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CSC 225 - Assignment 1

Devroop Banerjee
V00837868

1.

A	B	O	Ω
$(\log n)^3$	n	Yes	No
$2n^2 + 4n$	$4n^2$	No	No
$n!$	2^n	No	Yes
n^5	n^4	No	Yes
100	1,000,000	No	No
n^2	$(1.5)^n$	Yes	No

2. $2^{100} = O(\log\log n) = O(\sqrt{\log n}) = O(6n\log n) = O(\log n)^2$

$= O(4^{\log n}) = O(3n^{0.5}) = O(n^3) = O(4^n) = O(2^{2^n})$

3. Pg 208 -

1.4.6 a) $N + \frac{N}{2} + \frac{N}{4} + \frac{N}{8} \ldots\ldots 1$ $\left[a\left(\frac{r^n-1}{r-1}\right)\right]$

$\Rightarrow 1\left(\frac{2^{\log_2 N+1}-1}{2-1}\right)$

$\Rightarrow ((2\cdot N)-1)$

$\therefore$ Ans $\Rightarrow O(N)$

b) $1+2+4+8+\ldots\ldots+N$ $\left[a\left(\frac{r^n-1}{r-1}\right)\right]$

$\Rightarrow 1\left(\frac{2^{\log_2 N+1}-1}{2-1}\right)$

$\Rightarrow ((2\cdot N)-1)$

$\therefore$ Ans $\Rightarrow O(N)$

c) $1(N)+2(N)+4(N)+8(N)+\ldots\ldots+(N)(N)$

$\Rightarrow N(1+2+4+8+\ldots\ldots+N)$ $\left[a\left(\frac{r^n-1}{r-1}\right)\right]$

$\Rightarrow N\left(1\left(\frac{2^{\log_2 N+1}-1}{2-1}\right)\right)$

$\Rightarrow N((2\cdot N)-1)$

$\Rightarrow 2\cdot N^2 - N$

$\therefore$ Ans $\Rightarrow O(N^2)$

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4. $\sum_{i=1}^{n} 2i-1 = n^2 \quad \forall n \geq 1$

When $n=1$ $\sum_{i=1}^{n} 2-1=1$ & $1^2=1$

For $n+1$

$\sum_{i=1}^{n+1} 2(i+1)-1$ $\qquad$ $(n+1)^2$

$\Rightarrow 2(n+1)-1+\sum_{i=1}^{n} 2(i+1)-1$ $\qquad$ $\Rightarrow (n+1)(n+1)$

$\Rightarrow 2n+2-1+n^2$ $\qquad$ $\Rightarrow n^2+2n+1$

$\Rightarrow n^2+2n+1$

$\Rightarrow (n+1)^2$

$\therefore$ Proved $\sum_{i=1}^{n} 2i-1 = n^2$ by induction.

5. $\sum_{i=1}^{n} \frac{1}{i(i+1)} = \frac{n}{n+1}$ $\forall n \geq 1$

When $n=1$. $\sum_{i=1}^{n} \frac{1}{1(1+1)} = 1/2$ & $\frac{1}{1+1} = 1/2$

For $n+1$

$\sum_{i=1}^{n+1} \frac{1}{i(i+1)} = \frac{1}{(n+1)(n+2)} + \sum_{i=1}^{n} \frac{1}{i(i+1)}$.

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

$\Rightarrow \frac{1+(n+2)n}{(n+1)(n+2)} = \frac{1+n^2+2n}{(n+1)(n+2)} = \frac{(n+1)}{(n+2)}$

$\frac{n}{n+1}$

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

$\therefore$ Proved by induction.

6. Make integer sum;
Make integer missingValue;
Make integer formulaICantUse;
For (integer i = 0 ; till i is lesser than A.length; increment i by 1){
    Add value of A at index i to sum;
}

For(integer j = 1; till j is lesser than/equal to A.length; increment i by 1){
    formulaICantUse = formulaICantUse + j;
}
missingValue = formulaICantUse - sum;
return missingValue;