Return vs. "Side-effects"

- A function definition has a list of parameter "inputs" and a single returned "result".

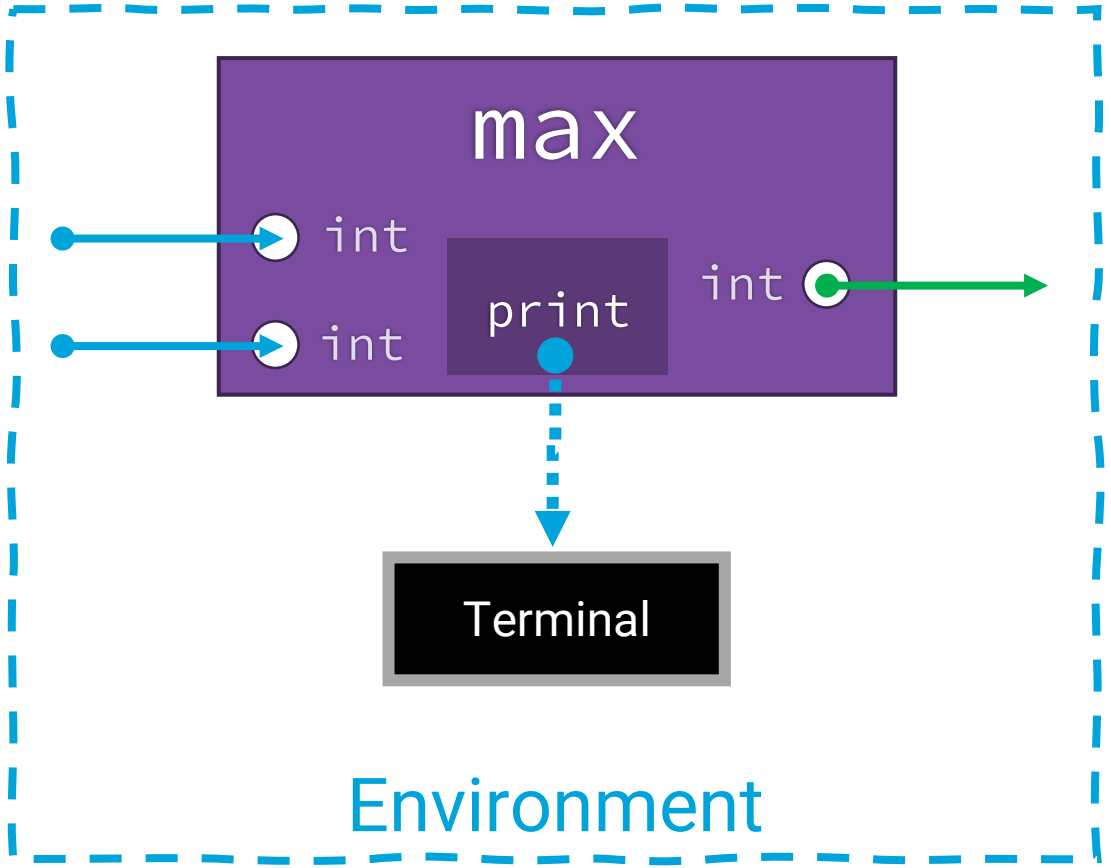
- What happens if you call ***`print`*** from within a function definition?
  - Consider the modified max function.
  - This breaks our model!

- Our *Fundamental Pattern* also has an *Environment*
  - An algorithm may have "side-effects" on its "environment"

- The terminal your program is running in is part of its environment

- When you call the built-in print function, it has a "side-effect" that produces output in the terminal

```
def max(a: int, b: int) -> int:
    """Return the largest of two numbers."""
    print(str(a) + ", " + str(b))
    if a > b:
        return a
    else:
        return b
```



Challenge Question - What the output printed to the terminal when this program runs?

```
def f(n: int) -> int:
    """A function with side-effects."""
    print(n)
    return n + 1

f(2)
x: int = f(4)
print("x: " + str(x))
```

The `return` Statement vs. Printing

- **The `return` statement** is ***for the computer*** to use as the evaluated result of the originating function call expression
  - A bookmark is dropped when you *call* a function.
    When that function's body reaches a *return statement,* the returned value is "substituted" for the function call expression and the program continues.

- **Printing *is for getting information out of the program***.
  - Typically, it is *for humans to see*.
  - To present data to the user of a program you must *output* it in some way.

- With a function that returns a value and has no other side-effects, you can print the value it returns by:
  - 1. Printing the function call expression directly, such as **`print(a_func())`**, or
  - 2. By storing its return value in a variable and later printing the variable.

Procedures are functions that return *nothing*...

- ...their whole purpose is to produce a side-effect on the environment.

- The purpose of procedures is to produce side-effects such as printing output.
  - The **print** function is a procedure!

- Use a ***return type*** of **`None`** to declare a procedure.

```
def print_repeatedly(line: str, repeats: int) -> None:
    """Print a line a specific number of repetitions."""
    i: int = 0
    while i < repeats:
        print(line)
        i = i + 1


print_repeatedly("hello", 5)
print_repeatedly("world", 5)
```