DAA

Tutorial-2

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Q1.

```
Void fun (int n)
{
    int j = 1 , i = 0;
    while (i<n)
    {
        i+ = j;
        j++;
    }
}
```

$j = 1$ $i = 1$

$j = 2$ $i = 1+2$

$j = 3$ $i = 1+2+3$

$i = 1+2+3+ \dots m < n$

$\Rightarrow \frac{m(m+1)}{2} < n$

$\frac{m^2+m}{2} < n \Rightarrow m < \sqrt{n}$

$\Rightarrow m \approx \sqrt{n}$

By summation method

$\sum_{i=1}^{m} 1 \Rightarrow 1+1+1+\dots m = 1+1+\dots \sqrt{n}$

$= \sqrt{n}$

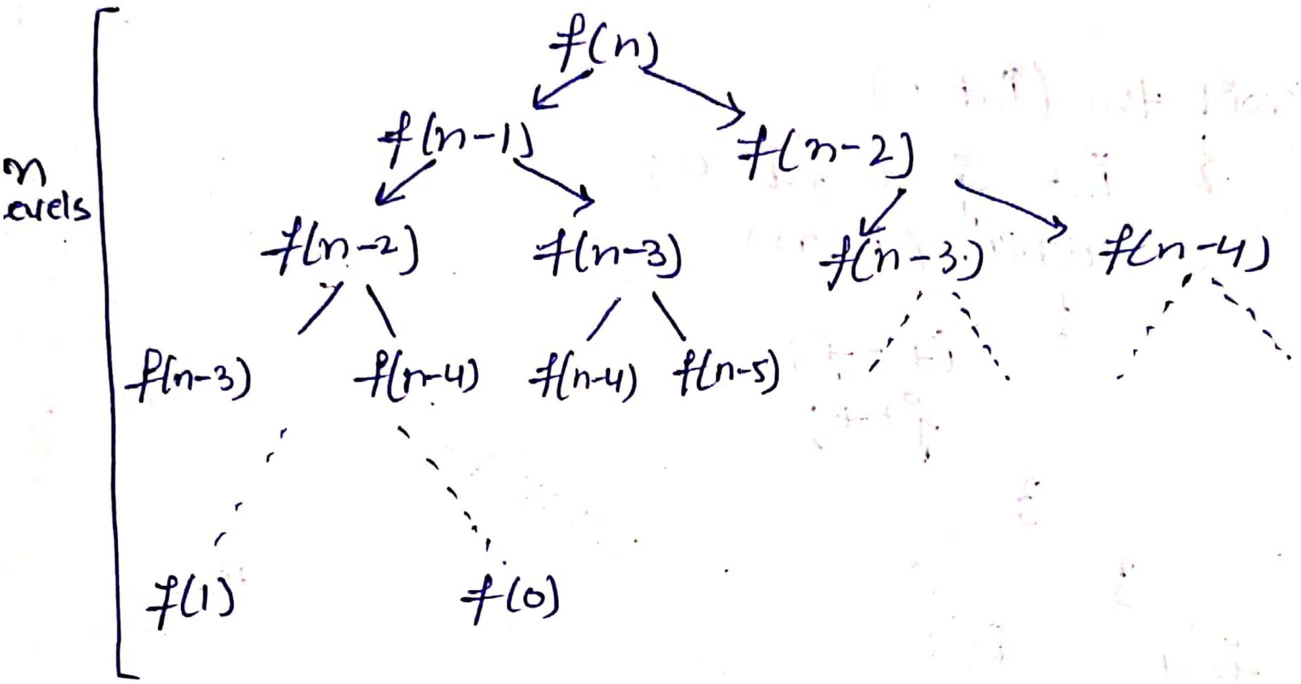
$T(n) = \sqrt{n}$ Ans

Ans2. for fibonacci series

$f(n) = f(n-1) + f(n-2)$

$f(0) = 0 \quad f(1) = 1$

forming a tree



At every function call, we get 2 function calls; for n levels, $2 \times 2 \cdots n$ times $= 2^n$

$T(n) = O(2^n)$ Ans.

Maximum space :- space complexity depends on the maximum depth of the tree so

space complexity $= O(n)$

Ans3. $T(n) = O(n^3)$

Multiplication of two square matrix

```
for (i=0; i<r1 ; i++)
   {
      for(j=0 ; j<c1 ; j++)
       {
          for(k=0; k<c1 ; k++)
           {
             res[i][j]+= a[i][k] * b[k][j];
           }
       }
   }
```

n logn

```
Void quick-sort (int arr[], int low, int heigh)
{
    if (low < high)
    {
        int pi = partition(arr, low, high);
        quicksort (arr, low, pi-1);
        quick sort (arr, pi+1, high);
    }
}

int partition (int arr[], int low, int high)
{   int pivot = arr[high];
    int i = (low-1);
    for (int j = low; j<= high-1; j++
    {
        if (arr [i] < pivot)
        {
            i++;
            swap (&arr [i], & arr [j]);
        }
    }
    swap (& arr (i+1], & arr (high);
    return (i+1);
}
```

log (log n)

```
for ( i=2 ; i<n ; i= i * i )
{
    count ++;
}
```

Scanned with CamScanner

Ans 4. $T(n) = T\left(\frac{n}{4}\right) + T\left(\frac{n}{2}\right) + Cn^2$

$$\begin{array}{ccccccc|c} & & & n & & & & 0 \\ & T(n/4) & & & & T(n/2) & & 1 \\ T(n/8) & & T(n/16) & & T(n/4) & & T(n/8) & 2 \end{array}$$

At Level $0 \rightarrow Cn^2$

$1 \rightarrow \frac{n^2}{4^2} + \frac{n^2}{2^2} = C\frac{5n^2}{16}$

$2 \rightarrow \frac{n^2}{8^2} + \frac{n^2}{16^2} + \frac{n^2}{4^2} + \frac{n^2}{2^2} = \left(\frac{5}{16}\right)^2 n^2 C$

max Levels $= \frac{n}{2^k} = 1$ taking log both side

$k = \log n$

$T(n) = C\left(n^2 + \frac{5}{16}n^2 + \left(\frac{5}{16}\right)^2 n^2 ----\right)$

$Cn^2\left[1 + \frac{5}{16} + \left(\frac{5}{16}\right)^2 + --- \left(\frac{5}{16}\right)^{\log n}\right]$

$= Cn^2 \times 1 \times \left(\frac{1 - \left(\frac{5}{16}\right)^{\log n}}{1 - \frac{5}{16}}\right)$

$= Cn^2 \frac{16}{11}\left(1 - \left(\frac{5}{16}\right)^{\log n}\right)$

$= O(n^2 C)$

Ans 5.

```
int fun ( int n)
{
    for (i=1; i<=n; i++)
    {
        for (j=1; j<n; j+=i)
        // O(1)
    }
}
```

i	j
1	1
2	1+3+5
3	1+4+7
!	1+5+9
n	

$$\sum_{i=1}^{n} \frac{n-1}{i}$$

$$T(n) = \frac{n-1}{1} + \frac{n-1}{2} + \cdots + \frac{n-1}{n}$$

$$= n\left(1+\frac{1}{2}+\frac{1}{3}+\cdots\frac{1}{n}\right) - 1\left[1+\frac{1}{2}+\frac{1}{3}+\cdots\frac{1}{n}\right]$$

$$= n\log n - \log n$$

$$= O(n \log n)$$

Ans6.

for(i = 2 ; i <= n; i = Pow(i, k))
{
  // O(1)

where k is Constant

$$TC = 2, 2^k, 2^{k^2}, 2^{k^n} \dots 2^{k \log_k(\log n)}$$

$$2^{k \log_k(\log n)} = 2^{\log n} = n$$

So there are total

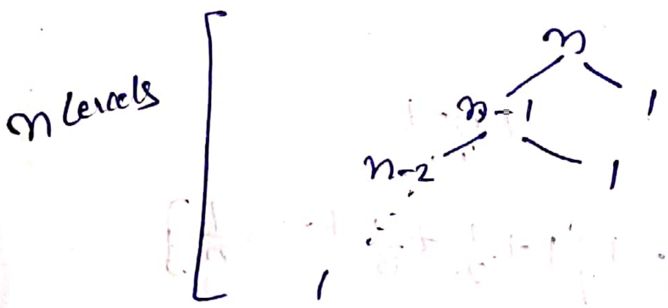
$\log_k(\log n)$ iterations

$$T(n) = O(\log_k \log n)$$

Ans7.

Given algo divides array in 99% & 1% part

$$T(n) = T(n-1) + O(1)$$



$$T(n) = T(n-1) + T(n-2) + \dots T(1) + O(1)$$
$$= n$$
$$T(n) = O(n)$$

Lowest height = 2
highest height = n
diff = n-2 $\quad n \geq 1$

the given algorithm provides linear result.

Ans 8:

Considering large values of n

a) $100 < \log\log n < \log n < (\log n)^2 < \sqrt{n} < n < n\log n <$
$\log(n!) < n^2 < 2^n < 4^n < 2^{2n}$

b) $1 < \log\log n < \sqrt{\log n} < \log n < \log 2n < 2\log n < n$
$< n\log n < 2n < 4n < \log(n!) < n^2 < n! < 2^{2^n}$

c) $96 < \log_8 n < \log 2n < 5n < n\log_6 n < n\log_2 n <$
$\log(n!) < 8n^2 < 7n^3 < n! < 8^{2n}$