Lecture 7: Iteration

Comp 102 (sec: A,B)

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Recap

Recap

```
if <condition> :
    < code >
    < code >
    ...
```

- **Two choices**, we care about **only one**

Recap

```
if <condition> :
    < code >
    < code >
    ...
```

```
if <condition>:
    < code >
    ...
else:
    <code>
    ...
```

- **Two choices**, we care about **both**

Recap

```
if <condition> :
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```
if <condition>:
    < code >
    ...
else:
    <code>
    ...
```

```
if <condition>:
    < code >
    ...
elif <condition>:
    <code>
    ...
elif <condition>:
    <code>
    ...
else:
    <code>
    ...
```

- **Multiple choices**

Loops

- **Commands Available:**
  - `forward()`
  - `remove()`
  - `repeat n:`

- **Commands Available:**
  - `forward()`
  - `remove()`
  - `repeat n:`
- **Solution:**
  1. `repeat 3:`
  2. `  remove()`
  3. `forward()`
  4. `forward()`

- **Commands Available:**
  - `forward()`
  - `remove()`
  - `repeat n:`

- **Commands Available:**
  - `forward()`
  - `remove()`
  - `repeat n:`
- **Solution Possible?**

- **Commands Available:**
  - `forward()`
  - `remove()`
  - `repeat n:`
- **Solution Possible?**
  NO

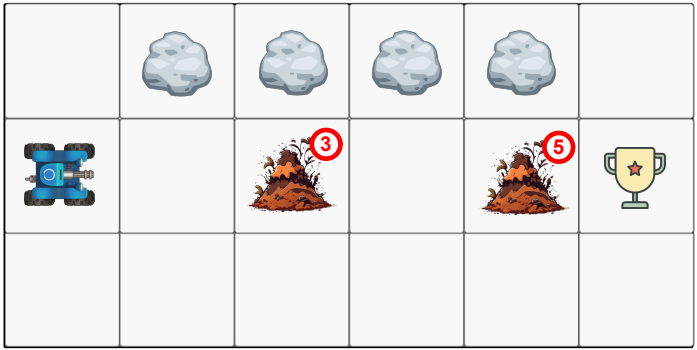
- **Commands Available:**
  - `forward()`
  - `remove()`
  - `repeat n:`
  - `while <condition>:`
  - `has_dirt`

- **Commands Available:**
  - `forward()`
  - `remove()`
  - `repeat n:`
  - `while <condition>:`
  - `has_dirt`

- **Solution:**

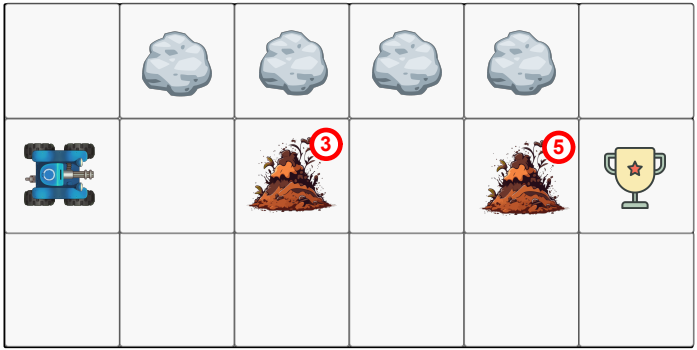
```
1 while has_dirt:
2     remove()
3 forward()
4 forward()
```

- **Commands Available:**
  - `forward()`
  - `remove()`
  - `repeat n:`
  - `has_dirt`
  - `if <condition>:`
  - `while <condition>:`

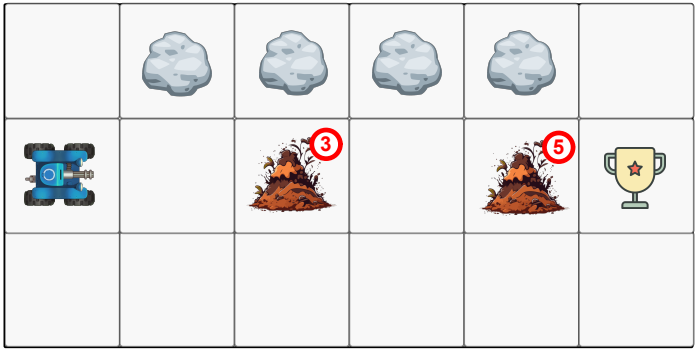


- **Solution:**

```
1 forward()
2 repeat 3:
3     remove()
4 forward()
5 forward()
6 repeat 5:
7     remove()
8 forward()
9 forward()
```

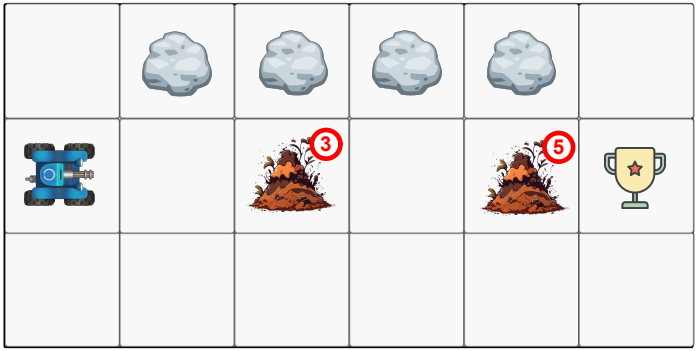


- **Commands Available:**
  - `forward()`×1
  - `remove()`×1
  - `repeat n:`×1
  - `has_dirt`×2
  - `if <condition>:`×1
  - `while <condition>:`×1



- **Solution:**

```
1 repeat 5:
2     if has_dirt:
3         while has_dirt:
4             remove()
5     forward()
```



- **Solution:**

```
1 repeat 5:
2     if has_dirt:
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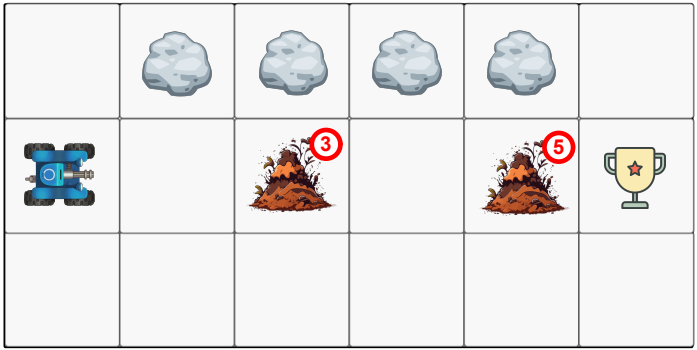
```

Improve ?



- **Solution:**

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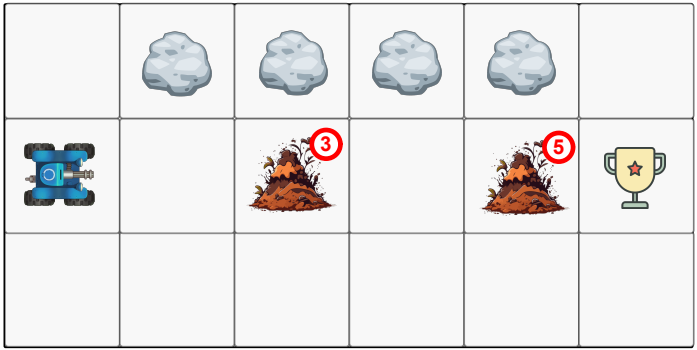


While Loop in Python

```
if <condition>:
    <code>
    ...
```

While Loop in Python

```
while
  if <condition>:
      <code>
      ...
```

if vs while

```
if <condition>:
    <code>
    ....
```

```
while <condition>:
    <code>
    ....
```

if vs while

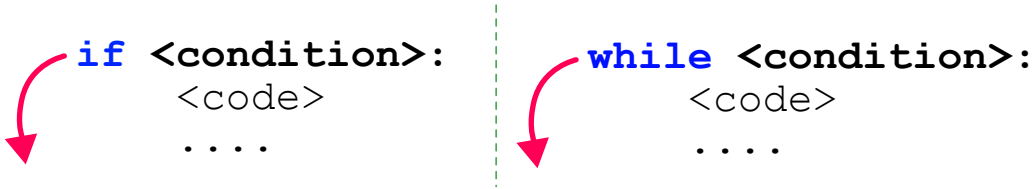
Both go in when condition is True

```
if <condition>:
    <code>
    ....
```

```
while <condition>:
    <code>
    ....
```

if vs while

Both go out when condition is False



if vs while

runs only Once

```
if <condition>:
    <code>
    ....
```

get's out of the if condition

runs multiple times

```
while <condition>:
    <code>
    ....
```

goes back to the start

Big Idea

while loop is a supercharged **if statement**

The **break** keyword causes the loop to terminate immediately

runs only Once

```
if <condition>:
    <code>
    ....
```

runs only Once

```
while <condition>:
    <code>
    ....
    break
```

The **break** keyword causes the loop to terminate immediately

runs only Once

```
if <condition>:
    <code>
    ....
```

runs only Once

```
while <condition>:
    <code>
    ....
    break
```

Now they both behave exactly the same!

while loop Example

```
You are in the Lost Forest.
************
************
☺
************
************
Go left or right?
```

Program:

```
where = input("You're in the Lost Forest. Go left or right? ")
while where == "right":
    where = input("You're in the Lost Forest. Go left or right? ")
print("You got out of the Lost Forest!")
```

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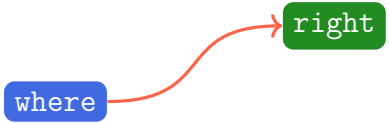

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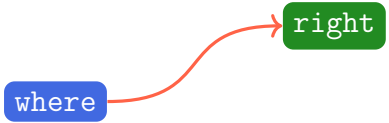

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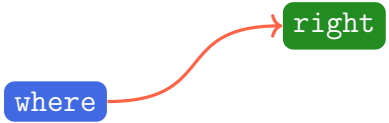

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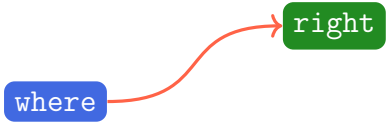

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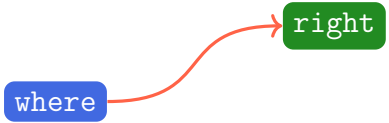

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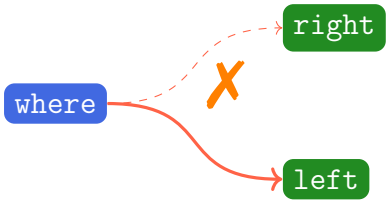

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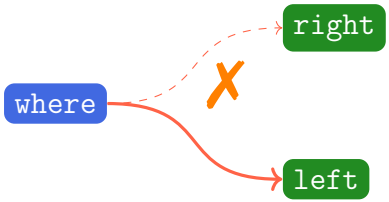

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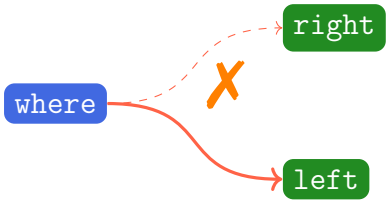

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```

You Try!

What is printed when you type ‘RIGHT’?

(note the case)

```
where = input("Go left or right? ")
while where == "right":
    where = input("Go left or right? ")
print("You got out!")
```

while loop Example

```
n = int(input("Enter a non-negative integer: "))
while n > 0:
    print('x')
    n = n-1
```

Shell

while loop Example

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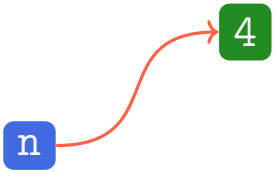

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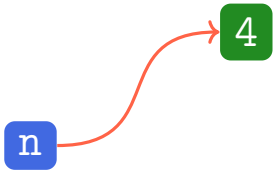

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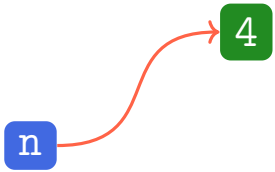

Shell

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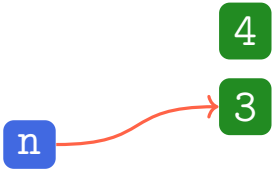

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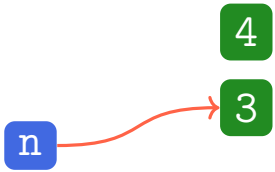

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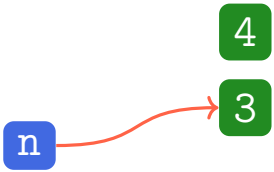

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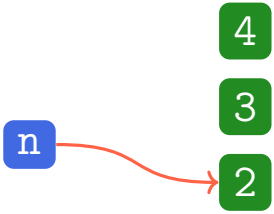

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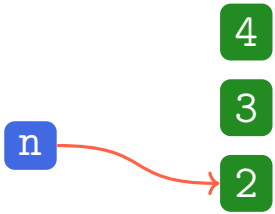

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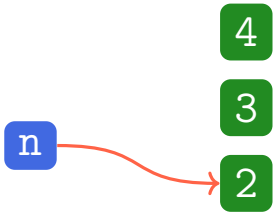

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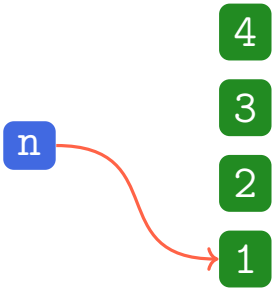

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```
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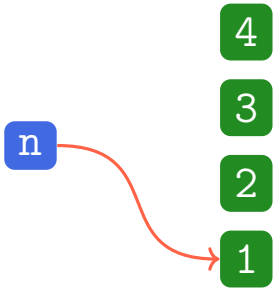

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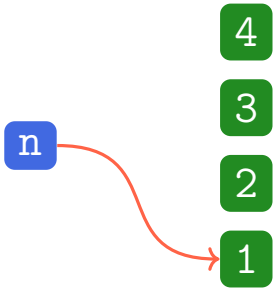

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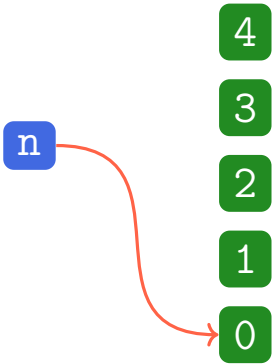

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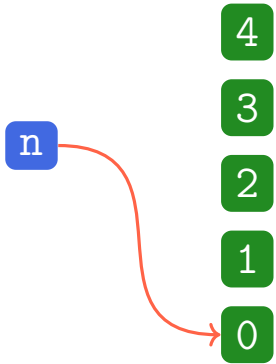

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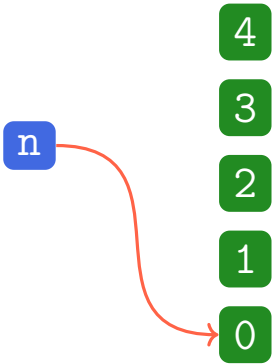

while loop Example

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while n > 0:
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```

What happens without this last line? Try it!

while loop Example

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```

What happens without this last line? Try it!

To terminate:

- Hit `Ctrl + c`

You Try!

Run this code and stop the infinite loop in your IDE

```
while True:
    print("nooooooo")
```

Big Idea

while loops can **repeat** code inside **indefinitely**!

Sometimes they need your intervention to end the program.

You Try!

Expand this code to show a sad face when the user entered the while loop more than 2 times.

Hint: use a variable as a counter

```
where = input("Go left or right? ")
while where == "right":
    where = input("Go left or right? ")
print("You got out!")
```

You Try! — Solution

```
count = 0
where = input("Go left or right? ")
while where == "right":
    count = count + 1
    where = input("Go left or right? ")
if count > 2:
    print(":(")
print("You got out!")
```

You Try! — Solution

```
count = 0
where = input("Go left or right? ")
while where == "right":
    count = count + 1
    where = input("Go left or right? ")
if count > 2:
    print(":(")
print("You got out!")
```

✓ start the counter at 0, **before** the loop
✓ add 1 on **every** trip through the body
✓ check **after** the loop ends — `count > 2` means 3 or more trips

Iterate through **numbers in a sequence**

```
n = 0
while n < 5:
    print(n)
    n = n+1
```

Iterate through **numbers in a sequence**

Set loop variable outside while loop

```
n = 0
while n < 5:
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Iterate through **numbers in a sequence**

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Set loop variable outside while loop

Test loop variable in condition

Iterate through **numbers in a sequence**

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n = 0
while n < 5:
    print(n)
    n = n+1
```

Set loop variable outside while loop

Test loop variable in condition

Increment loop variable inside while loop

Iterate through **numbers in a sequence**

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n = 0
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Increment loop variable inside while loop

Almost all `while` loop programs have a similar structure

Iteration Examples

Sum of Numbers: $1 + 2 + 3 + 4$

```
sum = 0
i = 1
while i <= 4:
    sum = sum + i
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```

Iteration Examples

Sum of Numbers: $1 + 2 + 3 + 4$

Initialize the sum to 0

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sum = 0
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Iteration Examples

Sum of Numbers: $1 + 2 + 3 + 4$

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sum = 0
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Initialize the sum to 0

Set loop variable outside while loop

Test loop variable in condition

Keep track of a running sum

Iteration Examples

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increment loop variable inside while loop eg. to $i = i + 1$

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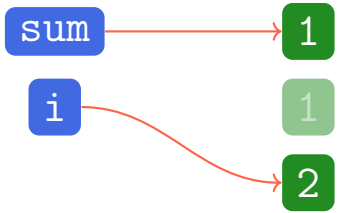


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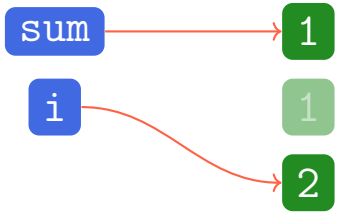


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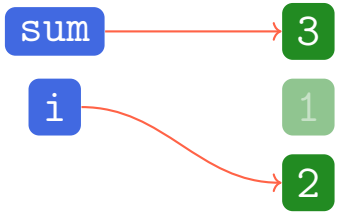

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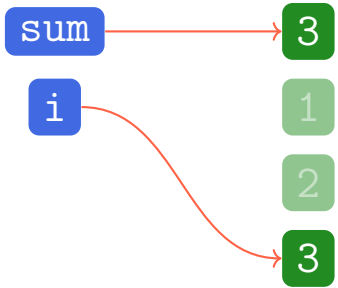

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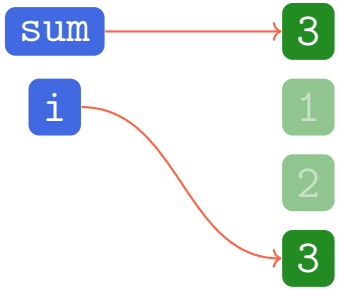

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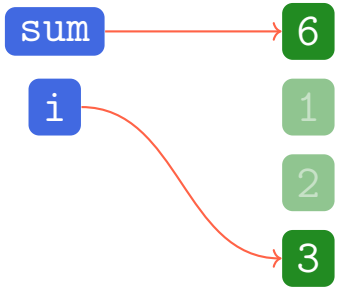

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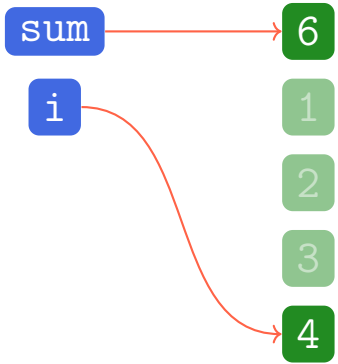

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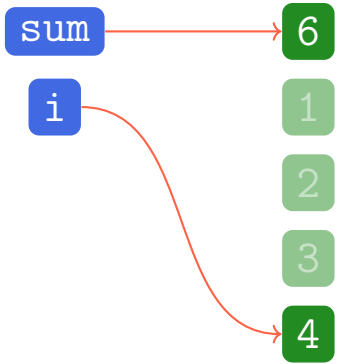

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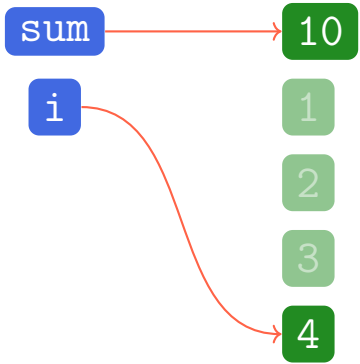

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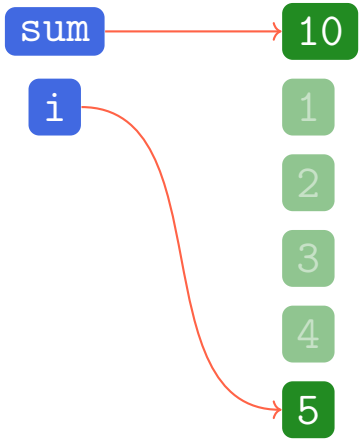

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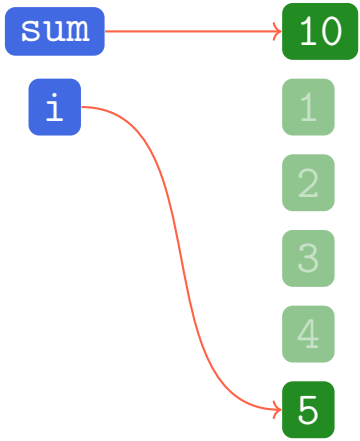

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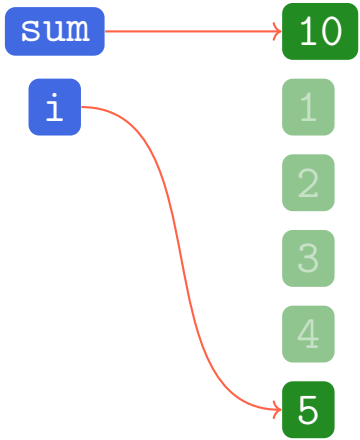

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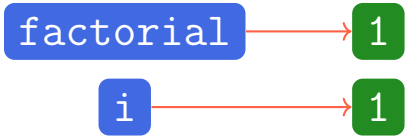


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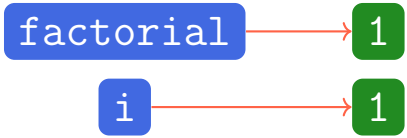


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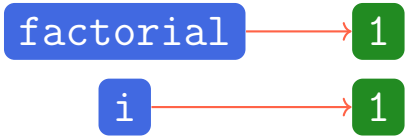


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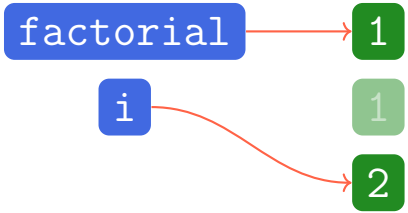


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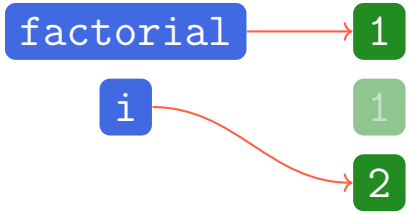


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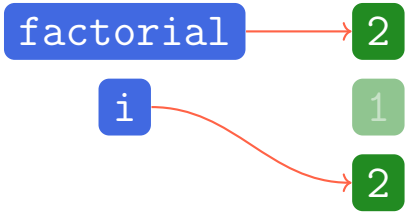


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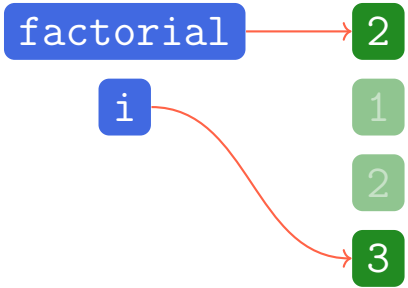

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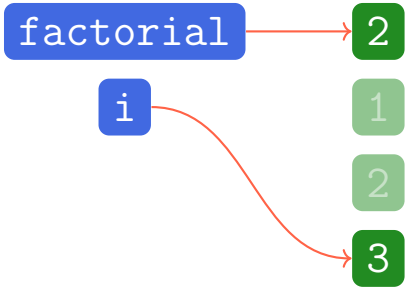

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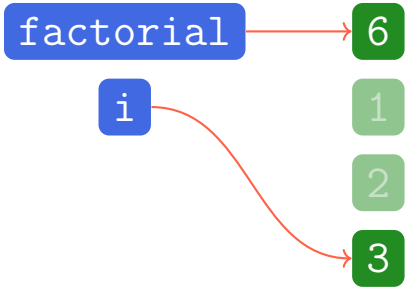

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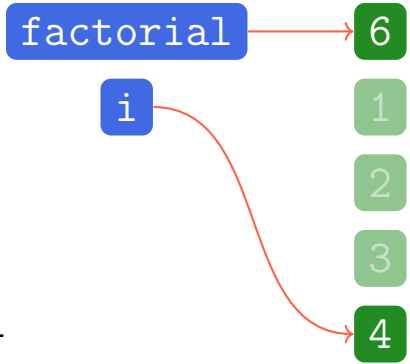

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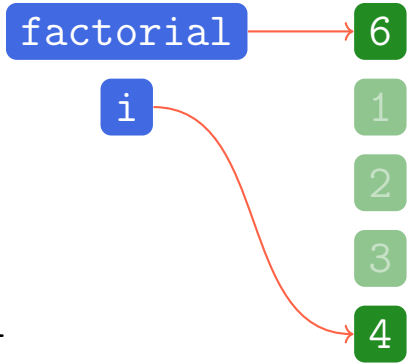

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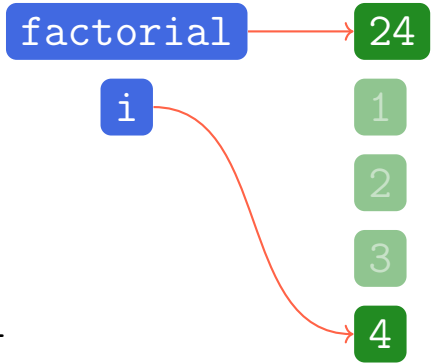

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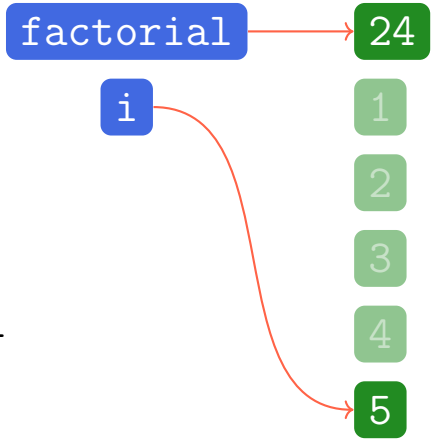

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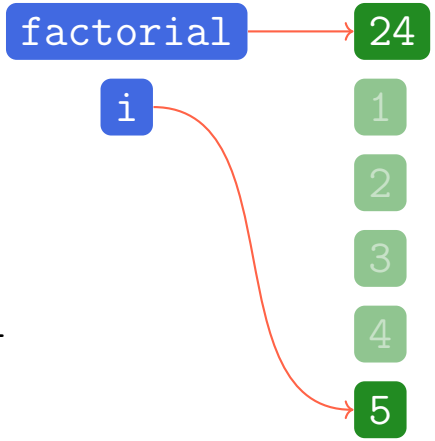

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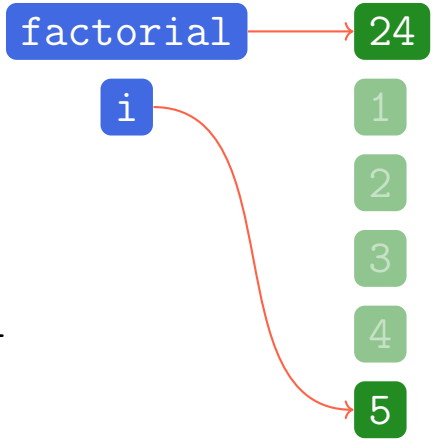

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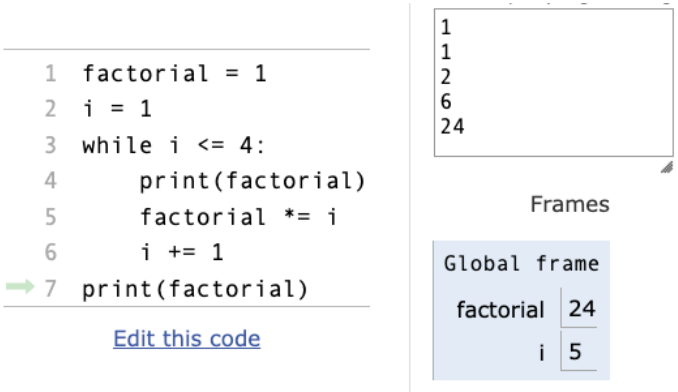


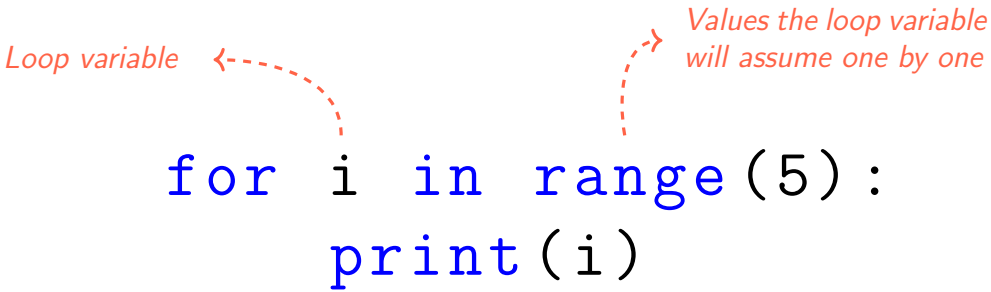
Useful Tip

Python Tutor can help you visualize how your code works

If you're stuck, try running your code there!

`for` Loops

for Loop Syntax



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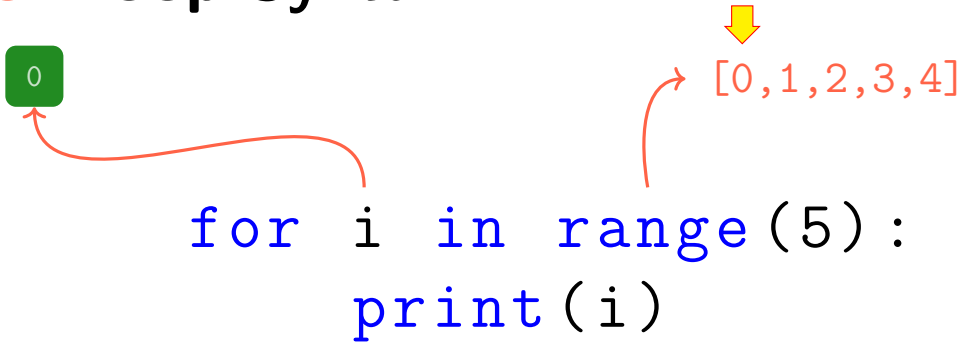

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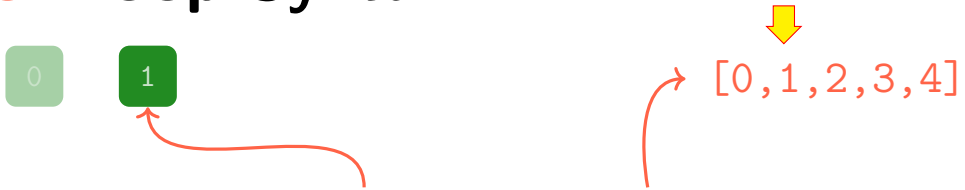

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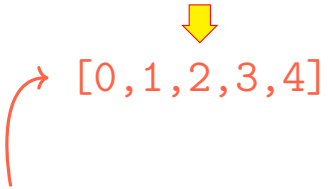


```
for i in range(5):
    print(i)
```

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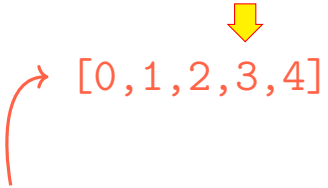


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for Loop Syntax

[0,1,2,3,4]

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range(start, stop, step) Function

- Generates a **sequence** of ints, following a pattern
- A lot like what we saw for **slicing strings**

range(start, stop, step) Function

- Generates a **sequence** of ints, following a pattern
- A lot like what we saw for **slicing strings**
- Often omit start and step, e.g:
  - `for i in range(4):`
    - `start` defaults to 0
    - `step` defaults to 1
  - `for i in range(3,5):`
    - `step` defaults to 1

You Try!

What do these print?

1. ```
   for i in range(1,4,1):
       print(i)
   ```
2. ```
   for j in range(1,4,2):
       print(j*2)
   ```
3. ```
   for me in range(4,0,-1):
       print("$"*me)
   ```
   ```

You Try!

What do these print?

1.
```
for i in range(1,4,1):
    print(i)
```
→ 1 2 3 *(one per line; the stop 4 is left out)*

2.
```
for j in range(1,4,2):
    print(j*2)
```
→ 2 6 *(j is 1, then 3; 5 is past the stop)*

3.
```
for me in range(4,0,-1):
    print("$"*me)
```
→ $$$$ $$$ $$ $ *(me is 4, 3, 2, 1; never 0)*

Loop over Strings

What will this print?

```
s = "hello"
for i in range(5):
    print(s[i])
```

You Try!

Count the number of ‘a’ characters in any given string e.g. ‘casablanca’.

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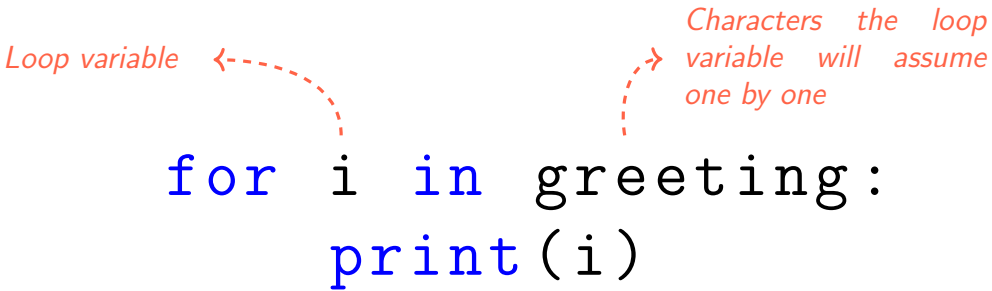
```
s = "casablanca"
count = 0
for i in range(len(s)):
    if s[i] == "a":
        count = count + 1
print(count)
```

✓ `range(len(s))` visits every index 0 . . . 9, so `s[i]` is each character in turn
✓ the `if` guards the counter: only an `"a"` adds 1
✓ print **after** the loop — prints 4 for `casablanca`

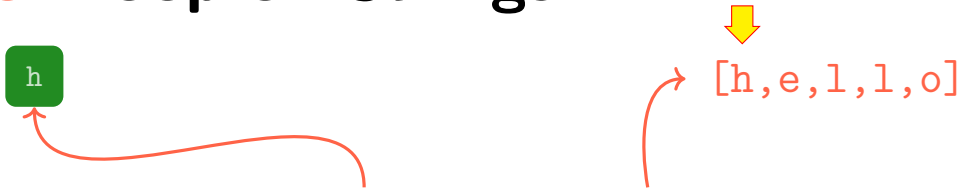
for Loop on Strings

```
greeting = 'hello'
for i in greeting:
    print(i)
```

for Loop on Strings



for Loop on Strings



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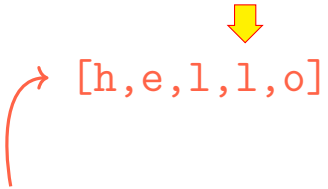


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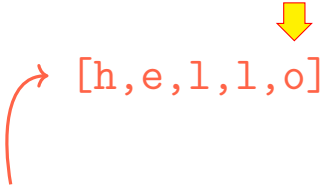
for Loop on Strings




```
for i in greeting:
    print(i)
```

in has two meanings in Python.

- When used with for loops:
  - **in** can be used to iterate over a sequence.
- When used with strings:
  - **in** can be used to check if a character is in a string.
  - **in** can be used to check if one string is in another string.
- It can be used to check if a character is in a string.

The in Operator

a.k.a the **membership operator**.

Try the following code in Python shell:

- `'a' in 'banana'`
- `'cat' in 'caterpillar'`
- `'q' in 'comp102'`
- `'o' in 'aeiou'`

Loop over Strings

Code to check for letter i or u in a string. All 3 do the same thing:

```
s = "demo loops - fruit loops"
for index in range(len(s)):
    if s[index] == 'i' or s[index] == 'u':
        print("There is an i or u")
```

Loop over Strings

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s = "demo loops - fruit loops"
for index in range(len(s)):
    if s[index] == 'i' or s[index] == 'u':
        print("There is an i or u")
```

```
for char in s:
    if char == 'i' or char == 'u':
        print("There is an i or u")
```

Loop over Strings

Code to check for letter i or u in a string. All 3 do the same thing:

```
s = "demo loops - fruit loops"
for index in range(len(s)):
    if s[index] == 'i' or s[index] == 'u':
        print("There is an i or u")
```

```
for char in s:
    if char == 'i' or char == 'u':
        print("There is an i or u")
```

```
for char in s:
    if char in 'iu':
        print("There is an i or u")
```

You Try!

- How many 2's in a string number? (895244254)
- Sum of all 2's in a string number? (895244254)
- How many vowels in a sentence?

You Try!

- Assume you are given a string of lowercase letters in variable s. Count how many unique letters there are in the string. For example if:
  `s = "abca"`
  Then your code prints 3.

Questions?

Exit Ticket

Today's question *(2 minutes)*

Run this loop:

```
for i in range(4):
    print(i)
```

(a) How many numbers are printed?

(b) What is the **last** number printed?

COMP 102 — Exit Ticket #7

Name: _____

Roll #: _____ Date: _____

Answer:

Hand it to me on your way out.
No name, no attendance.