



Python Programming Loops (for, while)

GCSE Student Booster

Starter - *For or While?*

2 minutes

Which type of loop would you use when solving the following problems:

1. A times table creator
2. A shopping list builder
3. Displaying a calendar for the current month
4. Asking a user for their login

Starter - *For or While?*

1. A times table creator: **For loop**

Times tables are usually for 1x, 2x ... up to 10x.

As this is a fixed number of times it lends itself to a for loop

2. A shopping list builder: **While Loop**

Shopping lists have a wide variety of items on them, an unknown quantity.

Our solution wants to loop around asking for each item.

As we don't know how many items, a while loop is best

3. Displaying a calendar for the current month: **For Loop**

There is a fixed number of days in a month. Although the months can vary, once you know which month you are displaying it's a defined amount.

4. Asking a user for their login: **While loop / For loop**

The answer for this problem depends on how the system will behave if the user enters an incorrect login. If they are allowed unlimited retries it's a while loop, if they get a fixed number, say 3 attempts, then it's a for loop.

What was the point of the starter?

At the beginning looking at the problem and thinking about the Algorithm features helps with algorithm design.

Types of **Algorithm features** you might find in a solution

While

Looping a variable number of times
(condition controlled)

For

Looping a fixed number of times
(count controlled)

If

Selecting between two choices

File read/write

For data that is stored/retrieved

Array

Multiple items of the same data type to be manipulated



Learning Aims

- Understand the difference between for and while loops and when you would use them
- Be clear on the terms count-controlled and condition-controlled loops
- Be able to analyse, modify and create code using loops



Check in

1 minute

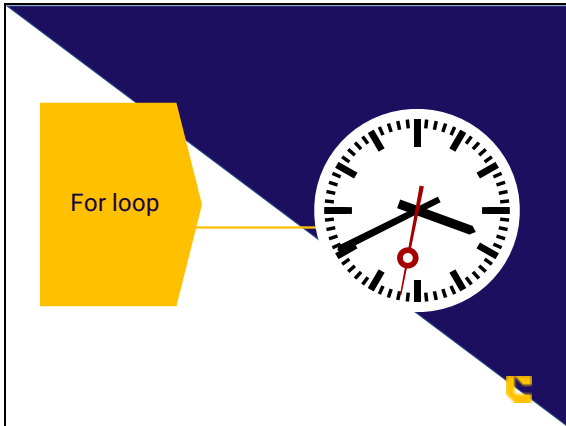
On a scale of 1-10 (1-low, 10-high) what is your confidence:

1. Understanding/reading code that uses **for** loops
2. Writing code that uses **for** loops

and

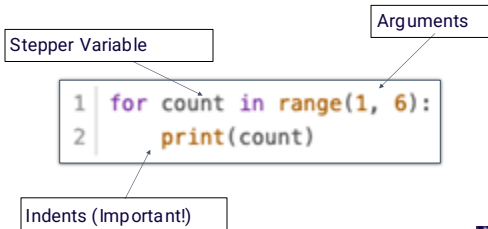
3. What do you want to learn from this session?





Definition – For loop

For loops are count controlled, meaning that you specify the number of times that you wish the instructions to be repeated.



Python – For loop variations

1 argument: The number of times to loop

```
for count in range(6):  
    print(count)
```

Output

0
1
2
3
4
5

Python – For loop variations

2 arguments: The starting value and ending value of the stepper variable

```
1 for count in range(1, 6):  
2     print(count)
```

Output

```
1  
2  
3  
4  
5
```

Python – For loop variations

3 arguments: The starting value and ending value, and step interval.

```
1 for count in range(1, 6, 2):  
2     print(count)
```

Output

```
1  
3  
5
```

Python – For loops

```
for i in range(1, 11):  
    print(i)
```

What does this code do?

Prints numbers 1-10 inclusive, with each number on a separate line.

```
1  
2  
3  
4  
5  
6  
7  
8  
9  
10
```

Python - For loops

```
for num in range(5, 0, -1):
    print(num)
```

What does this code do?

Counts down from 5 to 1, with each number on a separate line.

5
4
3
2
1



For Loop - check-in

2 minutes

```
1 result = 42
2 for number in range(3):
3     if number == 3:
4         result = result * number
5     else:
6         result = result + number
7 print("result is", result)
```

What will be the output when this code is run A, B, C, or D?

A Result is 42	B Result is 43
C Result is 88	D Result is 45

[Python tutor: How a for loop works](#)



For loop - Activity

5-10 minutes

Time to practice. Open the activity instructions and code shared with you.

You will have some code and the first task is to predict what it does....don't run it yet

The teacher will take you through what you will be doing

Activity 1

Look at the code that has been shared with you

```
1 times_table = 5
2 answer = 0
3 print("Here is the ", times_table, " times table")
4 multiplier = input(" ")
5 answer = multiplier * times_table
6 print(multiplier, " times ", times_table, " is ", answer)
```

Predict
In the box predict what you think the code will do when run

Run
Now run the code, what did it do?

Investigate
In the box predict what you think the code will do when run

1. Line 6 is used to output the times table message on the screen. In the first iteration, what is the value of the variable multiplier?

2. What does the * symbol mean on Line 5

For Loop Activity

Investigate **Answers**

```
1 times_table = 5
2 answer = 0
3 print("Here is the ", times_table, " times table")
4 for multiplier in range(1,11):
5     answer = multiplier * times_table
6     print(multiplier, " times ", times_table, "is ", answer)
7
```

- Line 6 is used to output the times table message on the screen. In the first iteration, what is the value of the variable multiplier?
1
- what does the * symbol mean on Line 5
Multiply
- What happens to the value of the multiplier variable after each iteration?
Increases by 1
- Change the values to range(2,22). What happens?
Creates a 2x-22x times table



For loop – Activity

Modify, Make

10-15 minutes

Complete the activities in the modify section to alter the code you have been given.

Then go on to the make activity to create a brand new application using what you have learnt.

Activity 2

Modify

Using the code make the modifications below. run it after each task to make sure it works

- Change the code so that it displays the timetable up to 12x
- Add a feature to ask the user what times table they want to display, e.g. if they enter 5, it should display 1x- 2x-9-12... up to 12x9
- Add to your solution by asking the user to also input how big they want their times table = g if they enter 9 for the times table and 3 for the size, they get 1x9x3, 2x9x3, 3x9x3

Make

Taking what you have learnt so far tackle this new problem

Create a quiz that tests a player's knowledge of their times tables. The program should:

- Ask the user which times table they would like to test
- Ask the maximum value they would like to go to
- Go through each multiplication in turn and ask for the correct answer
- If the player is correct, then "correct" should be displayed
- Else, "incorrect" should be displayed

Challenge level - if you get that finished, add a feature that keeps the score



For loops

Common misconceptions

It's not obvious that the stepper variable **automatically increments** each time round the loop

Number of times it loops.
In this example it loops 5 times not 6

```
1 for count in range(1, 6):
2     print(count)
```

Carefully check indents
If it's not indented under the for it's not part of the loop



For Loops

Not just for numbers

Iterate through all the characters in a string

```
word = input("Please enter a word: ")
for letter in word:
    print(letter)
```

Please enter a word: booster
b
o
o
s
t
e
r

Iterate through all the strings in a list

```
stock = ["strawberry laces", "milk bottles", "fruit salad"]
for i in range(len(stock)):
    print(stock[i])
```

strawberry laces
milk bottles
fruit salad



For Loops

Not just for numbers

```
fruits = ["apple", "banana", "orange"]
for fruit in fruits:
    print("I like", fruit)
```

What does this code do?

Iterates through the 'fruits' list and prints out each fruit consecutively with the text "I like" in front of each one.

I like apple
I like banana
I like orange



While Loop



Definition - while loop

While loops are condition controlled, meaning that a set of instructions is repeated based on whether a condition evaluates as True or False

If this outcome of the comparison of this line is True, line 5 and 6 are executed, if False the loop ends and goes to line 7

```
1 password = "1234"
2 password_guess = ""
3
4 while password_guess != password:
5     print("Please enter your password: ")
6     password_guess = input()
```

Everything that is indented below the while statement is repeated

This is a comparison operator that is used with the values either side. There are six common ones this is Not Equals (!=)

While loop - condition operators

1 minute

What are the names of these condition operators?

```
1 while age < 18:
2
3 while score <= highScore:
4
5 while anotherGo == "yes":
6
7 while airQuality > 350:
8
9 while temperature >= 30:]
```

While loop - condition operators

<	Less than
<=	Less than or equal to
==	Equal to
>	Greater than
>=	Greater than or equal to
!=	Not equal to

While Loop – check-in

2 minutes

```

1 stars = 3
2 planets = 5
3 while( planets > 1):
4     stars = stars + 2
5     planets = planets -1
6 print(stars)

```

What will be the output when this code is run?

A 3	B 5
C 13	D 11

[How a while loop works](#)

While loop – Activity

5-10 minutes

Time to practice. Open the activity instructions and code shared with you.

You will have some code and the first task is to predict what it does....don't run it yet.

The teacher will take you through what you will be doing.

Activity 1 – [Link to code](#)

Look at the code that has been shared with you

```

1 number=7
2 guesses=5
3 while guesses >= number:
4     guess = int(input("Guess a number between 1 and 10: "))
5     if guess == number:
6         print("correct")
7     else:
8         print("incorrect")
9     print("well done")

```

Predict

In the box predict what you think the code will do when run.

Run

Now run the code, what did it do?

Investigate

Now have a good look at the code and answer the following

1. What does the condition operator ">=" do on Line 3?

While loop – Activity

10-15 minutes

Complete the activities in the modify section to alter the code you have been given.

Then go on to the make activity to create a brand new application using what you have learnt.

Activity 2

Modify
Using the code make the modifications below. run it after each task to make sure it works

1. **Count:** Add a feature to count the number of guesses and display it after each guess.
 - a. Initialise the variable guesses first at the top of your program.
 - b. Decide what line of code will increment the variable by one after each guess.
 - c. Place the line of code in the most appropriate place.
 - d. Test your new code by printing the variable to see if it increments after each guess in the format "Number of guesses so far:"
2. **Top guesser:** Add a feature that prints at the end of the game "you are a top guesser" if they guess in less than three attempts.
3. **Limited guess:** Limit the number of guesses to five attempts, if they exceed five it displays the message "too many attempts, better luck next time"

Make

Take what you have learnt so far tackle this new problem

Perfect Pizza: Create a program that

- allows the user to make a custom pizza by adding the toppings of their choice
- when they have finished adding toppings, they enter the typing NAME.
- keep track of the cost of the pizza, and display it after baking
- pizza cost is £2 for the base and £1 for each topping

Challenge level: if you get that finished work out a way to remember what all the toppings are and display them just before you bake it

While loops

Common misconceptions

Instant termination

The loop only ends after the evaluation which happens only once each iteration

True or False?

Not being sure which causes the loop to end

```
1 password = "1234"
2 password_guess = ""
3
4 while password_guess != password:
5     print("Please enter your password: ")
6     password_guess = input()
```

Carefully check indents

If it's not indented under the while it's not part of the loop



Loops in Exams

- Shown in a pseudocode/reference language - not Python - [See the specification](#)
- You might have a question asking you to draw a flowchart, so practice representing loops in flowchart form.
- Questions with loops often include iterating through arrays (lists).

[2022 Paper 2 from OCR on their website](#)



Loops in Exams

- Make sure that you read the question properly!
- Double check the range (sometimes the question might use a 0 at start and sometimes a 1)
- Underline where the question states condition-controlled or counter-controlled and ensure that you use the correct type of loop.
- When asked to write an algorithm from scratch, look for key words such as 'repeats' to indicate that a loop is involved.



Check in

2 minutes

1. Indefinite iteration describes which loop type?
2. How many types of condition operator are there?
3. **FOR i in range(6)** - what is the value of i in the first iteration?
4. What is value of i in the last iteration?
5. Does a WHILE end IF the condition is True or False?
6. How many different formats of the range function are there?





Learning with Isaac

Isaac provides all the knowledge and lots of practice to get confident with For and While loops in programming and exams

- [Concepts - Iteration](#)
- Questions - examples [While](#), [Race Times](#), and more with [Question finder](#)
- Code snippets in Pseudocode/Python/C#



Check for more ISAAC boosters

Keep an eye out for more student booster events



Learning Aims

That you can confidently:

- Understand the difference between for and while loops and when you would use them
- Be clear on the terms count-controlled and condition-controlled loops
- Be able to analyse, modify and create code using loops

Through lots of hands-on practice



"Everyone in this country should learn how to program because it teaches you how to think"

Steve Jobs



Thank you