

①

A()

{

 $i=1, s=1$ while ($s \leq n$)

{

 $i++;$ $s = s + i;$

}

Prf (" — ");

 $s = 1, 3, 6, 10, 15, 21, \dots, n$ $i = 1, 2, 3, 4, 5, \dots, k$ \xrightarrow{k}

$$\frac{k(k+1)}{2} > n$$

$$\frac{k^2 + k}{2} > n$$

$$k = O(\sqrt{n})$$

②

for ($i=1; i \leq n; i++$)for ($j=1; j \leq i; j++$)for ($k=1; k \leq 100; k++$)

Prf (" — ");

$i=1$	3	3	n
$j=1$	1-3	1-3	1-n
$k=100$	2x100	3x100	n x 100

$$1 \times 100 + 2 \times 100 + 3 \times 100 + \dots + n \times 100$$

$$100 (1 + 2 + 3 + \dots + n) = 100 \frac{n(n+1)}{2}$$

$$\approx O(n^2)$$

③

A()

{

for ($i=1; i \leq n; i++$)for ($j=1; j \leq n; j++$)

Prf (" — ");

$i=1$ $j=1-n$ n times	$i=2$ $j=1-n$ $n/2$ times	$i=3$ $j=1-n$ $n/3$ times	\dots	$i=k$ $j=1-n$ n/k times	$i=n$ $j=1-n$ 1
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$$= n(1 + \frac{1}{2} + \frac{1}{3} + \dots + \frac{1}{n})$$

$$= n(\log n)$$

$$\approx (n \log n)$$

④ A.C)

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int n = 22k;
for (i=1; i<=n; i++)
{
    j=2;
    while (j<=n)
    {
        j=j2;
        Pf(" ———");
    }
}

```

$$\begin{aligned}
 n &= 2^{2^k} \\
 \log_2 n &= 2^k \\
 \log \log n &= k.
 \end{aligned}$$

$k=1$ $n=4$ $j=2, 2^2$ $n \times 2 \text{ times}$	$k=2$ $n=16$ $j=2, 2^2, 2^4$ $n \times 3 \text{ times}$	$k=3$ $n=256$ $j=2, 2^2, 2^4, 2^8$ $n \times 4 \text{ times}$...
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$$\begin{aligned}
 &\therefore n \times (k+1) \\
 &\quad n \times (\log \log n + 1) \\
 &\approx O(n \log \log n).
 \end{aligned}$$

5

for ($i=1; i \leq n; i++$)
 for ($j=1; j \leq i^2; j++$)
 for ($k=1; k \leq n/2; k++$)
 Pf ("first prog");

$i=$	1	2	3	4	...
$j=$	1	4	9	16	...
$k=$	$n/2$	$n/2$	$n/2$	$n/2$...

$$\frac{n}{2} \times 1 + \frac{n}{2} \times 4 + \frac{n}{2} \times 9 + \dots + \frac{n}{2} \times n^2$$

$$\frac{n}{2} (1 + 4 + 9 + \dots + n^2)$$

$$= \frac{n}{2} \left(\frac{n(n+1)(2n+1)}{6} \right)$$

$$\approx O(n^4)$$

$$\begin{aligned} i^2 &= n \\ j^2 &= n^2 \\ n/2 \times n^2 &= \dots \end{aligned}$$

$$\begin{aligned} &+ \frac{n}{2} n^2 \\ &1^2 + 2^2 + 3^2 + \dots + n^2 \\ &\downarrow \\ &\frac{n(n+1)(2n+1)}{6} \end{aligned}$$

6

AC)

for ($i=1, i < n, i = i \times 2$)
 Pf ("first prog");

$$\begin{aligned} 3 &\Rightarrow \log_3 n \\ 6 &= \log_6 n \\ 10 &= \log_{10} n \end{aligned}$$

$$i^0 = 1, 2, 4, \dots, n$$

$$2^0, 2^1, 2^2, \dots, 2^k$$

$$\begin{aligned} n &= 2^k \\ k &= \log_2 n \end{aligned}$$

$$\approx O(\log_2 n)$$

✓ for ($i = n/2, i \leq n; i++$)
 for ($j = 1, j \leq n/2, j++$)
 for ($k = 1; k \leq n; k = k * 2$)
 pf (—);
 $\frac{n}{2} \times \frac{n}{2} \times \log_2 n$
 $= O(n^2 \log_2 n)$

✓ for ($i = n/2; i \leq n; i++$)
 for ($j = 1; j \leq n; j = 2 * j$)
 for ($k = 1, k \leq n, k = k * 2$)
 pf (— —).
 $\frac{n}{2} \times \log_2 n \times \log_2 n$
 $= O(n (\log_2 n)^2)$

✓ assume $n \gg 2$.

A()

{

while ($n > 1$)

{

$n = n/2$

}

}

2^1

2^2

2^3

1

2^n

2^{n-1}

1

1

2^1

1

2^k

$k = \log_2 n$

$\log_2 20$

4

1

1

1

1

$O(\lfloor \log_2 n \rfloor)$

$\lfloor \log_2 20 \rfloor$