```
int noName (int n, int target, int limit )
{
  int * ptr = nullptr;
    for ( int i=0 ; i<n ; i++ ){
        ptr = new int (rand() % limit);
        if ( *ptr == target)
            return i;
    }
    return -1;
}
```

worst : target is not found during the for loop => time complex = $O(n)$

Best : target is found in the first iteration => time comple = $\Omega(1)$ constant

$n = 5$ target 3 limit 2

ptr $\longrightarrow$

i	n	ptr	*ptr
$\cancel{0}$	5	~~1080~~	5
$\cancel{1}$		1010	10
$\cancel{2}$		~~200~~	20
$\cancel{3}$		800	80
$\cancel{4}$		220	22
5			

$\boxed{n}$ iteration

a.
```
for ( cnt4=0; i=1; i<=n; i *= 2)
    for( j=1 ; j <= i ; j++)
        cnt4 ++ ;
```

---

b.
```
for( cnt2=0; i=1; i<=n; i ++)
    for( j=1 ; j <= i ; j++)
        cnt2++;
```

---

c.
```
for (cnt3 =0; i=1 ; i<=n; i *=2)
    for( j=1 ; j <=n; j++)
        cnt3++;
```

$n = 10 \rightarrow$

	i	n	j	cnt++
5	$\cancel{1}$	10	1 2^0	$\cancel{0}$
1 2 4			2	$\cancel{1}$
$\log_2 5$	$\cancel{2}$		$\cancel{1}$ 2^1	$\cancel{2}$
			$\cancel{2}$	3
			3	
$\log_2 10 \approx 3 \ldots$	$\cancel{4}$		$\cancel{1}$	$\cancel{4}$
			$\cancel{2}$	$\cancel{5}$
$i \log_2 10$			$\cancel{3}$	$\cancel{6}$
			$\cancel{4}$	$\cancel{7}$
$\log_2 n \cdot \log_2 n$	8		$\cancel{1}$ 2^3	$\cancel{8}$
			$\cancel{2}$	$\cancel{9}$
$(\log n)^2$			$\cancel{3}$	$\cancel{10}$
			$\cancel{4}$	4
			$\cancel{5}$	$\cancel{12}$
			$\cancel{6}$	$\cancel{13}$
			$\cancel{7}$	$\cancel{14}$
			$\cancel{8}$	15
			9	16

1	2^0
2	2^1
4	2^2
8	2^3

$1 + 2 + 4 \ldots + 2n$

$= 2n$

$O(n)$

$\log n < n$

outer loop $\rightarrow \log_2 n = O(\log_2 n)$

inner loop $\rightarrow$ 2^0

2^1

2^2

$\vdots$

$2^0 + 2^1 + \ldots \; 2^{\log_2 n}$

b)

n	i	j	cnt2
5	~~1~~	~~1~~	~~0~~
		~~2~~	~~1~~
	~~2~~	~~1~~	~~2~~
		~~2~~	~~3~~
		3	
	~~3~~	~~1~~	~~4~~
		2	~~5~~
		~~3~~	~~6~~
		4	
	~~4~~	~~1~~	~~7~~
		~~2~~	~~8~~
		~~3~~	~~9~~
		~~4~~	~~10~~
		5	
	5	~~1~~	~~11~~
		~~2~~	~~12~~
		~~3~~	~~13~~
		4	14
		~~5~~	15
		6	

outer loop → n

inner loop → i

Dominant factor is the nested loop

$$1 + 2 + 3 + 4 + \cdots 5$$

$$\frac{n}{2}(a_1 + a_n) = \frac{n}{2}(1+n)$$

$$\frac{n}{2} + \frac{n^2}{2} = n^2$$

$$O(n^2)$$

c)

n	i	j	cnt3
5	~~1~~	~~1~~	~~0~~
		~~2~~	~~1~~
		~~3~~	~~2~~
		~~4~~	~~3~~
		~~5~~	~~4~~
		~~6~~	5
	2	5	
	3	5	

outer loop → $\log_2 n$

inner loop → n

$n \log_2 n$

$O(n * \log(n))$

$f(n) = \log n \longrightarrow \log (10^3)^{100000} = 100000 \underbrace{\log 1000}_{10}$

$= 10^6$

1 Hour $\longrightarrow 10^6 \times 3600$

1 month $\longrightarrow 10^6 \times 2592 \times 10^3 = 2592 \times 10^9$

1 century $\longrightarrow 10^6 \times 31536 \times 10^5 = 31536 \times 10^{11}$

$f(n) = n$

$\xrightarrow{1\ \text{sec}} \quad \sqrt{10^{300000}} = \text{infinity } \infty$

$\xrightarrow{1\ \text{hour}} \quad \infty \cdot 3600 = \infty$

$\xrightarrow{1\ \text{month}} \quad \infty \cdot 2592000 = \infty$

$\xrightarrow{1\ \text{century}} \quad \infty \cdot 3153600000 = \infty$

$$f(n) = n \log(n)$$

$$1 \text{ sec} \longrightarrow 10^{300000} \underbrace{\log 10^{300000}}_{10^{6}} = 10^{300000} \times 10^{6} = 10^{300006}$$

$$1 \text{ hours} \longrightarrow 3600 \times 10^{300006}$$

$$1 \text{ Month} \longrightarrow 2592000 \times 10^{300006}$$

$$1 \text{ Century} \longrightarrow 3153600000 \times 10^{300006}$$

$f(n) = n^2$

1 sec $\longrightarrow$ $(10^{3000000})^2$

1 hour $\longrightarrow$ $3600 \times (10^{3000000})^2$

1 month $\longrightarrow$ $2592000 \times (10^{3000000})^2$

1 century $\longrightarrow$ $3153600000 \times (10^{3000000})^2$

$f(n) = n^3$

$\xrightarrow{1\ \text{sec}} (10^{300000})^3$

$\xrightarrow{1\ \text{hour}} 3600 \times (10^{300000})^3$

$\xrightarrow{1\ \text{month}} 2592000 \times (10^{300000})^3$

$\xrightarrow{1\ \text{century}} 3153600000 \times (10^{300000})^3$

$$f(n) = 2^{n}$$

$$\xrightarrow{1 \text{ sec}} \quad 2^{10^{300000}}$$

$$\xrightarrow{1 \text{ hour}} \quad 3600 \times 2^{10^{300000}}$$

$$\xrightarrow{1 \text{ month}} \quad 2592000 \times 2^{10^{300000}}$$

$$\xrightarrow{1 \text{ century}} \quad 3153600000 \times 2^{10^{300000}}$$