Tishk International University
IT Department
Course Code: IT-117

Programming I

Lecture 6

Do-While & Nested Loops

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Outline

- The do-while loop
- While vs do-while
- Sentinels
- Nested Loops

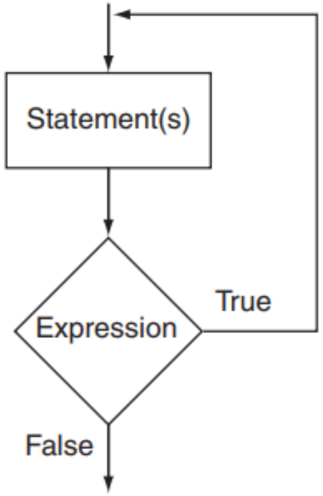
Objectives

- Understand and utilize the do-while loop for executing code repeatedly, ensuring at least one execution.
- Differentiate between while and do-while loops, understanding their distinct execution methods and choosing the appropriate loop based on program needs.
- Learn about sentinels, special values marking the end of input or signaling conditions within loops, ensuring proper loop termination and effective data handling.
- Grasp nested loops' concept for creating intricate patterns, traversing multi-dimensional structures, and solving problems requiring repetitive operation.

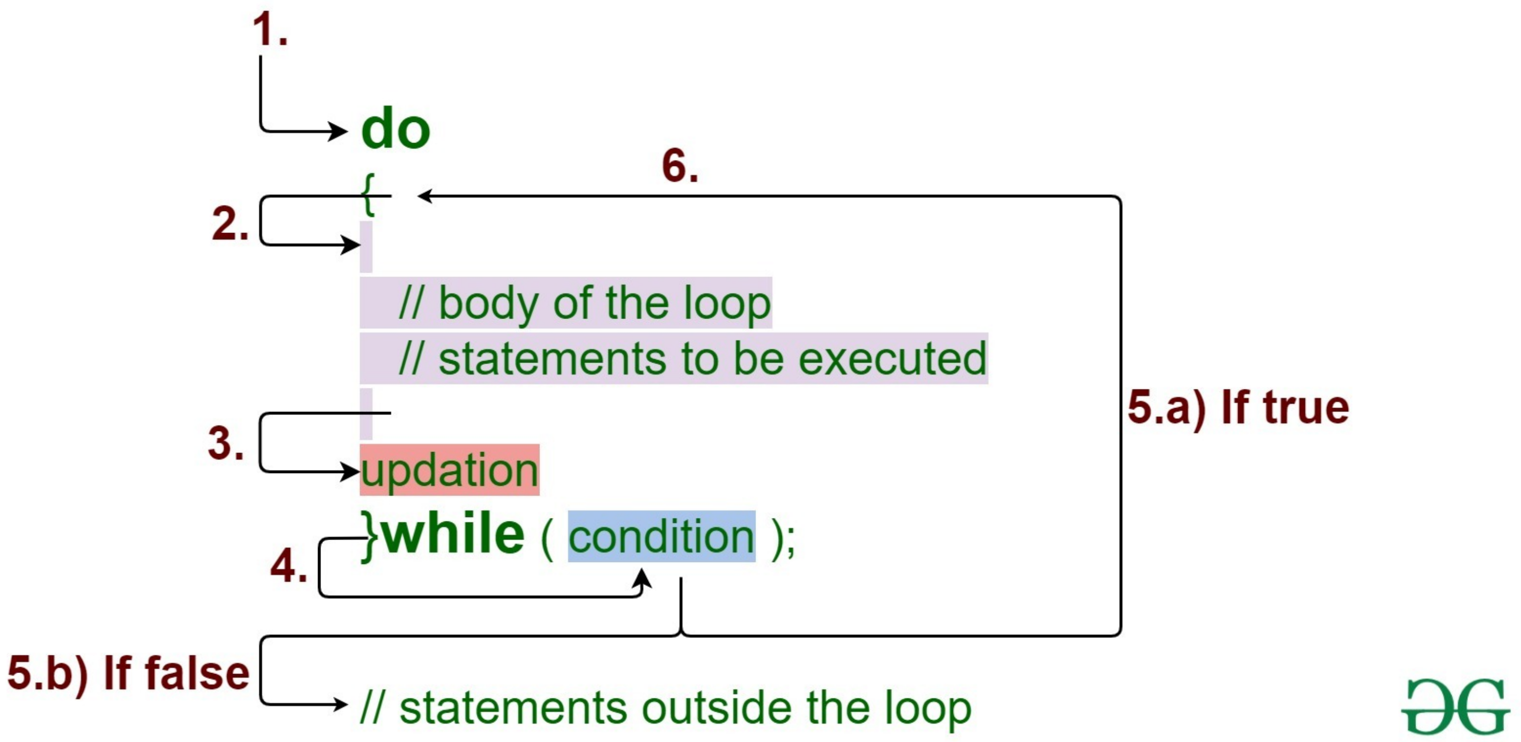
The do-while Loop

- The do-while loop is a posttest loop.
- It tests its expression after each iteration.
- It always executes at least one iteration, even if the expression is initially false.
- While loops test their expression before the first iteration, whereas do-while loops test their expression after the first iteration.
- Format of a do-while loop with a single statement in its body:

```
do
{
   statement;
   statement;
   // Place as many statements here
   // as necessary.
} while (expression);
```



Do - While Loop



Example #1

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

int main() {
    int number;

    do {
        cout << "Enter a positive number: ";
        cin >> number;
    } while (number <= 0);

    cout << "Thank you for entering a positive number!\n";

    return 0;
}
```

Output

```
Enter a positive number: -4
Enter a positive number: 4
Thank you for entering a positive number!
```

Example #2

```cpp
#include <iostream>
using namespace std;
int main(){

    string name;
    int quiz1, quiz2, quiz3;
    double average;
    char again; // To hold Y/N

    do{
        cout<<"Input student name: ";
        cin>>name;
        cout << "Enter the mark of 3 quizzes: ";
        cin >> quiz1 >> quiz2 >> quiz3;

        // Calculate and display the average.
        average = (quiz1 + quiz2 + quiz3) / 3.0;
        cout << "Name: "<<name<<".\t The average: " << average << ".\n";

        // Does the user want to average another set?
        cout << "Do you want to average another set? (Y/N) ";
        cin >> again;
    } while (again == 'Y' || again == 'y');

    return 0;
}
```

Output

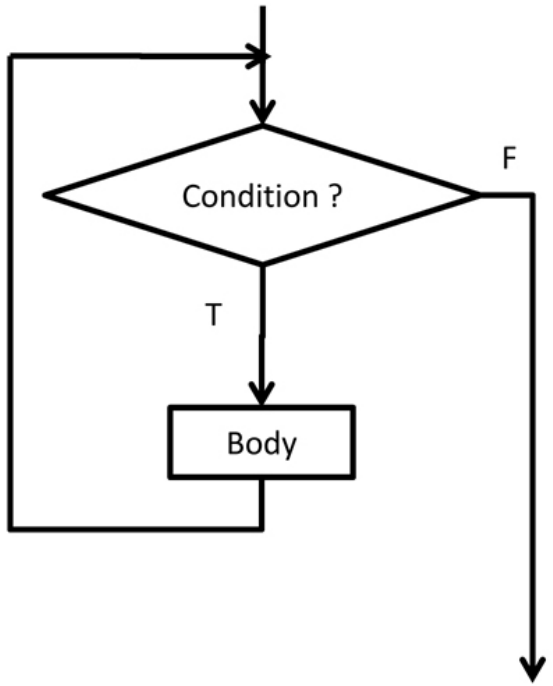
```
Input student name: Alan
Enter the mark of 3 quizzes: 3 4 2
Name: Alan.  The average: 3.
Do you want to average another set? (Y/N) y
Input student name: Kamal
Enter the mark of 3 quizzes: 3 4 3
Name: Kamal.     The average: 3.33333.
Do you want to average another set? (Y/N) n
```

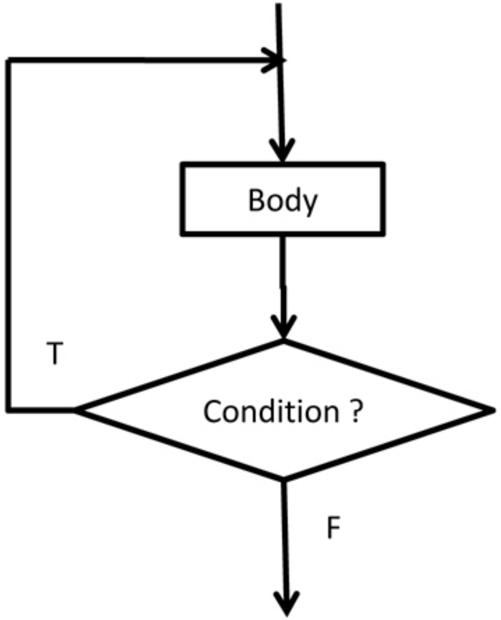
while vs do while

While versus Do-While Loops

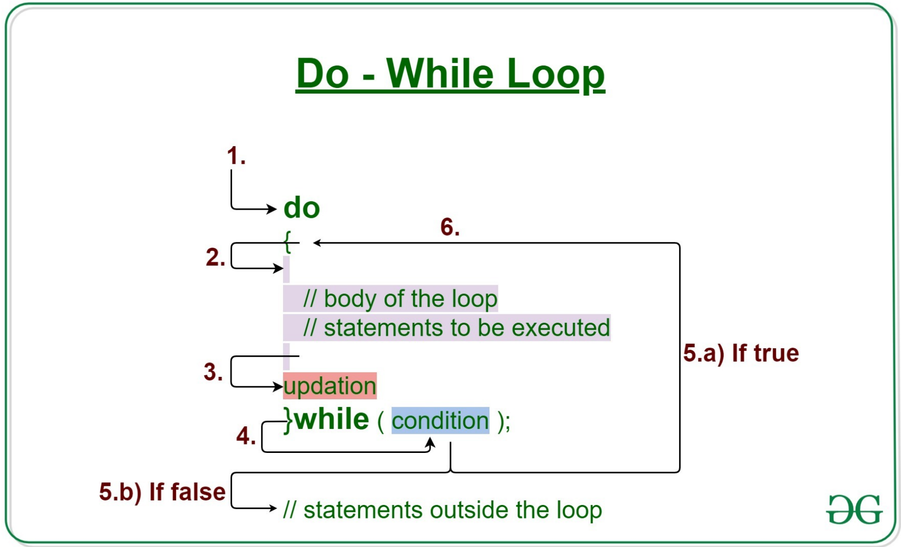
```
while( condition )
        body;
```

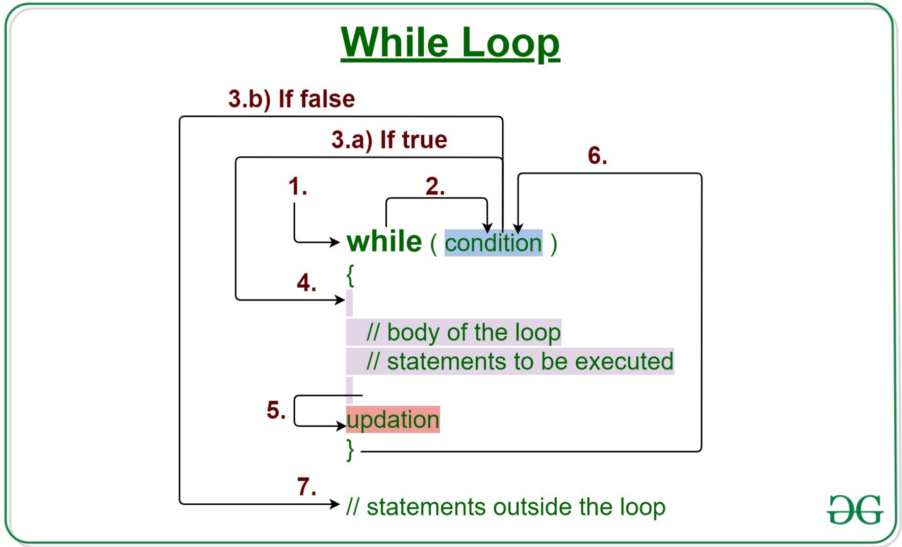
```
do {
        body;
} while( condition );
```





while vs do while





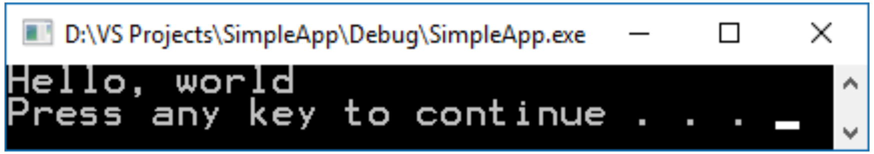
while vs do while

```
int a = 5;
while ( a <= 3)
{
	cout << "Hello, world" << endl;
	a++;
}
```

```
int a = 5;
do
{
	cout << "Hello, world" << endl;
	a++;
} while ( a <= 3);
```

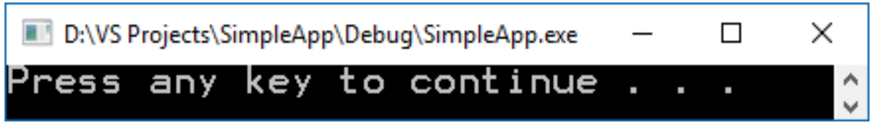
1 loop

0 loop



D:\VS Projects\SimpleApp\Debug\SimpleApp.exe

```
Hello, world
Press any key to continue . . .
```



D:\VS Projects\SimpleApp\Debug\SimpleApp.exe

```
Press any key to continue . . .
```

Sentinels

- A sentinel is a special value denoting the end of a list of values.
- It is distinct from other values in the list, serving as a signal that no more values need to be entered.
- When the user inputs the sentinel value, the loop terminates.

```cpp
#include <iostream>
using namespace std;
int main(){

    int grade,counter=0,total=0;

    cout << "Enter a grade (-1 to exit): ";
    cin >> grade;
    while (grade != -1){
        total = total + grade;
        counter++;
        cout << "Enter a grade (-1 to exit): ";
        cin >> grade;
    }
    cout << "Average of grades are: " << total / float(counter);

    return 0;
}
```

Output

```
Enter a grade (-1 to exit): 78
Enter a grade (-1 to exit): 57
Enter a grade (-1 to exit): 98
Enter a grade (-1 to exit): 65
Enter a grade (-1 to exit): 77
Enter a grade (-1 to exit): 83
Enter a grade (-1 to exit): -1
Average of grades are: 76.3333
```

Deciding Which Loop to Use?

- **While Loop**:
  - Conditional loop repeating as long as a condition exists.
  - Pretest loop: It checks the condition before the iteration.
  - Suitable when the loop shouldn't iterate if the condition is false initially.
- **Do-While Loop**:
  - Conditional loop that iterates at least once.
  - Posttest loop: It checks the condition after the first iteration.
  - Ideal for scenarios where you always want the loop to run at least once, like repeating a menu.
- **For Loop**:
  - Pretest loop with built-in expressions for initialization, testing, and updating.
  - Convenient for controlling iterations using a counter variable.

Tips for using loops

- **Set Clear Objectives:** Before using a loop, define the purpose and goals of the loop.
- **Choose the Right Loop Type:** Understand the different types of loops available and choose the one that best fits your task.
    - Use a **for loop** for a known number of iterations,
    - a **while loop** for indefinite iterations with a condition, and
    - a **do-while loop** when you want to ensure the loop body executes at least once.
- **Initialize and Update Variables Carefully:** Initialize and update loop variables meticulously for accuracy.
- **Use Break wisely:** Utilize the break statement to exit a loop prematurely when a specific condition is met.

Nested Loops

- **Definition**:
  - Nested loops are loops within loops.
- **Structure**:
  - Outer loop controls the iteration over rows.
  - Inner loop manages the iteration over columns.
- **Usage**:
  - Create complex patterns and structures.
  - Traverse multi-dimensional arrays.
  - Solve problems requiring repetitive operations.
- **Example**:
  - Printing patterns, such as squares, triangles, or rectangles.
  - Accessing elements in matrices or multi-dimensional arrays.

Nested Loops - Example #1

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

int main() {
    for (int i = 0; i < 3; i++) {
        for (int j = 0; j < 3; j++) {
            cout << "* ";
        }
        cout << endl;
    }
    return 0;
}
```

Output

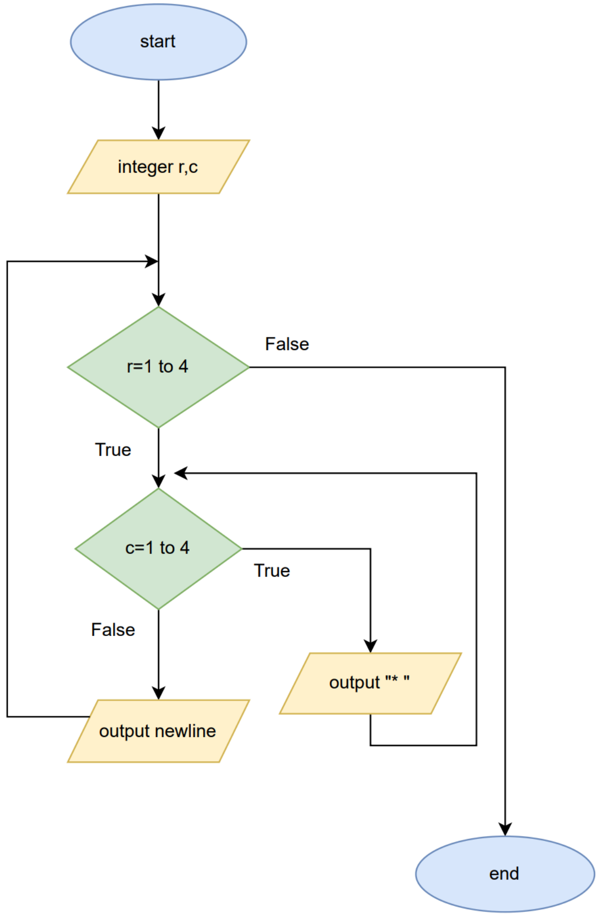
```
* * *
* * *
* * *
```

Nested Loops - Example #2

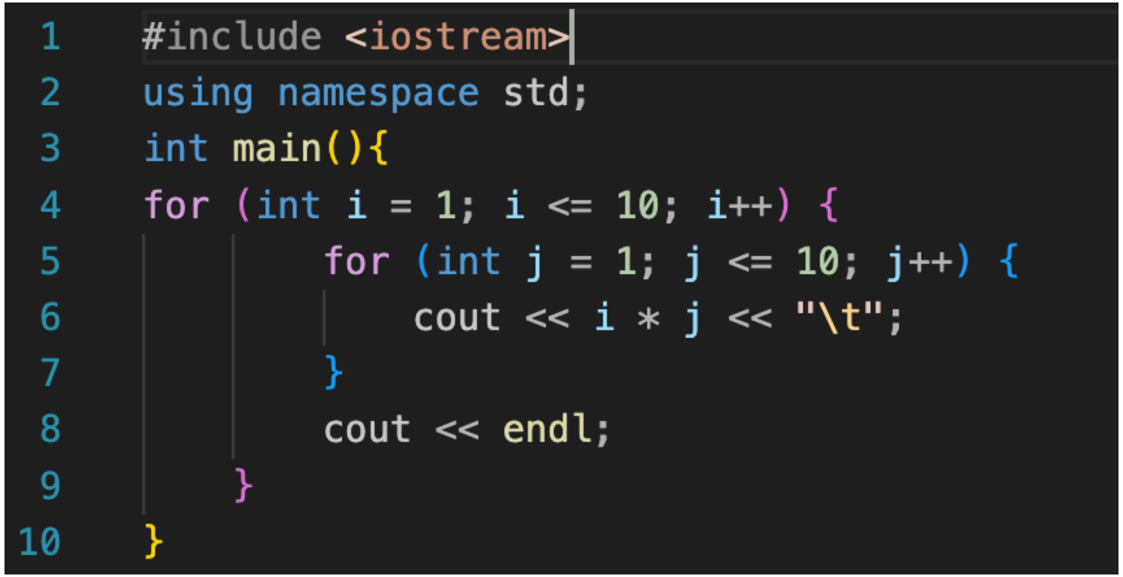
```
#include <iostream>
using namespace std;
int main(){

    for (int r = 1; r <= 4; r++){
        for (int c = 1; c <= r; c++){
            cout << "* ";
        }
        cout << endl;
    }

    return 0;
}
```

Output

```
*
* *
* * *
* * * *
```

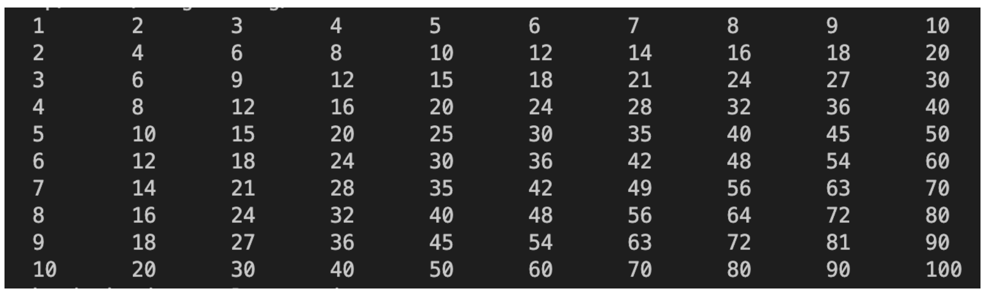


Nested Loops - Example #3



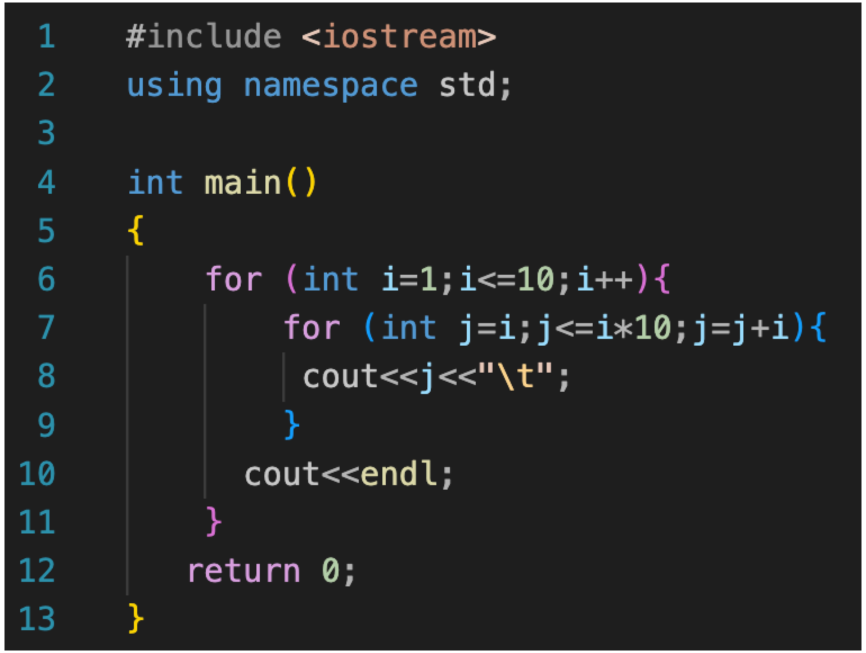
```cpp
#include <iostream>
using namespace std;
int main(){
for (int i = 1; i <= 10; i++) {
        for (int j = 1; j <= 10; j++) {
            cout << i * j << "\t";
        }
        cout << endl;
    }
}
```

Output



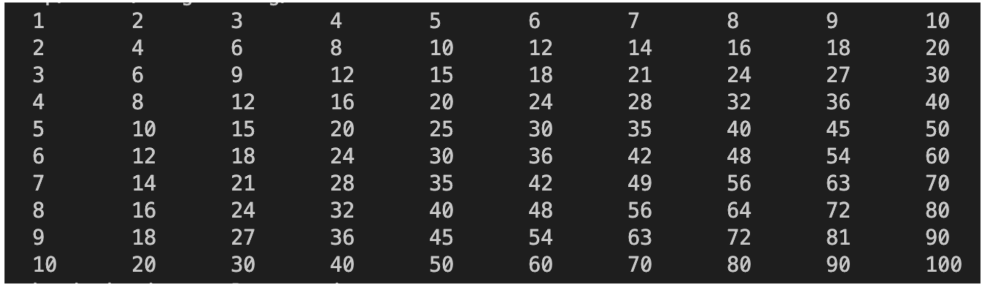
```
1       2       3       4       5       6       7       8       9       10
2       4       6       8       10      12      14      16      18      20
3       6       9       12      15      18      21      24      27      30
4       8       12      16      20      24      28      32      36      40
5       10      15      20      25      30      35      40      45      50
6       12      18      24      30      36      42      48      54      60
7       14      21      28      35      42      49      56      63      70
8       16      24      32      40      48      56      64      72      80
9       18      27      36      45      54      63      72      81      90
10      20      30      40      50      60      70      80      90      100
```

Nested Loops - Example #3 (Another way)



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

int main()
{
    for (int i=1;i<=10;i++){
        for (int j=i;j<=i*10;j=j+i){
         cout<<j<<"\t";
        }
      cout<<endl;
    }
  return 0;
}
```

Output



```
1       2       3       4       5       6       7       8       9       10
2       4       6       8       10      12      14      16      18      20
3       6       9       12      15      18      21      24      27      30
4       8       12      16      20      24      28      32      36      40
5       10      15      20      25      30      35      40      45      50
6       12      18      24      30      36      42      48      54      60
7       14      21      28      35      42      49      56      63      70
8       16      24      32      40      48      56      64      72      80
9       18      27      36      45      54      63      72      81      90
10      20      30      40      50      60      70      80      90      100
```

Thank You

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