

A gamified introduction to Python Programming

Lecture 6

Everything about for loops

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Outline (Chapter 6)

- What is the **list type**?
(quick intro, more on this later)
- What is a **for loop** and how to implement a basic one using a list as generator?
- What is the **range() generator**?
- What is the **zip() generator**?
- What is the **enumerate() generator**?
- What are **nested for loops**?
- What is **breaking** and **continuing** in for loops?

The list type (short intro)

- Let us first introduce a new type of objects, called **lists**.

Definition (lists): a **list** is a **sequence** of several variables or elements, listed, in order, between **brackets** and separated by **commas**.

Lists can contain variables of any types (int, float, string, etc.) and lists can also contain mixed types of variables.

```
1 a_list = [0, 1, 2, 3, 4]
2 print(a_list)
3 print(type(a_list))
```

```
[0, 1, 2, 3, 4]
<class 'list'>
```

```
1 another_list = ['a', 'b', 'c', 'd']
2 print(another_list)
```

```
['a', 'b', 'c', 'd']
```

```
1 a_float = 3.14
2 an_int = 10
3 a_string = 'Hello'
4 mixed_list = [a_float, an_int, a_string]
5 print(mixed_list)
```

```
[3.14, 10, 'Hello']
```

The list type (short intro)

- Let us first introduce a new type of objects, called **lists**.

Definition (lists): a list is a sequence of several variables or elements, ordered, in order, between brackets and separated by commas.

Lists can contain variables of any types (int, float, string, etc.) and lists can also contain mixed types of variables.

We will learn more about lists in the next coming lectures!

```
1 a_list = [0, 1, 2, 3, 4]
2 print(a_list)
3 print(type(a_list))
```

```
[0, 1, 2, 3, 4]
<class 'list'>
```

```
1 another_list = ['a', 'b', 'c', 'd']
2 print(another_list)
```

```
['a', 'b', 'c', 'd']
```

```
1 a_float = 3.14
2 an_int = 10
3 a_string = 'Hello'
4 mixed_list = [a_float, an_int, a_string]
5 print(mixed_list)
```

```
[3.14, 10, 'Hello']
```

The **for** statement

Sometimes in programming, there is a block of code that you want to repeat **for a fixed or given number of times**.

- It could be done with a **while** statement, but **there is a more convenient way**.
- **The more convenient way:**
A **for** statement is used to repeat a given block of code **for** a given number of times.

```
1  # Counting from 1 to 5
2  # (While loop edition)
3  i = 0
4  while (i<5) :
5      i += 1
6      print(i)
```

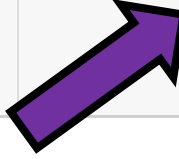
1
2
3
4
5

The **for** statement

The **for** loop - How it works:

- Use the **for** keyword,
- It is immediately followed by a **variable name**, called an **iteration variable**,

```
1  # Counting from 1 to 5
2  # (For loop edition)
3  my_list = [1, 2, 3, 4, 5]
4  for i in my_list:
5      print(i)
```



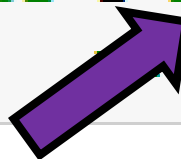
1
2
3
4
5

The **for** statement

The **for** loop - How it works:

- Use the **for** keyword,
- It is immediately followed by a **variable name**, called an **iteration variable**,
- Use the **in** keyword to indicate that the **iteration variable** will take values in a given **list**,

```
1  # Counting from 1 to 5
2  # (For loop edition)
3  my_list = [1, 2, 3, 4, 5]
4  for i in my_list:
5      print(i)
```



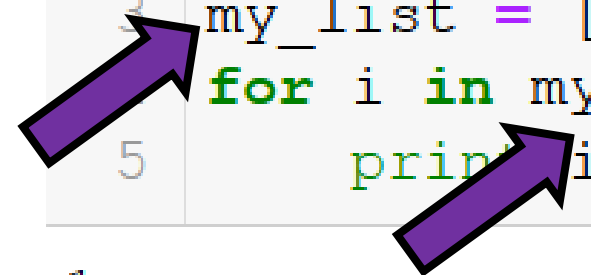
1
2
3
4
5

The **for** statement

The **for** loop - How it works:

- Use the **for** keyword,
- It is immediately followed by a **variable name**, called an **iteration variable**,
- Use the **in** keyword to indicate that the **iteration variable** will take values in a given **list**,
- Provide a **list** object, finish with a **:** **symbol**.

```
1  # Counting from 1 to 5
2  # (For loop edition)
3  my_list = [1, 2, 3, 4, 5]
4  for i in my_list:
5      print(i)
```



1
2
3
4
5

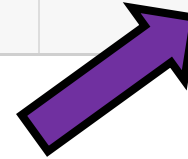
The **for** statement

The **for** loop - How it works:

- Use the **for** keyword,
- It is immediately followed by a **variable name**, called an **iteration variable**,
- Use the **in** keyword to indicate that the **iteration variable** will take values in a given **list**,
- Provide a **list** object, finish with a **:** **symbol**.
- **Indent some** code to be repeated inside the **for**, as in **if/while**.

```
1  # Counting from 1 to 5
2  # (For loop edition)
3  my_list = [1, 2, 3, 4, 5]
4  for i in my_list:
5      print(i)
```

1
2
3
4
5

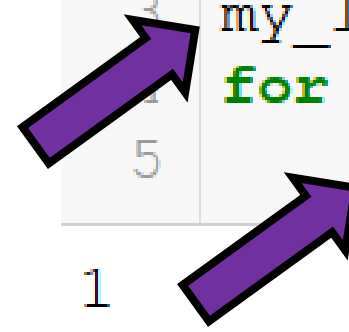


The **for** statement


The **for** loop - How it works:

- Use the **for** keyword,
- It is immediately followed by a **variable name**, called an **iteration variable**,
- Use the **in** keyword to indicate that the **iteration variable** will take values in a given **list**,
- Provide a **list** object, finish with a **:** **symbol**.
- **Indent some** code to be repeated inside the **for**, as in **if/while**.

```
1  # Counting from 1 to 5
2  # (For loop edition)
3  my_list = [1, 2, 3, 4, 5]
4  for i in my_list:
5      print(i)
```



1
2
3
4
5



Notice how **the iteration variable value changes after each repetition of the code** inside the for loop.

An example: average grade for student

Not using a **for** loop

- Lots of variable
- Long code

```
1 grade1 = 75
2 grade2 = 85
3 grade3 = 80
4 grade4 = 72
5 grade5 = 65
6 number_of_grades = 5
7 total_grade = grade1 + grade2 + grade3 + grade4 + grade5
8 average_grade = total_grade/number_of_grades
9 print(average_grade)
```

75.4

Using a **for** loop

- Cleaner and shorter code
- Modular (works with any number of grades in list)

```
1 grades_list = [75, 85, 80, 72, 65]
2 number_of_grades = 0
3 total_grade = 0
4 for grade in grades_list:
5     number_of_grades += 1
6     total_grade += grade
7 average_grade = total_grade/number_of_grades
8 print(average_grade)
```

75.4

The `range()` generator

Problem: typing a list of numbers manually is **cumbersome**, especially if it is supposed to contain lots of elements/numbers.

```
1 my_list = [0,1,2,3,4]
2 for i in my_list:
3     print(i)
```

0
1
2
3
4

**LAZINESS: THE MOST PROMINENT
CHARACTERISTIC
OF A DEVELOPER**



The `range()` generator

Solution: The `range()` generator can be used to replace the list object in the `for` loop definition.

- It receives an integer **n**.
- Here, `range(n)` means: the **iteration variable** will take **n** successive values, starting from 0 and incrementing by 1 each time.

```
1 my_list = [0,1,2,3,4]
2 for i in my_list:
3     print(i)
```

0
1
2
3
4

```
1 for j in range(5):
2     print(j)
```

0
1
2
3
4

The `range()` generator

Up to three parameters can be given to the `range()` generator.

- **2 parameters: `range(m, n)`**
makes the **iteration variable** take successive values, starting from **`m` (instead of 0)** and incrementing by 1 each time, until we reach **`n` (with `n` not included)**.

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

```
-1  
0  
1  
2  
3  
4  
5
```

The `range()` generator

Up to three parameters can be given to the `range()` generator.

- **3 parameters: `range(m, n, p)`**
makes the **iteration variable** take successive values, starting from **`m`** (instead of the default value 0) and incrementing by **`p`** (instead of the default value 1) each time, until we reach **`n`** (again, `n` not included).

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

```
-1  
0  
1  
2  
3  
4  
5
```

```
1 for j in range(1, 9, 2):  
2     print(j)
```

```
1  
3  
5  
7
```

```
1 for j in range(10, -4, -2):  
2     print(j)
```

```
10  
8  
6  
4  
2  
0  
-2
```

Note: Can use negative values as `m`, `n` and `p`.

The `range()` generator hides a list (almost)

The `range()` generator “hides” a list (almost), in the sense that it gives instructions on how to generate a list.

- If you ask Python to print the result of a `range()`, not that useful...!
- But ask it to convert the `range()` into a `list` and then print it... You should be able to visualize the list!

```
x = range(5)
print(x)
x2 = list(range(5))
print(x2)
x3 = list(range(1, 9, 2))
print(x3)
x4 = list(range(10, -4, -2))
print(x4)
```

```
range(0, 5)
[0, 1, 2, 3, 4]
[1, 3, 5, 7]
[10, 8, 6, 4, 2, 0, -2]
```


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Which of the following correctly describes the range(5) function?

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How many prints will appear on screen?

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How many prints will appear on screen?


① Start presenting to display the poll results on this slide.

The `zip()` generator

Want to browse through the elements of multiple lists at the same time?

- The `zip()` generator takes **multiple lists of equal length** (same number of elements).

```
1 my_list = [2, 7, 8, 4]
2 my_list2 = ["Apple", "Banana", "Pineapple", "Peach"]
3 for number, fruit in zip(my_list, my_list2):
4     # Separator
5     print("-----")
6     # Print index and value iteration variables
7     # on each loop iteration
8     print(number)
9     print(fruit)
```




```
-----
2
Apple
-----
7
Banana
-----
8
Pineapple
-----
4
Peach
```

The `zip()` generator

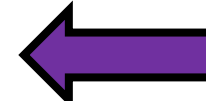
Want to browse through the elements of multiple lists at the same time?

- The `zip()` generator takes **multiple lists of equal length** (same number of elements).
- Updates that many **iteration variables** on each loop iteration, in a **synchronized manner** (moves both iteration variables at the same speed on both lists)

```
1 my_list = [2, 7, 8, 4]
2 my_list2 = ["Apple", "Banana", "Pineapple", "Peach"]
3 for number, fruit in zip(my_list, my_list2):
4     # Separator
5     print("-----")
6     # Print index and value iteration variables
7     # on each loop iteration
8     print(number)
9     print(fruit)
```



```
-----
2
Apple
-----
7
Banana
-----
8
Pineapple
-----
4
Peach
```




The `enumerate()` generator

The `enumerate()` generator can be used to **update two iteration variables** at once.

On each loop iteration:

- The first one takes values consisting of the **position index** (1st, 2nd, 3rd, ... element),
- The second is takes **value** of the element in the list.

```
1 my_list = [2, 7, 8, 4, 9]
2 for index, value in enumerate(my_list):
3     # Separator
4     print("-----")
5     # Print index and value iteration variables
6     # on each loop iteration
7     print(index)
8     print(value)
```



```
-----
0
2
-----
1
7
-----
2
8
-----
3
4
-----
4
9
```

The `enumerate()` generator

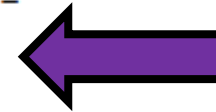
The `enumerate()` generator can be used to **update two iteration variables** at once.

On each loop iteration:

- The first one takes values consisting of the **position index** (1st, 2nd, 3rd, ... element),
- The second is takes **value** of the element in the list.

```
1 my_list = [2, 7, 8, 4, 9]
2 for index, value in enumerate(my_list):
3     # Separator
4     print("-----")
5     # Print index and value iteration variables
6     # on each loop iteration
7     print(index)
8     print(value)
```

```
-----
0
2
-----
1
7
-----
2
8
-----
3
4
-----
4
9
```



Note: In Python, we start counting from 0.

What we call the 1st element of the list in English, is called the 0th element (index = 0) in programming.



**What will be displayed when running the following code?
(Careful, there might be something sketchy about it!)**

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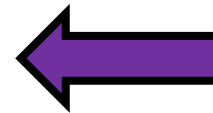
Nesting **for** loops

Just like we **nested if** statements earlier, we can **nest for** loops.

- Works “almost” like the **zip** generator,
- But updates the **iteration variables** in an **unsynchronized manner**.
- Convenient for checking all combinations of values in two given lists!

```
1 my_list = [2, 7, 8]
2 my_list2 = ["Apple", "Banana"]
3 for number in my_list:
4     for fruit in my_list2:
5         # Separator
6         print("-----")
7         # Print index and value iteration variables
8         # on each loop iteration
9         print(number)
10        print(fruit)
```

```
-----
2
Apple
-----
2
Banana
-----
7
Apple
-----
7
Banana
-----
8
Apple
-----
8
Banana
```



The **break** statement (episode 2)

In a previous lecture, we have seen how the **break** statement is used to **interrupt** a **while** loop.

- It also works with **for** loops!
- When the **break** keyword is encountered in a **for** loop, it will **stop the iterations early**, before we have been able to see all elements in the list/generator.

```
1 my_list = [1, 2, 3, 4, 5]
2 for value in my_list:
3     # Separator
4     print("-----")
5     # Print iteration variable value
6     print(value)
7     # Break if
8     if (value == 3):
9         print("Breaking for loop")
10        break
```

1

2

3

Breaking for loop

The **continue** statement

Similar to the **break** statement, which was be used to **interrupt** a **while/for** loop...

- We can define the **continue** statement!
- When encountered in the indented code inside a **for** loop, it **ends the current iteration and moves on to the next one**.

```
1 my_list = [1, 2, 3, 4, 5]
2 for value in my_list:
3     # Separator
4     print("-----")
5     # Continue if
6     if(value == 3):
7         print("Skipping instructions in for loop")
8         continue
9     # Print iteration variable value
10    print(value)
```

```
-----
1
-----
2
-----
Skipping instruction in for loop
-----
4
-----
5
```

The **else** statement (episode 2)

Similar to the **else** statement, which was used in **if** statements...

- We can define the **else** statement in **for** loops.
- It defines a piece of code to be executed when the **for** loop ends normally.
- **Normally**: completed all iterations, without being interrupted by a **break**.

```
1 my_list = [1, 2, 3, 4, 5]
2 for value in my_list:
3     # Separator
4     print("-----")
5     # Print iteration variable value
6     print(value)
7 else:
8     # Instruction to execute, once the for loop ends
9     print("We're done!")
```

```
-----
1
-----
2
-----
3
-----
4
-----
5
We're done!
```

The **else** statement (episode 2)

Similar to the **else** statement, which was used in **if** statements...

- We can define the **else** statement in **for** loops.
- It defines a piece of code to be executed when the **for** loop ends normally.
- **Normally**: completed all iterations, without being interrupted by a **break**.

```
1 my_list = [1, 2, 3, 4, 5]
2 for value in my_list:
3     # Separator
4     print("-----")
5     # If break
6     if (value == 3):
7         break
8     # Print iteration variable value
9     print(value)
10 else:
11     # Instruction to execute, once the for loop ends
12     print("We're done!")
```

```
-----
1
-----
2
-----
```




Which values will be displayed when we execute this code?

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To recap

We have seen multiple ways to make **for** loops work

1. **Pass a list:** easiest way, browse through each element one by one.
2. **The `range()` generator:** Replace a list of regularly spaced values with a `range()` generator, as to avoid having to type the elements of the list manually.
3. **The `zip()` generator:** Browse through multiple lists elements in a synchronized manner. Useful for one-to-one matchings between lists.
4. **The `enumerate()` generator:** Updates two iteration variables at once, one being the position index of the element in the list, and the second being the value of said element in list.
5. **Nesting `for` loops:** Browse through multiple lists elements in an unsynchronized manner. Useful for checking all combinations.



Conclusion (Chapter 6)

- What is the **list type**?
(quick intro, more on this later)
- What is a **for loop** and how to implement a basic one using a list as generator?
- What is the **range() generator**?
- What is the **zip() generator**?
- What is the **enumerate() generator**?
- What are **nested for loops**?
- What is **breaking** and **continuing** in for loops?

Practice activities: basic for loops

Let us practice a bit with for loops, with the following activities

Activity 1 - How many items in my inventory.ipynb

Activity 2 - Best equipment finder.ipynb

Activity 3 - Best equipment finder v2.ipynb

Activity 4 - Find the missing card.ipynb

Activity 1 - How many items in my inventory

- In several video games, the main character will have an **inventory system**, i.e. a list of items that he/she is carrying at the moment.



Activity 1 - How many items in my inventory

- In several video games, the main character will have an **inventory system**, i.e. a list of items that he/she is carrying at the moment. This **inventory** could be defined as a **list**, as shown below.

```
inventory = ["Sword", "Armor", "Potion", "Potion", "Torch", "Potion",  
             "Bow", "Potion", "Torch", "Potion"]
```

- Our objective is to write a function **how_many_items()**, which:
 - **receives** an **inventory list**, such as the one above, as its first parameter,
 - **receives** an **item name**, as a second parameter (e.g. `item_name = "Torch"`)
 - and **returns the number of times the item** in question **appears in the inventory**.

Activity 2 - Best equipment finder

- Let us define an **inventory list**, below, which contains a list of weapons that our character has acquired during gameplay.

inventory = ["Dull Sword", "Wooden Branch", "Master Sword", "Iron Sword", "Silver Sword"]

- Let us also consider we have been given a **second list**, which contains the **attack points for each weapon** currently in inventory, in order:

weapon_stats = [1, 1, 10, 5, 8]

- Write a function **maximal_attack_points()**, which
 - **receives** the **weapon_stats list** as its only parameter,
 - and **returns the maximal attack points** we would have if we were to equip the **best weapon** currently in inventory.

Activity 3 - Best equipment finder v2

- Let us define an **inventory list**, below, which contains a list of weapons that our character has acquired during gameplay.

inventory = ["Dull Sword", "Wooden Branch", "Master Sword", "Iron Sword", "Silver Sword"]

- Let us also consider we have been given a **second list**, which contains the **attack points for each weapon** currently in inventory, in order:

weapon_stats = [1, 1, 10, 5, 8]

- **Task:** As in activity 2, but I want **the name of the best weapon to be returned** instead of the maximal attack points I would obtain if I decided to equip it!

Activity 4 - Find the missing card

```
1 complete_deck = ['Ace of Hearts', 'Two of Hearts', 'Three of Hearts', 'Four of Hearts', \
2                 'Five of Hearts', 'Six of Hearts', 'Seven of Hearts', 'Eight of Hearts', \
3                 'Nine of Hearts', 'Ten of Hearts', 'Jack of Hearts', 'Queen of Hearts', \
4                 'King of Hearts', 'Ace of Diamonds', 'Two of Diamonds', 'Three of Diamonds', \
5                 'Four of Diamonds', 'Five of Diamonds', 'Six of Diamonds', 'Seven of Diamonds', \
6                 'Eight of Diamonds', 'Nine of Diamonds', 'Ten of Diamonds', 'Jack of Diamonds', \
7                 'Queen of Diamonds', 'King of Diamonds', 'Ace of Spades', 'Two of Spades', \
8                 'Three of Spades', 'Four of Spades', 'Five of Spades', 'Six of Spades', 'Seven of Spades', \
9                 'Eight of Spades', 'Nine of Spades', 'Ten of Spades', 'Jack of Spades', 'Queen of Spades', \
10                'King of Spades', 'Ace of Clubs', 'Two of Clubs', 'Three of Clubs', 'Four of Clubs', \
11                'Five of Clubs', 'Six of Clubs', 'Seven of Clubs', 'Eight of Clubs', 'Nine of Clubs', \
12                'Ten of Clubs', 'Jack of Clubs', 'Queen of Clubs', 'King of Clubs']
13 print(complete_deck)
```

```
['Ace of Hearts', 'Two of Hearts', 'Three of Hearts', 'Four of Hearts', 'Five of Hearts', 'Six of Hearts', 'Seven of
Hearts', 'Eight of Hearts', 'Nine of Hearts', 'Ten of Hearts', 'Jack of Hearts', 'Queen of Hearts', 'King of Hearts',
'Ace of Diamonds', 'Two of Diamonds', 'Three of Diamonds', 'Four of Diamonds', 'Five of Diamonds', 'Six of Diamonds',
'Seven of Diamonds', 'Eight of Diamonds', 'Nine of Diamonds', 'Ten of Diamonds', 'Jack of Diamonds', 'Queen of Diamon
ds', 'King of Diamonds', 'Ace of Spades', 'Two of Spades', 'Three of Spades', 'Four of Spades', 'Five of Spades', 'Si
x of Spades', 'Seven of Spades', 'Eight of Spades', 'Nine of Spades', 'Ten of Spades', 'Jack of Spades', 'Queen of Sp
ades', 'King of Spades', 'Ace of Clubs', 'Two of Clubs', 'Three of Clubs', 'Four of Clubs', 'Five of Clubs', 'Six of
Clubs', 'Seven of Clubs', 'Eight of Clubs', 'Nine of Clubs', 'Ten of Clubs', 'Jack of Clubs', 'Queen of Clubs', 'King
of Clubs']
```

Activity 4 - Find the missing card

```
1 # This first deck is missing a Three of Diamonds.
2 deck1 = ['Nine of Diamonds', 'Queen of Spades', 'Queen of Hearts', 'Eight of Hearts', 'King of Spades', \
3         'Nine of Clubs', 'Jack of Hearts', 'Eight of Clubs', 'Seven of Hearts', 'Ten of Diamonds', \
4         'Five of Spades', 'Jack of Diamonds', 'Three of Hearts', 'Queen of Diamonds', 'Queen of Clubs', \
5         'Five of Diamonds', 'Five of Hearts', 'Nine of Spades', 'Four of Hearts', 'King of Diamonds', \
6         'Two of Spades', 'Ace of Spades', 'Two of Clubs', 'Nine of Hearts', 'Six of Hearts', 'Ten of Hearts', \
7         'Six of Diamonds', 'Six of Spades', 'Ace of Hearts', 'Two of Hearts', 'Six of Clubs', \
8         'King of Hearts', 'King of Clubs', 'Seven of Clubs', 'Four of Clubs', 'Four of Diamonds', \
9         'Ten of Clubs', 'Two of Diamonds', 'Five of Clubs', 'Jack of Clubs', 'Seven of Diamonds', \
10        'Eight of Spades', 'Ten of Spades', 'Eight of Diamonds', 'Four of Spades', 'Three of Spades', \
11        'Seven of Spades', 'Three of Clubs', 'Ace of Clubs', 'Jack of Spades', 'Ace of Diamonds']
```

Activity 4 - Find the missing card

Write a function **find_missing_card()**.

- It receives a **complete deck of cards** as its first parameter, and receives a **second deck**, as its second parameter.
- The second deck is a standard deck that has been shuffled and is **missing exactly one card at most**.
- The function **find_missing_card()** should **return the name of the one card that is missing** in the second deck. It should **return None**, if no card is missing.
- The incomplete decks are missing one card at most (or none) and contain no duplicates or cards that are not in the complete deck.