Information, Computation, Communication

Learning Python

Loops – Part I

Agenda

- While
  - Examples
  - Infinite loops
- For
  - Examples
- range( )
- Examples
  - Factorial
  - Count digits

while Loops

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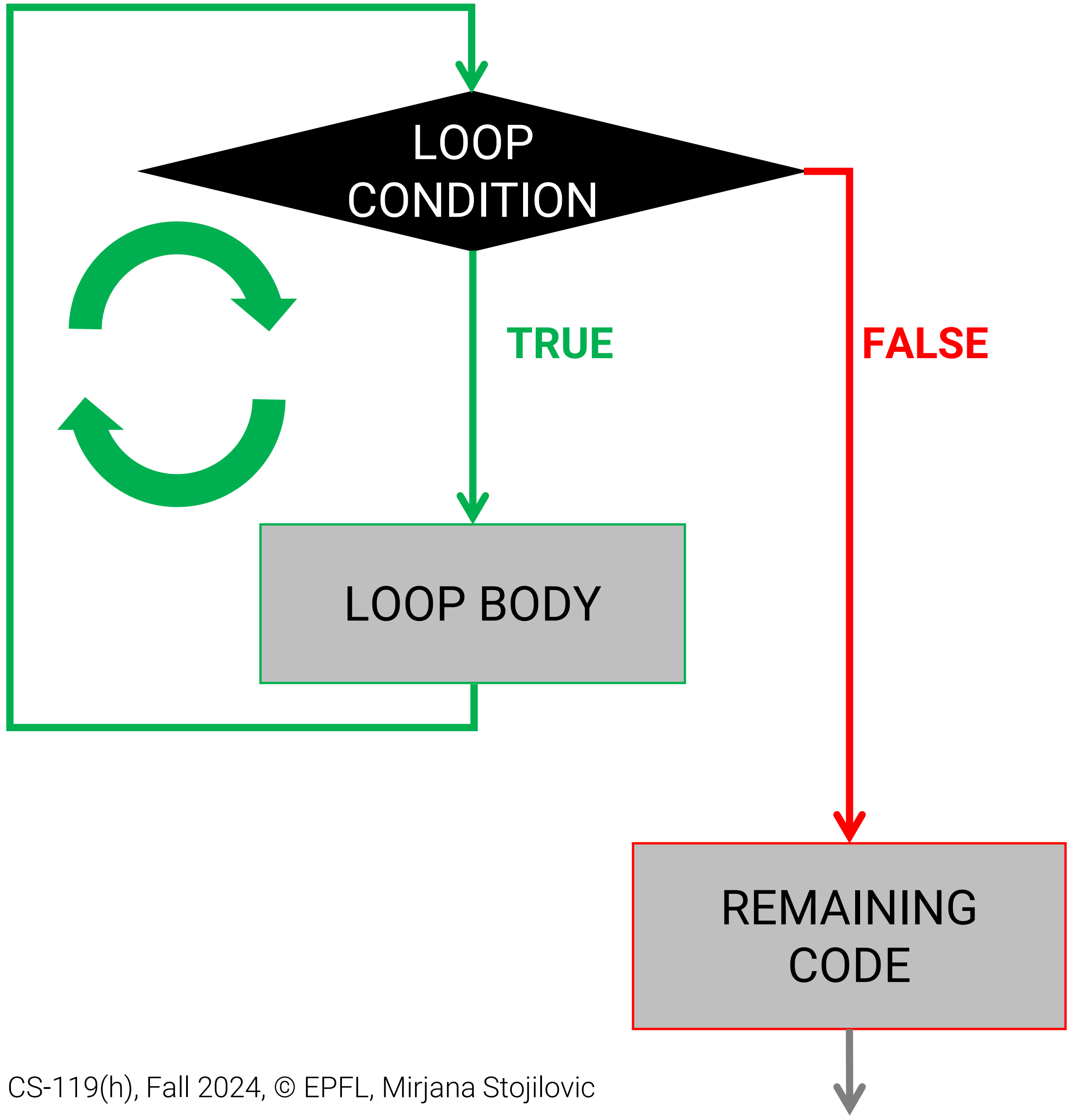
while Loops



- Python while loop statement **repeatedly** executes a block of code as long as the loop **condition** evaluates to **true**

- Syntax of the while loop:

```
while condition_is_true:
     # loop body
     block_of_code
```

while Loops

Examples

Q: Write a code that, for a given positive number **n**, prints out the sequence of numbers from **0 to n-1**, separated by commas

while Loops

Examples

Q: Write a code that, for a given positive number **n**, prints out the sequence of numbers from **0 to n-1**, separated by commas

```python
# Initialize the helper variable i
i = 0
# Loop and print numbers from i to n-1
while i < n:
    # Below, end = is used to specify the characters to print last
    print(i, end=", ")
    # Helper variable must be updated to avoid an infinite loop
    i += 1
```

Infinite Loops

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- Loop condition must be made false at some point during code execution
  - If that never happens, loop repeats infinitely many times
- **Infinite loops are bad**
- In case of unresponsive code or code that does not stop running, use **CTRL-C** combination of keyboard keys to terminate the program execution

while Loops

Example: Infinite Loop

- Try the below lines in the Python interpreter

```
>>> while True:
...     print('Type Ctrl-C to stop me...')
```

- And type ENTER twice
  - Once to exit the loop
  - Second time to run the code (the loop)

EXAMPLES

while Loops

Example: Infinite Loop

```
>>> while True:
...     print('Type Ctrl-C to stop me...')
Type Ctrl-C to stop me...
Type Ctrl-C to stop me...
Type Ctrl-C to stop me...
Type Ctrl-C to stop me...
Type Ctrl-C to stop me...
Traceback (most recent call last):
  File "<stdin>", line 2, in <module>
KeyboardInterrupt
>>>
```

Hit ENTER twice here

Hit Ctrl-C here

for Loops

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for Loops

- In Python, **for** loops step through items in an ordered sequence or an iterable object (strings, lists, tuples, …)

```
for item in iterable_object:   # assign object item to target
    # loop body
    block_of_code
```

EXAMPLES

for Loop

Example

Try this example in the Python interpreter

```
>>> for i in 'tictoc':    # assign object item to variable i
...     print(2 * i)      # repeated loop body: use object item
```

for Loop

Example

Try this example in the Python interpreter

```
>>> for i in 'tictoc':    # assign object item to variable i
...     print(2 * i)      # repeated loop body: use object item
...
tt   # The first item is the letter t, repeated twice
ii   # Next item is the letter i, repeated twice
cc   # Next item is the letter c, repeated twice
tt   # Next item is the letter t, repeated twice
oo   # Next item is the letter o, repeated twice
cc   # The last item is the letter c, repeated twice
>>>
```

range( )

https://docs.python.org/3/library/stdtypes.html#range

Python Function range( )

- The Python function range( ) creates a sequence of numbers on the fly
- It can be called in a few different ways:
  - Single parameter form: **range(stop)**
  - Two parameter form: **range(start, stop)**
  - Three parameter form: **range(start, stop, step)**
- To reverse the sequence, use the Python function **reversed( )**

https://docs.python.org/3/library/stdtypes.html#range

range(stop)

- **range(stop)** creates a sequence of numbers from **0** to **stop-1**
- We say that **stop** is "exclusive" (not included in the sequence)
- **stop** must be **positive**, or an empty sequence will be returned

- Examples:
  - range(1)
    - creates a sequence of a single element: 0
  - range(5)
    - creates a sequence of five elements: 0, 1, 2, 3, 4
  - range(-5)
    - creates an empty sequence (no elements)

range(start, stop)

- **range(start, stop)** creates a sequence of numbers from **start** to **stop-1**
- **stop** must be greater than the **start,** or an empty sequence will be returned
- The ith element in the sequence becomes
  - $\textbf{element}_i \textbf{ = start + i}$, where $i \geq 0$ and $\textbf{element}_i \textbf{ < stop}$

range(start, stop)

- Examples:
  - range(2, 5)
    - creates a sequence of three elements: 2, 3, 4
  - range(-2, 5)
    - creates a sequence of seven elements: -2, -1, 0, 1, 2, 3, 4
  - range(-2, -3)
    - creates an empty sequence (no elements)
  - range(-2, -1)
    - creates a sequence of a single element: -2
  - **reversed**(range(-1, 1))
    - returns a sequence 0, -1

range(start, stop, step)

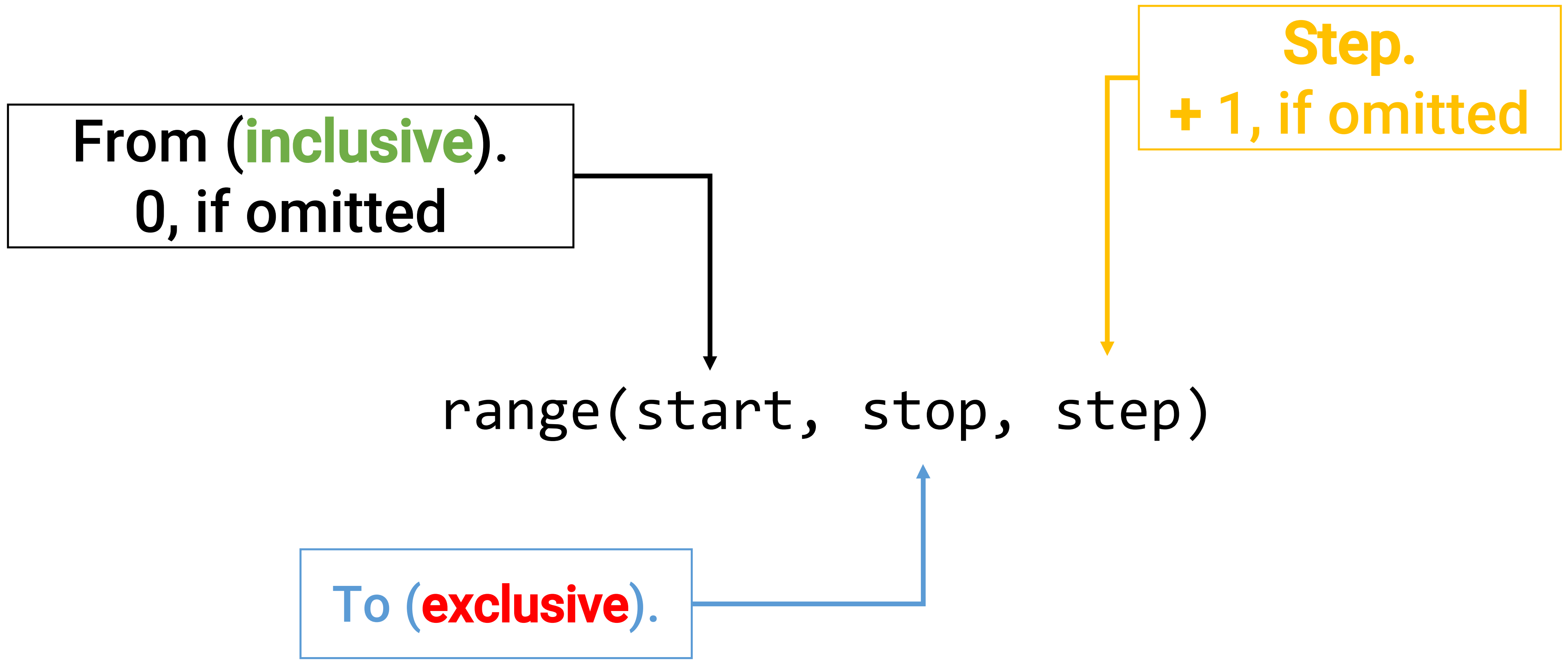
- **range(start, stop, step)** creates a sequence of numbers from **start** to **stop-1**, in steps of **step**
- For a **positive step**, the ith element in the sequence becomes
  - **$element_i$ = start + step*i**, where $i \geq 0$ and **$element_i$ < stop**
- For a **negative step**, the ith element in the sequence becomes
  - **$element_i$ = start + step*i**, where $i \geq 0$ and **$element_i$ > stop**

range(start, stop, step)

- Examples:
  - range(2, 5, 2)
    - creates a sequence of two elements: 2, 4
  - range(-2, 5, 3)
    - creates a sequence of three elements: -2, 1, 4
  - range(-2, -8, 2)
    - creates an empty sequence (no elements)
  - range(-2, -8, -2)
    - creates a sequence of three elements: -2, -4, -6
  - **reversed**(range(1, 10, 2))
    - returns a sequence 9, 7, 5, 3, 1

Python Function range( )

Summary



```
range(start, stop, step)
```

Examples

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Factorial

Write a code that repeatedly asks for an integer number. As long as the received number **n** is negative, the program asks again. Otherwise, it computes **n!** and prints the result.

Factorial

Write a code that repeatedly asks for an integer number. As long as the received number **n** is negative, the program asks again. Otherwise, it computes **n!** and prints the result.

```
ask_again = True
while ask_again:
    n = int(input("Enter a number..."))
    if n >= 0:
        n_factorial = 1
        for i in range(2, n + 1):
            n_factorial *= i
        print(f"{n}! = {n_factorial}")
        ask_again = False
```

Count Digits

Write a piece of code that takes an integer number and returns its number of digits. If the input is zero, the program outputs "Error: Entered number is zero. Exiting…"

Count Digits

Write a piece of code that takes an integer number and returns its number of digits. If the input is zero, the program outputs "Error: Entered number is zero. Exiting…"

```
n = int(input("Enter a number…")) # accept an integer input from the user
if n == 0:
    print("Error: Entered number is zero. Exiting...")
else:
    v = -n if n < 0 else n # make a negative number positive by negating it
    digits = 0             # initialize variable to count the digits
    while v:               # loop until all digits are processed
        digits += 1        # increment the digit count for every iteration
        v //= 10           # remove the last digit
    print(f"There are {digits} digits in {n}.")
```

Count Digits

Without loops

Write a piece of code that takes an integer number and returns its number of digits. If the input is zero, the program outputs "Error: Entered number is zero. Exiting…"

Hint: Python has a built-in function ***len()*** *which returns the number of items in an object (e.g., characters in a string, elements in a list, etc.)*

Count Digits

Without loops

Write a piece of code that takes an integer number and returns its number of digits. If the input is zero, the program outputs "Error: Entered number is zero. Exiting…"

```
n_str = input("Enter a number…")
n = int(n_str)
# check if the number is not zero
if n:
    # If the number is positive, the length of the string gives the digit count
    # If the number is negative, subtract 1 from the length to account for the negative sign
    digits = len(n_str) if n > 0 else len(n_str) - 1
    print(f"There are {digits} digits in {n}.")
else:
    print("Error: Entered number is zero. Exiting...")
```

Next topic: Lists