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Lecture 2

- Loops
- While Loops
- For Loops
- Improving with User Input
- More About Lists
- Length
- Dictionaries
- Mario
- Summing Up

Loops

- Essentially, loops are a way to do something over and over again.
- Begin by typing `code cat.py` in the terminal window.

  Running this code by typing `python cat.py`, you'll notice that the program meows three times.
- In developing as a programmer, you want to consider how one could improve areas of one's code where one types the same thing over and over again. Imagine where one might want to "meow" 500 times. Would it be logical to type that same expression of `print("meow")` over and over again?
- Loops enable you to create a block of code that executes over and over again.

While Loops

- The `while` loop is nearly universal throughout all coding languages.
- Such a loop will repeat a block of code over and over again.
- In the text editor window, edit your code as follows:

```
i = 3
while i != 0:
    print("meow")
```

  Notice how even though this code will execute `print("meow")` multiple times, it will never stop! It will loop forever. `while` loops work by repeatedly asking if the condition of the loop has been fulfilled. In this case, the compiler is asking, "does `i` not equal zero?" When you get stuck in a loop that executes forever, you can press `ctrl + c` on your keyboard to break out of the loop.

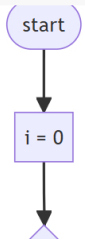
```
    i = i - 1
```

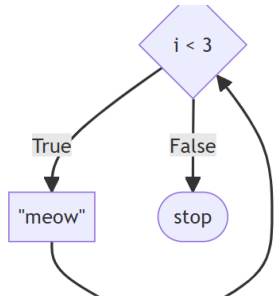
  Notice that now our code executes properly, reducing `i` by `1` for each "iteration" through the loop. The term iteration has special significance within coding. By iteration, we mean one cycle through the loop. The first iteration is the "0th" iteration through the loop. The second is the "1st" iteration. In programming, we count starting with 0, then 1, then 2.
- We can further improve our code as follows:

```
i = 1
while i <= 3:
    print("meow")
    i = i + 1
```

  Notice that when we code `i = i + 1` we assign the value of `i` from the right to the left. Above, we are starting `i` at one, like most humans count (1, 2, 3). If you execute the code above, you'll see it meows three times. It's best practice in programming to begin counting with zero.
- We can improve our code to start counting with zero:

```
i = 0
while i < 3:
    print("meow")
    i += 1
```





For Loops

- A `for` loop is a different type of loop.
- To best understand a `for` loop, it's best to begin by talking about a new variable type called a `list` in Python. As in other areas of our lives, we can have a grocery list, a to-do list, etc.
- A `for` loop iterates through a `list` of items. For example, in the text editor window, modify your `cat.py` code as follows:

```
for i in [0, 1, 2]:
    print("meow")
```

  Notice how clean this code is compared to your previous `while` loop code. In this code, `i` begins with `0`, meows, `i` is assigned `1`, meows, and, finally, `i` is assigned `2`, meows, and then ends.

- While this code accomplishes what we want, there are some possibilities for improving our code for extreme cases. At first glance, our code looks great. However, what if you wanted to iterate up to a million? It's best to create code that can work with such extreme cases. Accordingly, we can improve our code as follows:

```
for i in range(3):
    print("meow")
```

```
for _ in range(3):
    print("meow")
```

  Notice how changing the `i` to `_` has zero impact on the functioning of our program.

- Our code can be further improved. To stretch your mind to the possibilities within Python, consider the following code:

```
print("meow" * 3)
```

  Notice how it will meow three times, but the program will produce `meowmeowmeow` as the result. Consider: How could you create a line break at the end of each meow?

- Indeed, you can edit your code as follows:

```
print("meow\n" * 3, end="")
```

  Notice how this code produces three meows, each on a separate line. By adding `end=""` and the `\n` we tell the compiler to add a line break at the end of each meow.

Improving with User Input

```
while True:
    n = int(input("What's n? "))
    if n < 0:
        continue
    else:
        break
```

- Notice that we've introduced two new keywords in Python, `continue` and `break`. `continue` explicitly tells Python to go to the next iteration of a loop. `break`, on the other hand, tells Python to "break out" of a loop early before it has finished all of its iterations. In this case, we'll `continue` to the next iteration of the loop when `n` is less than 0—ultimately reprompting the user with "What's n?". If, though, `n` is greater than or equal to 0, we'll `break` out of the loop and allow the rest of our program to run.
- It turns out that the `continue` keyword is redundant in this case. We can improve our code as follows:

```
while True:
    n = int(input("What's n? "))
    if n > 0:
        break

for _ in range(n):
    print("meow")
```

```
def get_number():
    while True:
        n = int(input("What's n? "))
        if n > 0:
            return n
```

```
def meow(n):
    for _ in range(n):
        print("meow")


main()
```

Notice how not only did we change your code to operate in multiple functions, but we also used a `return` statement to `return` the value of `n` back to the `main` function.

More About Lists

```
print(students[0])
print(students[1])
print(students[2])
```

Notice how we have a `list` of students with their names as above. We then print the student who is at the 0th location, "Hermoine". Each of the other students is printed as well.

- Just as we illustrated previously, we can use a loop to iterate over the list. You can improve your code as follows:

```
students = ["Hermoine", "Harry", "Ron"]

for student in students:
    print(student)
```

Notice that for each `student` in the `students` list, it will print the student as intended. You might wonder why we did not use the `_` designation as discussed prior. We choose not to do this because `student` is explicitly used in our code.

- You can learn more in Python's documentation of lists.

Length

```
for i in range(len(students)):
    print(i + 1, students[i])
```

Notice how executing this code results in not only getting the position of each student plus one using `i + 1`, but also prints the name of each student. `len` allows you to dynamically see how long the list of the students is regardless of how much it grows.

- You can learn more in Python's documentation of len.

Dictionaries

- `dict`s or dictionaries is a data structure that allows you to associate keys with values.
- Where a `list` is a list of multiple values, a `dict` associates a key with a value.
- Considering the houses of Hogwarts, we might assign specific students to specific houses.

Hermione	Harry	Ron	Draco

```
houses = ["Gryffindor", "Gryffindor", "Griffindor", "Slytherin"]
```

Notice that we can promise that we will always keep these lists in order. The individual at the first position of `students` is associated with the house at the first position of the `houses` list, and so on. However, this can become quite cumbersome as our lists grow!

- We can better our code using a `dict` as follows:

```
students = {
    "Hermoine": "Gryffindor",
    "Harry": "Gryffindor",
    "Ron": "Gryffindor",
    "Draco": "Slytherin",
}
print(students["Hermoine"])
print(students["Harry"])
print(students["Ron"])
print(students["Draco"])
```

Notice how we use `{}` curly braces to create a dictionary. Where `list`s use numbers to iterate through the list, `dict`s allow us to use words.

- Run your code and make sure your output is as follows:

```
students = {
```

```
    "Hermoine": "Gryffindor",
    "Harry": "Gryffindor",
    "Ron": "Gryffindor",
    "Draco": "Slytherin",
}
for student in students:
    print(student)
```

Notice how, executing this code, the for loop will only iterate through all the keys, resulting in a list of the names of the students. How could we print out both values and keys?

- Modify your code as follows:

```
students = {
    "Hermoine": "Gryffindor",
    "Harry": "Gryffindor",
    "Ron": "Gryffindor",
    "Draco": "Slytherin",
}
for student in students:
    print(student, students[student])
```

```
    "Hermoine": "Gryffindor",
    "Harry": "Gryffindor",
    "Ron": "Gryffindor",
    "Draco": "Slytherin",
}
for student in students:
    print(student, students[student], sep=", ")
```

Notice how this creates a clean separation of a `,` between each item printed.

- If you execute `python hogwarts.py`, you should see the following:

```
$ python hogwarts.py
Hermoine, Gryffindor
Harry, Gryffindor
Ron, Gryffindor
Draco, Slytherin
```

- What if we have more information about our students? How could we associate more data with each of the students?

	name	house	patronus
2	Ron	Gryffindor	Jack Russell terrier
3	Draco	Slytherin	

- You can imagine wanting to have lots of data associated with multiple keys. Enhance your code as follows:

```
students = [
    {"name": "Hermoine", "house": "Gryffindor", "patronus": "Otter"},
    {"name": "Harry", "house": "Gryffindor", "patronus": "Stag"},
    {"name": "Ron", "house": "Gryffindor", "patronus": "Jack Russell terrier"},
    {"name": "Draco", "house": "Slytherin", "patronus": None},
]
```

Notice how this code creates a `list` of `dict`s. The `list` called `students` has four `dicts` within it: One for each student. Also, notice that Python has a special `None` designation where there is no value associated with a key.

- Now, you have access to a whole host of interesting data about these students. Now, further modify your code as follows:

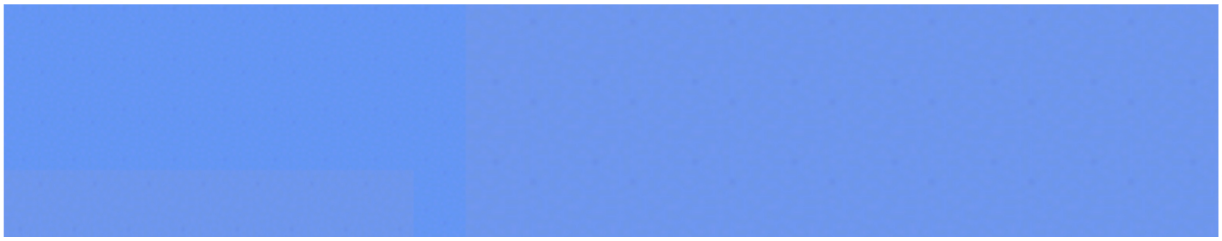
```
students = [
    {"name": "Hermoine", "house": "Gryffindor", "patronus": "Otter"},
```

Notice how the `for` loop will iterate through each of the `dict`s inside the `list` called `students`.

- You can learn more in Python's Documentation of `dict`s.

Mario

- Remember that the classic game Mario has a hero jumping over bricks. Let's create a textual representation of this game.



- Begin coding as follows:

```
print("#")
print("#")
print("#")
```

Notice how we are copying and pasting the same code over and over again.

- Consider how we could better the code as follows:

```
for _ in range(3):
def main():
    print_column(3)


def print_column(height):
    for _ in range(height):
        print("#")


main()
```

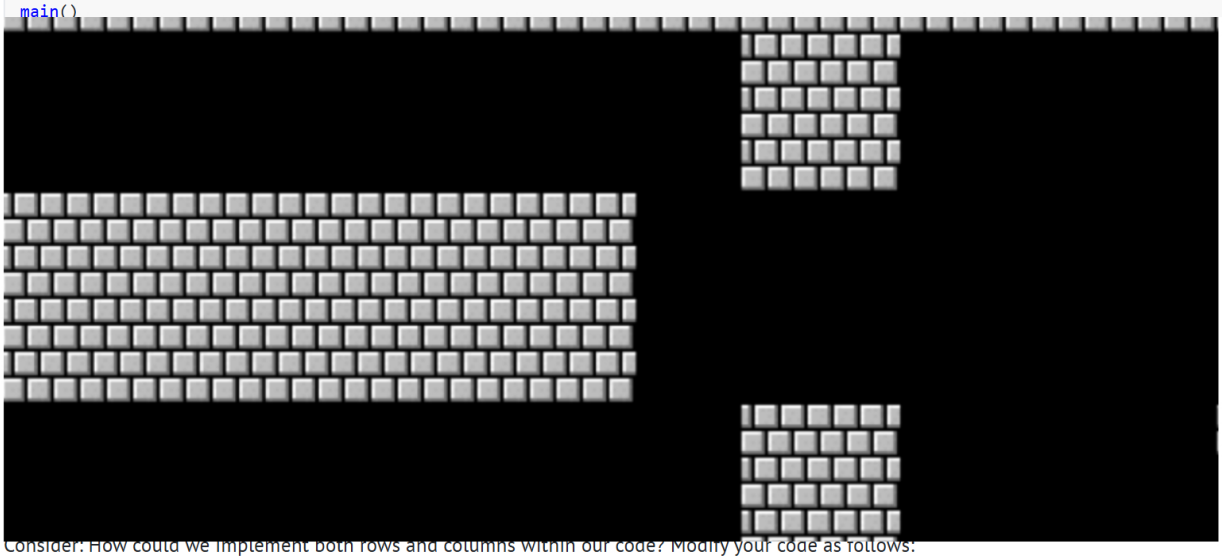
Notice how our column can grow as much as we want without any hard coding.

- Now, let's try to print a row horizontally. Modify your code as follows:

```
def main():
    print_row(4)


def print_row(width):
    print("?" * width)


main()
```



- Consider: How could we implement both rows and columns within our code? Modify your code as follows:

```
def main():
    print_square(3)


def print_square(size):

    # For each row in square
    for i in range(size):

        # For each brick in row
        for j in range(size):

            #  Print brick
            print("#", end="")

        # Print blank line
```

```
        print()


main()
```

Notice that we have an outer loop that addresses each row in the square. Then, we have an inner loop that prints a brick in each row. Finally, we have a `print`

```
def print_square(size):
    for i in range(size):
        print_row(size)


def print_row(width):
    print("#" * width)


main()
```

Summing Up

You now have another power in your growing list of your Python abilities. In this lecture, we addressed...

- `list`
- `dict`