# Python

Control Flow

## Real power of programs comes from:

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repetition

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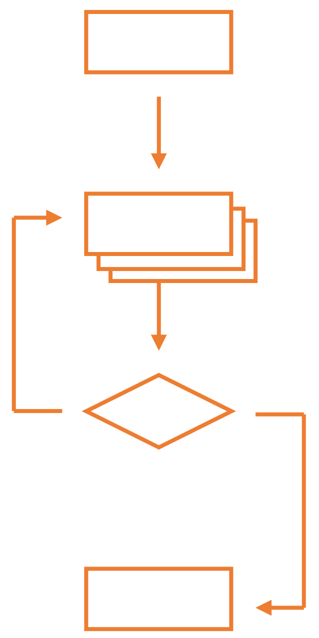
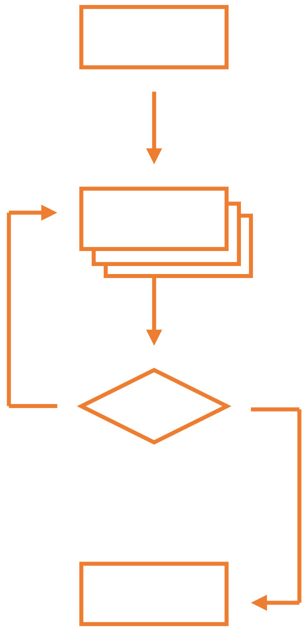


## Real power of programs comes from:

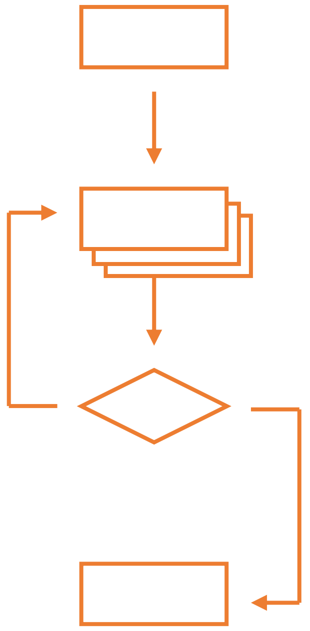
repetition

selection

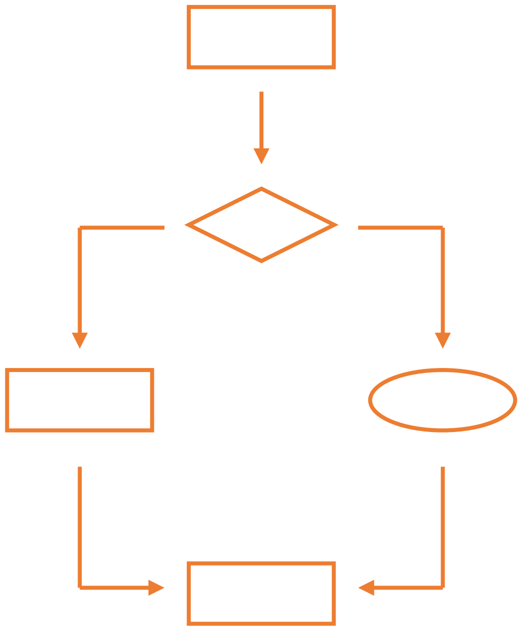


## Real power of programs comes from:

repetition



selection



## Simplest form of repetition is *while loop*

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```
num_moons = 3
while num_moons > 0:
    print(num_moons)
    num_moons -= 1
```

## Simplest form of repetition is *while loop*

```
num_moons = 3
while num_moons > 0:     ← test
    print(num_moons)
    num_moons -= 1
```

## Simplest form of repetition is *while loop*

```
num_moons = 3
while num_moons > 0:
    print(num_moons)
    num_moons -= 1
```

$\leftarrow$ do

## Simplest form of repetition is *while loop*

```
num_moons = 3
while num_moons > 0:
    print(num_moons)
    num_moons -= 1
3
```

do

## Simplest form of repetition is *while loop*

```
num_moons = 3
while num_moons > 0:        ← test again
    print(num_moons)
    num_moons -= 1
3
```

## Simplest form of repetition is *while loop*

```
num_moons = 3
while num_moons > 0:
    print(num_moons)
    num_moons -= 1
3
2
```

## Simplest form of repetition is *while loop*

```
num_moons = 3
while num_moons > 0:
    print(num_moons)
    num_moons -= 1
3
2
1
```

## While loop may execute zero times

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```
print('before')
num_moons = -3
while num_moons > 0:
    print(num_moons)
    num_moons -= 1
print('after')
```

## While loop may execute zero times

```
print('before')
num_moons = -3
while num_moons > 0:
    print(num_moons)
    num_moons -= 1
print('after')
```

$\leftarrow$ not true when first tested…

## While loop may execute zero times

```
print('before')
num_moons = -3
while num_moons > 0:
    print(num_moons)
    num_moons -= 1
print('after')
```

$\xleftarrow{}$ …so this is never executed

## While loop may execute zero times

```
print('before')
num_moons = -3
while num_moons > 0:
    print(num_moons)
    num_moons -= 1
print('after')
before
after
```

## While loop may execute zero times

```
print('before')
num_moons = -3
while num_moons > 0:
    print(num_moons)
    num_moons -= 1
print('after')
```

```
before
after
```

Important to consider this case when designing and testing code

## While loop may also execute forever

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```
print('before')
num_moons = 3
while num_moons > 0:
    print(num_moons)
print('after')
```

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before
```

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while num_moons > 0:
    print(num_moons)
print('after')
```

```
before
3
```

## While loop may also execute forever

```
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num_moons = 3
while num_moons > 0:
    print(num_moons)
print('after')
```

```
before
3
3
```

## While loop may also execute forever

```
print('before')
num_moons = 3
while num_moons > 0:
    print(num_moons)
print('after')
before
3
3
3
```

## While loop may also execute forever

```
print('before')
num_moons = 3
while num_moons > 0:
    print(num_moons)
print('after')
```

```
before
3
3
3
⋮
```

## While loop may also execute forever

```
print('before')
num_moons = 3
while num_moons > 0:
    print(num_moons)
print('after')
before
3
3
3
⋮
```

Nothing in here changes

the loop control condition

## While loop may also execute forever

```
print('before')
num_moons = 3
while num_moons > 0:
    print(num_moons)
print('after')
before
3
3
3
⋮
```

Usually not the desired behavior…

## While loop may also execute forever

```
print('before')
num_moons = 3
while num_moons > 0:
    print(num_moons)
print('after')
before
3
3
3
⋮
```

Usually not the desired behavior…

…but there *are* cases where it's useful

## Why indentation?

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Studies show that's what people actually pay attention to

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Python Style Guide (PEP 8) recommends 4 spaces

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- Every textbook on C or Java has examples where indentation and braces don't match

Doesn't matter how much you use, but whole block must be consistent

Python Style Guide (PEP 8) recommends 4 spaces

And no tab characters

## Side note on IDEs (Integrated Development Environments)

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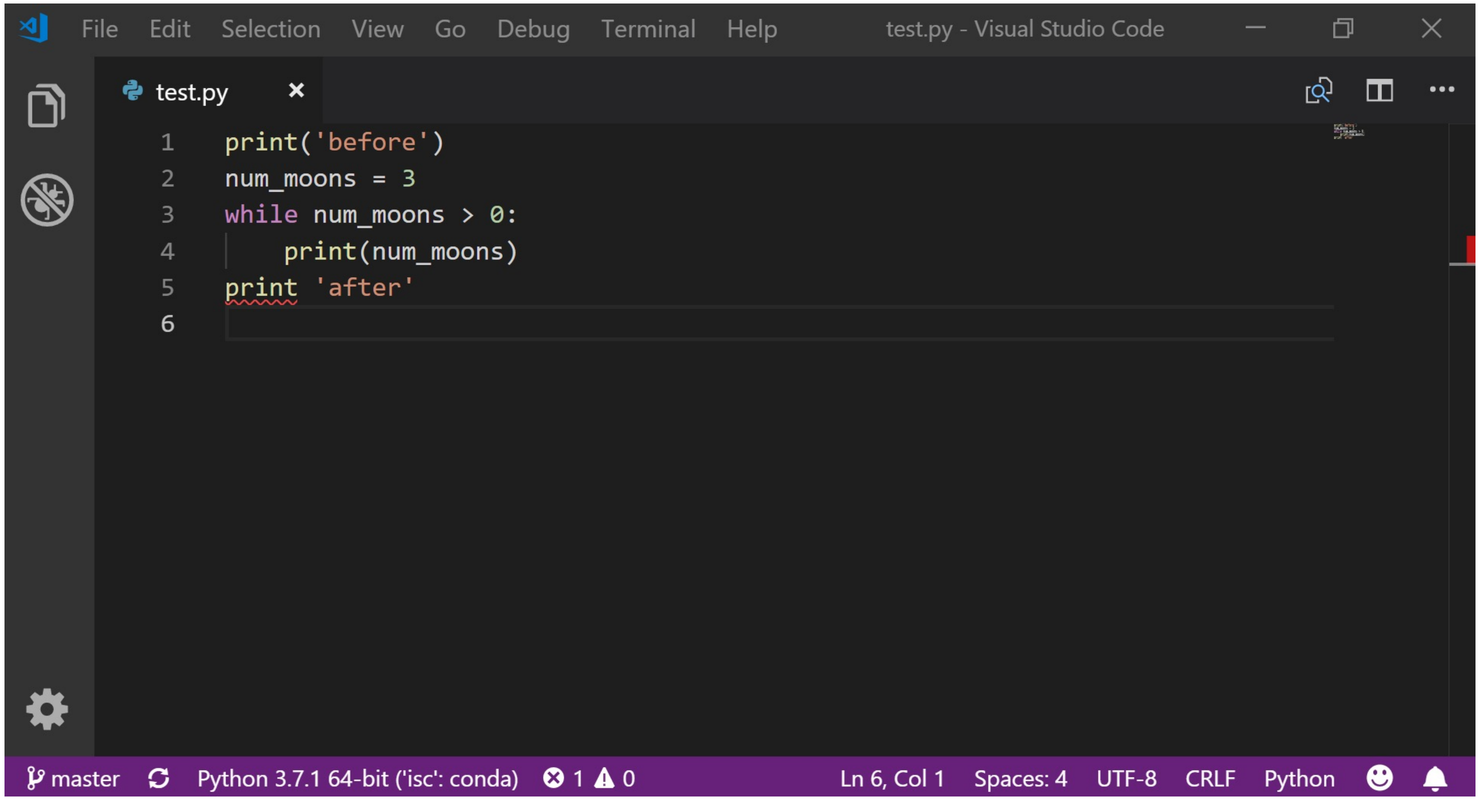
An IDE is a nicer place to write, edit and run code from all in one. Most often also include syntax highlighting, error highlighting and debugging built in (debugging will be taught later in the course).


File Edit Selection View Go Debug Terminal Help
test.py - Visual Studio Code
test.py

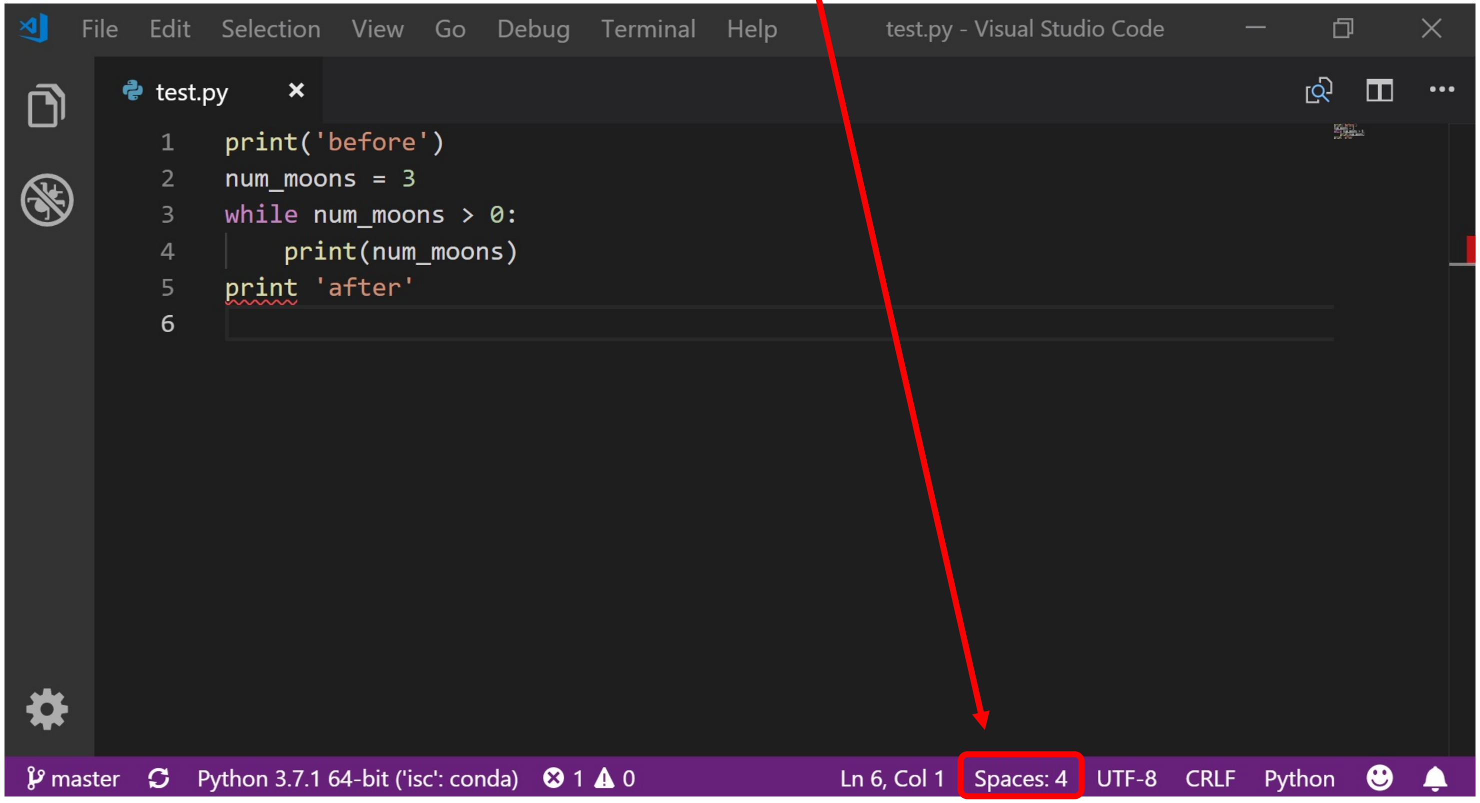
```
print('before')
num_moons = 3
while num_moons > 0:
    print(num_moons)
print 'after'

```

master
Python 3.7.1 64-bit ('isc': conda)
1 0
Ln 6, Col 1 Spaces: 4 UTF-8 CRLF Python

## Side note on IDEs (Integrated Development Environments)

Most IDEs will also let you choose your indentation too, so you don't have to manually type 4 spaces...



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print('before')
num_moons = 3
while num_moons > 0:
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print 'after'
```

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## Use `if`, `elif`, and `else` to make choices

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```
moons = 3
if moons < 0:
    print('less')
elif moons == 0:
    print('equal')
else:
    print('greater')
```

## Use `if`, `elif`, and `else` to make choices

```
moons = 3
if moons < 0:
    print('less')
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← not true when first tested...

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```
moons = 3
if moons < 0:
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    print('equal')
else:
    print('greater')
```

← ...so this is *not* executed

## Use `if`, `elif`, and `else` to make choices

```
moons = 3
if moons < 0:
    print('less')
elif moons == 0:
    print('equal')
else:
    print('greater')
```

← this isn't true either...

## Use `if`, `elif`, and `else` to make choices

```
moons = 3
if moons < 0:
    print('less')
elif moons == 0:
    print('equal')  ← ...so this isn't executed
else:
    print('greater')
```

## Use `if`, `elif`, and `else` to make choices

```
moons = 3
if moons < 0:
    print('less')
elif moons == 0:
    print('equal')
else:
    print('greater')
```

$\longleftarrow$ nothing else has executed...

## Use `if`, `elif`, and `else` to make choices

```
moons = 3
if moons < 0:
    print('less')
elif moons == 0:
    print('equal')
else:
    print('greater')
```

← ...so this *is* executed

## Use `if`, `elif`, and `else` to make choices

```
moons = 3
if moons < 0:
    print('less')
elif moons == 0:
    print('equal')
else:
    print('greater')
greater
```

## Use `if`, `elif`, and `else` to make choices

```
moons = 3
if moons < 0:
    print('less')
elif moons == 0:
    print('equal')
else:
    print('greater')
greater
```

Always start with **`if`**

## Use `if`, `elif`, and `else` to make choices

```
moons = 3
if moons < 0:
    print('less')
elif moons == 0:
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greater
```

Always start with **`if`**

Can have any number of **`elif`** clauses (including none)

## Use `if`, `elif`, and `else` to make choices

```
moons = 3
if moons < 0:
    print('less')
elif moons == 0:
    print('equal')
else:
    print('greater')
greater
```

Always start with **`if`**

Can have any number of **`elif`** clauses (including none)

And the **`else`** clause is optional

## Use `if`, `elif`, and `else` to make choices

```
moons = 3
if moons < 0:
    print('less')
elif moons == 0:
    print('equal')
else:
    print('greater')
greater
```

Always start with **`if`**

Can have any number of **`elif`** clauses (including none)

And the **`else`** clause is optional

Always tested in order

## Blocks may contain blocks

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```
num = 0
while num <= 10:
    if (num % 2) == 1:
        print(num)
    num += 1
```

## Blocks may contain blocks

```
num = 0
while num <= 10:
    if (num % 2) == 1:
        print(num)
    num += 1
```

Count from 0 to 10

## Blocks may contain blocks

```
num = 0
while num <= 10:
    if (num % 2) == 1:
        print(num)
    num += 1
```

$\leftarrow$ Print odd numbers

## Blocks may contain blocks

```
num = 0
while num <= 10:
    if (num % 2) == 1:
        print(num)
    num += 1
1
3
5
7
9
```

## A better way to do it

## A better way to do it

```
num = 1
while num <= 10:
    print(num)
    num += 2
```

## A better way to do it

```
num = 1
while num <= 10:
    print(num)
    num += 2
1
3
5
7
9
```

## More ways to control flow while inside a loop:

`break`, `continue`, `pass`

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`break`, `continue`, `pass`

e.g. Print the first multiple of a given value

## `break, continue, pass`

e.g. Print the first multiple of a given value

```
value = 14
trial = 2
while trial < value:
    if value % trial == 0:
        print(trial)
        break
    trial += 1
```

```
2
```

## break, continue, pass

e.g. Print the first odd multiple of a given value

```
value = 14
trial = 2
while trial < value:
    if trial % 2 == 0:
        trial += 1
        continue
    if value % trial == 0:
        print(trial)
        break
    trial += 1
```

```
7
```

## `break, continue, pass`

If you get to a point in your logic where you want to specifically do nothing, you can use `pass`

```
value = 14
trial = 2
while trial < value:
    if trial % 2 == 0:
        pass
    if value % trial == 0:
        print(trial)
        break
    trial += 1
```

```
2
```

# Python

Common operators: `and`, `not` and `or`

## Testing expressions

You may want to create a more complex expression when testing using `if` or `while`.

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```
age = 23
name = "Jemma"
height = 1.63
```

$\leftarrow$ Some variables

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You may want to create a more complex expression when testing using `if` or `while`.

```
age = 23
name = "Jemma"
height = 1.63
```

$\leftarrow$ Some variables

What if we want someone with all of these qualities?
What if we want someone who is some of these qualities?

## Introducing the `and`, `not` and `or` operators

You may want to create a more complex expression when testing using `if` or `while`.

```
age = 23
name = "Jemma"
height = 1.63
if age == 23:
    print("Correct age")
if name == "Jemma":
    print("Correct name")
if height == 1.63:
    print("Correct height")
```

## Introducing the `and`, `not` and `or` operators

You may want to create a more complex expression when testing using `if` or `while`.

```
age = 23
name = "Jemma"
height = 1.63
if age == 23:
    print("Correct age")
if name == "Jemma":
    print("Correct name")
if height == 1.63:
    print("Correct height")
```

Could perform 3 tests to make sure the 3 variables are correct

This seems inefficient

## Using and

Block executes only if both expressions return True

```
age = 23
name = "Jemma"
height = 1.63
if name == "Jemma" and age == 23:
   print("It is Jemma!")
It is Jemma!
```

## Using `and`

`and` can be chained more than once too:

```
age = 23
name = "Jemma"
height = 1.63
if name == "Jemma" and age >= 20 and height < 2:
   print("It is like Jemma!")
It is like Jemma!
```

## Using `not`

`not` will reverse the Boolean result of an expression, we can use it to make blocks that execute only if the expression returns `False` or `None`

```
age = 22
name = "Rachel"
height = 1.65
if not name == "Jemma":
    print("It isn't Jemma!")
It isn't Jemma!
```

## Using `not`

Can be used to see if variable not in a collection:

```
x = 25
if x not in [1, 2, 3]:
    print("Didn't find x in list")
Didn't find x in list
```

Can be used to reverse Boolean logic:

```
if not x == 100:
    print("x is not 100")
x is not 100
```

## Using `or`

`or` will return `True` if either or both expressions are `True`:

```
greeting = "Hello"
if greeting == "Hi" or greeting == "Hello":
    print("Good day")
Good day
```

Can be chained more than once:

```
x = 25
if x < 0 or x > 100 or x == 25:
    print("x is correct")
x is correct
```

## Chaining all of these operators

All of these operators can be chained together to create more complex expressions:

```
start = False
end = 55
status = "STARTED"
if status == "STARTED" and (start is not False or end > 0):
    print("Running")
Running
```

You might need brackets (as above) to specify the precedence of evaluation of expressions.

created by

Greg Wilson

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