(1)

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Algorithm_HW(1)

1) which Kind of growth best characterizes tese functions?

1) $3n \rightarrow$ Linear
2) $3n^2 \rightarrow$ Playnomial
3) $2^n \rightarrow$ exponential
4) $(3/2)^n \rightarrow$ exponential
5) $1000 \rightarrow$ Constant
6) $1 \rightarrow$ Constant
7) $(3/2)n \rightarrow$ linear
8) $3n^3 \rightarrow$ Polynomial

2) RanK from slowest $\longrightarrow$ Fastest in growing

$n^2, 2^n, n, n^3, (3/2), 1 \rightarrow 1, n, n^2, n^3, (3/2)^n, 2^n$

3) Match each function with equivelnt function

$n+30$ n^4

$n^2+2n-10$ $3n-1$

$n^3 * 3n$ n^2+3n

$\log_2 2x$ $\log_2 2x$

(2)

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5- Functions $\log n$, $\log_8 n$

a) $\log n$ is $O(\log_8 n)$

$\log n \le C \cdot \log_8 n$

$C = 2$, $n = 3$

b) $\log n$ is $\Omega(\log_8 n)$

$\log n \ge C \cdot \log_8 n$ → Can't exist

b and c are wrong

6- Determine whether each of these Functions is $O(x)$, $\Omega(x^2)$ or $\Theta(x^2)$

a) $f(x) = 10$

$10 \le C \cdot x$ → $C = 10$, $x \ge 1$

$F(x)$ is $O(x)$

$10 \ge C \cdot x^2$ $\quad \div x^2$

$\frac{10}{x^2} \ge C$

↳ always decreasing

$F(x)$ is not $\Omega(x^2)$ or $\Theta(x^2)$

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b) $f(x) = 3x + 7$

$$3x + 7 \le C \cdot x \qquad \div x$$

$$3 + \frac{7}{x} \le C \rightarrow C = 10,\ x = 1$$

$F(x)$ is $O(x)$

$$3x + 7 \ge C \cdot x^2 \qquad \div x^2$$

$$\cancel{3} \quad \boxed{\frac{3}{x} + \frac{7}{x^2}} \ge C$$

↳ always decreasing

$F(x)$ is not $\Omega(x^2)$ or $\Theta(x^2)$

c) $F(x) = 5 \log x$

$$5 \log x \le C \cdot x \qquad \div x$$

$$\cancel{5} \quad \frac{5 \log x}{x} \le C \rightarrow C = 1$$

$F(x)$ is $O(x)$ and not $\Omega(x^2)$

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d) $F(x) = x^2 + x + 1$

$x^2 + x + 1 \leq C \cdot x \quad \div x$

$x + 1 + \frac{1}{x} \leq C \rightarrow$ not true

$F(x)$ is not $O(x)$

$x^2 + x + 1 \geq C \cdot x^2 \quad \cancel{\div x^2}$

$\cancel{1 + \frac{1}{x} + \frac{1}{x^2} \geq C}$ $\hookrightarrow C = 1,\ x = 2$

$x^2 + x + 1 \leq C \cdot x^2$

$C = 2,\ x = 3$

$F(x)$ is $\Theta(x^2)$

e) $F(x) = 17x + 11$

$17x + 11 \leq C \cdot x \rightarrow \quad C = 28,\ x = 1$

$F(x)$ is $O(x)$

$17x + 11 \geq C \cdot x^2 \quad \div x^2$

$\frac{17}{x} + \frac{11}{x} \geq C$ $\hookrightarrow$ alwass deeresing

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f) $F(x) = x^2 + 1000$

$x^2 + 1000 \leq C \cdot x \qquad \div x$

$x + \frac{1000}{x} \leq C \qquad C = 1001 , x = 1$

$F(x)$ is $O(x)$

$x^2 + 1000 \leq C \cdot x^2 \qquad \div x^2$

$1 + \frac{1000}{x^2} \leq C$

↳ always decresing

g) $F(x) = x \log x$

$x \log x \leq C \cdot x \qquad \div x$

$\log x \leq C \qquad C = 2 , x = 2$

$F(x)$ is $O(x)$

$x \log x \geq C \cdot x^2 \qquad \div x^2$

$\frac{\log x}{x} \geq C$

↳ always decresing

2021026g (6)

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6) $F(x) = 2^x \Rightarrow$

$2^x \leq c \cdot x \rightarrow$ Can't exist

$2^x \geq c \cdot x^2 \rightarrow c = 1$

$2^x \leq c \cdot x^2 \rightarrow c = 2$

$F(x)$ is $\Theta(x)^2$

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7) a) $n \log(n^2+1) + n^2 \log n$

$O(n \log n^2) + O(n^2 \log n)$

$O(2n \log n^2) + O(n^2 \log n)$

is $O(n^2 \log n)$

b) $(n \log n + 1)^2 + (\log n + 1)(n^2 + 1)$

$(n \log n)^2 + 2n \log n + n^2 \log n + \log n + n^2 + 2$

$O((n \log n)^2) + O(n^2 \log(n))$

$\hookrightarrow O(n \log n)^2$

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c) $(n^3+n^2\log n)(\log n+1)+(17\log n+19)(n^3+2)$

$=[n^3\log n+n^3+n^2(\log n)^2+n^2\log n]+[17n^3\log n+34\log n$
$+19n^3+38]$

$O(n^3\log n)+O(17n^3\log n)$

$\hookrightarrow O(17n^3\log n)$

d) $(2^n+n^2)(n^3+3^n)$

$=2^n n^3+6^n+n^5+n^2 3^n$

$=2^n n^3+n^2 3^n+6^n+n^5$

= 32	36	36	32	when $n=2$
= 216	242	216	243	when $n=3$
= 1024	1296	1298	1024	when $n=4$

$3^n n^2 \geq 2^n n^3$, $6^n \geq n^5$

$=$

$3^n n^2 \geq 6^n$

is $O(3^n n^2)$

(8)

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8)

a) $n(n+1)$ and $2000n^2$

$\downarrow$

n^2+1 $2000n^2 \rightarrow$ same

b) $100n^2$ and $0.01n^3 \rightarrow$ lower

c) $\log_2 n$ and $\ln n \rightarrow$ same

d) $\log_2^2 n$ and $\log_2 n^2$

$\downarrow$

$2\log_2 n \rightarrow$ higher

e) 2^{n-1} and $2^n \rightarrow$ same

f) $(n-1)!$ and $n! \rightarrow$ ~~same~~ lower

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9)

For i ← 0 to m-1 do
For j ← 0 to n-1 do

if(a[i]==b[j]){
print a[i];}

10) Find gcd (31415, 14142)

1 → (14142, 3131)

2 → (3131, 1618)

3 → (1618, 1513)

4 → (1513, 105)

5 → (105, 43)

6 → (43, 19)

7 → (19, 5)

8 → (5, 4)

9 → (4, 1)

10 → (1, 0) = 1

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11) طارق عادل سيد أحمد

1- Take the goat and drop at the other side
2- Come back and take the Cabbage.
3- drop it and take the goat back
4- take the wolf and drop the goat
5. drop the ~~goat~~ wolf with the ~~Cabbage~~ Cabbag
6- go back take the goat

12) $a = \sqrt{p(p-a)(p-b)(p-c)}$, where $p = (a+b+c)/2$

14)

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for i ← 0 to n-1 do
for j ← 1 to n-1 do
        if [a[i] - a[j] < dmin]
                dmin ← a[i] - a[j];
        return dmin;
```