Functions

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CS106A, Stanford University

Boolean Variable

```
karel_is_awesome = True

my_bool = 1 < 2
```


Boolean Operations

```
a = True

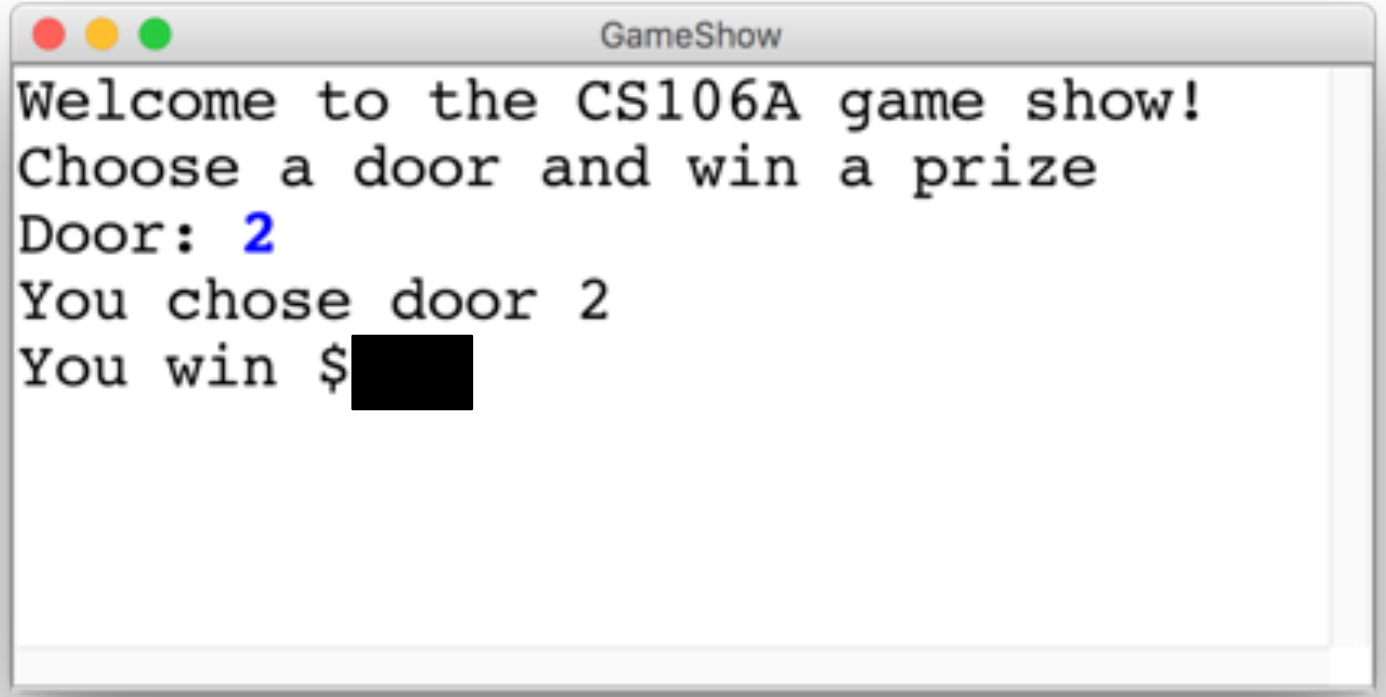
b = False


both_true = a and b

either_true = a or b

opposite = not a
```

Game Show


GameShow
Welcome to the CS106A game show!
Choose a door and win a prize
Door: 2
You chose door 2
You win $

Choose a Door

```
door = int(input("Door: "))
# while the input is invalid
while door < 1 or door > 3 :
    # tell the user the input was invalid
    print("Invalid door!")
    # ask for a new input
    door = int(input("Door: "))
```

or

The Door Logic

```
prize = 4

if door == 1:
    prize = 2 + 9 // 10 * 100

elif door == 2:
    locked = prize % 2 != 0
    if not locked:
        prize += 6

elif door == 3 :
    for i in range(door):
        prize += i
```


Civilization advances by extending the number of operations we can perform without thinking about them.

-Alfred North Whitehead

Learn How To:

1. Write a function that takes in input
2. Write a function that gives back output
3. Trace function calls using stacks

Calling functions

```
turn_right()
```

```
move()
```

```
input("string please! ")
```

```
print("hello world")
```

```
float("0.42")
```

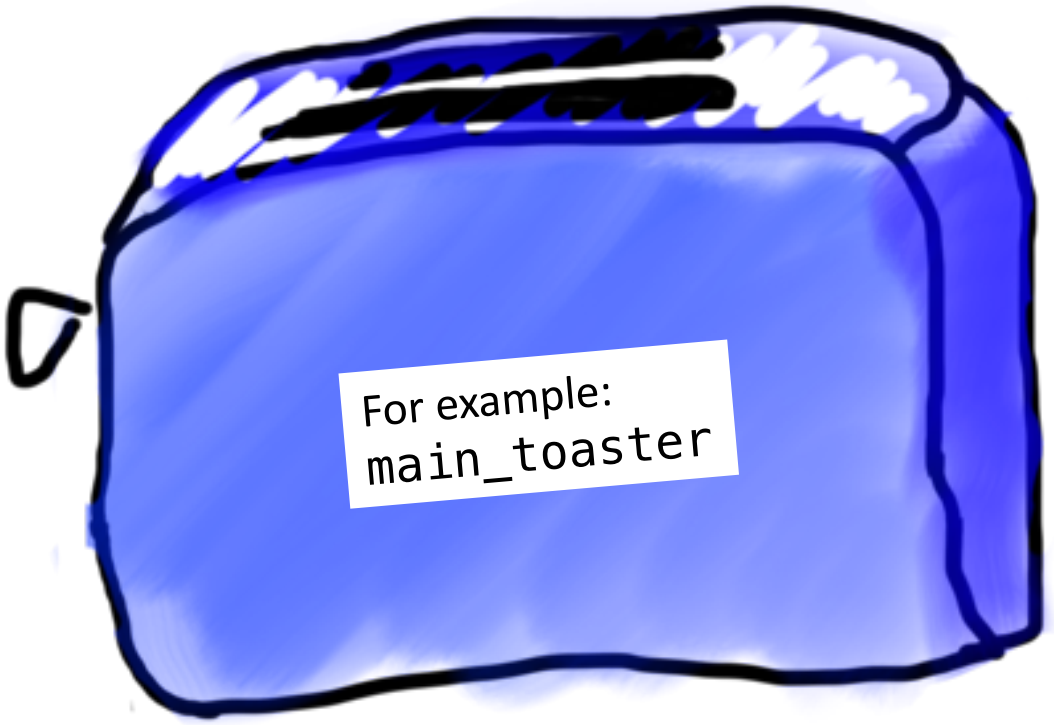
```
math.sqrt(25)
```


Defining a function

```
def turn_right():
    turn_left()
    turn_left()
    turn_left()
```

Big difference with python functions:
Python functions can **take in data**, and can **return data**!

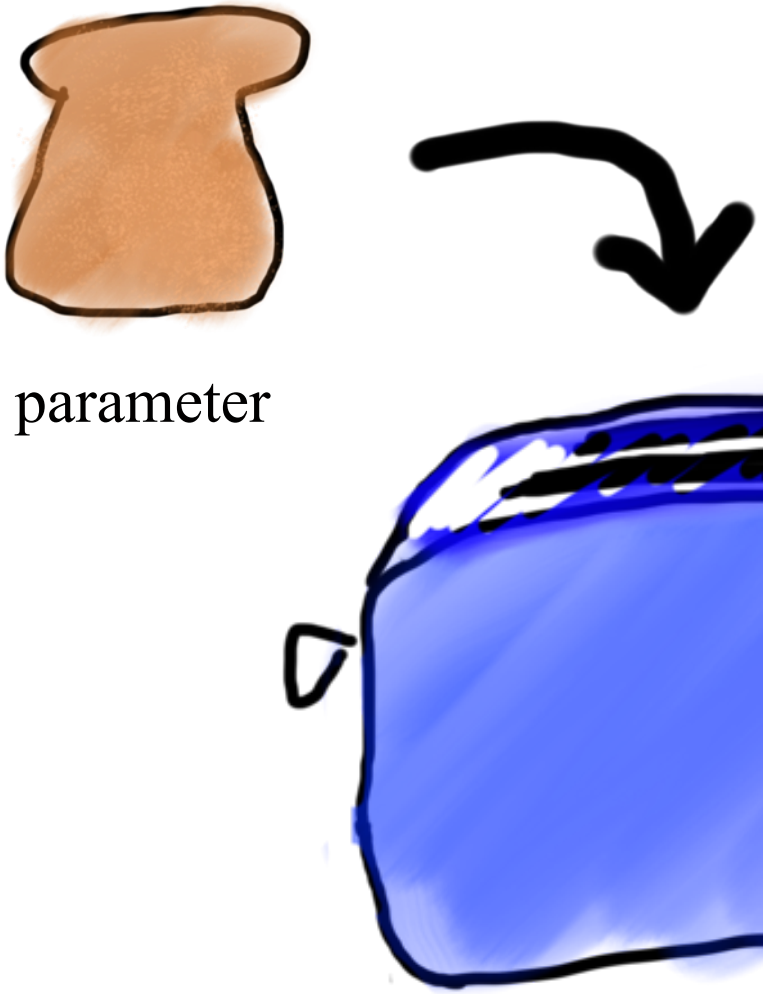
Toasters are functions



Toasters are functions

parameter

Toasters are functions



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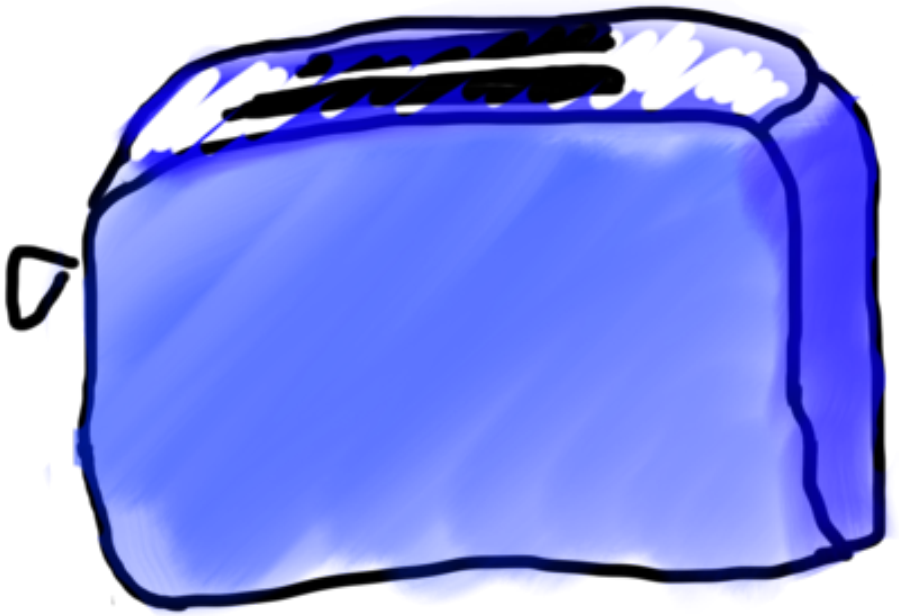

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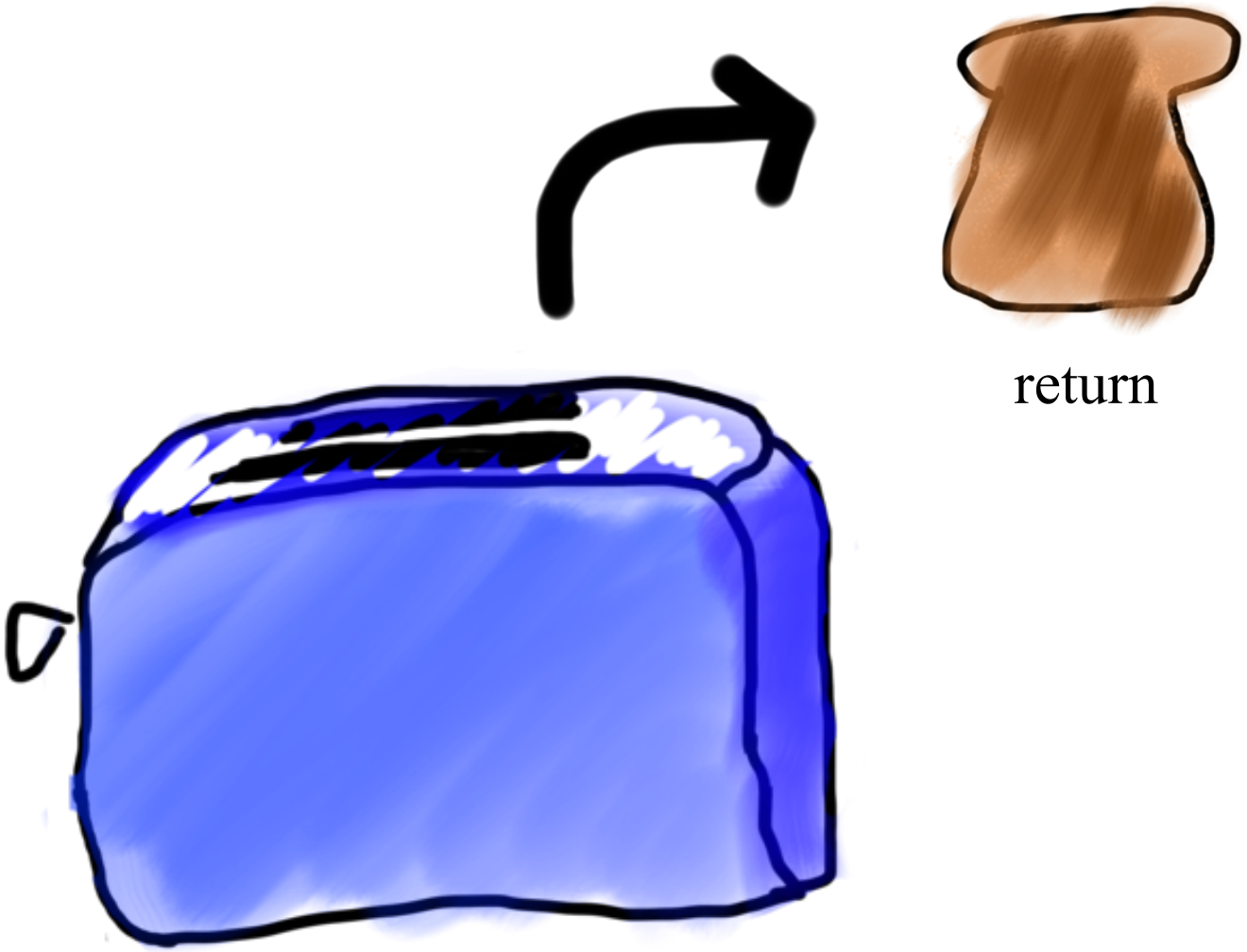

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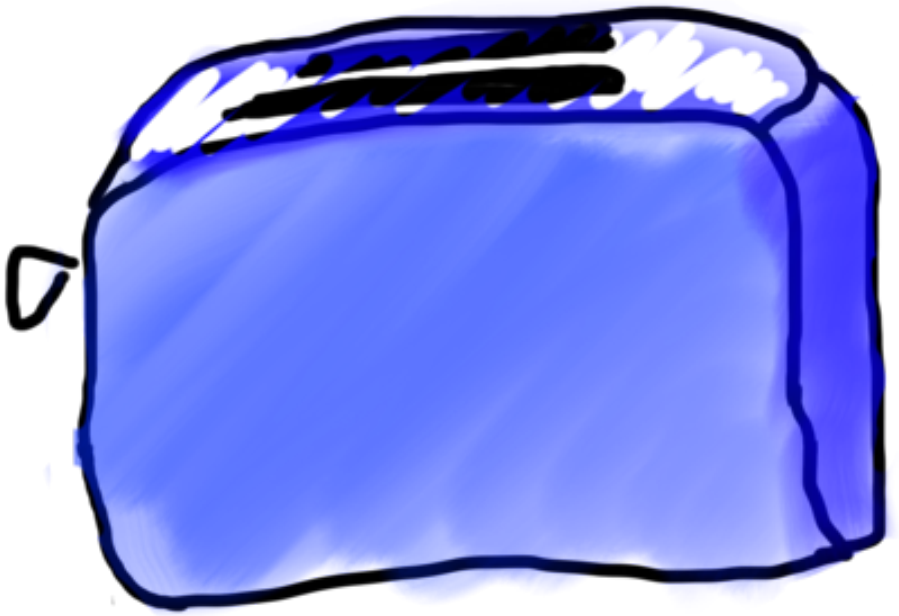

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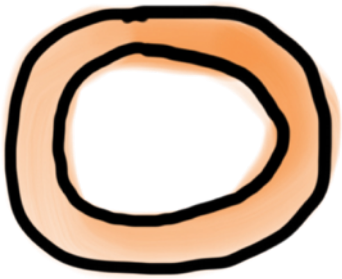
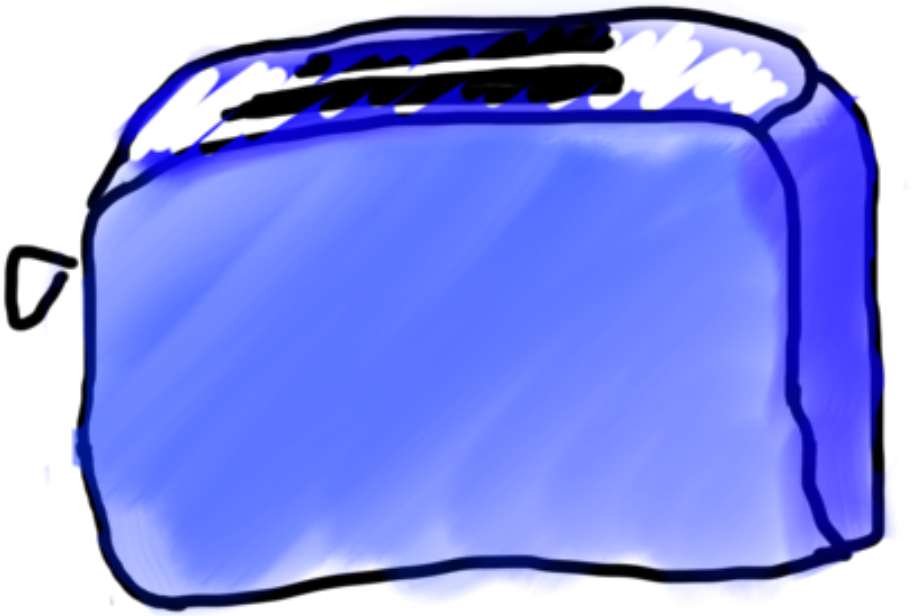
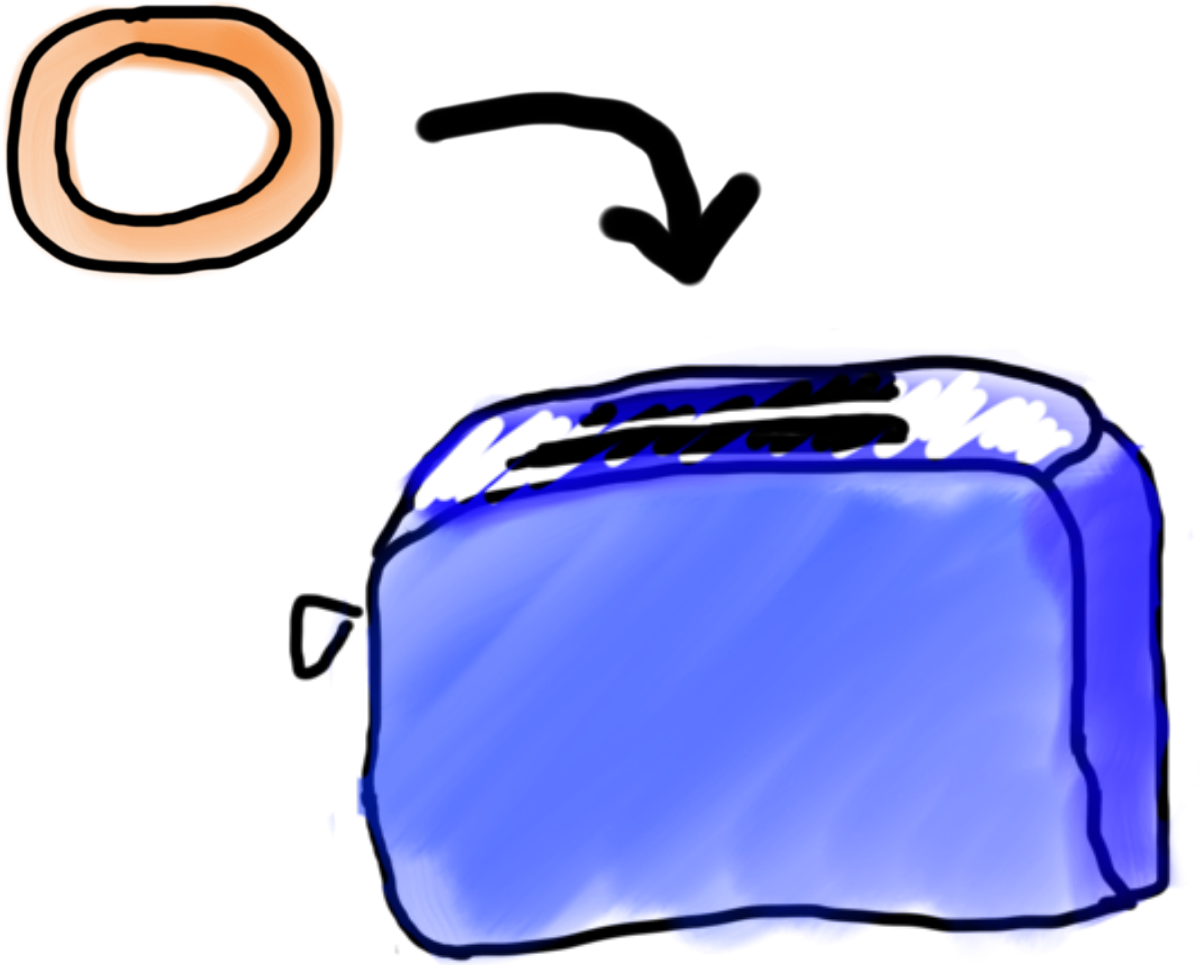




* You don’t need a second toaster if you want to toast bagels. Use the same one.

Toasters are functions



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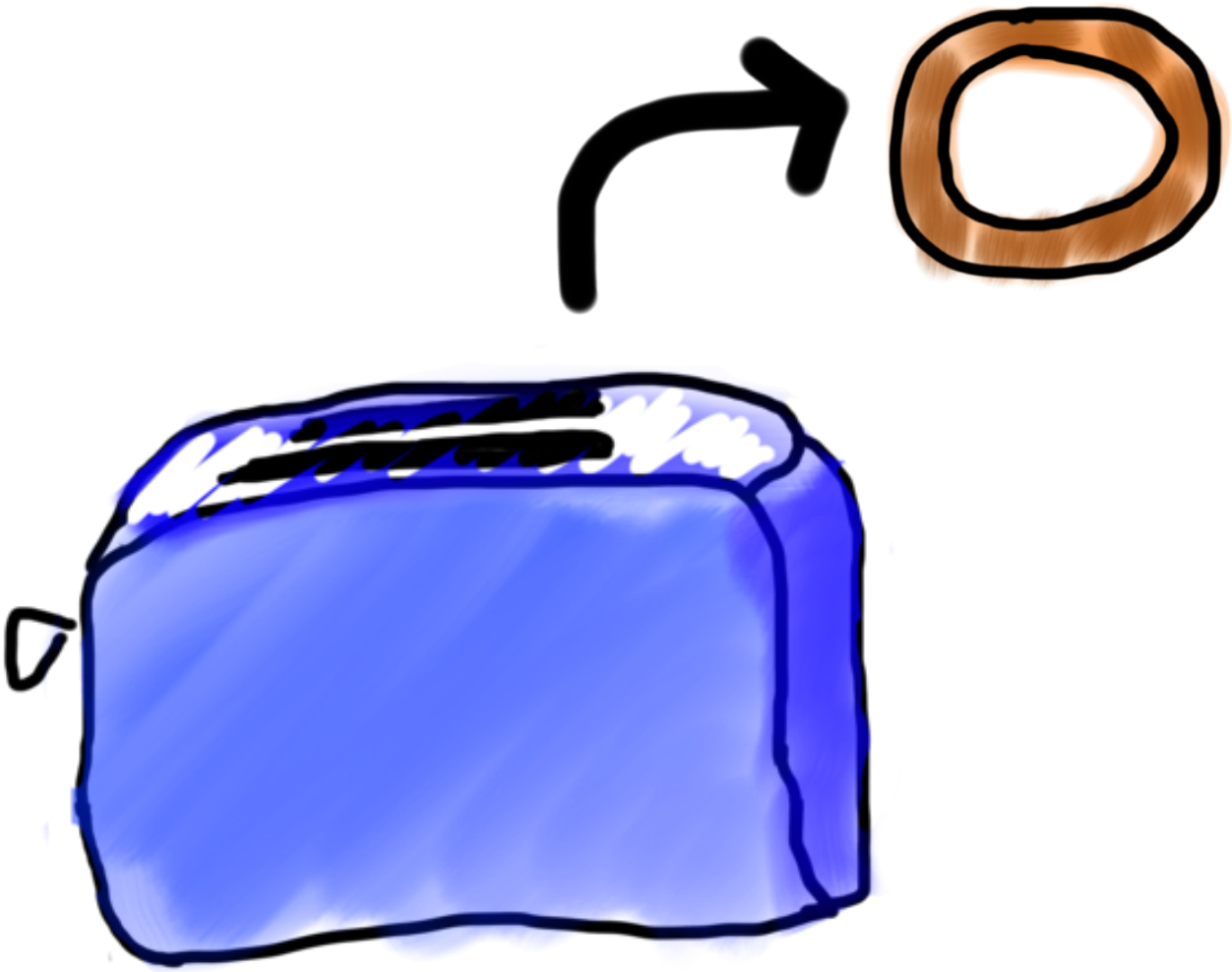

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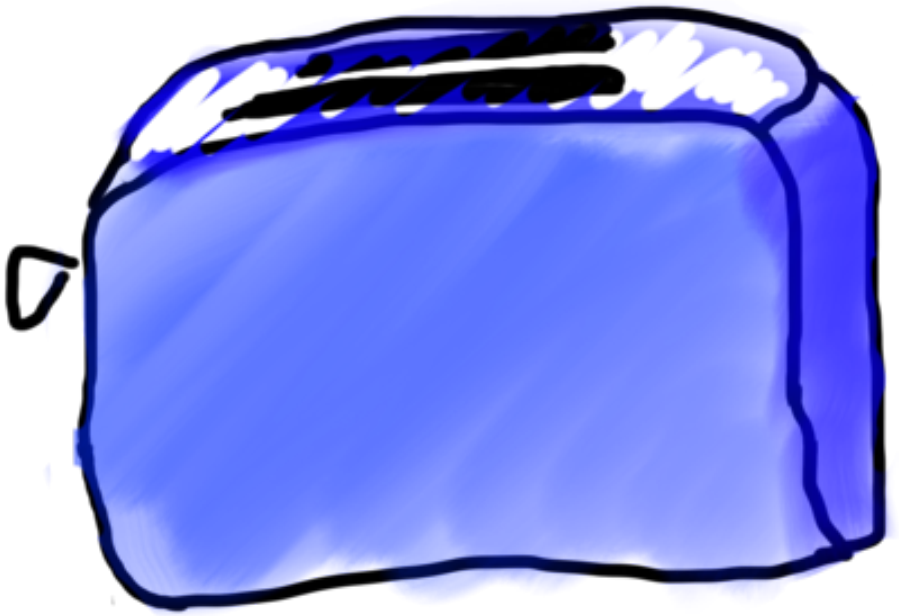

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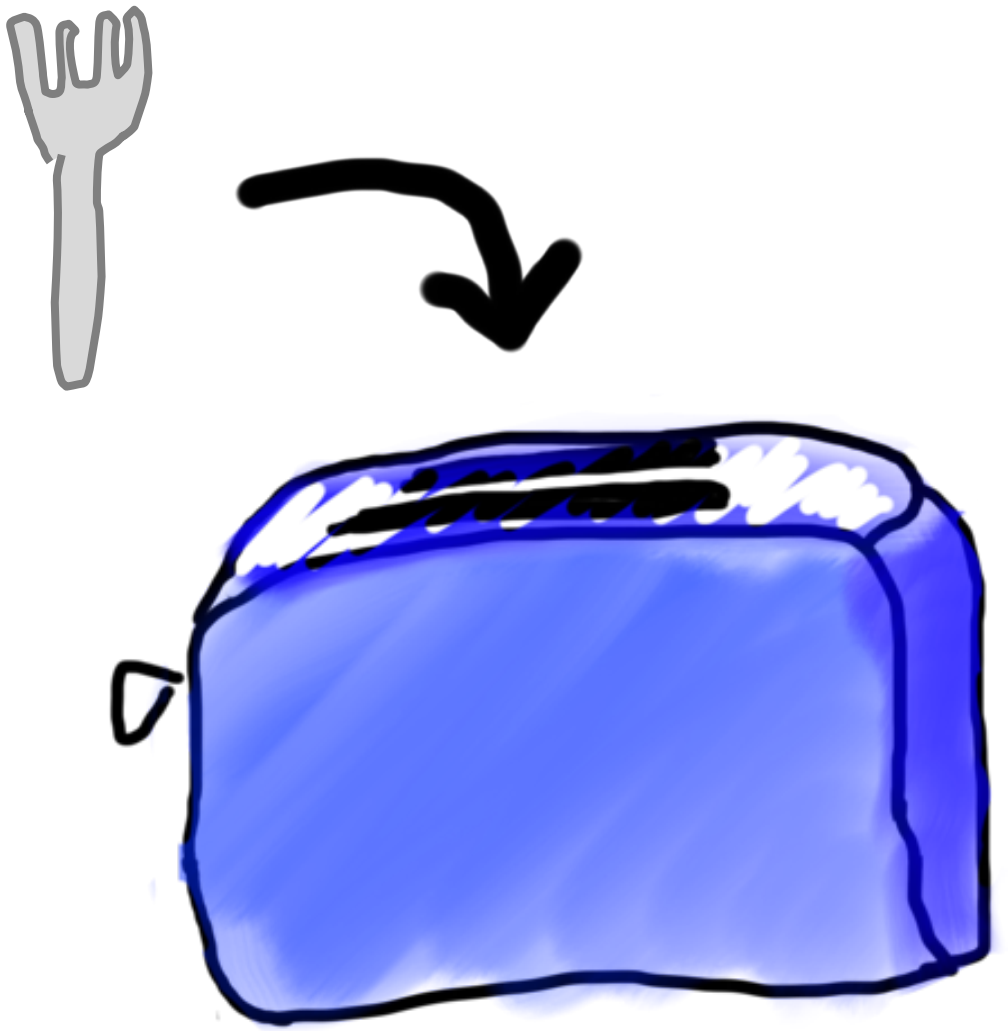

Toasters are functions

functions are Like Toasters

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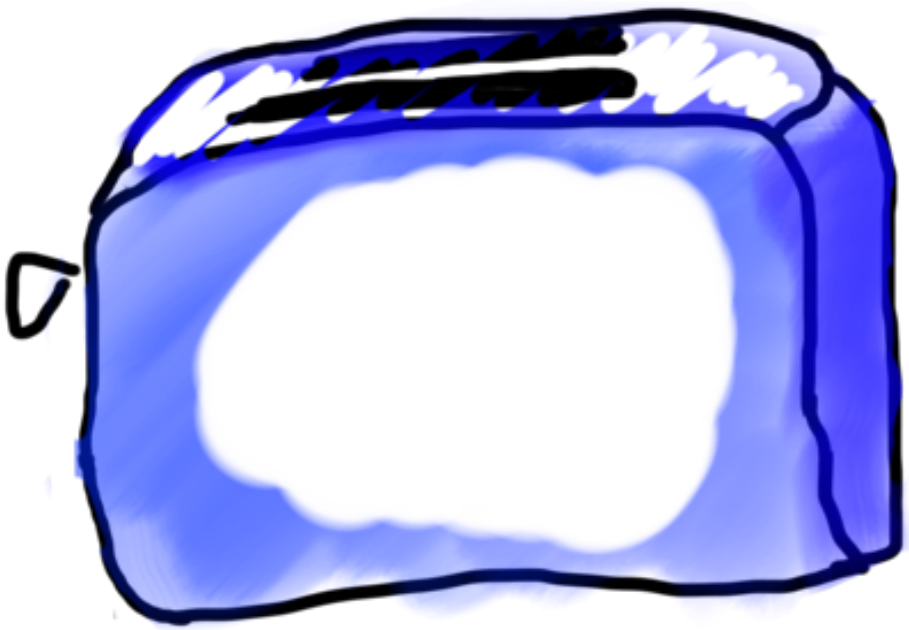

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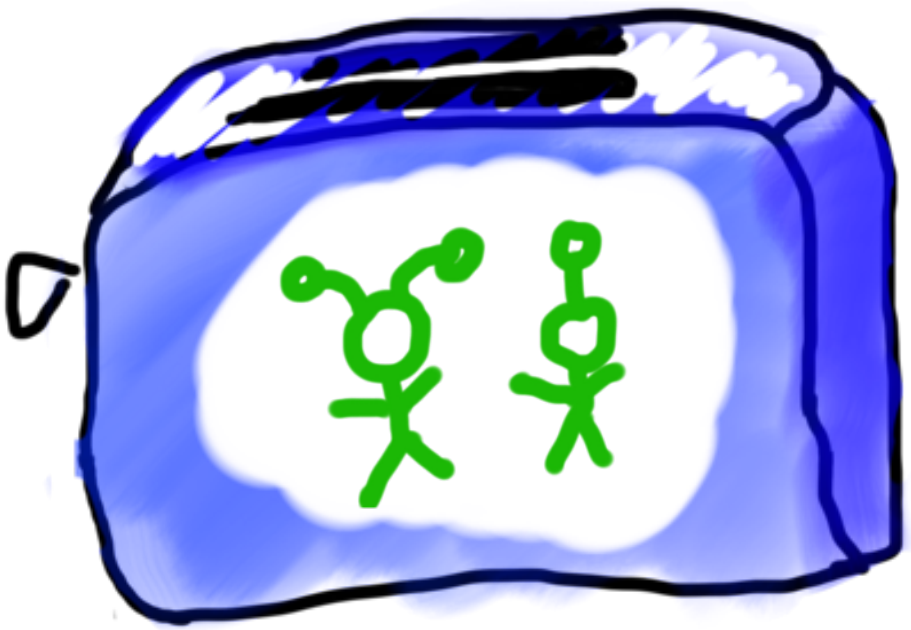

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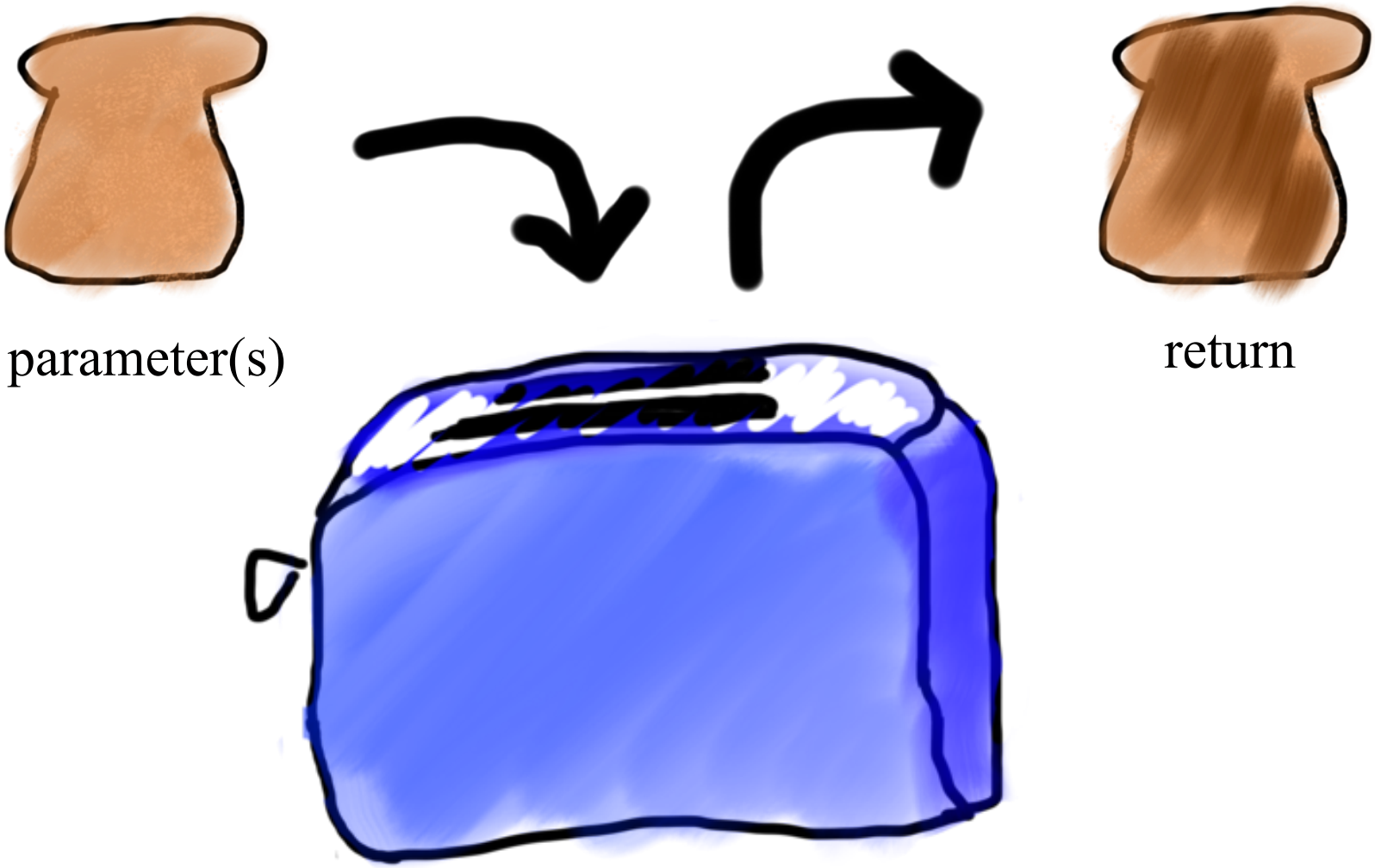

Formally

```
def name_of_function(parameters):
    statements
    # optionally
    return value
```

- ***name:*** information passed into function
- ***parameters:*** information passed into function
- ***return*:** information given back from the function

Classic Challenge for CS106A

Perhaps the most underrated concept by students

Anatomy of a function

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

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


Anatomy of a function

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

function "call"

function "definition"

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


Anatomy of a function

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

name

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

Anatomy of a function

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

Input given

Input expected

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

Anatomy of a function

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

Arguments

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

Parameters

Anatomy of a function

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

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

body

Anatomy of a function

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

This call "evaluates" to the value returned

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

Ends the function and gives back a value

Anatomy of a function

Also a function call

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

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

Anatomy of a function

No parameters (expects no input)

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

```
def average(a, b):
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```


Anatomy of a function

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

When a function ends it "returns"

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

Parameters

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

Is returning
the same as printing?

Is returning
the same as printing?

NO

Learn by Example

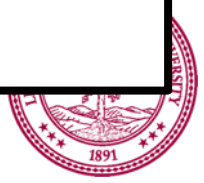
No Parameter, No Return

```
def print_intro():
    print("Welcome to class")
    print("It's the best part of my day.")


def main():
    print_intro()
```

terminal

```
> python intro.py
```



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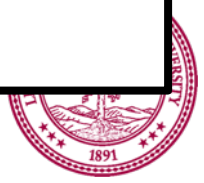

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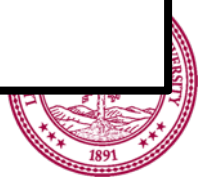

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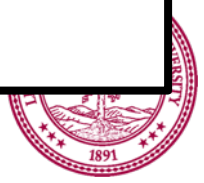

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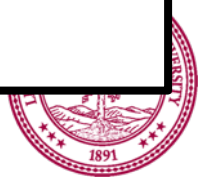

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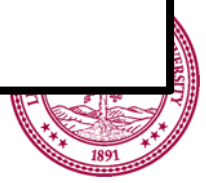

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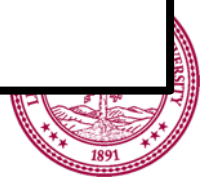

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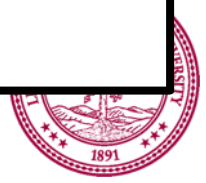


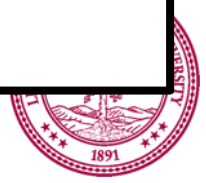
No Parameter, No Return

```
def print_intro():
    print("Welcome to class")
    print("It's the best part of my day.")


def main():
    print_intro()
main()
```

terminal

```
> python intro.py
Welcome to class
It’s the best part of my day
```



Parameter Example

```
def print_opinion(num):
    if(num == 5):
        print("I love 5!")
    else :
        print("Whattever")


def main():
    print_opinion(5)
```

terminal

```
> python opinion.py
```

Parameter Example

main memory

No variables

terminal

> python opinion.py

```
def print_opinion(num):
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Parameter Example

main memory

No variables

print_opinion memory

terminal

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```

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Parameter Example

main memory

No variables

print_opinion memory

num

terminal

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```

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Parameter Example

main memory

No variables

print_opinion memory

num **5**

terminal

> python opinion.py

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Parameter Example

main memory

No variables

print_opinion memory

num 5

terminal

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Parameter Example

main memory

No variables

print_opinion memory

num 5

terminal

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I love 5!
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Parameter Example

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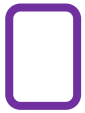

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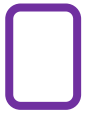

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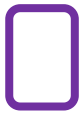

Parameter and Return Example

```
def meters_to_cm(meters):
    return 100 * meters


def main():
    result = meters_to_cm(5.2)
    print(result)
```

terminal

```
> python m2cm.py
```

Parameter and Return Example

main memory

No variables

terminal

> python m2cm.py

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def meters_to_cm(meters):
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Parameter and Return Example

main memory

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Parameter and Return Example

main memory

No variables

meteresToCm memory

terminal

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Parameter and Return Example

main memory

No variables

meteresToCm memory

meters | 5.2

terminal

```
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Parameter and Return Example

main memory

No variables

meteresToCm memory

meters | 5.2

terminal

> python m2cm.py

```
def meters_to_cm(meters):
    return 100 * meters
```

520.0

```
def main():
    result = meters_to_cm(5.2)
    print(result)
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Parameter and Return Example

main memory

No variables

terminal

```
> python m2cm.py
```

```
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```

520.0

Parameter and Return Example

main memory


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    return 100 * meters


def main():
    result = meters_to_cm(5.2)
    print(result)
```

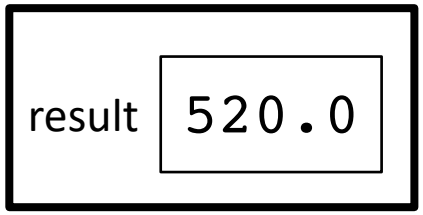
520.0

terminal

```
> python m2cm.py
```

Parameter and Return Example

main memory




```
def meters_to_cm(meters):
    return 100 * meters



def main():
    result = meters_to_cm(5.2)
    print(result)
```

terminal

```
> python m2cm.py
520.0
```

Parameter and Return Example

```
def meters_to_cm(meters):
    return 100 * meters


def main():
    print(meters_to_cm(5.2))
    print(meters_to_cm(9.1))
```

terminal

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> python m2cm.py
```

Parameter and Return Example

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def meters_to_cm(meters):
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def main():
    print(meters_to_cm(5.2))
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Parameter and Return Example

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def meters_to_cm(meters):
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def main():
    print(meters_to_cm(5.2))
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```

910.0

terminal

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520.0
```

Parameter and Return Example

```
def meters_to_cm(meters):
    return 100 * meters


def main():
    print(meters_to_cm(5.2))
    print(meters_to_cm(9.1))
```

910.0

terminal

```
> python m2cm.py
520.0
910.0
```

Contrasting Case:

```
# How is this function
def meters_to_cm_case1(meters):
    return 100 * meters
```

```
# Different than this function?
def meters_to_cm_case2(meters):
    print(100 * meters)
```


Is returning
the same as printing?

Is returning
the same as printing?

NO

Multiple Return Statements

```
def max(num1, num2):
    if num1 >= num2:
        return num1

    return num2


def main():
    larger = max(5, 1)
```

terminal

```
> python maxmax.py
```

Multiple Return Statements

main memory

No variables

```
def max(num1, num2):
    if num1 >= num2:
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def main():
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terminal

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Multiple Return Statements

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Multiple Return Statements

main memory

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def main():
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```

terminal

```
> python maxmax.py
```

Multiple Return Statements

main memory

No variables

max memory

num1 num2

```
def max(num1, num2):
    if num1 >= num2:
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    return num2



def main():
    larger = max(5, 1)
```

terminal

```
> python maxmax.py
```

Multiple Return Statements

main memory

No variables

max memory

num1 **5**

num2

```
def max(num1, num2):
    if num1 >= num2:
        return num1

    return num2



def main():
    larger = max(5, 1)
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terminal

```
> python maxmax.py
```

Multiple Return Statements

main memory

No variables

max memory

num1 **5**

num2 **1**

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```
> python maxmax.py
```

Multiple Return Statements

main memory

No variables

max memory

num1 | 5 | num2 | 1

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def main():
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```

5

terminal

```
> python maxmax.py
```

Multiple Return Statements

main memory

No variables

max memory

num1 | 5 | num2 | 1

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terminal

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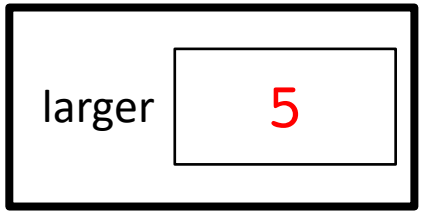
```

Multiple Return Statements

main memory

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    return num2



def main():
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```

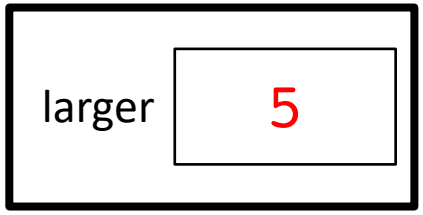
5

terminal

```
> python maxmax.py
```

Multiple Return Statements

main memory

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```

terminal

```
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```

Multiple Return Statements

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def main():
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```


Multiple Return Statements

```
def max(num1, num2):
    if num1 >= num2:
        return num1

    return num2


def main():
    larger = max(1, 5)
```


Multiple Return Statements

main memory

No variables

```
def max(num1, num2):
    if num1 >= num2:
        return num1

    return num2
```

```
def main():
    larger = max(1, 5)
```

Multiple Return Statements

main memory

No variables

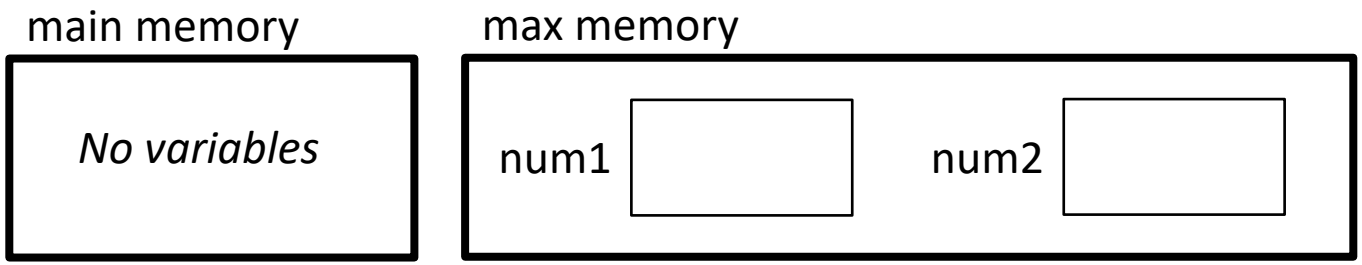
```
def max(num1, num2):
    if num1 >= num2:
        return num1

    return num2



def main():
    larger = max(1, 5)
```

Multiple Return Statements

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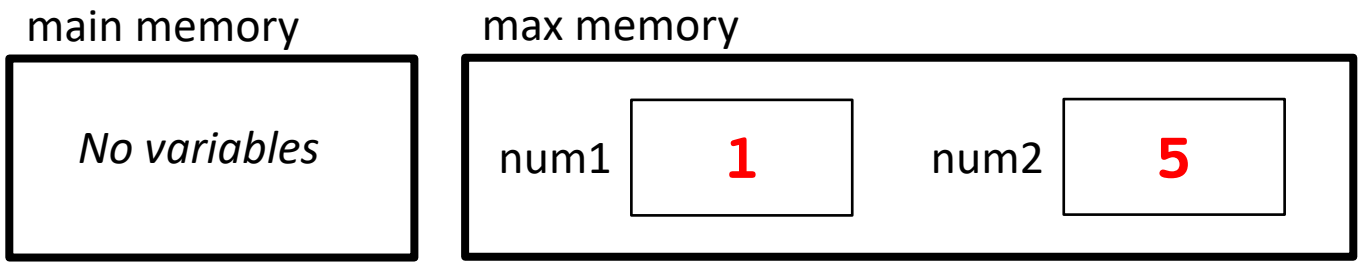
    if num1 >= num2:
        return num1

    return num2



def main():
    larger = max(1, 5)
```

Multiple Return Statements

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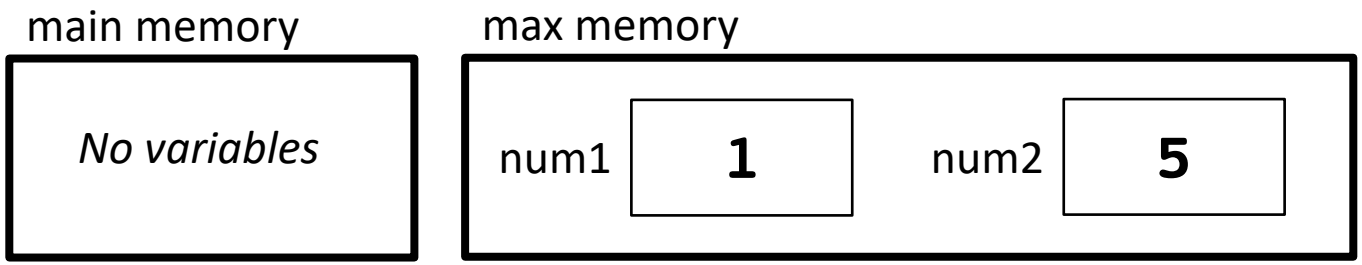
```

Multiple Return Statements

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    return num2


def main():
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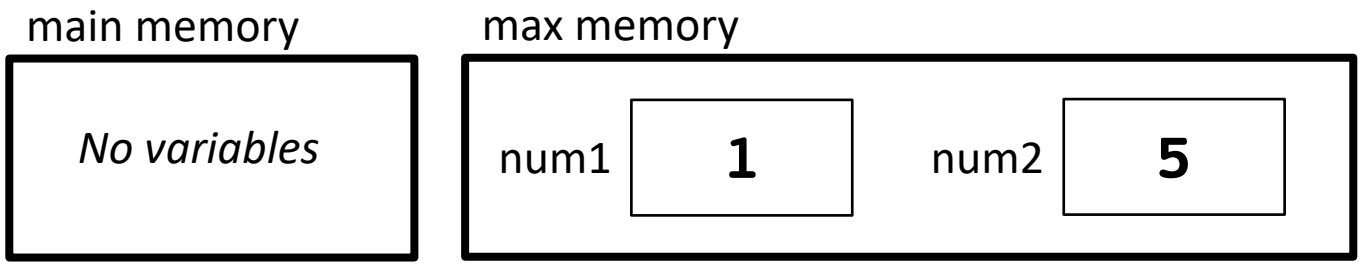
```

Multiple Return Statements




```
def max(num1, num2):
    if num1 >= num2:
        return num1

    return num2
```

5

```
def main():
    larger = max(1, 5)
```

Multiple Return Statements

main memory

No variables

```
def max(num1, num2):
    if num1 >= num2:
        return num1

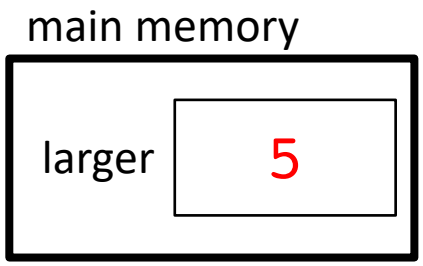
    return num2



def main():
    larger = max(1, 5)
```

5

Multiple Return Statements

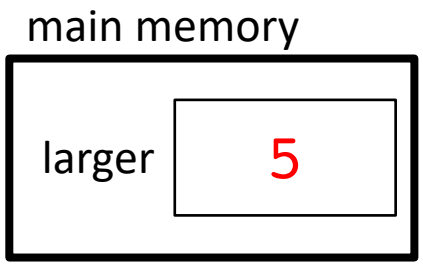



```
def max(num1, num2):
    if num1 >= num2:
        return num1

    return num2
```

```
def main():          5
    larger = max(1, 5)
```

Multiple Return Statements

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def main():
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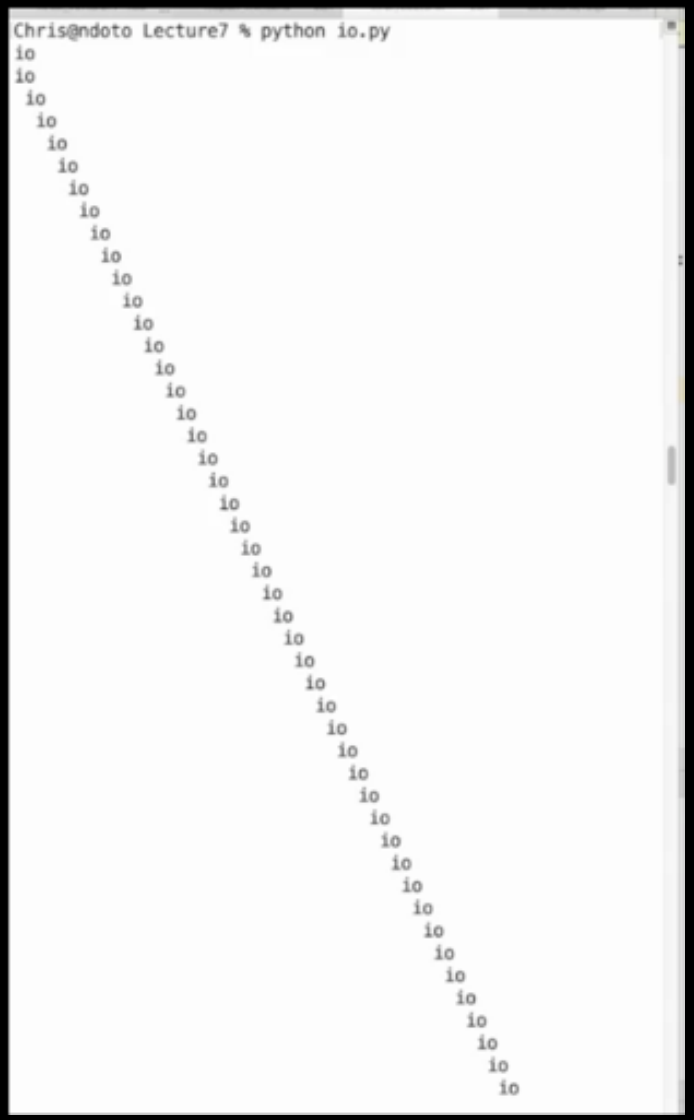
```

Function for IO



I give you

```
print_no_return
```

What functions do you define?