MA144: Problem Solving and Computer Programming

Lecture-13

Loops, break, continue

Loops

- Group of statements that are executed repeatedly while some condition remains true
- Each execution of the group of statements is called an iteration of the loop
    - for
    - while
    - do-while

```
for()
 {    statement-1;
      statement-2;
      statement-3;
 }
```

for loop

```
for(expr1; expr2; expr3)
 {    statement-1;
      statement-2;
      statement-3;
 }
```

- expr1 (initialization) : initialize parameters
- expr2 (loop-continuation test): loop continues if expression is non-zero
- expr3 (update): used to alter the value of the parameters after each iteration

- Initialization, loop-continuation test, and update can contain arithmetic expressions

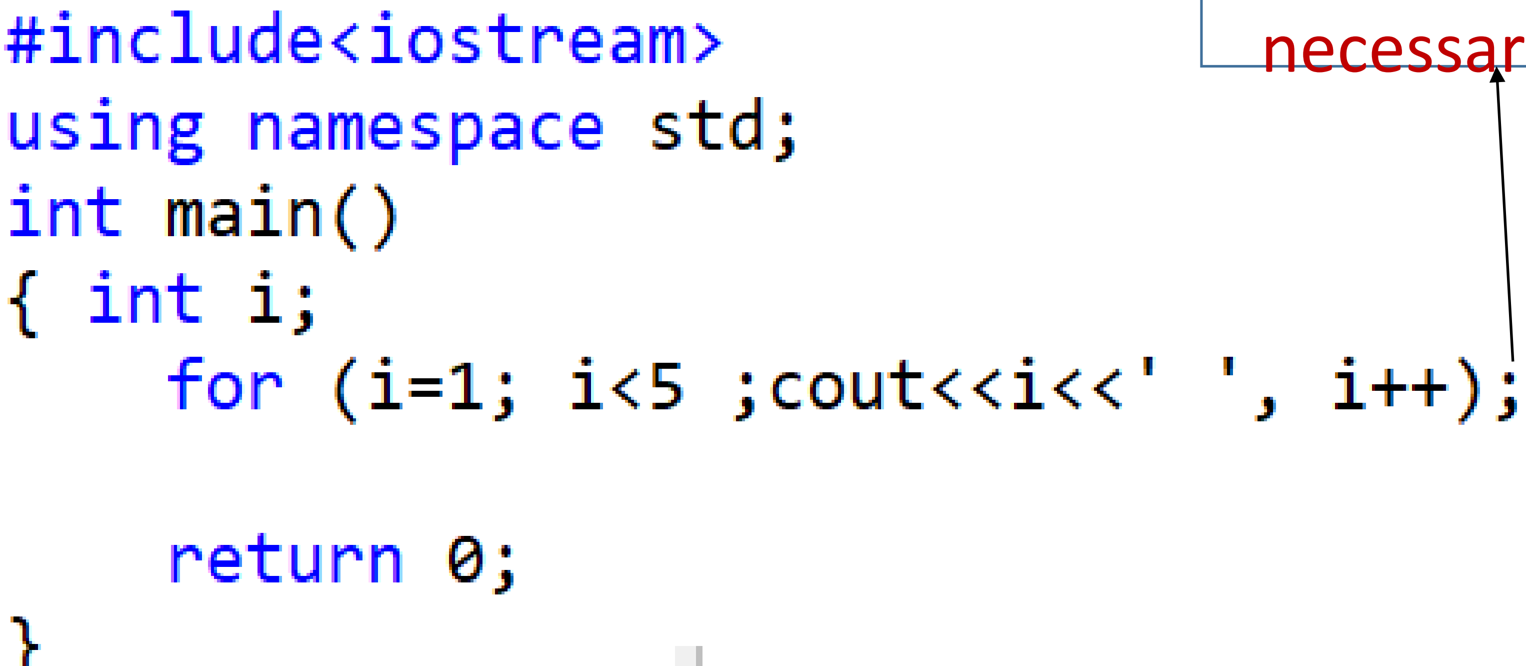
```
for(i=a+b; i!=2*c%d; i+=a/d)
```

  - Update may be negative (decrement)

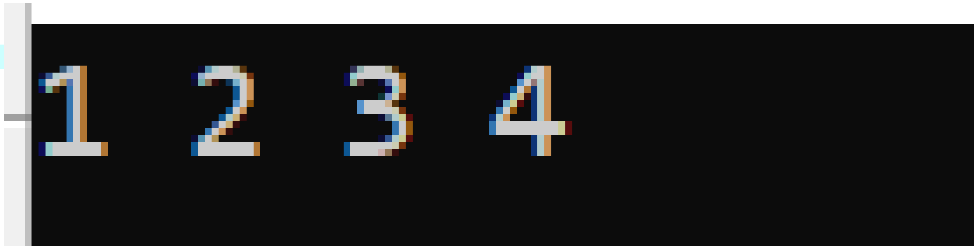
    ```
    for (i = 10; i >= 0; --i)
    ```

- We can give several expressions separated by commas in place of expr1 and expr3 in a for loop to do *multiple* assignments

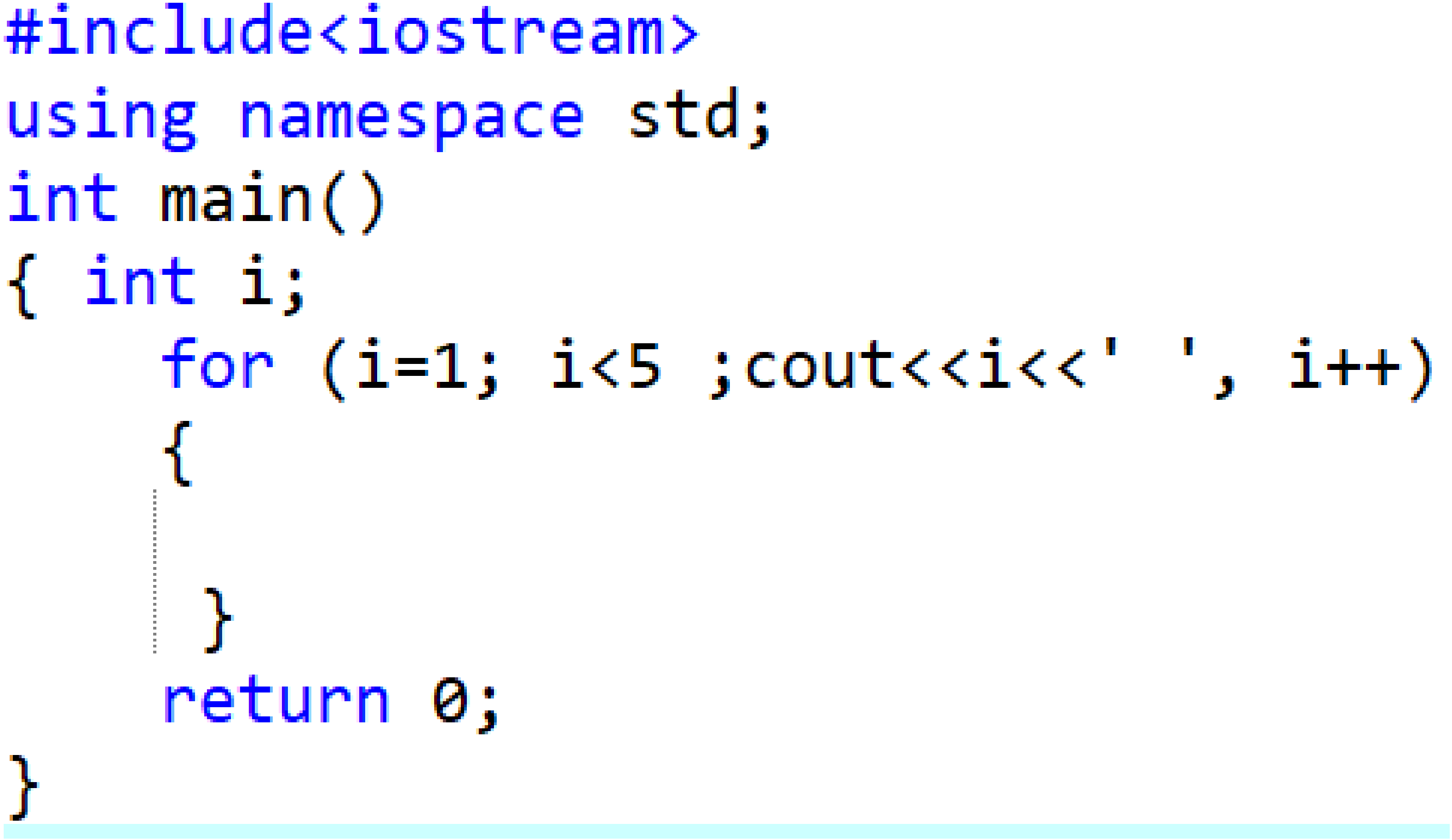
; is necessary



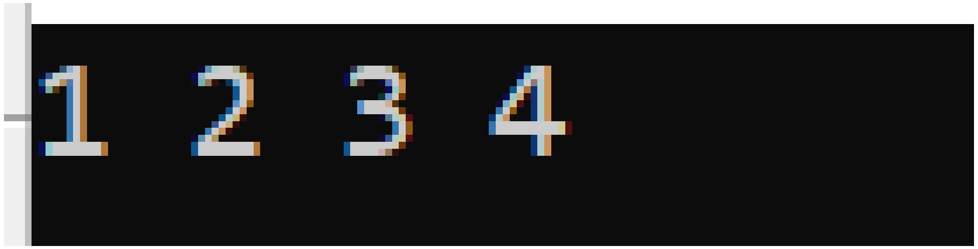
```
#include<iostream>
using namespace std;
int main()
{ int i;
    for (i=1; i<5 ;cout<<i<<' ', i++);

    return 0;
}
```



```
1 2 3 4
```



```
#include<iostream>
using namespace std;
int main()
{ int i;
    for (i=1; i<5 ;cout<<i<<' ', i++)
    {

     }
    return 0;
}
```



```
1 2 3 4
```

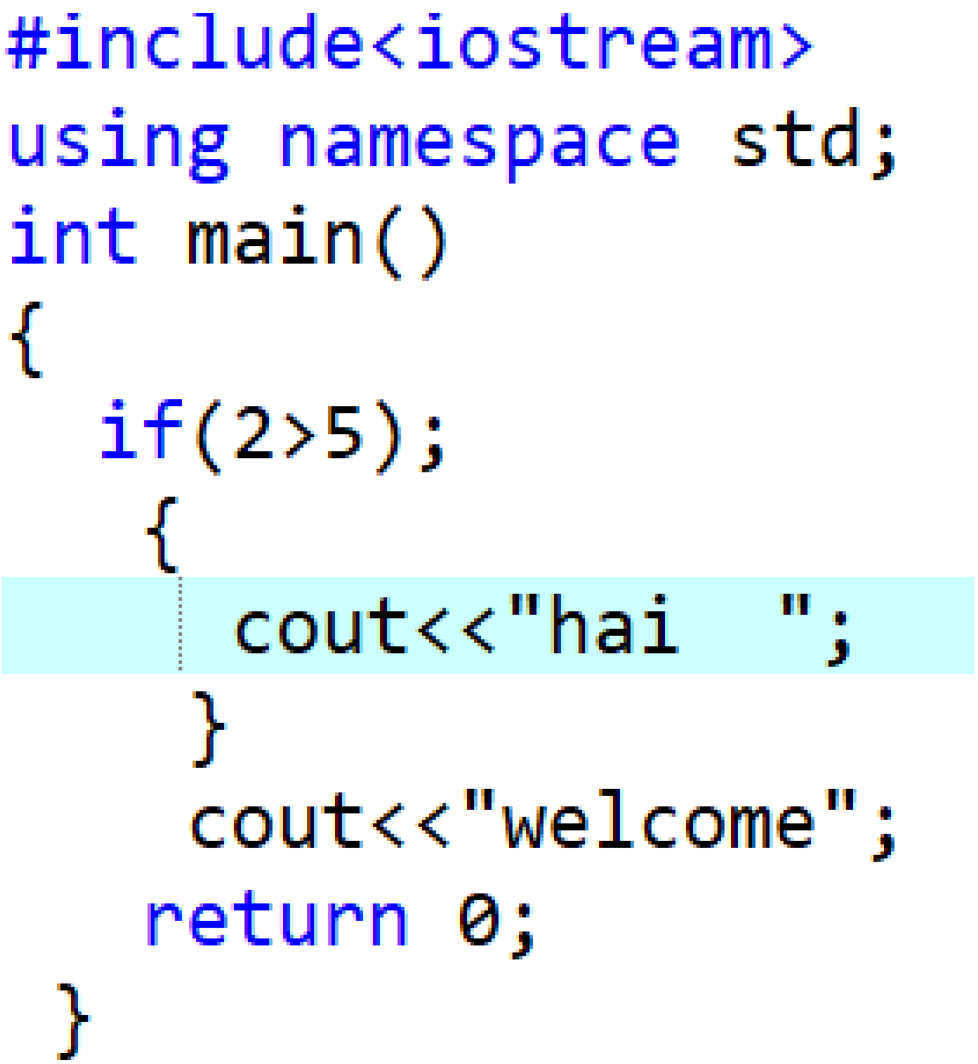
Semicolon ;

is same as

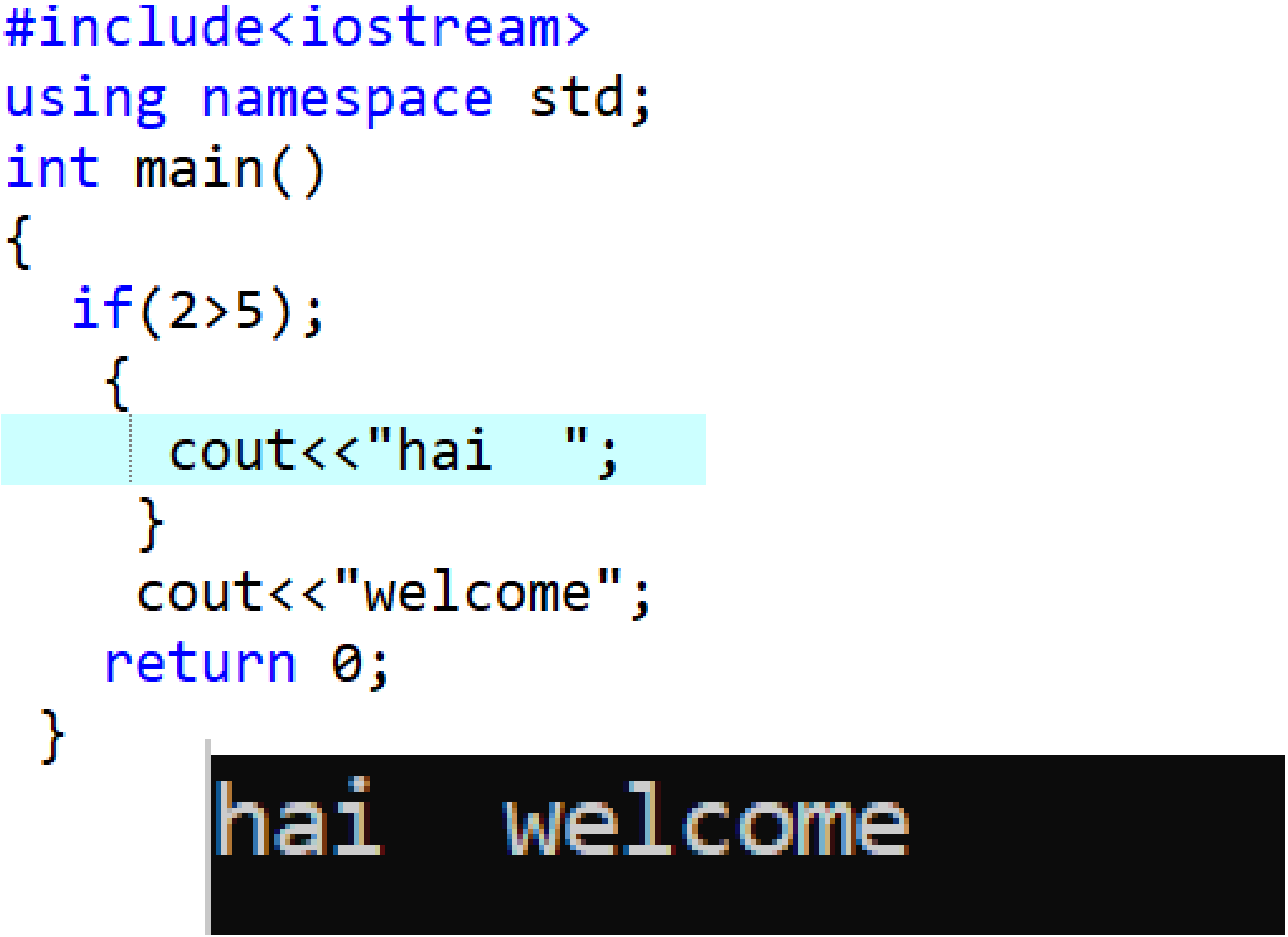
{

} empty block

Guess the output of the following program.

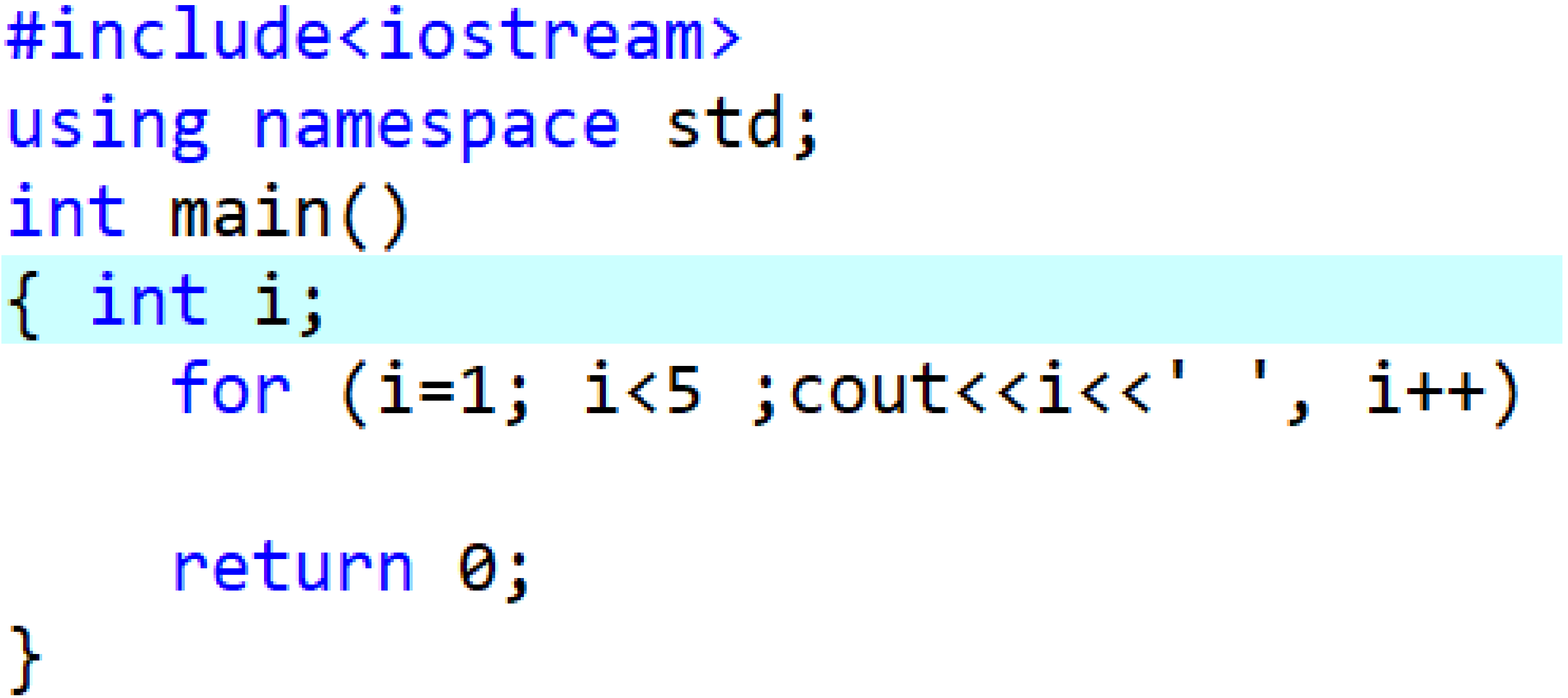


```
#include<iostream>
using namespace std;
int main()
{
  if(2>5);
   {
     cout<<"hai  ";
    }
    cout<<"welcome";
   return 0;
 }
```



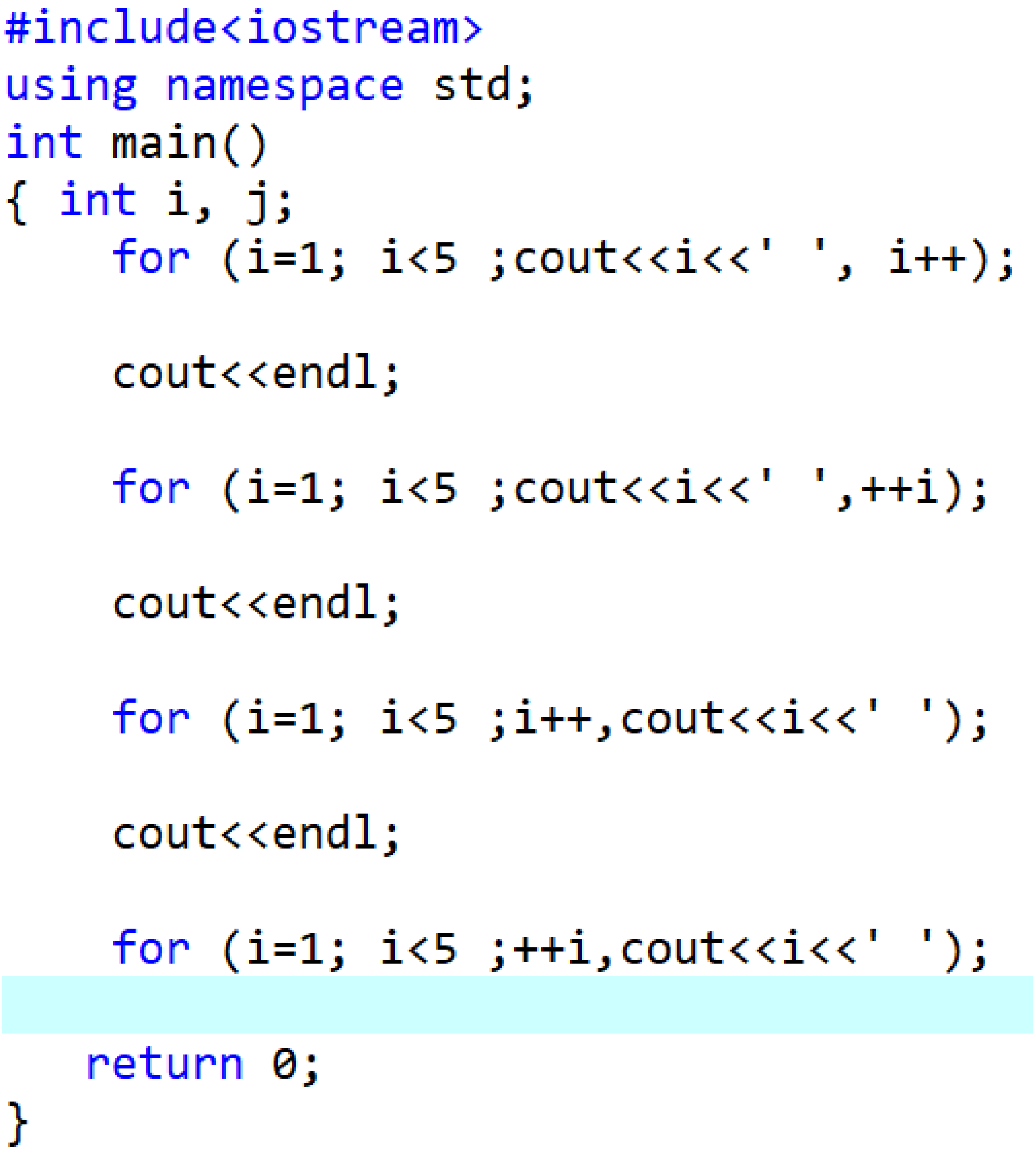
```cpp
#include<iostream>
using namespace std;
int main()
{
  if(2>5);
   {
     cout<<"hai  ";
    }
    cout<<"welcome";
   return 0;
 }
```

```
hai  welcome
```

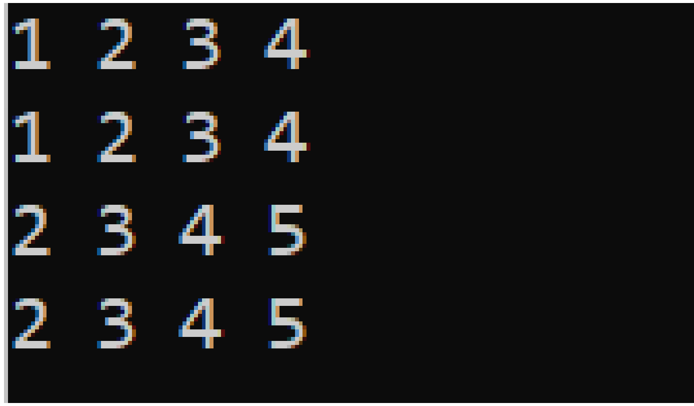


```
#include<iostream>
using namespace std;
int main()
{ int i;
    for (i=1; i<5 ;cout<<i<<' ', i++)

    return 0;
}
```

[redacted]

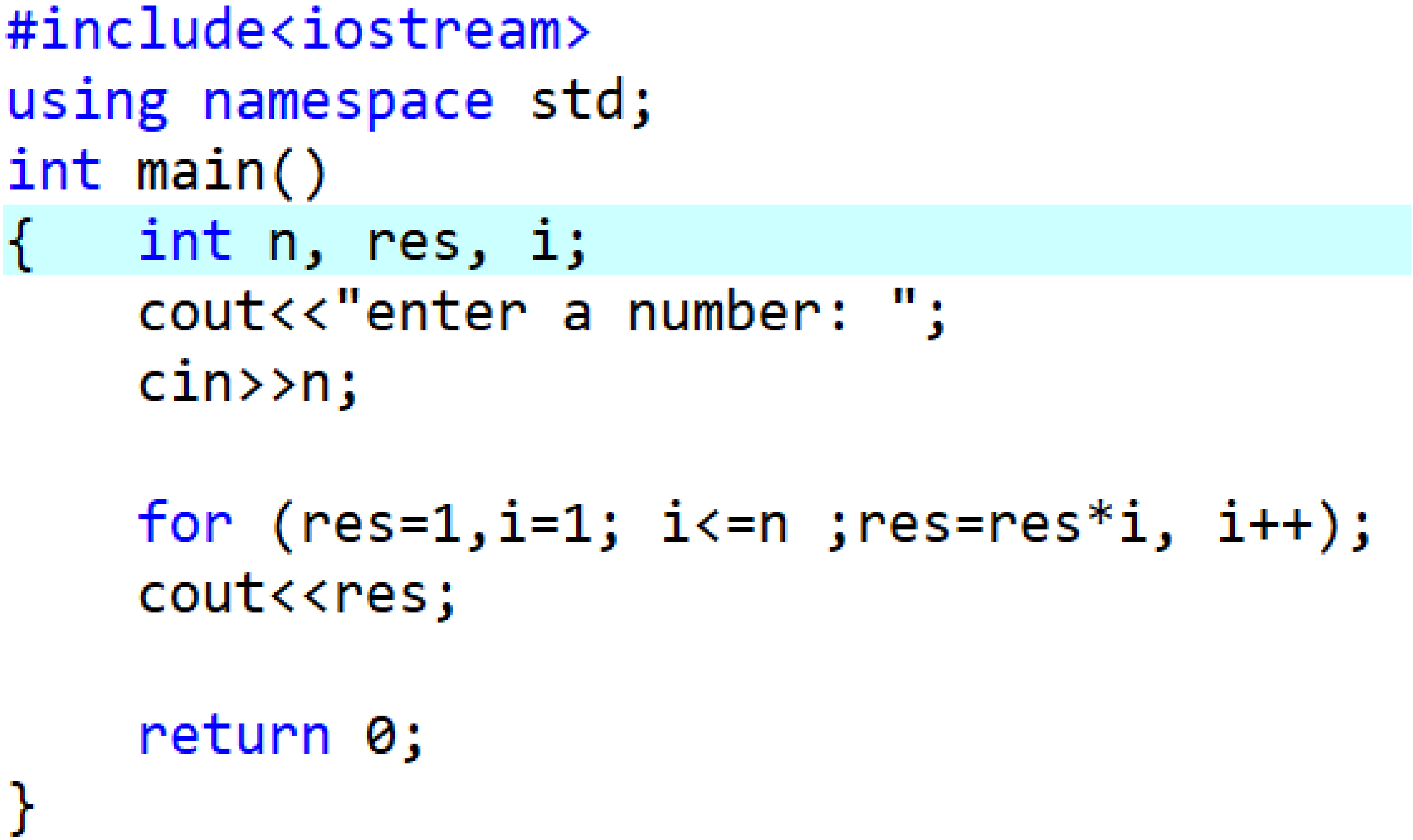


```
#include<iostream>
using namespace std;
int main()
{ int i, j;
    for (i=1; i<5 ;cout<<i<<' ', i++);

    cout<<endl;

    for (i=1; i<5 ;cout<<i<<' ',++i);

    cout<<endl;

    for (i=1; i<5 ;i++,cout<<i<<' ');

    cout<<endl;

    for (i=1; i<5 ;++i,cout<<i<<' ');

   return 0;
}
```



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

Guess the output of the following program.



```
#include<iostream>
using namespace std;
int main()
{   int n, res, i;
    cout<<"enter a number: ";
    cin>>n;

    for (res=1,i=1; i<=n ;res=res*i, i++);
    cout<<res;

    return 0;
}
```

Infinite Loops

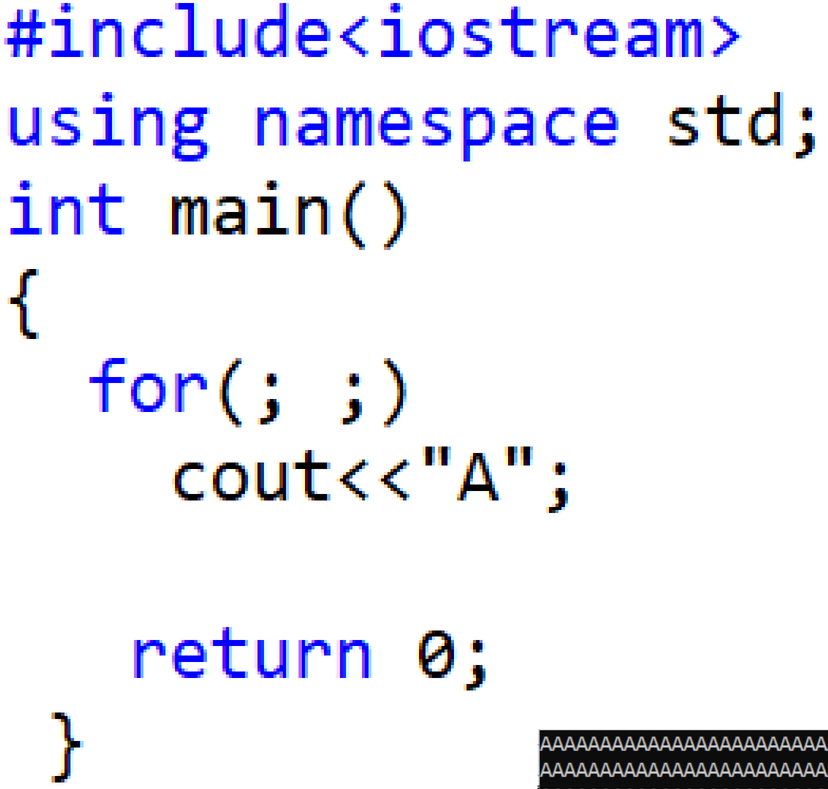
```
for(; ;)
{   statement1;
    statement2;
    statement3;
}
```

```
while(1)
{   statement1;
    statement2;
    statement3;
}
```

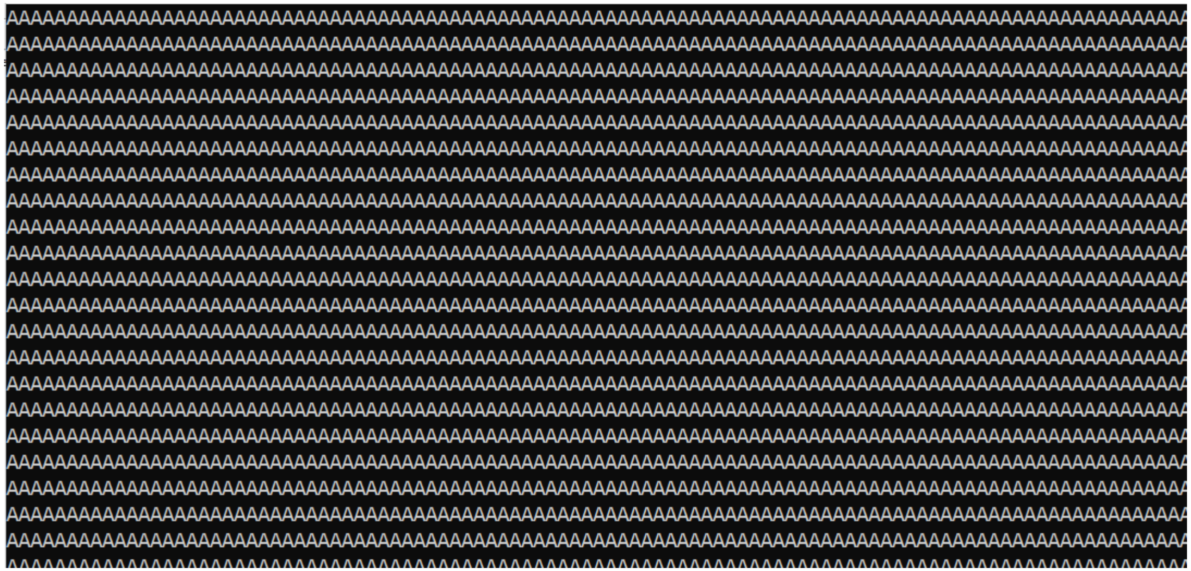
```
do
{   statement1;
    statement2;
    statement3;
}while(1)
```

Condition is necessary in while and do-while

Infinite for Loop



```
#include<iostream>
using namespace std;
int main()
{
   for(; ;)
     cout<<"A";

    return 0;
 }
```



```
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```
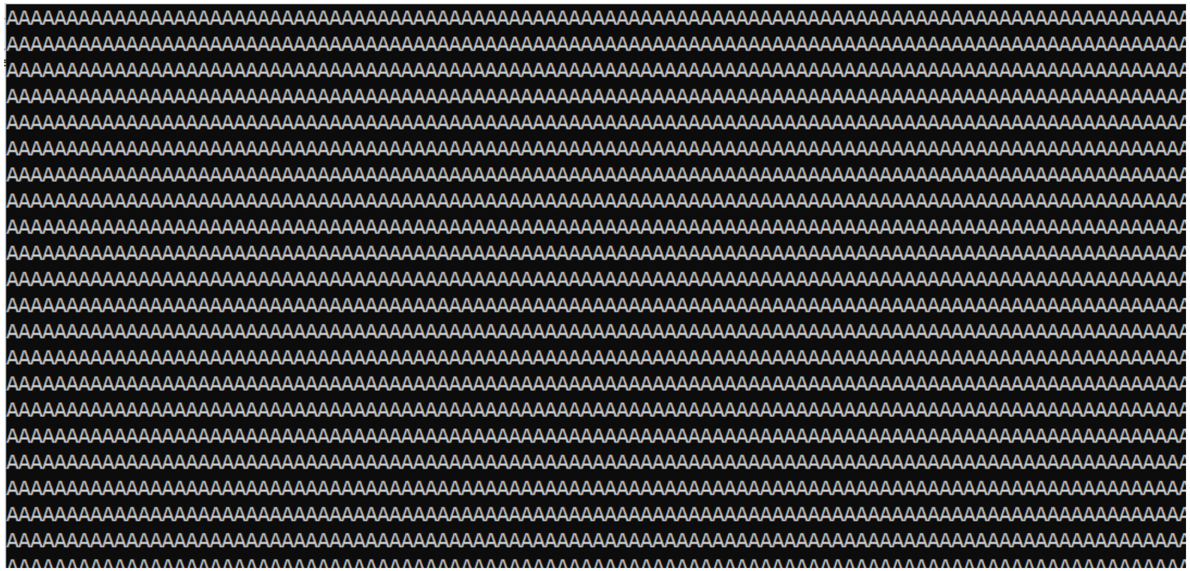

```
#include<iostream>
using namespace std;
int main()
{ int i;
  for(i=1; ;i++)
    cout<<"A";

   return 0;
 }
```

Another
Infinite for Loop



```
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```
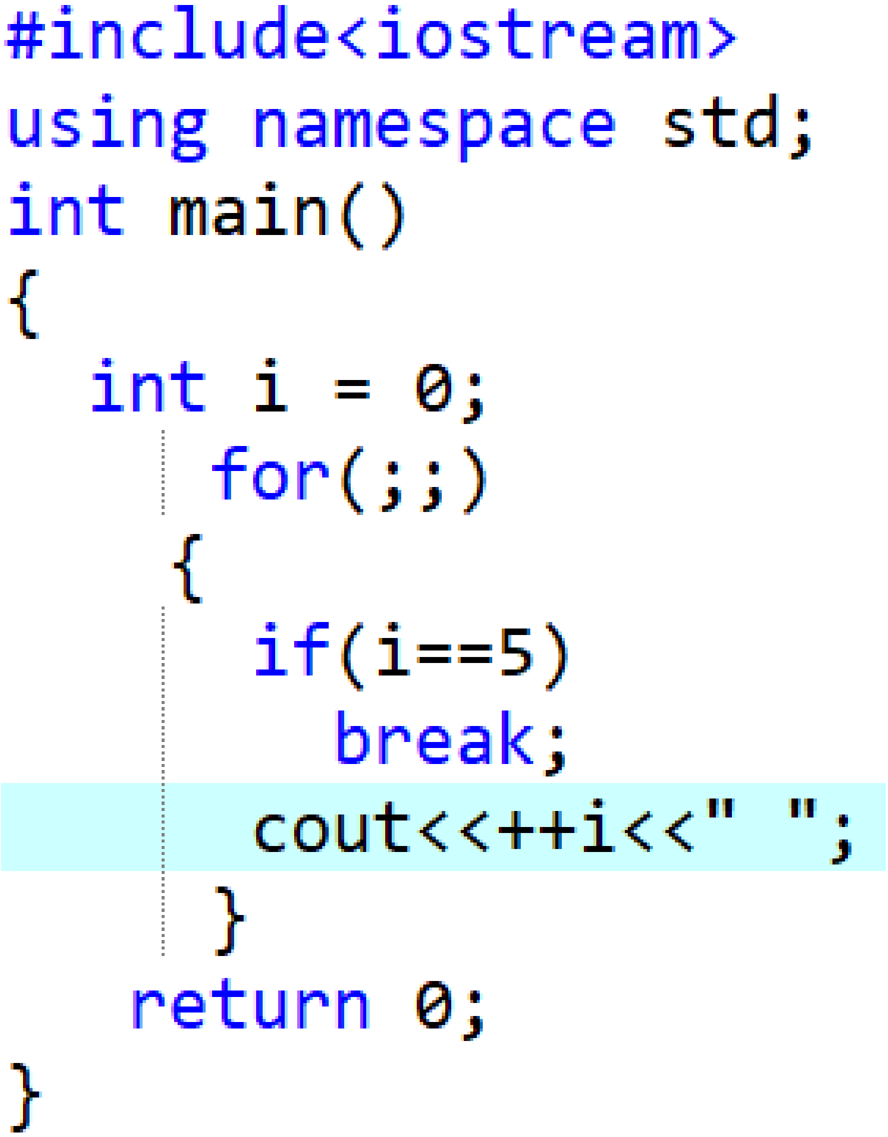
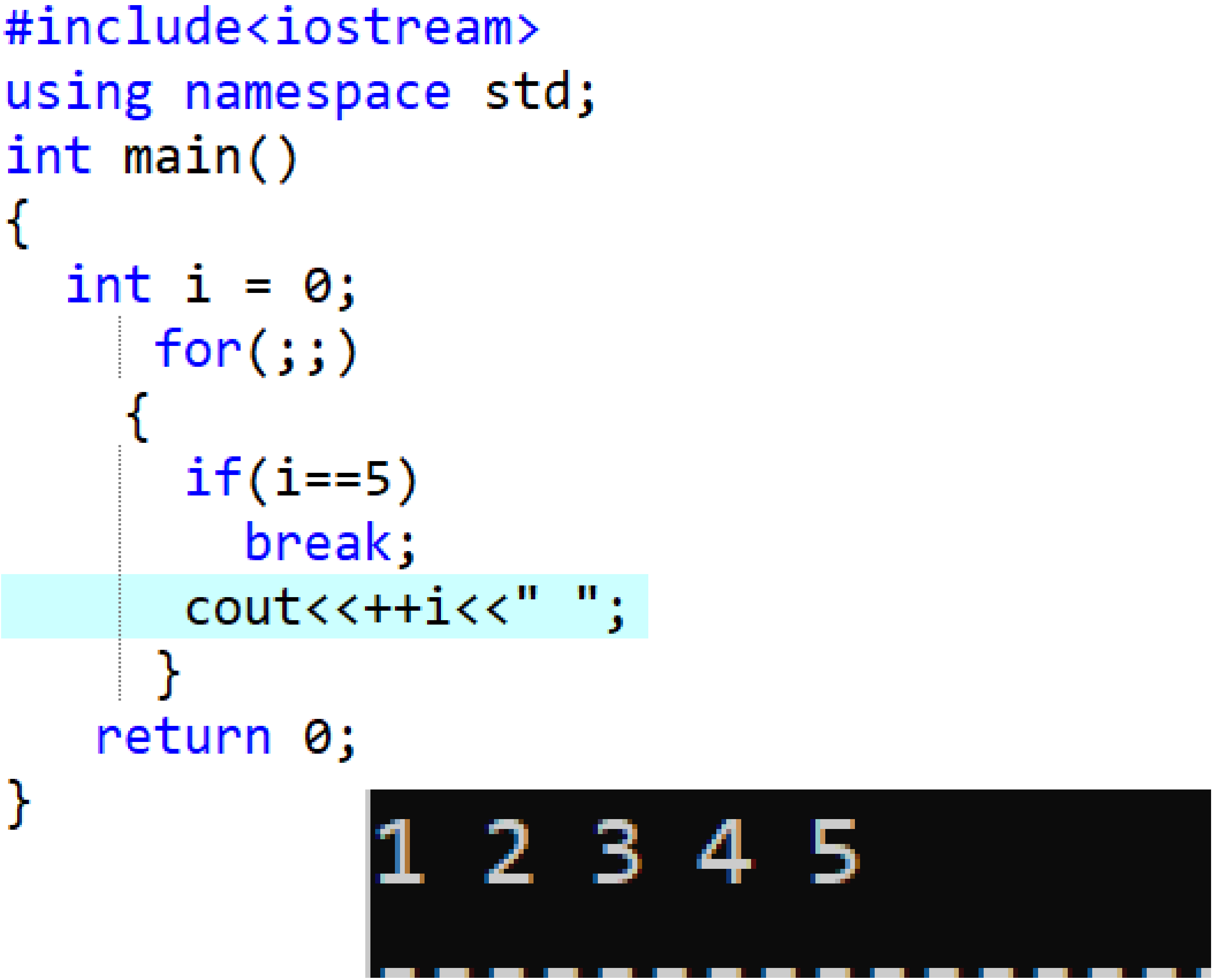

Find out the output of the following program.



```
#include<iostream>
using namespace std;
int main()
{
  int i = 0;
     for(;;)
    {
      if(i==5)
        break;
      cout<<++i<<" ";
     }
   return 0;
}
```



```cpp
#include<iostream>
using namespace std;
int main()
{
  int i = 0;
     for(;;)
    {
      if(i==5)
        break;
      cout<<++i<<" ";
     }
   return 0;
}
```

```
1 2 3 4 5
```

Relation between for and while loops.

```
for(expr1; expr2; expr3)
 {    statement-1;
      statement-2;
      statement-3;
 }
```

same as

```
expr1;
while(expr2)
 {    statement-1;
      statement-2;
      statement-3;
     expr3;
 }
```

The `break` statement

- Break out of the loop body { }
  - can use with while, do-while, for, switch
  - does not work with if, if-else

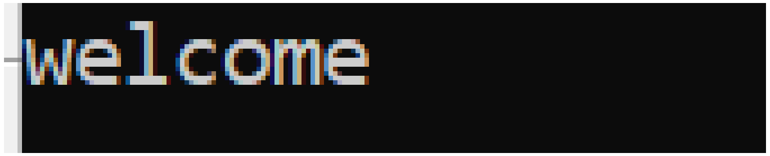
```
#include<iostream>
using namespace std;
int main()
{
  int i;
  if(5>3)
   break;

   cout<<"hai";
   return 0;
 }
```

✗

[Error] break statement not within loop or switch

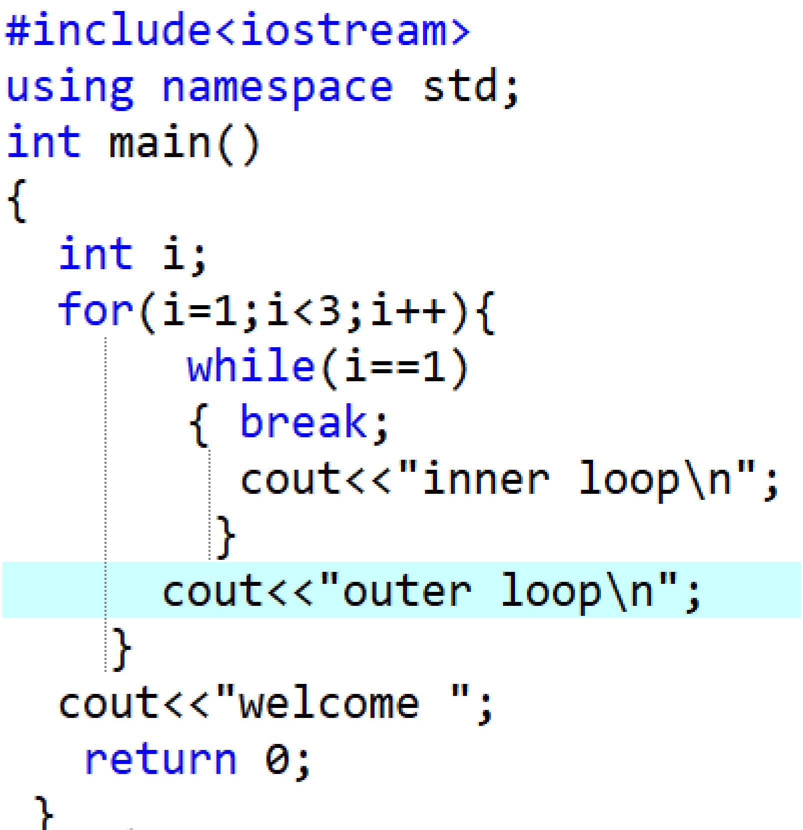
```
#include<iostream>
using namespace std;
int main()
{
  int i;
  for(i=1;i<10;i++){
       if(5>3)
          break;

       cout<<"hai";
   }
  cout<<"welcome";
   return 0;
 }
```

✓

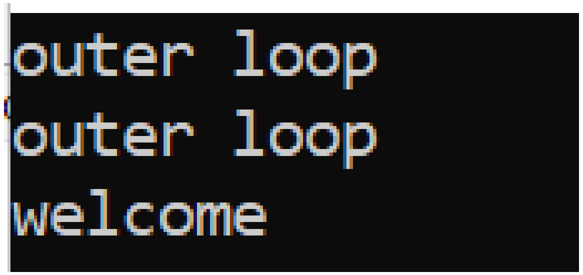


```
welcome
```

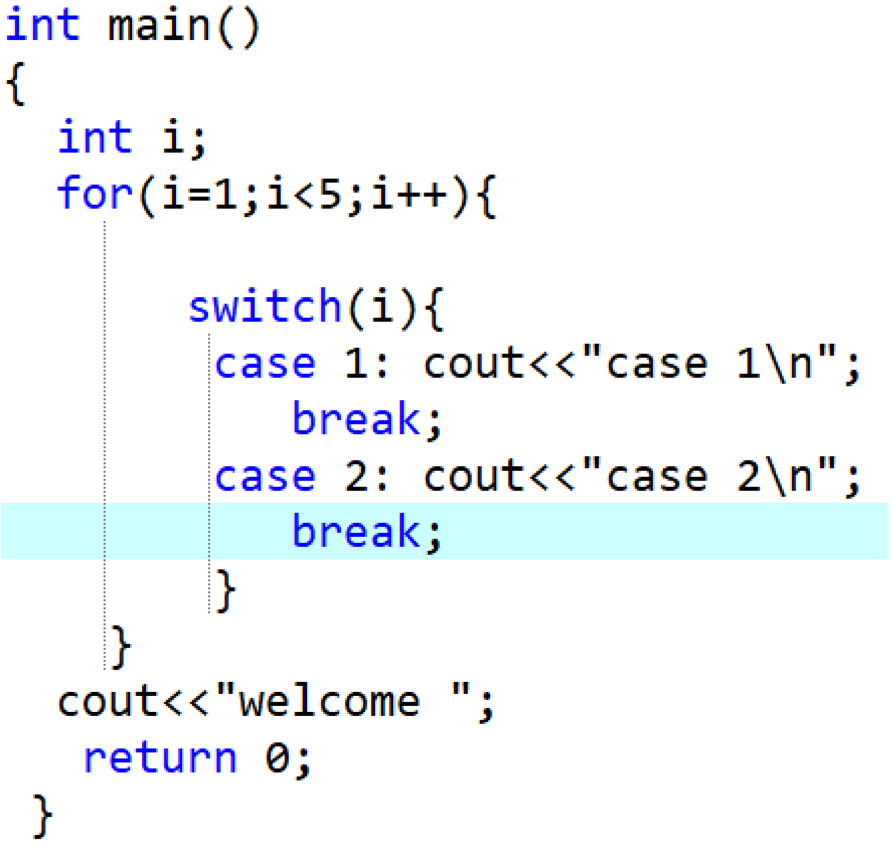
- ends only the innermost loop/switch that contains it.



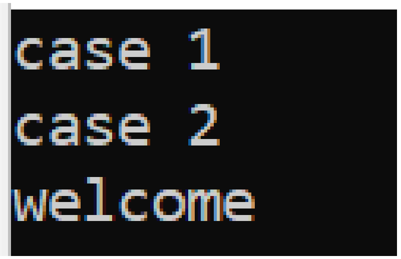
```
#include<iostream>
using namespace std;
int main()
{
  int i;
  for(i=1;i<3;i++){
       while(i==1)
       { break;
         cout<<"inner loop\n";
        }
      cout<<"outer loop\n";
    }
  cout<<"welcome ";
   return 0;
 }
```



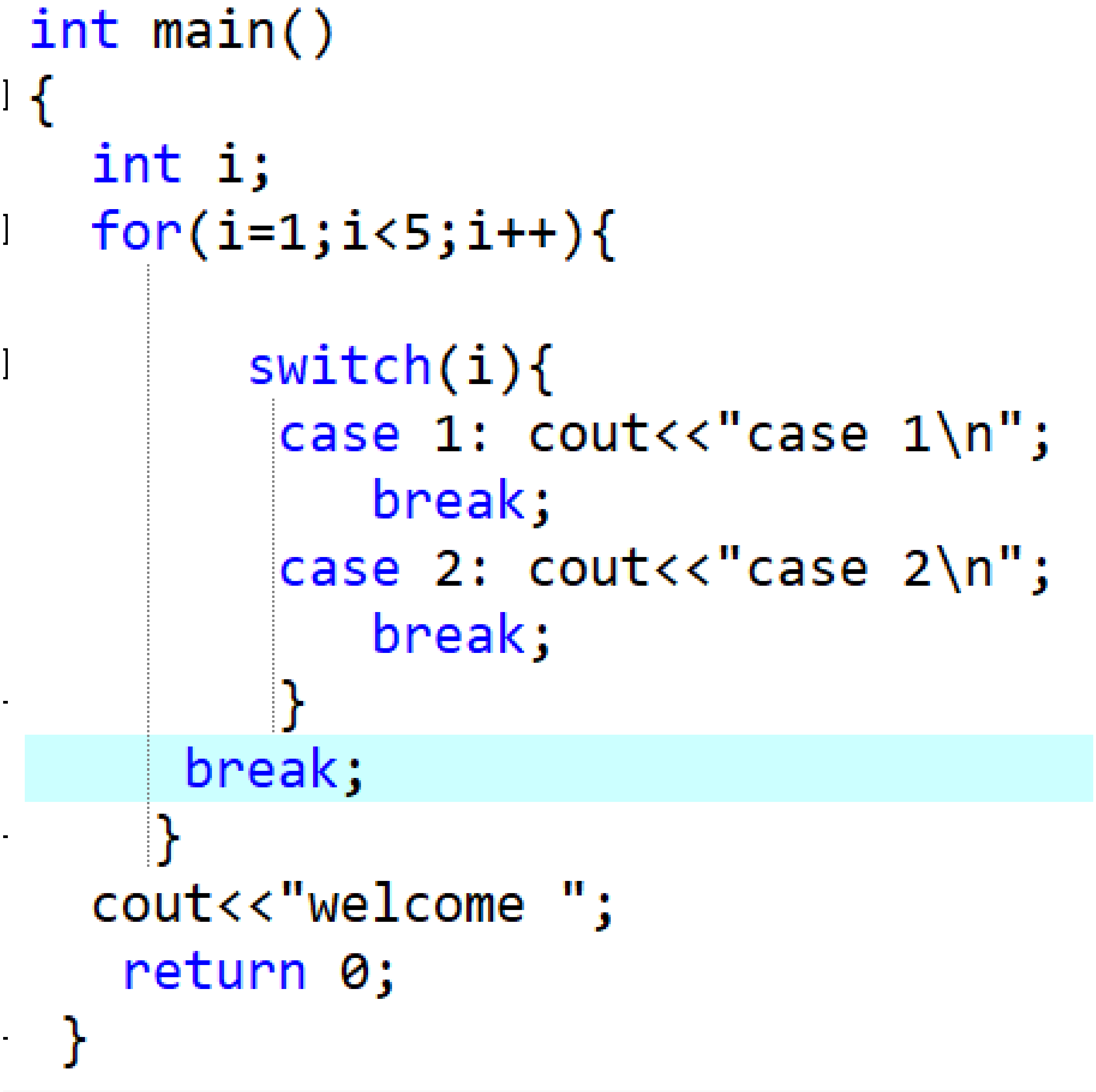
```
outer loop
outer loop
welcome
```



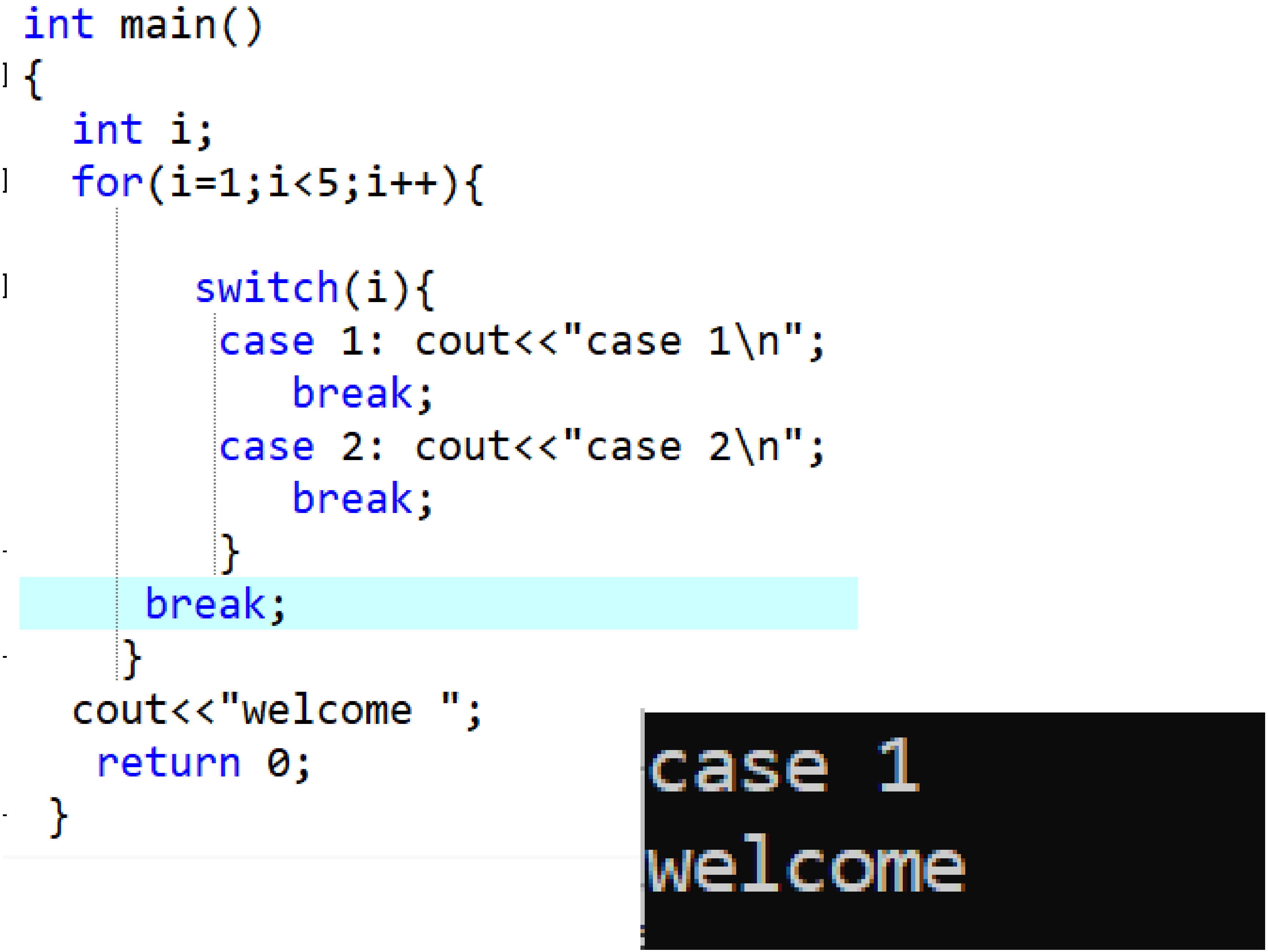
```
int main()
{
  int i;
  for(i=1;i<5;i++){

       switch(i){
        case 1: cout<<"case 1\n";
           break;
        case 2: cout<<"case 2\n";
           break;
        }
    }
  cout<<"welcome ";
   return 0;
 }
```



```
case 1
case 2
welcome
```



```
int main()
{
  int i;
  for(i=1;i<5;i++){

       switch(i){
        case 1: cout<<"case 1\n";
           break;
        case 2: cout<<"case 2\n";
           break;
        }
     break;
    }
  cout<<"welcome ";
   return 0;
 }
```



```
int main()
{
  int i;
  for(i=1;i<5;i++){

       switch(i){
        case 1: cout<<"case 1\n";
           break;
        case 2: cout<<"case 2\n";
           break;
        }
    break;
    }
  cout<<"welcome ";
   return 0;
 }
```

```
case 1
welcome
```

The `continue` statement

Syntax

```
continue;
```

- opposite to that of break statement,
- instead of terminating the loop, it forces to execute the next iteration of the loop
- when the continue statement is executed in the loop,

  (i) the code inside the loop following the continue statement will be skipped

  (ii) next iteration of the loop will begin.

```
for(i=1; i<=10; i++)
{   statement-1;
    statement-2;
    continue;
    statement-3;
    statement-4;
}
```

❌

Difference between `continue` and `break`

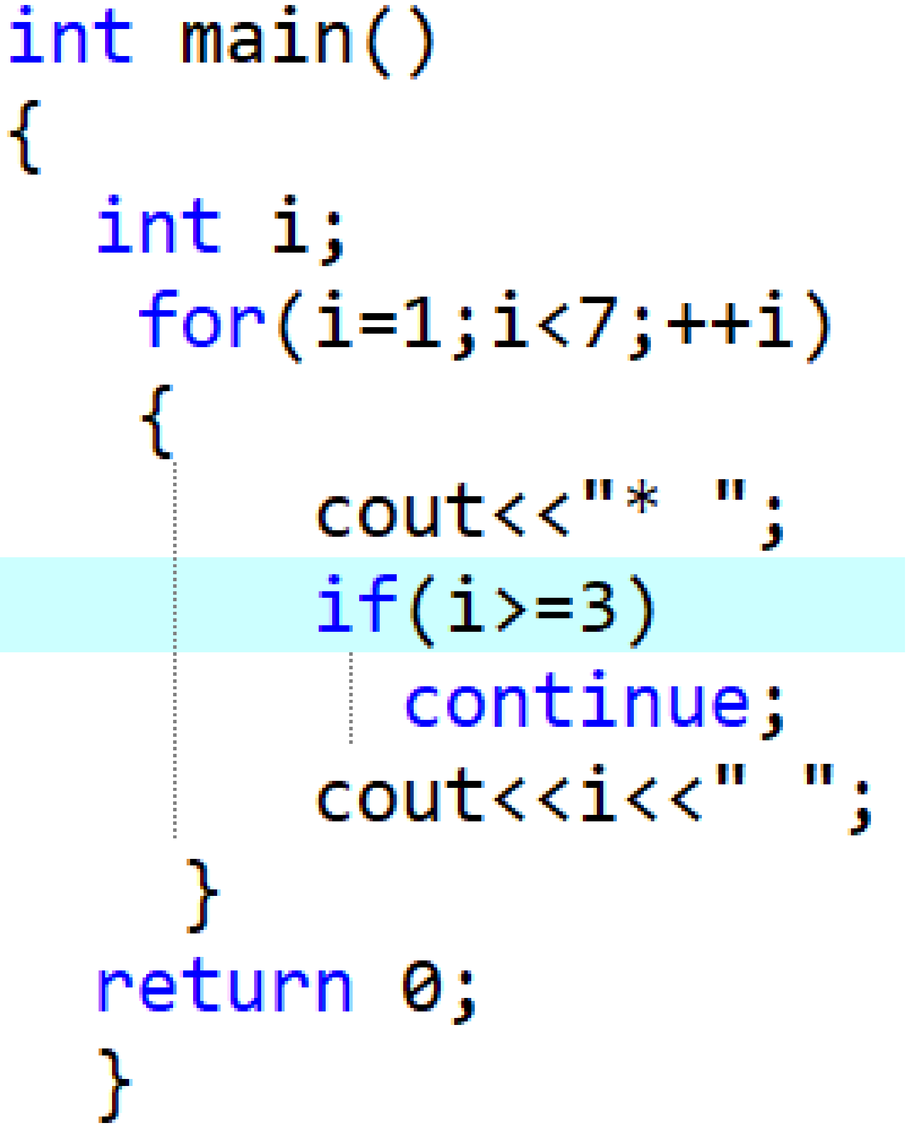
`break`

- exits loop

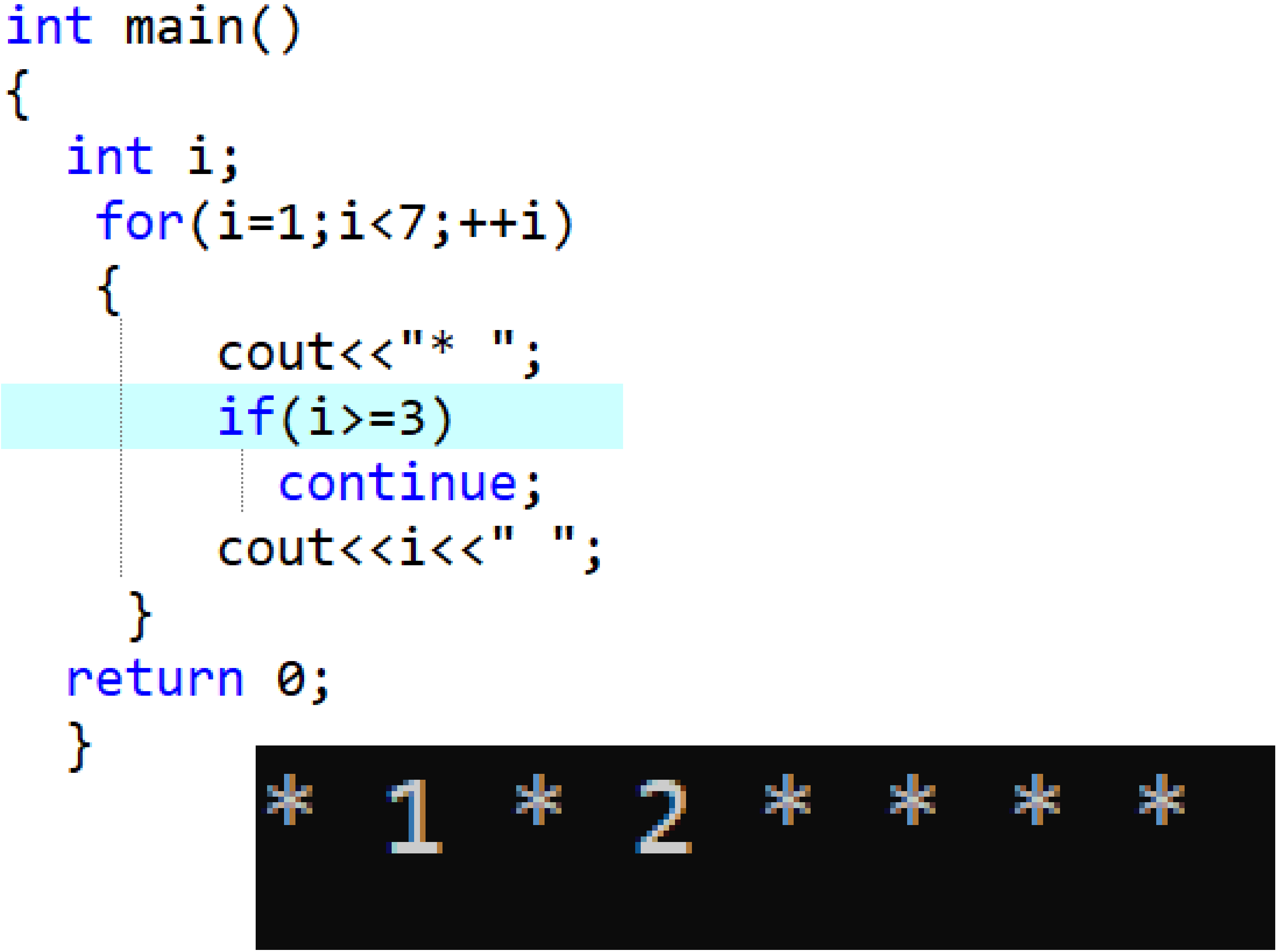
`continue`

- exits the current iteration of the loop

What would be the output ?



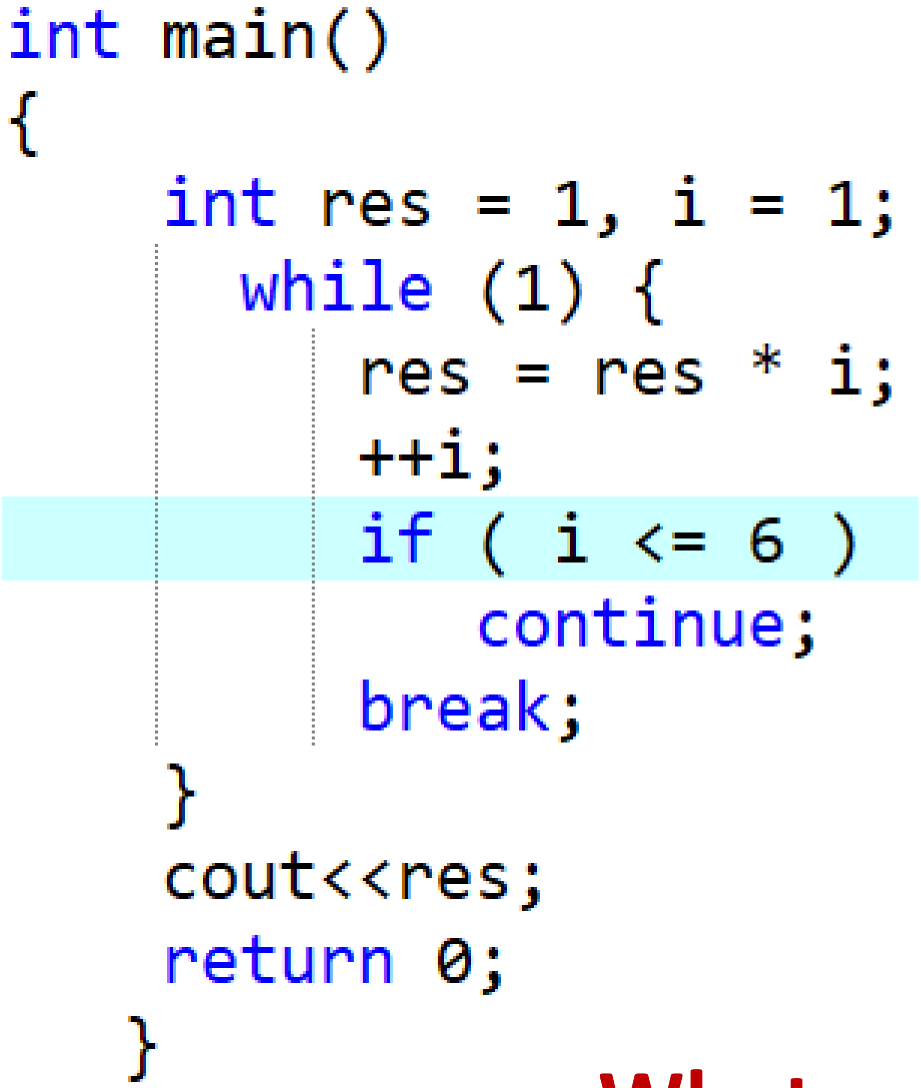
```
int main()
{
   int i;
    for(i=1;i<7;++i)
    {
          cout<<"*  ";
          if(i>=3)
             continue;
          cout<<i<<"  ";
     }
   return 0;
   }
```



```
int main()
{
  int i;
   for(i=1;i<7;++i)
   {
       cout<<"* ";
       if(i>=3)
         continue;
       cout<<i<<" ";
    }
  return 0;
  }
```

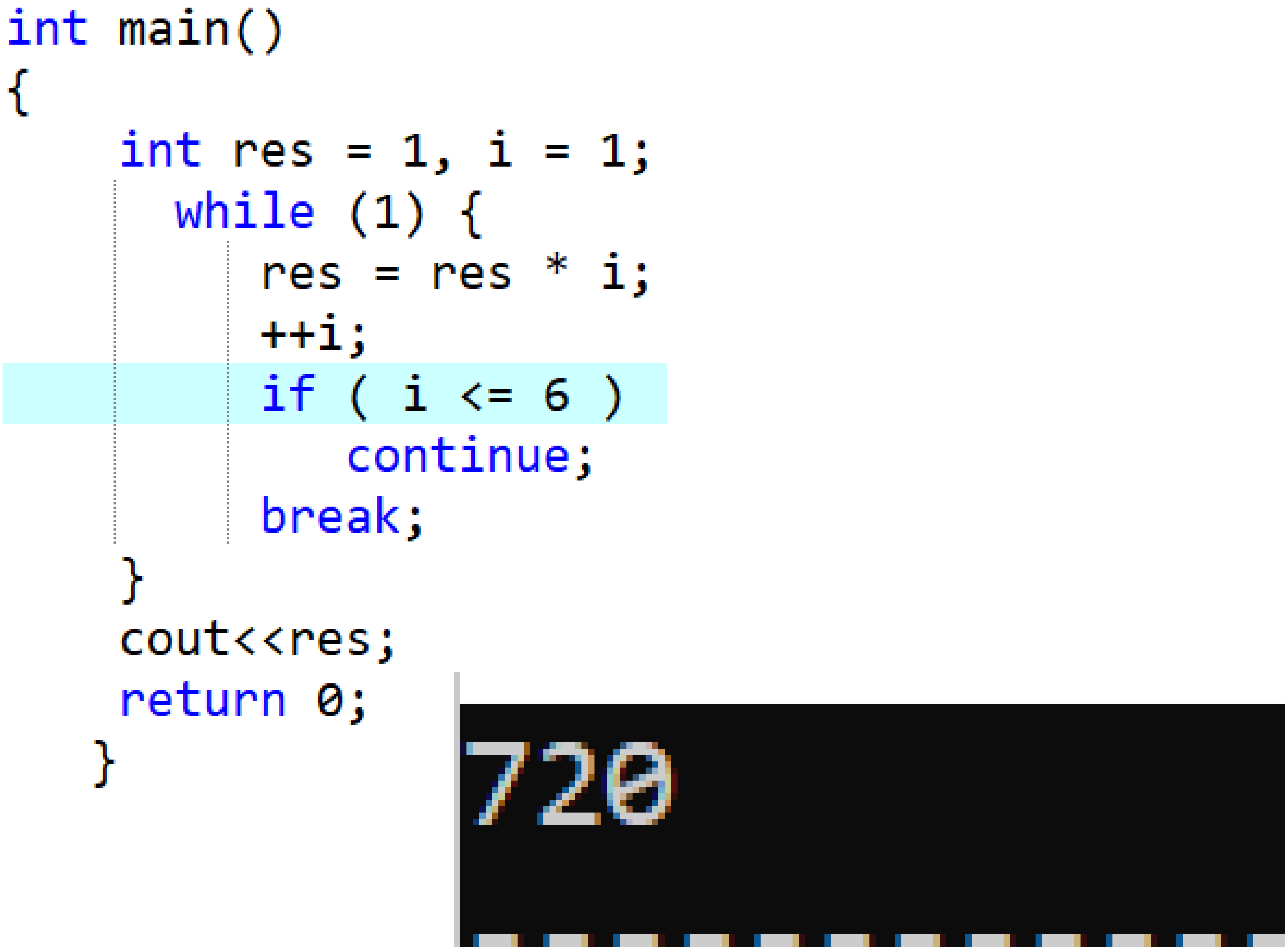
```
* 1 * 2 * * * *
```

Usage of both continue and break



```
int main()
{
    int res = 1, i = 1;
      while (1) {
         res = res * i;
         ++i;
         if ( i <= 6 )
            continue;
         break;
    }
    cout<<res;
    return 0;
   }
```

What would be the output ?

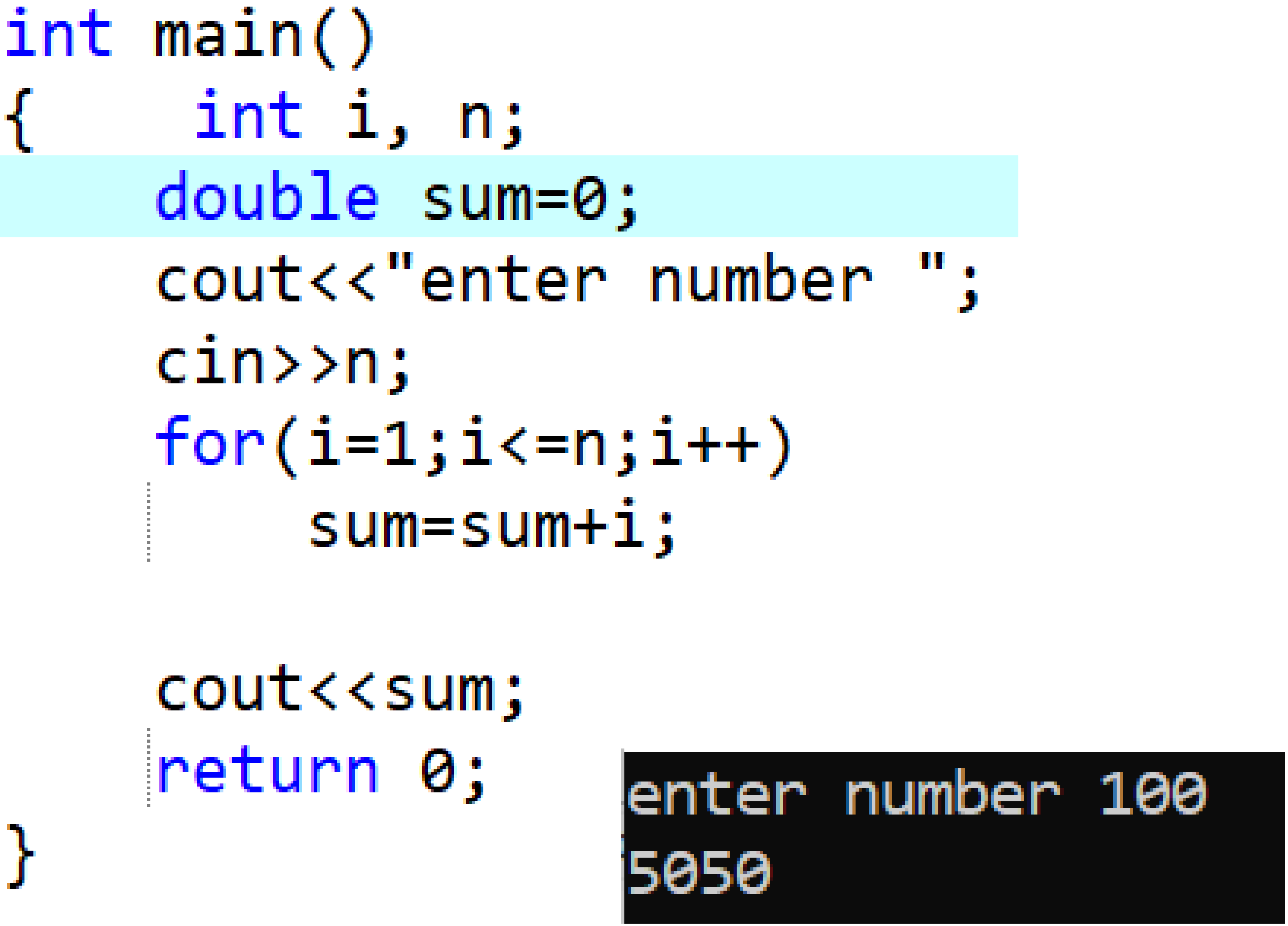


```
int main()
{
    int res = 1, i = 1;
      while (1) {
         res = res * i;
         ++i;
         if ( i <= 6 )
            continue;
         break;
    }
    cout<<res;
    return 0;
  }
```

```
720
```

Programs on finding sum of the series

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

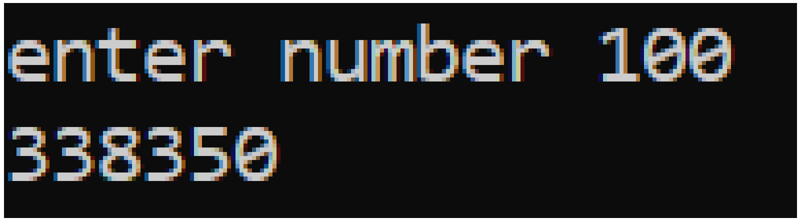


```
int main()
{      int i, n;
     double sum=0;
     cout<<"enter number ";
     cin>>n;
     for(i=1;i<=n;i++)
           sum=sum+i;

     cout<<sum;
     return 0;
}
```

```
enter number 100
5050
```

$$\mathbf{1^2 + 2^2 + 3^2 + 4^2 + \cdots + \boldsymbol{n}^2}$$

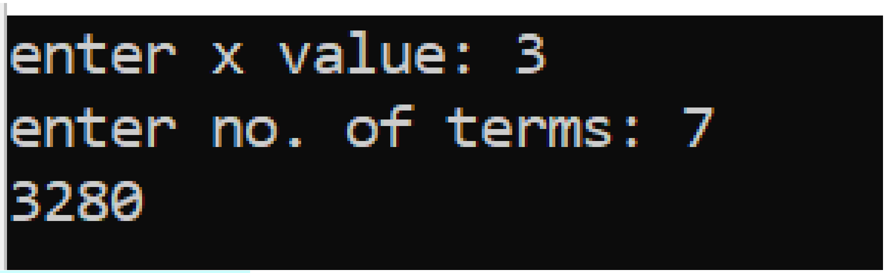
```cpp
int main()
{     int i, n;
      double sum=0;
      cout<<"enter number ";
      cin>>n;
      for(i=1;i<=n;i++)
              sum=sum+i*i;

      cout<<sum;
      return 0;
}
```



```
enter number 100
338350
```

$$1 + x + x^2 + x^3 + x^4 + \cdots + x^n$$

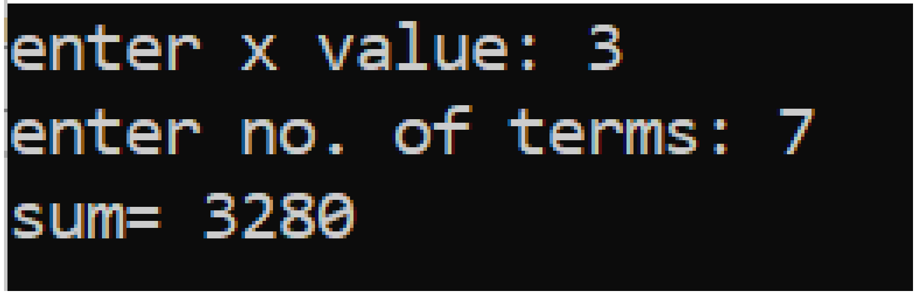
```
int main()
{     int i, n, x, j;
      double sum=1, t ;
      cout<<"enter x value: ";
      cin>>x;
      cout<<"enter no. of terms: ";
      cin>>n;
      for(i=1;i<=n;i++)
      {
         t=1;
         for(j=1;j<=i;j++)
                t=t*x;
         sum=sum+t;
       }
      cout<<sum;
      return 0;
}
```



```
enter x value: 3
enter no. of terms: 7
3280
```

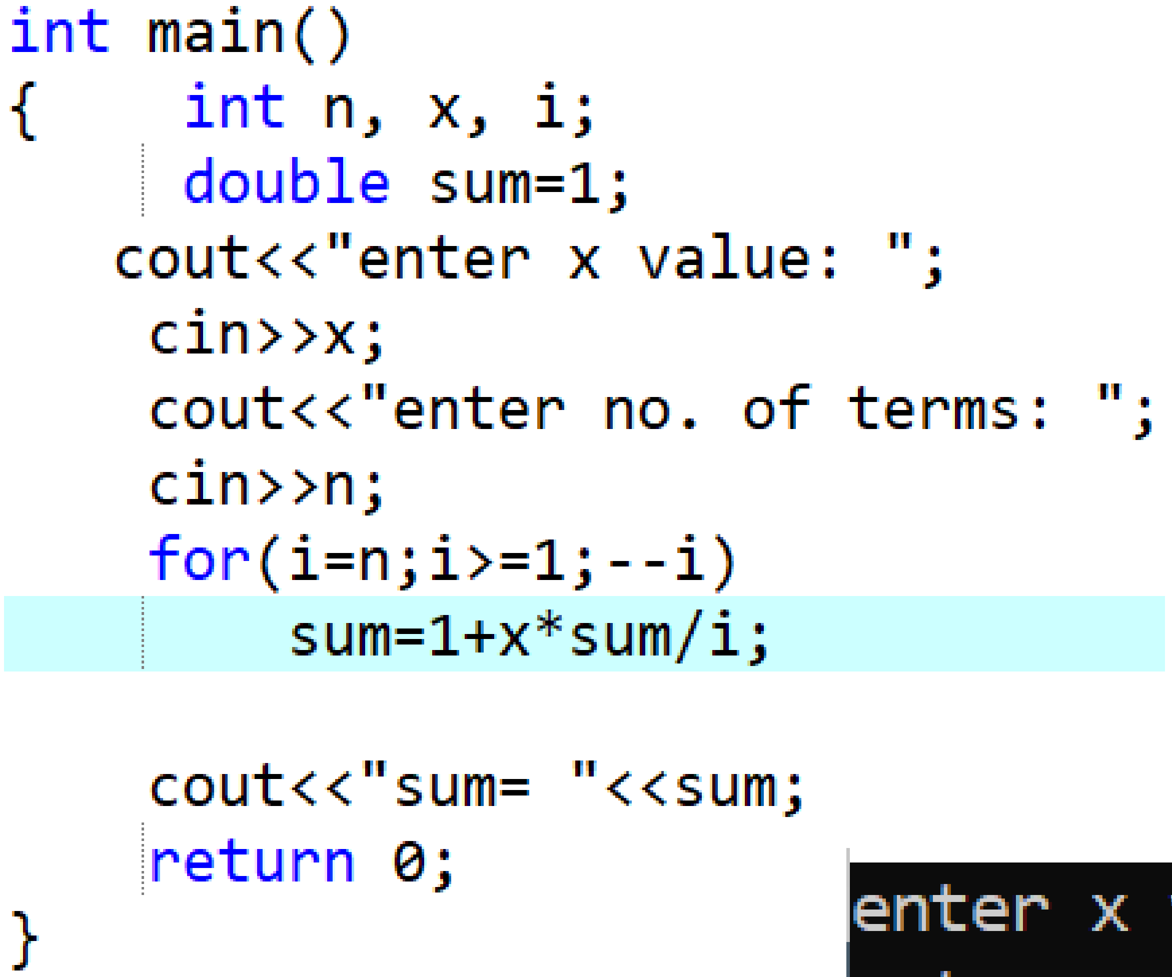
$1 + x + x^2 + x^3 + x^4 + \cdots + x^n$ (using one loop)

```
int main()
{     int n, x, i;
      double sum=1;
    cout<<"enter x value: ";
     cin>>x;
     cout<<"enter no. of terms: ";
     cin>>n;
     for(i=n;i>=1;--i)
         sum=1+x*sum;

     cout<<"sum= "<<sum;
     return 0;
}
```

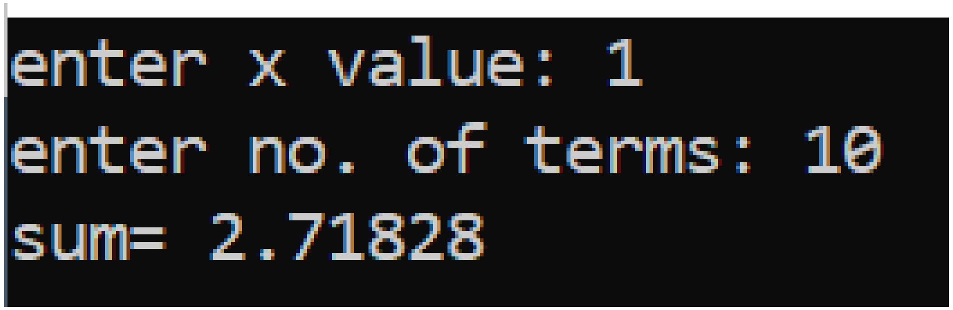


```
enter x value: 3
enter no. of terms: 7
sum= 3280
```

$$1+\frac{x}{1!}+\frac{x^2}{2!}+\frac{x^3}{3!}+\frac{x^4}{4!}+\cdots+\frac{x^n}{n!}$$



```
int main()
{     int n, x, i;
      double sum=1;
    cout<<"enter x value: ";
     cin>>x;
     cout<<"enter no. of terms: ";
     cin>>n;
     for(i=n;i>=1;--i)
         sum=1+x*sum/i;

     cout<<"sum= "<<sum;
     return 0;
}
```



```
enter x value: 1
enter no. of terms: 10
sum= 2.71828
```

Decimal to binary conversion
(prints binary in reverse order)