Analysis of Algorithms

Assignment 5

Protik Dey

Ans: to the Ques: No: 1

```
find-median(A, B, sa, ea, sb, eb):

    ma = ⌊(sa+ea)/2⌋;   //median of A
    mb = ⌊(sb+eb)/2⌋;   //median of B

    if(len(A)==1 && len(B)==1)
        return (A[0]+B[0])/2;

    else if (len(A)==2 && len(B)==2)
        return (max(A[0], B[0])+
                min(A[1], B[1]))/2;

    else if(A[ma] > B[mb])
        return find-median(A, B, sa, ma-1, mb+1,
                           eb)
    else if(A[ma] < B[mb])
        return find-median(A, B, ma+1, ea, sb,
                           mb-1)
    else
        return A[ma]
```

Time Complexity: At each step, the problem size is reduced by half. So the run time is $O(\log n)$.

Ans: to the Ques: No: 2(a)

A Red-Black tree will have maximum number of internal nodes if it has alterenating red and black nodes and if it is a complete binary tree. So the black height will be half of the actual height. Let h = height of the R-B tree. So black height, $b = h/2$

$\Rightarrow h = 2b$

So the largest possible number of interernal nodes is $2^{h} - 1$

$$\boxed{= 2^{2b} - 1}$$

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Ans: to the Ques: No: 2(b)

To have the minimum number of internal nodes, the R-B tree will have no red nodes as if there is a red node, there must be two black nodes. So the height of the tree will be black height, $h = b$. So the smallest possible number of internal nodes is $2^{h} - 1 = \boxed{2^{b} - 1}$

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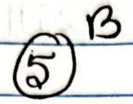
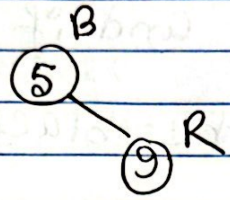
Ans: to the Ques: No: 3

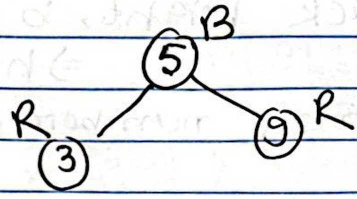
Initial:



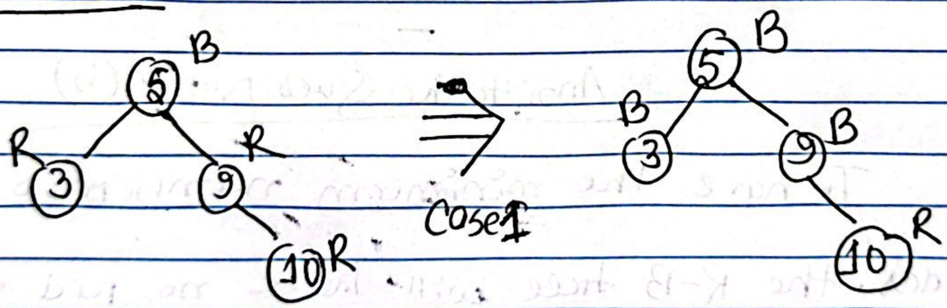
Insert 9:



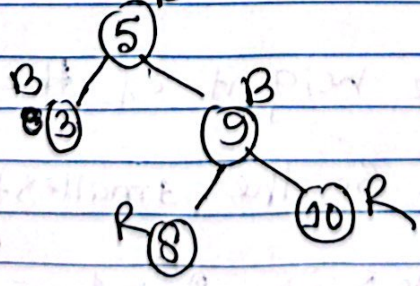
Insert 3:



Insert 10:



Insert 8:



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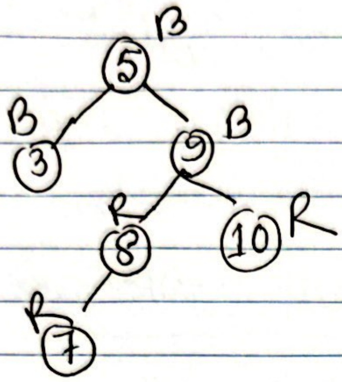
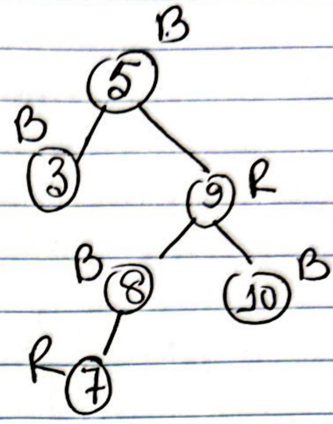
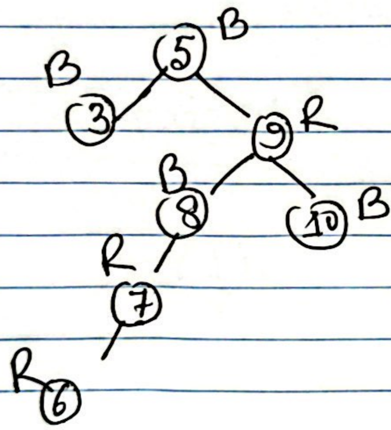


case 1 $\Longrightarrow$



Insert 6:



case 3 $\Longrightarrow$