CS202: FUNDAMENTALS OF COMPUTER SCIENCE II

HOMEWORK - 3

Balanced Search Trees and Heaps

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CS202 - 01

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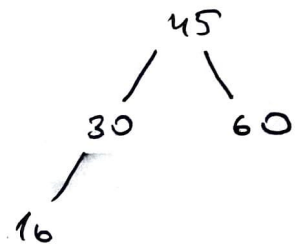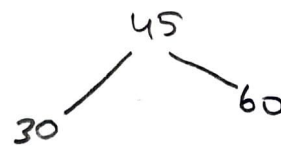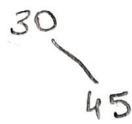
Question 1

a) AVL Tree

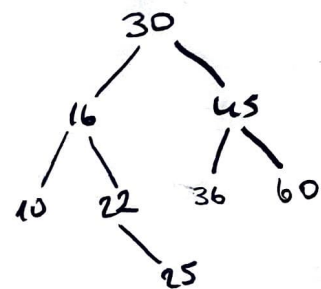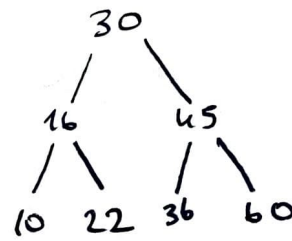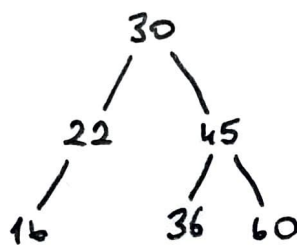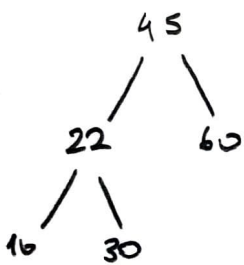inserting : 30, 45, 60, 16, 22, 36, 10, 25

[# step] ← notation

```
    30                  30                    45                   45
                          \              30      60           30      60
                           45                                          
                                                               16
```

[#1]   [#2]   [#3]   [#4]

```
      45                  30                    30                      30
   22    60           22    45               16    45               16    45
 16  30            16     36  60          10 22 36 60            10 22  36 60
                                                                      25
```

[#5]   [#6]   [#7]   [#8]

deleting :   10, 45, 22

```
        30                      30                        30
     22    45               22      60                 25    60
  16  25 36 60          16 25  36                   16      36
```
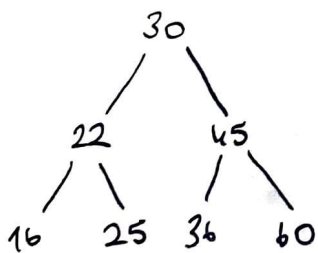
[#1]   [#2]   [#3]
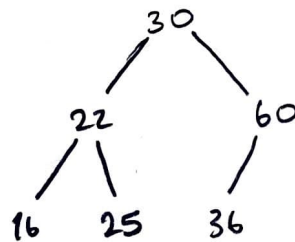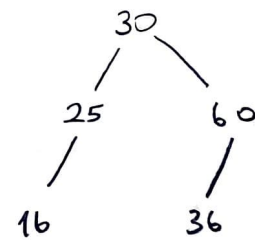
b) 2-3 Tree

inserting : 30, 45, 60, 16, 22, 36, 10, 25

30

#1

30 45

#2

```
        45
       /  \
     30    60
```

#3

```
        45
       /  \
  16  30   60
```

#4

```
       22  45
      /  |   \
    16  30    60
```

#5

```
        22   45
       /   |    \
     16  30 36   60
```

#6

```
          22        45
         /    |        \
    10 16   30 36       60
```

#7

```
              30
            /    \
          22      45
         /  \     /  \
    10 16   25  36   60
```

#8

deleting 10, 45, 22

```
              30
            /    \
          22      45
         /  \    /  \
       16   25 36   60
```

#1

```
        22      30
       /    |      \
     16    25    36 60
```

#2

```
          30
         /    \
     16 25    36 60
```

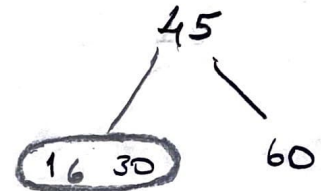#3

c) 2-3-4 Tree

inserting: 30, 45, 60, 16, 22, 36, 10, 25

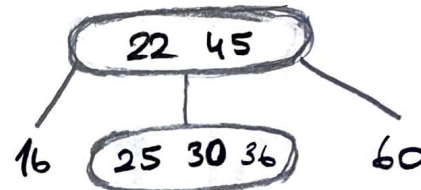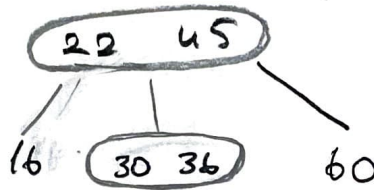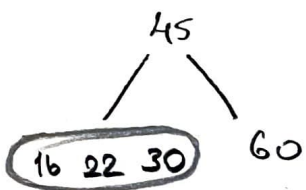a b c ← 4-node
a b ← 3-node
a ← 2-node

30

(30 45)

(30 45 60)

45
├── (16 30)
└── 60

#1   #2   #3   #4

45
├── (16 22 30)
└── 60

(22 45)
├── 16
├── (30 36)
└── 60

(22 45)
├── 16
├── (25 30 36)
└── 60

#5   #6   #7

(22 45)
├── (10 16)
├── (25 30 36)
└── 60

#8

deleting: 10, 45, 22

(22 45)
├── 16
├── (25 30 36)
└── 60

(22 30)
├── 16
├── 25
└── (36 60)

30
├── (16 25)
└── (36 60)
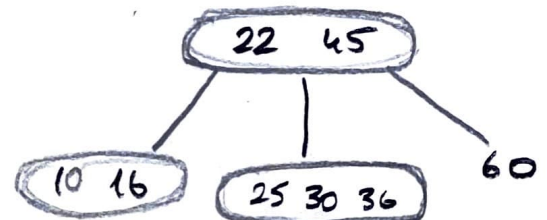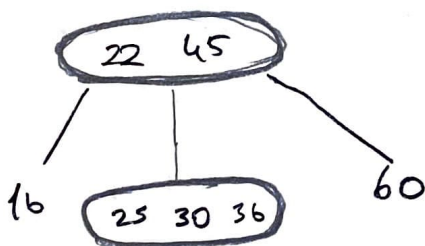
#1   #2   #3
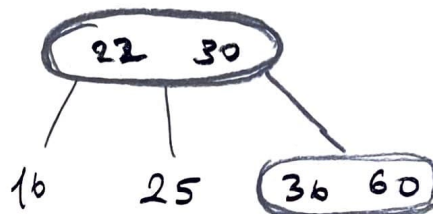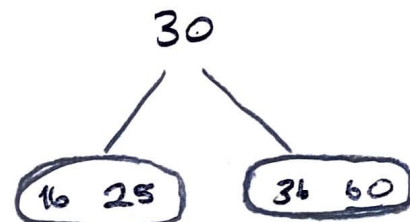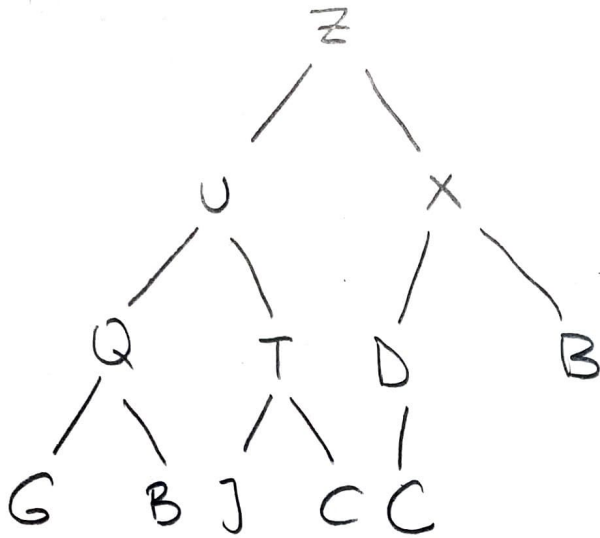
Question 2

a) heap Insert(); resulting max-heap

b) heap Rebuild(); resulting max-heap