$$a^{100} = \underbrace{(a * a * a * \cdots * a)}_{100\ times\ multiplication}$$

$$(100)_{10} = (1100100)_2$$

$$100 = 2^6 + 2^5 + 2^2 = 64 + 32 + 4$$

$$a^{100} = a^{\left(2^6+2^5+2^2\right)} = a^{(64+32+4)} = a^{2^6} * a^{2^5} * a^{2^2}$$

$$\underbrace{a^{\left(2^1\right)} \xrightarrow[muliply\ once]{square} a^{\left(2^2\right)} \xrightarrow[muliply\ once]{square} a^{\left(2^3\right)} \xrightarrow[muliply\ once]{square} a^{\left(2^4\right)} \dots}_{log_2(n)\ times\ multiplication}$$

$$O(n + \sum_{k=0}^{log_2(n)-1} 2^k) = O(n+n) = O(n)$$

$$\frac{O(n)}{n} = O(1)$$

$$\boxed{2} \longrightarrow \boxed{3x^2} \longrightarrow \boxed{4x^5} + \boxed{4} \longrightarrow \boxed{3x} \longrightarrow \boxed{-2x^2} \longrightarrow \boxed{5x^6}$$

$$\xrightarrow{link} \boxed{2} \longrightarrow \boxed{3x^2} \longrightarrow \boxed{4x^5} \longrightarrow \boxed{4} \longrightarrow \boxed{3x} \longrightarrow \boxed{-2x^2} \longrightarrow \boxed{5x^6}$$

$$\xrightarrow{sort} \boxed{2} \longrightarrow \boxed{4} \longrightarrow \boxed{3x} \longrightarrow \boxed{3x^2} \longrightarrow \boxed{-2x^2} \longrightarrow \boxed{4x^5} \longrightarrow \boxed{5x^6}$$

$$\xrightarrow{merge} \boxed{6} \longrightarrow \boxed{3x} \longrightarrow \boxed{x^2} \longrightarrow \boxed{4x^5} \longrightarrow \boxed{5x^6}$$