

Nesting Repetitions

LECTURE 6

Objectives

After completing the lesson, the student will be able to:

- Explain the syntax of nested for loops.
- Write programs using nested for statements and run the program.
- Explain the syntax of nested while loop.
- Write programs using nested repetition statement and run the program.
- Describe the output of relatively complex programs with repetition.

Nested Loops

A nested loop is a loop within a loop, an inner loop within the body of an outer one.

How this works is that the first pass of the outer loop triggers the inner loop, which executes to completion.

Then the second pass of the outer loop triggers the inner loop again.

This repeats until the outer loop finishes.

Nested for Loops

General syntax:

```
for variable in range([start], stop, [step]):  
    for variable in range([start], stop, [step]):  
        Inner loop statements  
    outer loop statements
```

start – (optional) produces a sequence that starts with the value start.

stop – loop continues up to, but not including stop value.

step – (optional) used as the increment or decrement between numbers.

If the start or step values not included, it starts from 0 and increment by 1.

Example – Nested for Loops

```
for i in range(3):  
    for j in range(4):  
        print("This is INNER LOOP")  
    print("This is OUTER LOOP ")
```

For every iteration of the outer loop, the inner loop iterates 4 times.

The total number of iterations of inner loop is 4.

Example – Nested for Loops

This is INNER LOOP

This is INNER LOOP

This is INNER LOOP

This is INNER LOOP

This is OUTER LOOP

This is INNER LOOP

This is INNER LOOP

This is INNER LOOP

This is INNER LOOP

This is OUTER LOOP

This is INNER LOOP

This is INNER LOOP

This is INNER LOOP

This is INNER LOOP

This is OUTER LOOP

Nested for Loops

```
for i in range(4,5):  
    for j in range(1,11,1):  
        print(i, "*", j, "=", i*j)
```

Output of the above nested loops is multiplication table of 4 up to 10.

Nested for Loops

$$4 * 1 = 4$$

$$4 * 2 = 8$$

$$4 * 3 = 12$$

$$4 * 4 = 16$$

$$4 * 5 = 20$$

$$4 * 6 = 24$$

$$4 * 7 = 28$$

$$4 * 8 = 32$$

$$4 * 9 = 36$$

$$4 * 10 = 40$$

Nested for Loops

```
print("                Multiplication Table")
print("*" * 50)
for j in range(1,11):
    for k in range(1,11):
        print("%4d" %(j*k), end=" ")
    print()
print("*" * 50)
```

Output

Multiplication Table

```
*****
```

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 for Loops

The 1st line prints the title.

The 2nd line prints the asterisk “*” 50 times.

The 3rd line is the outer loop, which starts from 1 and iterates up to 10. It takes the default step value 1.

The 4th line is the inner loop, which starts from 1 and iterates up to 10. It takes the default step value 1. The inner loop iterates 10 times for every iteration of the outer loop.

Nested for Loops

% Is the conversion specifier. It tells that what it follows is the formula you want for displaying the data.

The `%4d` is a format formula to display an integer aligned to the right in a minimum field of 4.

The `end=" "` at the end of the 5th line means, after printing this, end it with a space and stay on the same line. This is used to print all the values on the same line.

The 6th line is used to print the values of the next iteration on a new line.

Nested for Loops

The following program uses a nested for loop to find the prime numbers from 2 to 50.

```
for i in range(2, 50, 1):  
    for j in range(2, 50, 1):  
        if not(i%j):  
            break  
    if (j>i/j):  
        print("%3d"%i, " is prime")
```

Nested while Loops

General Syntax:

Initialize outer loop variable

while condition:

Initialize inner loop variable

while condition:

Statements

Increment/decrement statement of inner loop

Increment/decrement statement of the outer loop

Remember to indent the statements correctly

Nested while Loops

```
i = 1
print("-" * 50)
while i < 11:
    n = 1
    while n <= 10:
        print("%4d" % (i * n), end=" ")
        n = n + 1
    print()
    i = i + 1
print("-" * 50)
```

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

Combining Loops

```
for i in range(1,10,1):  
    j = 1  
    while (j<=i):  
        print("x", end=" ")  
        j = j + 1  
    print("")
```

Output:

```
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 x x x  
x x x x x x x x  
x x x x x x x x x
```

Combining Loops

```
for i in range(10, 0, -1):  
    j = 1  
    while (j<=i):  
        print("x", end=" ")  
        j = j + 1  
    print("")
```

Output:

```
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 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 x x  
x x  
x
```

Combining Loops

```
for i in range(10,0,-1):  
    j = 1  
    while (j<=i):  
        print("x", end=" ")  
        j = j + 1  
    print("")
```

Nested while Loops

The following program uses a nested for loop to find the prime numbers from 2 to 50.

```
i = 2
while(i < 50):
    j = 2
    while(j <= (i/j)):
        if not(i%j):
            break
        j = j + 1
    if (j > i/j) :
        print("%3d"%i, "is prime")
    i = i + 1
```

Nested for Loops - Write output

Write the output of the following nested for loops

```
list1 = ["Apple", "Banana", "Cucumba", "Drumstick"]  
for i in list1:  
    for x in i:  
        print(x)
```

Nested for Loops - Write output

Write the output of the following nested for loops

```
list1 = ["Apple", "Banana", "Cucumba", "Drumstick"]  
for i in list1:  
    for x in i:  
        print(x,)
```

Nested for Loops - Write output

Write the output of the following nested for loops

```
list1 = ["Ant", "Flea", "Moth"]  
for i in list1:  
    for x in i:  
        print(x, end=" ")  
    print()
```

Nested for Loops - Write output

Write the output of the following nested for loops

```
list1 = ["Ant", "Flea", "Moth"]  
for i in list1:  
    for x in i:  
        print(i, end=" ")  
    print()
```


Nested while Loops - Write output

Write the output of the following nested for loops

```
x = -5
y = 5
while x <= y:
    print("X is now: ", x)
    x = x + 1
    while x <= 0:
        print("X is negative")
        x = x + 1
```