Welcome to the labs!

Cryptography!

Thank you to our Sponsors!

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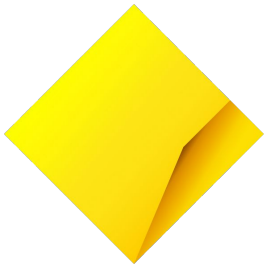


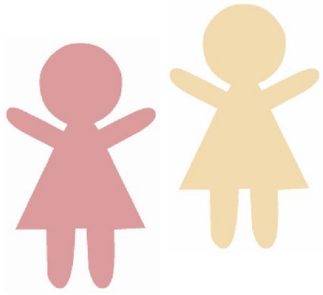
Commonwealth Bank

Who are the tutors?

Who are you?

Two Truths and a Lie

1. Get in a group of 3-5 people
2. Tell them three things about yourself:
   a. Two of these things should be true
   b. One of these things should be a lie!
3. The other group members have to guess which is the lie



Log on

Log on and jump on the GPN website

girlsprogramming.network/workshop

You can see:

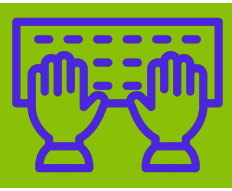
- These **slides** (to take a look back on or go on ahead).
- A link to the EdStem course
- Helpful bits of text you can **copy and paste**!

Tell us you're here!

Click on the
Start of Day Survey
and fill it in now!

Introduction to Edstem

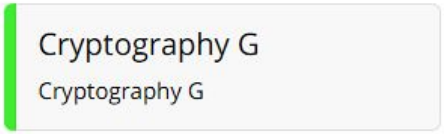
Signing up to Edstem



We are shifting all our courses to a new website called “Edstem” so here’s an overview of how to sign up and how to use it.

First let’s go through how to create an account.

1. Follow this link: https://edstem.org/au/join/qKyppB
2. Type in your name and your personal email address
3. Click Create Account
4. Go to your email to verify your account
5. Create a password
6. It should then take you to the courses home page.
7. Click on the one we will be using for this project: →



If you don’t have access to your email account, ask a tutor for a GPN edStem login

Getting to the lessons

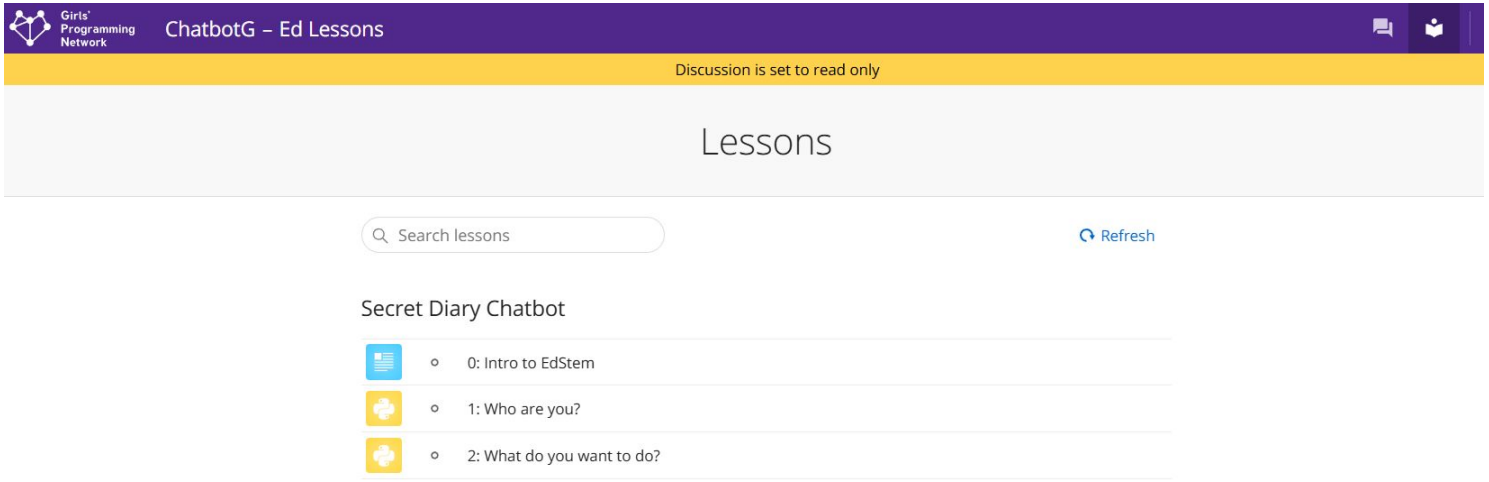
1. Once you are in the course, you'll be taken to a discussion page.
2. Click the button for the lessons page (top right - looks like a book)

The set up of the workbook

The main page:

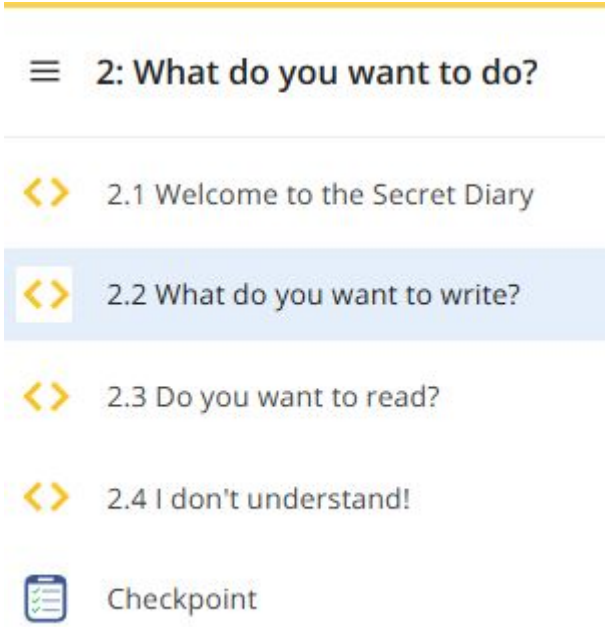
- Heading at the top that tells you the project you are in
- List of “Chapters” - They have an icon that looks like this:

- To complete your project, work through the chapters one at a time



Inside a Chapter

Inside a chapter there are two main types of pages:



1. **Lessons** - where you will do your coding.
   They have this icon: 

2. **Checkpoints**  Checkpoint

   Each chapter has a checkpoint to complete to move to the next chapter. Make sure you scroll down to see all the questions in a checkpoint.

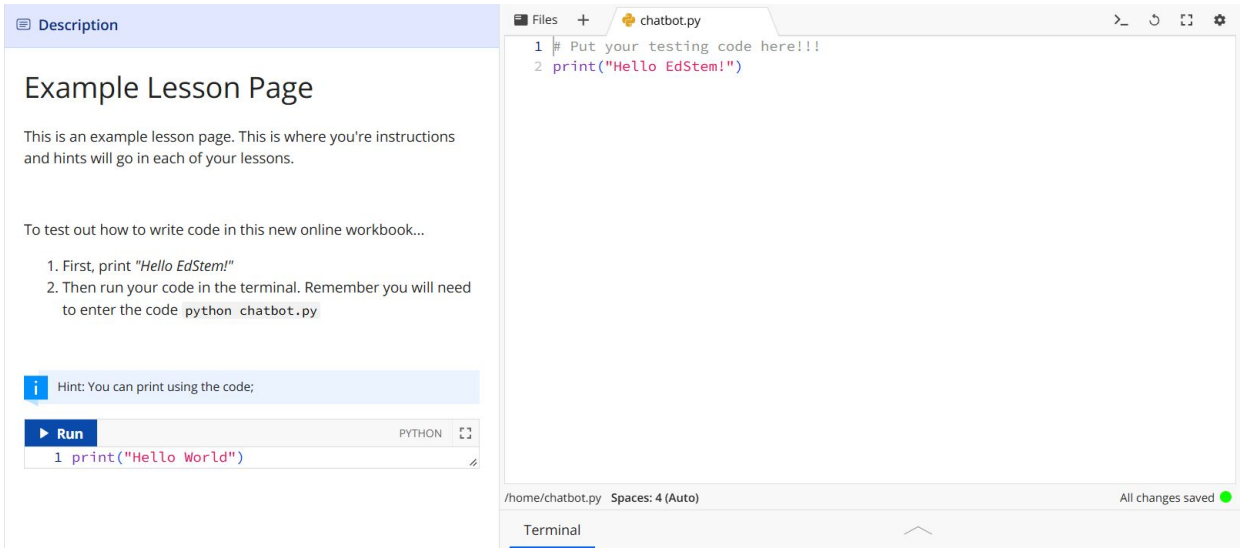
How to do the work

In each lesson there is:

1. A section on the left with instructions
2. A section on the right for your code

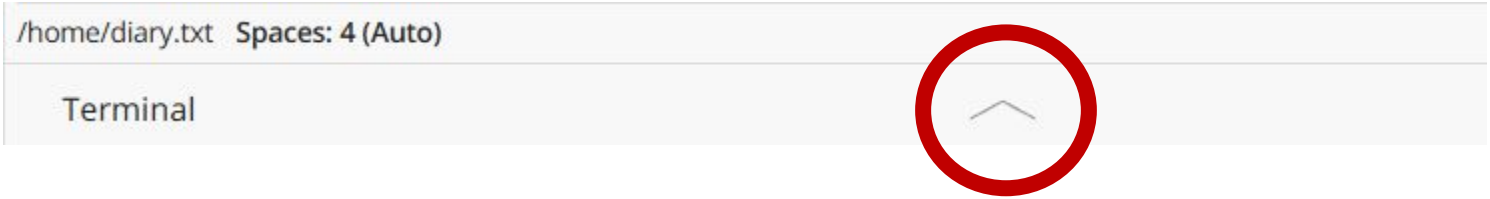
You will need to **copy your code from the last lesson**, then follow the instructions to change your code

There are also Hints and Code Blocks to help you



Running your code...

1. Open the Terminal window below your code



2. Click button that says “Click here to activate the terminal”.

3. Your code should run automatically.
4. Click the button again to rerun your code.
5. You can resize the Terminal window.

Don’t worry if you forget. Tutors will help!

Some shortcuts...

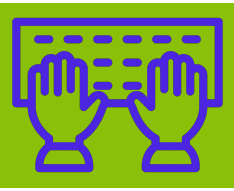
There are a couple things you can do to make copying your code from one page to another easier.

1) **Ctrl + A** Pressing these keys together will select all the text on a page

2) **Ctrl + C** Pressing these keys together will copy anything that's selected

3) **Ctrl + V** Pressing these keys together will paste anything you've copied

Need help with EdStem?

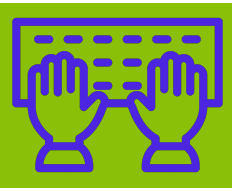


There is a section at the top of your workbook that explains how to use EdStem if you get stuck and need a reminder!

It's called 0: Intro to EdStem

Go to Part 0 and have a look!

Project time!



You now know all about EdStem!

You should now sign up and join our EdStem class. You should also have a look at part 0 of your workbook

Remember the tutors will be around to help!

Intro to Caesar Ciphers

Let’s get encrypting!

What is a cipher?

A cipher is a way to write a message so that no one else can read it!

Unless they know the secret key!

Examples of ciphers

If you've ever made up your own secret language or made notes to your friends so that other people can't read them, you've made a cipher!

For example:

gnidoc evol i

Can you figure out what this says?

Examples of ciphers

If you've ever made up your own secret language or made notes to your friends so that other people can't read them, you've made a cipher!

For example:

gnidoc evol i

Can you figure out what this says?

It says **I love coding** backwards!

Caesar Cipher

So what's a Caesar Cipher?

It's a cypher that Julius Caesar used in ancient Rome to send secret messages to his armies!

Let's learn how it works!

Make a Cipher Wheel

- Cut out green circle
- Cut out purple circle
- Put small circle on top of big circle matching centres
- Secure together with centre split pin
- Spin inside circle of letters around

Caesar Cipher Wheel template in Workshop Material folder

Shifting letters

A Caesar Cipher works by shifting letters in the alphabet so that they line up with new letters.

For example if we were to shift everything by 3 it would look like this:

a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z
d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z	a	b	c

Line up the ‘a’ on both wheels and then turn the inside wheel 3 letters **anti-clockwise** so that you have your letters lining up like this!

Encrypting

Now, let's encrypt **I love coding** using the wheel

For our Caesar Cipher we take each letter and replace it with the 'shifted' letter

So, let's start with the letter 'i'

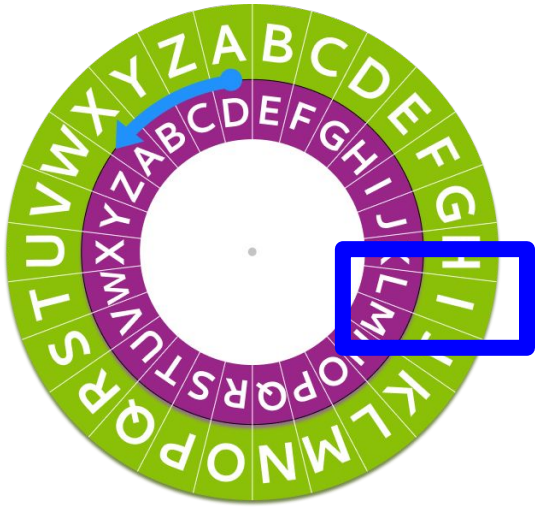
What new letter should we use to replace it?

>>> *Find letter i on the **outside** wheel and replace it with it's matching letter on the **inside** wheel* = the letter 'l'

Encrypting

Now, let's encrypt **I love coding** using the wheel

For our Caesar Cipher we take each letter and replace it with the 'shifted' letter



So, let's start with the letter 'i'

What new letter should we use to replace it?

>>> *Find letter i on the **outside** wheel and replace it with it's matching letter on the **inside** wheel* = the letter 'l'

Writing the whole message!

Let's do the rest of the message together

I love coding

I	Is replaced with	
o	Is replaced with	
v	Is replaced with	
e	Is replaced with	
c	Is replaced with	
o	Is replaced with	
d	Is replaced with	
i	Is replaced with	
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g	Is replaced with	

Writing the whole message!

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Writing the whole message!

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d	Is replaced with	g
i	Is replaced with	l
n	Is replaced with	q
g	Is replaced with	j

Secret Message

So our secret encrypted message is

L oryh frglqj

That's a lot harder to figure out than it just being backwards!

Encrypt your own name!

Using a key of minus 1 (so A=Z) (Jessica = Idrrhbz)

Write your name on the blank tag in name badge!

Decrypting

Writing secret messages isn't any fun if you can't figure out what they say!

Luckily you can also use your cipher wheel to *decrypt* a secret message.

How do you think we can do that?

What information do we need to know in order to decrypt a secret message?

It’s the key!

To decrypt a secret message **we need to know** the amount that we shifted the wheel when we encrypted it. That number is called **the key**!

Once we know the key we can just turn our wheel and read the wheel from the inside out!

*Find the letter on the **inside** wheel and replace it with it’s matching letter on the **outside** wheel*

Let’s check it works!

l	Is replaced with	
o	Is replaced with	
r	Is replaced with	
y	Is replaced with	
h	Is replaced with	
f	Is replaced with	
r	Is replaced with	
g	Is replaced with	
l	Is replaced with	
q	Is replaced with	
j	Is replaced with	

Let’s check it works!

l	Is replaced with	i
o	Is replaced with	
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q	Is replaced with	
j	Is replaced with	

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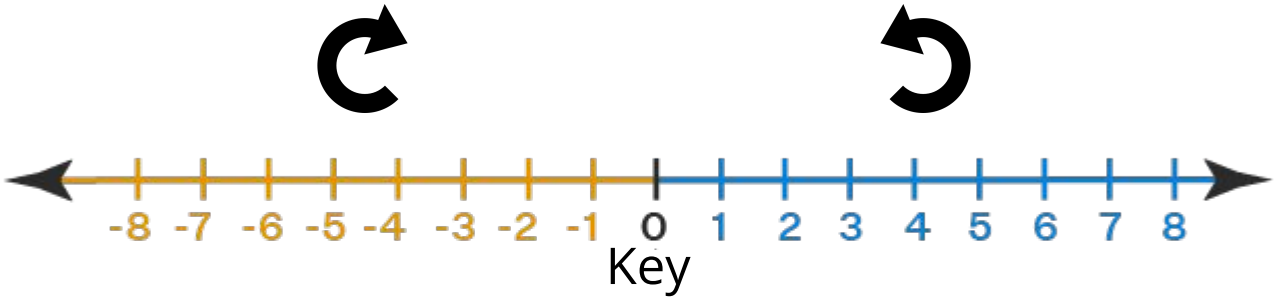
f	Is replaced with	c
r	Is replaced with	o
g	Is replaced with	d
l	Is replaced with	i
q	Is replaced with	n
j	Is replaced with	g

Another way to decrypt

- Another way to decrypt a message is to change the key value to become the negative of the encryption key value
- We will use this method in our code
- This is because to decrypt a message we need to shift the alphabet the opposite way.
- A negative key value means you turn your inner purple wheel to the right (clockwise)



Your Turn!

Try doing Lesson 1
using your Caesar Cipher wheels!

Your tutors are here to help you if you get stuck

Strings, Ints & Modulo

Strings!

Strings are a sequence of characters in python.

Strings are created by enclosing characters inside `"quotes"`

`>>> alphabet = 'abcdefghijklmnopqrstuvwxyz'` creates a string variable that contains the letters of the alphabet

We can add strings together

```
>>> "abc" + “def” = “abcdef”
```

Strings

We can get individual letters from a string using indexes.

```
>>> yum = "chocolate"
>>> yum[0]

>>> yum[5]

>>> yum[-1]

>>> yum[500]
```

Strings

We can get individual letters from a string using indexes.

```
>>> yum = "chocolate"
>>> yum[0]
'c'
>>> yum[5]


>>> yum[-1]


>>> yum[500]
```

Computers start counting from 0, not 1!

Strings

We can get individual letters from a string using indexes.

```
>>> yum = "chocolate"
>>> yum[0]
'c'
>>> yum[5]
'l'
>>> yum[-1]

>>> yum[500]
```

Computers start counting from 0, not 1!

Strings

We can get individual letters from a string using indexes.

```
>>> yum = "chocolate"
>>> yum[0]
'c'
>>> yum[5]
'l'
>>> yum[-1]
'e'
>>> yum[500]
```

Computers start counting from 0, not 1!

Strings

We can get individual letters from a string using indexes.

```
>>> yum = "chocolate"
>>> yum[0]
'c'
>>> yum[5]
'l'
>>> yum[-1]
'e'
>>> yum[500]
IndexError: string index out of range
```

Computers start counting from 0, not 1!

Searching Strings

If we want to find where a letter is in a string, we look it up using `index()`

```
>>> yum = "chocolate"
>>> yum.index('h')


>>> yum.index('o')


>>> yum.index('z')
```

Searching Strings

If we want to find where a letter is in a string, we look it up using `index()`

```
>>> yum = "chocolate"
>>> yum.index('h')
1
>>> yum.index('o')

>>> yum.index('z')
```

Searching Strings

If we want to find where a letter is in a string, we look it up using `index()`

```
>>> yum = "chocolate"
>>> yum.index('h')
1
>>> yum.index('o')
2
>>> yum.index('z')
```

Only the index of the first 'o' is returned!

Searching Strings

If we want to find where a letter is in a string, we look it up using `index()`

```
>>> yum = "chocolate"
>>> yum.index('h')
1
>>> yum.index('o')
2
>>> yum.index('z')
ValueError: substring not found
```

Only the index of the first 'o' is returned!

Test if character in string

We can test if a character is in a string!

```
>>> yum = "chocolate"
>>> if ‘a’ in yum:
```

Maths on Indexes!

We can use any sort of **int** as an index, including the result of an expression or maths equation!

```
>>> yum = "chocolate"
>>> len(yum)


>>> yum[9 - 1]
```

Maths on Indexes!

We can use any sort of **int** as an index, including the result of an expression or maths equation!

```
>>> yum = "chocolate"
>>> len(yum)
9
>>> yum[9 - 1]
```

Maths on Indexes!

We can use any sort of **int** as an index, including the result of an expression or maths equation!

```
>>> yum = "chocolate"
>>> len(yum)
9
>>> yum[9 - 1]
'e'
```

Modulo %

Modulo **%** is a maths operation

% gives the **remainder** of a division

You'll need to use it in your code!

- 10 % 8 = 2 (10 divided by 8 is 1 with remainder 2)
- 20 % 7 = 6 (20 divided by 7 is 2 with remainder 6)
- 5 % 6 = 5 (5 divided by 6 is 0 with remainder 5)

Project time!

You now know all about strings, ints and modulo!

Let's put what we learnt into our project

Try Lesson 3

The tutors will be around to help!

For Loops

For Loops

For loops allow you to do something a certain number of times.

We use them when we know exactly how many times we want to do something!

For Loops

```
number = 10
for i in range(number):
    #Do something
```

For Loops

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number = 10
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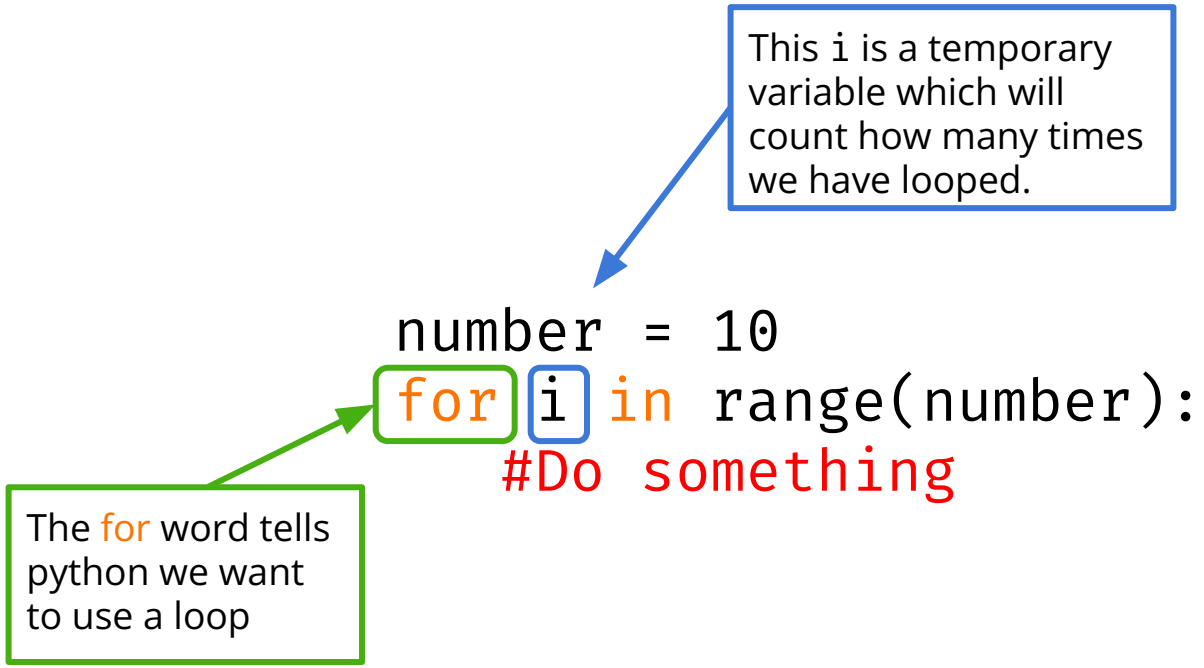
The for word tells python we want to use a loop

For Loops


This i is a temporary variable which will count how many times we have looped.
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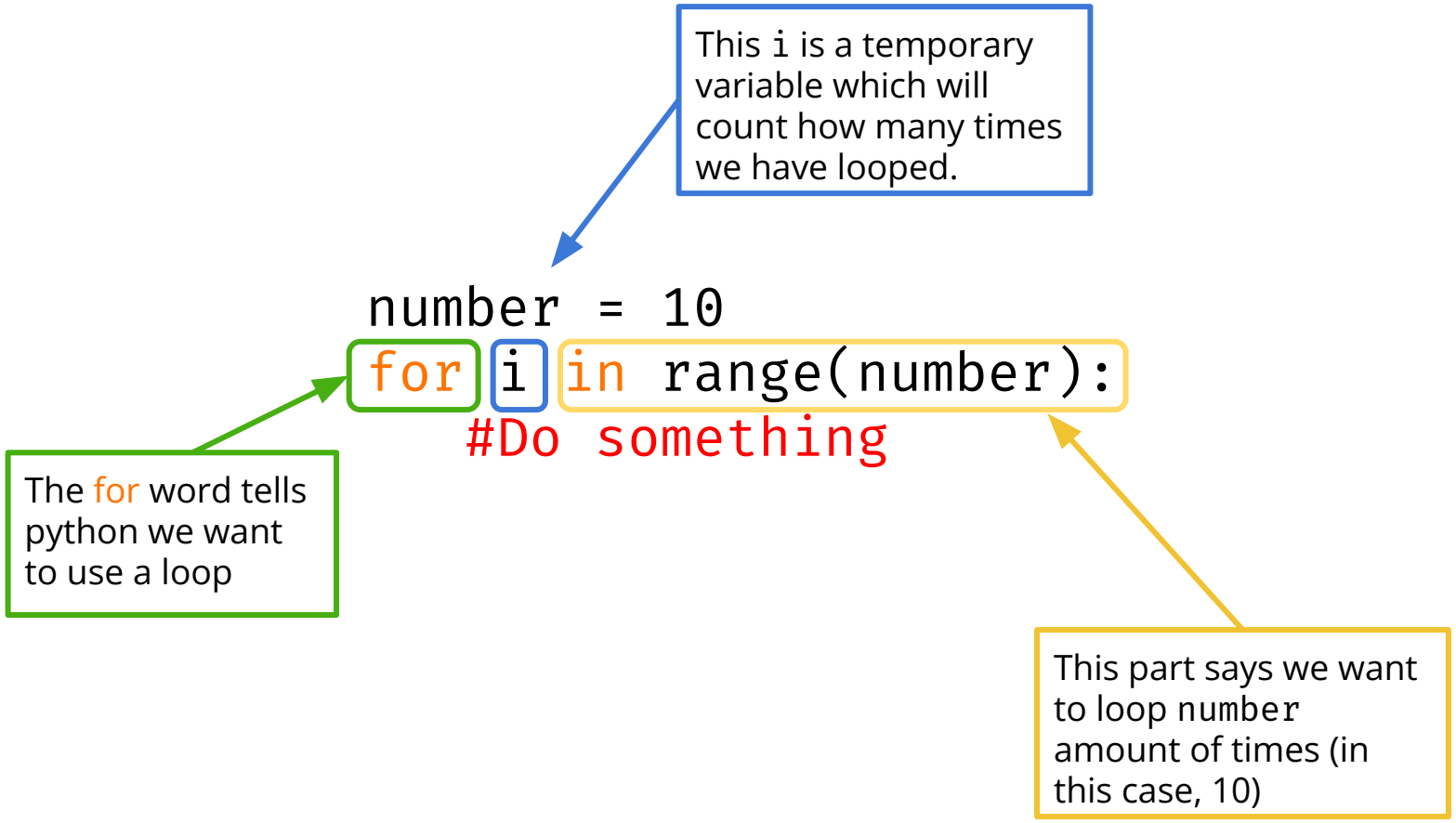
for i in range(number):
#Do something
The for word tells python we want to use a loop

For Loops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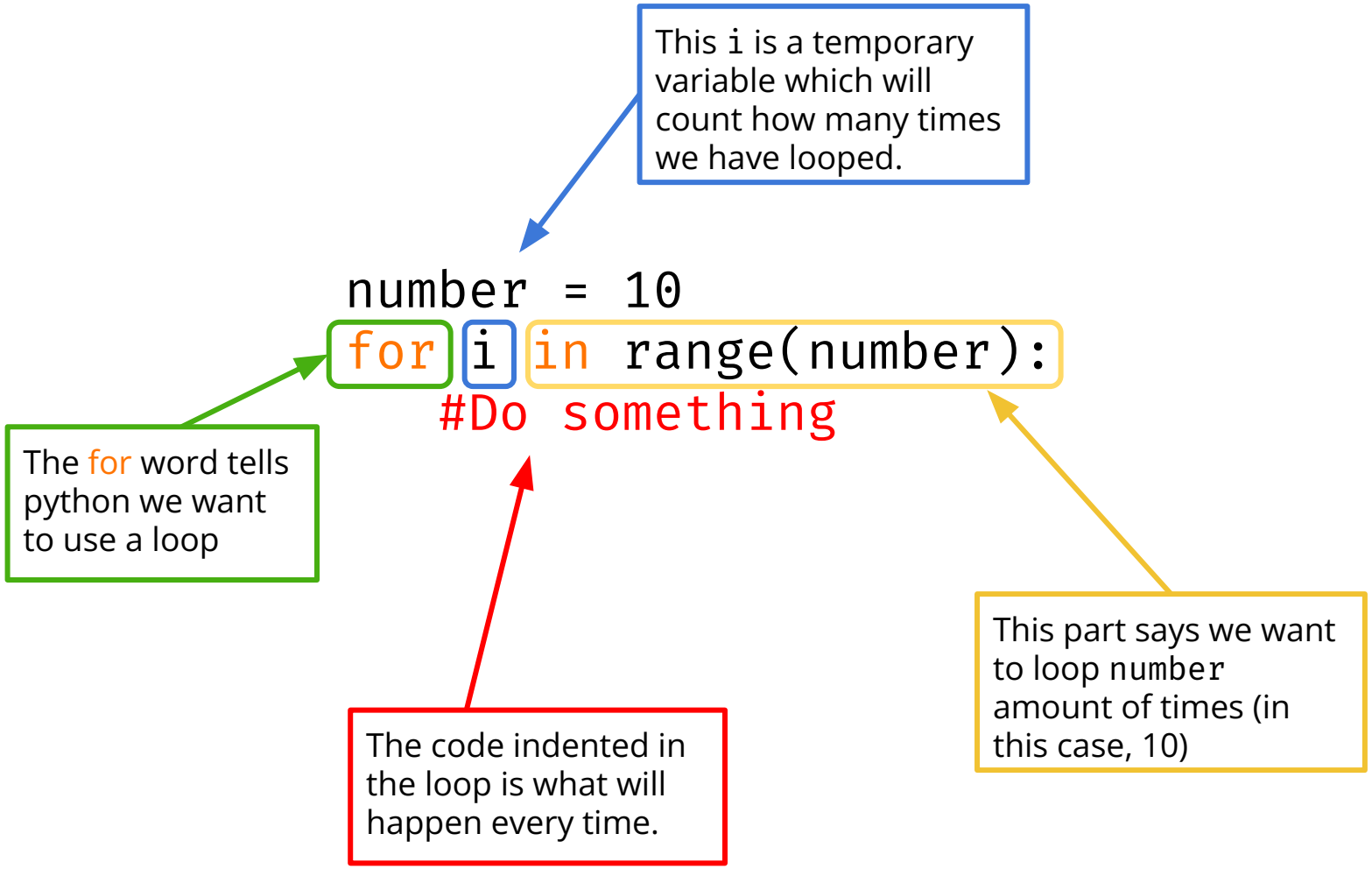
The for word tells python we want to use a loop
This part says we want to loop number amount of times (in this case, 10)

For Loops


This i is a temporary variable which will count how many times we have looped.
number = 10
for i in range(number):
#Do something
The for word tells python we want to use a loop
The code indented in the loop is what will happen every time.
This part says we want to loop number amount of times (in this case, 10)

Looping how many times?

We can loop through a list:

```
friends = 4
for i in range(friends):
    print(“Hello friend!”)
```

What’s going to happen?

We do what’s in the for loop as many times as what is in the “range”

Looping how many times?

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```

What’s going to happen?

```
>>> Hello friend!
>>> Hello friend!
>>> Hello friend!
>>> Hello friend!
```

We do what’s in the for loop as many times as what is in the “range”

Project Time!

Now you know how to use a for loop!

Try to do Lesson 4

...if you are up for it!

The tutors will be around to help!

Intro to Vigenere Ciphers

Caesar Cipher

So now you know what a Caesar Cipher is, let's look at a more complicated cipher!

A Caesar Cipher uses just 1 key to encrypt and decrypt the message, a Vigenere cypher uses a whole word as the key!

The keyword

Let’s see how it uses a whole word by doing an example together!

Let’s use the keyword

pizza

Splitting it into keys

Now we take the keyword and we split it into a bunch of keys!

Each letter of the alphabet equals a different number

(a=0, b=1, c=2 etc.)

Now we change our keyword into a bunch of different keys by replacing each letter with its number in the alphabet

p **i** **z** **z** **a**

Splitting it into keys

Now we take the keyword and we split it into a bunch of keys!

Each letter of the alphabet equals a different number (a=0, b=1, c=2 etc.)

Now we change our keyword into a bunch of different keys by replacing each letter with its number in the alphabet

p	**i**	**z**	**z**	**a**
15				

Splitting it into keys

Now we take the keyword and we split it into a bunch of keys!

Each letter of the alphabet equals a different number (a=0, b=1, c=2 etc.)

Now we change our keyword into a bunch of different keys by replacing each letter with its number in the alphabet

p	**i**	**z**	**z**	**a**
15	8			

Splitting it into keys

Now we take the keyword and we split it into a bunch of keys!

Each letter of the alphabet equals a different number

(a=0, b=1, c=2 etc.)

Now we change our keyword into a bunch of different keys by replacing each letter with its number in the alphabet

p	**i**	**z**	**z**	**a**
15	8	25		

Splitting it into keys

Now we take the keyword and we split it into a bunch of keys!

Each letter of the alphabet equals a different number (a=0, b=1, c=2 etc.)

Now we change our keyword into a bunch of different keys by replacing each letter with its number in the alphabet

p	**i**	**z**	**z**	**a**
15	8	25	25	

Splitting it into keys

Now we take the keyword and we split it into a bunch of keys!

Each letter of the alphabet equals a different number (a=0, b=1, c=2 etc.)

Now we change our keyword into a bunch of different keys by replacing each letter with its number in the alphabet

p	**i**	**z**	**z**	**a**
15	8	25	25	0

Loop the word

Let’s try encrypting a message with our keyword using a Vigenere cipher now!

I love coding

Each letter in our message will line up with a letter in our keyword and we will keep looping the keyword like this:

i	**l**	**o**	**v**	**e**	**c**	**o**	**d**	**i**	**n**	**g**
p	**i**	**z**	**z**	**a**	**p**	**i**	**z**	**z**	**a**	**p**

Using the numbers

Now we replace each letter of our keyword with the numbers that we worked out before:

i	l	o	v	e	c	o	d	i	n	g
15	8	25	25	0	15	8	25	25	0	15

Next we just shift each letter in our message like we do with a Caesar Cipher but with the key that it lines up with.

What key does the letter C use?

Using the numbers

Now we replace each letter of our keyword with the numbers that we worked out before:

i	l	o	v	e	c	o	d	i	n	g
15	8	25	25	0	15	8	25	25	0	15

Next we just shift each letter in our message like we do with a Caesar Cipher but with the key that it lines up with.

What key does the letter C use? 15

Making the secret message

i	Using key: **15**	Is replaced with
l	Using key: **8**	Is replaced with
o	Using key: **25**	Is replaced with
v	Using key: **25**	Is replaced with
e	Using key: **0**	Is replaced with
c	Using key: **15**	Is replaced with
o	Using key: **8**	Is replaced with
d	Using key: **25**	Is replaced with
i	Using key: **25**	Is replaced with
n	Using key: **0**	Is replaced with
g	Using key: **15**	Is replaced with

Making the secret message

i	Using key: **15**	Is replaced with	x
l	Using key: **8**	Is replaced with	
o	Using key: **25**	Is replaced with	
v	Using key: **25**	Is replaced with	
e	Using key: **0**	Is replaced with	
c	Using key: **15**	Is replaced with	
o	Using key: **8**	Is replaced with	
d	Using key: **25**	Is replaced with	
i	Using key: **25**	Is replaced with	
n	Using key: **0**	Is replaced with	
g	Using key: **15**	Is replaced with	

Making the secret message

i	Using key: **15**	Is replaced with	x
l	Using key: **8**	Is replaced with	t
o	Using key: **25**	Is replaced with	
v	Using key: **25**	Is replaced with	
e	Using key: **0**	Is replaced with	
c	Using key: **15**	Is replaced with	
o	Using key: **8**	Is replaced with	
d	Using key: **25**	Is replaced with	
i	Using key: **25**	Is replaced with	
n	Using key: **0**	Is replaced with	
g	Using key: **15**	Is replaced with	

Making the secret message

i	Using key: **15**	Is replaced with	x
l	Using key: **8**	Is replaced with	t
o	Using key: **25**	Is replaced with	n
v	Using key: **25**	Is replaced with	
e	Using key: **0**	Is replaced with	
c	Using key: **15**	Is replaced with	
o	Using key: **8**	Is replaced with	
d	Using key: **25**	Is replaced with	
i	Using key: **25**	Is replaced with	
n	Using key: **0**	Is replaced with	
g	Using key: **15**	Is replaced with	

Making the secret message

i	Using key: **15**	Is replaced with	x
l	Using key: **8**	Is replaced with	t
o	Using key: **25**	Is replaced with	n
v	Using key: **25**	Is replaced with	u
e	Using key: **0**	Is replaced with	
c	Using key: **15**	Is replaced with	
o	Using key: **8**	Is replaced with	
d	Using key: **25**	Is replaced with	
i	Using key: **25**	Is replaced with	
n	Using key: **0**	Is replaced with	
g	Using key: **15**	Is replaced with	

Making the secret message

i	Using key: **15**	Is replaced with	x
l	Using key: **8**	Is replaced with	t
o	Using key: **25**	Is replaced with	n
v	Using key: **25**	Is replaced with	u
e	Using key: **0**	Is replaced with	e
c	Using key: **15**	Is replaced with	
o	Using key: **8**	Is replaced with	
d	Using key: **25**	Is replaced with	
i	Using key: **25**	Is replaced with	
n	Using key: **0**	Is replaced with	
g	Using key: **15**	Is replaced with	

Making the secret message

i	Using key: **15**	Is replaced with	x
l	Using key: **8**	Is replaced with	t
o	Using key: **25**	Is replaced with	n
v	Using key: **25**	Is replaced with	u
e	Using key: **0**	Is replaced with	e
c	Using key: **15**	Is replaced with	r
o	Using key: **8**	Is replaced with	
d	Using key: **25**	Is replaced with	
i	Using key: **25**	Is replaced with	
n	Using key: **0**	Is replaced with	
g	Using key: **15**	Is replaced with	

Making the secret message

i	Using key: **15**	Is replaced with	x
l	Using key: **8**	Is replaced with	t
o	Using key: **25**	Is replaced with	n
v	Using key: **25**	Is replaced with	u
e	Using key: **0**	Is replaced with	e
c	Using key: **15**	Is replaced with	r
o	Using key: **8**	Is replaced with	w
d	Using key: **25**	Is replaced with	
i	Using key: **25**	Is replaced with	
n	Using key: **0**	Is replaced with	
g	Using key: **15**	Is replaced with	

Making the secret message

i	Using key: **15**	Is replaced with	x
l	Using key: **8**	Is replaced with	t
o	Using key: **25**	Is replaced with	n
v	Using key: **25**	Is replaced with	u
e	Using key: **0**	Is replaced with	e
c	Using key: **15**	Is replaced with	r
o	Using key: **8**	Is replaced with	w
d	Using key: **25**	Is replaced with	c
i	Using key: **25**	Is replaced with	
n	Using key: **0**	Is replaced with	
g	Using key: **15**	Is replaced with	

Making the secret message

i	Using key: **15**	Is replaced with	x
l	Using key: **8**	Is replaced with	t
o	Using key: **25**	Is replaced with	n
v	Using key: **25**	Is replaced with	u
e	Using key: **0**	Is replaced with	e
c	Using key: **15**	Is replaced with	r
o	Using key: **8**	Is replaced with	w
d	Using key: **25**	Is replaced with	c
i	Using key: **25**	Is replaced with	h
n	Using key: **0**	Is replaced with	
g	Using key: **15**	Is replaced with	

Making the secret message

i	Using key: **15**	Is replaced with	x
l	Using key: **8**	Is replaced with	t
o	Using key: **25**	Is replaced with	n
v	Using key: **25**	Is replaced with	u
e	Using key: **0**	Is replaced with	e
c	Using key: **15**	Is replaced with	r
o	Using key: **8**	Is replaced with	w
d	Using key: **25**	Is replaced with	c
i	Using key: **25**	Is replaced with	h
n	Using key: **0**	Is replaced with	n
g	Using key: **15**	Is replaced with	

Making the secret message

i	Using key: **15**	Is replaced with	x
l	Using key: **8**	Is replaced with	t
o	Using key: **25**	Is replaced with	n
v	Using key: **25**	Is replaced with	u
e	Using key: **0**	Is replaced with	e
c	Using key: **15**	Is replaced with	r
o	Using key: **8**	Is replaced with	w
d	Using key: **25**	Is replaced with	c
i	Using key: **25**	Is replaced with	h
n	Using key: **0**	Is replaced with	n
g	Using key: **15**	Is replaced with	v

Secret Message

So our secret encrypted message is **x tnue rwchnv**

To decrypt it you do the same thing with each letter and key that you did to decrypt in the Caesar cipher

- change the key value to become the negative of the encryption key value
- turn the wheel backwards (clockwise) to undo the encryption and get the secret message
- this shifts the alphabet the opposite way to what we did to encrypt the message

Turn it back!

x	Using key: **15**	Is replaced with
t	Using key: **8**	Is replaced with
n	Using key: **25**	Is replaced with
u	Using key: **25**	Is replaced with
e	Using key: **0**	Is replaced with
r	Using key: **15**	Is replaced with
w	Using key: **8**	Is replaced with
c	Using key: **25**	Is replaced with
h	Using key: **25**	Is replaced with
n	Using key: **0**	Is replaced with
v	Using key: **15**	Is replaced with

Turn it back!

x	Using key: **15**	Is replaced with	i
t	Using key: **8**	Is replaced with	
n	Using key: **25**	Is replaced with	
u	Using key: **25**	Is replaced with	
e	Using key: **0**	Is replaced with	
r	Using key: **15**	Is replaced with	
w	Using key: **8**	Is replaced with	
c	Using key: **25**	Is replaced with	
h	Using key: **25**	Is replaced with	
n	Using key: **0**	Is replaced with	
v	Using key: **15**	Is replaced with	

Turn it back!

x	Using key: **15**	Is replaced with	i
t	Using key: **8**	Is replaced with	l
n	Using key: **25**	Is replaced with	
u	Using key: **25**	Is replaced with	
e	Using key: **0**	Is replaced with	
r	Using key: **15**	Is replaced with	
w	Using key: **8**	Is replaced with	
c	Using key: **25**	Is replaced with	
h	Using key: **25**	Is replaced with	
n	Using key: **0**	Is replaced with	
v	Using key: **15**	Is replaced with	

Turn it back!

x	Using key: **15**	Is replaced with	i
t	Using key: **8**	Is replaced with	l
n	Using key: **25**	Is replaced with	o
u	Using key: **25**	Is replaced with	
e	Using key: **0**	Is replaced with	
r	Using key: **15**	Is replaced with	
w	Using key: **8**	Is replaced with	
c	Using key: **25**	Is replaced with	
h	Using key: **25**	Is replaced with	
n	Using key: **0**	Is replaced with	
v	Using key: **15**	Is replaced with	

Turn it back!

x	Using key: **15**	Is replaced with	i
t	Using key: **8**	Is replaced with	l
n	Using key: **25**	Is replaced with	o
u	Using key: **25**	Is replaced with	v
e	Using key: **0**	Is replaced with	
r	Using key: **15**	Is replaced with	
w	Using key: **8**	Is replaced with	
c	Using key: **25**	Is replaced with	
h	Using key: **25**	Is replaced with	
n	Using key: **0**	Is replaced with	
v	Using key: **15**	Is replaced with	

Turn it back!

x	Using key: **15**	Is replaced with	i
t	Using key: **8**	Is replaced with	l
n	Using key: **25**	Is replaced with	o
u	Using key: **25**	Is replaced with	v
e	Using key: **0**	Is replaced with	e
r	Using key: **15**	Is replaced with	
w	Using key: **8**	Is replaced with	
c	Using key: **25**	Is replaced with	
h	Using key: **25**	Is replaced with	
n	Using key: **0**	Is replaced with	
v	Using key: **15**	Is replaced with	

Turn it back!

x	Using key: **15**	Is replaced with	i
t	Using key: **8**	Is replaced with	l
n	Using key: **25**	Is replaced with	o
u	Using key: **25**	Is replaced with	v
e	Using key: **0**	Is replaced with	e
r	Using key: **15**	Is replaced with	c
w	Using key: **8**	Is replaced with	
c	Using key: **25**	Is replaced with	
h	Using key: **25**	Is replaced with	
n	Using key: **0**	Is replaced with	
v	Using key: **15**	Is replaced with	

Turn it back!

x	Using key: **15**	Is replaced with	i
t	Using key: **8**	Is replaced with	l
n	Using key: **25**	Is replaced with	o
u	Using key: **25**	Is replaced with	v
e	Using key: **0**	Is replaced with	e
r	Using key: **15**	Is replaced with	c
w	Using key: **8**	Is replaced with	o
c	Using key: **25**	Is replaced with	
h	Using key: **25**	Is replaced with	
n	Using key: **0**	Is replaced with	
v	Using key: **15**	Is replaced with	

Turn it back!

x	Using key: **15**	Is replaced with	i
t	Using key: **8**	Is replaced with	l
n	Using key: **25**	Is replaced with	o
u	Using key: **25**	Is replaced with	v
e	Using key: **0**	Is replaced with	e
r	Using key: **15**	Is replaced with	c
w	Using key: **8**	Is replaced with	o
c	Using key: **25**	Is replaced with	d
h	Using key: **25**	Is replaced with	
n	Using key: **0**	Is replaced with	
v	Using key: **15**	Is replaced with	

Turn it back!

x	Using key: **15**	Is replaced with	i
t	Using key: **8**	Is replaced with	l
n	Using key: **25**	Is replaced with	o
u	Using key: **25**	Is replaced with	v
e	Using key: **0**	Is replaced with	e
r	Using key: **15**	Is replaced with	c
w	Using key: **8**	Is replaced with	o
c	Using key: **25**	Is replaced with	d
h	Using key: **25**	Is replaced with	i
n	Using key: **0**	Is replaced with	
v	Using key: **15**	Is replaced with	

Turn it back!

x	Using key: **15**	Is replaced with	i
t	Using key: **8**	Is replaced with	l
n	Using key: **25**	Is replaced with	o
u	Using key: **25**	Is replaced with	v
e	Using key: **0**	Is replaced with	e
r	Using key: **15**	Is replaced with	c
w	Using key: **8**	Is replaced with	o
c	Using key: **25**	Is replaced with	d
h	Using key: **25**	Is replaced with	i
n	Using key: **0**	Is replaced with	n
v	Using key: **15**	Is replaced with	

Turn it back!

x	Using key: **15**	Is replaced with	i
t	Using key: **8**	Is replaced with	l
n	Using key: **25**	Is replaced with	o
u	Using key: **25**	Is replaced with	v
e	Using key: **0**	Is replaced with	e
r	Using key: **15**	Is replaced with	c
w	Using key: **8**	Is replaced with	o
c	Using key: **25**	Is replaced with	d
h	Using key: **25**	Is replaced with	i
n	Using key: **0**	Is replaced with	n
v	Using key: **15**	Is replaced with	g

Your Turn!

Now you try on your own!

Try doing Lesson 0 - Lesson 3 of the second workbook!

https://edstem.org/au/join/zCfRbq

Your tutors are here to help you if you get stuck

Functions!

Simpler, less repetition, easier to read code!

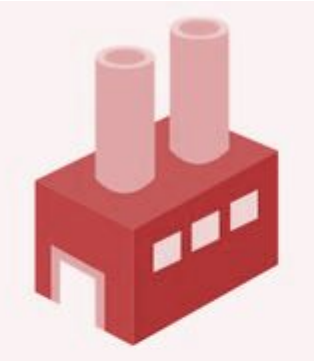
How functions fit together!

Functions are like factories!

Timber Mill

Your main factory!

Metal Worker

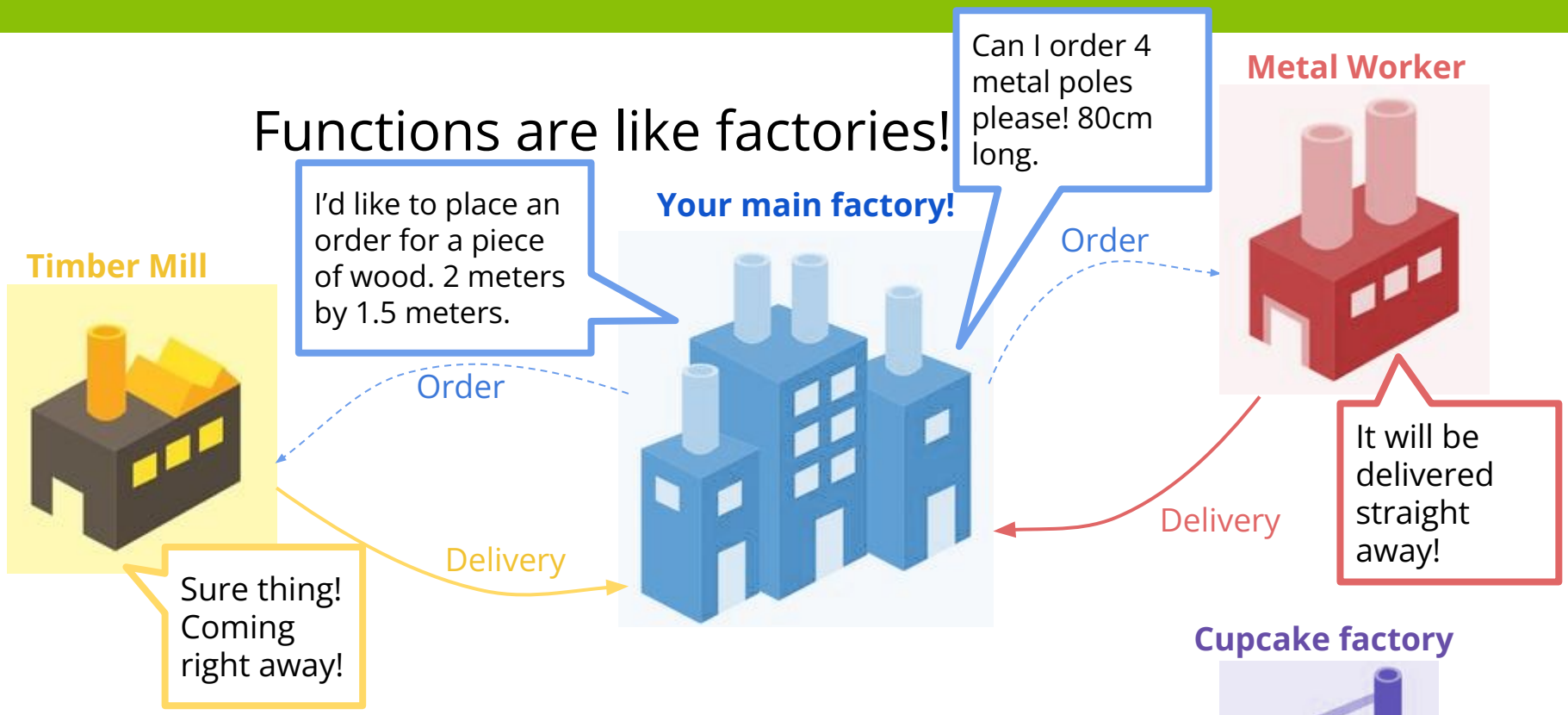


Cupcake factory

Running a factory doesn't mean doing all the work yourself, you can get other factories to help you out!

How functions fit together!

Functions are like factories!



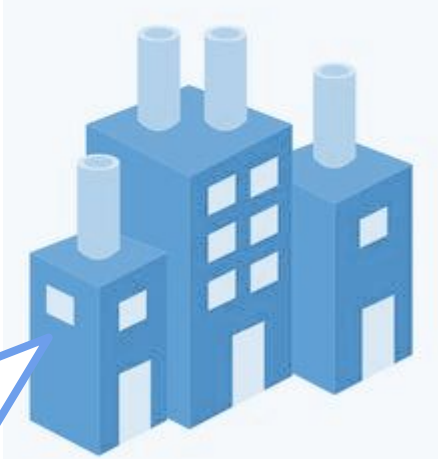
Asking other factories to do some work for you makes your main task simper. You can focus on the assembly!

How functions fit together!

Functions are like factories!

Metal Worker

Your main factory!



Timber Mill

Look at this beautiful table I made!

Outsourcing made it simple!

Cupcake factory

How functions fit together!

Your main code!

You can write a bunch of helpful functions to **simplify** your **main goal**!

You can **write** these **once** and then **use** them **lots** of times! They can be **anything** you like!

Helps with printing nicely

Uses stats to make decisions

Does calculations

Don’t reinvent the wheel

We’re already familiar with some python in built functions like print and input!

There’s lots of functions python gives us to save us reinventing the wheel!

For instance we can use len to get the length of a string, rather than having to write code to count every letter!

```
>>> len("Hello world")
11
```

Try these:

```
>>> name = "Renee"
>>> len(name)
5

>>> int("6")
6

>>> str(6)
"6"
```

Defining your own functions

Built in functions are great! But sometimes we want custom functions!

Defining our own functions means:

- We cut down on repeated code
- Nice function names makes our code clear and easy to read
- We can move bulky code out of the way

Defining your own functions

Then you can use your function by calling it!

```
def cat_print():
    print("""
                          #
                           #
                           #
                 ^..^ #####
                 =TT=      ;
                  #########
                  # #   # #
                  M M   M M """)


cat_print()
cat_print()
```

Which will do this!

```
                          #
                           #
                           #
                 ^..^ #####
                 =TT=      ;
                  #########
                  # #   # #
                  M M   M M
                          #
                           #
                           #
                 ^..^ #####
                 =TT=      ;
                  #########
                  # #   # #
                  M M   M M
```

Defining your own functions

Then you can use your function by calling it!

```
def cat_print():
    print("""
                        #
                         #
                         #
                ^..^ #####
                =TT=      ;
                 #########
                 # #   # #
                 M M   M M
                        #
                         #
                         #
                ^..^ #####
                =TT=      ;
                 #########
                 # #   # #
                 M M   M M
cat_print()
cat_print()
```

When using a function in a **script** make sure you define the function first.

It doesn't matter if you call it from inside another function though!

Which will do this!

```
                        #
                         #
                         #
                ^..^ #####
                =TT=      ;
                 #########
                 # #   # #
                 M M   M M
                        #
                         #
                         #
                ^..^ #####
                =TT=      ;
                 #########
                 # #   # #
                 M M   M M
```

Functions often need extra information

Functions are more useful if we can change what they do

We can do this by giving them arguments (aka parameters)

```
>>> def hello(person):
...     print('Hello, ' + person + ', how are you?')
>>> hello('Alex')
Hello, Alex, how are you?
```

Here, we give the hello() function a name

Any string will work

```
>>> hello('abcd')
Hello, abcd, how are you?
```

Functions can take multiple arguments

Often we want to work with multiple pieces of information.

You can actually have as many parameters as you like!

This function takes two numbers, adds them together and prints the result.

```
>>> def add(x, y):
...     print(x + y)
>>> add(3, 4)
7
```

Arguments stay inside the function

The arguments are not able to be accessed outside of the function declaration.

```
>>> def hello(person):
...     print('Hello, ' + person + '!')
>>> print(person)
Traceback (most recent call last):
File "<stdin>", line 1, in <module>
NameError: name 'person' is not defined
```

Variables stay inside the function

Neither are variables made inside the function. They are **local variables**.

```
>>> def add(x, y):
...     z = x + y
...     print(z)
>>> add(3, 4)
7
>>> z
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
NameError: name 'z' is not defined
```

Global variables are not affected

Changing a variable in a function **only changes it *inside* the function.**

```
>>> z = 1
>>> def add(x, y):
...     z = x + y
...     print(z)
>>> add(3, 4)
7
```

Global variables are not affected

Changing a variable in a function **only changes it *inside* the function.**

```
>>> z = 1
>>> def add(x, y):
...     z = x + y
...     print(z)
>>> add(3, 4)
7
```

What's the value of z now?

```
>>> print(z)
```

Global variables are not affected

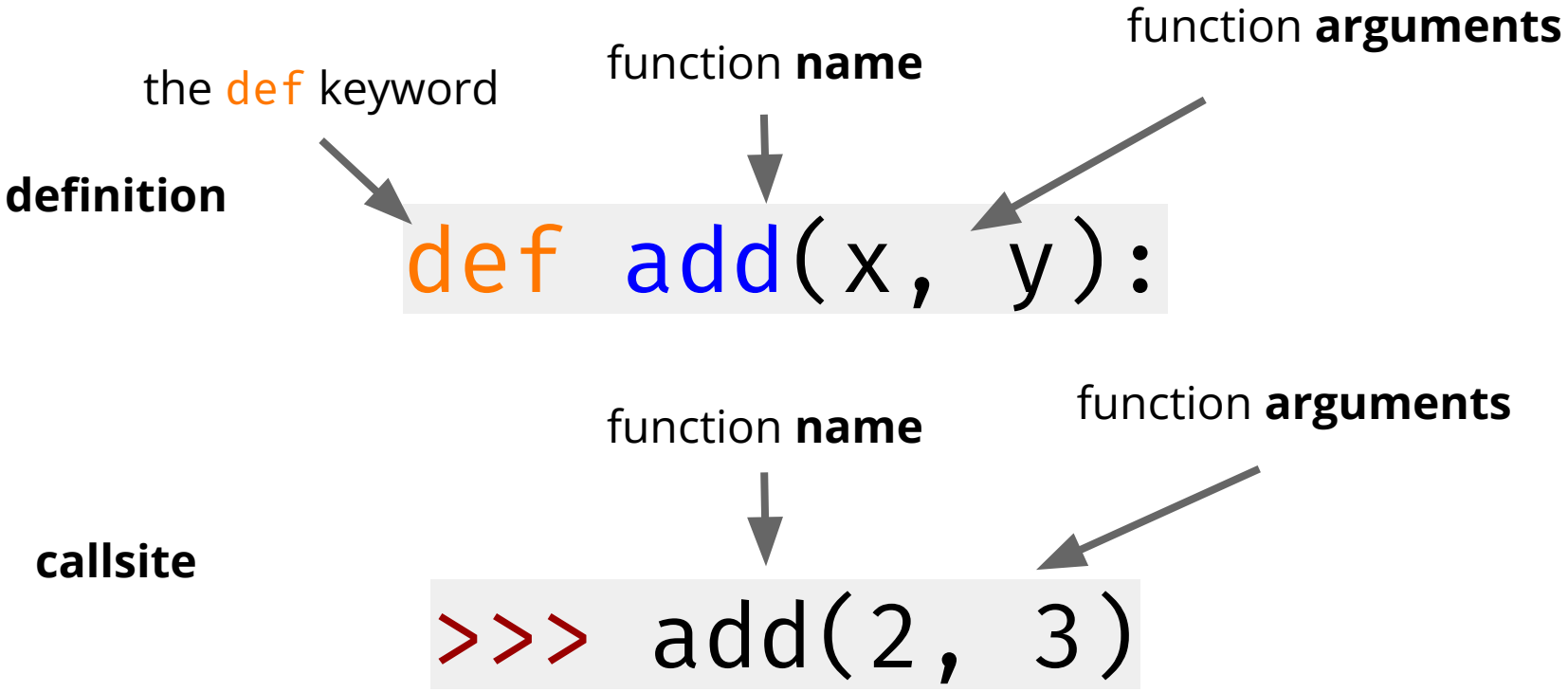
Changing a variable in a function **only changes it *inside* the function.**

```
>>> z = 1
>>> def add(x, y):
...     z = x + y
...     print(z)
>>> add(3, 4)
7
```

What's the value of z now?

```
>>> print(z)
1
```

Recap: A function signature



Giving something back

At the moment our function just does a thing, but it's not able to give anything back to the main program.

Currently, we can't use the result of add()

```
>>> def add(x, y):
...     print(x + y)
>>> sum = add(1, 3)
4
>>> sum
```

sum has no value!

Giving something back

Using `return` in a function immediately returns a result.

```
>>> def add(x, y):
...     z = x + y
...     return z
...
>>> sum = add(1, 3)
>>> sum
4
```

Giving something back

When a function returns something, the *control* is passed back to the main program, so no code after the `return` statement is run.

```
>>> def add(x, y):
...     print('before the return')
...     z = x + y
...     return z
...     print('after the return')
>>> sum = add(1, 3)
before the return
>>> sum
4
```

Here, the `print` statement after the `return` never gets run.

Project time!

Now you know how to build function!

Now try to do Lesson 4 of the second workbook!

The tutors will be around to help!