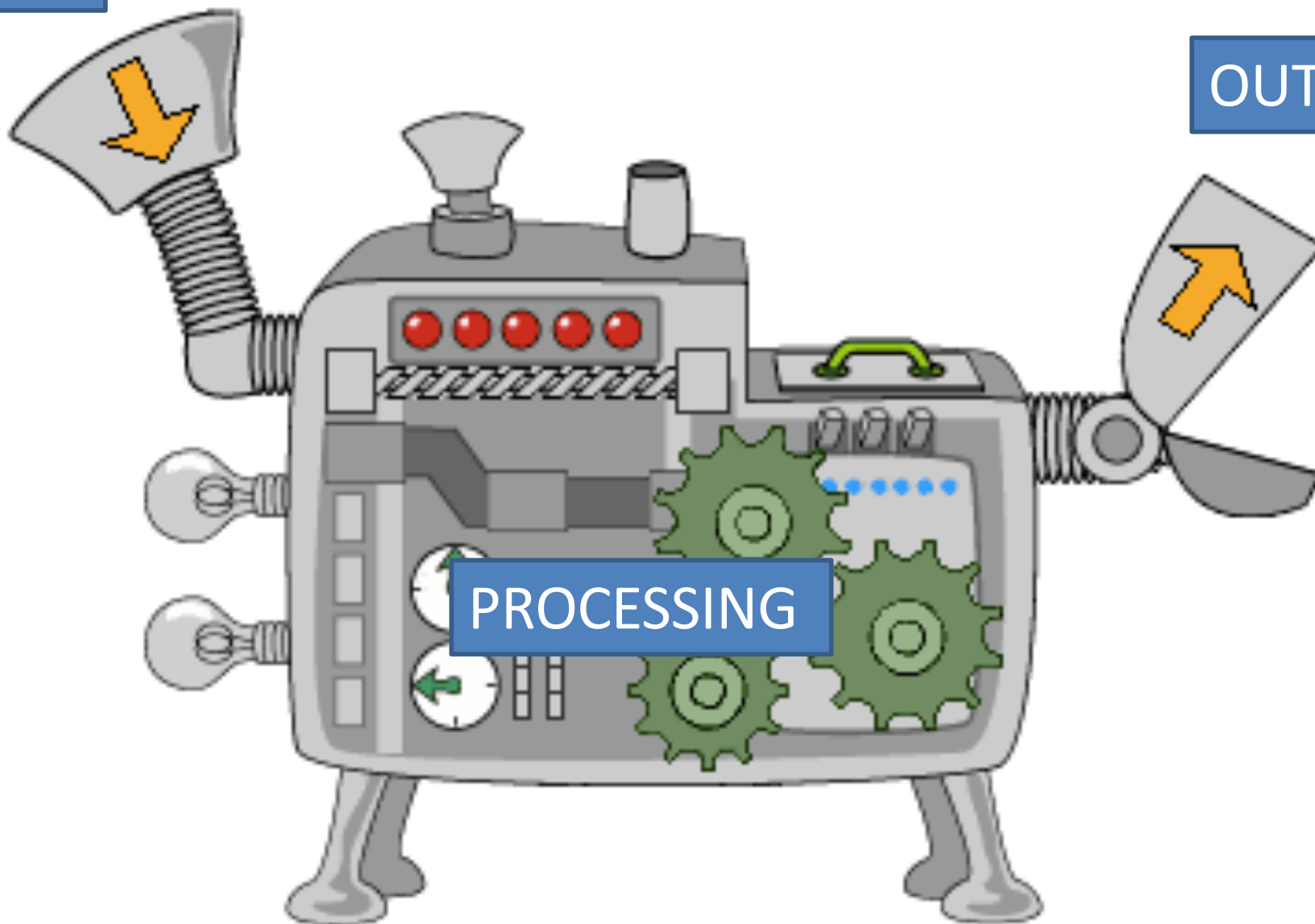


INPUT



OUTPUT

PROCESSING

```
def average(a, b, c):  
    avg = (a + b + c)/3  
    print("The average of your \  
        numbers is", avg)
```

```
def average(a, b, c):  
    avg = (a + b + c) / 3  
    print("The average of your \\  
        numbers is", avg)  
  
def main():  
    x = int(input("Give me a number: "))  
    y = int(input("Give me a number: "))  
    z = int(input("Give me a number: "))  
    average(x, y, z)
```

main ()

When main calls average, Python copies the values of x, y, and z (local variables in main) into a, b, and c (local variables in average).

- Pretend we're calculating grades for a class that has three homework assignments and three tests. Your final grade in the class is weighted so that
 - 75% of the final grade is from the **average of the three tests**, and
 - 25% is from the **average of the three homework assignments**.
- We'd like to write a program to use our average function to take the averages of the test and homework grades, and then weight those averages appropriately to compute a final course grade.

```
def average(a, b, c):
    avg = (a + b + c)/3
    print("The average of your numbers is", avg)

def main():
    test1 = input("Give me the first test grade: ")
    test2 = input("Give me the second test grade: ")
    test3 = input("Give me the third test grade: ")
    average(test1, test2, test3)

    hw1 = input("Give me the first HW grade: ")
    hw2 = input("Give me the second HW grade: ")
    hw3 = input("Give me the third HW grade: ")
    average(hw1, hw2, hw3)

    # some code here to weight the test average by 0.75
    # and the quiz average by 0.25 and combine them.

main()
```

```
def average(a, b, c):  
    avg = (a + b + c)/3  
    print("The average of you
```

```
def main():  
    test1 = input("Give me th  
    test2 = input("Give me th  
    test3 = input("Give me th  
    average(test1, test2, tes  
  
    hw1 = input("Give me the  
    hw2 = input("Give me the  
    hw3 = input("Give me the  
    average(hw1, hw2, hw3)
```

```
# some code here to weight the test average by 0.75  
# and the quiz average by 0.25 and combine them.
```

```
main()
```

main can't see the "avg" variable inside of average because avg is a local variable.

Furthermore, whenever we call average, a new avg variable is created and the old one is lost. Even if we could access avg from main, there's no way we could have both the homework and test avg values at the same time.

```
def average(a, b, c):  
    avg = (a + b + c)/3
```

What we want to do is:

```
final_grade = 0.75 * (avg from the first call to average) + 0.25 * (avg  
from the 2nd call)
```

```
test3 = input("Give me the third test grade: ")  
average(test1, test2, test3)
```

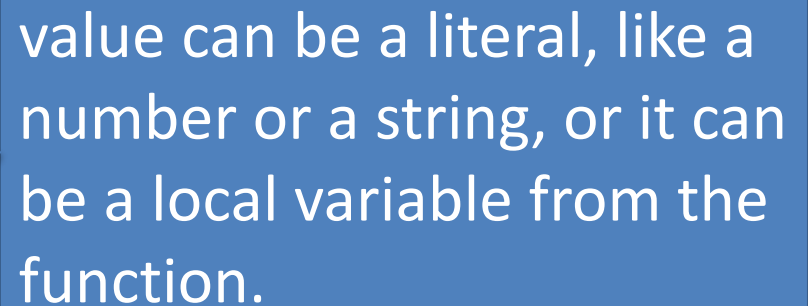
```
hw1 = input("Give me the first HW grade: ")  
hw2 = input("Give me the second HW grade: ")  
hw3 = input("Give me the third HW grade: ")  
average(hw1, hw2, hw3)
```

```
# some code here to weight the test average by 0.75  
# and the quiz average by 0.25 and combine them.
```

```
main()
```

Return values to the rescue!

```
def function(param1, param2, ...):  
    statement  
    statement  
    [ more statements if desired ]  
    return value
```



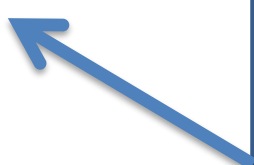
value can be a literal, like a number or a string, or it can be a local variable from the function.

Return values to the rescue!

```
def function(param1,  
            statement  
            statement  
            [ more statements if desired ]  
            return value
```

When Python sees a line in a function beginning with "return," the function immediately ends, and the value is sent back to the caller.

value can be a literal, like a number or a string, or it can be a local variable from the function.



Capturing the return value

- Use an assignment statement to "capture" the return value, otherwise it disappears!
- Syntax:

```
variable = function(arg1, arg2, ...)
```



This variable "captures" the return value from the function. The variable will be set to whatever is after the word "return" in the function definition.

When Python sees a line like this, the function is called normally. However, when the function ends with return and a value is "sent back" to the caller, the value is copied into the variable you specify.

```
def average(a, b, c):  
    avg = (a + b + c)/3  
    return avg
```

Notice average now returns the local variable avg, and the print statement is removed.

```
def main():  
    test1 = input("Give me the first test grade: ")  
    test2 = input("Give me the second test grade: ")  
    test3 = input("Give me the third test grade: ")  
    test_avg = average(test1, test2, test3)  
    print("Your test average is", test_avg)  
    hw1 = input("Give me the first HW grade: ")  
    hw2 = input("Give me the second HW grade: ")  
    hw3 = input("Give me the third HW grade: ")  
    hw_avg = average(hw1, hw2, hw3)  
    print("Your homework average is", hw_avg)  
    final_grade = 0.75 * test_avg + 0.25 * hw_avg  
    print("Your final grade is", final_grade)
```

```
main()
```

```
def average(a, b, c):  
    avg = (a + b + c) / 3  
    return avg
```

```
def main():
```

```
    test1 = input("Give me the first test grade: ")  
    test2 = input("Give me the second test grade: ")  
    test3 = input("Give me the third test grade: ")  
    test_avg = average(test1, test2, test3)  
    print("Your test average is", test_avg)  
    hw1 = input("Give me the first HW grade: ")  
    hw2 = input("Give me the second HW grade: ")  
    hw3 = input("Give me the third HW grade: ")  
    hw_avg = average(hw1, hw2, hw3)  
    print("Your homework average is", hw_avg)  
    final_grade = 0.75 * test_avg + 0.25 * hw_avg  
    print("Your final grade is", final_grade)
```

```
main()
```

main calls average: values test1, test2, and test3 are copied into a, b, and c.

```
def average(a, b, c):  
    avg = (a + b + c)/3  
    return avg
```

average returns a copy of its local variable avg back to main, and the value is assigned to test_avg.

```
def main():  
    test1 = input("Give me the first test grade: ")  
    test2 = input("Give me the second test grade: ")  
    test3 = input("Give me the third test grade: ")  
    test_avg = average(test1, test2, test3)  
    print("Your test average is", test_avg)  
    hw1 = input("Give me the first HW grade: ")  
    hw2 = input("Give me the second HW grade: ")  
    hw3 = input("Give me the third HW grade: ")  
    hw_avg = average(hw1, hw2, hw3)  
    print("Your homework average is", hw_avg)  
    final_grade = 0.75 * test_avg + 0.25 * hw_avg  
    print("Your final grade is", final_grade)
```

```
main()
```

```
def average(a, b, c):  
    avg = (a + b + c) / 3  
    return avg
```

```
def main():  
    test1 = input("Give me the first test grade: ")  
    test2 = input("Give me the second test grade: ")  
    test3 = input("Give me the third test grade: ")  
    test_avg = average(test1, test2, test3)  
    print("Your test average is", test_avg)  
    hw1 = input("Give me the first HW grade: ")  
    hw2 = input("Give me the second HW grade: ")  
    hw3 = input("Give me the third HW grade: ")  
    hw_avg = average(hw1, hw2, hw3)  
    print("Your homework average is", hw_avg)  
    final_grade = 0.75 * test_avg + 0.25 * hw_avg  
    print("Your final grade is", final_grade)
```

```
main()
```

main calls average: values hw1, hw2, and hw3 are copied into a, b, and c.

```
def average(a, b, c):  
    avg = (a + b + c)/3  
    return avg
```

average returns a copy of its local variable avg back to main, and the value is assigned to hw_avg.

```
def main():  
    test1 = input("Give me the first test grade: ")  
    test2 = input("Give me the second test grade: ")  
    test3 = input("Give me the third test grade: ")  
    test_avg = average(test1, test2, test3)  
    print("Your test average is", test_avg)  
    hw1 = input("Give me the first HW grade: ")  
    hw2 = input("Give me the second HW grade: ")  
    hw3 = input("Give me the third HW grade: ")  
    hw_avg = average(hw1, hw2, hw3)  
    print("Your homework average is", hw_avg)  
    final_grade = 0.75 * test_avg + 0.25 * hw_avg  
    print("Your final grade is", final_grade)
```

```
main()
```

- Arguments/parameters and return values make your functions more flexible.
- Imagine if the sqrt function were defined as:

```
def sqrt():  
    x = float(input("Enter number: "))  
    print("Square root is", x)
```

– Then you couldn't do something like:

```
distance = math.sqrt(x**2 + y**2)
```


- When writing functions, you should test them to make sure they work in all kinds of situations.
 - Does `average()` work with negative numbers?
Floating point numbers?
- You can write a program to do testing, by calling the function with varying arguments.
- Or, you can test your function using the Python Shell (the window where every line starts with `>>>`)

- Write a function called **salary** that takes two arguments: your *hourly wage* and your *tax bracket percent* (e.g., 0.15). This function should **return** your total income for the year, after taxes are deducted. Assume you are paid for 40 hours/week, 52 weeks/year.
 - The definition line will be **def salary(wage, bracket):**
 - Do not write a main() function. Test this from the Python shell.
- Write a function called **direction** that takes two float arguments, *x* and *y*. Consider an arrow on the Cartesian plane pointing from (0, 0) to (x, y). This function should return the string "NE", "SE", "SW", "NW" depending on the direction that the arrow points. Assume *x* and *y* will never be zero.
 - The def line will be: **def direction(x, y):**