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STEM Digital Academy

School of Science & Technology

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Introduction to Data Structures and Lists

Programming and Algorithms

Lecture by

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```
n = 3
for i in range(1,n+1):
    print("Hello World!")
```

```
Hello World!
Hello World!
Hello World!
```

What will we Cover?

- Overview of what data structures are
- Introduction to the list data structure
- Storing data in lists

Data

Data:

- Collection of facts or statistics
- Input to a computer program
- Output from a computer program

Data types covered:

- Numeric data types (int and float)
- Boolean
- String

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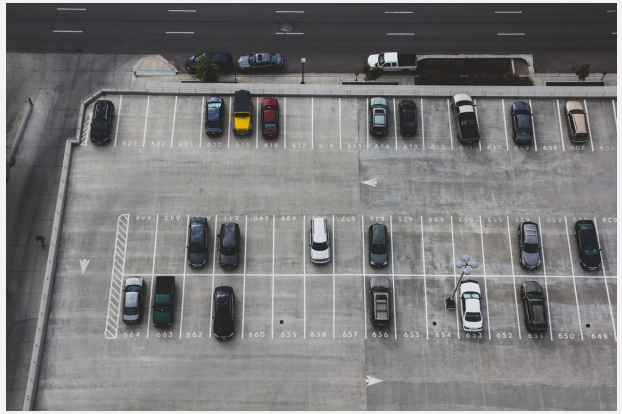
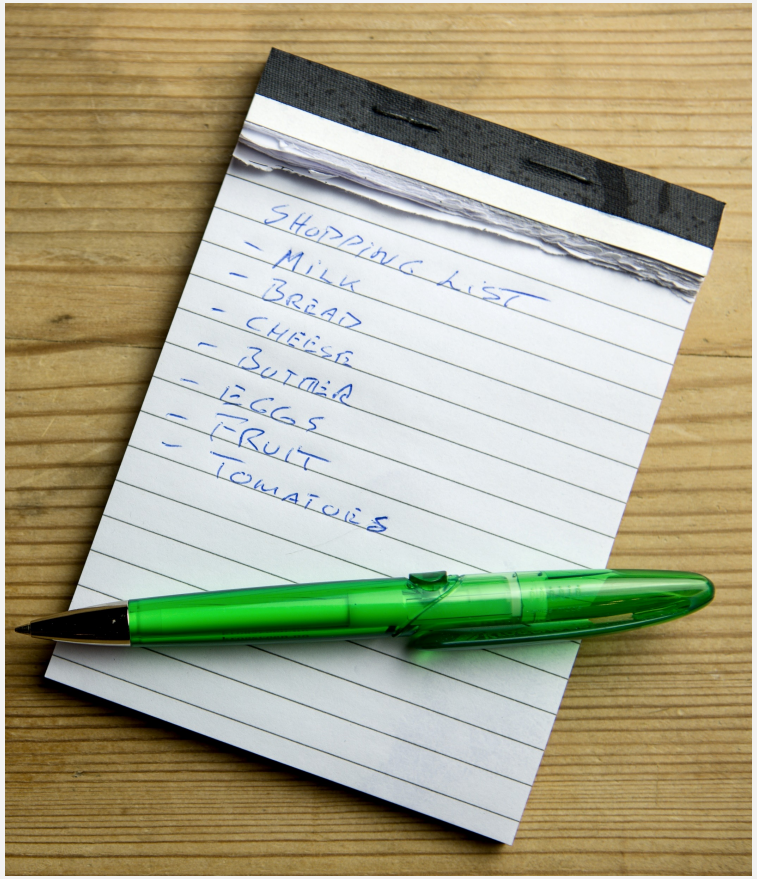
What are Data Structures?

- Containers that can hold multiple items of data
- Used to organise, manage, retrieve and store data
- Covered in this video:
  - Lists
- Covered later:
  - Tuples
  - Sets
  - Dictionaries

Examples of Data Structures



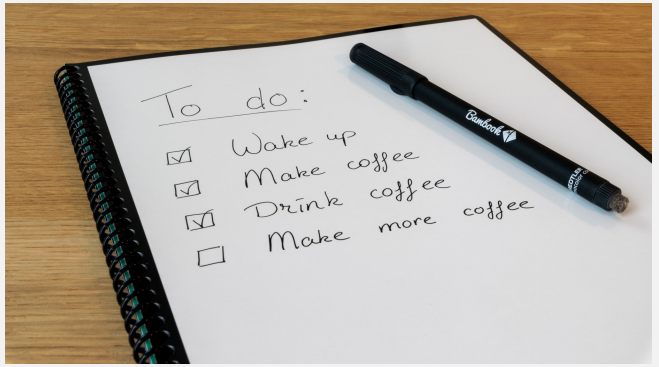


What is the Purpose of Lists?

- Handle large volume of data more easily
- Store multiple values in same container
  - Can store values of the same or different data types
- Work well when items in the container change dynamically

Examples:

- Attendance list for an event
- Shopping basket



List Data Type

- Ordered sequence of data items
- Data items within a list are called elements
- Items can be of any data type, including list
- Lists are defined using square brackets [ ] around the elements separated with commas

```
# fruit_list contains 4 elements of type string
fruit_list = ["apple", "banana", "pineapple", "orange"]
# list1 contains 4 elements of type string, int, float, bool
list1 = ["Area 1", 365, 33.2, True]
```

Accessing List Elements

- List element positions are indexed
  - 0 is the index of the first element position
  - 1 is the index of the second element position
  - List length - 1 (or just -1) is the index of the last element position
- List elements can be accessed by using the list name followed by the index of the element inside the [ ]
  - `fruit_list[0]` returns `"apple"`
  - `fruit_list[-1]` returns `"orange"`, the last element
  - `list1[3]` returns `True`

Examples I

Printing the list and its elements

```
list1 = [1, 2, 3]
print(list1)
```

```
[1, 2, 3]
```

```
list1 = [1, 2, 3]
print(list1[-1])
```

```
3
```

```
list1 = [1, 2, 3]
print(list1[0])
```

```
1
```

Modifying an element of the list

```
list1 = [1, 2, 3]
list1[1] += 1
print(list1)
```

```
[1, 3, 3]
```

```
list1 = [1, 2, 3]
list1[1] = list1[0]
print(list1)
```

```
[1, 1, 3]
```

```
list1 = [1, 2, 3]
list1[1] = False
print(list1)
```

```
[1, False, 3]
```

Examples II

Printing the list and its elements

```
list1 = [1, 2, 3]
print(list1)
```

```
[1, 2, 3]
```

```
list1 = [1, 2, 3]
print(list1[-1])
```

```
3
```

```
list1 = [1, 2, 3]
print(list1[0])
```

```
1
```

Modifying an element of the list

```
list1 = [1, 2, 3]
list1[1] += 1
print(list1)
```

```
[1, 3, 3]
```

```
list1 = [1, 2, 3]
list1[1] = list1[0]
print(list1)
```

```
[1, 1, 3]
```

```
list1 = [1, 2, 3]
list1[1] = False
print(list1)
```

```
[1, False, 3]
```

List Properties

- Lists are mutable, so elements can be:
  - Altered
  - Added
  - Removed
- Lists can be empty
  - Used to initialize empty lists and add elements later
- Lists can contain another list as an element

Examples III

Empty list

```
list2 = []
print(list2)
```

```
[]
```

Lists as elements

```
list3 = [[1, 2, 3], 4, 5, []]
print(list3)
```

```
[[1, 2, 3], 4, 5, []]
```

Lists as elements

```
list1 = [1, 2, 3]
list2 = []
list3 = [list1, 4, 5, list2]
print(list3)
```

```
[[1, 2, 3], 4, 5, []]
```

Printing an element of type list

```
list1 = [1, 2, 3]
list2 = []
list3 = [list1, 4, 5, list2]
print(list3[0])
```

```
[1, 2, 3]
```

Common Errors in Python

Accessing and element with an index greater than length - 1:

```
list1 = [1, 2, 3]
print(list1[3])
```

```
---------------------------------------------------------------------------
IndexError                                Traceback (most recent call last)
~\AppData\Local\Temp\ipykernel_15176\3794075674.py in <module>
      1 list1 = [1, 2, 3]
----> 2 print(list1[3])

IndexError: list index out of range
```

Error location

Error description

Error type

Try It Yourself

Enter and run the following statements in the python environment:

```
list1 = [2, 3]
sum = list1[0] + list1[1]
print(sum)
```

```
list2 = [1, 2, 3]
list2[0] += list2[2]
print(list2[0])
```

```
list3 = [5, "orange"]
list3[0] -= 2
print(list3[1], list3[0])
```

```
list4 = [15, True]
if list4[1] == True:
 print(list4[0])
```

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