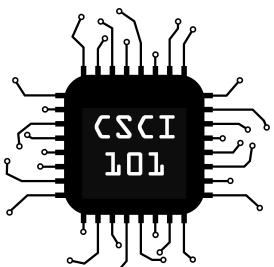
Lists & The `for` Loop



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- `my_list[2]` is `"Hello"`
- `my_list[0]` is `1`

Why Zero-Indexed?

In lower-level programming languages, lists are stored as simply a base address in memory, and the value in the brackets is the offset. The offset is added to the base address to find the memory address of the item.

Address	···	1350	1351	1352	1353	1354	···
Value	···	12	13	7	21	3	···

Note: These addresses and values are just an example, not real values.

List Indexed Assignment

Lists can be changed once they are created, to do so, assign to the list at the index desired.

```
mynums = [4, 5, 6]
mynums[2] = 7
print(mynums)
```

```
[4, 5, 7]
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print(mynums)
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```
[4, 5, 7]
```

However, assignment to indices not currently in the list is **not allowed**. This example will cause an error.

```
mynums = [4, 5, 6]
mynums[3] = 7        # bad, 3 is out of range!
```

List Concatenation

Similar to how strings can be concatenated using the + operator, so can lists.

```
a = [5, 6, 7, 8]
b = ["we", "can", "concatenate"]
c = a + b
print(a)
print(b)
print(c)
```

```
[5, 6, 7, 8]
["we", "can", "concatenate"]
[5, 6, 7, 8, "we", "can", "concatenate"]
```

Lists in Lists

Lists can store data of **any** type, *including lists*.

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nested = [[1, 2, 3], [4, 5, 6]]
```

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Lists can store data of **any** type, *including lists*.

```
nested = [[1, 2, 3], [4, 5, 6]]
```

Accessing and assigning is done by using another set of brackets.

```
print(nested[0][0])
nested[0][0] = nested[1][0]
print(nested)
```

```
1
[[4, 2, 3], [4, 5, 6]]
```

Practice: List Manipulation

Open a new program and define this variable at the top:

```
magiclist = [[1, 2], [3, 4], ["Oh", "Hey"]]
```

Then, your program should (in order):

1. Set the second element in the first list to the first element in the first list
2. Subtract 1 from the first element in the second list
3. Set the second element in the second list to the *length of* the second element in the third list
4. Replace the third list with a string obtained by concatenating both elements of the third list together
5. Replace the string (the third element of `magiclist`) with its length
6. Print `magiclist`

If all went well, your program should print `[[1, 1], [2, 3], 5]`.

Iterating Over a List using `while`

Using what we know about **`while`** loops, we can iterate over a list using a counter variable. Here is an example:

```
i = 0
while i < len(my_list):
    print(my_list[i])
    i = i + 1
```

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while i < len(my_list):
    print(my_list[i])
    i = i + 1
```

If `my_list` was `[1, 2, "Hello", "Python"]`, then this would print:

```
1
2
Hello
Python
```

Iterating Over a List using `for`

Python provides a clean **range-based** construct for iterating over **iterables** called `for`. Here's it's syntax:

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for var_name in iterable:
    # do something
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```

So here is an example of iterating over our previous list:

```
for item in my_list:
    print(item)
```

```
1
2
Hello
Python
```

Generating Ranges

The generator function `range` creates an iterable for looping over a sequence of numbers. The syntax is `range(`*`start`*`, `*`stop`*`, `*`step`*`)`.

- *`start`* is the number to start on
- *`stop`* is the number to stop **before**
- *`step`* is the amount to increment each time

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

```
0
1
2
3
4
```

Range: `step` is Optional

If you do not provide `step` to the range function, Python will assume that you want to increment by one every time.

Here is an example:

```
for i in range(0, 5):
    print(i)
```

```
0
1
2
3
4
```

Range: `start` is Optional

If you do not provide `start` or `step` to the range function, Python will assume that you want to increment by one every time *and* to start at zero.

Here is an example:

```
for i in range(5):
    print(i)
```

```
0
1
2
3
4
```

Repeat n times

So you want to repeat something n times?

```
n = 5
for i in range(n):
    print("Hello, World!")
```

```
Hello, World!
Hello, World!
Hello, World!
Hello, World!
Hello, World!
```

Practice: Trace the Loops

First, trace the loop by hand and determine the output. Then, type the loop into a Python script and run it to determine if you were correct.

Loop 4

```
for i in range(3):
    for j in range(2):
        print(i, j)
```

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Loop 5

```
favnums = [4, 3, 1]
stats = ["my new favorite", "okay", "boring"]
for num in favnums:
    for stat in stats:
        print(num, "is", stat)
    print("Tomorrow...")
print("I'm sticking with", favnums[1])
```