

GCSE OCR

Computer Science
J277

4

Arrays

Unit 7 Programming



PG ONLINE

Objectives

- Use one- and two-dimensional arrays in the design of solutions to simple problems

Starter

- Imagine a medieval computer game for two players that uses variables to store their data – e.g.

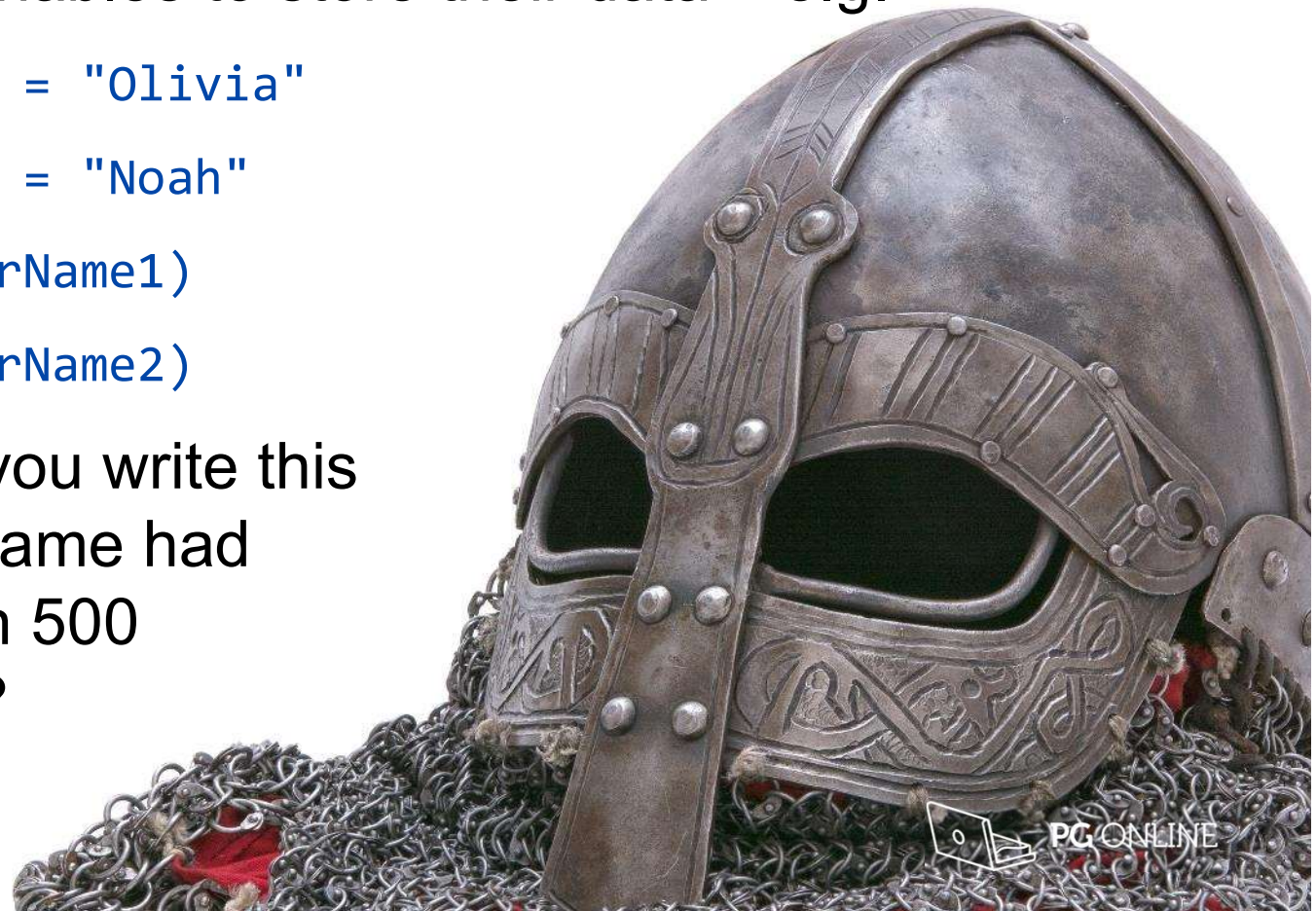
```
playerName1 = "Olivia"
```

```
playerName2 = "Noah"
```

```
print(playerName1)
```

```
print(playerName2)
```

- How would you write this code if the game had an army with 500 players in it?



Starter

Answers

- One solution would be to create a variable for every player

```
playerName1 = "Olivia"
```

```
playerName2 = "Noah"
```

```
...
```

```
playerName500 = "Elijah"
```

- This would involve lots of copying and pasting of code and become a big problem with writing algorithms
 - **Instead other data structures such as arrays are used**



Arrays

- An array is a data structure that allows you to hold many items of data which is referenced by one identifier
 - All items of data in the array must be of the same data type
- An array of 10 integers called `userNames` could be declared as:
 - `array usernames[10]`

usernames →

0	
1	
2	
3	
4	
5	
6	
7	
8	
9	



Arrays

- Information can be read from or added to the array using the index number
 - Indexes in most languages start at 0 not 1
- To add five usernames we would use:

```
array usernames[10]
usernames[0] = "psmith"
usernames[1] = "ltorvalds"
usernames[2] = "pwatts"
usernames[3] = "sjones"
usernames[4] = "mpatel"
```

Usernames →

0	"psmith"
1	"ltorvalds"
2	"pwatts"
3	"sjones"
4	"mpatel"
5	
6	
7	
8	
9	

- How would you add five more usernames?
- How would you find an array's length?



Arrays

- How would you add five more usernames?

```
usernames[5] = "bwright"  
usernames[6] = "mgreen"  
usernames[7] = "dthomas"  
usernames[8] = "nwhite"  
usernames[9] = "fdavies"
```

- How would you find an array's length?

```
usernames.length //this returns 10
```

Answers

Username


0	"psmith"
1	"ltorvalds"
2	"pwatts"
3	"sjones"
4	"mpatel"
5	"bwright"
6	"mgreen"
7	"dthomas"
8	"nwhite"
9	"fdavies"



Arrays

- An array has a fixed length
 - We cannot add any more usernames to the array shown
 - To add more usernames, we would need to create a new larger array and copy the names across
 - Python doesn't have an array data structure – it instead uses lists which can alter their length
- How would you write a FOR loop to output all the usernames in the array?

Usernames



0	"psmith"
1	"ltorvalds"
2	"pwatts"
3	"sjones"
4	"mpatel"
5	"bwright"
6	"mgreen"
7	"dthomas"
8	"nwhite"
9	"fdavies"



Arrays

Answers

- How would you write a FOR loop to output all the usernames in the array?

```
for i = 0 to usernames.length  
    print(username[i])  
endfor
```

- Adapt the code so that the user can enter a username and find out if it is present in the array
 - What type of search algorithm have you used?

Usernames →

0	"psmith"
1	"ltorvalds"
2	"pwatts"
3	"sjones"
4	"mpatel"
5	"bwright"
6	"mgreen"
7	"dthomas"
8	"nwhite"
9	"fdavies"



Linear searching an array

Answers

- Adapt the code so that the user can enter a username and find out if it is present in the array

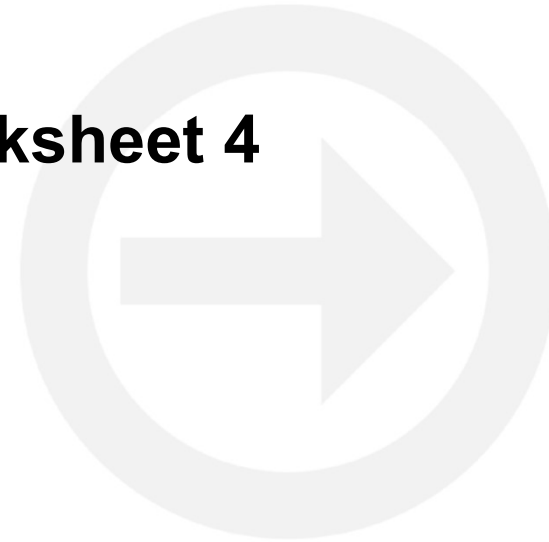
```
search = input("Type in username: ")  
for i in range(usernames.length)  
    if usernames[i] == search  
        print("Name found")
```

- What type of search algorithm have you used?
 - This algorithm is a linear search



Worksheet 4

- Now complete **Task 1** on **Worksheet 4**



Advantages of using arrays

- Imagine that you want to input, sort and print 100 user names. It would be very inconvenient to use 100 different variable names

- Using an array, you can write:

```
for i = 0 to 99
    userNames[i] = input("Enter next name: ")
next i
(Sort the names)
for i = 0 to 99
    print(UserName[i])
next i
```

- What algorithm could be used to sort a list?



Linear search

- In a linear search, each item is examined in sequence until the item is found or the end of the list is reached

- How can this algorithm be made more efficient?

```
resort = ["Margate", "Swansea", "Brighton",  
         "St Ives", "Cromer"]
```

```
for n = 0 to resort.length  
    if townName == resort[n] then  
        found = True  
    endif
```

```
next n
```

- Suggest a different loop and Boolean expression



Linear search

- The search should stop as soon as the item is found

```
resort = ["Margate", "Swansea", "Brighton",  
         "St Ives", "Cromer"]
```

```
found = False
```

```
i = 0
```

```
while NOT found AND i < resort.length
```

```
    if townName == resort[i] then
```

```
        found = True
```

```
    endif
```

```
    i = i + 1
```

```
endwhile
```

- How many times is the loop performed if you are searching for Brighton? Or Bournemouth?



The bubble sort

- Each item in a list is compared to the one next to it, and if it is greater, they swap places
- At the end of one pass through the list, the largest item is at the end of the list
- This is repeated until the items are sorted
- Suppose you have an array of five names to be sorted:

Sam	Ron	Tom	Bob	Mo
-----	-----	-----	-----	----



Bubble sort algorithm

```
names = ["Sam", "Ron", "Tom", "Bob", "Mo"]
numItems = len[names]
for i = 0 to numItems - 2
    for j = 0 to numItems - i - 2
        if names[j] > names[j + 1] then
            swap the items
        endif
    next j
next i
```

- How can you perform the part of the algorithm that says 'swap the items'?

Swapping items in an array

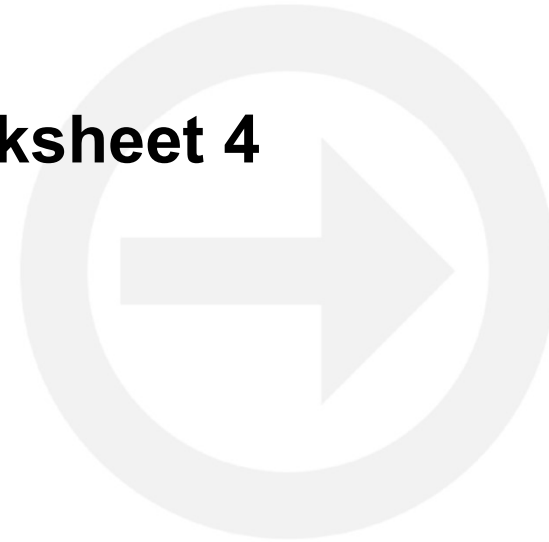
Answers

```
names = ["Sam", "Ron", "Tom", "Bob", "Mo"]
numItems = len[names]
for i = 0 to numItems - 2
    for j = 0 to numItems - i - 2
        if names[j] > names[j + 1] then
            temp = names[j]
            names[j] = names[j + 1]
            names[j + 1] = temp
        endif
    next j
next i
```



Worksheet 4

- Now complete **Task 2** on **Worksheet 4**



Two-dimensional arrays

- Suppose you wanted to hold in a program, 5 marks for each of 3 students

	0	1	2	3	4	
Student1	12	14	8	7	17	0
Student2	6	8	5	3	13	1
Student3	16	15	9	10	18	2

- These marks could be put into a 2D array
- You can set individual items in the array like this:

```
mark[2][4] =18
```

- What is the value of `mark[1][0]`?



Processing a 2D array

- Find and display the total mark for each student:

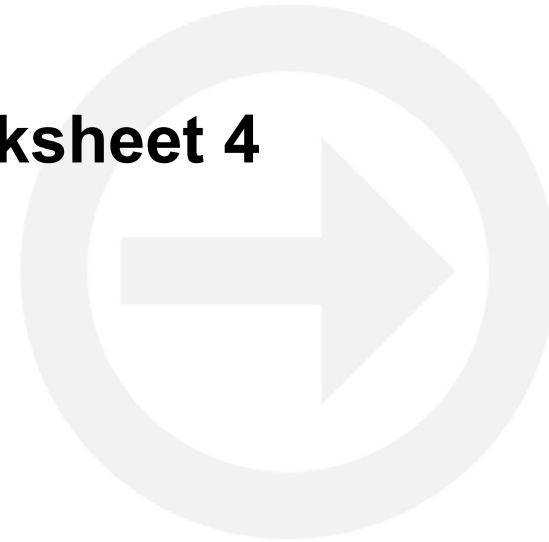
Student1	12	14	8	7	17
Student2	6	8	5	3	13
Student3	16	15	9	10	18

```
for s = 0 to 2
    studentTotal = 0
    for m = 0 to 4
        studentTotal = studentTotal + mark[s] [m]
    next m
    print(studentTotal)
next s
```



Worksheet 4

- Now complete **Task 3** on **Worksheet 4**



Plenary

- Complete the following with the words beneath

_____ allow many data items to be stored under one _____. Each item in the array can be accessed by its array _____. Indexes start at _____. By using a _____ we can easily loop through an array. Arrays have a _____ and all items in the array have the same _____.

zero

index

FOR loop

fixed length

arrays

data type

identifier



Plenary

Answers

- Complete the following with the words beneath

Arrays allow many data items to be stored under one **identifier**. Each item in the array can be accessed by its array **index**. Indexes start at **zero**. By using a **FOR loop** we can easily loop through an array. Arrays have a **fixed length** and all items in the array have the same **data type**.

zero**index****FOR loop****fixed length****arrays****data type****identifier**

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