/* *
* Title : Balanced Search Trees , Hashing and Graphs
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* Section : 1
* Assignment : 4
* Description : Question 1, 2, and 3
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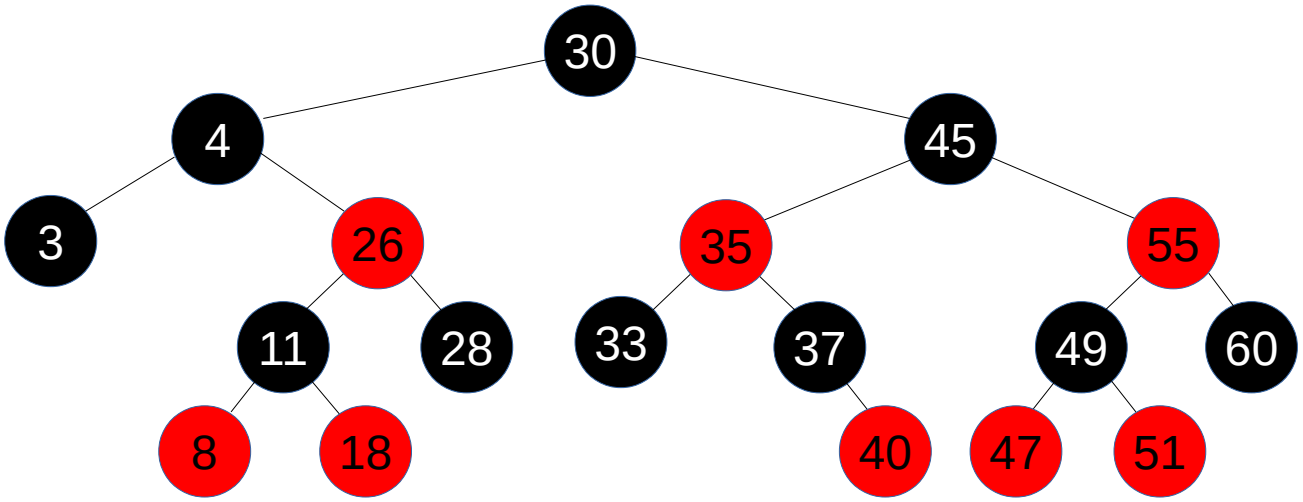
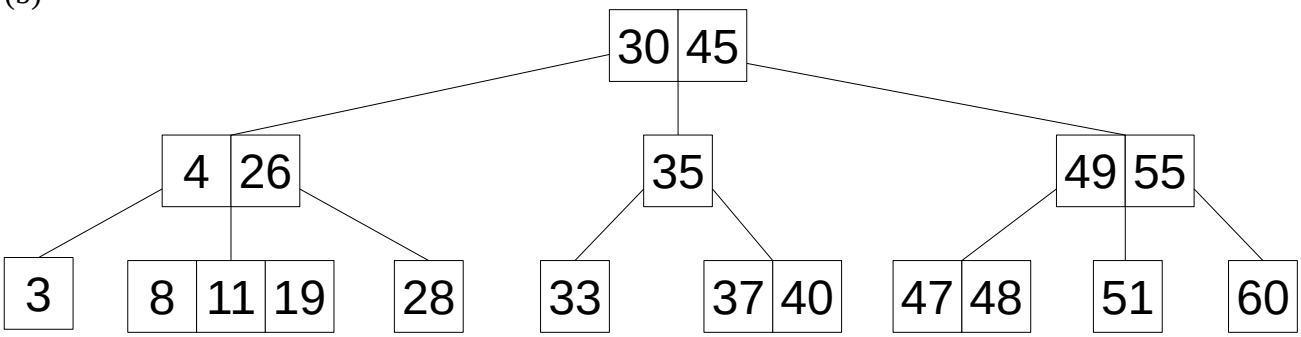
Question 1:

(a)




(b)




Question 2:

| **Data Structure** | **insert** | **extractMin** |
|---|---|---|
| unsorted array | O(1) | O(n) |
| red-black tree | O(logn) | O(logn) |
| hashing | O(1) | O(n) |
| min-heap | O(1) | O(logn) |
| sorted linked list | O(n) | O(1) |

Question 3:

(a) $2^h - 1 \leq N \leq \frac{3^{(h+1)} - 3}{2}$

(b) If the right child is a red node then the right sub-tree has red node at the root; due to the fact that the root of the red-black tree cannot be a red node, the right sub-tree is not a red-black tree.

(c) We can insert all the integers to a hash table at O(N). We select every element A in the array one by one at O(N) and look for its complement target-A in the hash table at O(1). Therefore the time complexity of the algorithm is O(N).