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Tutorial-2

1. $j=1 \quad i=1$
$j=2 \quad i=1+2$
$j=3 \quad i=1+2+3$

$\left.\right]$ m-level

for (i)

$\therefore 1+2+3+ \ldots < n$

$1+2+3+m < n$

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

$m \approx \sqrt{n}$

By summation method

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

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

2. for fibonacci Series

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

By forming a tree

$f(n)$ $\qquad f(0)=0$, $f(1)=1$

$f(n-1) \qquad f(n-2)$

$f(n-2) \quad f(n-3) \quad f(n-3) \quad f(n-4)$

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

$T(n) = 2^n$

Maximum Space: Considering Recursion, $T(n) = O(n)$

without considering Recursion, $T(n) = O(1)$

3. (i) nlogn → Quick Sort

```
void quicksort (int a[], int low, int high)
{     if (low < high)
      { int pi = partition (a, low, high);
        quicksort (a, low, pi-1);
        quicksort (a, pi+1, high);
      }
}

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

(ii) n^3 → Multiplication of 2 sq. matrix

```
for (int i=0; i<r1; i++)
   four (int j=0; j<c2; j++)
      for (int k=0; k<c1; k++)
      {
          res [i][j] += a{i][k]*
                        b[k][j];
      }
```

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(iii) $\log(\log n)$

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

4. At level $\to 0 \to Cn^2$

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

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

max level $= \frac{n}{2^k} = 1$

$= k = \log_2 n$

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

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

$T(n) = O(n^2 C) = O(Cn^2)$

5. $T(n) = \frac{(n-1)}{1} + \frac{(n-1)}{2} + \ldots \frac{(n-1)}{n}$

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

$= n\log n - \log n$

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

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6. for $i,$ where,

2^1 $\quad 2^{k^m} \le n$

2^k $\quad k^m = \log_2 n$

2^{k^2} $\quad m = \log_k \log_2 n$

2^{k^3}

$\therefore \sum_{i=1}^{m} 1$

$\Rightarrow 1+1+1 \ldots m$

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

7. Given ~~array~~ algo divides array in 99% and 1% part

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

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

$= n \times n$

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

Lowest height $= 2$

Highest height $= n$

$\therefore$ difference $= n-2$, $n > 1$

The given algo produces linear result.

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

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

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