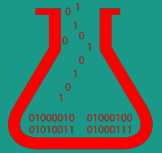
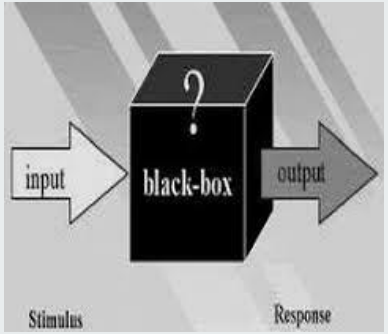
FUNCTIONS



What is a function?

- Think of a function as a machine that does a specific task
- The function ‘machine’ has a defined input and and output
- You put something known in and get something known out



What is a function?

KNOWN INPUT -> PROCESS -> EXPECTED OUTPUT

function ()

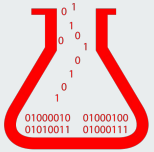
- If you put the wrong thing in what will happen?

Definition

A function is an object that:

1. Takes in pre-specified data as arguments
2. Processes the data in pre-determined way
3. Returns the data after processing

This way of programming minimizes “**unintended side effects**”



Function syntax

Terminate the function def with a ":"

Declare the function definition

```
def skill_to_expert(argument):
    """Takes the name of a skill and tells you what
    to call the expert at that skill

    USE EXAMPE : out=skill_to_expert('art')
    ARGUMENTS: string with skill name"""

    expert = argument +  'ist'

    return expert
```

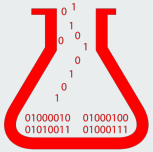
The input is processed in the body of the function

NOTE the indent of 4 spaces or one tab to delimit the body of the function

The Docstring gives information to the user and can be called with help ()

use """ triple quotes

Return specifies the output



Make the function object

- Before we execute the function it is just an object (like a book or a cell phone)
- It is just sitting in object space doing nothing!
- When we print it Python tells us its type (function) and memory address

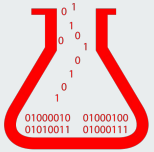
```
def skill_to_expert(argument):
    """Takes the name of a skill and outputs expert name
    USE EXAMPE : out=skill_to_expert('art')
    ARGUMENTS: string with skill name"""

    expert = argument +  'ist'
    return expert

```

```
print(skill_to_expert)
```

```
<function skill_to_expert at 0x10be41ea0>
```



Start with a working example

Since there is a good example in the documentation, we can start with that

Make sure everything is in working as expected

```
4 out=skill_to_expert('art')
5 print (out)
```

```
artist
```

Moving forward

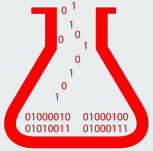
- We verified that the example works
- Try it with a different word
- Remove the variable assignment so it simply outputs to the workspace

```
7 skill_to_expert('BBQ')
8
```

```
'BBQist'
```

** NOTE the output is not bound to any variable so we can see it but then it's GONE!

This is a good way to test rapidly your function but if you want to use it again bind it to a variable like we did with "out" (on the last slide)



Functions have expected inputs

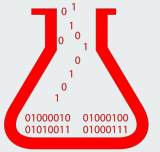
- If you send the wrong variable type into a function, Python emits an error and tells you specifically what went wrong (read it from the bottom up)
  - We'll get to errors more later!

```
   4 skill_to_expert(1)
```

```
---------------------------------------------------------------------------
TypeError                                 Traceback (most recent call last)
<ipython-input-11-2399ce3bc3fc> in <module>()
      2
      3
----> 4 skill_to_expert(1)

<ipython-input-6-ad7ada7d86cd> in skill_to_expert(argument)
      9     ARGUMENTS: string with skill name"""
     10
---> 11     expert = argument +  'ist'
     12
     13     return expert

TypeError: unsupported operand type(s) for +: 'int' and 'str'
```



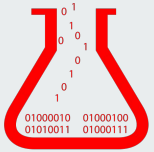
What is Functional Programming?

Functional Programming is a style of programming

- The main tenet of Functional Programming is that the programmer has complete control over what occurs in the program.

- The elimination of unintended **side effects**

- **Purity** of code
  - a pure function takes a **defined input** and returns a **defined output**



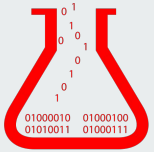
What is Functional Programming?

As shown in the example above, the function clearly does one thing:

skill_to_expert('skill') -> 'skillist'

skill_to_expert(1) -> TypeError!

- In other words, it avoids unintended side effects and does a defined job



Benefits of functional programming (discuss)

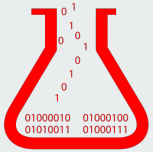
Modularity - it should be easy to remove and replace functions without affecting other code areas

Reusability - clear definition makes reuse in other context possible

Abstraction - the details of the function internals are obscured allowing the are programmer to think about higher order code processes

Scalability - clear definition of task blocks allows replication and scaling

Ease of troubleshooting - broken code can be traced to single isolated functions



Learn about the function - Docstrings matter!

- We can call the help() function:
  - Takes your function name as an argument and returns its docstring
- Hopefully there is a good doc string with a working example to get us started!

```
1 help(skill_to_expert)
```

```
Help on function skill_to_expert in module __main__:

skill_to_expert(argument)
    Takes the name of a skill and tells you what
    to call the expert at that skill

    USE EXAMPE : out=skill_to_expert('art')
    ARGUMENTS: string with skill name
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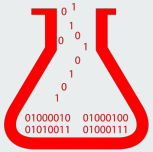
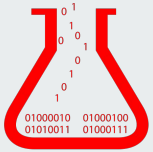


More Functions

```
1  import random
2  # random generates pseudo-random numbers from a given set
3
4  def coin_flip(tosses):
5      '''coin_flip takes an integer number of tosses
6      and outputs a list of random outcomes'''
7
8      outcome = []
9      coin = ['heads','tails']
10     for toss in range(tosses):
11         outcome.append(random.choice(coin))
12     return(outcome)
13
14 coin_flip(5)
```

What's the expected output?



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11         outcome.append(random.choice(coin))
12     return(outcome)
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14 coin_flip(5)
15
```
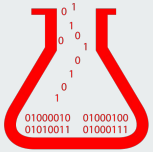
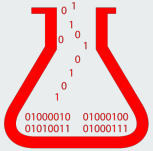

```
['tails', 'tails', 'heads', 'tails', 'heads']
```



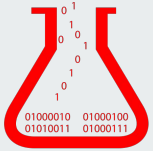
Practice Problem:

Create a function that takes in a string and returns a new string with the letters scrambled.



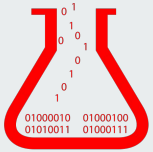
Practice Problem:

Create a function that takes in a string and returns it translated into Pig Latin



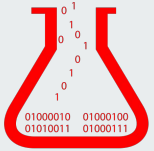
Practice Problem:

Create a function that takes in in an integer and returns the factorial of that number



Practice Problem:

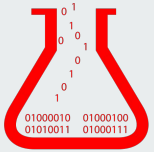
Rewrite this as a recursive function:
Create a function that takes in in an integer and returns the factorial of that number



Practice Problem:

Create a function that takes in a list of ingredients, then returns a list of meals that can be made with those ingredients.

You'll need to create a dictionary with meal: [list of ingredients] to create this.



Questions?