# GCSE

Practical programming skills in Python

# Two-dimensional lists

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9

## Objectives

- Understand the nature of a 2D list
- Be able to use a 2D list to solve a problem

## Starter activity

- A hotel has five floors, including the ground floor
- What order would you choose if you had to clean all the rooms in this hotel?
  - Try to describe the algorithm using as few steps as possible

## Starter activity

1. Clean all the rooms on the ground floor
2. Then the first floor
3. Then the second floor
4. Then the third floor
5. Then the fourth floor

## Starter activity

```
• For each floor in the hotel:
      For each room on that floor:
          Clean that room
```

## One-dimensional lists

- A one-dimensional list allows you to store several values together in one place

`names`

| 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| “Alison” | “Bob” | “Carol” | “Dave” | “Edgar” |

```
names[1] = "Bob"
  len(names) = 5
```

## Two-dimensional lists

- A two-dimensional list allows you to store data that would usually fit into a table

`highScores` points in each game

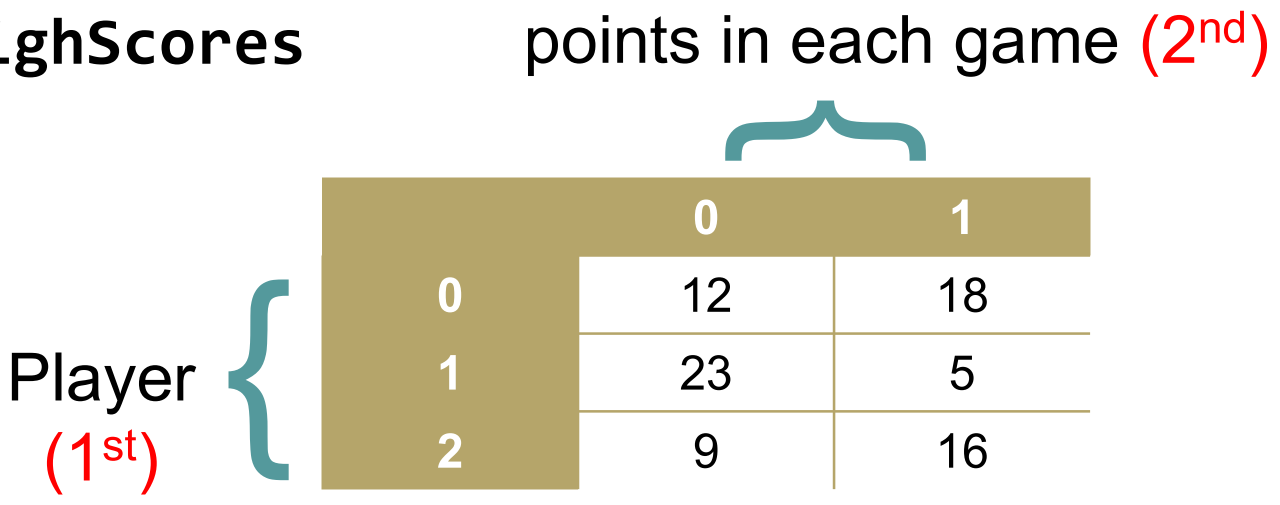
player

|   | 0 | 1 |
|---|---|---|
| 0 | 12 | 18 |
| 1 | 23 | 5 |
| 2 | 9 | 16 |

# Two-dimensional lists

- You address the row first (which player)
- Then the column (which go)

`highScores`



points in each game (2nd)

Player (1st)

|   | 0 | 1 |
|---|---|---|
| 0 | 12 | 18 |
| 1 | 23 | 5 |
| 2 | 9 | 16 |

# Two-dimensional lists

- You address the row first (which player)
- Then the column (which go)

**`highScores`**

points in each game (2nd)

Player (1st)

| | 0 | 1 |
|---|---|---|
| **0** | 12 | 18 |
| **1** | 23 | 5 |
| **2** | 9 | 16 |

```
highScores[1][0] =
```

## Two-dimensional lists

- You address the row first (which player)
- Then the column (which go)

**`highScores`** points in each game (2nd)

Player (1st)

| | 0 | 1 |
|---|---|---|
| 0 | 12 | 18 |
| 1 | 23 | 5 |
| 2 | 9 | 16 |

```
highScores[1][0] =
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# Two-dimensional lists

- You address the row first (which player)
- Then the column (which go)

**`highScores`**

points in each game (2nd)

Player (1st)

| | 0 | 1 |
|---|---|---|
| 0 | 12 | 18 |
| 1 | 23 | 5 |
| 2 | 9 | 16 |

```
highScores[1][0] =
```

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# Two-dimensional lists

- You address the row first (which player)
- Then the column (which go)

**`highScores`**

points in each game (2nd)

Player (1st)

|   | 0 | 1 |
|---|---|---|
| 0 | 12 | 18 |
| 1 | 23 | 5 |
| 2 | 9 | 16 |

```
highScores[1][0] = 23
```

## Worksheet 9a

- Complete **Question 1**

## Creating a 2-D List

- Try the following code

```
highScores = [ [12,18], [23,5], [9,16] ]
print(highScores)
print(highScores[1][0])
```

| | 0 | 1 |
|---|---|---|
| 0 | 12 | 18 |
| 1 | 23 | 5 |
| 2 | 9 | 16 |

## Creating a 2-D List

- A 2-D list is basically a list of lists

$$\texttt{highScores = [ }\underbrace{\texttt{[12,18]}}_{\text{Player 0}}\texttt{, }\underbrace{\texttt{[23,5]}}_{\text{Player 1}}\texttt{, }\underbrace{\texttt{[9,16]}}_{\text{Player 2}}\texttt{ ]}$$

| | 0 | 1 |
|---|---|---|
| 0 | 12 | 18 |
| 1 | 23 | 5 |
| 2 | 9 | 16 |

## Appending to a 2-D List

- Append an extra list to add an extra row:

```
highScores = [ [12,18], [23,5], [9,16] ]
highScores.append([20,20])
```

| | 0 | 1 |
|---|---|---|
| 0 | 12 | 18 |
| 1 | 23 | 5 |
| 2 | 9 | 16 |
| 3 | 20 | 20 |

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# Worksheet 9a

- Complete **Questions 2 - 5**

## Finding the size of a list

- What will be the result of this code?

```
highScores = [ [12,18], [23,5], [9,16] ]
print(len(highScores))
```

| | 0 | 1 |
|---|---|---|
| 0 | 12 | 18 |
| 1 | 23 | 5 |
| 2 | 9 | 16 |

## Finding the size of a list

- What will be the result of this code?

```
highScores = [ [12,18], [23,5], [9,16] ]
print(len(highScores))
```

|  |  | 0 | 1 |
|---|---|---|---|
|  | 0 | 12 | 18 |
| 3 { | 1 | 23 | 5 |
|  | 2 | 9 | 16 |

# Finding the size of a list

- What will be the result of this code?

```
highScores = [ [12,18], [23,5], [9,16] ]
print(len(highScores[0]))
```

| | 0 | 1 |
|---|---|---|
| 0 | 12 | 18 |
| 1 | 23 | 5 |
| 2 | 9 | 16 |

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## Finding the size of a list

- What will be the result of this code?

```python
highScores = [ [12,18], [23,5], [9,16] ]
print(len(highScores[0]))
```

$\overbrace{\qquad\qquad\qquad}^{2}$

|  | 0 | 1 |
|---|---|---|
| 0 | 12 | 18 |
| 1 | 23 | 5 |
| 2 | 9 | 16 |

## Worksheet 9b

- Complete **Question 1**

# Stepping through a list

- How can you print out each score for player 0?

```
highScores = [ [12,18] , [23,5] , [9,16] ]
```

| | 0 | 1 |
|---|---|---|
| 0 | 12 | 18 |
| 1 | 23 | 5 |
| 2 | 9 | 16 |

## Stepping through a list

- How can you print out each score for player 0?

```
highScores = [ [12,18] , [23,5] , [9,16] ]
print(highScores[0][0])
print(highScores[0][1])
```

| | 0 | 1 |
|---|---|---|
| **0** | 12 | 18 |
| **1** | 23 | 5 |
| **2** | 9 | 16 |

## Stepping through a list

- How can you print out each score for player 0?

```
highScores = [ [12,18] , [23,5] , [9,16] ]
print(highScores[0][0])
print(highScores[0][1])
```

- Can this be done more efficiently with a loop?

| | 0 | 1 |
|---|---|---|
| 0 | 12 | 18 |
| 1 | 23 | 5 |
| 2 | 9 | 16 |

## Stepping through a list

- How can you print out each score for player 0?

```
highScores = [ [12,18] , [23,5] , [9,16] ]
for i in range(len(highScores[0])):
    print(highScores[0][i])
```

| | 0 | 1 |
|---|---|---|
| 0 | 12 | 18 |
| 1 | 23 | 5 |
| 2 | 9 | 16 |

## Stepping through a list

- How can you print out each score for player 0?

```
highScores = [ [12,18] , [23,5] , [9,16] ]
for i in range(len(highScores[0])):
    print(highScores[0][i])
```

`len(highScores[0]) = 2`

| i | target | value |
|---|---|---|
| | | |
| | | |

| | 0 | 1 |
|---|---|---|
| 0 | 12 | 18 |
| 1 | 23 | 5 |
| 2 | 9 | 16 |

## Stepping through a list

- How can you print out each score for player 0?

```
highScores = [ [12,18] , [23,5] , [9,16] ]
for i in range(len(highScores[0])):
   print(highScores[0][i])
```

```
len(highScores[0]) = 2
```

| i | target | value |
|---|---|---|
| 0 | | |
| | | |

| | 0 | 1 |
|---|---|---|
| 0 | 12 | 18 |
| 1 | 23 | 5 |
| 2 | 9 | 16 |

## Stepping through a list

- How can you print out each score for player 0?

```
highScores = [ [12,18] , [23,5] , [9,16] ]
for i in range(len(highScores[0])):
   print(highScores[0][i])
```

`len(highScores[0]) = 2`

| i | target | value |
|---|---|---|
| 0 | [0][0] | |
| | | |

| | 0 | 1 |
|---|---|---|
| 0 | 12 | 18 |
| 1 | 23 | 5 |
| 2 | 9 | 16 |

## Stepping through a list

- How can you print out each score for player 0?

```
highScores = [ [12,18] , [23,5] , [9,16] ]
for i in range(len(highScores[0])):
   print(highScores[0][i])
```

`len(highScores[0]) = 2`

| i | target | value |
|---|---|---|
| 0 | [0][0] | 12 |
| | | |

| | 0 | 1 |
|---|---|---|
| 0 | 🟥 12 | 18 |
| 1 | 23 | 5 |
| 2 | 9 | 16 |

## Stepping through a list

- How can you print out each score for player 0?

```
highScores = [ [12,18] , [23,5] , [9,16] ]
for i in range(len(highScores[0])):
    print(highScores[0][i])
```

`len(highScores[0]) = 2`

| i | target | value |
|---|---|---|
| 0 | [0][0] | 12 |
| | | |

| | 0 | 1 |
|---|---|---|
| 0 | 12 | 18 |
| 1 | 23 | 5 |
| 2 | 9 | 16 |

## Stepping through a list

- How can you print out each score for player 0?

```
highScores = [ [12,18] , [23,5] , [9,16] ]
for i in range(len(highScores[0])):
   print(highScores[0][i])
```

```
len(highScores[0]) = 2
```

| i | target | value |
|---|---|---|
| 0 | [0][0] | 12 |
| 1 | [0][1] | |

| | 0 | 1 |
|---|---|---|
| 0 | 12 | 18 |
| 1 | 23 | 5 |
| 2 | 9 | 16 |

## Stepping through a list

- How can you print out each score for player 0?

```
highScores = [ [12,18] , [23,5] , [9,16] ]
for i in range(len(highScores[0])):
   print(highScores[0][i])
```

`len(highScores[0]) = 2`

| i | target | value |
|---|---|---|
| 0 | [0][0] | 12 |
| 1 | [0][1] | 18 |

|  | 0 | 1 |
|---|---|---|
| 0 | 12 | 🟥 18 |
| 1 | 23 | 5 |
| 2 | 9 | 16 |

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# Worksheet 9b

- Complete **Questions 2** and **3**

## Stepping through a list

- How can you get the total score for player 0?

```
highScores = [ [12,18] , [23,5] , [9,16] ]
for i in range(len(highScores[0])):
   print(highScores[0][i])
```

| | 0 | 1 |
|---|---|---|
| 0 | 12 | 18 |
| 1 | 23 | 5 |
| 2 | 9 | 16 |

## Stepping through a list

- How can you get the total score for player 0?

```
total = 0
highScores = [ [12,18] , [23,5] , [9,16] ]
for i in range(len(highScores[0])):
   total = total + highScores[0][i])
print(total)
```

| | 0 | 1 |
|---|---|---|
| 0 | 12 | 18 |
| 1 | 23 | 5 |
| 2 | 9 | 16 |

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## Worksheet 9b

- Complete **Questions 4** and **5**

## Sorting a list

- Suppose we have a 2-D list `gameScores`, with contents shown in the table below
- We want to sort the list in descending order of scores
  - How could you refer to Dave's name?
  - How could you refer to Phil's score?

| | 0 | 1 |
|---|---|---|
| 0 | Dave | 18 |
| 1 | Christina | 23 |
| 2 | Phil | 20 |

## Sorting a list

- To create this 2D list, use the following statement:

```
gameScores =
[["Dave",18],["Christina",23],["Phil",20]]
```

|   | 0 | 1 |
|---|---|---|
| 0 | Dave | 18 |
| 1 | Christina | 23 |
| 2 | Phil | 20 |

## A bubble sort

```
Repeat this ‘numRows’ - 1 times:
```

| | 0 | 1 |
|---|---|---|
| 0 | Dave | 18 |
| 1 | Christina | 23 |
| 2 | Phil | 20 |

## A bubble sort

```
Repeat this ‘numRows’ - 1 times:
    Check if scores in the next two rows
      are in the wrong order
```

| | 0 | 1 |
|---|---|---|
| 0 | Dave | 18 |
| 1 | Christina | 23 |
| 2 | Phil | 20 |

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## A bubble sort

```
Repeat this ‘numRows’ - 1 times:
    If the two scores are in the wrong order
        Swap the rows
```

| | 0 | 1 |
|---|---|---|
| 0 | Dave | 18 |
| 1 | Christina | 23 |
| 2 | Phil | 20 |

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## A bubble sort

```
Repeat the whole process ‘numRows - 1’ times:
    Repeat this ‘numRows’ - 1 times:
        If two scores are in the wrong order
            Swap the rows
```

| | 0 | 1 |
|---|---|---|
| 0 | Dave | 18 |
| 1 | Christina | 23 |
| 2 | Phil | 20 |

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## A bubble sort algorithm

```
numRows = len(gameScores)
for i in range(numRows-1):
   for j in range(numRows-1):
      #compare the scores in next 2 rows
      if gameScores[j][1] < gameScores [j+1][1]:
         # swap the rows
         temp = gameScores[j]
         gameScores[j]= gameScores[j+1]
         gameScores[j+1] = temp
```

## Sorting a 2D list

- You can use a lambda function to sort a 2D list
  - A lambda function allows you to specify which column to sort on
  - data is a temporary variable to store each row
  - data[1] means that the sort is done on column 1

```
highScores =
sorted(highScores, key=lambda data:data[1])
```

|   | 0 | 1 |
|---|---|---|
| 0 | Dave | 18 |
| 1 | Phil | 20 |
| 2 | Christina | 23 |

## Sorting a 2D list in descending order

- To sort in descending order of score:

```
highScores = sorted(highScores, key=lambda
data:data[1], reverse = True)
```

- How would you sort on name in reverse alphabetical order?

| | 0 | 1 |
|---|---|---|
| 0 | Dave | 18 |
| 1 | Phil | 20 |
| 2 | Christina | 23 |

## Worksheet 9c

- Complete **Worksheet 9c**

## Plenary

- Which statement below would print the value highlighted in black?
  - print(values[0][1])
  - print(values[1][0])
  - print(values[0,1])
  - print(values[1,0])

| | 0 | 1 |
|---|---|---|
| 0 | 12 | 18 |
| 1 | 23 | 20 |
| 2 | 9 | 23 |

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## Plenary

- What code would print the value highlighted in black?
  - print(values[0][1])
  - print(values[1][0])
  - print(values[0,1])
  - print(values[1,0])

|   | 0 | 1 |
|---|---|---|
| 0 | 12 | 18 |
| 1 | 23 | 20 |
| 2 | 9 | 23 |

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