PA 7 Part 1: Heap Worksheet
DSC 30 Fall 2021

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PID	A 1 7 7 8 6 4 2 4

1. Insert the following elements in the given order to an empty **binary (d = 2) max-heap**. Draw the tree representation of the heap after all insertions.

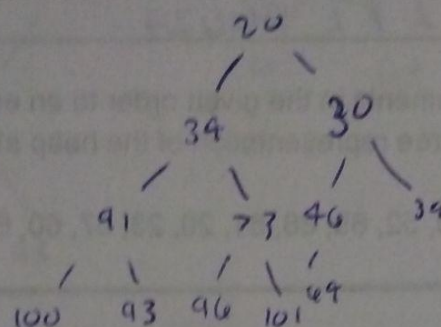   Elements to insert: [80, 52, 69, 88, 61, 20, 23, 57, 60, 66, 80, 95]
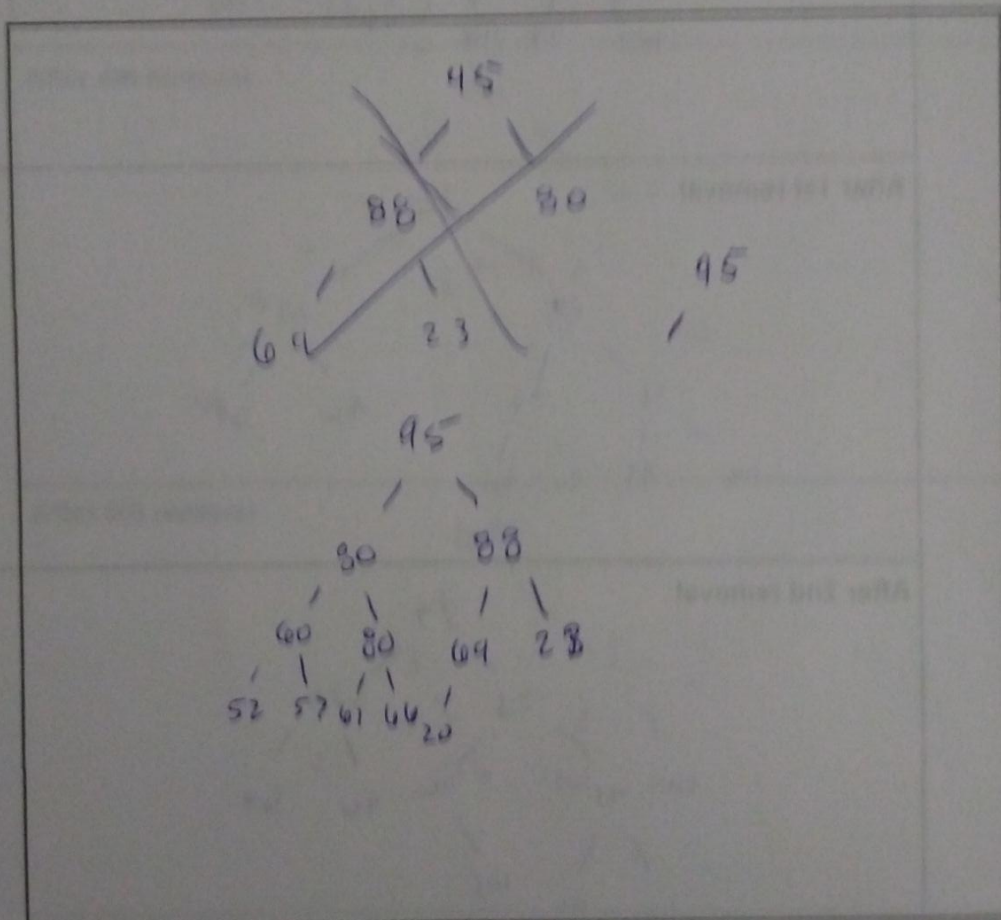
2. Remove the top element 5 times from the given **binary min-heap** and draw the tree representations of the initial heap and the heap after **each** removal.
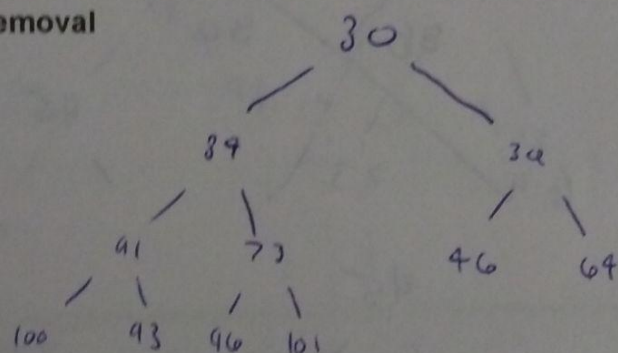
Array representation of the initial heap:
[20, 34, 30, 91, 73, 46, 39, 100, 93, 96, 101, 64]

Initial heap

```
              20
            /    \
          34      30
         /  \    /  \
       91   73  46   39
      / \   / \  /
    100 93 96 101 64
```

After 1st removal

```
              30
            /    \
          39      34
         /  \    /  \
       91   73  46   64
      / \   / \
    100 93 96 101
```

After 2nd removal

```
              39
            /    \
          73      34
         /  \    /  \
       91   96  46   64
      / \   /
    100 93 101
```

After 3rd removal

```
                        94
                       /  \
                     73    94
                    /  \   /  \
                  91   96 101  64
                 /  \
              100    93
```

After 4th removal

```
                        96
                       /  \
                     73    64
                    /  \   /  \
                  91   96 101  93
                 /
              100
```

After 5th removal

```
                        64
                       /  \
                     73    93
                    /  \   /  \
                  91   96 101  100
```
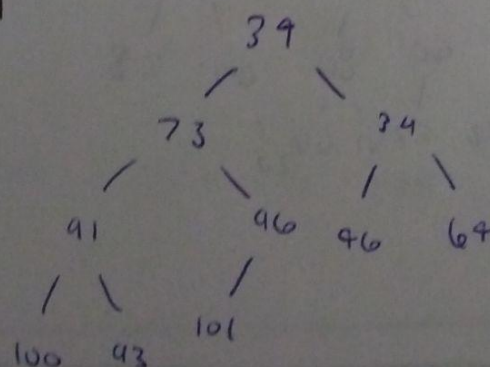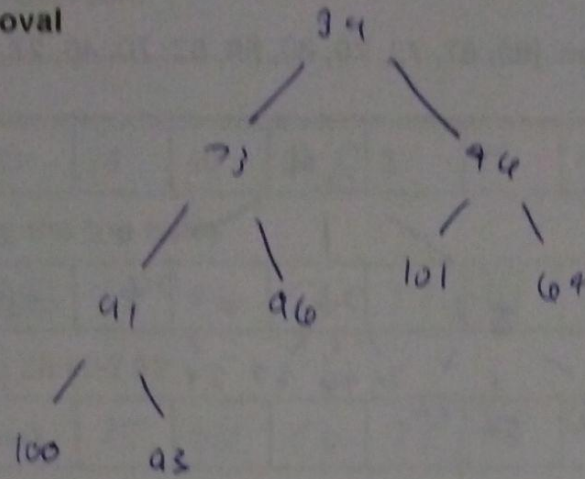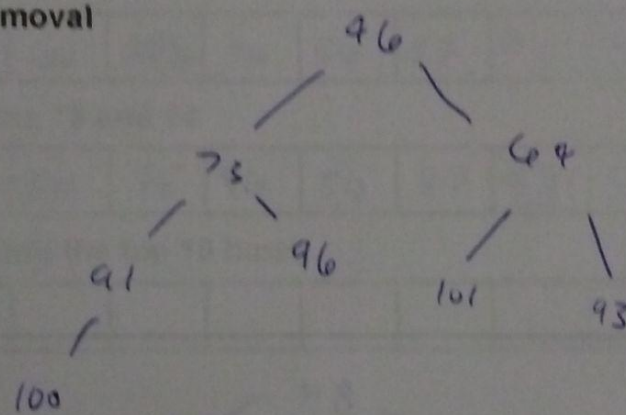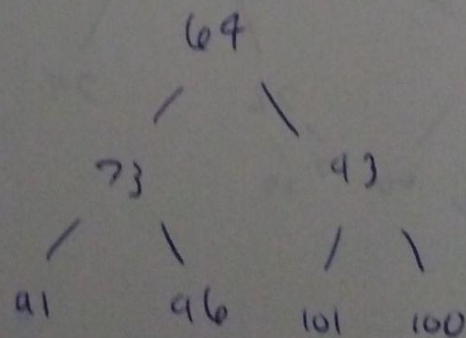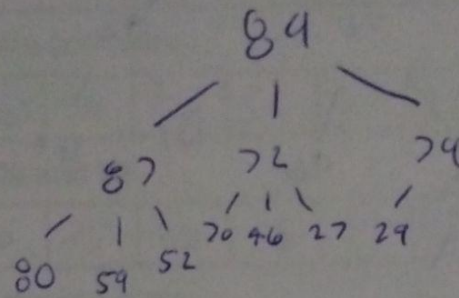
3. Draw the tree representations of the d-ary max-heaps from the following array representation. Choose d = {3, 4}.

Array representation: [89, 87, 72, 79, 80, 59, 52, 70, 46, 27, 29]

3-ary

4-ary

4. Write down the array representations of the given **3-ary max-heap** after each specified operation. Note that each operation should be performed on the result of the previous operation.

Original

90	72	83	74	46	56	37	75	49	60	43	

After removing the top twice

75	72	60	74	46	56	37	43	49			

After inserting 28 and 92

92	72	60	75	46	56	37	43	49	28	74	

After removing the top once

75	72	60	74	46	56	37	43	49	28		

After inserting 79 and 74

74	72	60	75	46	56	37	43	49	28	79	74

After removing the top 10 times

37	28										