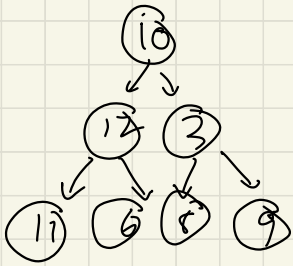
4a) [10, 12, 3, 11, 6, 8, 9]



Index of last non-leaf node

$n/2 - 1$

$7/2 - 1 = 2$

Last non leaf node at index 2

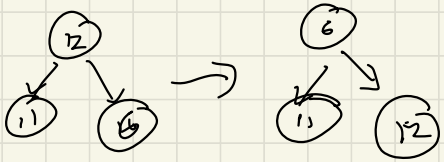
Heapify nodes [10, 12, 3] in reverse

Heapify (2)

Do nothing, 3 is smaller than its child 8 & 9

Heapify (1)

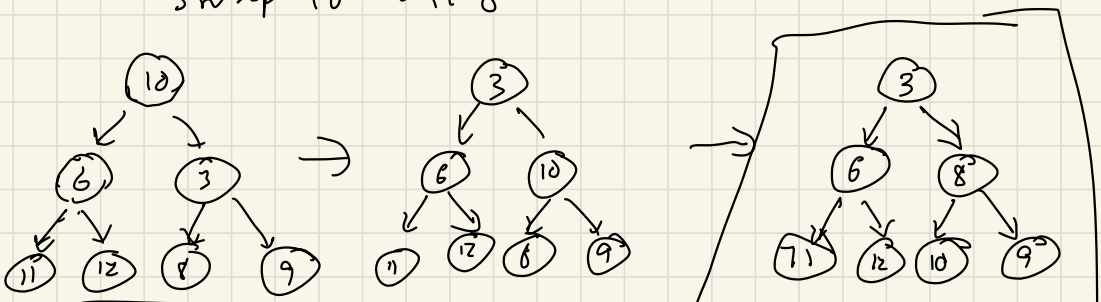
Swap 12 and 6



Heapify (0)

Swap 10 with 3

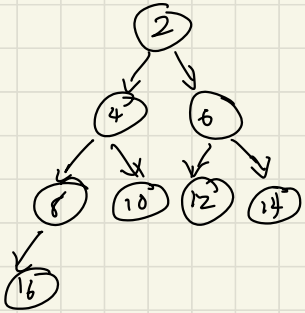
Swap 10 with 8



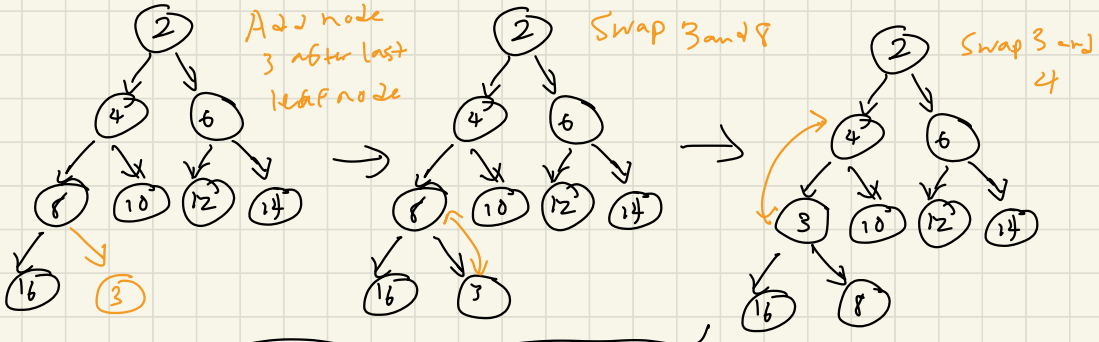
Resulting Heap:

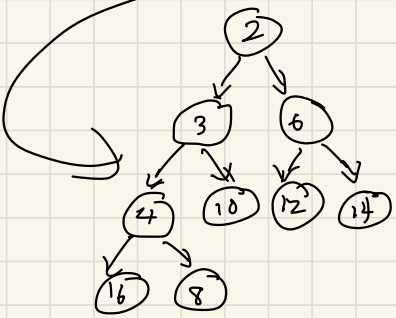
[3, 6, 8, 11, 12, 10, 9]

4b) Initial Configuration: [2, 4, 6, 8, 10, 12, 14, 16]



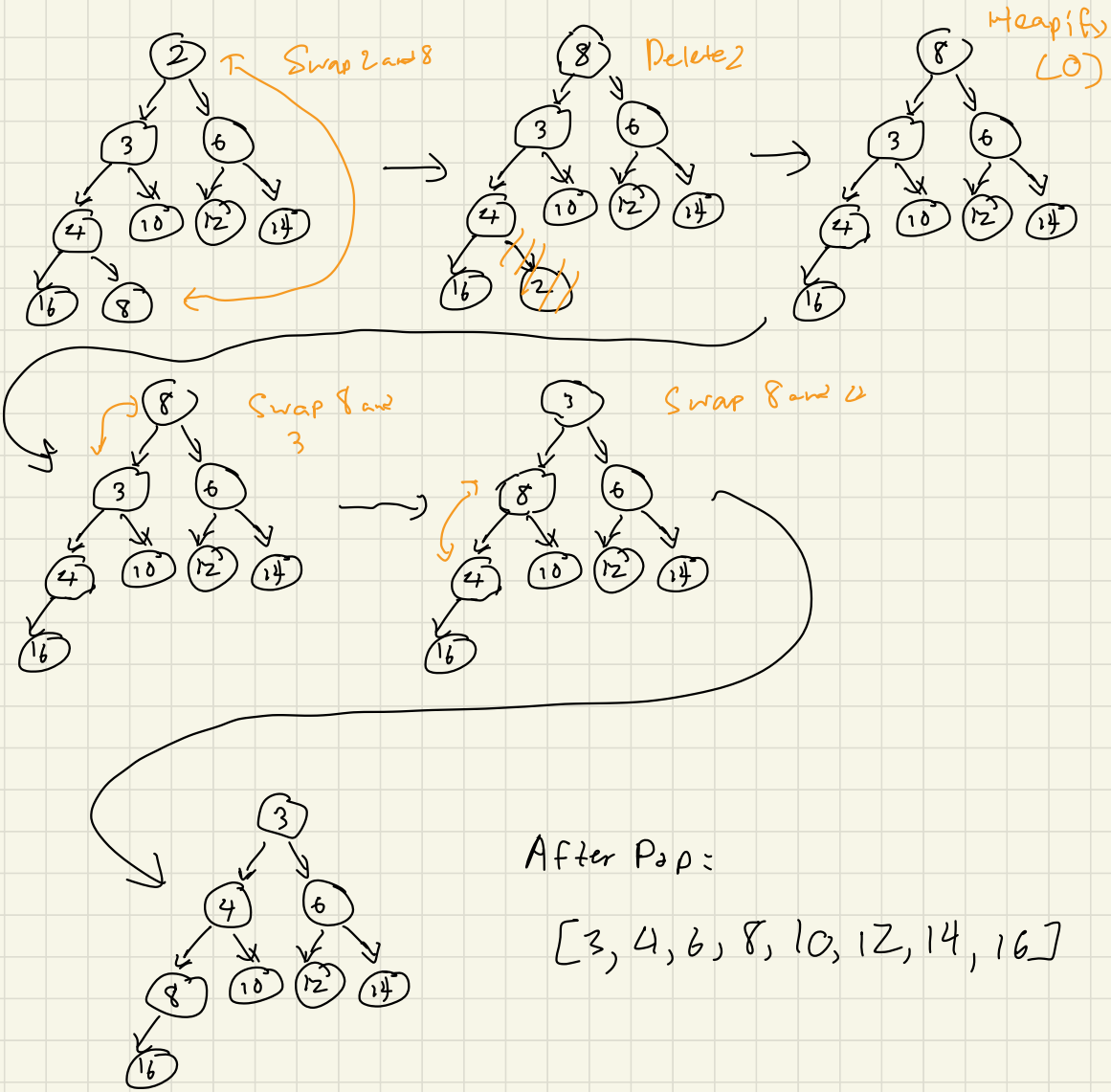
Insert 3





After Insert(3):
[2, 3, 6, 4, 10, 12, 14, 16, 8]

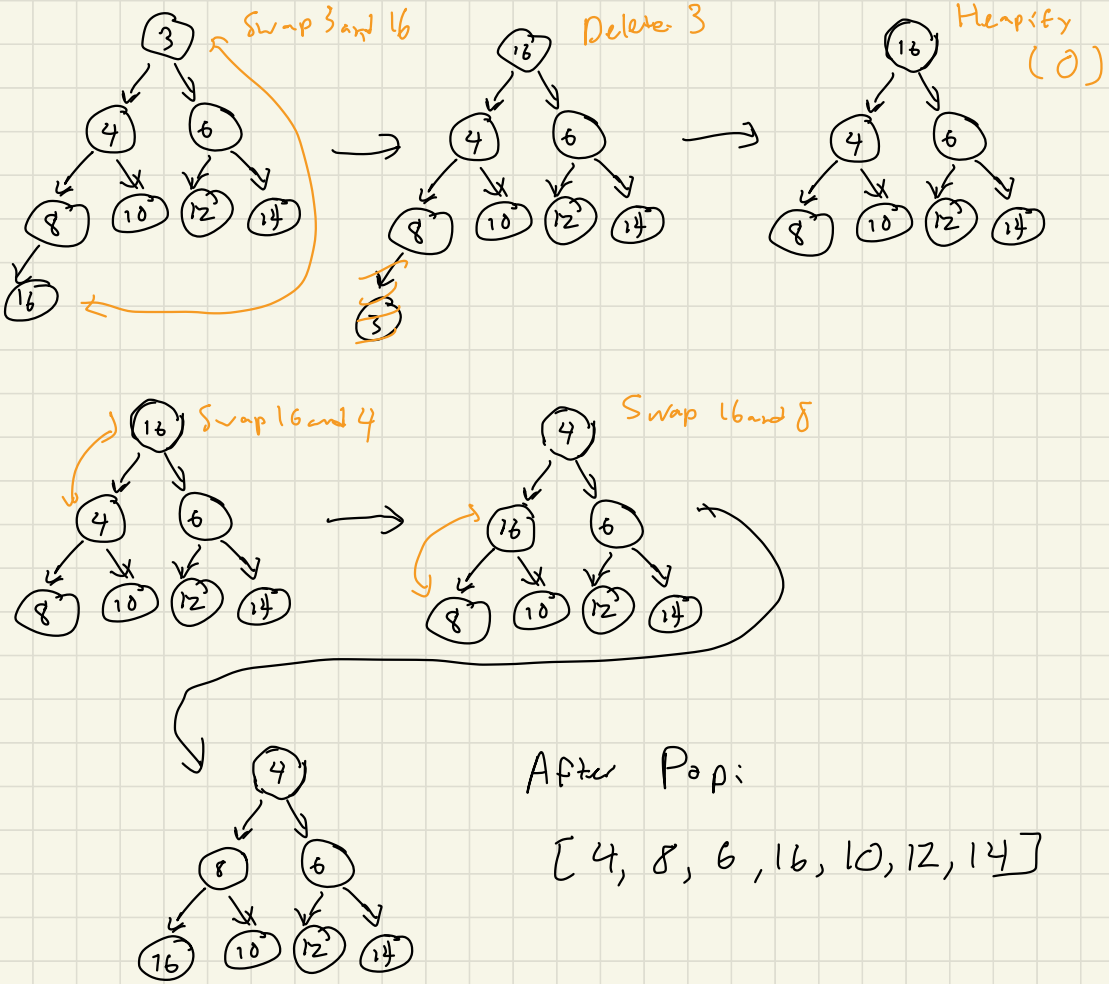
Pop



After Pop:

[3, 4, 6, 8, 10, 12, 14, 16]

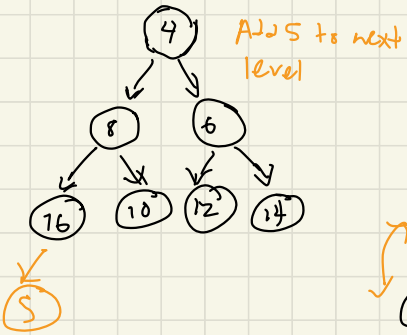
Pop

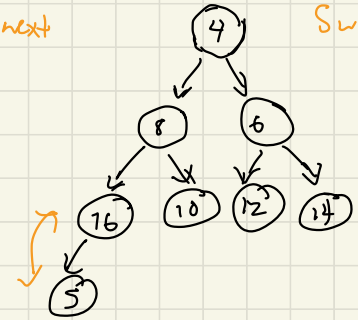


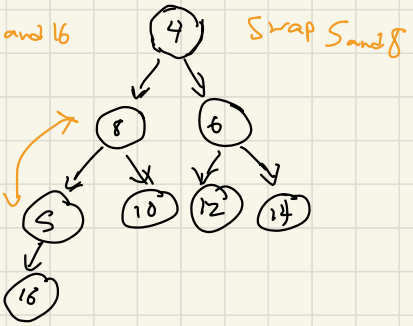
After Pop:

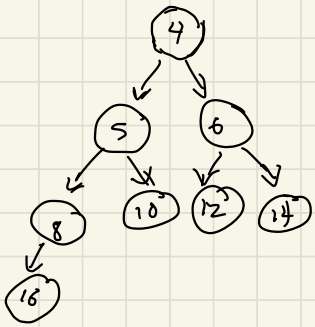
[4, 8, 6, 16, 10, 12, 14]

Insert 5









After Insert 5:

[4, 5, 6, 8, 10, 12, 14, 16]