COMP110

CL05 – f-Strings, Positional Arguments, Optional Parameters, and an Intro to Recursion

Reminders

- **Quiz 00:** Regrade requests will be open **till 11:59pm tomorrow night!**
    - Please submit a regrade request if you believe your quiz was not graded correctly according to the rubric
- **LS07** and **CQ01** due tonight at 11:59pm
- **Quiz 01** on Friday
    - Practice quiz and key available on site

Want extra support? We’re here and *want* to help!

Warm-up

Write a function called check_first_letter that takes a input two strs: word and letter

It should return “match!” if the first character of word is letter

Otherwise, it should return “no match!”

Examples:

- check_first_letter(word=”happy”, letter=”h”) would return “match!”
- check_first_letter(word=”happy”, letter=”s”) would return “no match!”

f-strings (formatted string literals)

A helpful way to embed expressions directly into strings!

Without f-strings:

```
print("They are " + str(30 + 1))
```

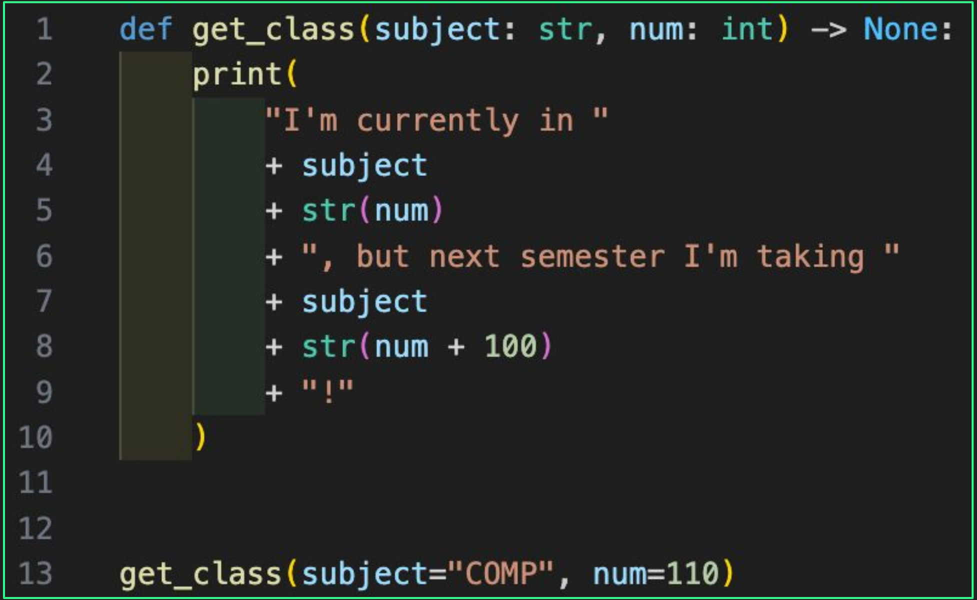
With f-strings:

```
print(f"They are {30 + 1}")
```

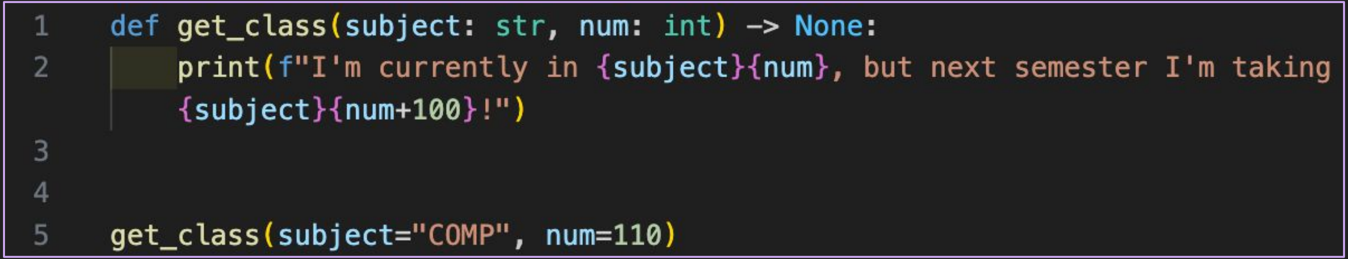
Both will output the string:

```
They are 31
```

f-strings (formatted string literals)

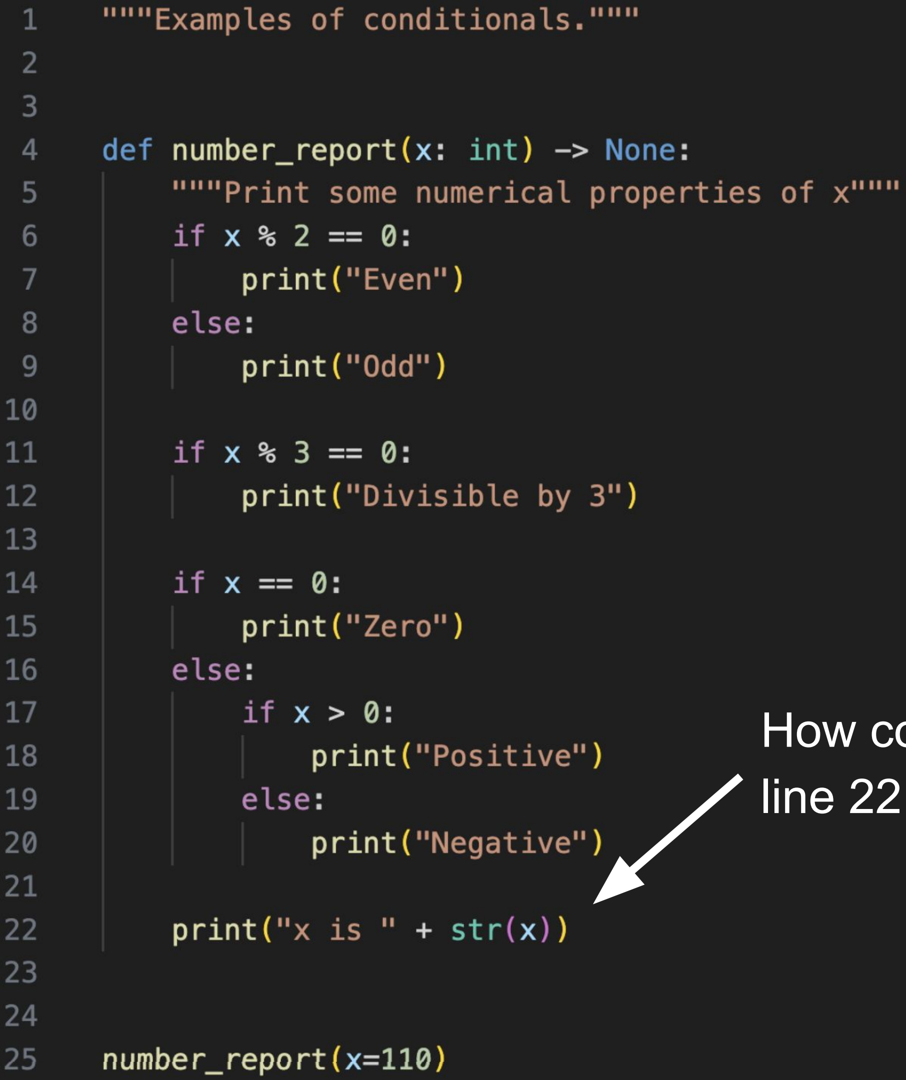


```python
def get_class(subject: str, num: int) -> None:
    print(
        "I'm currently in "
        + subject
        + str(num)
        + ", but next semester I'm taking "
        + subject
        + str(num + 100)
        + "!"
    )


get_class(subject="COMP", num=110)
```



```python
def get_class(subject: str, num: int) -> None:
    print(f"I'm currently in {subject}{num}, but next semester I'm taking {subject}{num+100}!")


get_class(subject="COMP", num=110)
```

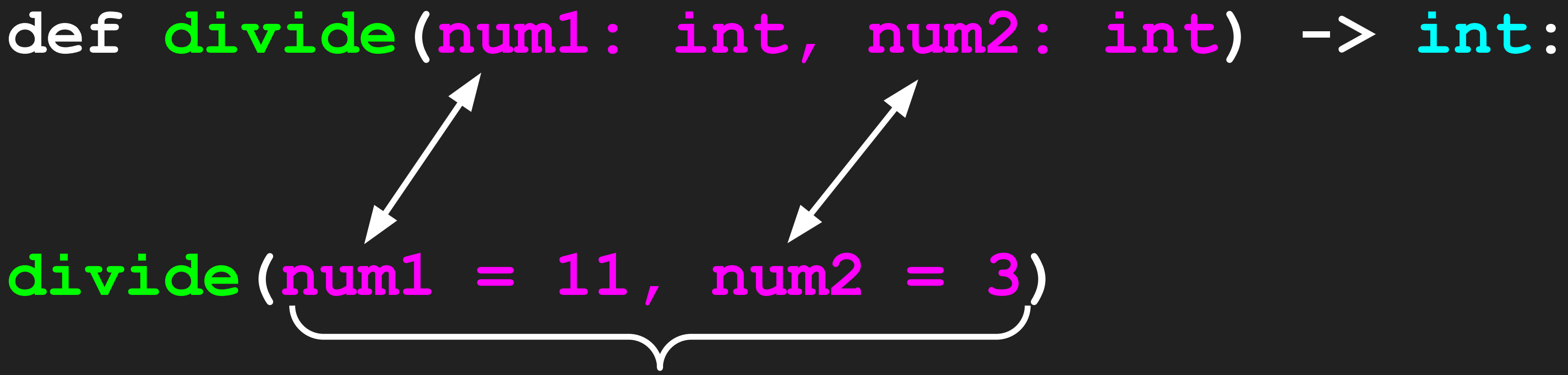
Will these two versions of the get_class function print the exact same phrase?



```
1   """Examples of conditionals."""
2
3
4   def number_report(x: int) -> None:
5       """Print some numerical properties of x"""
6       if x % 2 == 0:
7           print("Even")
8       else:
9           print("Odd")
10
11      if x % 3 == 0:
12          print("Divisible by 3")
13
14      if x == 0:
15          print("Zero")
16      else:
17          if x > 0:
18              print("Positive")
19          else:
20              print("Negative")
21
22      print("x is " + str(x))
23
24
25  number_report(x=110)
```

How could we convert the print statement on line 22 to use an f-string?

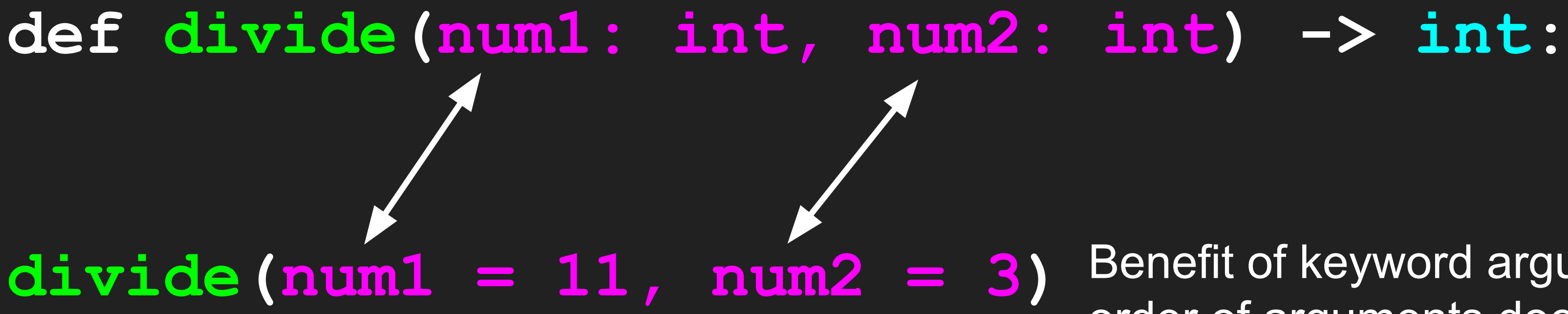
Recall: Signature vs Call



```
def divide(num1: int, num2: int) -> int:


divide(num1 = 11, num2 = 3)
```

These are called keyword arguments, since you are assigning values based on the parameter names.

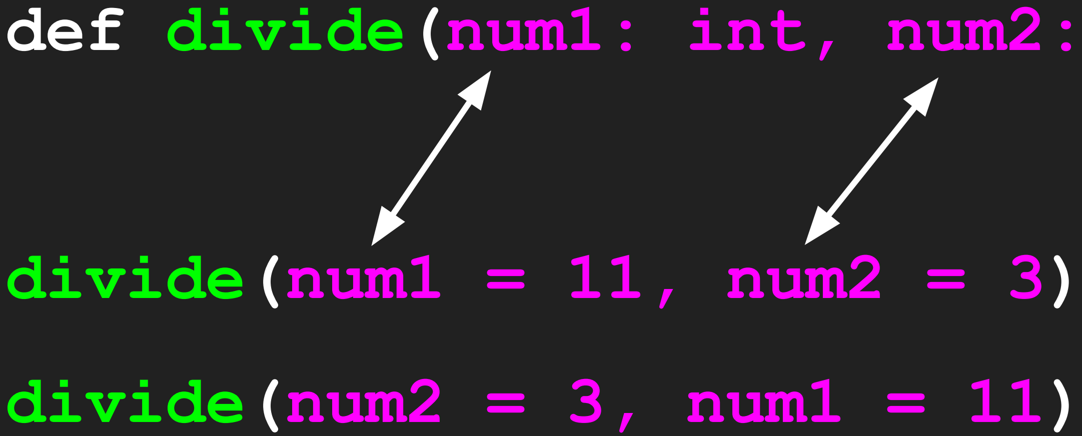
Keyword arguments



```
def divide(num1: int, num2: int) -> int:


divide(num1 = 11, num2 = 3)
```

Benefit of keyword arguments: order of arguments doesn’t matter.

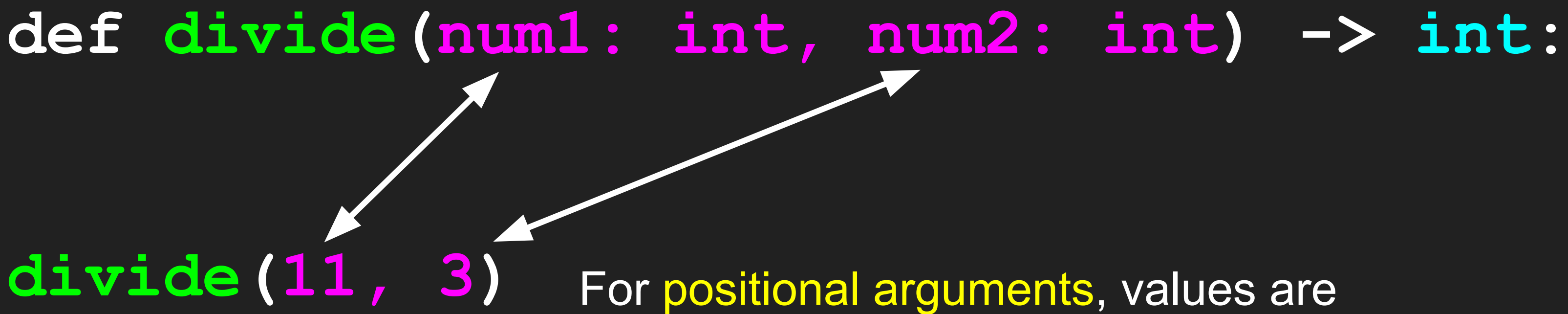
Keyword arguments



```
def divide(num1: int, num2: int) -> int:


divide(num1 = 11, num2 = 3)

divide(num2 = 3, num1 = 11)
```

Benefit of keyword arguments: order of arguments doesn’t matter.

Positional Arguments



```
def divide(num1: int, num2: int) -> int:


divide(11, 3)
```

For positional arguments, values are assigned based on the order (*position*) of the arguments.

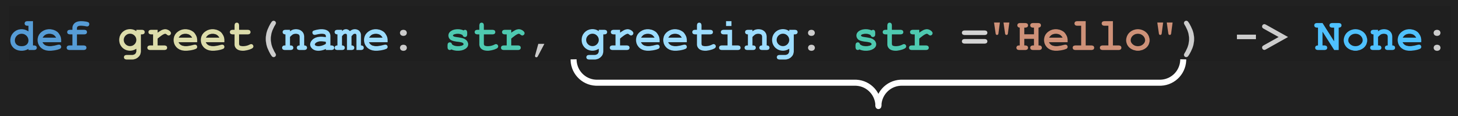
Named constants

- Variables that are meant to hold a value that doesn't change throughout the program's execution
- Naming convention: all uppercase letters, with underscores between any words

```
PI: float = 3.14

FREEZING_F: int = 32

FREEZING_C: int = 0
```

Default parameters

- A parameter in a function signature that is assigned a default value. If a function call does not provide a value for that parameter, the default value is used
- *** Default parameters should come ***after*** non-default parameters in the function signature ***



```python
def greet(name: str, greeting: str ="Hello") -> None:
```

default parameter

Default parameters

- A parameter in a function signature that is assigned a default value. If a function call does not provide a value for that parameter, the default value is used
- *** Default parameters should come ***after*** non-default parameters in the function signature ***

```python
def greet(name: str, greeting: str ="Hello") -> None:
```

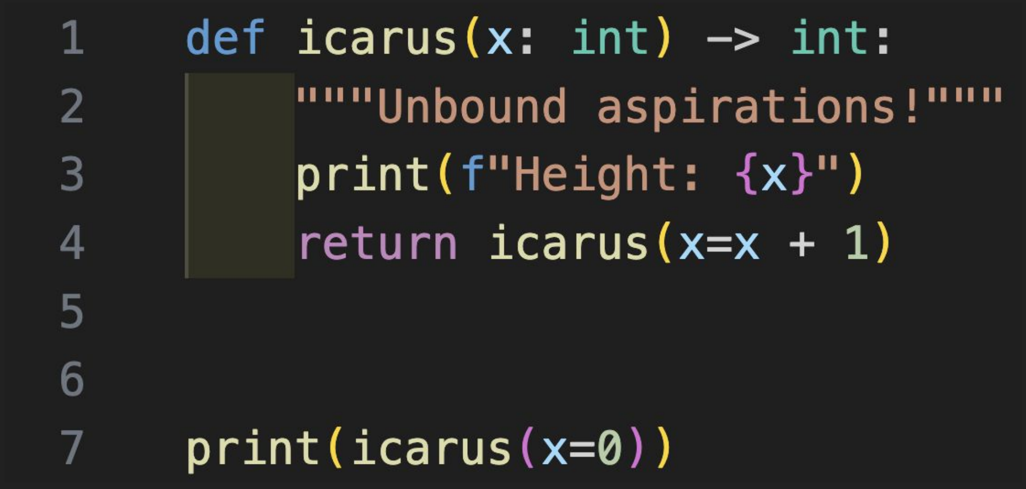
default parameter

Happy with the default greeting? `greet(name="Conor")`

Want to specify your own greeting? `greet(name="Conor", greeting="Hi")`

Your job: Diagram *at least* 2 function call frames…

But stop when you get tired or run out of lead!

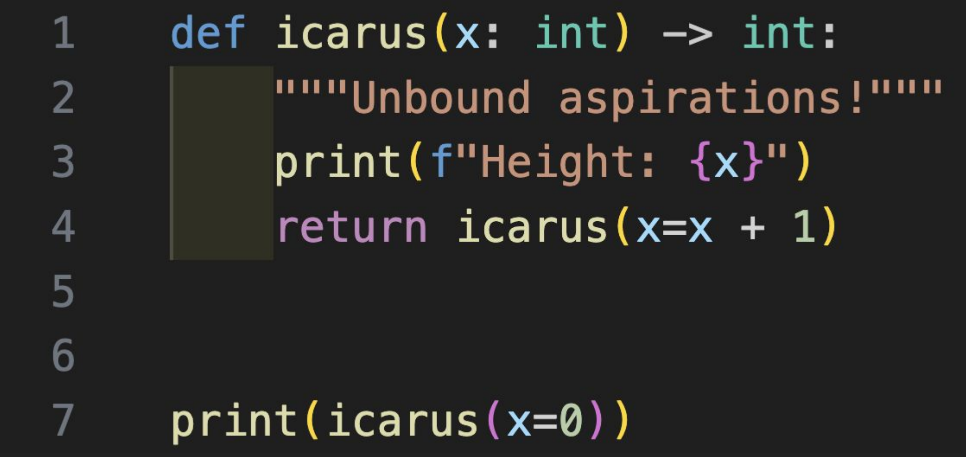


```python
def icarus(x: int) -> int:
    """Unbound aspirations!"""
    print(f"Height: {x}")
    return icarus(x=x + 1)


print(icarus(x=0))
```

Questions to discuss with your neighbor(s):

What seems *wrong* with this function?

How might you prevent it?



```python
def icarus(x: int) -> int:
    """Unbound aspirations!"""
    print(f"Height: {x}")
    return icarus(x=x + 1)


print(icarus(x=0))
```

Stack Overflow and Recursion Errors

When a programmer writes a function that calls itself indefinitely (*infinitely*), the **function call stack** will *overflow…*

This leads to a **`Stack Overflow`** or **`Recursion Error`**:

```
RecursionError: maximum recursion depth exceeded while
calling a Python object
```

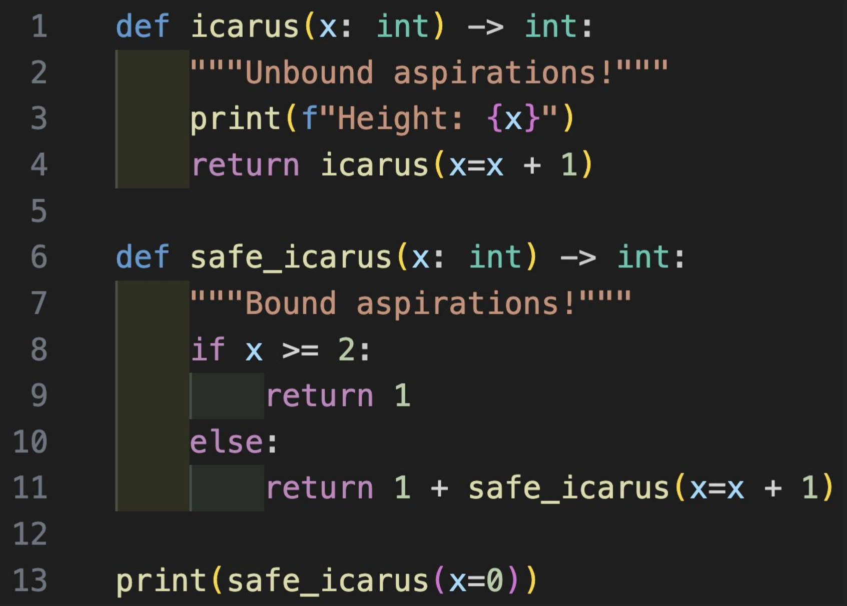
Base Cases and Recursive Cases

The key to writing recursive functions that are non-infinite!

To avoid StackOverflow Errors and infinite recursion:

1. You must have at least one **base case**
    a. Base case: a branch in a recursively defined function that ***does not recur***
2. **Recursive cases** must change the arguments of recursive calls such that they make progress toward a base case

Trace the following program in a diagram:



```python
def icarus(x: int) -> int:
    """Unbound aspirations!"""
    print(f"Height: {x}")
    return icarus(x=x + 1)

def safe_icarus(x: int) -> int:
    """Bound aspirations!"""
    if x >= 2:
        return 1
    else:
        return 1 + safe_icarus(x=x + 1)

print(safe_icarus(x=0))
```

`factorial` Algorithm

Create a recursive function called `factorial` that will calculate the product of all positive integers less than or equal to an int, `n`. E.g.,

`factorial(n=5)` would return: 5*4*3*2*1 = **120**

`factorial(n=2)` would return: 2*1 = **2**

`factorial(n=1)` would return: 1 = **1**

`factorial(n=0)` would return: **1**

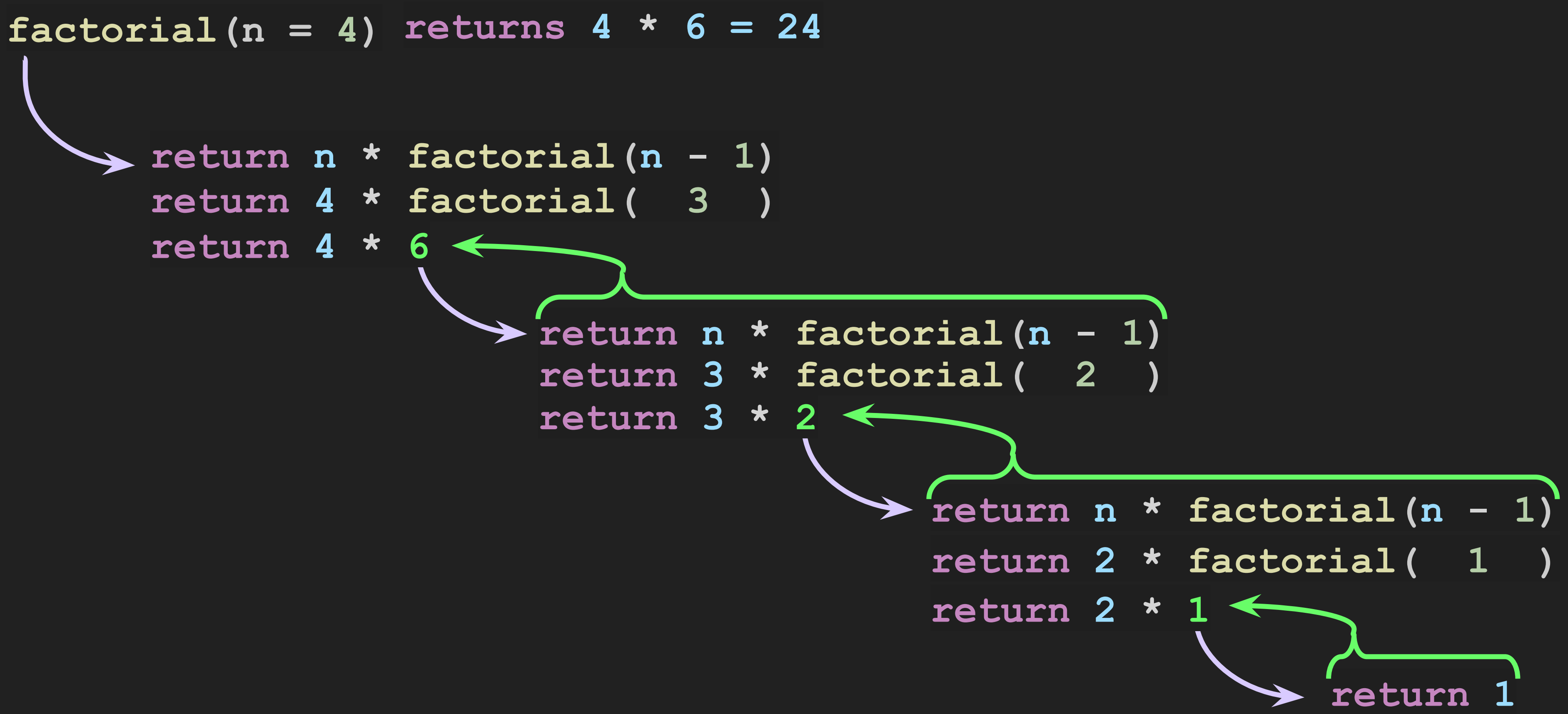
Conceptually, what will our **base case** be?

What will our **recursive case** be?

What is an **edge case** for this function? How could we account for it?

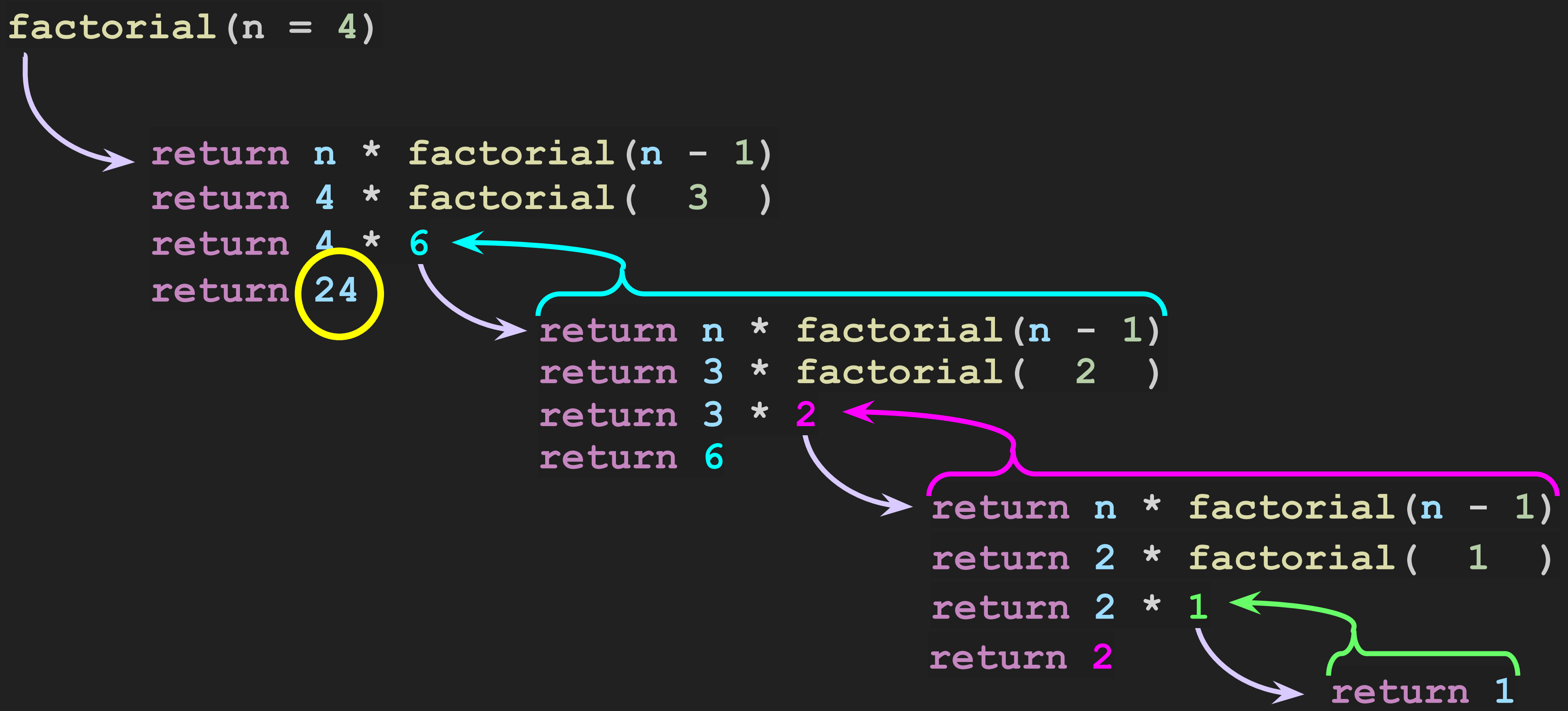
Visualizing recursive calls to `factorial`

Visualizing recursive calls to `factorial`



```
factorial(n = 4) returns 4 * 6 = 24

        return n * factorial(n - 1)
        return 4 * factorial(  3  )
        return 4 * 6

                return n * factorial(n - 1)
                return 3 * factorial(  2  )
                return 3 * 2

                        return n * factorial(n - 1)
                        return 2 * factorial(  1  )
                        return 2 * 1

                                return 1
```

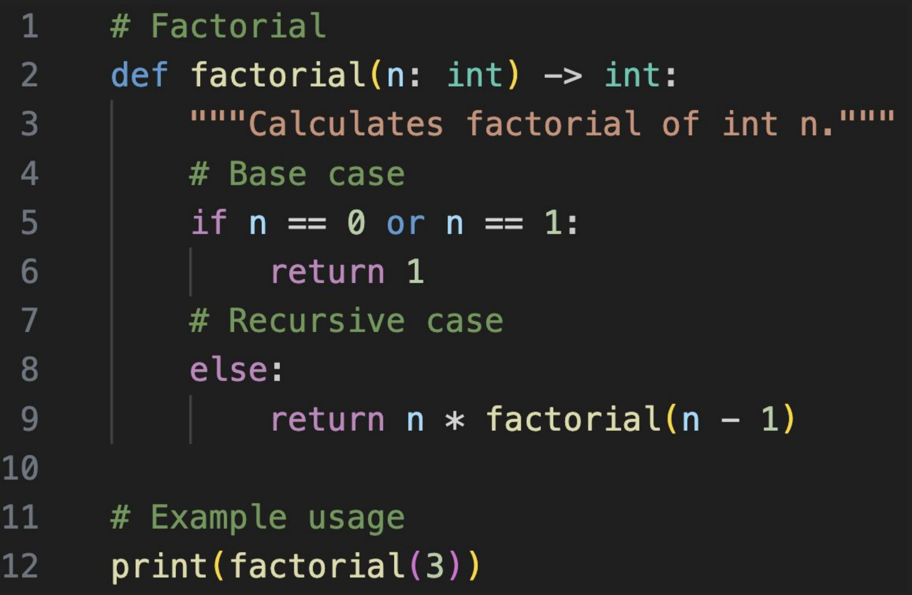
Visualizing recursive calls to `factorial`



```
factorial(n = 4)

      return n * factorial(n - 1)
      return 4 * factorial(  3  )
      return 4 * 6
      return 24

                return n * factorial(n - 1)
                return 3 * factorial(  2  )
                return 3 * 2
                return 6

                                return n * factorial(n - 1)
                                return 2 * factorial(  1  )
                                return 2 * 1
                                return 2

                                                 return 1
```

Let’s write the **`factorial`** function in VS Code!

Memory diagram



```python
# Factorial
def factorial(n: int) -> int:
    """Calculates factorial of int n."""
    # Base case
    if n == 0 or n == 1:
        return 1
    # Recursive case
    else:
        return n * factorial(n - 1)

# Example usage
print(factorial(3))
```

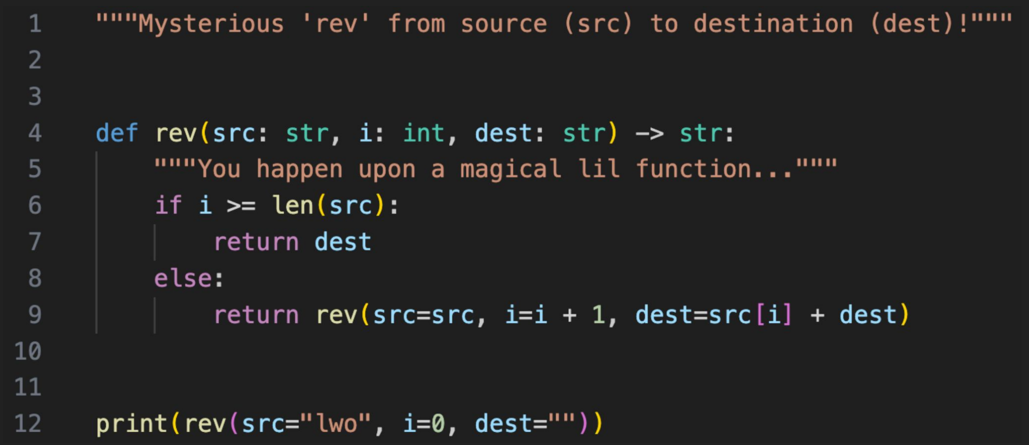
Checklist for developing a recursive function:

Base case:

- ❏ Does the function have a clear base case?
  - ❏ Ensure the base case returns a result directly (without calling the function again).
- ❏ Will the base case *always* be reached?

Recursive case:

- ❏ Ensure the function moves closer to the base case with each recursive call.
- ❏ Combine returned results from recursive calls where necessary.
- ❏ Test the function with edge cases (e.g., empty inputs, smallest and largest valid inputs, etc.). Does the function account for these cases?



```python
"""Mysterious 'rev' from source (src) to destination (dest)!"""


def rev(src: str, i: int, dest: str) -> str:
    """You happen upon a magical lil function..."""
    if i >= len(src):
        return dest
    else:
        return rev(src=src, i=i + 1, dest=src[i] + dest)


print(rev(src="lwo", i=0, dest=""))
```