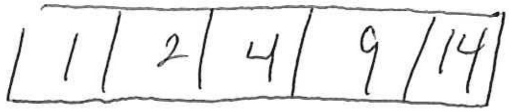
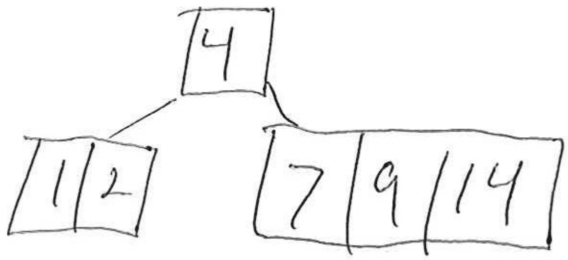
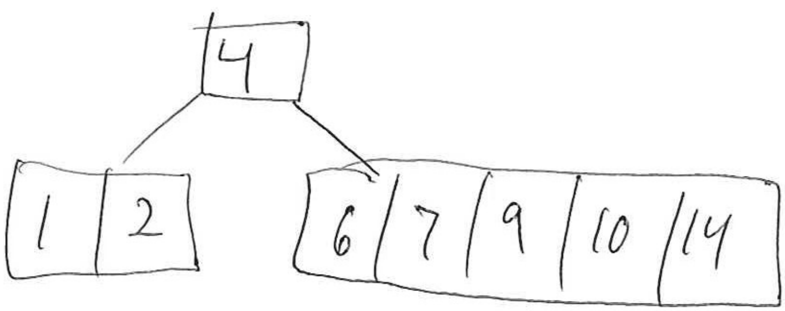
3. First 5 inserts:



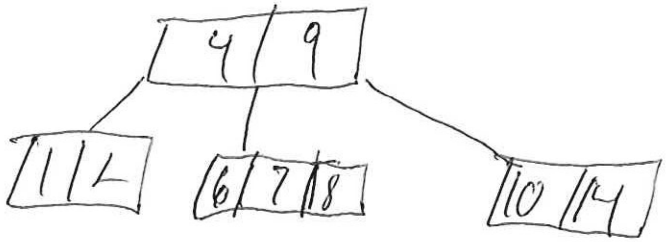
⇓ Insert 7



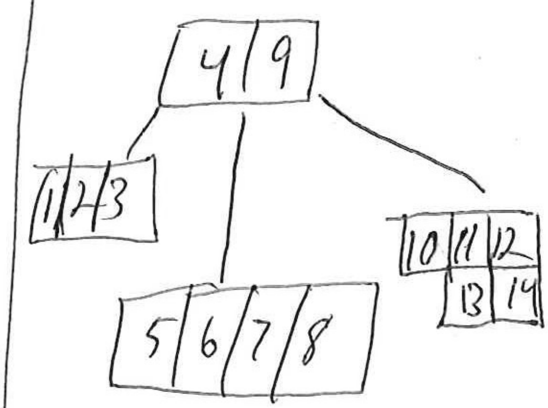
Before Inserting 8:



⇓ Insert 8



Final Tree:



(3) a) For a set of n possible locations number of possible placement of toll booths is 2^n

For each possible placement running time for calculating sum of money for all the tolls and checking for regulation (can be done alongside) is $O(n)$

So running time for brute force algorithm is $O(n 2^n)$.

b) Recursive definition for $a[j]$:

Base case : $a[0] = 0$

Otherwise : $a[j] = \max\{a[\text{index of } l(j)] + t[j],$
$a[j-1]\}$

c)
```
DP (a, T, L) {
    a[0] = 0;
    for i=1 to n
        if (a[L[i]] + T[i] > a[i-1])
            a[i] = a[L[i]] + T[i];
        else
            a[i] = a[i-1];
    end for
}
```

Here, $L[i]$ = index of $l(i)$ which can be computed as the following procedure.

```
computeL (a, L) {
    L[0] = 0;
    for i = 1 to n
        for j = i-1 to 1
            if (a[i] - a[j] >= 10) {
                L[i] = j;
                break;
            }
        end for
    end for
}
```

d) The algorithm make one call of the procedure computeL() and another call to DP() where they take $O(n^2)$ and $O(n)$ time respectively. Hence overall running time for the algorithm is $O(n^2)$