

n=5

①

```
for(int i=0; i<n; i++) {
    for(int j=0; j<n; j++) {
        cout << "x ";
    }
    cout << "\n";
}
```

```

x x x x x
x x x x x
x x x x x
x x x x x
x x x x x

```

working: i=0 → j=0 1 2 3 4
 i=1 → j=0 1 2 3 4
 i=2 → j=0 1 2 3 4
 i=3 → j=0 1 2 3 4
 i=4 → j=0 1 2 3 4

②

```
for(int i=0; i<n; i++) {
    for(int j=0; j<=i; j++) {
        cout << "x ";
    }
    cout << "\n";
}
```

```

x
x x
x x x
x x x x
x x x x x

```

working: i=0 → j=0
 i=1 → j=0 1
 i=2 → j=0 1 2
 i=3 → j=0 1 2 3
 i=4 → j=0 1 2 3 4

③

```
for(int i=1; i<=n; i++) {
    for(int j=1; j<=i; j++) {
        cout << j << " ";
    }
    cout << "\n";
}
```

```

1
1 2
1 2 3
1 2 3 4
1 2 3 4 5

```

working:

i=1 → j=1
 i=2 → j=1 2
 i=3 → j=1 2 3
 i=4 → j=1 2 3 4
 i=5 → j=1 2 3 4 5

④

```

for (int i=1; i<=n; i++) {
    for (int j=1; j<=i; j++) {
        cout << " ";
    }
    cout << "\n";
}

```

working:

$i=1 \rightarrow j=1$
 $i=2 \rightarrow j=1, 2$
 $i=3 \rightarrow j=1, 2, 3$
 $i=4 \rightarrow j=1, 2, 3, 4$
 $i=5 \rightarrow j=1, 2, 3, 4, 5$

```

1
2 2
3 3 3
4 4 4 4
5 5 5 5 5

```

⑤

```

for (int i=1; i<=n; i++) {
    for (int j=0; j<=n-i; j++) {
        cout << " ";
    }
    cout << "\n";
}

```

working:

$i=1 \rightarrow j=0, 1, 2, 3, 4$
 $i=2 \rightarrow j=0, 1, 2, 3$
 $i=3 \rightarrow j=0, 1, 2$
 $i=4 \rightarrow j=0, 1$
 $i=5 \rightarrow j=0$

```

x x x x x
x x x x
x x x
x x
x

```

$n-i+1$
 $5-1+1=5$
 $5-2+1=4$
 $5-3+1=3$
 $5-4+1=2$
 $5-5+1=1$

⑥

```

for (int i=1; i<=n; i++) {
    for (int j=1; j<=n-i+1; j++) {
        cout << " ";
    }
    cout << "\n";
}

```

working:

$i=1 \rightarrow j=1, 2, 3, 4, 5$
 $i=2 \rightarrow j=1, 2, 3, 4$
 $i=3 \rightarrow j=1, 2, 3$
 $i=4 \rightarrow j=1, 2$
 $i=5 \rightarrow j=1$

```

1 2 3 4 5
1 2 3 4
1 2 3
1 2
1

```

$n-i+1$
 $5-1+1=5$
 $5-2+1=4$
 $5-3+1=3$
 $5-4+1=2$
 $5-5+1=1$


```

(4) for (int i=0; i<n; i++) {
    for (int j=0; j<n-i-1; j++) {
        swap(i, j);
    }
    for (int j=0; j<n-i-1; j++) {
        swap(i, j);
    }
    swap(i, j);
}

```

working:

$i=0 \rightarrow j=0$ 0000+0000
 $i=1 \rightarrow j=0$ 000++000
 $i=2 \rightarrow j=0$ 00++++00
 $i=3 \rightarrow j=0$ 0+++++0
 $i=4 \rightarrow j=0$ ++++++

*
 * * *
 * * * * *
 * * * * *
 * * * * *

$n-i-1$
 $2i+1$ 5-0-1=4
 $2(0)+1=1$ 5-1-1=3
 $2(1)+1=3$ 5-2-1=2
 $2(2)+1=5$ 5-3-1=1
 $2(3)+1=7$ 5-4-1=0
 $2(4)+1=9$

```

(5) for (int i=0; i<n; i++) {
    for (int j=0; j<i; j++) {
        swap(i, j);
    }
    for (int j=0; j<2*n-(2*i+1); j++) {
        swap(i, j);
    }
    for (int j=0; j<i; j++) {
        swap(i, j);
    }
    swap(i, j);
}

```

working:

$i=0 \rightarrow j=+$ ++++++
 $i=1 \rightarrow j=0$ 0+++++0
 $i=2 \rightarrow j=0$ 00++++00
 $i=3 \rightarrow j=0$ 000++++000
 $i=4 \rightarrow j=0$ 0000++++0000

* * * * *
 * * * * *
 * * * * *
 * * * * *
 * * * * *

$2n-(2*i+1)$
 9 2(5)-(2(0)+1)
 7 10-1=9
 5 2(1)-(2(1)+1)
 3 10-3=7
 1 2(5)-(2(2)+1)
 10-5=5
 2(5)-(2(3)+1)
 10-7=3
 2(5)-(2(4)+1)
 10-9=1

⑨

```
for (int i = 1; i <= 2n - 1; i++) {
    int stars = i;
    if (i % 2 == 0)
        stars = 2n - i;
    for (int j = 1; j <= stars; j++) {
        cout << "x ";
    }
    cout << endl;
}
```

```

x
x x
x x x
x x x x
x x x x
x x x
x x
x

```

$$2^n - 1$$

$$2(5) - 1 = 9$$

working:

i	j
1	1
2	2
3	3
4	4
5	5
6	4
7	3
8	2
9	1

$$2^n - 1$$

$$2(5) - 1 = 9$$

$$2^n - 1$$

$$2(5) - 1 = 9$$

$$2^n - 1$$

$$2(5) - 1 = 9$$

⑩

```
int start = 1;
for (int i = 0; i < n; i++) {
    if (i % 2 == 0)
        start = 1;
    else
        start = 0;
    for (int j = 0; j <= i; j++) {
        cout << start << " ";
        start = 1 - start;
    }
    cout << endl;
}
```

even

i	start
0	1
1	0
2	1
3	0
4	1

working:

i	j
0	0
1	0 1
2	0 1 0
3	0 1 0 1
4	0 1 0 1 0

1. false

i	start
0	1
1	0
2	1
3	0
4	1

①

```

int space = 2B(n-1);
for (int i=1; i<=n; i++) {
    for (int j=1; j<=i; j++) {
        cout<<j;
    }
    for (int j=1; j<=space; j++) {
        cout<<" ";
    }
    for (int j=i; j>=1; j--) {
        cout<<j;
    }
    cout<<endl;
    space = space/2; (every time decrease to 2)
}

```

working:

i=1	j=1	0000000001
i=2	j=1	2000000021
i=3	j=1	300000321
i=4	j=1	40004321
i=5	j=1	54321

8
6
4
2
0

1 1
1 2 2
1 2 3 3 2 1
1 2 3 4 4 3 2 1
1 2 3 4 5 4 3 2 1

2⁽ⁿ⁻¹⁾
2⁽⁵⁻¹⁾ = 8

②

```

int num=1;
for (int i=1; i<=n; i++) {
    for (int j=1; j<=i; j++) {
        cout<<(num + " ");
        num = num+1;
    }
    cout<<endl;
}

```

i=1	j=1	1	F
i=2	j=1	2	3 F
i=3	j=1	4	5 6 F
i=4	j=1	7	8 9 10 F
i=5	j=1	11	12 13 14 15 F

1
2 3
4 5 6
7 8 9 10
11 12 13 14 15


```

13) for(int i=0; i<n; i++) {
    for(char ch='A'; ch<='A'+i; ch++) {
        cout<<ch<<" ";
    }
    cout<<endl;
}

```

```

A
A B
A B C
A B C D
A B C D E

```

working:

i=0	ch=A	A
i=1	ch=A B	A B
i=2	ch=A B C	A B C
i=3	ch=A B C D	
i=4	ch=A B C D E	

```

14) for(int i=0; i<n; i++) {
    for(char ch='A'; ch<='A'+(n-i-1); ch++) {
        cout<<ch<<" ";
    }
    cout<<endl;
}

```

A+B-E
A+B-D
A+B-C
A+B-B
A+B-A

```

A B C D E
A B C D
A B C
A B
A

```

working:

i=0	ch=A+4 - A B C D E
i=1	ch=A+3 - A B C D
i=2	ch=A+2 - A B C
i=3	ch=A+1 - A B
i=4	ch=A - A

n-i-1
5-0-1=4
5-1-1=3
5-2-1=2
5-3-1=1
5-4-1=0

```

15) for(int i=0; i<n; i++) {
    for(int j=0; j<=i; j++) {
        cout<<(char)(('A'+i))<<" ";
    }
    cout<<endl;
}

```

```

A
B B
C C C
D D D D
E E E E E

```

working:

i=0	ch=A	j=0	A
i=1	ch=B B	j=0 1	
i=2	ch=C C C	j=0 1 2	
i=3	ch=D D D D	j=0 1 2 3	
i=4	ch=E E E E E	j=0 1 2 3 4	

Col)

```

for(same?) {
    char ch='A'+i;
    for(same j) {
        cout<<ch<<" ";
    }
    cout<<endl;
}

```



```

⑥ for (int i = 0; i < n; i++) {
    for (int j = 0; j < n - i - 1; j++) {
        cout << " ";
    }
    char ch = 'A';
    int break = (2 * i + 1) / 2;
    for (int j = 1; j <= 2 * i + 1; j++) {
        cout << ch;
        if (j <= break)
            ch++;
        else
            ch--;
    }
    for (int j = 0; j < n - i - 1; j++)
        cout << " ";
    cout << "\n";
}

```

A
 ABA
 ABCBA
 ABCDCBA
 ABCDEDCBA

n-i-1
 5-0-1=4
 3
 2
 1
 0

2 * i + 1
 2(0) + 1 = 1
 2(1) + 1 = 3
 2(2) + 1 = 5
 2(3) + 1 = 7
 2(4) + 1 = 9

2 * i + 1
 2(0)

Working:

i=0	j=0	+ + + A + + +
i=1	j=	+ + + ABA + +
i=2		+ + ABCBA + +
i=3		+ ABCDCBA +
i=4		ABCDEDCBA

(15)

```

for (int i = 0; i < n; i++) {
    for (char ch = 'E'; i < ch < 'B'; ch++) {
        cout << ch << " ";
    }
    cout << "\n";
}

```

```

E
DE
LDE
BCDE
ABCDE

```

working:

```

i=0 ch=E-0=E
i=1 ch=E-1=DE
i=2 ch=E-2=BCDE
i=3 ch=E-3=ABCDE
i=4 ch=E-4=ABCDE

```

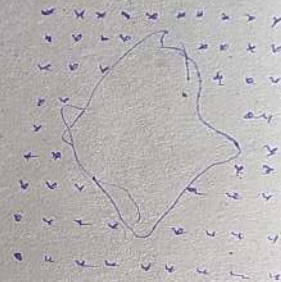
(16)

```

int st = 0;
for (int i = 0; i < n; i++) {
    for (int j = 1; j <= n - i; j++) {
        cout << "* ";
    }
    for (int j = 0; j < st; j++) {
        cout << " ";
    }
    for (int j = 1; j <= n - i; j++) {
        cout << "* ";
    }
    st += 2;
    cout << "\n";
}

st = 2 * n - 2;
for (int i = 1; i <= n; i++) {
    for (int j = 1; j <= i; j++) {
        cout << "* ";
    }
    for (int j = 0; j < st; j++) {
        cout << " ";
    }
    for (int j = 1; j <= i; j++) {
        cout << "* ";
    }
    st -= 2;
    cout << "\n";
}

```



21.

for (int i=0; i<n&n-1; i++) {

for (int j=0; j<n-1; j++) {

int top=i;

int bottom=j;

int high=(2*n-2)-j;

int left=(2*n-2)-i;

cout <

}

cout <

}

5 5 5 5 5 5 5 5 5 5
 5 4 4 4 4 4 4 4 4 5
 5 4 3 3 3 3 4 4 4 5
 5 4 3 2 2 3 4 4 4 5
 5 4 3 2 1 2 3 4 4 5
 5 4 3 2 2 3 4 4 4 5
 5 4 4 4 4 4 4 4 4 5
 5 5 5 5 5 5 5 5 5 5