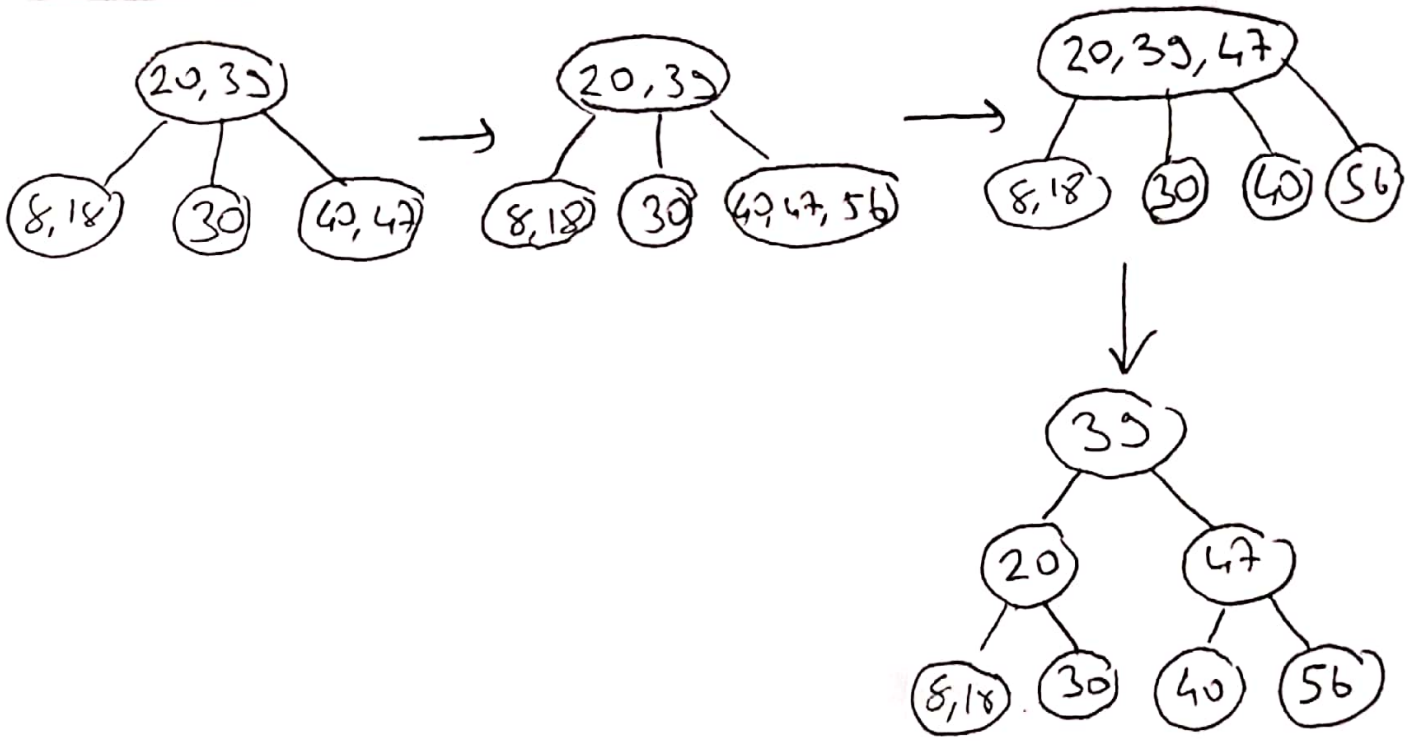

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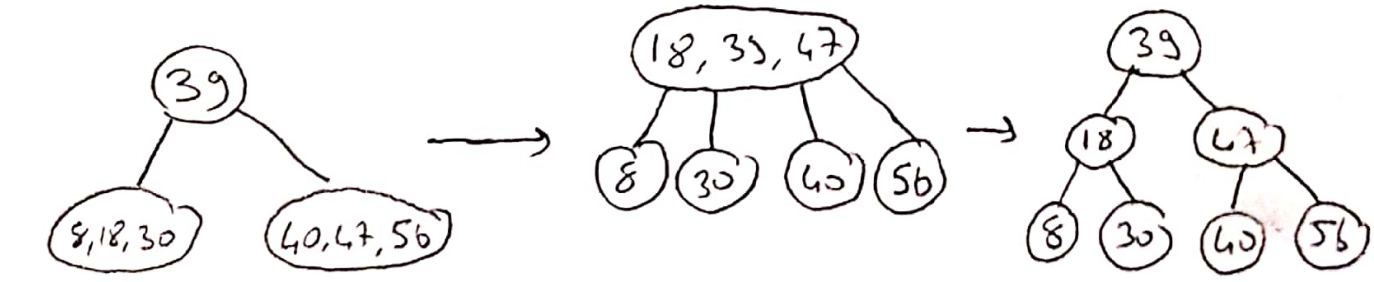

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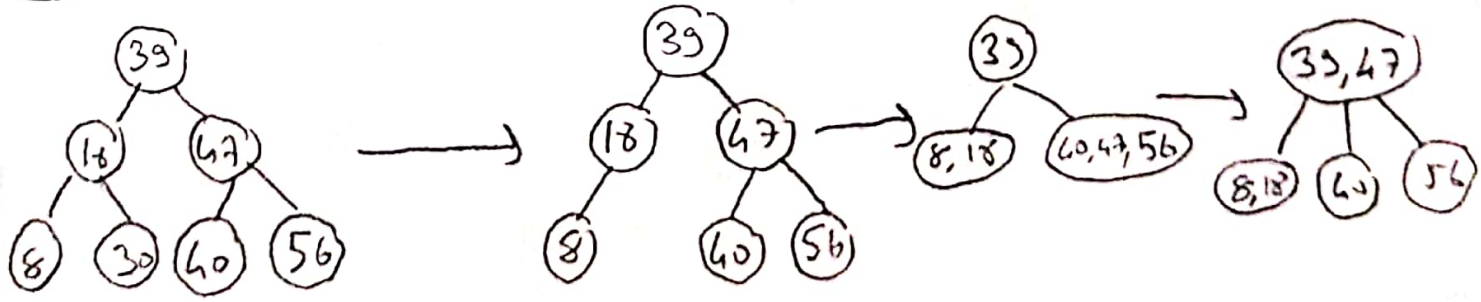

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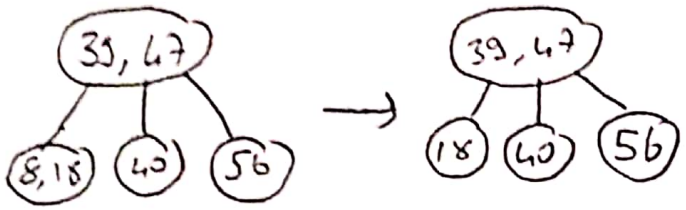

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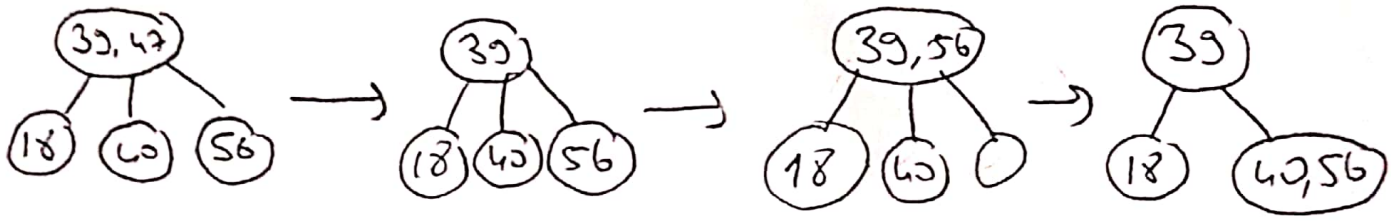

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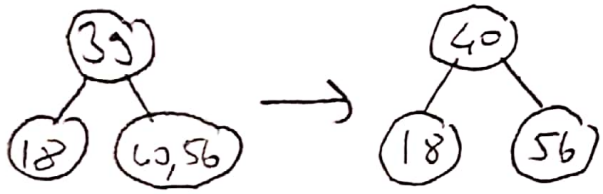

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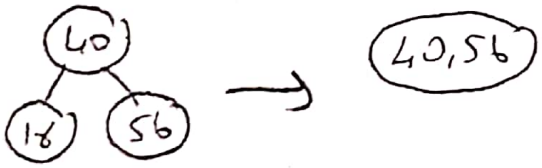

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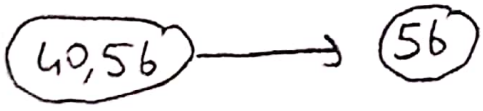

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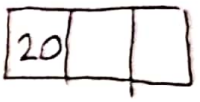

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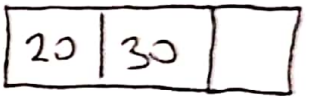

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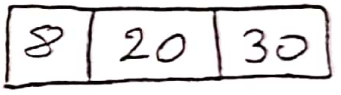

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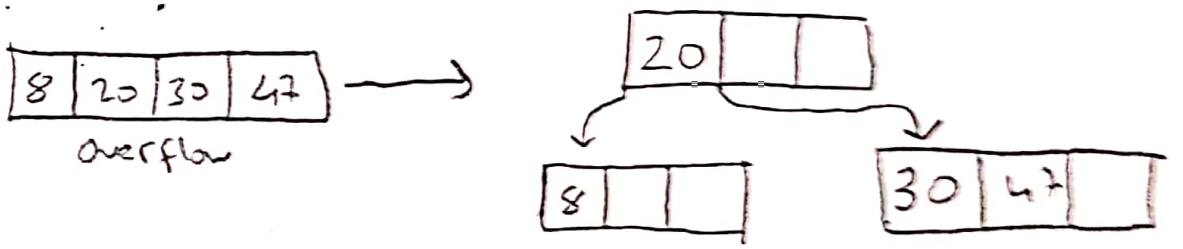

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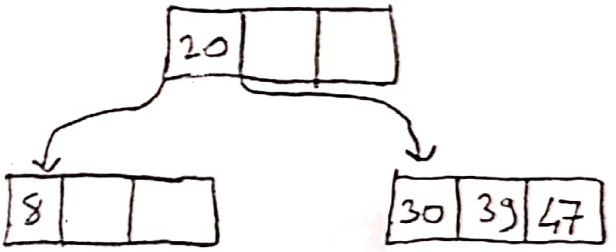

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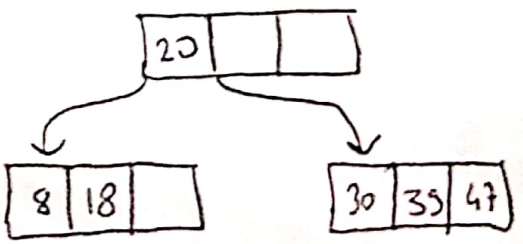

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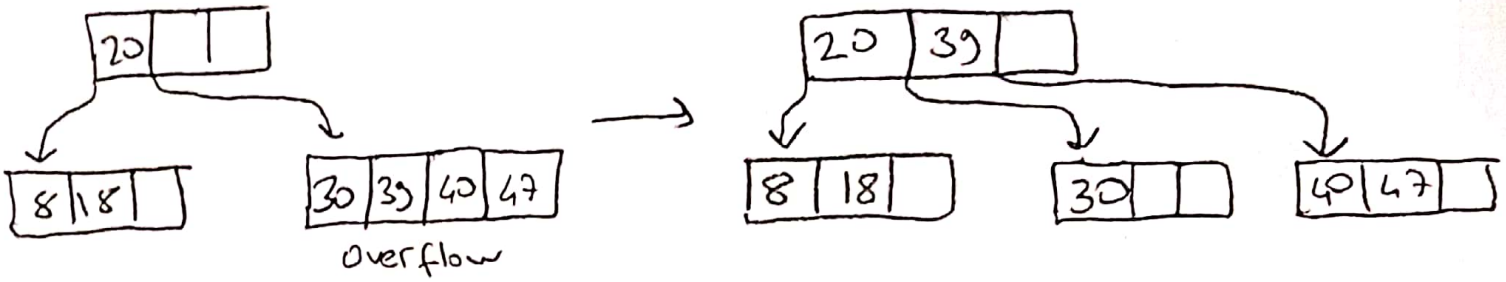

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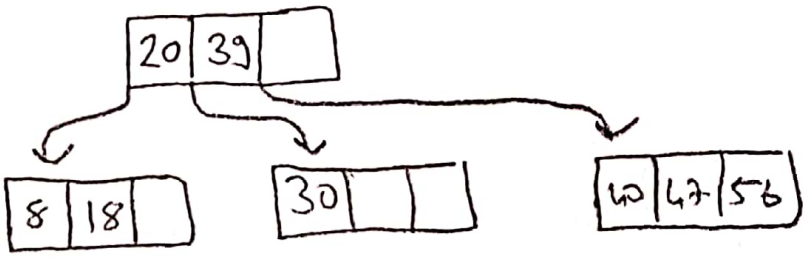

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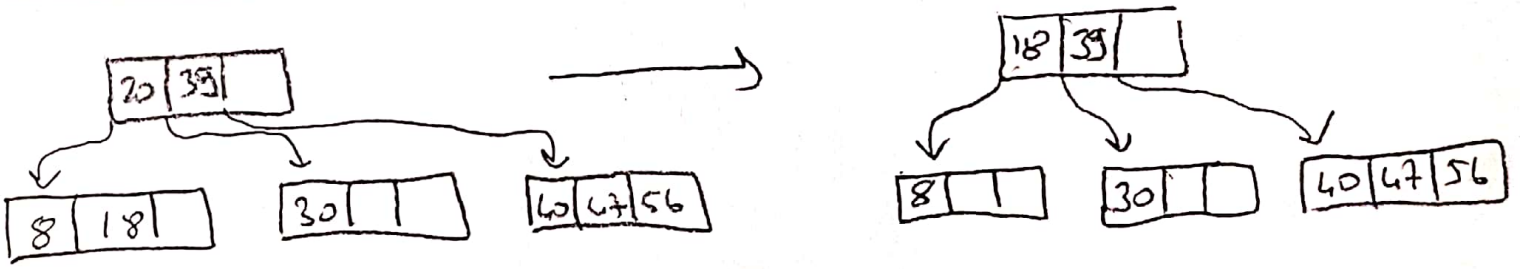

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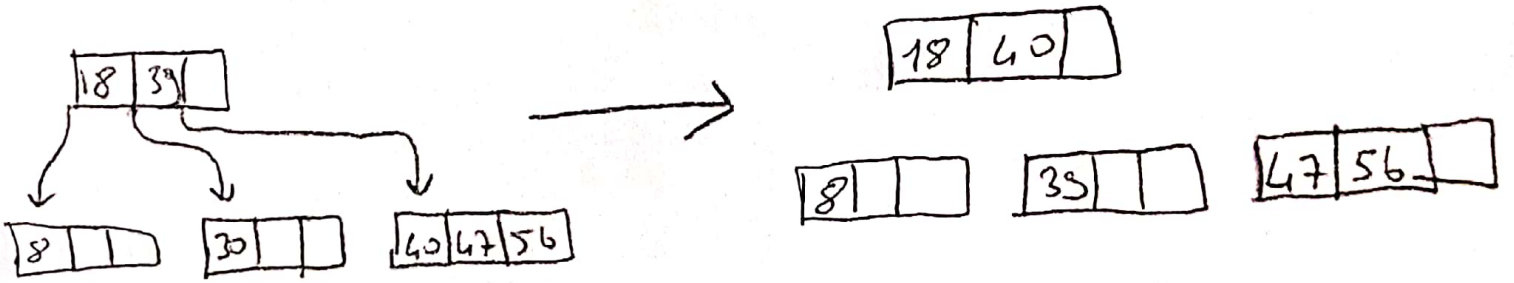

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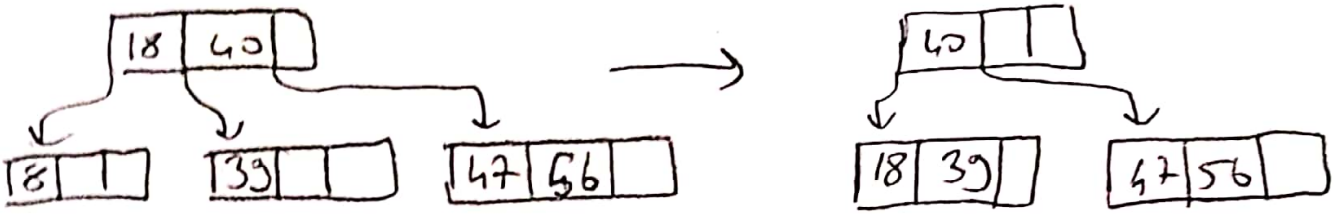

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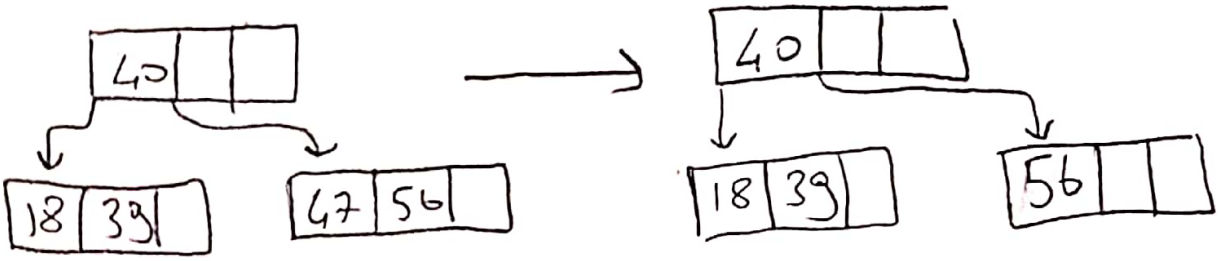

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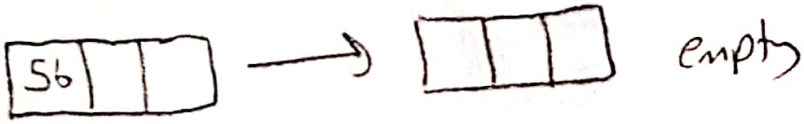

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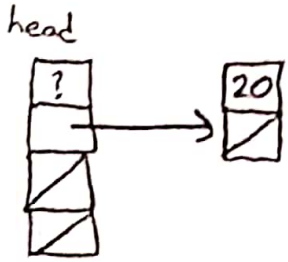

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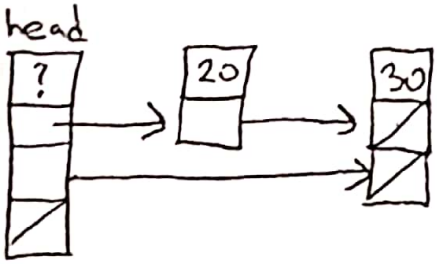

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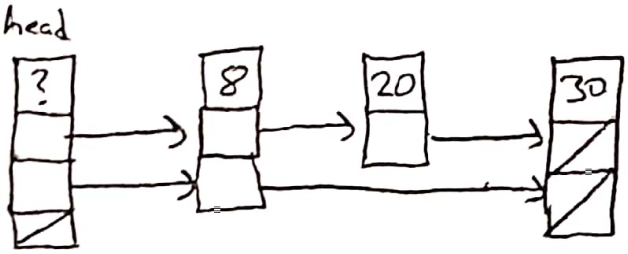

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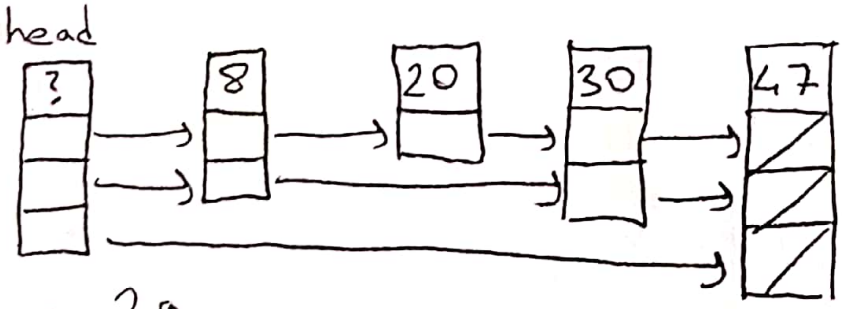

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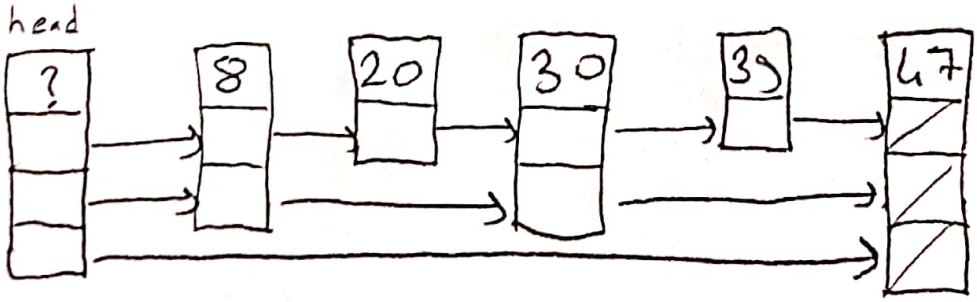

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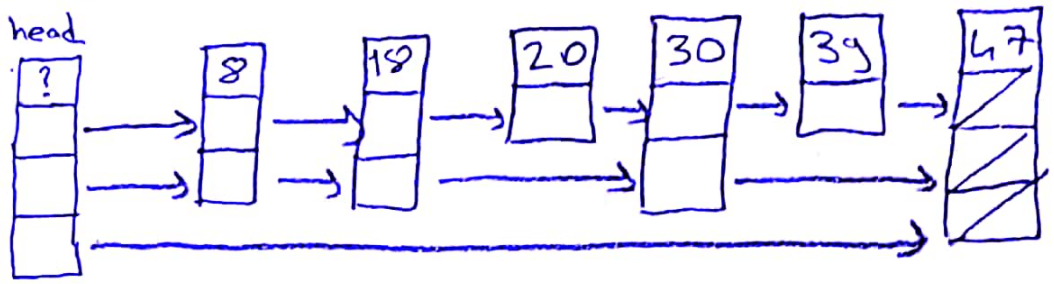

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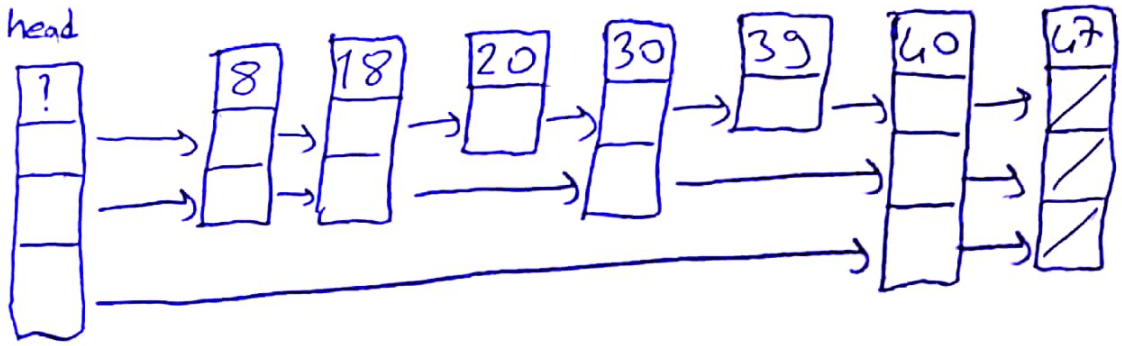

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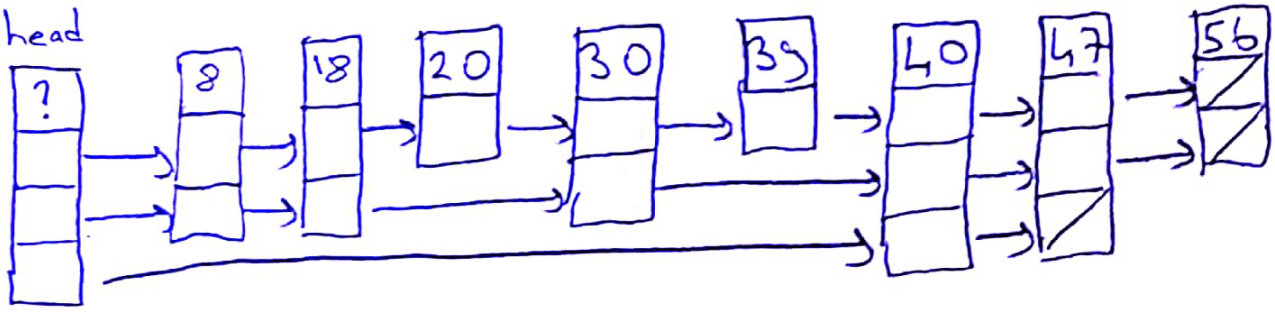

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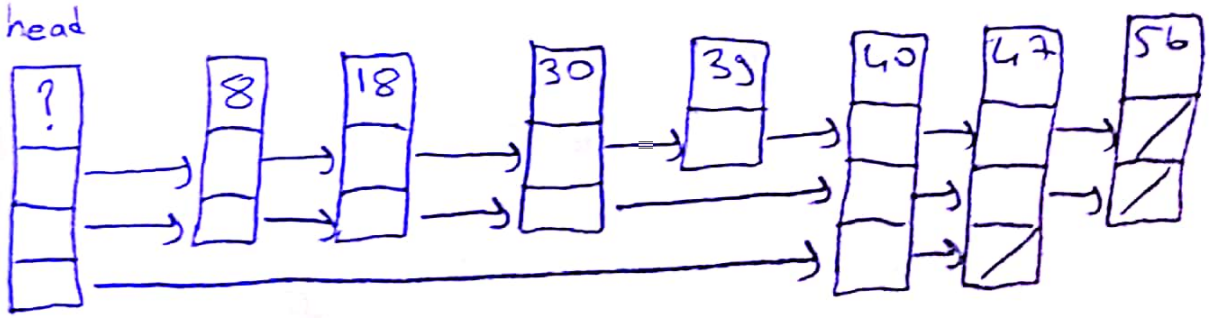

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