Topic	NESTED FOR LOOPS	
Class Description	The student will learn to create start and number patterns using nested for loops in Python.	
Class	PRO C99	
Class time	45 mins	
Goal	● Learn about nested for loops. ● Draw a star and number pattern using nested for loops.	
Resources Required	● Teacher Resources: 　○ Laptop with internet connectivity 　○ Earphones with mic 　○ Notebook and pen 　○ Smartphone ● Student Resources: 　○ Laptop with internet connectivity 　○ Earphones with mic 　○ Notebook and pen	
Class structure	Warm-Up Teacher-led Activity 1 Student-led Activity 1 Wrap-Up	10 mins 10 mins 20 mins 05 mins

WARM-UP SESSION - 10 mins
Teacher Starts Slideshow **Slide 1 to 4** Refer to speaker notes and follow the instructions on each slide.

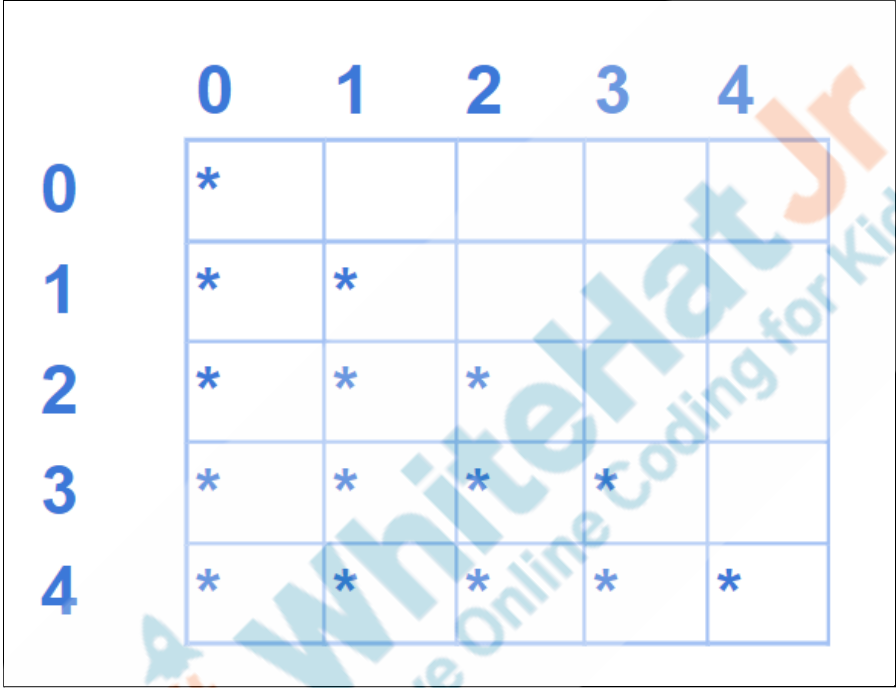|	
Hey <student's name>. How are you? It's great to see you! Are you excited to learn something new today?	**ESR**: Hi, thanks! Yes I am excited about it!

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Following are the WARM-UP session deliverables: ● Greet the student. ● Revision of previous class activities. ● Quizzes.	Click on the slide show tab and present the slides

WARM-UP QUIZ
Click on In-Class Quiz

Continue WARM-UP Session
Slide 5 to 15

Following are the session deliverables:
● Appreciate the student.
● Narrate the story by using hand gestures and voice modulation methods to bring in more interest in students.

Teacher Ends Slideshow

TEACHER-LED ACTIVITY - 10 mins

Teacher Initiates Screen Share

ACTIVITY

● **Print Patterns using nested for loops**

Teacher Action	Student Action
In today's class, we are going to learn more about **for loops** and how to use multiple loops together. Are you excited?	

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Let's get started.	**ESR**: Yes.
Start a Google Colab Notebook <u>Teacher Activity 1</u>. *Open <u>Teacher Activity 2</u> as an illustration to discuss and explain the number of rows and columns required to do the student activity.* Can you explain the picture? Great!	**ESR**: There are some stars arranged in a triangular shape.
Clearly, we can see 1 star at the top, and then 2 stars in the next line and so on, with the 5 stars in the last line. So, how would you draw this pattern? ***Note****: Encourage the student to give answers and be more involved in the discussion. Guide the student and let the student come to an answer for using a print() method.* Good!	**ESR:** We can print 1 star, 2 stars, 3 stars, 4 stars, and 5 stars using **print()** method.

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Sure, that is one of the ways. Let's try using the **print()** method and see if we can form this star pattern.

- We will start with using **1 star** as a string inside the **print()** method.
- Then we can use one more **print()** method to print **2 stars** with one space in between the two stars and so on.

The teacher writes the code as shown below.

```
print("*")
print("* *")
print("* * *")
print("* * * *")
print("* * * * *")

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

Well, that's great, we did get the same pattern!

But what if I want to make a pattern of 10 or 50 stars, then do you think this is a better way to draw this pattern?

Okay. Why do you think it's not better?

ESR: No.

ESR: Because we are repeating the print

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Note: *Encourage the student to give answers and be more involved in the discussion.*	statement multiple times.
Exactly!	
As programmers, we should always look for better ways and definitely avoid repetition wherever we can.	
So, there should be a way to tell the computer to use the **print()** statement only once.	
Do you remember what we use in programming to avoid repetition? Superb!	**ESR**: We use loops.
We will now use loops to draw this pattern.	
But before we can start using loops to draw this pattern, we will need to understand how the computer will understand it while using loops!	
In the previous class we learned about the list data type in Python, but in lists, data is stored in a sequential manner, one after the other.	
But everything in a computer is NOT sequentially stored. For this, let's divide the star pattern in the form of a grid of **equal numbers of rows and columns**.	
Can you tell me how many rows or columns we will need to make a pattern of 5 stars?	
	ESR: We will need 5 rows and 5 columns.

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Great!

We can divide the pattern into a 5X5 grid that is 5 rows and 5 columns.

This will give us 25 boxes, such that one box has only one star.

*				
*	*			
*	*	*		
*	*	*	*	
*	*	*	*	*

Once we make the grid, we need some identification to refer to these 25 boxes. Any idea how we can do that? Well, each row and column can be represented with a number starting from 0, the same we do for elements in	**ESR**: Varied.

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the list.

Open Teacher Activity 4, as an illustration, to discuss how rows and columns can be represented.

Using the **row number** and **column number,** we can select any box.

Generally, we first start with finding a row number, and then we find the column.

For example, we get the highlighted box for row 3 and column 2.

Open Teacher Activity 4, as an illustration, to discuss how to select a particular box of the grid using row numbers and column numbers can be represented.

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Now that we have understood how we can represent this pattern in the form of a grid(rows and columns), we need to tell the computer to understand this pattern in this format.

Building the pattern formation logic:

We will need two loops:
- The first one is to trace through all the rows(outer loop).
- The second one is to trace all columns(inner loop).
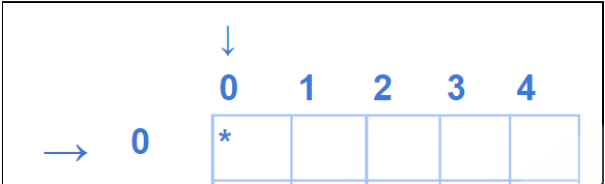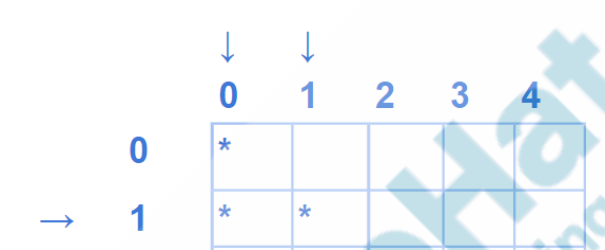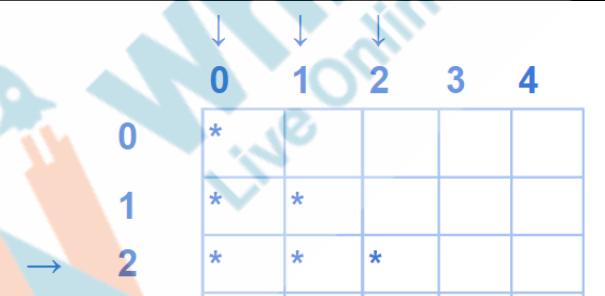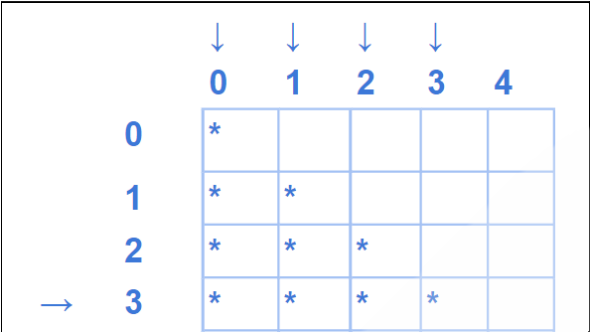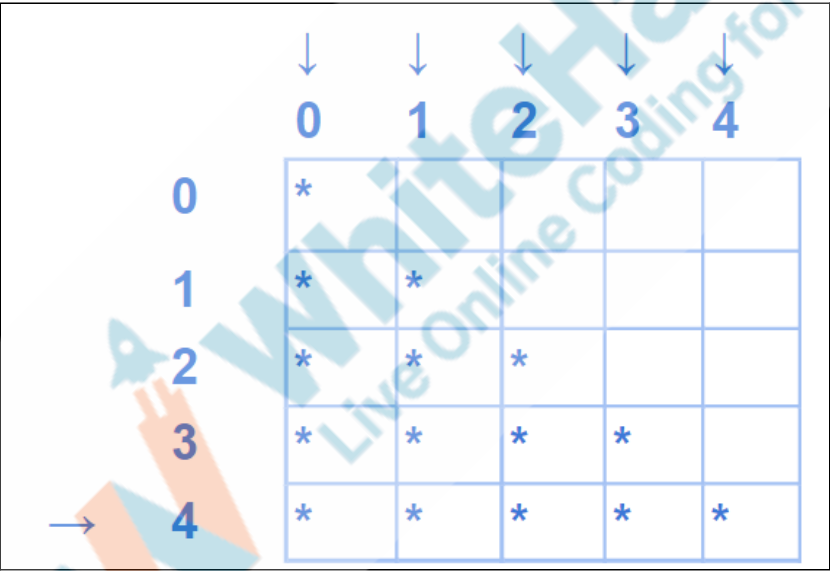
Now let's understand this in more detail.

Open Teacher Activity 4, as an illustration, to discuss how to select a particular box of the grid using row numbers and column numbers can be represented.
First, we will start with **row 0**, and we will go through **column 0** and print **1 star**.

ESR: Negative.

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Then we will go through **row 1**, we will go through **columns 0 and 1** to print **2 stars**.	

Then we will go through **row 2**, we will go through **columns 0, 1, and 2** to print **3 stars**.	

Then we will go through **row 3**, we will go through **columns 0, 1, 2, and 3** to print **4 stars**.	

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We will go to **row 4**, through **columns 0, 1, 2, 3, 4** to print **5 stars**.

What do you think is happening?	**ESR:** Varied.
Note: Encourage the student to give answers and be more involved in the discussion. Let the student build his/her logical thinking!	
We are printing stars in 5 rows such that row 1 has 1 star, row 2 has 2 stars, and so on.	

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To summarize the logic for this:

- Use the outer loop to loop through all the rows
    - Use the inner loop to loop through columns such the **column number <= row number**

When we use one loop inside another loop, that is called a **nested loop**.

Open Teacher Activity 5 to show and explain the syntax to the students.

Syntax:

Syntax 1 :

```
for repetition_var_1 in sequence:
    for repetition_var_2 in sequence:
        statement 1
        statement 2
        .....
        .....
        .....
        statement 10
```

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Syntax 2 :

```
for repetition_var_1 in range(start_val, end_val,steps):
    for repetition_var_2 in range(start_val, end_val,steps):
        statement 1
        statement 2
        .....
        .....
        .....
        statement 10
```

Let's write a program based on this logic to print the star pattern:

1. Take the value for the number row from the user into a variable called **num**.

2. Loop 5 times, instead of taking a list of 5 numbers, we will use the **range()** method to take 5 numbers for looping:

   a. **Outer loop**: Loop for **range(0,num)**

   b. **Inner loop**:
      i. Loop for **range(0,row number + 1)**
      ii. Print stars inside the inner loop. The **end=" "** is used to place a space after the displayed string instead of a newline.

   c. Use **print()** nothing in the outer loop for the newline. We can also use **print("\n")** for the

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<u>newline</u>. *The teacher writes the code.*	

```
[2]  num = int(input("Enter the number of rows: "))

     Enter the number of rows: 5

     for i in range(0, num):
             for j in range(0, i + 1):
                 print("*", end=" ")
             print()

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

Let's try to print a number pattern instead of stars, what do you think we can do for this? Instead of printing stars in the inner loop, we can directly print the looping variable. *The teacher writes the code.*	**ESR**: Varied.

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```
[4]  for i in range(0, num):
         for j in range(0, i + 1):
             print(j, end=" ")
         print()

0
0 1
0 1 2
0 1 2 3
0 1 2 3 4
```

The pattern starts from 0 since our inner loop starts from 0, what should we do to print the pattern starting from 1? We can start the range() of the inner loop from 1	ESR: Varied.

```
[5]  for i in range(1, num+1):
         for j in range(1, i + 1):
             print(j, end=" ")
         print()

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

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That was interesting! We learned how to use nested for loops and print star and number patterns using that. Now you will write a function to print the stars and numbers pattern in reverse order. Are you excited?	**ESR:** Yes.

<table>
<tr><td colspan="2" style="background:red; text-align:center">Teacher Stops Screen Share</td></tr>
<tr><td>So now it's your turn.
Please share your screen with me.</td><td></td></tr>
<tr><td colspan="2" style="background:#c6e0b4; text-align:center">Teacher Starts Slideshow
Slide 16 to 17
Refer to speaker notes and follow the instructions on each slide.</td></tr>
<tr><td>We have one more class challenge for you.
Can you solve it?

Let's try. I will guide you through it.</td><td></td></tr>
<tr><td colspan="2" style="background:#c6e0b4; text-align:center">Teacher Ends Slideshow</td></tr>
<tr><td colspan="2" style="background:#ffd966; text-align:center">STUDENT-LED ACTIVITY - 20 mins</td></tr>
<tr><td colspan="2" style="background:#b4c7e7">
● **Ask the student to press the ESC key to come back to the panel.**
● **Guide the student to start Screen Share.**
● **The teacher gets into Fullscreen.**
</td></tr>
<tr><td colspan="2" style="background:#fce4d6; text-align:center"><u>ACTIVITY</u></td></tr>
</table>

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● Write a program to draw a reverse star pattern.

Teacher Action	Student Action
Guide the student to start a Google Colab Notebook using <u>*Student Activity 1*</u>.	
Guide the student to write a pattern of stars given in <u>*Student Activity 2*</u>. 1. Take the value for the number row from the user into a variable called **num**. 2. Loop 5 times, instead of taking a list of 5 numbers, we will use the **range()** method to take 5 numbers for looping: a. **Outer loop**: Loop for **range(0,num)** b. **Inner loop**: i. Loop for **range(num, row number, -1)** ii. Print stars inside the inner loop. The **end= " "** is used to place a space after the displayed string instead of a newline. c. Use **print()** nothing in the outer loop for the newline. We can also use print("\n") for the newline.	

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```
[6]  for i in range(0, num):
         for j in range(num, i, -1):
             print("*", end=" ")
         print()

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

You did really amazing work today!

We were learned to about nested for loops and print amazing patterns using nested for loops.

Teacher Guides Student to Stop Screen Share

WRAP UP SESSION - 5 mins

Teacher Starts Slideshow
Slide 18 to 22

Activity details
Following are the WRAP-UP session deliverables:
- Appreciate the student.
- Revise the current class activities.
- Discuss the quizzes.

WRAP-UP QUIZ
Click on In-Class Quiz

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Continue WRAP-UP Session
Slide 23 to 28

</div>

Activity Details

Following are the session deliverables:
- Explain the facts and trivia
- Next class challenge
- Project for the day
- Additional Activity (Optional)

<div align="center">

FEEDBACK

</div>

- **Appreciate and compliment the student for trying to learn a difficult concept.**
- **Get to know how they are feeling after the session.**
- **Review and check their understanding.**

Teacher Action	Student Action
You get Hats off for your excellent work! In the next class, we will learn about Dictionary data type, and we build classes and objects to apply OOPs concepts in Python.	*Make sure you have given at least 2 Hats Off during the class for:* Creatively Solved Activities +10 Great Question +10 Strong Concentration +10

<div align="center">

PROJECT OVERVIEW DISCUSSION
Refer the document below in Activity Links Sections

</div>

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Teacher Clicks	**✖ End Class**

ADDITIONAL ACTIVITIES

Additional Activities
Encourage the student to extend the student activity to write a reverse number pattern.

Let's try to print a number pattern instead of stars in the reverse order.

Instead of printing stars in the inner loop, we can directly print the looping variable.

1. Take the value for the number row from the user into a variable called **num**.

2. Loop 5 times, instead of taking a list of 5 numbers, we will use the **range()** method to take 5 numbers for looping:

    a. **Outer loop**: Loop for **range(num, 0, -1)**

        i. **Inner loop**:
        Loop for **range(1, row number+1)**
        Print stars inside the inner loop. The **end= " "** is used to place a space after the displayed string instead of a newline.

    b. Use **print()** nothing in the outer loop for the newline. We can also use print("\n") for the newline.

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```
num = int(input("Enter the number of rows: "))

Enter the number of rows: 5
```

```
for i in range(num, 0, -1):
    for j in range(1, i+1):
        print(j, end=" ")
    print()
```

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

ACTIVITY LINKS		
Activity Name	**Description**	**Link**
Teacher Activity 1	Google Colab Notebook	Google Colaboratory
Teacher Activity 2	Star Pattern	https://s3-whjr-v2-prod-bucket.whjr.online/4e325b47-03bb-41c9-a1d4-046e5498d6e0.png
Teacher Activity 3	Grid Representation	https://s3-whjr-curriculum-uploads.whjr.online/c9fc5acd-342e-42e0-ac8c-1d556e90b073.gif
Teacher Activity 4	Row and Column Number	https://s3-whjr-curriculum-uploads.whjr.online/bafc625e-40db-43b4-8f45-e381f1fdeb9e.gif
Teacher Activity 5	Reference Code	https://colab.research.google.com/drive/1605M3QlV6W6Sh6H1bt

		ZIK7zLhN3DLCAM?usp=sharing
Student Activity 1	Google Colab Notebook	Google Colaboratory
Student Activity 2	Reverse Star Pattern	https://s3-whjr-v2-prod-bucket.whjr.online/c00b8301-f9cb-45f3-b4b3-ba13d02bf650.png
Teacher Reference 1	Project Document	https://s3-whjr-curriculum-uploads.whjr.online/23f4e309-ac0b-4d3b-bda9-f7565c0b92bb.pdf
Teacher Reference 2	Project Solution	https://colab.research.google.com/drive/10tCV5aBeVqjkEvsZwbMR5SgW82KC1x2h?usp=sharing
Teacher Reference 3	Visual-Aid	https://s3-whjr-curriculum-uploads.whjr.online/8849a144-05e9-41dd-86a8-07f45f9a496a.html
Teacher Reference 4	In-Class Quiz	https://s3-whjr-curriculum-uploads.whjr.online/5e225b8d-00c9-4c40-bfbb-fe7742a6fce9.pdf