Functions and Parameters

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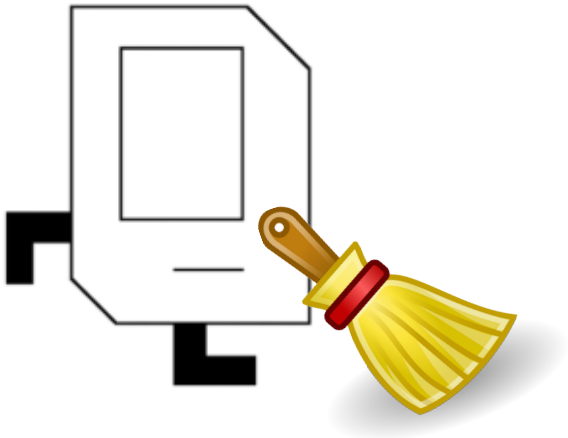
Based on slides by Chris Piech and Mehran Sahami
CS106A, Stanford University

Housekeeping



- Reminder: Diagnostic is on **Thursday, July 9th**
  - Takes place during class time
  - Like an exam
    - Really meant for you to gauge your understanding
  - Covers material through today
  - Email Wil if you have a time conflict or are outside the Americas

Learning Goals

1. Get more practice with function parameters
2. Understand information flow in a program
3. Learn about Python's doctest feature

Recall, Our Friend the Function

```
def main():
    avg = average(5.0, 10.2)
    print(avg)
```

function "call"

function "definition"

```
def average(a, b):
    sum = a + b
    return sum / 2
```

Recall, Our Friend the Function

arguments

```
def main():
    avg = average(5.0, 10.2)
    print(avg)
```

parameters

```
def average(a, b):
    sum = a + b
    return sum / 2
```

Parameters

Parameters let you provide a function with some information when you are calling it.

A Full Program

```
# Constant - visible to all functions
MAX_NUM = 4


def main():
    for i in range(MAX_NUM):
        print(i, factorial(i))



def factorial(n):
    result = 1
    for i in range(1, n + 1):
        result *= i

    return result
```

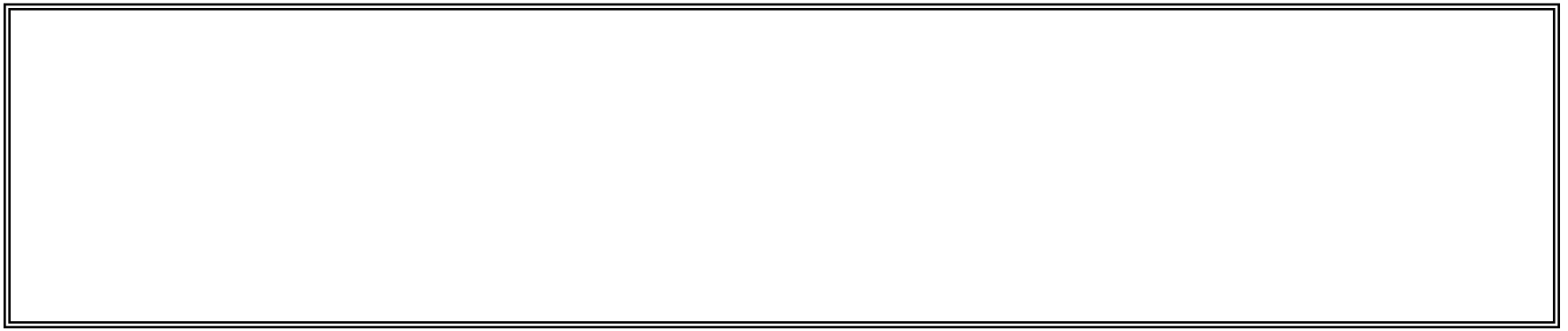
A Full Program

```
# Constant - visible to all functions
MAX_NUM = 4


def main():
    for i in range(MAX_NUM):
        print(i, factorial(i))



def factorial(n):
    result = 1
    for i in range(1, n + 1):
        result *= i

    return result
```

Understand the mechanism

```
def main():
    for i in range(MAX_NUM):
        print(i, factorial(i))
```

i 



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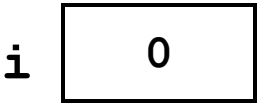

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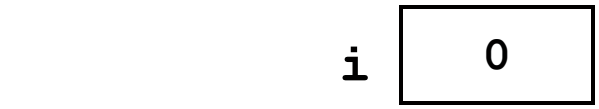

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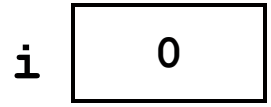

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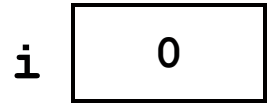

```
def factorial(n):
    result = 1
    for i in range(1, n + 1):
        result *= i

    return result
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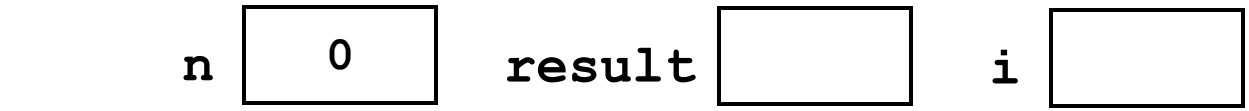

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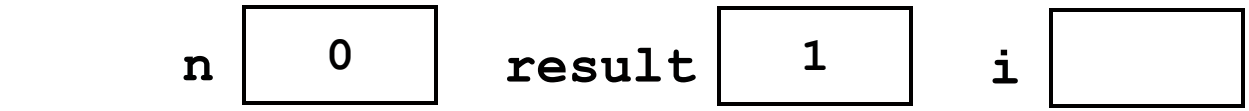

```
def factorial(n):
    result = 1
    for i in range(1, n + 1):
        result *= i

    return result
```

n	0	result	1	i	1

```
def factorial(n):
    result = 1
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    return result
```

n	0	result	1	i	1

```
def factorial(n):
    result = 1
    for i in range(1, n + 1):
        result *= i

    return result
```

n 0 result 1 i 1

```
def main():
    for i in range(MAX_NUM):
        print(i, factorial(i))
```

1

i 0

```
def main():
    for i in range(MAX_NUM):
        print(i, factorial(i))
```

1

i | 0

```
0   1
```

```
def main():
    for i in range(MAX_NUM):
        print(i, factorial(i))
```

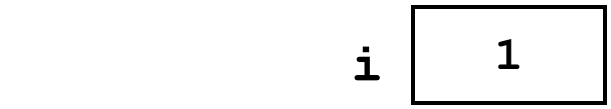

```
0  1
```

```
def main():
    for i in range(MAX_NUM):
        print(i, factorial(i))
```

i | 1

```
0  1
```

```
def main():
    for i in range(MAX_NUM):
        print(i, factorial(i))
```




```
0  1
```

```
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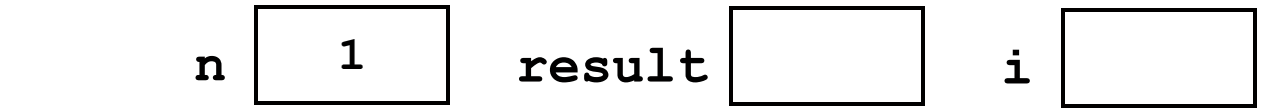
    result = 1
    for i in range(1, n + 1):
        result *= i

    return result
```




```
0  1
```

```
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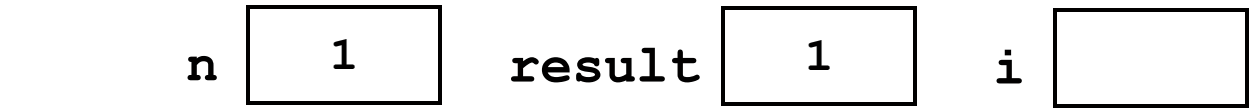


```
0  1
```

```
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    return result
```

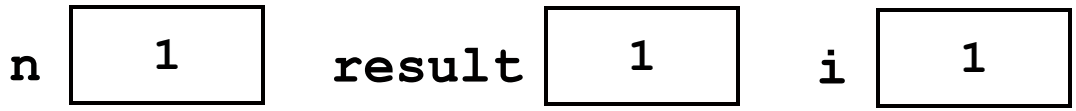


```
0  1
```

```
def factorial(n):
    result = 1
    for i in range(1, n + 1):
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    return result
```
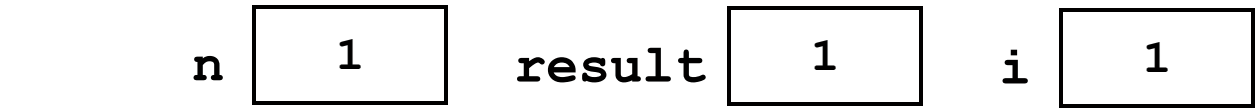
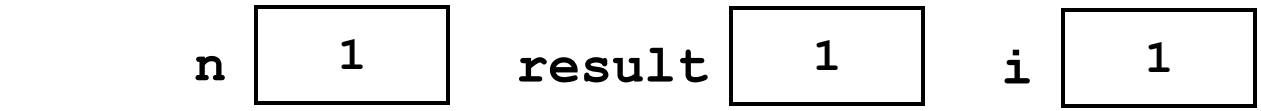




```
0   1
```

```
def factorial(n):
    result = 1
    for i in range(1, n + 1):
        result *= i

    return result
```




```
0  1
```

```
def factorial(n):
    result = 1
    for i in range(1, n + 1):
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```
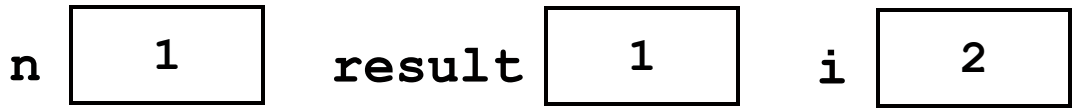
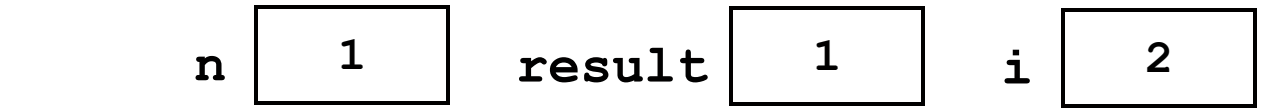




```
0   1
```

```
def factorial(n):
    result = 1
    for i in range(1, n+1):
        result *= i

    return result
```




```
0  1
```

```
def main():
    for i in range(MAX_NUM):
        print(i, factorial(i))
```

1

i 1

```
0  1
```

```
def main():
    for i in range(MAX_NUM):
        print(i, factorial(i))
```

1

i 1

```
0   1
1   1
```

```
def main():
    for i in range(MAX_NUM):
        print(i, factorial(i))
```

i | 2

```
0   1
1   1
```

```
def main():
    for i in range(MAX_NUM):
        print(i, factorial(i))
```

i | 2

```
0   1
1   1
```

```
def main():
    for i in range(MAX_NUM):
        print(i, factorial(i))
```

i | 2

```
0   1
1   1
```

```
def main():
    for i in range(MAX_NUM):
        print(i, factorial(i))
```

i | 2

```
0   1
1   1
```

```
def main():
    for i in range(MAX_NUM):
        print(i, factorial(i))
```

2

i 2

```
0   1
1   1
```

```
def main():
    for i in range(MAX_NUM):
        print(i, factorial(i))
```

2

i 2

```
0   1
1   1
2   2
```

```
def main():
    for i in range(MAX_NUM):
        print(i, factorial(i))
```

i 3

```
0  1
1  1
2  2
```

```
def main():
    for i in range(MAX_NUM):
        print(i, factorial(i))
```

i | 3

```
0   1
1   1
2   2
```

```
def main():
    for i in range(MAX_NUM):
        print(i, factorial(i))
```

i 3

```
0  1
1  1
2  2
```

```
def main():
    for i in range(MAX_NUM):
        print(i, factorial(i))
```

i 3

```
0  1
1  1
2  2
```

```
def main():
    for i in range(MAX_NUM):
        print(i, factorial(i))
```

6

i 3

```
0   1
1   1
2   2
```

```
def main():
    for i in range(MAX_NUM):
        print(i, factorial(i))
```

6

i 3

```
0   1
1   1
2   2
3   6
```

```
def main():
    for i in range(MAX_NUM):
        print(i, factorial(i))
```

i | 4

```
0   1
1   1
2   2
3   6
```

```
def main():
    for i in range(MAX_NUM):
        print(i, factorial(i))
```

i | 4

```
0   1
1   1
2   2
3   6
```

```
def main():
    for i in range(MAX_NUM):
        print(i, factorial(i))
```

i | 4

Done!

```
0   1
1   1
2   2
3   6
```

Parameters

Every time a function is called, new memory is created for that call.

Parameter values are passed in.

All *local* variables start fresh (no old values)

An interlude: doctest

Doctest

```
def factorial(n):
    """
    This function returns the factorial of n
    Input: n (number to compute the factorial of)
    Returns: value of n factorial
    Doctests:
    >>> factorial(3)
    6
    >>> factorial(1)
    1
    >>> factorial(0)
    1
    """
    result = 1
    for i in range(1, n + 1):
        result *= i
    return result
```

Doctest

```
def factorial(n):
    """
    This function returns the factorial of n
    Input: n (number to compute the factorial of)
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    Doctests:
    >>> factorial(3)
    6
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    1
    >>> factorial(0)
    1
    """
    result = 1
    for i in range(1, n + 1):
        result *= i
    return result
```

Say this was in file "fact.py"
To run doctests (on PC):

> py -m doctest fact.py -v

Let's try it!!

Bad Times With functions

```
# NOTE: This program is buggy!!

def add_five(x):
    x += 5



def main():
    x = 3
    add_five(x)
    print(f"x = {x}")
```

Let's "trace" this program

Bad Times With functions

```
# NOTE: This program is buggy!!

def add_five(x):
    x += 5



def main():
    x = 3
    add_five(x)
    print(f"x = {x}")
```

Good Times With functions

```
# NOTE: This program is feeling just fine...

def add_five(x):
    x += 5
    return x


def main():
    x = 3
    x = add_five(x)
    print(f"x = {x}")
```

For primitive types (e.g., int, float, Boolean, string):

- **Copies** of values are passed as parameters.
- Variable that was passed in as an argument is **not** changed when you modify parameter in the function.

Pass by “Value”

Careful!

No Functions in Functions

```
def main():
    print("hello world")
    def say_goodbye():
        print("goodbye!")
```

Technically legal, but often a sign at the start that you are confusing function *definition* and function *call*

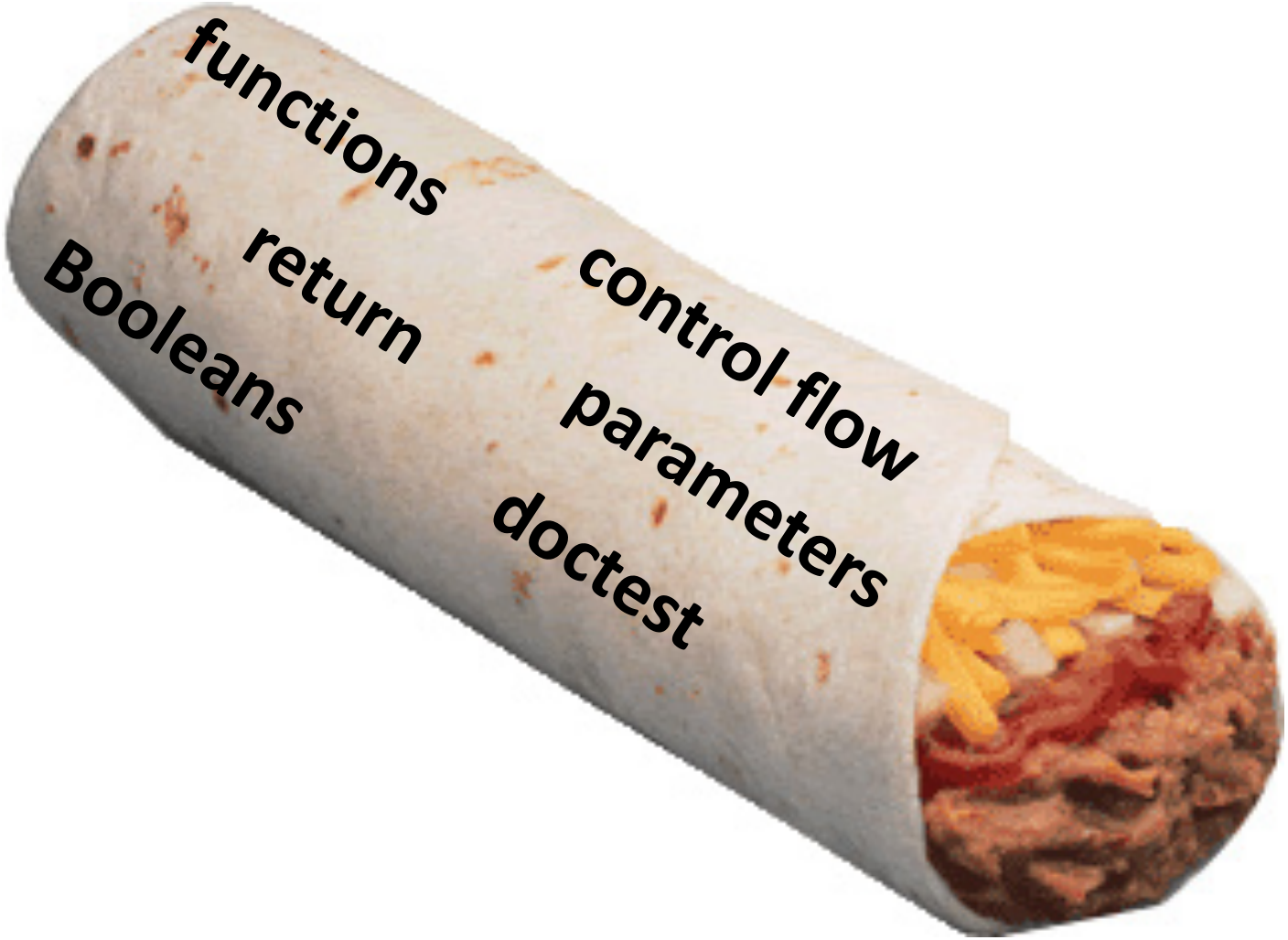
No functions in functions

```
def main():
    print("hello world")
    say_goodbye()


def say_goodbye():
    print("goodbye!")
```

Learning Goals

1. Get more practice with function parameters
2. Understand information flow in a program
3. Learn about Python's doctest feature


functions
return
Booleans
control flow
parameters
doctest

The Whole Burrito: calendar.py