Science & Technology Facilities Council | UK Research and Innovation | NERC SCIENCE OF THE ENVIRONMENT

Python

Control Flow

Centre for Environmental Data Analysis
SCIENCE AND TECHNOLOGY FACILITIES COUNCIL
NATURAL ENVIRONMENT RESEARCH COUNCIL

software carpentry

National Centre for Atmospheric Science
NATURAL ENVIRONMENT RESEARCH COUNCIL

National Centre for Earth Observation
NATURAL ENVIRONMENT RESEARCH COUNCIL

Real power of programs comes from:

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repetition

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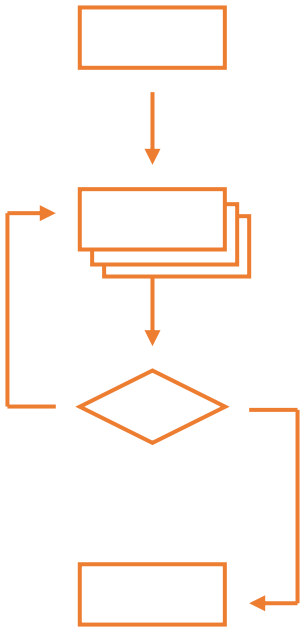
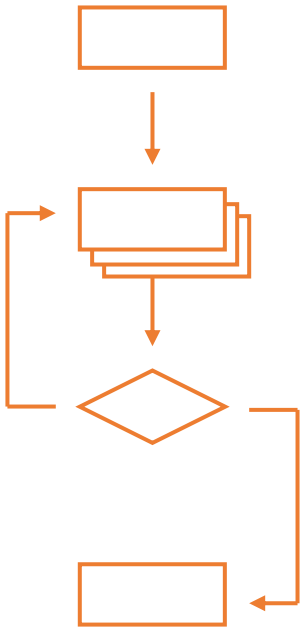


Real power of programs comes from:

repetition

selection



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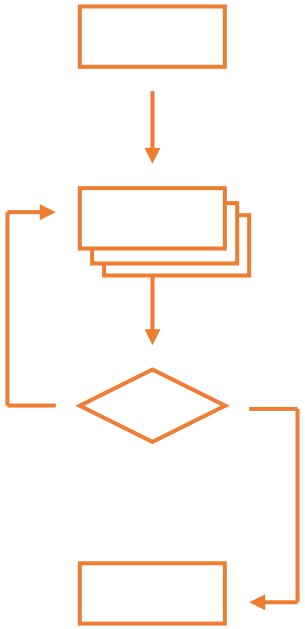
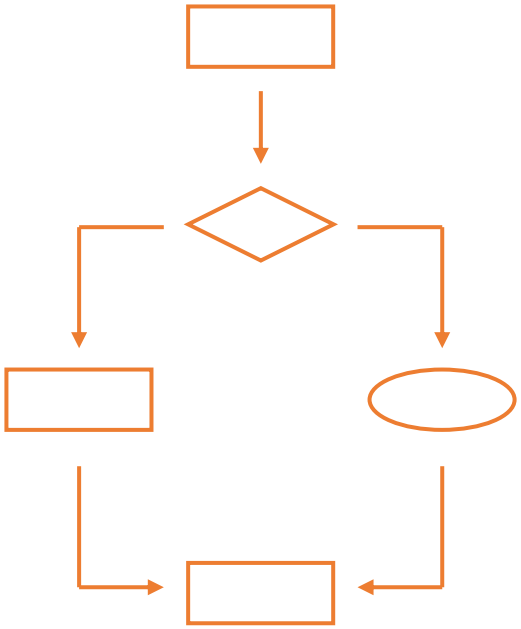


selection



Simplest form of repetition is *while loop*

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

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test

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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:
    print(num_moons)
    num_moons -= 1
```

← test again

```
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

While loop may execute zero times

```
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:
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    num_moons -= 1
print('after')
```

← 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')
```

…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

While loop may also execute forever

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

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

While loop may also execute forever

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

```
before
3
3
3
⋮
```

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

```
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)
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```

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

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Python Style Guide (PEP 8) recommends 4 spaces

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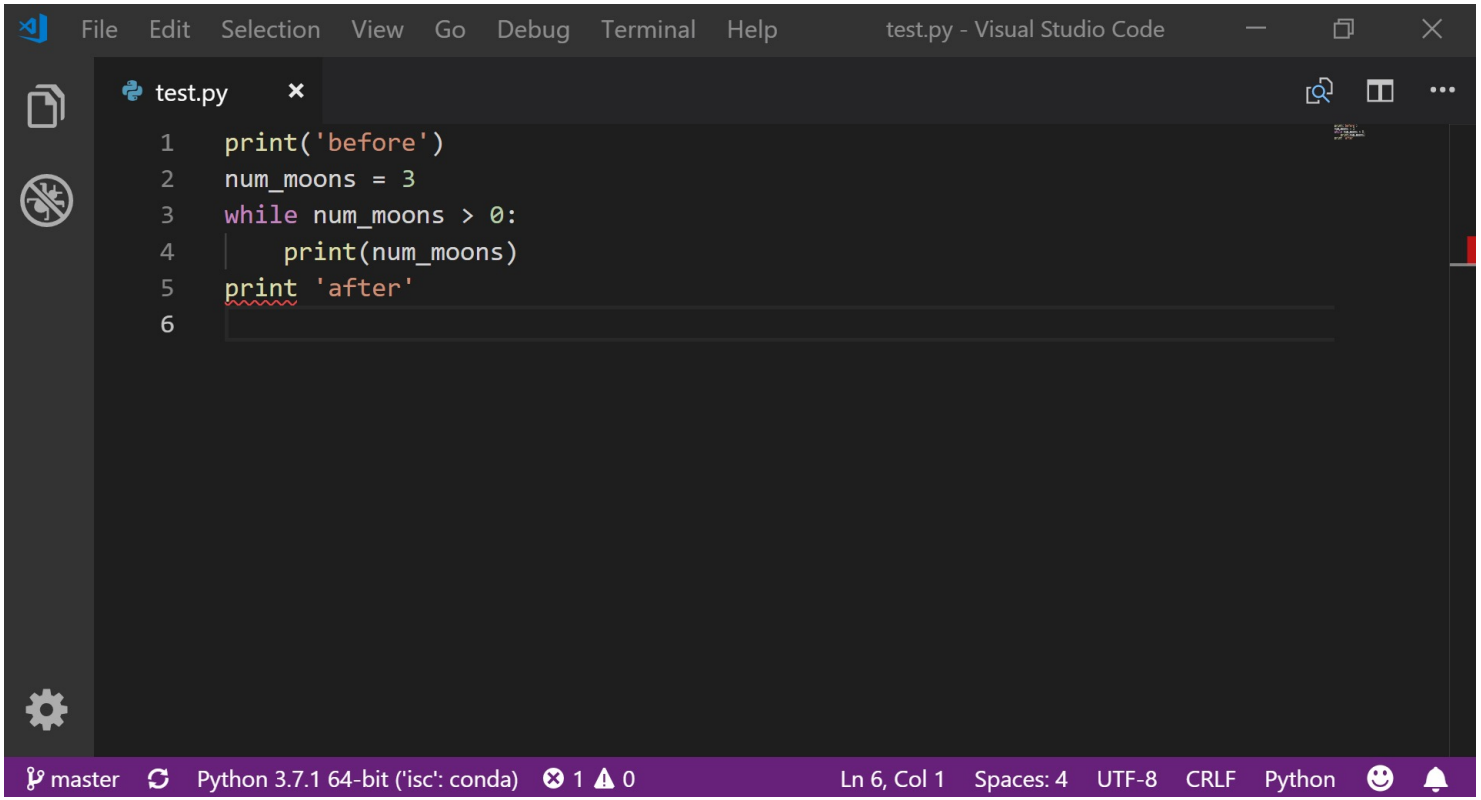
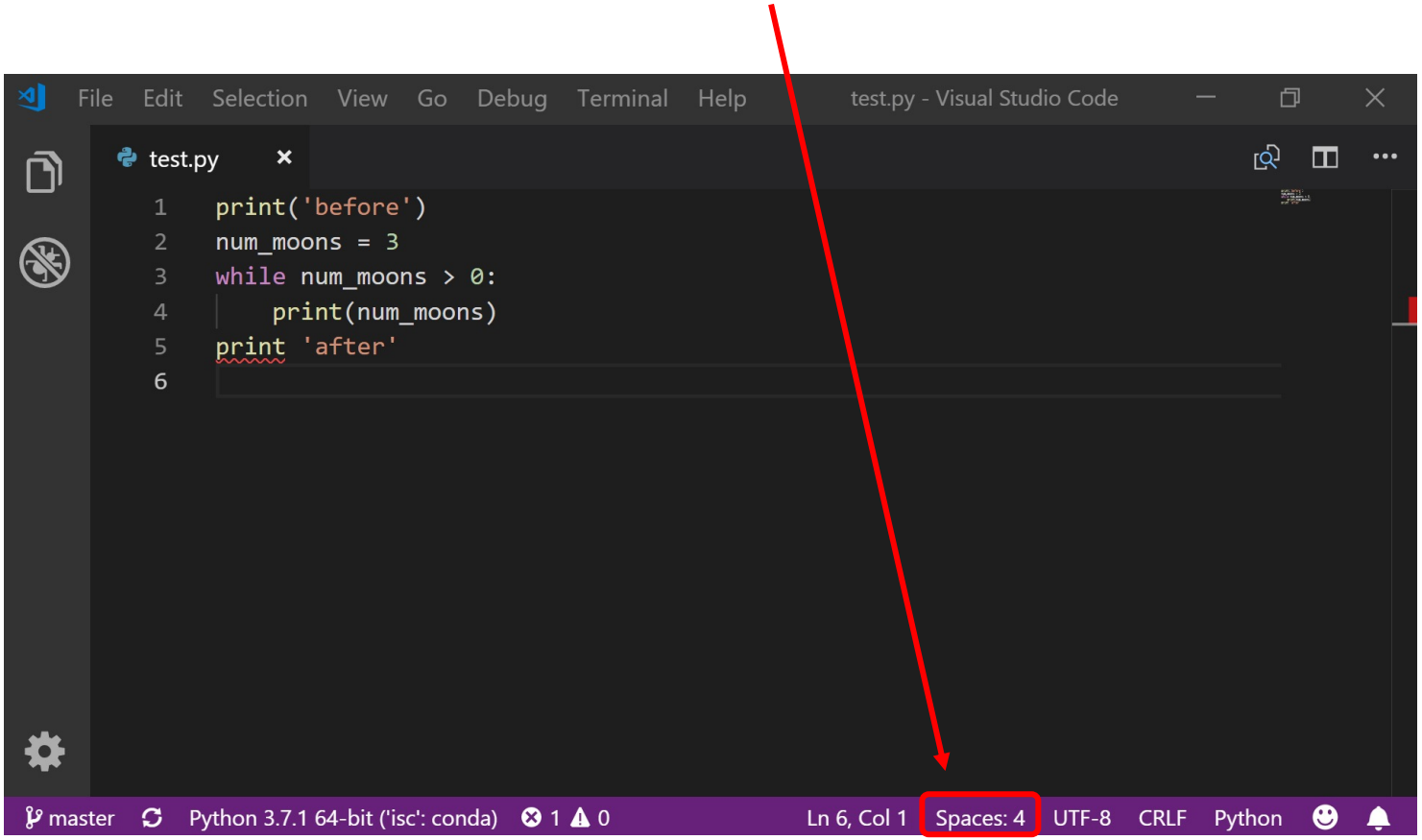
An IDE is a nicer place to write, edit and run code from all in one. Most often also include syntax highlighting, error highlighting and debugging built in (debugging will be taught later in the course).



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…



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

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moons = 3
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← not true when first tested…

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...so this is *not* executed

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moons = 3
if moons < 0:
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```

← this isn't true either...

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

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moons = 3
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```

...so this isn't executed

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

```
moons = 3
if moons < 0:
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```

← nothing else has executed…

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moons = 3
if moons < 0:
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```


...so this *is* executed

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

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moons = 3
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```

```
greater
```

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moons = 3
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```
greater
```

Always start with **`if`**

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```
greater
```

Always start with **`if`**

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

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```
moons = 3
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```
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:
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```

```
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
```

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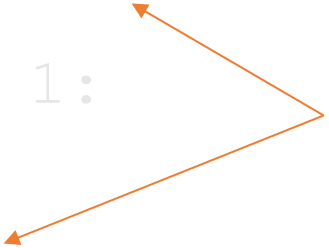

Count from 0 to 10

Blocks may contain blocks

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

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
```

created by

Greg Wilson

September 2010