

## Lists, Tuples and Strings

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## Outcomes

- After completing this presentation, you are expected to be able to:
  1. Create a collection of things using a list or a tuple in Python
  2. Manage a collection of things in a list
  3. Explain the big difference between lists and tuples
  4. Create a two dimensional structure using lists and tuples
  5. Explain the Python representation of strings

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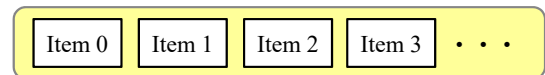
## Storing a Collection of Data

- You have seen the use of variables to store simple data such as a number or a string (=a piece of text)
- Instead of a single piece of data it will be useful if you can store a collection of data in a variable inside a program
- For example, in a shooting game, if you can store a collection of monsters in one place, you will be able to manage them a lot easier than having them stored separately

```
monsters = 
```

## Lists

- Lists are a way to store a collection of items



- They can be used to store many items together
- The items can be of any type
- For example, you can store a collection of numbers and text together in a list:



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## Using a List

- To create a list in Python you use a pair of square brackets to enclose the items you need, for example:


```
girlfriends = ["Gwen", "Lois", "Mary"]
```

- To check a particular item in the list, you need to say which item you want by using an *index*
- For example, to print the first item from the above list, you can use this code:

```
print(girlfriends[0])
```

*Important! The first item has an index of 0, not 1!*

```
>>> girlfriends = ["Gwen", "Lois", "Mary"]
>>> print(girlfriends[0])
Gwen
```



## The Length of a List

- You can use `len( name of a list )` to tell you how many things are in the list
- For example:

```
>>> girlfriends = ["Gwen", "Lois", "Mary"]
>>> print(len(girlfriends))
3
```

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## Going Through Everything in a List

- There's 2 ways to go through everything in a list
- The first way is shown here:

```
>>> girlfriends = ["Gwen", "Lois", "Mary"]
>>> for thisgirlfriend in girlfriends:
    print(thisgirlfriend)

Gwen
Lois
Mary
```

## Going Through Everything in a List

- The second way is by using *range* to generate the index numbers, then using the index numbers:

```
>>> girlfriends = ["Gwen", "Lois", "Mary"]
>>> for index in range(len(girlfriends)):
    print(girlfriends[index])

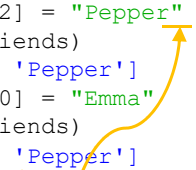
Gwen
Lois
Mary
```

- The first way is simpler than the second way, but sometimes you need to use the second way

## Changing an Item in a List

- You can change any item in a list, for example:

```
>>> girlfriends = ["Gwen", "Lois", "Mary"]
>>> girlfriends[2] = "Pepper"
>>> print(girlfriends)
['Gwen', 'Lois', 'Pepper']
>>> girlfriends[0] = "Emma"
>>> print(girlfriends)
['Emma', 'Lois', 'Pepper']
```



You can use either " ... " or ' ... ' to enclose a piece of text – see later

## Insert, Remove and Append a List

- You can insert/remove/append items at any time, for example: *'append' means 'put it at the end'*

```
>>> comment = ["Dave", "is", "human"]
>>> print(comment)
['Dave', 'is', 'human']
>>> comment.insert(2, "not")
>>> print(comment)
['Dave', 'is', 'not', 'human']
>>> comment.remove("human")
>>> print(comment)
['Dave', 'is', 'not']
>>> comment.append("evil!")
>>> print(comment)
['Dave', 'is', 'not', 'evil!']
```

*Insert before item 2 (the third item)*

*If there was more than one 'human' in the list, this would only remove the first one*

## Other Things You Can Do with Lists

- *sort* – sorts the list in increasing number/letter order

```
>>> words = ["cat", "dog", "apple", "bat"]
>>> words.sort()
>>> print(words)
['apple', 'bat', 'cat', 'dog']
```

- *reverse* – reverses the content of the list

```
>>> words = ["cat", "dog", "apple", "bat"]
>>> words.reverse()
>>> print(words)
['bat', 'apple', 'dog', 'cat']
```

- *count* – counts how many times something appears

```
>>> ages = [20, 21, 19, 20, 19, 22, 20, 20, 20, 18]
>>> ages.count(20)
5
```

## Other Things You Can Do with Lists

- *index* – finds the first occurrence of something

```
>>> ages = [20, 21, 19, 20, 19, 22, 20, 20, 20, 18]
>>> ages.index(19)
2
```

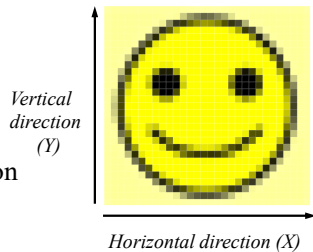
- *extend* – appends another list to this list

```
>>> happywords = ["I", "love", "you"]
>>> print(happywords)
['I', 'love', 'you']
>>> happywords.extend(["if", "you", "lend", "me", "money"])
>>> print(happywords)
['I', 'love', 'you', 'if', 'you', 'lend', 'me', 'money']
```

- There are other things you can do with lists, we may look at those later in the course if we have time

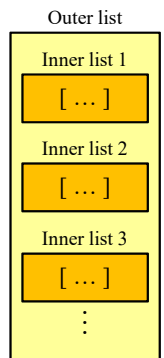
## Two Dimensional Structures

- In some cases a one dimensional (1D) structure (things that are arranged in one direction) is not enough
- For example, a digital camera image is a 2D structure
  - You need both the X location and Y location of a point to read its colour in an image



## Two Dimensional Structures

- A Python list is a 1D data structure
- What if you want to use a 2D structure?
  - Then you need to use lots of lists inside another list
- We call this a 'list of lists'
  - The outer list is one of the dimensions, and the inner lists are the other dimension



## Examples of a 1D List and a 2D List

- 1D example:
 

```
things = ["j", "o", "k", "e", "s"]
letter_o = things[1] # the "o" in second col
```
- 2D example:
 

```
things = [
    ["h", "a", "r", "r", "y"],
    ["l", "i", "k", "e", "s"],
    ["j", "o", "k", "e", "s"]
]
letter_o = things[2][1]
# the "o" in the third row second column
```

<b>things</b>				
j	o	k	e	s

<b>things[0]</b>				
h	a	r	r	y
<b>things[1]</b>				
l	i	k	e	s
<b>things[2]</b>				
j	o	k	e	s

Be careful! The general idea is [row] [col], not [col] [row]!

## What About Tuples?

- Basically, a tuple is the same idea as a list, **but** you can't change anything in a tuple after it is created
- To create a tuple you use a pair of parentheses (not square brackets) for the items, like this:
 

```
myfriend = ("John", 18, "CSE", 180, 70)
```
- To get a particular item from a tuple it's the same as a list, for example:
 

```
print( "Name of my friend:", myfriend[0] )
```

```
>>> myfriend = ("John", 18, "CSE", 180, 70)
>>> print("Name of my friend:", myfriend[0])
Name of my friend: John
>>>
```

You still use [] when getting an item from a tuple

## Trying to Change an Item in a Tuple

- If you try and change something inside a tuple, the program crashes:

```
>>> myfriend = ("John", 18, "CSE", 180, 70)
>>> myfriend[2] = "ECE"
Traceback (most recent call last):
  File "<pyshell#16>", line 1, in <module>
    myfriend[2] = "ECE"
TypeError: 'tuple' object does not support item assignment
>>> print(myfriend)
('John', 18, 'CSE', 180, 70)
>>>
```

- Using the language of computing, we say lists are *mutable* (can be changed) and tuples are *immutable* (cannot be changed)

## What Works With Tuples?

- len(), count() and index() work because they don't try to change the tuple content
- Creating a 2D structure in a tuple is fine e.g.
 

```
things = (("h", "a", "r", "r", "y"),
          ("l", "i", "k", "e", "s"),
          ("j", "o", "k", "e", "s"))
```
- insert(), remove(), append(), sort(), reverse(), extend() **all don't work** because they try to change the tuple content

## When to Use Tuples

- You may use only lists in your programming because they are ‘more powerful’ than tuples
- However, there are situations where it’s better to use tuples e.g.:
  - You want to ensure some data can’t be changed
  - There are some not common situations where a list doesn’t work but a tuple does, e.g. sometimes in a dictionary (this may be discussed later in another presentation)

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## A String is a Tuple of Letters

- In the world of computing, a *string* is the name for text
- Python thinks of a string as a tuple of letters
- For example: 

```
>>> mytext="Hello"
>>> print(mytext[1])
e
```
- Just like a tuple, you can’t directly change the content of a string:

```
>>> mytext[1]="a"
Traceback (most recent call last):
  File "<pyshell#18>", line 1, in <module>
    mytext[1]="a"
TypeError: 'str' object does not support item assignment
```

## Using Quotes " or '

- As we have mentioned before, you can use either " (double quotes) or ' (single quotes) to enclose the content of a string
- For example:
  - 'Hello!' is the same as "Hello!"
- However, you cannot mix them up like this:

```
>>> greeting = "Hello!"
SyntaxError: EOL while scanning string literal
```

- The error means Python does not understand the string, because it starts with a " and ends with a ' which confuses Python

## What Works With Strings?

- Just like a tuple, with a string you can use `len()`, `count()` and `index()`

```
>>> mytext="Hello"
>>> len(mytext)
5
>>> mytext.count("l")
2
>>> mytext.index("o")
4
```
- Just like a tuple, with a string `insert()`, `remove()`, `append()`, `sort()`, `reverse()`, `extend()` **all don’t work** because they try to change the string content