**Problem 1**

The up-heap bubbling is demonstrated below:

***Step 0****: Initial heap*

***Step1****: Adding 27 to heap*

***Step2****: Compare 27 and 56 , since 27<56 swap*

***Step3****: Compare 27 and 42 , since 27<42 swap, this is final state of heap*

**Problem 2**

The down-bubbling of the heap is demonstrated below:

***Step 0****: Initial heap*

***Step 1****: Remove 5 move last node(34) to top*

***Step 2****: Swap the root with the smaller of the 2 children*

***Step 3****: Swap the node again with the smaller of its children*

*The above is the final state*

**Problem 3**

Using the division method for hashing for inserting the sequence:

5, 8, 44, 23, 30, 34, 52, 32, 15, 16

First number insert

5 mod 11 = 5

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|  |  |  |  |  | \* |  |  |  |  |  |
|  |  |  |  |  | 5 |  |  |  |  |  |

Second number insert

8 mod 11 = 8

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|  |  |  |  |  | \* |  |  | \* |  |  |
|  |  |  |  |  | 5 |  |  | 8 |  |  |

Third number insert

44 mod 11 = 0

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| \* |  |  |  |  | \* |  |  | \* |  |  |
| 44 |  |  |  |  | 5 |  |  | 8 |  |  |

Fourth number insert

23 mod 11 = 1

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| \* | \* |  |  |  | \* |  |  | \* |  |  |
| 44 | 23 |  |  |  | 5 |  |  | 8 |  |  |

Fifth number insert

30 mod 11 = 8

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| \* | \* |  |  |  | \* |  |  | \* |  |  |
| 44 | 23 |  |  |  | 5 |  |  | 8 |  |  |
|  |  |  |  |  |  |  |  | 30 |  |  |

Sixth number insert

34 mod 11 = 1

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| \* | \* |  |  |  | \* |  |  | \* |  |  |
| 44 | 23 |  |  |  | 5 |  |  | 8 |  |  |
|  | 34 |  |  |  |  |  |  | 30 |  |  |

Seventh number insert

52 mod 11 = 8

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| \* | \* |  |  |  | \* |  |  | \* |  |  |
| 44 | 23 |  |  |  | 5 |  |  | 8 |  |  |
|  | 34 |  |  |  |  |  |  | 30 |  |  |
|  |  |  |  |  |  |  |  | 52 |  |  |

Eighth number insert

32 mod 11 = 10

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| \* | \* |  |  |  | \* |  |  | \* |  |  |
| 44 | 23 |  |  |  | 5 |  |  | 8 |  | 32 |
|  | 34 |  |  |  |  |  |  | 30 |  |  |
|  |  |  |  |  |  |  |  | 52 |  |  |

Nineth number insert

15 mod 11 = 4

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| \* | \* |  |  |  | \* |  |  | \* |  |  |
| 44 | 23 |  |  | 15 | 5 |  |  | 8 |  | 32 |
|  | 34 |  |  |  |  |  |  | 30 |  |  |
|  |  |  |  |  |  |  |  | 52 |  |  |

Tenth number insert

16 mod 11 = 5

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| \* | \* |  |  |  | \* |  |  | \* |  |  |
| 44 | 23 |  |  | 15 | 5 |  |  | 8 |  | 32 |
|  | 34 |  |  |  | 16 |  |  | 30 |  |  |
|  |  |  |  |  |  |  |  | 52 |  |  |