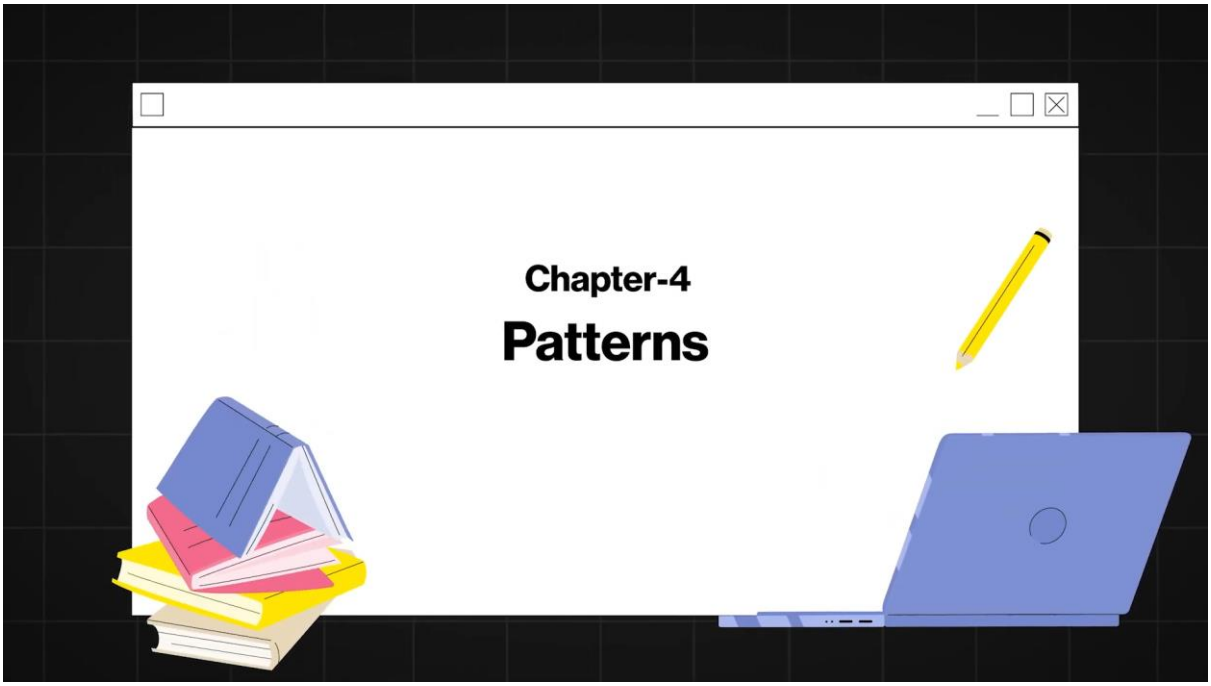
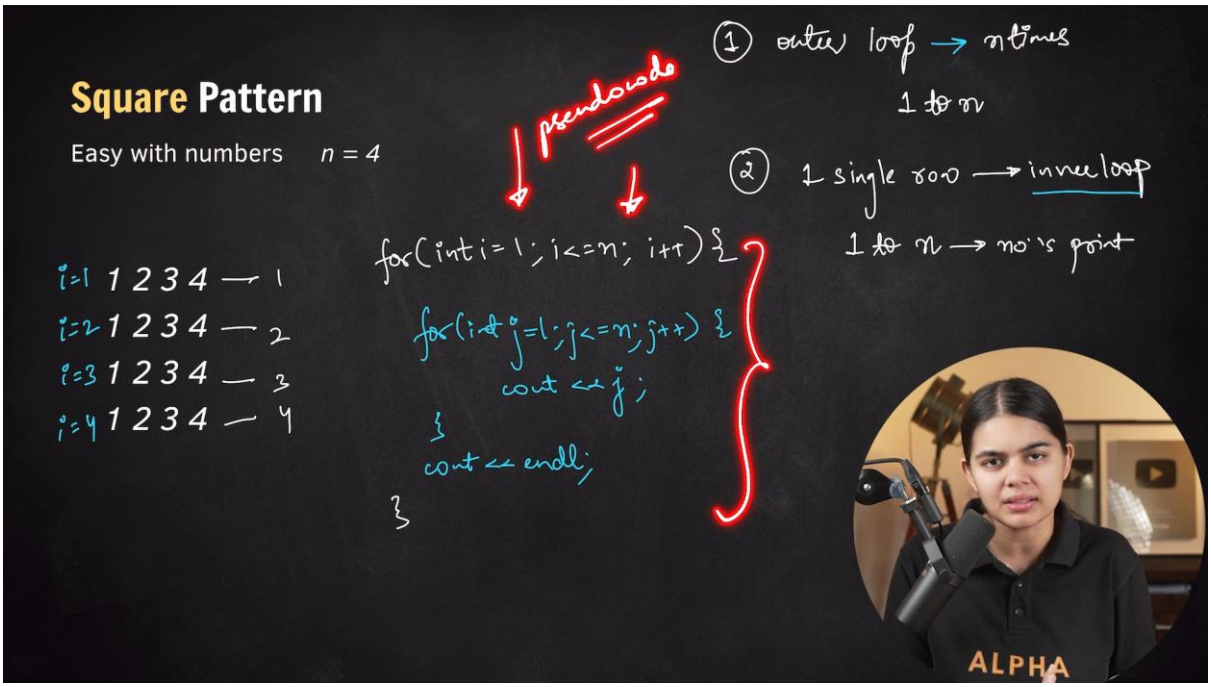
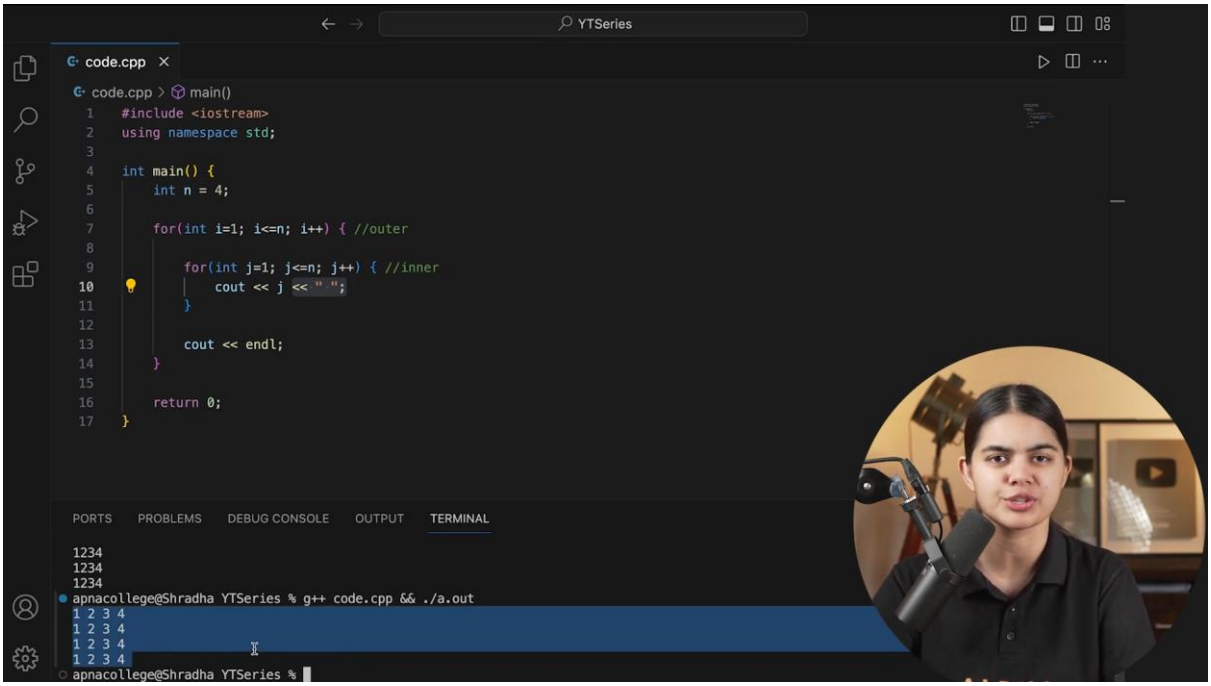
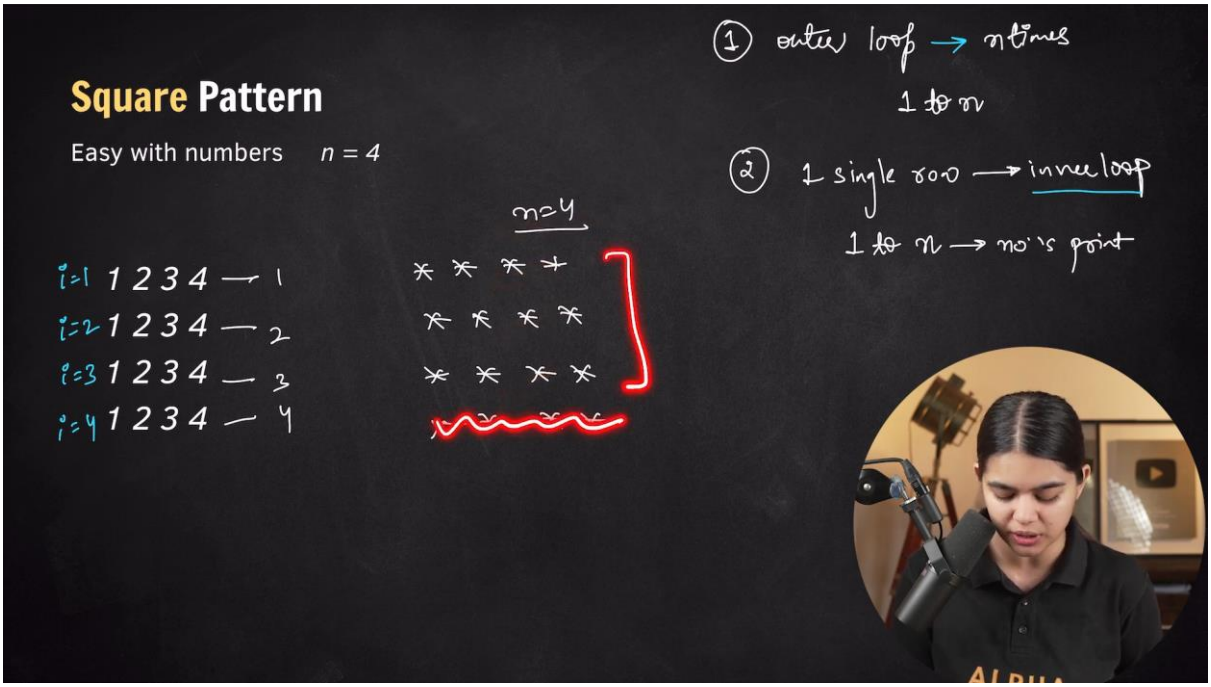
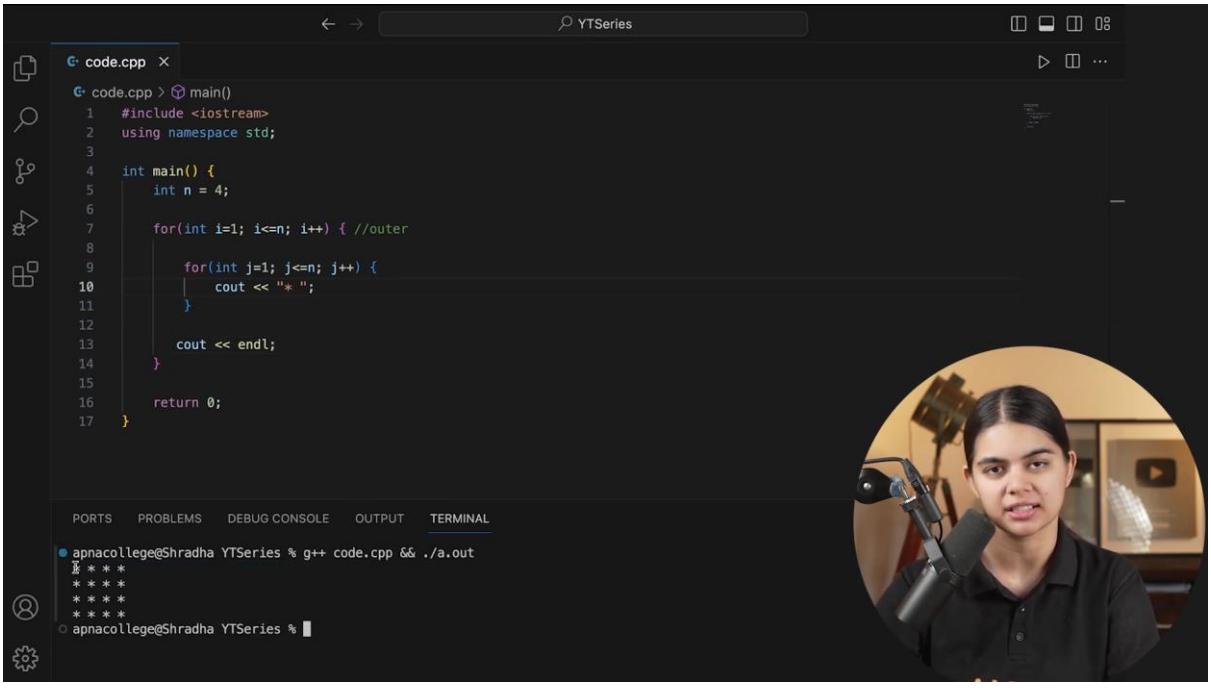

Chapter-4
Patterns

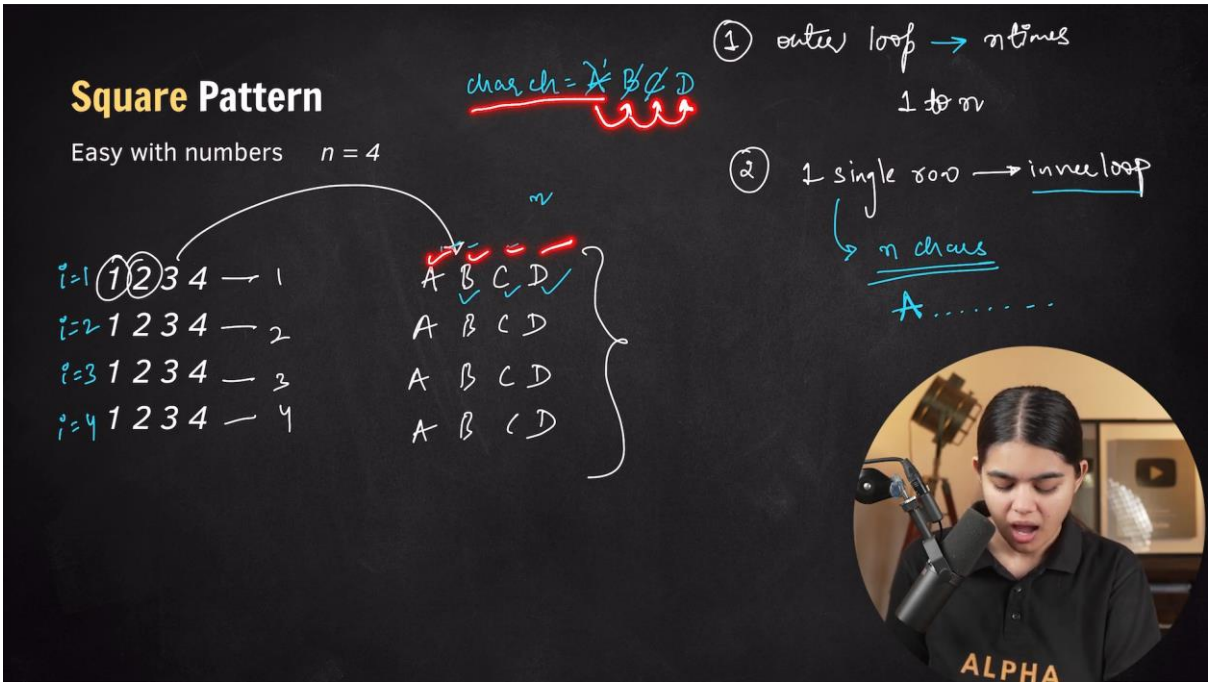

Patterns
for loop ✓
while / do-while

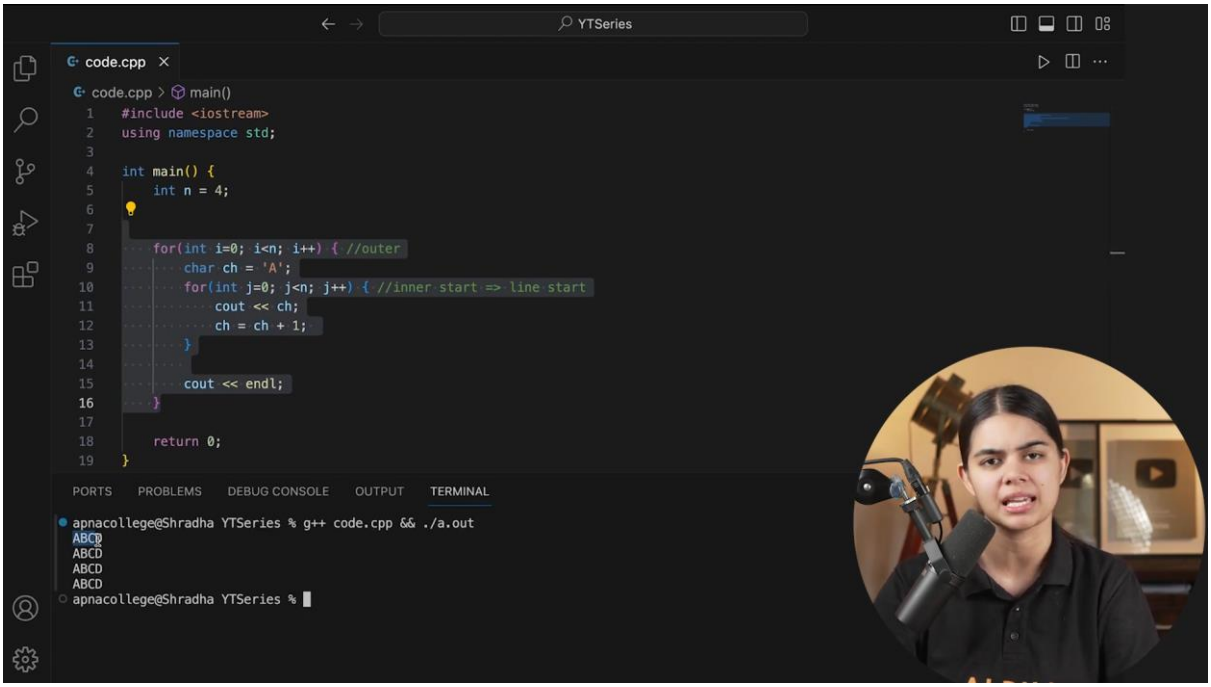

Square Pattern
Easy with numbers n = 4
i=1 1 2 3 4 — 1
i=2 1 2 3 4 — 2
i=3 1 2 3 4 — 3
i=4 1 2 3 4 — 4
pseudocode
for(int i=1; i<=n; i++){
for(int j=1; j<=n; j++) {
cout << j;
}
cout << endl;
}
① outer loop → n times
1 to n
② 1 single row → inner loop
1 to n → no's print
ALPHA

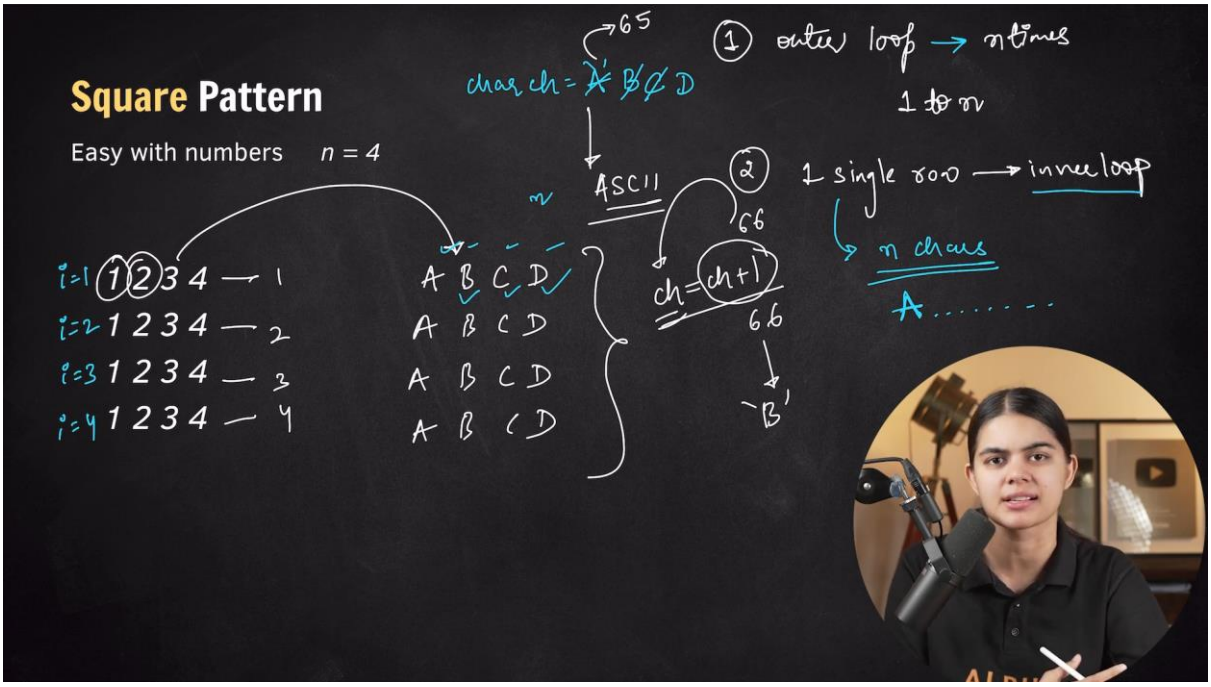

YTSeries
code.cpp
code.cpp > main()
#include <iostream>
using namespace std;
int main() {
int n = 4;
for(int i=1; i<=n; i++) { //outer
for(int j=1; j<=n; j++) { //inner
cout << j << " ";
}
cout << endl;
}
return 0;
}
PORTS PROBLEMS DEBUG CONSOLE OUTPUT TERMINAL
1234
1234
1234
apnacollege@Shradha YTSeries % g++ code.cpp && ./a.out
1 2 3 4
1 2 3 4
1 2 3 4
1 2 3 4
apnacollege@Shradha YTSeries %

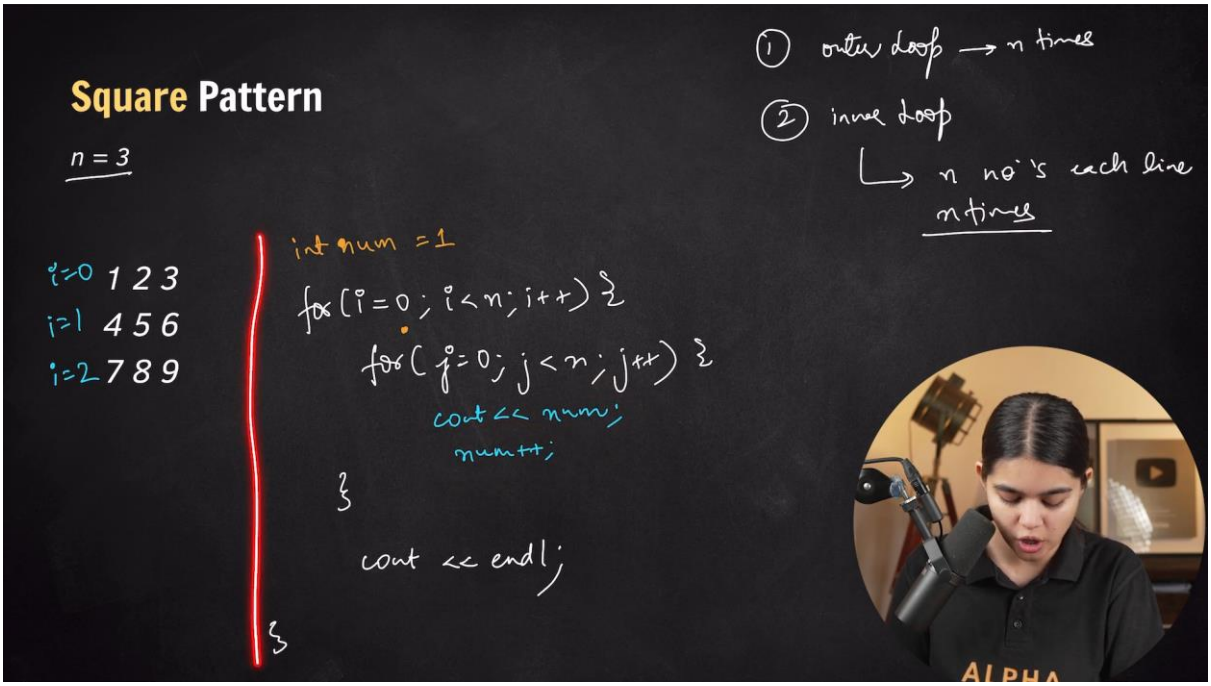

Square Pattern
Easy with numbers n = 4
1 outer loop → n times
1 to n
2 1 single loop → inner loop
1 to n → no's print
n=4
i=1 1 2 3 4 — 1
i=2 1 2 3 4 — 2
i=3 1 2 3 4 — 3
i=4 1 2 3 4 — 4

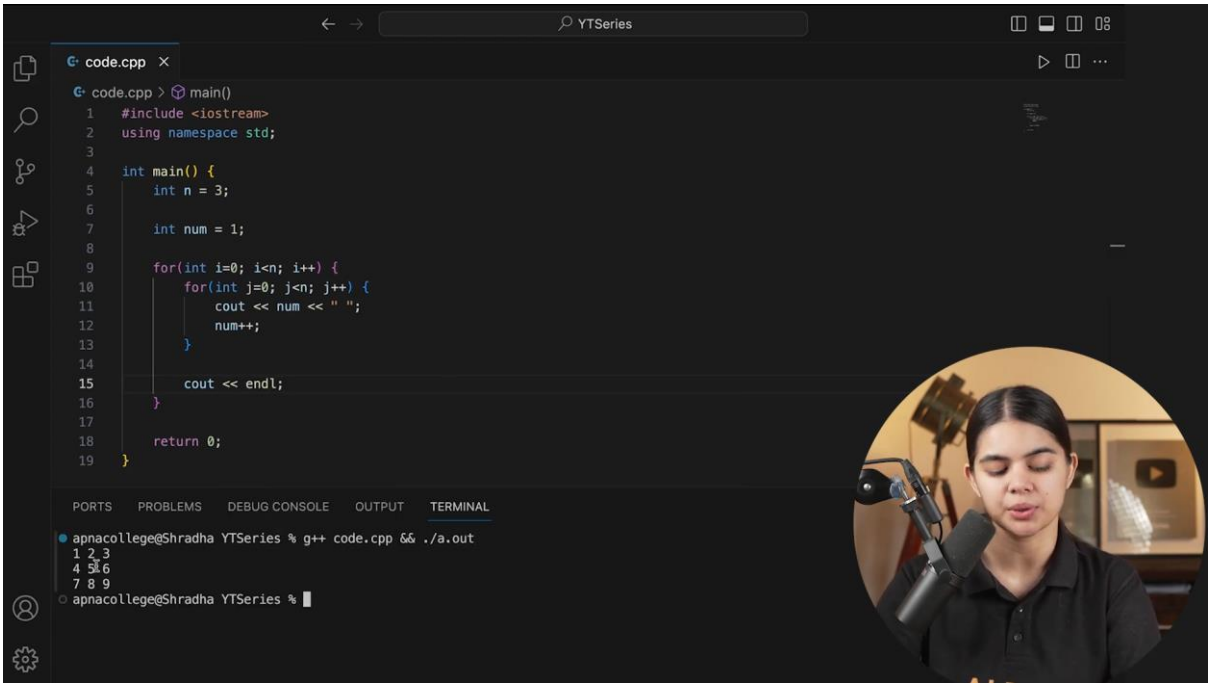

YTSeries
code.cpp
code.cpp > main()
#include <iostream>
using namespace std;
int main() {
int n = 4;
for(int i=1; i<=n; i++) { //outer
for(int j=1; j<=n; j++) {
cout << "* ";
}
cout << endl;
}
return 0;
}
PORTS PROBLEMS DEBUG CONSOLE OUTPUT TERMINAL
apnacollege@Shradha YTSeries % g++ code.cpp && ./a.out
* * * *
* * * *
* * * *
* * * *
apnacollege@Shradha YTSeries %

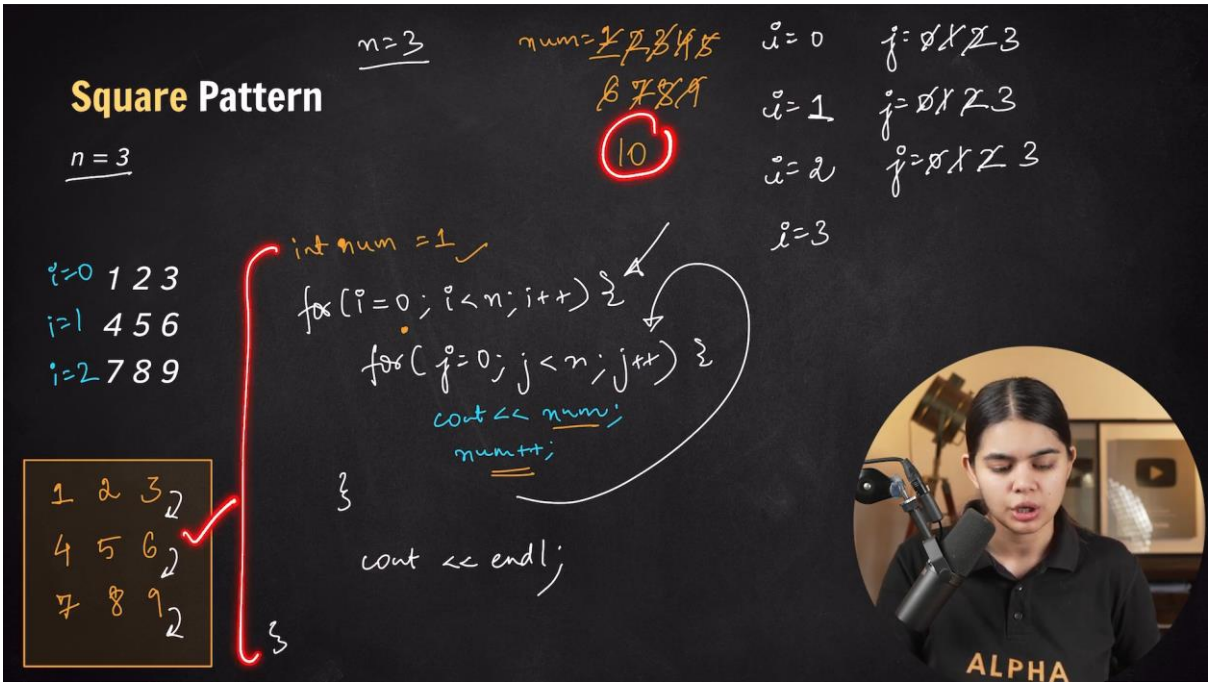

Square Pattern
Easy with numbers n = 4
char ch = A B C D
1 outer loop → n times
1 to n
2 1 single loop → inner loop
n chars
A . . . . . .
i=1 1 2 3 4 — 1
i=2 1 2 3 4 — 2
i=3 1 2 3 4 — 3
i=4 1 2 3 4 — 4
A B C D
A B C D
A B C D
A B C D
ALPHA


YTSeries
code.cpp
code.cpp > main()
#include <iostream>
using namespace std;
int main() {
int n = 4;
for(int i=0; i<n; i++) { //outer
char ch = 'A';
for(int j=0; j<n; j++) { //inner start => line start
cout << ch;
ch = ch + 1;
}
cout << endl;
}
return 0;
}
PORTS PROBLEMS DEBUG CONSOLE OUTPUT TERMINAL
apnacollege@Shradha YTSeries % g++ code.cpp && ./a.out
ABCD
ABCD
ABCD
ABCD
apnacollege@Shradha YTSeries %


Square Pattern
Easy with numbers n = 4
65
char ch = A B C D
ASCII
1 outer loop → n times
1 to n
2 1 single loop → inner loop
n chars
A . . . . . .
66
ch = ch+1
66
B
i=1 1 2 3 4 — 1
i=2 1 2 3 4 — 2
i=3 1 2 3 4 — 3
i=4 1 2 3 4 — 4
A B C D
A B C D
A B C D
A B C D


Square Pattern
n = 3
① outer loop → n times
② inner loop
↳ n no's each line
n times
i=0 1 2 3
i=1 4 5 6
i=2 7 8 9
int num = 1
for(i=0; i<n; i++) {
for(j=0; j<n; j++) {
cout << num;
num++;
}
cout << endl;
}


YTSeries
code.cpp
#include <iostream>
using namespace std;
int main() {
int n = 3;
int num = 1;
for(int i=0; i<n; i++) {
for(int j=0; j<n; j++) {
cout << num << " ";
num++;
}
cout << endl;
}
return 0;
}
PORTS PROBLEMS DEBUG CONSOLE OUTPUT TERMINAL
apnacollege@Shradha YTSeries % g++ code.cpp && ./a.out
1 2 3
4 5 6
7 8 9
apnacollege@Shradha YTSeries %


n=3
num=
10
i= 0 j= 0 1 2 3
i= 1 j= 0 1 2 3
i= 2 j= 0 1 2 3
i=3
Square Pattern
n = 3
i=0 1 2 3
i=1 4 5 6
i=2 7 8 9
int num = 1
for(i=0; i<n; i++) {
for(j=0; j<n; j++) {
cout << num;
num++;
}
cout << endl;
}
1 2 3
4 5 6
7 8 9

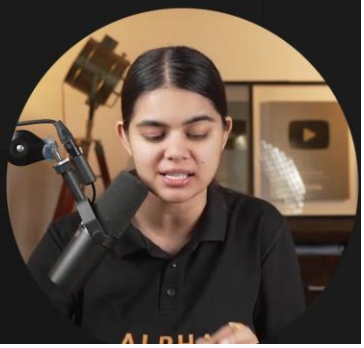
YTSeries

code.cpp

```cpp
using namespace std;

int main() {
    int n = 3;

    int num = 1;

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

        cout << endl;
    }

    cout << "after pattern : " << num << endl; //10
    return 0;
}
```

PORTS PROBLEMS DEBUG CONSOLE OUTPUT TERMINAL

```
apnacollege@Shradha YTSeries % g++ code.cpp && ./a.out
1 2 3
4 5 6
7 8 9
after pattern : 10
apnacollege@Shradha YTSeries %
```



Square Pattern

n = 3

n=3

A B C
D E F
G H I

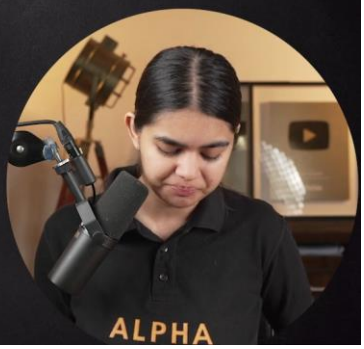
n=3

i=0 1 2 3
i=1 4 5 6
i=2 7 8 9

int num = 1

for(i=0; i<n; i++) {
  for(j=0; j<n; j++) {
    cout << num;
    num++;
  }
  cout << endl;
}

1 2 3
4 5 6
7 8 9



Triangle Pattern

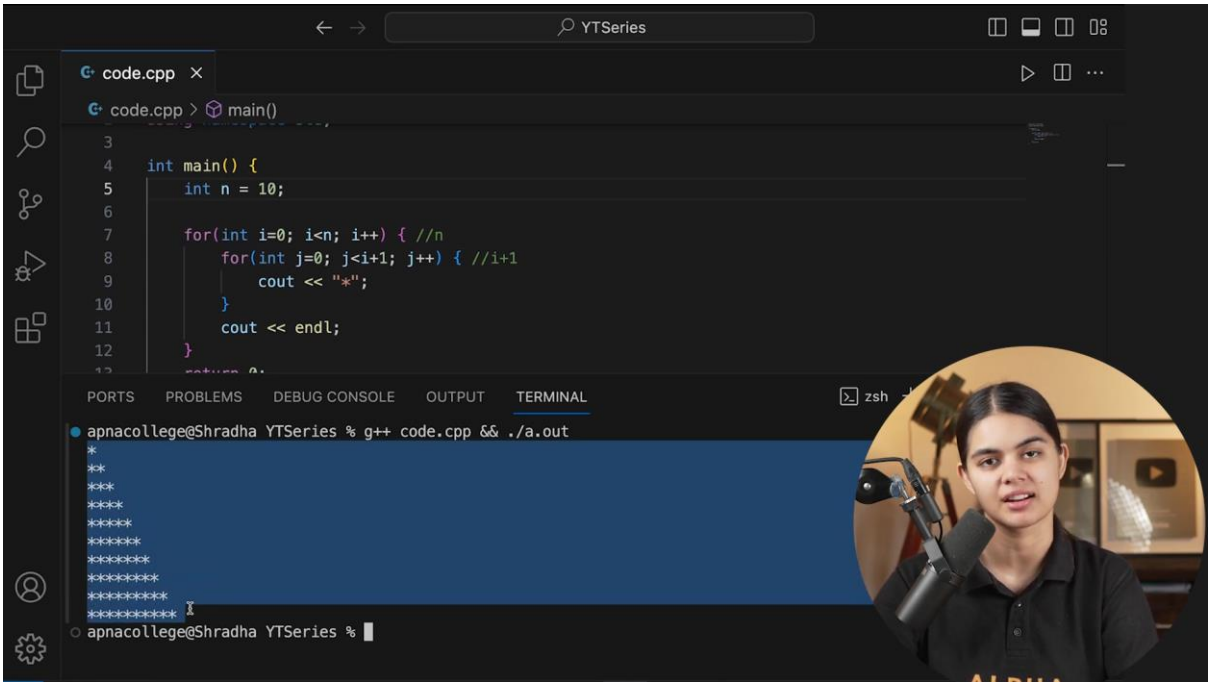
Easy with stars n = 4

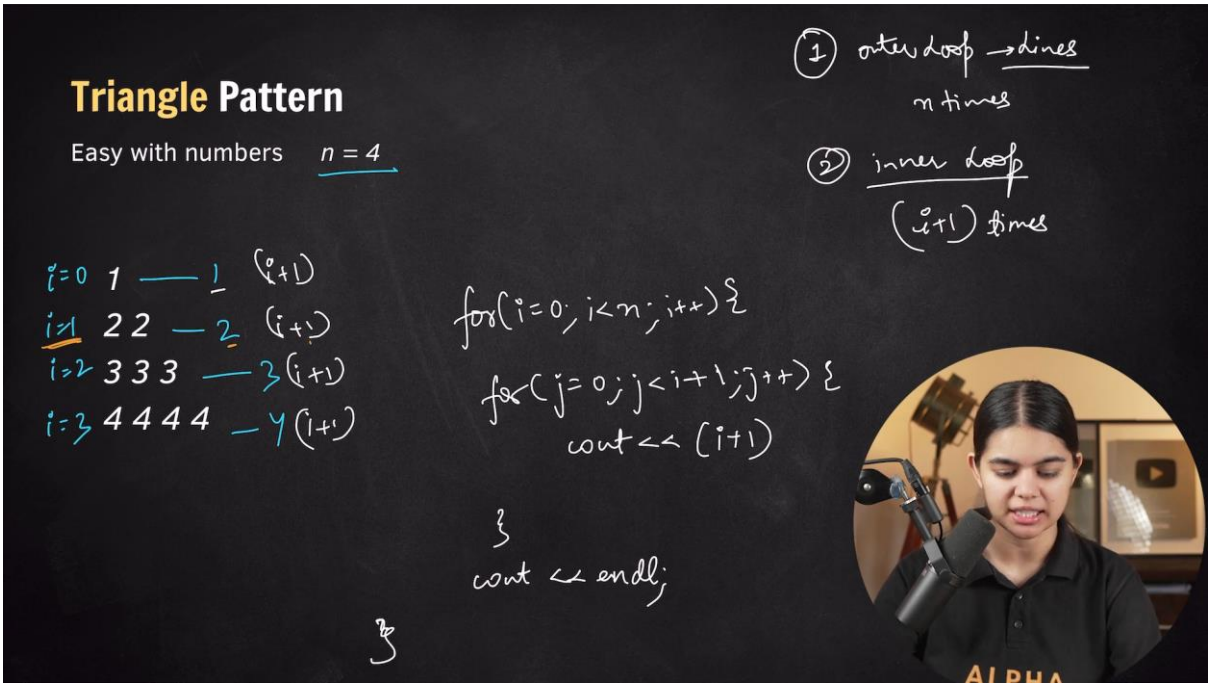
① outer loop → lines
0 to n-1

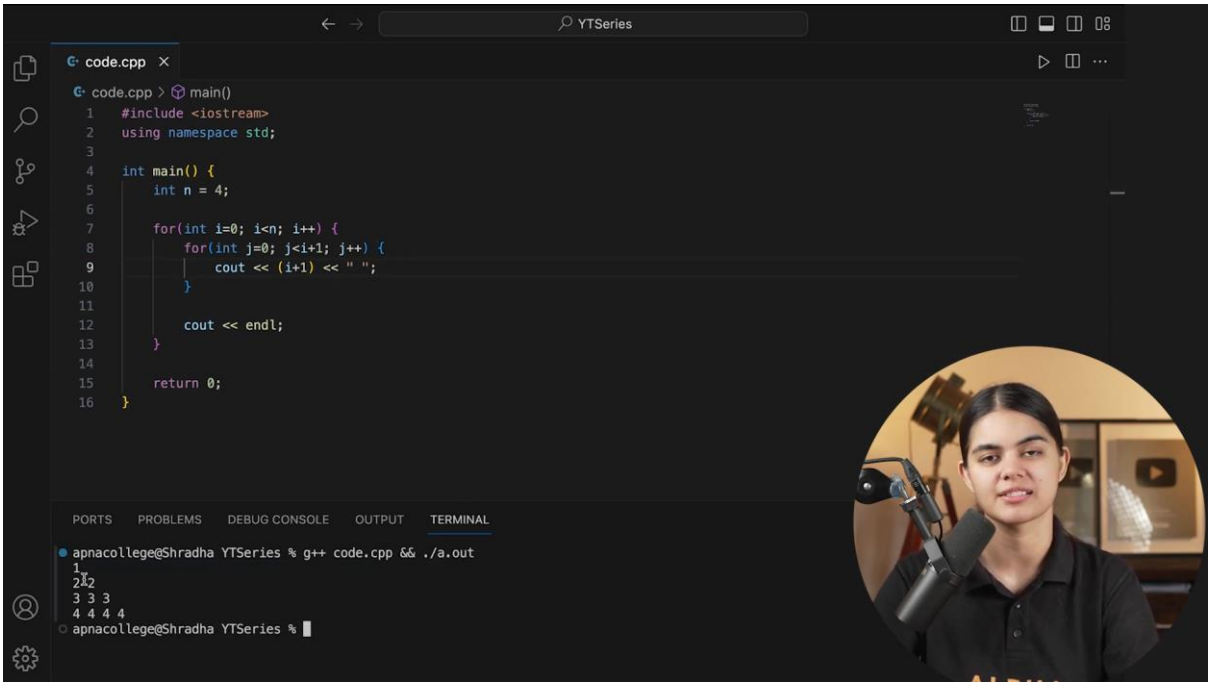
② inner loop
→ (i+1) stars
1 to i+1 ✓ (i+1)
0 to i ✓ (i+1)

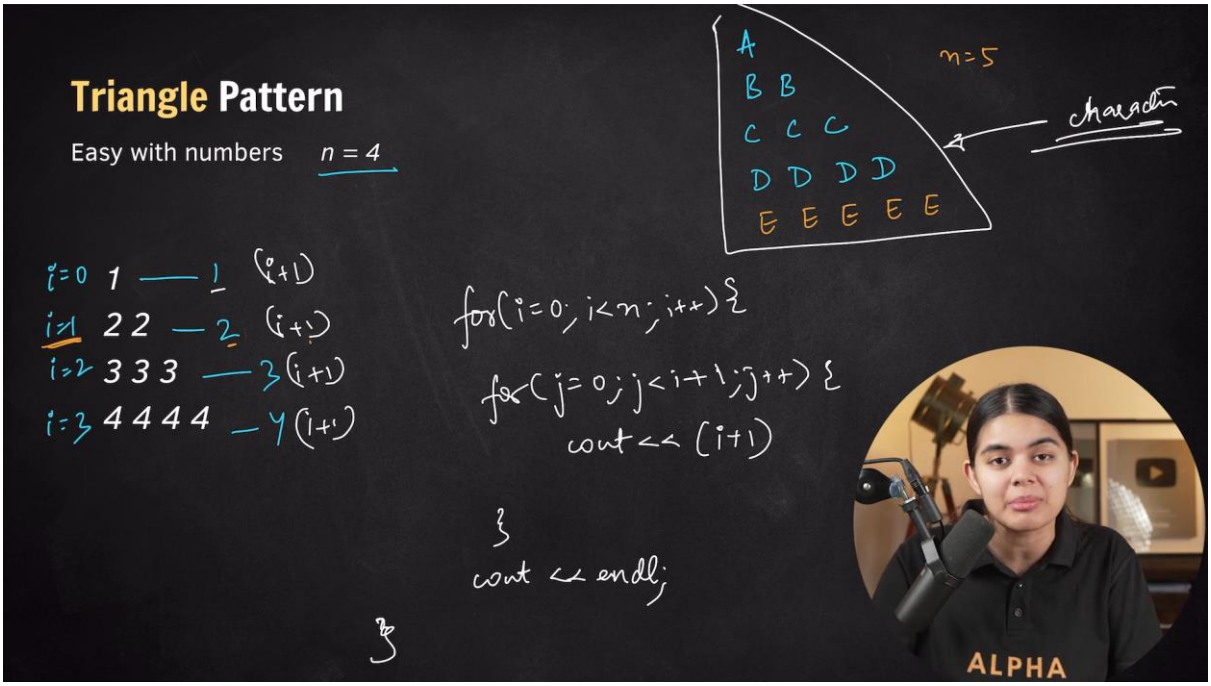
i=0 * → 1 i+1
i=1 * * → 2 i+1
i=2 * * * → 3 i+1
i=3 * * * * → 4 i+1

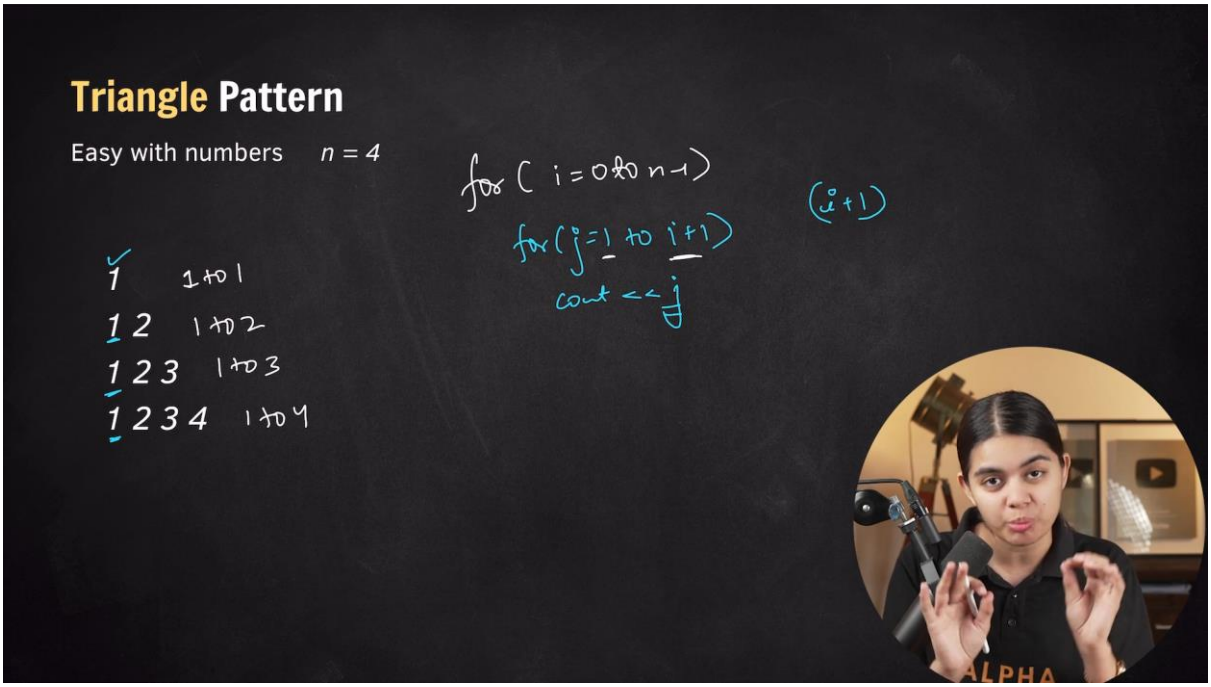
for(i=0; i<n; i++) {
  for(int j=0; j<i+1; j++) {
    cout << "*";
  }
  cout << endl;
}

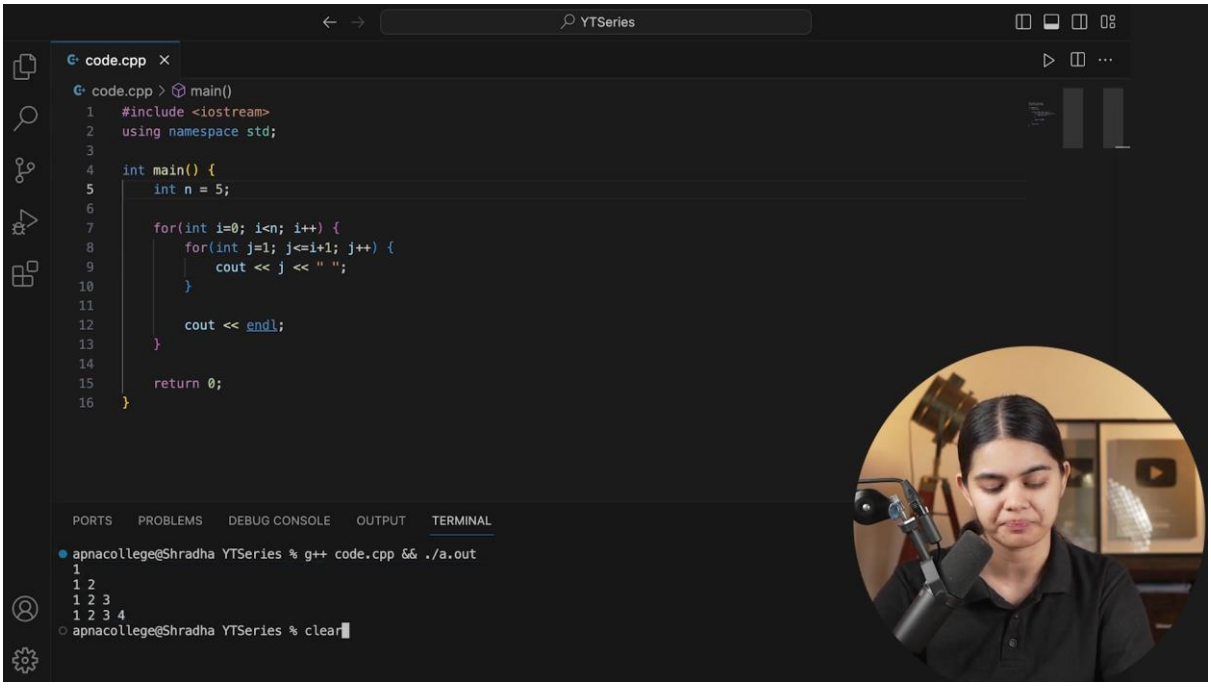

YTSeries
code.cpp
code.cpp > main()
int main() {
int n = 10;
for(int i=0; i<n; i++) { //n
for(int j=0; j<i+1; j++) { //i+1
cout << "*";
}
cout << endl;
}
PORTS PROBLEMS DEBUG CONSOLE OUTPUT TERMINAL
zsh
apnacollege@Shradha YTSeries % g++ code.cpp && ./a.out
*
**
***
****
*****
******
****
****
****
****
apnacollege@Shradha YTSeries %


Triangle Pattern
Easy with numbers n = 4
1 outer loop → lines
n times
2 inner loop
(i+1) times
i=0 1 — 1 (i+1)
i=1 2 2 — 2 (i+1)
i=2 3 3 3 — 3 (i+1)
i=3 4 4 4 4 — 4 (i+1)
for(i=0; i<n; i++){
for(j=0; j<i+1; j++){
cout << (i+1)
}
cout << endl;
}


YTSeries
code.cpp
code.cpp > main()
#include <iostream>
using namespace std;
int main() {
int n = 4;
for(int i=0; i<n; i++) {
for(int j=0; j<i+1; j++) {
cout << (i+1) << " ";
}
cout << endl;
}
return 0;
}
PORTS PROBLEMS DEBUG CONSOLE OUTPUT TERMINAL
apnacollege@Shradha YTSeries % g++ code.cpp && ./a.out
1
2 2
3 3 3
4 4 4 4
apnacollege@Shradha YTSeries %


Triangle Pattern
Easy with numbers n = 4
A
B B
C C C
D D D D
E E E E E
n=5
for(i=0; i<n; i++){
for(j=0; j<i+1; j++){
cout << (i+1)
}
cout << endl;
}
ALPHA


Triangle Pattern
Easy with numbers n = 4
for (i = 0 to n-1)
for(j = 1 to i+1)
cout << j
(i+1)
1 1 to 1
1 2 1 to 2
1 2 3 1 to 3
1 2 3 4 1 to 4
ALPHA


YTSeries
code.cpp
code.cpp > main()
#include <iostream>
using namespace std;
int main() {
int n = 5;
for(int i=0; i<n; i++) {
for(int j=1; j<=i+1; j++) {
cout << j << " ";
}
cout << endl;
}
return 0;
}
PORTS PROBLEMS DEBUG CONSOLE OUTPUT TERMINAL
apnacollege@Shradha YTSeries % g++ code.cpp && ./a.out
1
1 2
1 2 3
1 2 3 4
apnacollege@Shradha YTSeries % clear

Reverse Triangle Pattern

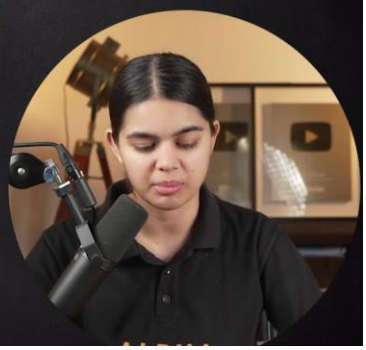
with numbers $n = 4$

```
1
2 1
3 2 1
4 3 2 1
```

```
for (i = 0 to n-1)
    for (j = i+1; j > 0; j--)
        cout << j;
```

```
for (i = 1 to i+1)
    for (i+1 to 1)
```

i++ → i--



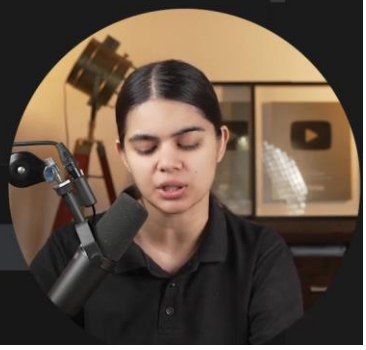
YTSeries

code.cpp

```cpp
#include <iostream>
using namespace std;

int main() {
    int n = 4;

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

    return 0;
}
```

PORTS PROBLEMS DEBUG CONSOLE OUTPUT TERMINAL

```
apnacollege@Shradha YTSeries % g++ code.cpp && ./a.out
1
2 1
3 2 1
4 3 2 1
apnacollege@Shradha YTSeries %
```

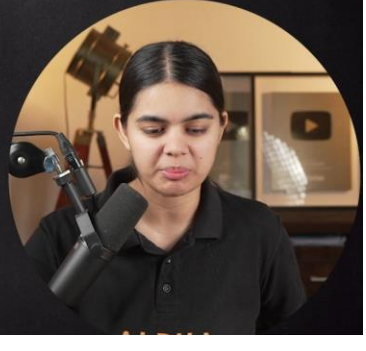


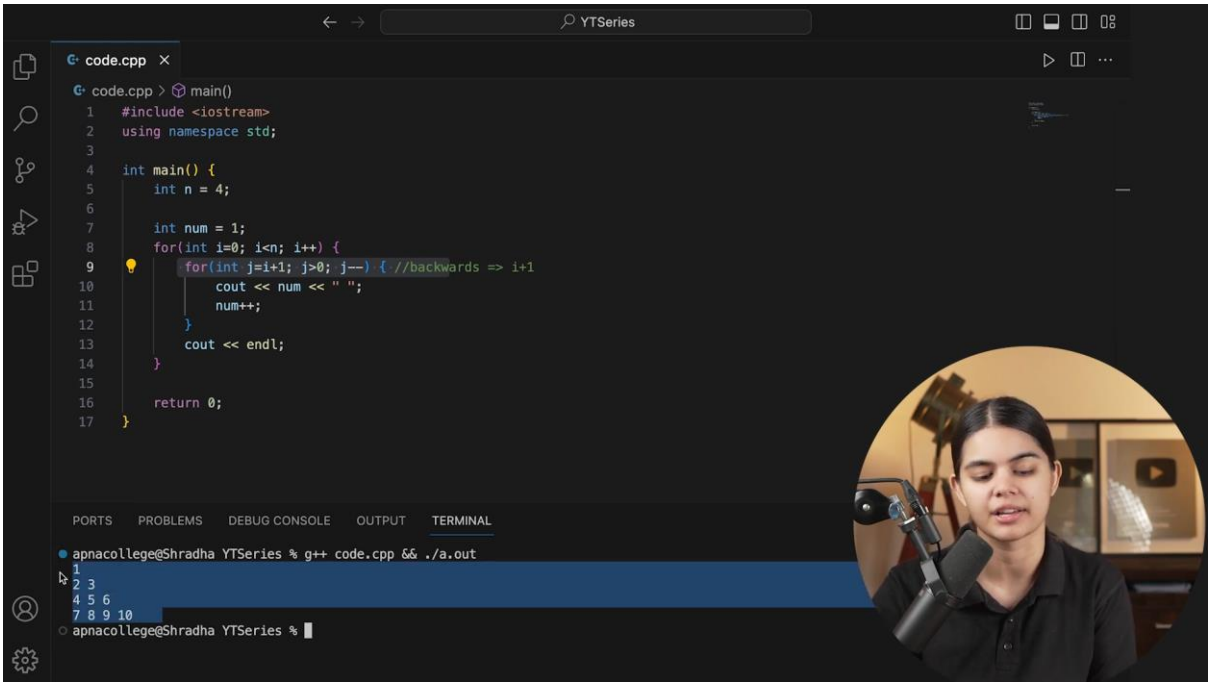
Floyd's Triangle Pattern

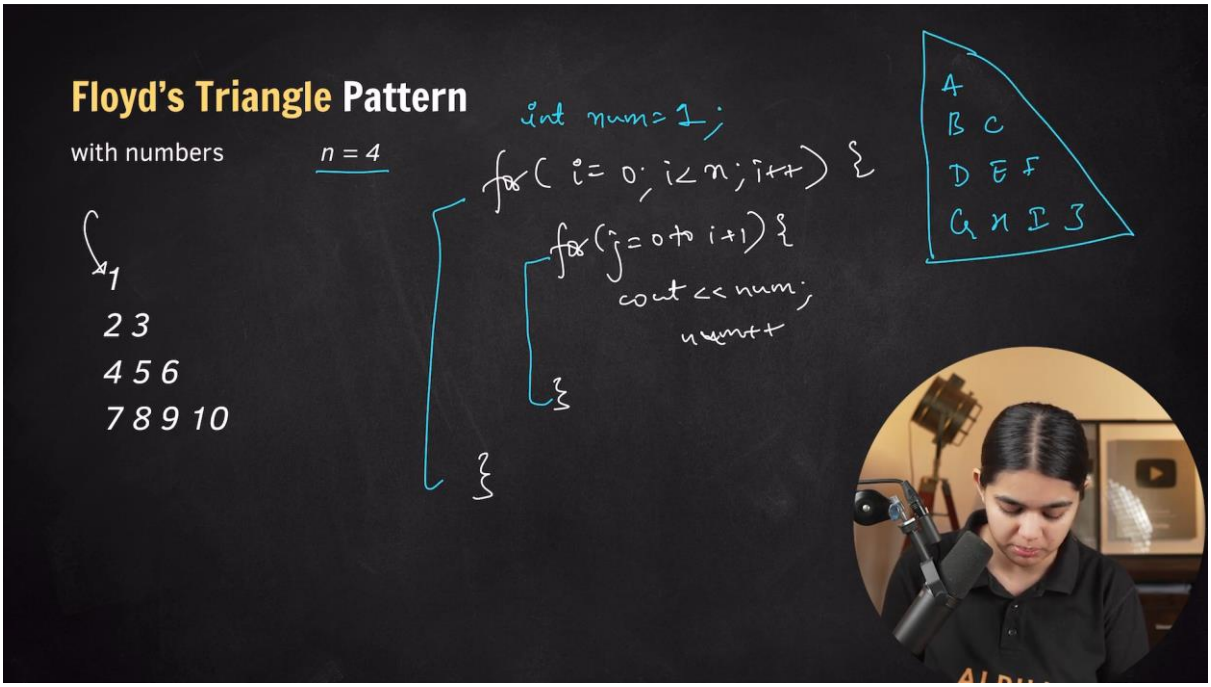
with numbers $n = 4$

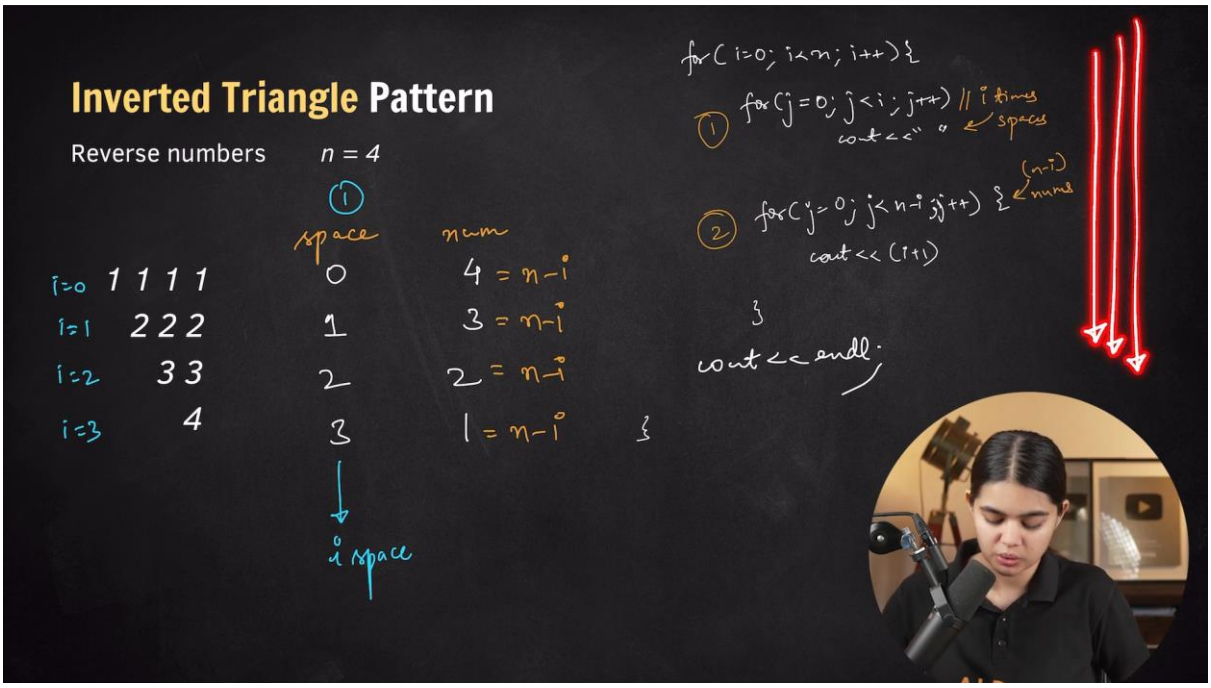
```
1
2 3
4 5 6
7 8 9 10
```

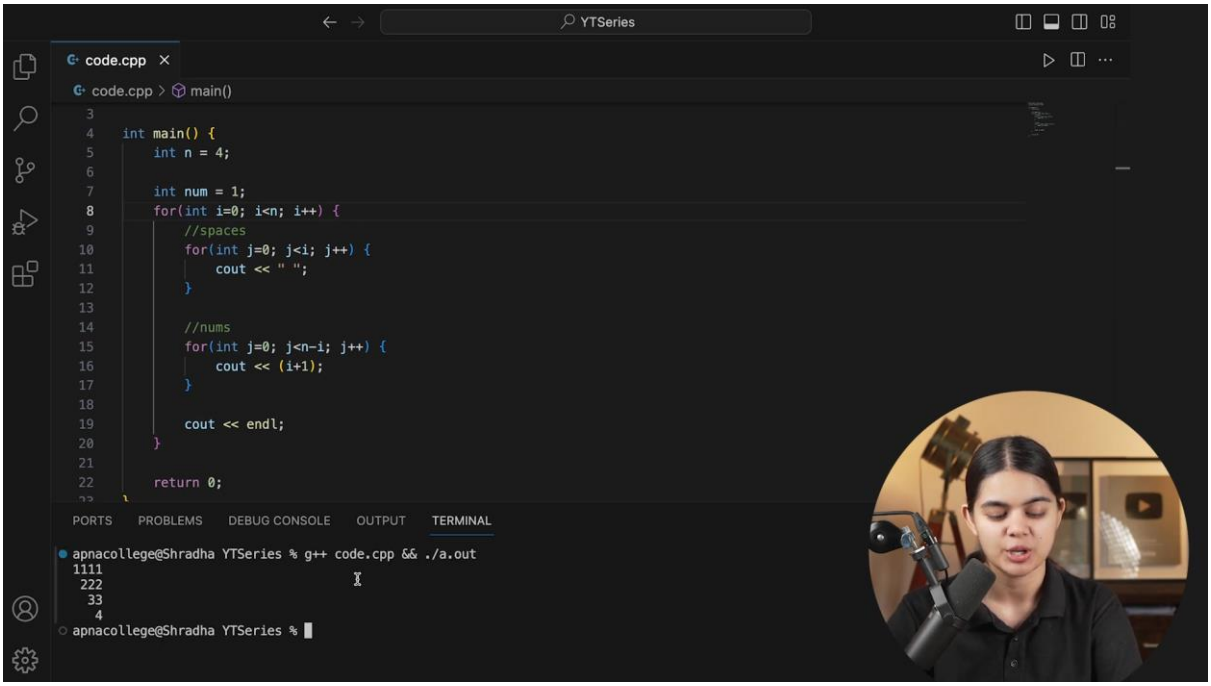
```
int num = 1;
for (i = 0; i < n; i++) {
    for (j = 0 to i+1) {
        cout << num;
        num++
    }
}
```

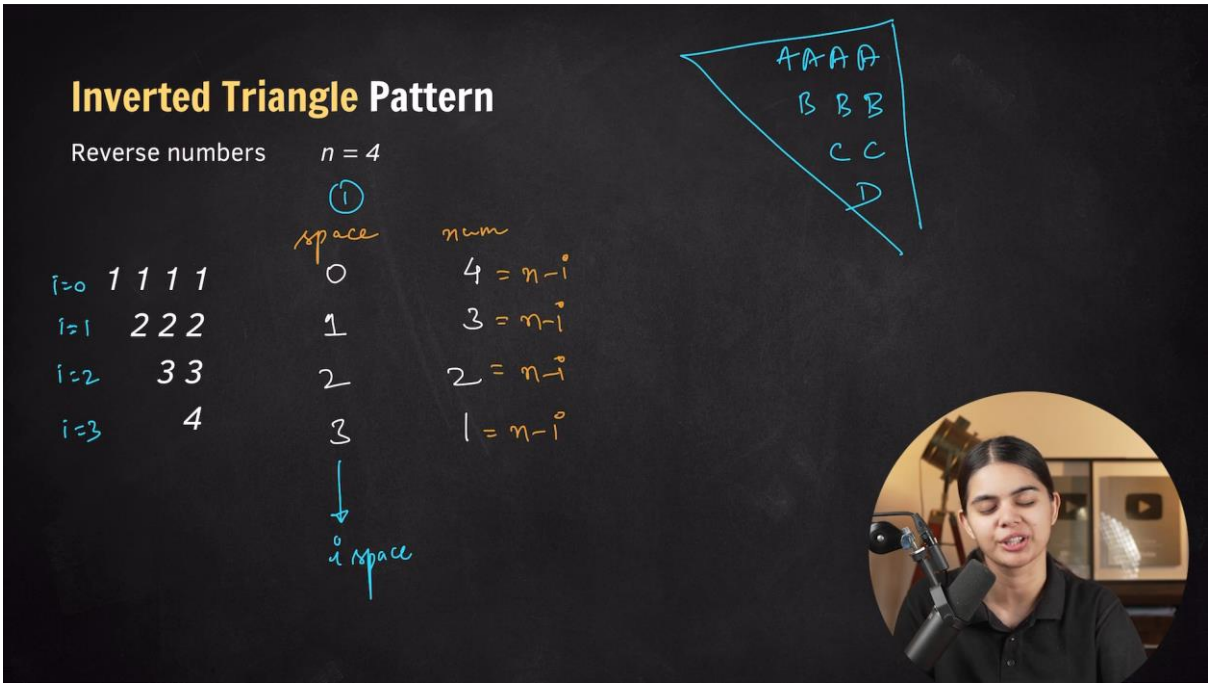


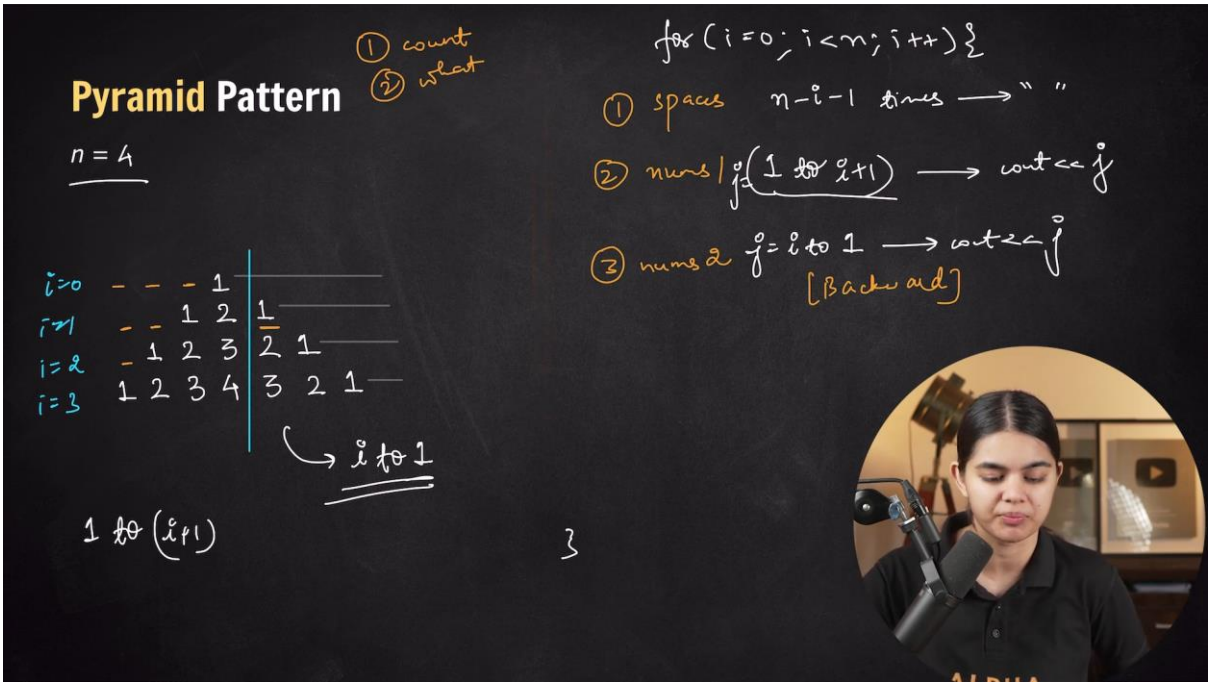

YTSeries
code.cpp
code.cpp > main()
#include <iostream>
using namespace std;
int main() {
int n = 4;
int num = 1;
for(int i=0; i<n; i++) {
for(int j=i+1; j>0; j--) { //backwards => i+1
cout << num << " ";
num++;
}
cout << endl;
}
return 0;
}
PORTS
PROBLEMS
DEBUG CONSOLE
OUTPUT
TERMINAL
apnacollege@Shradha YTSeries % g++ code.cpp && ./a.out
1
2 3
4 5 6
7 8 9 10
apnacollege@Shradha YTSeries %

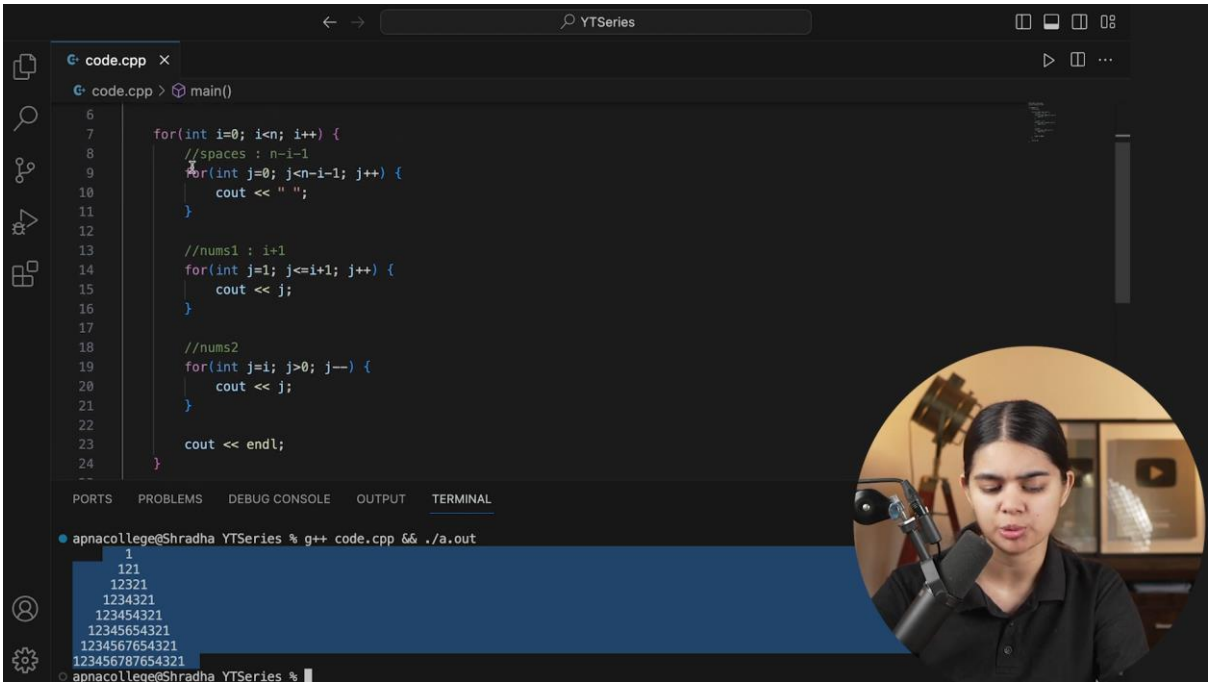

Floyd's Triangle Pattern
with numbers
n = 4
1
2 3
4 5 6
7 8 9 10
int num=1;
for(i=0; i<n; i++) {
for(j=0 to i+1) {
cout << num;
num++
}
}
A
B C
D E F
G H I J

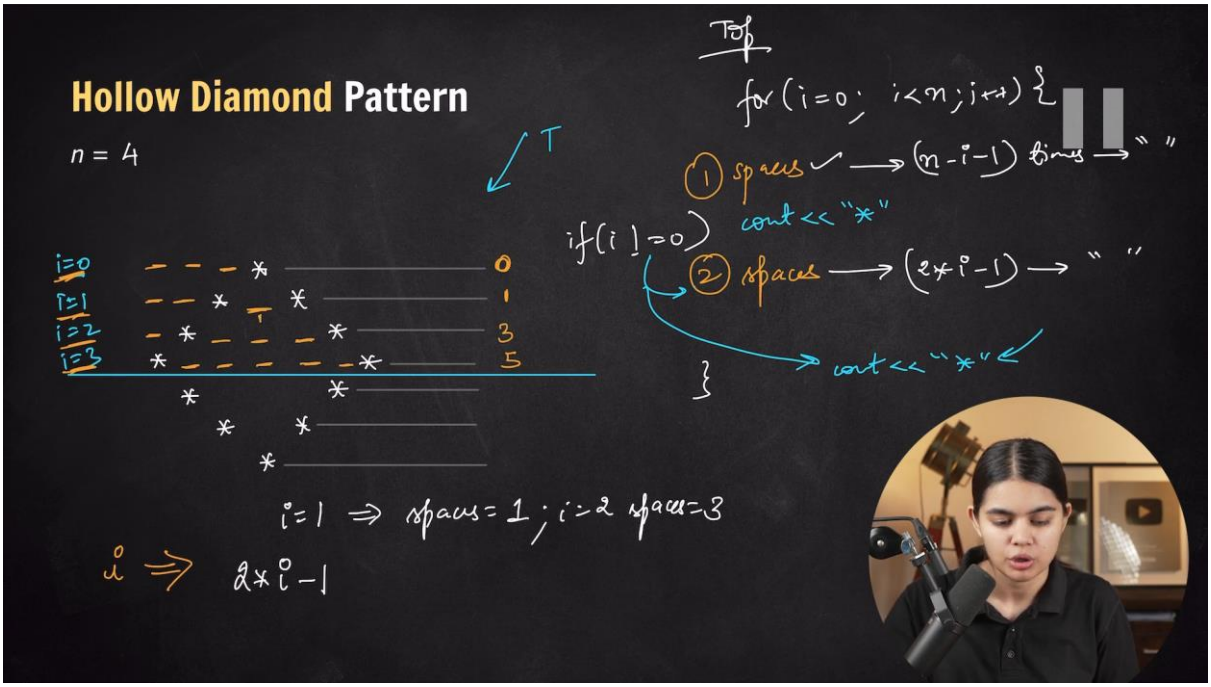

Inverted Triangle Pattern
Reverse numbers
n = 4
i=0 1 1 1 1
i=1 2 2 2
i=2 3 3
i=3 4
space
num
0
1
2
3
4 = n-i
3 = n-i
2 = n-i
1 = n-i
i space
for(i=0; i<n; i++){
for(j=0; j<i; j++) // i times
cout << " "
spaces
for(j=0; j<n-i; j++) {
(n-i) nums
cout << (i+1)
}
cout << endl;

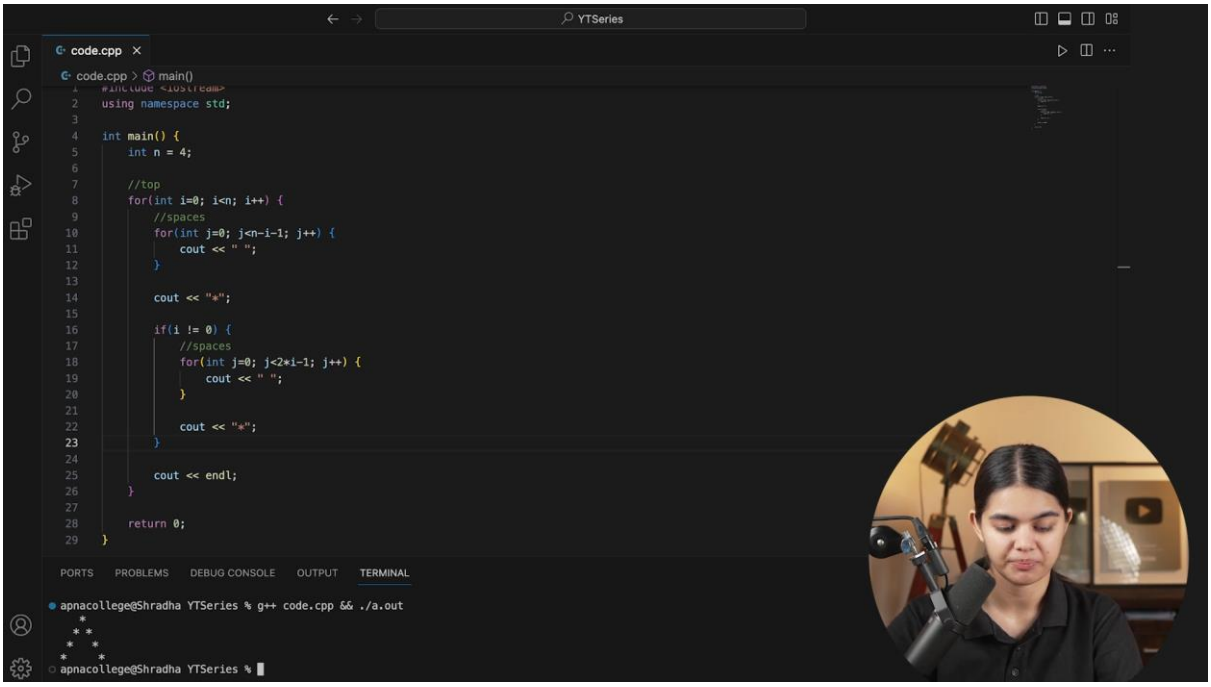

YTSeries
code.cpp
code.cpp > main()
int main() {
int n = 4;
int num = 1;
for(int i=0; i<n; i++) {
//spaces
for(int j=0; j<i; j++) {
cout << " ";
}
//nums
for(int j=0; j<n-i; j++) {
cout << (i+1);
}
cout << endl;
}
return 0;
PORTS PROBLEMS DEBUG CONSOLE OUTPUT TERMINAL
apnacollege@Shradha YTSeries % g++ code.cpp && ./a.out
1111
222
33
4
apnacollege@Shradha YTSeries %

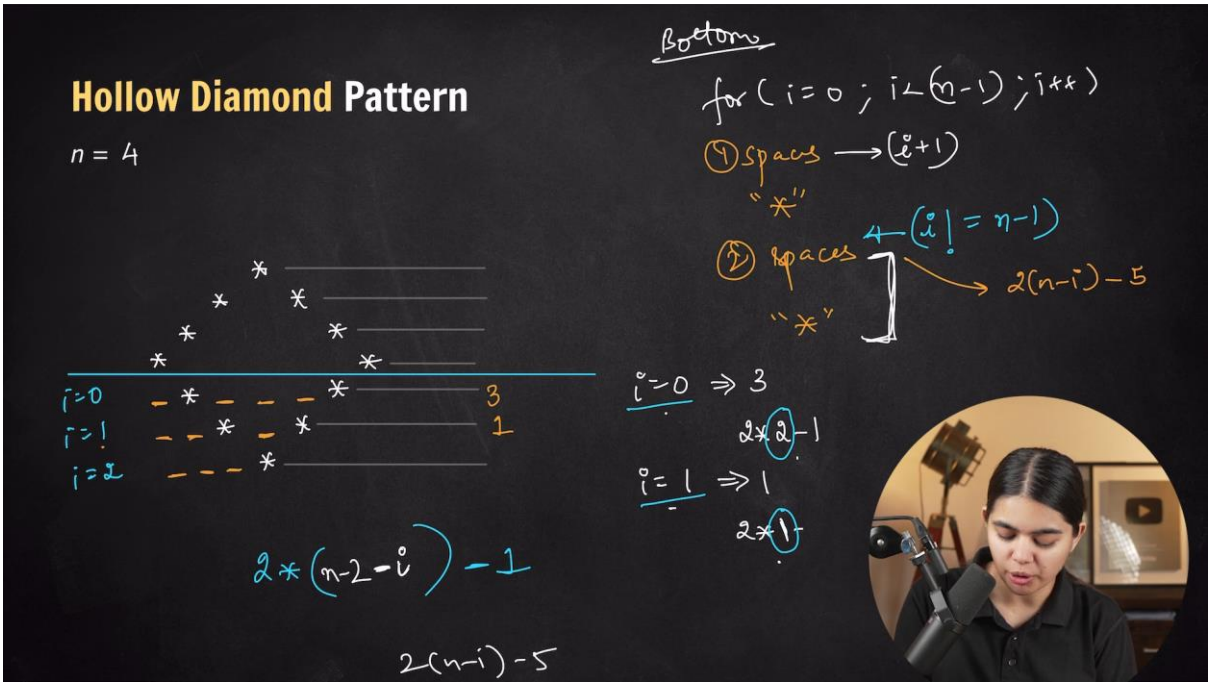

Inverted Triangle Pattern
Reverse numbers
n = 4
A A A A
B B B
C C
D
space
num
i=0 1 1 1 1
i=1 2 2 2
i=2 3 3
i=3 4
0
1
2
3
4 = n-i
3 = n-i
2 = n-i
1 = n-i
i space

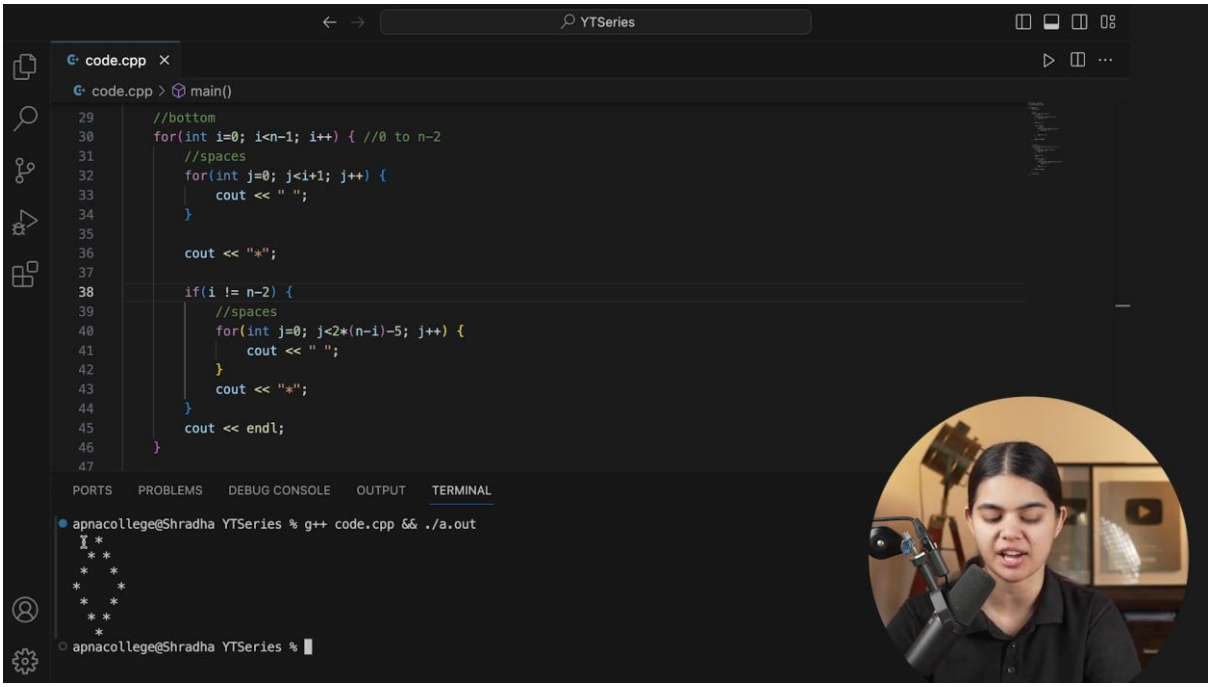

Pyramid Pattern
n = 4
① count
② what
for (i=0; i<n; i++){
① spaces n-i-1 times → " "
② nums | j=(1 to i+1) → cout<<j
② nums 2 j=i to 1 → cout<<j
[Backward]
i=0 _ _ _ 1
i=1 _ _ 1 2 1
i=2 _ 1 2 3 2 1
i=3 1 2 3 4 3 2 1
i to 1
1 to (i+1)
3

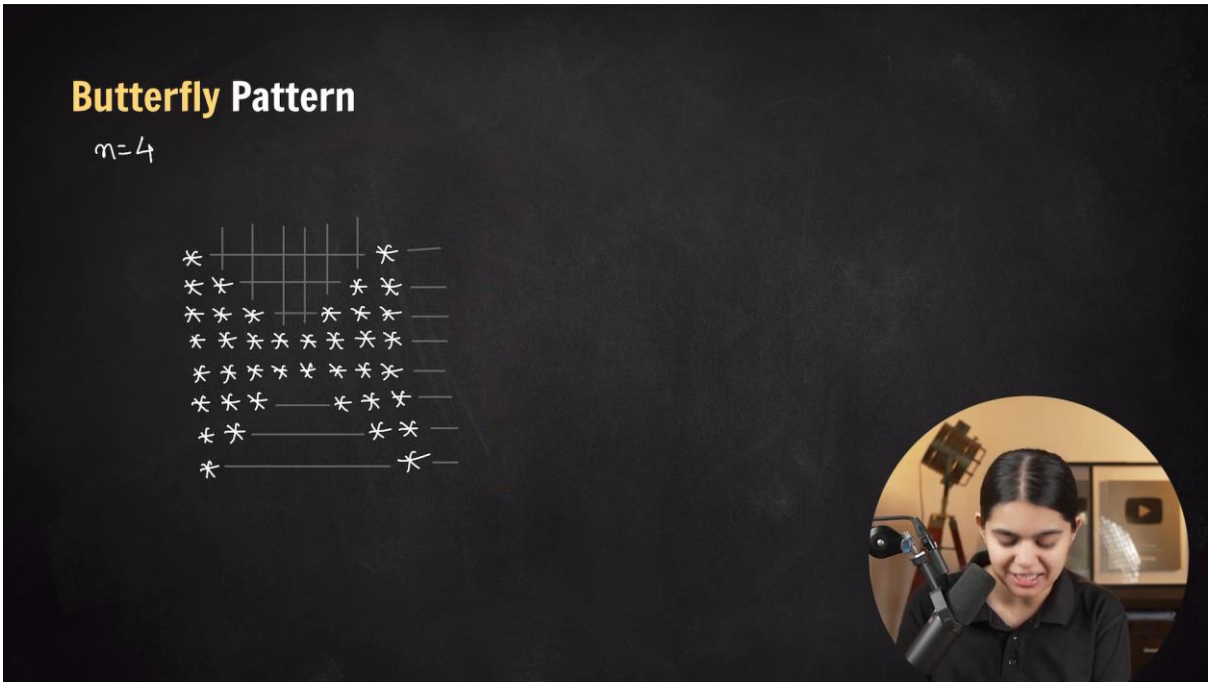

YTSeries
code.cpp
code.cpp > main()
for(int i=0; i<n; i++) {
//spaces : n-i-1
for(int j=0; j<n-i-1; j++) {
cout << " ";
}
//nums1 : i+1
for(int j=1; j<=i+1; j++) {
cout << j;
}
//nums2
for(int j=i; j>0; j--) {
cout << j;
}
cout << endl;
}
PORTS PROBLEMS DEBUG CONSOLE OUTPUT TERMINAL
apnacollege@Shradha YTSeries % g++ code.cpp && ./a.out
1
121
12321
1234321
123454321
12345654321
1234567654321
123456787654321
apnacollege@Shradha YTSeries %

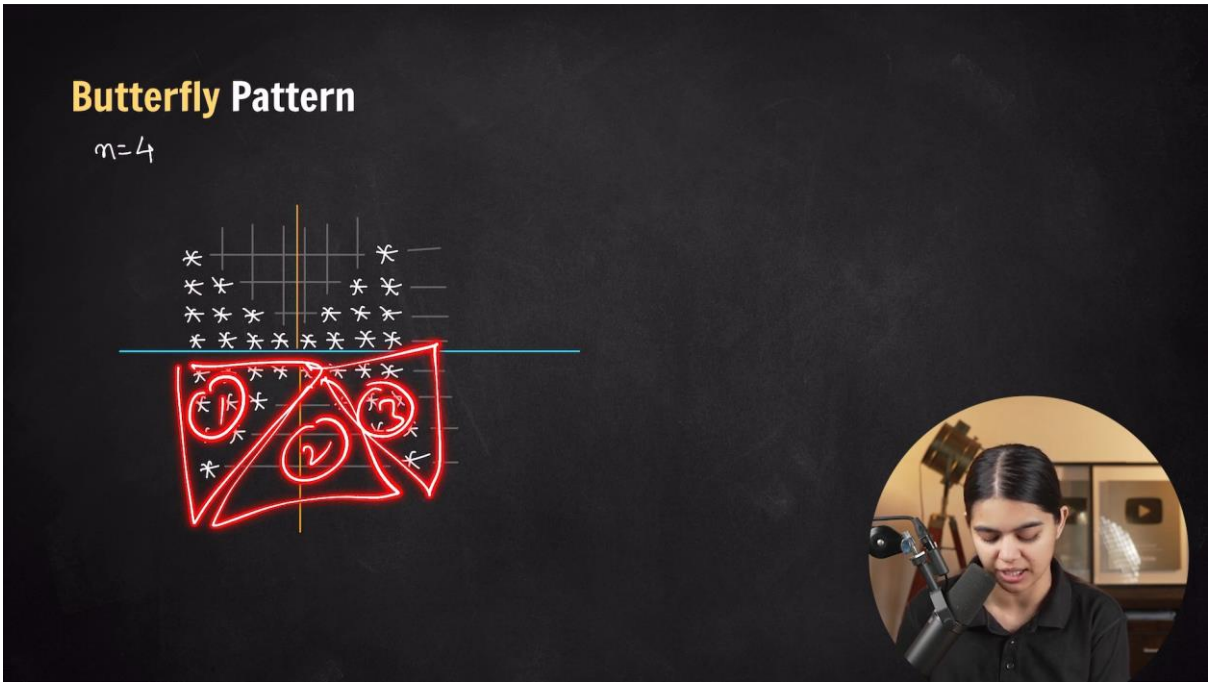

Hollow Diamond Pattern
n = 4
Top
for(i=0; i<n; i++) {
① spaces → (n-i-1) times → " "
if(i!=0)
cout << "*"
② spaces → (2*i-1) → " "
cout << "*"
}
i=0
i=1
i=2
i=3
i=1 ⇒ spaces = 1 ; i=2 spaces=3
i ⇒ 2*i-1


YTSeries
code.cpp
code.cpp > main()
#include <iostream>
using namespace std;
int main() {
int n = 4;
//top
for(int i=0; i<n; i++) {
//spaces
for(int j=0; j<n-i-1; j++) {
cout << " ";
}
cout << "*";
if(i != 0) {
//spaces
for(int j=0; j<2*i-1; j++) {
cout << " ";
}
cout << "*";
}
cout << endl;
}
return 0;
}
PORTS PROBLEMS DEBUG CONSOLE OUTPUT TERMINAL
apnacollege@Shradha YTSeries % g++ code.cpp && ./a.out
*
* *
* *
* *
apnacollege@Shradha YTSeries %


Hollow Diamond Pattern
n = 4
Bottom
for(i=0; i<(n-1); i++)
① spaces → (i+1)
"*"
② spaces 4 (i != n-1)
"*"
2(n-i)-5
i=0
i=1
i=2
3
1
i=0 ⇒ 3
2*(2)-1
i=1 ⇒ 1
2*1
2*(n-2-i)-1
2(n-i)-5


YTSeries
code.cpp
code.cpp > main()
//bottom
for(int i=0; i<n-1; i++) { //0 to n-2
//spaces
for(int j=0; j<i+1; j++) {
cout << " ";
}
cout << "*";
if(i != n-2) {
//spaces
for(int j=0; j<2*(n-i)-5; j++) {
cout << " ";
}
cout << "*";
}
cout << endl;
}
PORTS
PROBLEMS
DEBUG CONSOLE
OUTPUT
TERMINAL
apnacollege@Shradha YTSeries % g++ code.cpp && ./a.out
apnacollege@Shradha YTSeries %


Butterfly Pattern
n=4



Homework Solution:

```
#include <iostream>
using namespace std;

int main() {
  int n = 4;

  // Top half
  for (int i = 0; i < n; i++) {
    for (int j = 0; j <= i; j++) {
      cout << "*";
    }

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

    for (int j = 0; j <= i; j++) {
      cout << "*";
    }
    cout << endl;
  }
```

```
    // Bottom half
    for (int i = 0; i < n; i++) {
        for (int j = 0; j < n - i; j++) {
            cout << "*";
        }

        for (int j = 0; j < 2 * i; j++) {
            cout << " ";
        }

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

        cout << endl;
    }

    return 0;
}
```