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

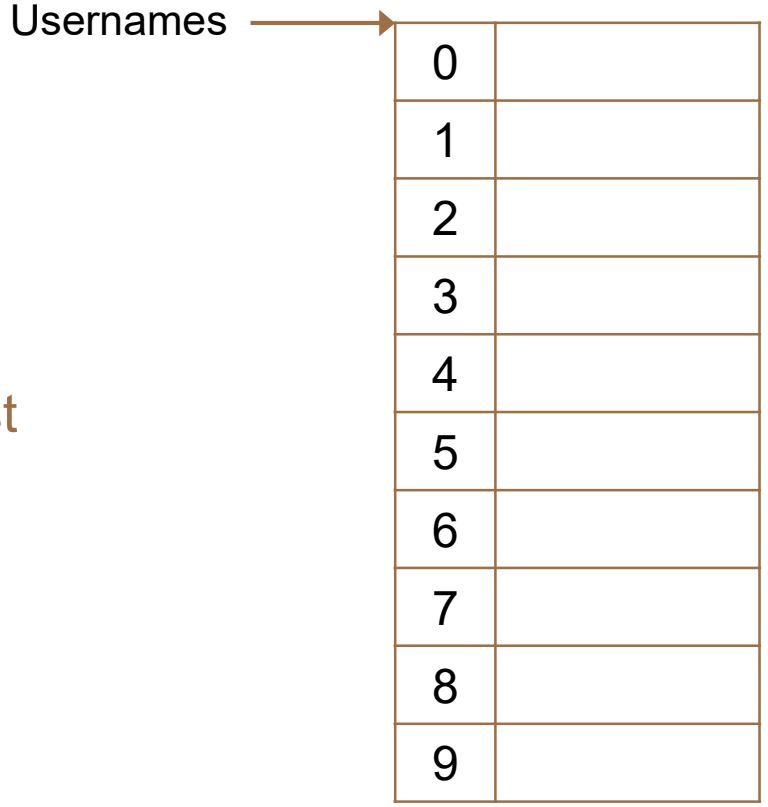
- One solution would be to create a variable for every player

```
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]`



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

Answers

- 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
```

Usernames →

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 an 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

Answers

- 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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