**Recap:**

1. For Loops
2. Counter
3. Print Indentation

**Learning Outcomes:**

1. 1 For loops with 1 counter
2. 2 For loops with 1 counter (Execute one after another in sequence with same indentation)
3. 3 For loops with 1 counter (Execute one after another in sequence with same indentation)
4. 3 For loops with 2 counters (Execute one after another in sequence with same indentation)
5. Nested For Loops (For loops in another For loops with 2 counters)

**Explanation Points:**

* Trace step by step the code sequence
* Code Tracing, using paper and pencil to trace the code
* No computer to be used

**Breakdown of Lesson Plan:**

|  |  |
| --- | --- |
| Lesson 8 | 60 min |
| Lesson 8 Quiz | 30 min |

*\*Note: There is a high chance of student not being able to complete on time.*

**Lesson 8.1**

In the first lesson of Module 2, we had learnt the concept of a counter. Let’s recap in the example below. Trace the code sequence on how you arrive at the values of i and value of the counter.

Example:

|  |  |
| --- | --- |
| *1* | counter = 0 |
| *2* | for i in range(5): # LOOP 1 |
| *3* | print(i, counter, “LOOP 1”) |
| *4* | counter = counter + 1 |
| *5* | print(counter) |

Output of example:

|  |  |  |  |
| --- | --- | --- | --- |
| **REF** | **Value of i** | **Value of counter** | **LOOP** |
| **A** | 0 | 0 | LOOP 1 |
| **B** | 1 | 1 | LOOP 1 |
| **C** | 2 | 2 | LOOP 1 |
| **D** | 3 | 3 | LOOP 1 |
| **E** | 4 | 4 | LOOP 1 |

Explanation of Example Code (In sequence):

Line 1 – Declares a variable called ***counter*** with the ***value of 0***

Line 2 – This is the start of the for-loop. The loop will run for ***5 times*** since it is ***range(5)***

Line 3 – When we first step into the for-loop,

Notice that the ***value of i = 0*** and ***value of counter = 0* [REF A]**

This is because when we run Line 2, range(5) - I will start with 0, followed by 1, followed by 2.. 3.. 4..

Line 4 – In this line, we will **increase** the value of counter by 1 i.e. *counter = counter + 1*

After running Line 4, the loop will restart again back at Line 3. This looping process will repeat for **5 times**

Line 3 – In the second loop, we look at the value of i and the value of counter. **[REF B]**

***Value of i = 1*** as we are in the loop for the **second** time

***Value of counter = 1*** as counter was increased by 1 previously.

This looping process will give us the output of example as seen in the Table above.

**Lesson 8.1**

Unique Case when range(0) is used

|  |  |
| --- | --- |
| *1* | counter = 0 |
| *2* | for i in range(0): # LOOP 1 |
| *3* | counter = counter + 1 |
| *4* | print(i, counter, “LOOP 1”) |
| *5* | print(counter) |

The output will only be 0. This is because ***for i in range(0)***, the for-loop does not execute. Since this is a unique case, you should remember this.

In the following tasks, **DO NOT** use the laptop. Trace the code sequence and fill in the blanks

Task 1

|  |  |
| --- | --- |
| *1* | counter = 0 |
| *2* | for i in range(5): # LOOP 1 |
| *3* | counter = counter + 1 |
| *4* | print(i, counter, “LOOP 1”) |
| *5* | print(counter) |

Output of Task 1:

|  |  |  |
| --- | --- | --- |
| **Value of i** | **Value of counter** | **LOOP** |
| 0 | 1 | LOOP 1 |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

**Lesson 8.1**

Task 2

|  |  |
| --- | --- |
| *1* | counter = 6 |
| ***2*** | **for i in range(5): # LOOP 1** |
| *3* | counter = counter - 1 |
| *4* | print(i, counter, “LOOP 1”) |
| *5* | print(counter) |

Output of Task 2:

|  |  |  |
| --- | --- | --- |
| **Value of i** | **Value of counter** | **LOOP** |
| 0 | 5 | LOOP 1 |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

Task 3

|  |  |
| --- | --- |
| *1* | counter = 6 |
| ***2*** | **for i in range(1,6): # LOOP 1** |
| *3* | counter = counter - 1 |
| *4* | print(i, counter, “LOOP1”) |
| *5* | print(counter) |

Output of Task 3:

|  |  |  |
| --- | --- | --- |
| **Value of i** | **Value of counter** | **LOOP** |
| 1 | 5 | LOOP1 |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

**Comparing between Task 2, 3, there are 2 key differences that resulted in different outputs. Identify the differences and explain why.**

|  |
| --- |
| 1.  2. |

**Lesson 8.1**

In Tasks 4 to 6, You might not need all lines in the output. **Trace** the code and fill up the blanks.

Task 4

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Code   |  |  | | --- | --- | | *1* | counter = 0 | | *2* | for i in range(5): # LOOP 1 | | *3* | counter = counter + 1 | | ***4*** | **print(i, counter, “LOOP1”)** | | *5* | print(counter) | | Output   |  |  | | --- | --- | | *1* | 0 1 LOOP1 | | *2* |  | | *3* |  | | *4* |  | | *5* |  | | *6* |  | | *7* |  | | *8* |  | | *9* |  | | *10* |  | |

Task 5

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Code   |  |  | | --- | --- | | *1* | counter = 0 | | *2* | for i in range(4): # LOOP 1 | | *3* | counter = counter + 2 | | ***4*** | **print(i, counter, “LOOP1”)** | | *5* | print(counter) | | Output   |  |  | | --- | --- | | *1* |  | | *2* |  | | *3* |  | | *4* |  | | *5* |  | | *6* |  | | *7* |  | | *8* |  | | *9* |  | | *10* |  | |

Task 6

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Code   |  |  | | --- | --- | | *1* | counter = 1 | | *2* | for i in range(5): # LOOP 1 | | *3* | counter = counter \* 2 | | ***4*** | **print(i, counter, “LOOP1”)** | | *5* | print(counter) | | Output   |  |  | | --- | --- | | *1* |  | | *2* |  | | *3* |  | | *4* |  | | *5* |  | | *6* |  | | *7* |  | | *8* |  | | *9* |  | | *10* |  | |

**Lesson 8.1**

In Tasks 7 to 9, we are now **using i** in the formula as seen in Line 3. You might not need all lines in the output. **Trace** the code and fill up the blanks.

Task 7

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Code   |  |  | | --- | --- | | *1* | counter = 0 | | *2* | for i in range(3,12): # LOOP 1 | | ***3*** | **counter = counter + i** | | *4* | print(i, counter, “LOOP1”) | | *5* | print(counter) | | Output   |  |  | | --- | --- | | *1* |  | | *2* |  | | *3* |  | | *4* |  | | *5* |  | | *6* |  | | *7* |  | | *8* |  | | *9* |  | | *10* |  | |

Task 8

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Code   |  |  | | --- | --- | | *1* | counter = 0 | | *2* | for i in range(4): # LOOP 1 | | ***3*** | **counter = 2 \* i** | | *4* | print(i, counter, “LOOP1”) | | *5* | print(counter) | | Output   |  |  | | --- | --- | | *1* |  | | *2* |  | | *3* |  | | *4* |  | | *5* |  | | *6* |  | | *7* |  | | *8* |  | | *9* |  | | *10* |  | |

Task 9

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Code   |  |  | | --- | --- | | *1* | counter = 1 | | *2* | for i in range(8): # LOOP 1 | | ***3*** | **counter = counter - i** | | *4* | print(i, counter, “LOOP1”) | | *5* | print(counter) | | Output   |  |  | | --- | --- | | *1* |  | | *2* |  | | *3* |  | | *4* |  | | *5* |  | | *6* |  | | *7* |  | | *8* |  | | *9* |  | | *10* |  | |

**Lesson 8.2**

In this section, we will now see 2 for-loops one after another. Do not use the laptop.

Example Code

|  |  |
| --- | --- |
| *1* | counter = 0 |
| *2* | for i in range(5): # LOOP 1 |
| *3* | counter = counter + 1 |
| *4* | print(i, counter, “LOOP1”) |
| *5* | for i in range(5): # LOOP 2 |
| *6* | counter = counter + 1 |
| *7* | print(i, counter, “LOOP2”) |
| *8* | print(counter) |

Output of example:

|  |  |  |  |
| --- | --- | --- | --- |
| **REF** | **Value of i** | **Value of counter** | **LOOP** |
| A | 0 | 1 | LOOP1 |
| B | 1 | 2 | LOOP1 |
| C | 2 | 3 | LOOP1 |
| D | 3 | 4 | LOOP1 |
| E | 4 | 5 | LOOP1 |
| F | 0 | 6 | LOOP2 |
| G | 1 | 7 | LOOP2 |
| H | 2 | 8 | LOOP2 |
| I | 3 | 9 | LOOP2 |
| J | 4 | 10 | LOOP2 |

Explanation of Example Code (In sequence):

In the example code, you can see 2 for-loops. Look at the indentation in the example code to identify the for-loop.

The first for-loop is in Line 2 – 4 ; the second for-loop is in Line 5 – 7

In the first for-loop, the value of i will increase from 0 to 4 and the value of counter is increased from 0 to 5. [REF A – REF E]

In the second for-loop, the value of i will restart and increase from 0 to 4 and the value of counter is increased from 5 to 10. [REF F – REF J]

Notice that the value of i is 0,1,2,3,4,0,1,2,3,4. It because the value of i is only assigned in the for loop. ***for i in range(5) in Line 2, Line 5.***

**Lesson 8.2**

Task 1

|  |  |
| --- | --- |
| *1* | counter = 0 |
| *2* | for i in range(3): # LOOP 1 |
| ***3*** | **counter = counter + 1** |
| *4* | print(i, counter, “LOOP1”) |
| *5* | for i in range(2): # LOOP 2 |
| ***6*** | **counter = counter + 1** |
| *7* | print(i, counter, “LOOP2”) |
| *8* | print(counter) |

|  |  |  |
| --- | --- | --- |
| **Value of i** | **Value of counter** | **LOOP** |
| 0 | 1 | LOOP1 |
|  |  |  |
|  |  |  |
| 0 | 4 | LOOP2 |
|  |  |  |

Task 2

|  |  |
| --- | --- |
| *1* | counter = 0 |
| *2* | for i in range(3): # LOOP 1 |
| ***3*** | **counter = counter + 1** |
| *4* | print(i, counter, “LOOP1”) |
| *5* | for i in range(2): # LOOP 2 |
| ***6*** | **counter = counter \* counter** |
| *7* | print(i, counter, “LOOP2”) |
| *8* | print(counter) |

|  |  |  |
| --- | --- | --- |
| **Value of i** | **Value of counter** | **LOOP** |
| 0 | 1 | LOOP1 |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

**Lesson 8.2**

Task 3

|  |  |
| --- | --- |
| *1* | counter = 0 |
| *2* | for i in range(3): # LOOP 1 |
| ***3*** | **counter = counter + 1** |
| *4* | print(i, counter, “LOOP1”) |
| *5* | for i in range(2): # LOOP 2 |
| ***6*** | **counter = counter - 2** |
| *7* | print(i, counter, “LOOP2”) |
| *8* | print(counter) |

|  |  |  |
| --- | --- | --- |
| **Value of i** | **Value of counter** | **LOOP** |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

In the following tasks 4 to 7, take note on the counter formula in **bold**. You might not need all lines in the output.

Task 4

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Code   |  |  | | --- | --- | | *1* | counter = 0 | | *2* | for i in range(3): # LOOP 1 | | ***3*** | **counter = counter + 1** | | *4* | print(i, counter, “LOOP1”) | | *5* | for i in range(5): # LOOP 2 | | ***6*** | **counter = (-1) \* counter** | | *7* | print(i, counter, “LOOP2”) | | *8* | print(counter) | | Output   |  |  | | --- | --- | | *1* |  | | *2* |  | | *3* |  | | *4* |  | | *5* |  | | *6* |  | | *7* |  | | *8* |  | | *9* |  | | *10* |  | |

**Lesson 8.2**

Task 5

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Code   |  |  | | --- | --- | | *1* | counter = 0 | | *2* | for i in range(3): # LOOP 1 | | ***3*** | **counter = counter + 1** | | *4* | print(i, counter, “LOOP1”) | | *5* | for i in range(3): # LOOP 2 | | ***6*** | **counter = 1 - counter** | | *7* | print(i, counter, “LOOP2”) | | *8* | print(counter) | | Output   |  |  | | --- | --- | | *1* |  | | *2* |  | | *3* |  | | *4* |  | | *5* |  | | *6* |  | | *7* |  | | *8* |  | | *9* |  | | *10* |  | |

Task 6

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Code   |  |  | | --- | --- | | *1* | counter = 0 | | *2* | for i in range(3): # LOOP 1 | | ***3*** | **counter = counter + i - 2** | | *4* | print(i, counter, “LOOP1”) | | *5* | for i in range(3): # LOOP 2 | | ***6*** | **counter = counter – i + 2** | | *7* | print(i, counter, “LOOP2”) | | *8* | print(counter) | | Output   |  |  | | --- | --- | | *1* |  | | *2* |  | | *3* |  | | *4* |  | | *5* |  | | *6* |  | | *7* |  | | *8* |  | | *9* |  | | *10* |  | |

Task 7

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Code   |  |  | | --- | --- | | *1* | counter = 0 | | *2* | for i in range(3): # LOOP 1 | | ***3*** | **counter = counter - 1 + 2** | | *4* | print(i, counter, “LOOP1”) | | *5* | for i in range(2): # LOOP 2 | | ***6*** | **counter = counter - 2 + 3** | | *7* | print(i, counter, “LOOP2”) | | *8* | print(counter) | | Output   |  |  | | --- | --- | | *1* |  | | *2* |  | | *3* |  | | *4* |  | | *5* |  | | *6* |  | | *7* |  | | *8* |  | | *9* |  | | *10* |  | |

**Lesson 8.3**

In this section, we will now see 3 for-loops one after another.

Example

|  |  |
| --- | --- |
| *1* | counter = 0 |
| *2* | for i in range(2): # LOOP 1 |
| ***3*** | **counter = counter + 1** |
| *4* | print(i, counter, “LOOP1”) |
| *5* | for i in range(3): # LOOP 2 |
| ***6*** | **counter = counter + 2** |
| *7* | print(i, counter, “LOOP2”) |
| *8* | for i in range(5): # LOOP 3 |
| ***9*** | **counter = counter + 3** |
| *10* | print(i, counter, “LOOP3”) |
| *11* | print(counter) |

|  |  |  |
| --- | --- | --- |
| **Value of i** | **Value of counter** | **LOOP** |
| 0 | 1 | LOOP1 |
| 1 | 2 | LOOP1 |
| 0 | 4 | LOOP2 |
| 1 | 6 | LOOP2 |
| 2 | 8 | LOOP2 |
| 0 | 11 | LOOP3 |
| 1 | 14 | LOOP3 |
| 2 | 17 | LOOP3 |
| 3 | 20 | LOOP3 |
| 4 | 23 | LOOP3 |

Explanation of Example Code:

In the example code, you can see 3 for-loops. Look at the indentation in the example code to identify the for-loop.

Loop 1: Line \_\_ to Line \_\_\_

Loop 2: Line \_\_ to Line \_\_\_

Loop 3: Line \_\_ to Line \_\_\_

Which Lines did the value of counter change?

Line \_\_\_ by \_\_\_\_\_\_\_\_

Line \_\_\_ by \_\_\_\_\_\_\_\_

Line \_\_\_ by \_\_\_\_\_\_\_\_

Where do we know how many times the code repeats? \_\_\_\_\_\_\_\_\_

**Lesson 8.3**

In the following tasks 1 to 6, take note on the counter formula **in bold**. You might not need all lines in the output.

Task 1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Code   |  |  | | --- | --- | | *1* | counter = 0 | | *2* | for i in range(2): # LOOP 1 | | ***3*** | **counter = counter + 3** | | *4* | print(i, counter, “LOOP1”) | | *5* | for i in range(3): # LOOP 2 | | ***6*** | **counter = counter + 2** | | *7* | print(i, counter, “LOOP2”) | | *8* | for i in range(4): # LOOP 3 | | ***9*** | **counter = counter + 1** | | *10* | print(i, counter, “LOOP3”) | | *11* | print(counter) | | Output   |  |  | | --- | --- | | *1* |  | | *2* |  | | *3* |  | | *4* |  | | *5* |  | | *6* |  | | *7* |  | | *8* |  | | *9* |  | | *10* |  | | *11* |  | |

Task 2

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Code   |  |  | | --- | --- | | *1* | counter = 0 | | *2* | for i in range(2): # LOOP 1 | | ***3*** | **counter = counter + 3** | | *4* | print(i, counter, “LOOP1”) | | *5* | for i in range(4): # LOOP 2 | | ***6*** | **counter = counter - 2** | | *7* | print(i, counter, “LOOP2”) | | *8* | for i in range(3): # LOOP 3 | | ***9*** | **counter = counter + 1** | | *10* | print(i, counter, “LOOP3”) | | *11* | print(counter) | | Output   |  |  | | --- | --- | | *1* |  | | *2* |  | | *3* |  | | *4* |  | | *5* |  | | *6* |  | | *7* |  | | *8* |  | | *9* |  | | *10* |  | | *11* |  | |

**Lesson 8.3**

Task 3

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Code   |  |  | | --- | --- | | *1* | counter = 0 | | *2* | for i in range(2): # LOOP 1 | | ***3*** | **counter = counter + 3 \* 3** | | *4* | print(i, counter, “LOOP1”) | | *5* | for i in range(4): # LOOP 2 | | ***6*** | **counter = counter - 2 \* 2** | | *7* | print(i, counter, “LOOP2”) | | *8* | for i in range(3): # LOOP 3 | | ***9*** | **counter = counter + 1 \* 1** | | *10* | print(i, counter, “LOOP3”) | | *11* | print(counter) | | Output   |  |  | | --- | --- | | *1* |  | | *2* |  | | *3* |  | | *4* |  | | *5* |  | | *6* |  | | *7* |  | | *8* |  | | *9* |  | | *10* |  | | *11* |  | |

Task 4

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| Code   |  |  | | --- | --- | | *1* | counter = 0 | | *2* | for i in range(2): # LOOP 1 | | ***3*** | **counter = counter - 3 \* 3** | | *4* | print(i, counter, “LOOP1”) | | *5* | for i in range(0): # LOOP 2 | | ***6*** | **counter = counter - 2** | | *7* | print(i, counter, “LOOP2”) | | *8* | for i in range(3): # LOOP 3 | | ***9*** | **counter = counter + 1** | | *10* | print(i, counter, “LOOP3”) | | *11* | print(counter) | | Output   |  |  | | --- | --- | | *1* |  | | *2* |  | | *3* |  | | *4* |  | | *5* |  | | *6* |  | | *7* |  | | *8* |  | | *9* |  | | *10* |  | | *11* |  | |

**Lesson 8.3**

Task 5

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| Code   |  |  | | --- | --- | | *1* | counter = 1 | | *2* | for i in range(4): # LOOP 1 | | ***3*** | **counter = counter + counter** | | *4* | print(i, counter, “LOOP1”) | | *5* | for i in range(3): # LOOP 2 | | ***6*** | **counter = counter - (2 \* counter)** | | *7* | print(i, counter, “LOOP2”) | | *8* | for i in range(2): # LOOP 3 | | ***9*** | **counter = counter + 1** | | *10* | print(i, counter, “LOOP3”) | | *11* | print(counter) | | Output   |  |  | | --- | --- | | *1* |  | | *2* |  | | *3* |  | | *4* |  | | *5* |  | | *6* |  | | *7* |  | | *8* |  | | *9* |  | | *10* |  | | *11* |  | |

Task 6

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Code   |  |  | | --- | --- | | *1* | counter = 10 | | *2* | for i in range(4): # LOOP 1 | | *3* | counter = counter - 1 | | ***4*** | **print(i, counter, “LOOP1”)** | | *5* | for i in range(2): # LOOP 2 | | *6* | counter = (-1) \* counter | | ***7*** | **print(i, counter, “LOOP2”)** | | *8* | for i in range(4): # LOOP 3 | | *9* | counter = counter + i | | ***10*** | **print(i, counter, “LOOP3”)** | | *11* | print(counter) | | Output   |  |  | | --- | --- | | *1* |  | | *2* |  | | *3* |  | | *4* |  | | *5* |  | | *6* |  | | *7* |  | | *8* |  | | *9* |  | | *10* |  | | *11* |  | |

**After doing tasks 1 to task 6, what are the key things to look out for when code tracing? Write down at least 3 learning points.**

|  |
| --- |
| 1.  2.  3. |

**Lesson 8.4**

In this section, we will now see 3 for loops one after another with 2 counters. You are to keep track of both counters and see how the counter changes.

In the table below, instead for 3 columns, there will be 4 columns. Additional column is used to store the value of the new counter.

Example Code:

|  |  |
| --- | --- |
| *1* | counter1 = 0 |
| *2* | counter2 = 0 |
| *3* | for i in range(2): # LOOP 1 |
| *4* | counter1 = counter1 + 1 |
| *5* | print(i, counter1, counter2, “# LOOP 1”) |
| *6* | for i in range(3): # LOOP 2 |
| *7* | counter2 = counter2 + 2 |
| *8* | print(i, counter1, counter2 , “# LOOP 2”) |
| *9* | for i in range(5): # LOOP 3 |
| *10* | counter1 = counter1 + 1 |
| *11* | counter2 = counter2 + 3 |
| *12* | print(i, counter1, counter 2, “# LOOP 3”) |
| *13* | print(counter1, counter2) |

Output for code:

|  |  |  |  |
| --- | --- | --- | --- |
| **Value of i** | **Value of counter1** | **Value of counter2** | **LOOP** |
| 0 | 1 | 0 | # LOOP 1 |
| 1 | 2 | 0 | # LOOP 1 |
| 0 | 2 | 2 | # LOOP 2 |
| 1 | 2 | 4 | # LOOP 2 |
| 2 | 2 | 6 | # LOOP 2 |
| 0 | 3 | 9 | # LOOP 3 |
| 1 | 4 | 12 | # LOOP 3 |
| 2 | 5 | 15 | # LOOP 3 |
| 3 | 6 | 18 | # LOOP 3 |
| 4 | 7 | 21 | # LOOP 3 |

**Explanation on the next Page**

**Lesson 8.4**

Explanation of Example Code:

Line 1 – Declares a variable called ***counter1*** with the ***value of 0***

Line 2 – Declares a variable called ***counter2*** with the ***value of 0***

Line 3-5 – This is the first for-loop. The loop will run for ***2 times*** since it is ***range(2)***

Line 4 – Increase the counter1 by 1

Line 6-8 – This is the second for-loop. The loop will run for ***3 times*** since it is ***range(3)***

Line 5 – Increase the counter2 by 2

Line 9-12 – This is the third for-loop. The loop will run for ***5 times*** since it is ***range(5)***

Line 10 – Increase the counter1 by 1

Line 11 – Increase the counter2 by 3

Line 13 – This will print out the final value of counter1 and counter2.

This looping process will give us the output of example as seen in the Table above.

Tips on tracing code:

1. Draw a table with the necessary headers
   1. Headers are usually the variables created
2. Read line-by-line and update the table whenever a variable change
3. Learn how for-loop work in different situations(sample cases below)
   1. for i in range(5)
   2. for i in range(1,6)
   3. for i in range(1,6,2)
   4. for i in range(0)
   5. for i in [0,1,2,3,4]
   6. for i in “01234”

**Lesson 8.4**

In the following tasks 1 to 4, take note on the counter formula. You might not need all lines in the output.

Task 1 – Notice that *counter1* and *counter2* start from a different number. Line 10 is also new.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Code   |  |  | | --- | --- | | *1* | counter1 = 5 | | *2* | counter2 = 5 | | *3* | for i in range(2): # LOOP 1 | | ***4*** | **counter1 = counter1 + 1** | | *5* | print(i, counter1, counter2, “LOOP1”) | | *6* | for i in range(3): # LOOP 2 | | ***7*** | **counter2 = counter2 + 1** | | *8* | print(i, counter1, counter2 , “LOOP2”) | | *9* | for i in range(5): # LOOP 3 | | ***10*** | **counter1 = counter1 + counter2** | | ***11*** | **counter2 = counter2 + 5** | | *12* | print(i, counter1, counter 2, “LOOP3”) | | *13* | print(counter1, counter2) | | Output   |  |  | | --- | --- | | *1* |  | | *2* |  | | *3* |  | | *4* |  | | *5* |  | | *6* |  | | *7* |  | | *8* |  | | *9* |  | | *10* |  | | *11* |  | | *12* |  | | *13* |  | |

Task 2 – Notice that Line 10 adds *counter2* to *counter1*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Code   |  |  | | --- | --- | | *1* | counter1 = 5 | | *2* | counter2 = 5 | | *3* | for i in range(1,10,2): # LOOP 1 | | ***4*** | **counter1 = counter1 + 1** | | *5* | print(i, counter1, counter2, “LOOP1”) | | *6* | for i in range(2,8,4): # LOOP 2 | | ***7*** | **counter2 = counter2 + 1** | | *8* | print(i, counter1, counter2 , “LOOP2”) | | *9* | for i in range(3): # LOOP 3 | | ***10*** | **counter1 = counter1 + counter2** | | ***11*** | **counter2 = counter2 + 5** | | *12* | print(i, counter1, counter 2, “LOOP3”) | | *13* | print(counter1, counter2) | | Output   |  |  | | --- | --- | | *1* |  | | *2* |  | | *3* |  | | *4* |  | | *5* |  | | *6* |  | | *7* |  | | *8* |  | | *9* |  | | *10* |  | | *11* |  | | *12* |  | | *13* |  | |

**Lesson 8.4**

Task 3 - Notice that *counter1* and *counter2* are both starting from a different number.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Code   |  |  | | --- | --- | | *1* | counter1 = 5 | | ***2*** | **counter2 = 2** | | *3* | for i in range(2): # LOOP 1 | | ***4*** | **counter1 = counter1 + counter2** | | *5* | print(i, counter1, counter2, “LOOP1”) | | *6* | for i in range(3): # LOOP 2 | | ***7*** | **counter2 = counter2 + 1** | | *8* | print(i, counter1, counter2 , “LOOP2”) | | *9* | for i in range(2): # LOOP 3 | | ***10*** | **counter1 = counter1 - counter2** | | ***11*** | **counter2 = counter2 + 1** | | *12* | print(i, counter1, counter 2, “LOOP3”) | | *13* | print(counter1, counter2) | | Output   |  |  | | --- | --- | | *1* |  | | *2* |  | | *3* |  | | *4* |  | | *5* |  | | *6* |  | | *7* |  | | *8* |  | | *9* |  | | *10* |  | | *11* |  | | *12* |  | | *13* |  | |

Task 4 – What if I change Line 10 and Line 11? If I reassign a new value instead of updating the value, I will always take the

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Code   |  |  | | --- | --- | | *1* | counter1 = 5 | | *2* | counter2 = 5 | | *3* | for i in range(1,10,2): # LOOP 1 | | ***4*** | **counter1 = counter2 + i** | | *5* | print(i, counter1, counter2, “LOOP1”) | | *6* | for i in range(2,8,4): # LOOP 2 | | ***7*** | **counter2 = counter1 + i** | | *8* | print(i, counter1, counter2 , “LOOP2”) | | *9* | for i in range(3): # LOOP 3 | | ***10*** | **counter1 = 1** | | ***11*** | **counter2 = 0** | | *12* | print(i, counter1, counter 2, “LOOP3”) | | *13* | print(counter1, counter2) | | Output   |  |  | | --- | --- | | *1* |  | | *2* |  | | *3* |  | | *4* |  | | *5* |  | | *6* |  | | *7* |  | | *8* |  | | *9* |  | | *10* |  | | *11* |  | | *12* |  | | *13* |  | |

**Lesson 8.5**

In this section, we will now see nested for loops. 1 for loop inside the other. Note on the indentation of the for loop.

Example Code

|  |  |
| --- | --- |
| *1* | counter1 = 0 |
| *2* | counter2 = 0 |
| *3* | i = -1 |
| *4* | j = -1 |
| ***5*** | **for i in range(3): # LOOP 1** |
| *6* | counter1 = counter1 + 1 |
| *7* | print(i, j, counter1, counter2, “# LOOP 1”) |
| ***8*** | **for j in range(3): # LOOP 2** |
| *9* | counter2 = counter2 + 1 |
| *10* | print(i, j, counter1, counter2 , “# LOOP 2”) |
| *11* | print(counter1, counter2) |

Output of Code

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Value of i** | **Value of j** | **Value of counter1** | **Value of counter2** | **LOOP** |
| 0 | -1 | 1 | 0 | # LOOP 1 |
| 0 | 0 | 1 | 1 | # LOOP 2 |
| 0 | 1 | 1 | 2 | # LOOP 2 |
| 0 | 2 | 1 | 3 | # LOOP 2 |
| 1 | 2 | 2 | 3 | # LOOP 1 |
| 1 | 0 | 2 | 4 | # LOOP 2 |
| 1 | 1 | 2 | 5 | # LOOP 2 |
| 1 | 2 | 2 | 6 | # LOOP 2 |
| 2 | 2 | 3 | 6 | # LOOP 1 |
| 2 | 0 | 3 | 7 | # LOOP 2 |
| 1 | 1 | 3 | 8 | # LOOP 2 |
| 2 | 2 | 3 | 9 | # LOOP 2 |

**Lesson 8.5**

Explanation of Example Code:

This is a nested for-loop example.

Line 3, 4 – We declared 2 variables called *i* and *j* and store the value of -1.

Most of the time we do not need to declare the variables beforehand but for educational purposes, we will do so that we can have a visual understanding of how the code works.

The indentation of 1 for loops (Loop 2) is inside of another for loop. (Loop 1)

Loop 1: Range(3) i.e 0,1,2 (3 times)

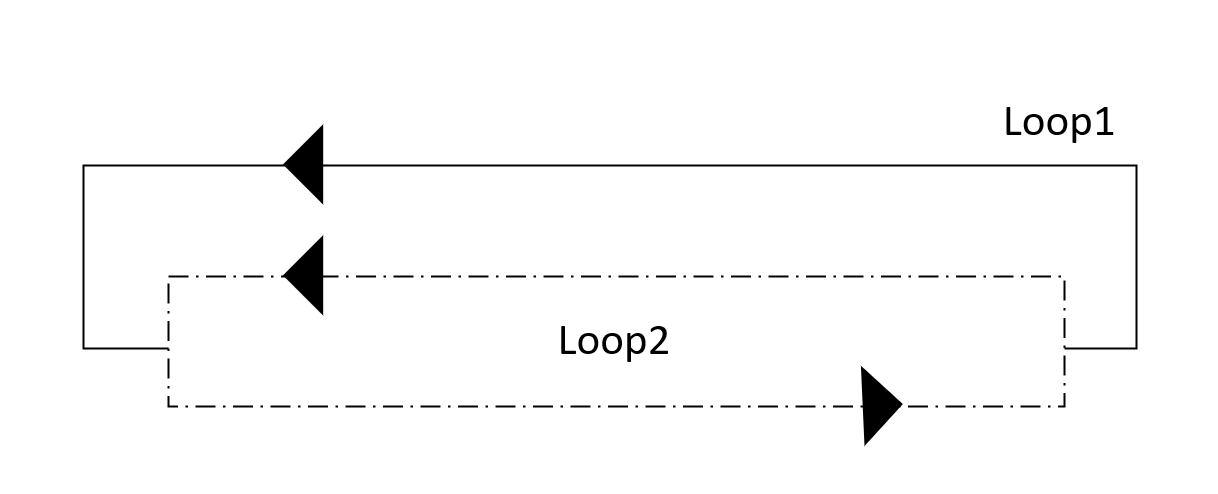
Loop 2: Range(3) ie 0,1,2 (3 times)

The code will execute loop 1 then loop 2. It will complete the full range of loop 2.

It will then move back to loop 1 then loop 2. It will complete the full range of loop 2.

It will then move back to loop 1 (for the last time), then loop 2. It will complete the full range of loop 2

Visually you can think of it as a loop inside of another loop.



**Lesson 8.5**

Comparing between 2 for-loops and nested for-loops with 2 counters – *counter1* & *counter2*.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Nested for-loops   |  |  | | --- | --- | | *1* | counter1 = 0 | | *2* | counter2 = 0 | | *3* | for i in range(3): # LOOP 1 | | *4* | counter1 = counter1 + 1 | | *5* | print(counter1, counter2, “LOOP1”) | | ***6*** | **for j in range(3): # LOOP 2** | | *7* | counter2 = counter2 + 1 | | *8* | print(counter1, counter2 , “LOOP2”) | | *9* | print(counter1, counter2) | | 2 for-loop   |  |  | | --- | --- | | *1* | counter1 = 0 | | *2* | counter2 = 0 | | *3* | for i in range(3): # LOOP 1 | | *4* | counter1 = counter1 + 1 | | *5* | print(counter1, counter2, “LOOP1”) | | ***6*** | **for j in range(3): # LOOP 2** | | *7* | counter2 = counter2 + 1 | | *8* | print(counter1, counter2 , “LOOP2”) | | *9* | print(counter1, counter2) | |  |

Let’s take a look at the line-by-line execution of the codes. The bold lines will show the current line being executed.

Step 1:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Nested for-loops   |  |  | | --- | --- | | ***1*** | **counter1 = 0** | | *2* | counter2 = 0 | | *3* | for i in range(3): # LOOP 1 | | *4* | counter1 = counter1 + 1 | | *5* | print(counter1, counter2, “LOOP1”) | | *6* | for j in range(3): # LOOP 2 | | *7* | counter2 = counter2 + 1 | | *8* | print(counter1, counter2 , “LOOP2”) | | *9* | print(counter1, counter2) | | 2 for-loop   |  |  | | --- | --- | | ***1*** | **counter1 = 0** | | *2* | counter2 = 0 | | *3* | for i in range(3): # LOOP 1 | | *4* | counter1 = counter1 + 1 | | *5* | print(counter1, counter2, “LOOP1”) | | *6* | for j in range(3): # LOOP 2 | | *7* | counter2 = counter2 + 1 | | *8* | print(counter1, counter2 , “LOOP2”) | | *9* | print(counter1, counter2) | |  |

**Lesson 8.5**

Step 2:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Nested for-loops   |  |  | | --- | --- | | *1* | counter1 = 0 | | ***2*** | **counter2 = 0** | | *3* | for i in range(3): # LOOP 1 | | *4* | counter1 = counter1 + 1 | | *5* | print(counter1, counter2, “LOOP1”) | | *6* | for j in range(3): # LOOP 2 | | *7* | counter2 = counter2 + 1 | | *8* | print(counter1, counter2 , “LOOP2”) | | *9* | print(counter1, counter2) | | 2 for-loop   |  |  | | --- | --- | | *1* | counter1 = 0 | | ***2*** | **counter2 = 0** | | *3* | for i in range(3): # LOOP 1 | | *4* | counter1 = counter1 + 1 | | *5* | print(counter1, counter2, “LOOP1”) | | *6* | for j in range(3): # LOOP 2 | | *7* | counter2 = counter2 + 1 | | *8* | print(counter1, counter2 , “LOOP2”) | | *9* | print(counter1, counter2) | |  |

Step 3:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Nested for-loops   |  |  | | --- | --- | | *1* | counter1 = 0 | | *2* | counter2 = 0 | | ***3*** | **for i in range(3): # LOOP 1** | | *4* | counter1 = counter1 + 1 | | *5* | print(counter1, counter2, “LOOP1”) | | *6* | for j in range(3): # LOOP 2 | | *7* | counter2 = counter2 + 1 | | *8* | print(counter1, counter2 , “LOOP2”) | | *9* | print(counter1, counter2) | | 2 for-loop   |  |  | | --- | --- | | *1* | counter1 = 0 | | *2* | counter2 = 0 | | ***3*** | **for i in range(3): # LOOP 1** | | *4* | counter1 = counter1 + 1 | | *5* | print(counter1, counter2, “LOOP1”) | | *6* | for j in range(3): # LOOP 2 | | *7* | counter2 = counter2 + 1 | | *8* | print(counter1, counter2 , “LOOP2”) | | *9* | print(counter1, counter2) | |  |

Step 4:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Nested for-loops   |  |  | | --- | --- | | *1* | counter1 = 0 | | *2* | counter2 = 0 | | *3* | for i in range(3): # LOOP 1 | | ***4*** | **counter1 = counter1 + 1** | | *5* | print(counter1, counter2, “LOOP1”) | | *6* | for j in range(3): # LOOP 2 | | *7* | counter2 = counter2 + 1 | | *8* | print(counter1, counter2 , “LOOP2”) | | *9* | print(counter1, counter2) | | 2 for-loop   |  |  | | --- | --- | | *1* | counter1 = 0 | | *2* | counter2 = 0 | | *3* | for i in range(3): # LOOP 1 | | ***4*** | **counter1 = counter1 + 1** | | *5* | print(counter1, counter2, “LOOP1”) | | *6* | for j in range(3): # LOOP 2 | | *7* | counter2 = counter2 + 1 | | *8* | print(counter1, counter2 , “LOOP2”) | | *9* | print(counter1, counter2) | |  |

**Lesson 8.5**

Step 5:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Nested for-loops   |  |  | | --- | --- | | *1* | counter1 = 0 | | *2* | counter2 = 0 | | *3* | for i in range(3): # LOOP 1 | | *4* | counter1 = counter1 + 1 | | ***5*** | **print(counter1, counter2, “LOOP1”)** | | *6* | for j in range(3): # LOOP 2 | | *7* | counter2 = counter2 + 1 | | *8* | print(counter1, counter2 , “LOOP2”) | | *9* | print(counter1, counter2) | | 2 for-loop   |  |  | | --- | --- | | *1* | counter1 = 0 | | *2* | counter2 = 0 | | *3* | for i in range(3): # LOOP 1 | | *4* | counter1 = counter1 + 1 | | ***5*** | **print(counter1, counter2, “LOOP1”)** | | *6* | for j in range(3): # LOOP 2 | | *7* | counter2 = counter2 + 1 | | *8* | print(counter1, counter2 , “LOOP2”) | | *9* | print(counter1, counter2) | |  |

Step 6: At this junction, how do we know when do we choose to jump to Line 6 or Line 3? We will look at the indentation of the code.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Nested for-loops   |  |  | | --- | --- | | *1* | counter1 = 0 | | *2* | counter2 = 0 | | *3* | for i in range(3): # LOOP 1 | | *4* | counter1 = counter1 + 1 | | *5* | print(counter1, counter2, “LOOP1”) | | ***6*** | **for j in range(3): # LOOP 2** | | *7* | counter2 = counter2 + 1 | | *8* | print(counter1, counter2 , “LOOP2”) | | *9* | print(counter1, counter2) | | 2 for-loop   |  |  | | --- | --- | | *1* | counter1 = 0 | | *2* | counter2 = 0 | | ***3*** | **for i in range(3): # LOOP 1** | | *4* | counter1 = counter1 + 1 | | *5* | print(counter1, counter2, “LOOP1”) | | *6* | for j in range(3): # LOOP 2 | | *7* | counter2 = counter2 + 1 | | *8* | print(counter1, counter2 , “LOOP2”) | | *9* | print(counter1, counter2) | |  |
|  |  |  |

**Lesson 8.5**

For the nested for-loops, the second for-loop is inside the first for-loop. We can visualize this as

|  |  |
| --- | --- |
| Figure - Nested For-Loop Diagram | Figure - 2 Parallel For-Loop Diagram |

Step 7:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Nested for-loops   |  |  | | --- | --- | | *1* | counter1 = 0 | | *2* | counter2 = 0 | | *3* | for i in range(3): # LOOP 1 | | *4* | counter1 = counter1 + 1 | | *5* | print(counter1, counter2, “LOOP1”) | | *6* | for j in range(3): # LOOP 2 | | ***7*** | **counter2 = counter2 + 1** | | *8* | print(counter1, counter2 , “LOOP2”) | | *9* | print(counter1, counter2) | | 2 for-loop   |  |  | | --- | --- | | *1* | counter1 = 0 | | *2* | counter2 = 0 | | *3* | for i in range(3): # LOOP 1 | | ***4*** | **counter1 = counter1 + 1** | | *5* | print(counter1, counter2, “LOOP1”) | | *6* | for j in range(3): # LOOP 2 | | *7* | counter2 = counter2 + 1 | | *8* | print(counter1, counter2 , “LOOP2”) | | *9* | print(counter1, counter2) | |  |

Step 8:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Nested for-loops   |  |  | | --- | --- | | *1* | counter1 = 0 | | *2* | counter2 = 0 | | *3* | for i in range(3): # LOOP 1 | | *4* | counter1 = counter1 + 1 | | *5* | print(counter1, counter2, “LOOP1”) | | *6* | for j in range(3): # LOOP 2 | | *7* | counter2 = counter2 + 1 | | ***8*** | **print(counter1, counter2 , “LOOP2”)** | | *9* | print(counter1, counter2) | | 2 for-loop   |  |  | | --- | --- | | *1* | counter1 = 0 | | *2* | counter2 = 0 | | *3* | for i in range(3): # LOOP 1 | | *4* | counter1 = counter1 + 1 | | ***5*** | **print(counter1, counter2, “LOOP1”)** | | *6* | for j in range(3): # LOOP 2 | | *7* | counter2 = counter2 + 1 | | *8* | print(counter1, counter2 , “LOOP2”) | | *9* | print(counter1, counter2) | |  |

**Lesson 8.5**

Step 9:

Notice that in ***nested for-loops***, we are stuck in the second for-loop (Loop2). This is because we need to complete Loop2 first before we go back to Loop1.

For the ***2 for-loops,*** we will need to complete Loop1 **fully** before moving to Loop2.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Nested for-loops   |  |  | | --- | --- | | *1* | counter1 = 0 | | *2* | counter2 = 0 | | *3* | for i in range(3): # LOOP 1 | | *4* | counter1 = counter1 + 1 | | *5* | print(counter1, counter2, “LOOP1”) | | ***6*** | **for j in range(3): # LOOP 2** | | *7* | counter2 = counter2 + 1 | | *8* | print(counter1, counter2 , “LOOP2”) | | *9* | print(counter1, counter2) | | 2 for-loop   |  |  | | --- | --- | | *1* | counter1 = 0 | | *2* | counter2 = 0 | | ***3*** | **for i in range(3): # LOOP 1** | | *4* | counter1 = counter1 + 1 | | *5* | print(counter1, counter2, “LOOP1”) | | *6* | for j in range(3): # LOOP 2 | | *7* | counter2 = counter2 + 1 | | *8* | print(counter1, counter2 , “LOOP2”) | | *9* | print(counter1, counter2) | |  |

Question Time:

For the above example code, answer the question.

Nested for-loop, how many times Line 7 is executed? \_\_\_\_\_\_

2 for-loop, how many times Line 7 is executed? \_\_\_\_\_\_

Nested for-loop, how many times Loop1 runs? \_\_\_\_\_\_

2 for-loop, how many times Loop2 runs? \_\_\_\_\_\_

Nested for-loop, what is the value of ***counter1*** at the end? \_\_\_\_\_\_

2 for-loop, what is the value of ***counter2*** at the end? \_\_\_\_\_\_

**Lesson 8.5**

Task 1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Code   |  |  | | --- | --- | | *1* | counter1 = 0 | | *2* | counter2 = 0 | | ***3*** | **for i in range(3): # LOOP 1** | | *4* | counter1 = counter1 + 1 | | *5* | print(i, counter1, counter2, “LOOP1”) | | ***6*** | **for j in range(3): # LOOP 2** | | *7* | counter2 = counter2 + 1 | | *8* | print(i, j, counter1, counter2 , “LOOP2”) | | *9* | print(counter1, counter2) | | Output   |  |  | | --- | --- | | *1* |  | | *2* |  | | *3* |  | | *4* |  | | *5* |  | | *6* |  | | *7* |  | | *8* |  | | *9* |  | | *10* |  | | *11* |  | |

Task 2

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Code   |  |  | | --- | --- | | *1* | counter1 = 10 | | *2* | counter2 = 10 | | ***3*** | **for i in range(3): # LOOP 1** | | *4* | counter1 = counter1 - 1 | | *5* | print(i, counter1, counter2, “LOOP1”) | | ***6*** | **for j in range(3): # LOOP 2** | | *7* | counter2 = counter2 + 1 | | *8* | print(i, j, counter1, counter2 , “LOOP2”) | | *9* | print(counter1, counter2) | | Output   |  |  | | --- | --- | | *1* |  | | *2* |  | | *3* |  | | *4* |  | | *5* |  | | *6* |  | | *7* |  | | *8* |  | | *9* |  | | *10* |  | | *11* |  | |

**Lesson 8.5**

Task 3

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Code   |  |  | | --- | --- | | *1* | counter1 = 5 | | *2* | counter2 = 7 | | *3* | for i in range(6): # LOOP 1 | | ***4*** | **counter1 = (counter1 + 2 ) \* 3** | | *5* | print(i, counter1, counter2, “# LOOP 1”) | | *6* | for j in range(3): # LOOP 2 | | ***7*** | **counter2 = (counter2 + 1) \* 2** | | *8* | print(j, counter1, counter2 , “# LOOP 2”) | | *9* | print(counter1, counter2) | | Output   |  |  | | --- | --- | | *1* |  | | *2* |  | | *3* |  | | *4* |  | | *5* |  | | *6* |  | | *7* |  | | *8* |  | | *9* |  | | *10* |  | | *11* |  | |

Task 4

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Code   |  |  | | --- | --- | | *1* | counter1 = 10 | | *2* | counter2 = 2 | | *3* | for i in range(4): # LOOP 1 | | ***4*** | **counter1 = counter1 + 1** | | *5* | print(i, counter1, counter2, “# LOOP 1”) | | *6* | for j in range(2): # LOOP 2 | | ***7*** | **counter2 = counter2 + 3** | | *8* | print(j, counter1, counter2 , “# LOOP 2”) | | *9* | print(counter1, counter2) | | Output   |  |  | | --- | --- | | *1* |  | | *2* |  | | *3* |  | | *4* |  | | *5* |  | | *6* |  | | *7* |  | | *8* |  | | *9* |  | | *10* |  | | *11* |  | |

**End of Lesson 8 Quiz**

**Question 1**

|  |  |
| --- | --- |
| *1* | counter = 0 |
| *2* | for i in range(8): # LOOP 1 |
| *3* | counter = counter + 2 |
| *4* | print(i, counter, “LOOP 1”) |
| *5* | print(counter) |

**Output:**

|  |  |
| --- | --- |
| 1 |  |
| 2 |  |
| 3 |  |
| 4 |  |
| 5 |  |
| 6 |  |
| 7 |  |
| 8 |  |
| 9 |  |
| 10 |  |
| 11 |  |
| 12 |  |

**End of Lesson 8 Quiz**

**Question 2**

|  |  |
| --- | --- |
| *1* | counter = 0 |
| *2* | for i in range(5): # LOOP 1 |
| *3* | counter = counter + 2 |
| *4* | print(i, counter, “# LOOP 1”) |
| *5* | for i in range(3): # LOOP 2 |
| *6* | counter = counter \* (-1) |
| *7* | print(i, counter, “# LOOP 2”) |
| *5* | print(counter) |

**Output:**

|  |  |
| --- | --- |
| 1 |  |
| 2 |  |
| 3 |  |
| 4 |  |
| 5 |  |
| 6 |  |
| 7 |  |
| 8 |  |
| 9 |  |
| 10 |  |
| 11 |  |
| 12 |  |

**End of Lesson 8 Quiz**

**Question 3**

|  |  |
| --- | --- |
| *1* | counter = 0 |
| *2* | for i in range(5): # LOOP 1 |
| *3* | counter = counter + 1 |
| *4* | print(i, counter, “# LOOP 1”) |
| *5* | for i in range(3): # LOOP 2 |
| *6* | counter = counter \* 2 |
| *7* | print(i, counter, “# LOOP 2”) |
| *8* | for i in range(4): # LOOP 3 |
| *9* | counter = counter - 3 |
| *10* | print(i, counter, “# LOOP 3”) |
| *11* | print(counter) |

**Output:**

|  |  |
| --- | --- |
| 1 |  |
| 2 |  |
| 3 |  |
| 4 |  |
| 5 |  |
| 6 |  |
| 7 |  |
| 8 |  |
| 9 |  |
| 10 |  |
| 11 |  |
| 12 |  |

**End of Lesson 8 Quiz**

**Question 4**

|  |  |
| --- | --- |
| *1* | counter1 = 1 |
| *2* | counter2 = 0 |
| *3* | for i in range(2): # LOOP 1 |
| *4* | counter1 = counter1 + 1 |
| *5* | print(i, counter1, counter2, “# LOOP 1”) |
| *6* | for j in range(4): # LOOP 2 |
| *7* | counter2 = counter2 + 3 |
| *8* | print(j, counter1, counter2 , “# LOOP 2”) |
| *9* | print(counter1, counter2) |

**Output:**

|  |  |
| --- | --- |
| 1 |  |
| 2 |  |
| 3 |  |
| 4 |  |
| 5 |  |
| 6 |  |
| 7 |  |
| 8 |  |
| 9 |  |
| 10 |  |
| 11 |  |
| 12 |  |