AlgoHack #7

ARRAYS IN PROGRAMING

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Review
Ravindu Ramesh Perera, Devanjith De Silva,
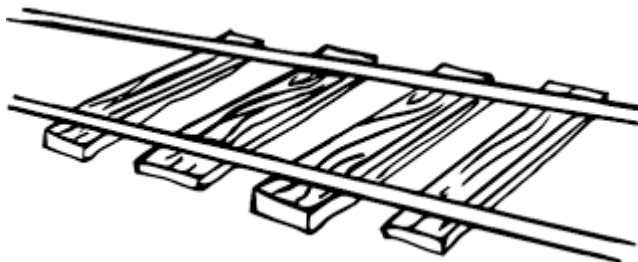Prabhashana Hasthidhara, Yamuna Ratnayake.

This railtrack has an **Array** of wooden bars

Array of colors

Array of emojis

Arrays in programming?
Array is a list of data or objects.
Each Array has a name.
In Arrays data is stored in a series of elements.

Explore Lists in Life

Give some Lists used in your life?
Can you put them to arrays as values?

This **coat hanger** is at Freddie Crows Restaurant. It has **3 hooks**. Each hook can hang one coat or a hat. On a rainy day Ami, Bimi and Cimi Crows come for dinner at Friedie's. Ami hang his coats and hat on hook 1 and 2. Bimi hang his coat on hook 3. Ami leaves. Bimi comes and hang his coat on hook 2. Cimi comes in a coat and hat.
Where will Cimi hang his coat and hat?
What is your advice to Freddie Crow?

What will be on hangar array ?

Event		Hook 1	Hook 2	Hook3
Before all				
Ami comes				
Bimi Comes				
Cimi Comes				

"ALGOHACK" is a string of **8** characters.
They are in an array of bytes in memory.

Write Your Name as a Character Array

If the 1st letter is in 1st element,
What is in 4th element?

Array Index starts with zero

element		A	L	G	O	H	A	C	K
Index		**0**			3			6	

The zero index

How many **elements** are in above array?

What is the character at i**ndex 0** ?

What is the array **index of G**

If there are **N elements**,

What is **index of last element**?.

Why last element number and its index is **different**?

How to access data in arrays?

First we have to declare the array with a name.

If we declare is as project

We can use project[index] to access its data..

What are the values in project array ?
project[0], project[4], project[7]
What will happen with project[8] and project[9] ?

Name is an array of characters.

It stores 8 characters in memory.

```
Name=["A","L","G","O","H","A","C","K"]
```

We can process this array using for … range
```
for x in range(0, 7): # loop condition
    print (Name[x])   #  x=array index
```

We can also process this as array of members
```
for letter in Name:
    print (letter)
```

What is the difference between two methods?
What are the advantages and disadvantages

.

Design an algorithm
Find **average marks** of 5 students.
Steps
1. **Store** marks in an array.
2. **Process** array in a loop to get sum of all values.
3. **Calculate Average** (formula = **sum/numvalues)**
4. **Output** Average.

Draw a flowchart and write a pseudocode.
Can you write a program to solve this problem.
Tip : marks=[65, 49, 60, 85, 56 , 86]
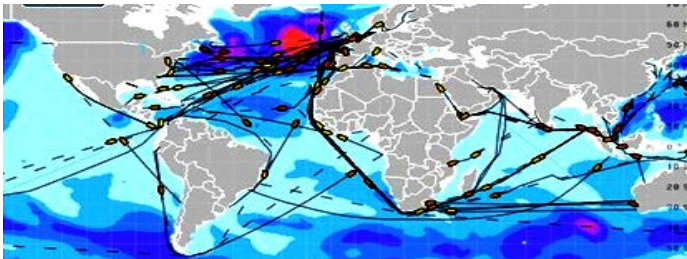

Python lists are arrays.
A list is an queue of elements.
Each element can keep a value or an object.
Wow! A list element can be another list.

Lists are mutable.

mutable means you can add, delete list elements any time. This is very useful in creating, analysing and visualising **complex data structures** for science.

Discuss Weather Maps and their uses.
How they use data collected globally.
What kinds of lists they may be using?

Accessing Data in Lists
myList=[1,2,3,4,5,6]
print (myList[2]) # display the 3rd element
myList[3]=12   # assign new value to 4th element
print (myList[3]) # What is the output ?
Subsets
We can obtain subsets of data from an array.
```
newlist=myList[2:5]
```

```
print(newlist)  # output [3,4,5]
```

Assign multiple values to a list
myList[0:2]=[2,4] # index 0 and 1 are updated
It is same as
myList[0]=2
myList[2]=4

Finding a maximum value in a list
For this we scan the list from beginning to end and
compare values.
```
myList=[2,4,7,0,12, 14,3, 3, 45, 24]
max=0
for N in myList:
    if max < N:
        max=N
print(max)
```

Explain what happens in above program.
Write a program to obtain minimum value of a list.
Modify your program to obtain index of the value?
What will happen if the array contain negative values?

The Array Length
The len() function help us to find the number of
elements in any array. We need this for processing
arrays in loops.
myList=[2,4,7,0,12, 14,3, 3, 45, 24]
n=len(myList)
print(n) # n is the number of elements in array

What is the output of above code?
A. What will be the output of *print (myList[n])* ?
B. What will be the output of p*rint (myList[n-1])* ?
Explain A and B.

Building a lists from scratch
We have to declare empty array first.
myList=[] # no data yet
myList[0] =1 # will give an error. **Why ?**

When we declare an empty array there are no elements
in it. When we try to update a non existing element we
get an error.

How to add an element to a list >
First we create an empty list in memory, say myList,
Then we can add elements one by one.

myList=[ ]   myList.append(7)   myList.append(3)

Empty Array   1st Element   2nd Element
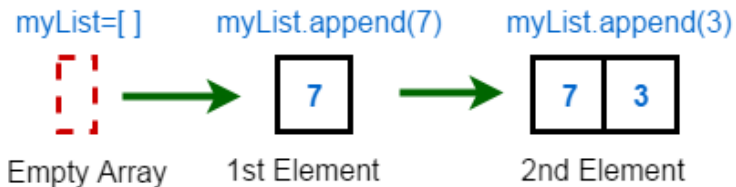
```
myList=[]
myList.append(7) # add 7 to the list
myList[0] =9 # change 1st element to 9
print (myList[0]) # now it works
```

What will happen if we add following code?
myList.append(5)
myList.append(-1)
print(myList)
Can you write a program to create list with numbers
from 1 to 100 ? *Tip : Use a loop*

Are these **valid python code?**

list2 = [1, 2, 3, 4, 5];
list1 = ['math', 'art', 2017, 2011];
list3 = ["a", "b", "c", d]
What happens with *list1.append(list2)*
What will be the output of *list1[4]* and **why?**
print(list1[4][1]) gives 2.
Discuss ldata types of ist elements..

Inserting Values

What happens when you insert a page to a file.

Here we insert 2017 to index **3.**
```
myList = [123, "xyz", "cat", "algohack"]
print (myList)
myList.insert( 3, 2017)
print (myList)
```

What happens to the list after insert?
Test list1.insert(0,list2) **and explain.**

Removing List Elements
```
list1 = [1, 2, 3, 4, 5 ];
print (list1)
```
del list1[2] # index 2 is removed
```
print (list1)
```
Explain output of above program.
What will be the output if you add
del list1[2]
print (list1)
What happens if you write del list1[100] and **why?**

Can Python join Lists ?
Prove [1, 2, 3] + [4, 5, 6] gives [1,2,3,4,5,6]
```
a=[1, 2, 3]
b=[4, 5, 6]
c=a+b
print(c)
```
Test the code and explain output.

List Repetition

```
a=["Hello"] * 4
print (a)
```

What will be the output ? and why ?

How to search lists?

How do you find "N" in following Array?

A	L	G	O	H	A	C	K

We have to **scan elements** to find "N".
We have **compare** each element to find "N"
if we find "N", we **return** true,
else **continue until** last element is scanned..

```
L1=["A", "L", "G", "O","H","A","C", "K"]
found=0
for c in L1:
    if (c=="H"):
        found=1
        break
if found==1:
    print "H Found"
```

Explain above program with a flow chart.
Can you write a program to output index of "N"

Members of Lists
in() method checks if a value is a member of a list.
3 in [1,2,3] returns **True,** 3 is a **member** of [1,2,3]

```
L1=["A","L","G","O","H","A","C", "K"]
if ("H" in L):
    print "H Found"
```

We can compare lists in python
cmp method returns 0 if lists are same, else -1.
list1=[1,2,3]
list2=[4,5,6]
list3=[1,2,3]
a=cmp(list1, list2)
b=cmp(list1, list3)
print(a,b)

Analyse output of above program **and explain**.

Max and Min Methods
max() returns maximum value in a list.
min() returns minimum value in a list.

```
list1=[1,2,3,4,5]
print(max(list1))
print(min(list1))
```

What will be the output if we use ?
list1= [323, 'xyz', 'abc', 'def']

A tuple is an immutable list. We can't change values.

```
tuple1 = ("sun","mercury", "venus",
"earth");
```

```
tuple2 = (1, 2, 3, 4, 5 );
a=tuple1[2]
print (a)
```

Why tuple1[2]=7 gives an **error?**
Write a program to show that, Tuples can be sliced,
joined like lists, but values can't be changed.

What will happen with following code?
len(tuple1)
cmp(tuple1,tuple2)
min(tuple2)
max(tuple2)
tuple2.insert(2,7)

Pop() method removes and returns last element

There is an elevator in city hospital with 10 floors. The
elevator get crowded during visiting hours. The last people get
on are the first to get off. This method is called Last In First
Out (LIFO) . Explain advantages of LIFO elevator.
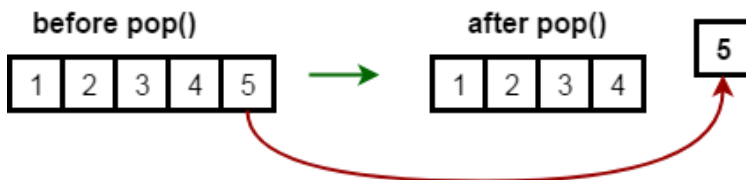

```
list1=[1,2,3,4,5,6,7]
N=list1.pop() # last element 7 removed and
returned
```

```
M=list1.pop()
```

What will be the output?
print(list1)
print(M,N)
Explain your answer

Reversing a List

Master Crow wants a program to store passwords by
reversing them, so ALGOHACK will be KCAHOGLA.
How will he do it by hand?
How many arrays does he need for processing?

Can following program help?
```
L1=["A","L","G","O","H","A","C","K"]
L2=[]
n=len(L1)    # find number of elements
for i in range (1, n+1):
    e=L1[n-i]
    L2.append(e)
print(L2)
```

Python reverse() method
```
L1 = [1, 2, 3, 4, 5]
L1.reverse()
print (L1)
```

Sorting Arrays

Sorting is important when we work with random data. We can search fast in an ordered list. If a teacher wants list of students entered randomly in alphabetical order, we have to sort names after taking the inputs.

Selection sort

```
list1 = [5,4,3,1,6,8,7,0,2] # not sorted
print (list1)
n=len(list1)
for i in range(n):
    for j in range(i+1, n):
        # print ("Checking index", i,   j )
        if(list1[i] > list1[j]):
            # print ("swaping ", list1[i],  list1[j] )
            temp=list1[i]
            list1[i] = list1[j]
            list1[j]=temp
print (list1)
```

Draw a flowchart and analyse list1 in each step of the program. Remove # comments and see what's happening inside. You can also use python debugger.

In python **list1.sort()** will does above task.

Extending a list

```
L1=[5, 4,3,5]
b=L1.count(5) # return how many times 5 appear in list
L2 = ["a", "b"];
L1.extend(L2)  # extend L1 adding L2
print (L1)
```

Python's Interactive Debugger
Python debugger helps pause a program, look at variables, and execute the program step-by-step. So we can understand what the program is actually doing to find any bugs in program logic.

Start debugger from **Debug** menu in python IDLE
Run following programs, Step over, and see how the program run and how variables change at different places.

a = 1 b = 2 c = 3 d= a + b + c print (d)	def add(a,b): 　c=a+b 　return c A, B = 1, 2 t=add(A,B) print (t)

AlgoHack aims to teach computer science to young people.

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