Loops

CSCI 1030U - Intro to Computer Science
@IntroCS

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Outline

- Loops
  - while loops
  - for loops

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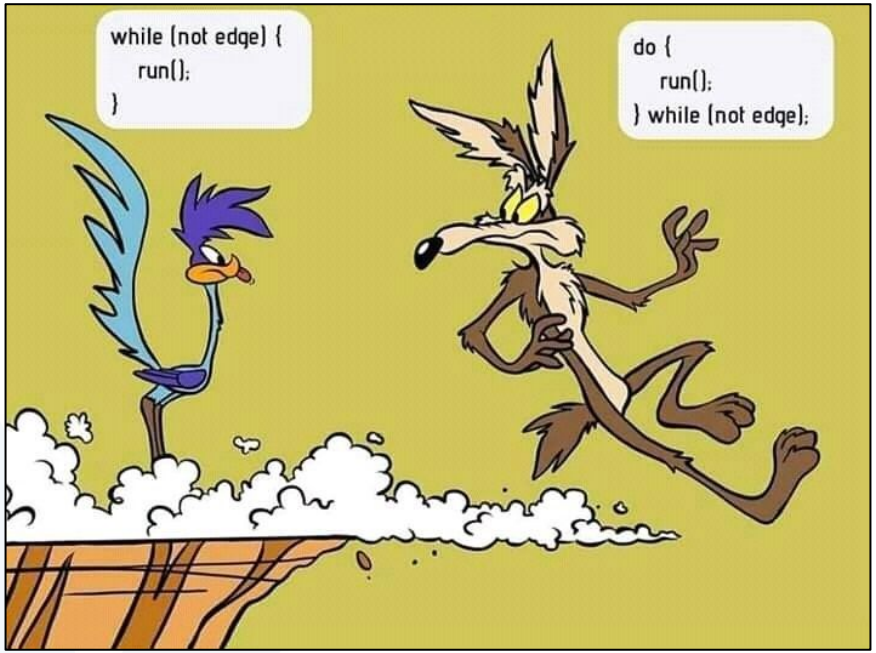
Loops

Loops - While Loops vs. Do-While



Loops

Loops - While

- A *while* loop is similar to an *if* statement, structurally
- The while loop executes the code block multiple times
  - Until the while loop's condition becomes false
  - A key detail is that the body of the loop must somehow modify the condition's value, or the loop will continue forever

Python:

```
x = 0
while x < 10:
    print(x, 'is small')
    x = x + 1
```

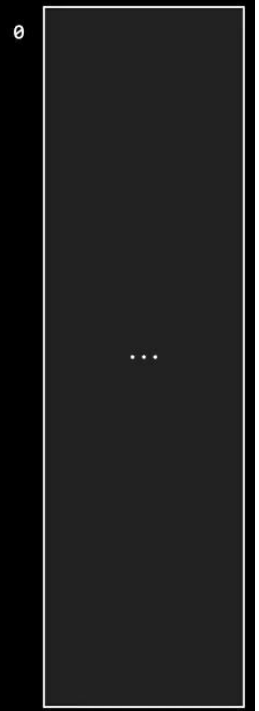
C++:

```
int x = 0;
while (x < 10) {
    cout << x << " is small";
    x = x + 1;
}
```

Loops - While

```
from random import randrange

our_hp = 60
opponent_hp = 60
while our_hp > 0 and opponent_hp > 0:
      opponent_hp -= randrange(20, 35)
      if opponent_hp > 0
            our_hp -= randrange(20, 35)
print(f'{our_hp=}')
print(f'{opponent_hp=}')
```



Loops - While

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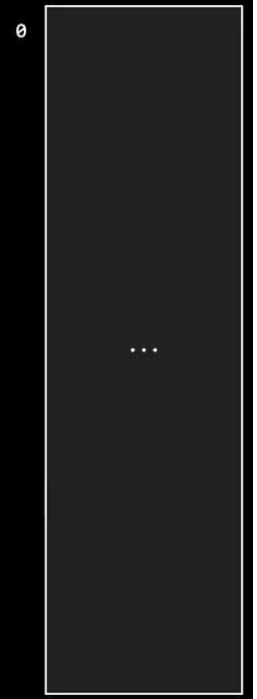


Loops - For

- A *for* loop is a shorthand for the most common loops
  - Loops following a predictable pattern
    - e.g. 1,2,3,4,5
    - e.g. 5,4,3,2,1
    - e.g. 2,4,6,8,10

Python:

```
for x in [0,1,2,3,4,5,6,7,8,9]:
    print(f'{x} is small')
```

or

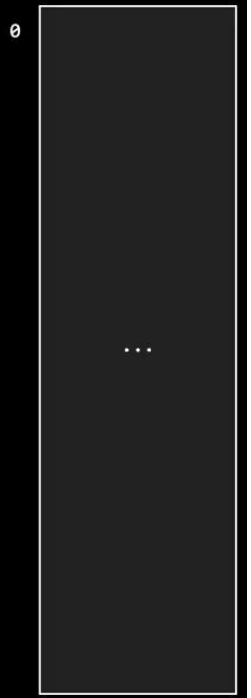
```
for x in range(10):
    print(f'{x} is small')
```

C++:

```
for (int x = 0; x < 10; x++) {
    cout << x << " is small";
}
```

Loops - For

```
for x in 'abcde':
    print(f'x = {x}.')
```



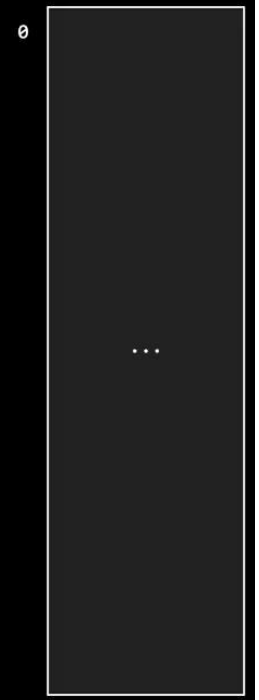
Loops - For

```
sum_of_nums = 0

for index in [0,1,2,3,4]:

    print(f'Hello there {index}!')

    sum_of_nums += index
```



Loops - Exit Conditions

- All loops must have exit conditions
  - An exit condition describes when to stop the repetition
  - Without an exit condition, we have an *infinite loop*
    - You can also have an infinite loop if you create an incorrect exit condition (e.g. one that is never true)
- Example:

Python:

```
x = 0
while x < 10:
    print(x, 'is small')
    x = x - 1
```

C++:

```
int x = 0;
while (x < 10) {
    cout << x << " is small";
    x = x - 1;
}
```

Demo - Loops

Coding Exercise 03a.1

- Write the code which, given a positive floating point number x, returns a value that is close to the value of e^x
  - Use the following convergent series:

$$e^x = \sum_{n=0}^{\infty} \frac{x^n}{n!} = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \cdots$$

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https://en.wikipedia.org/wiki/Taylor_series#List_of_Maclaurin_series_of_some_common_functions

Coding Challenge 03a.1

- Write the code which, given a positive floating point number x, returns a value that is close to the value of `sin x`
  - Use the following convergent series:

$$\sin x = \sum_{n=0}^{\infty} \frac{(-1)^n}{(2n+1)!} x^{2n+1} \approx x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!}$$

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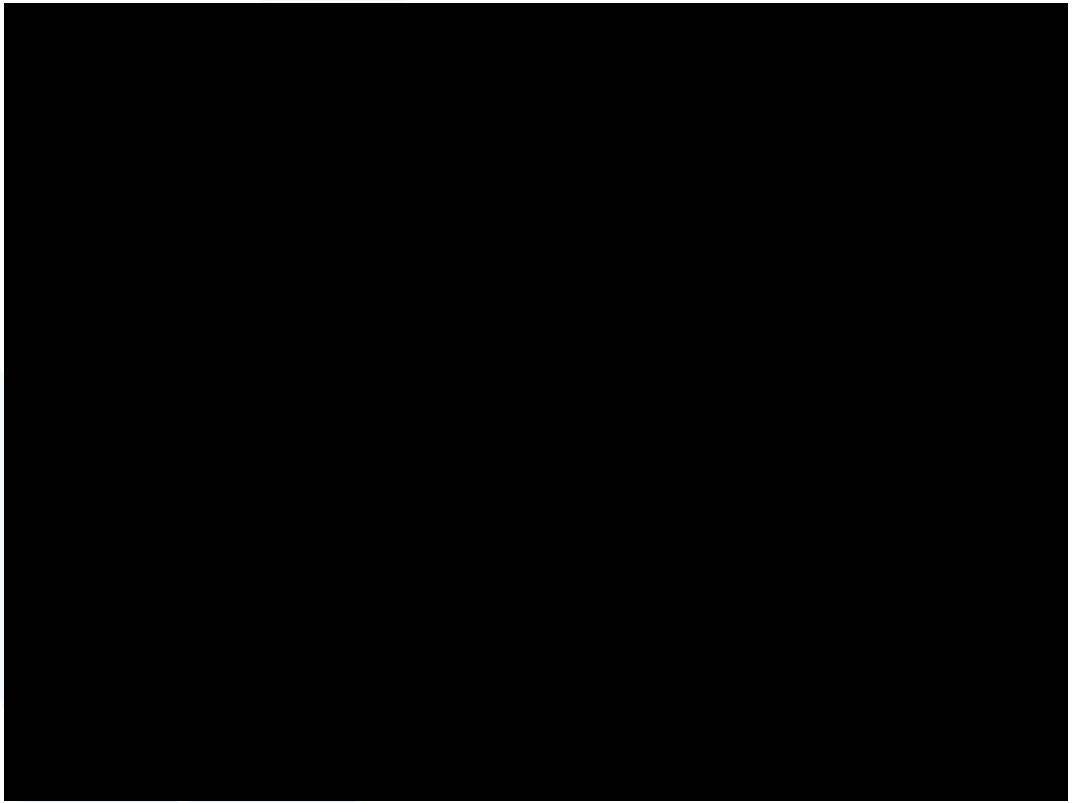
Coding Challenge 03a.1



Coding Exercise 03a.2 (Hard Mode)

- Write the code which, given a positive floating point number x, returns a value that is close to the square root of x
- Method:
  - Guess any square root estimate
  - Determine if the square of that estimate is too high or too low
  - Add or subtract from that estimate to bring it closer to the right answer

https://en.wikipedia.org/wiki/Bisection_method

Hackers' Corner

- Generators
  - `range(5, 15, 3)` produces a generator that counts upwards from 5 (inclusive) to 15 (exclusive), counting by 3s
  - You can make your own generators using generator expressions:
    - `(n**2 for n in [1,2,3,4,5])`
    - `(n for n in range(5, 15, 3))`

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Wrap-up

- Loops
  - while loops
  - for loops

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Coming Up

- Strings
- Lists

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