

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.

<pre>a = 1 b = 2 c = 3 d = a + b + c print (d)</pre>	<pre>def add(a,b): c=a+b return c A, B = 1, 2 t=add(A,B) print (t)</pre>
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AlgoHack #7



ARRAYS IN PROGRAMING

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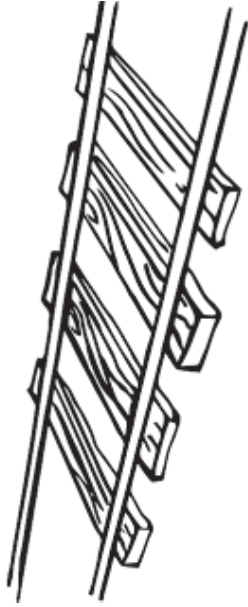


AlgoHack aims to teach Computer Science and Programming to young people, initiated by Shilpa Sayura Foundation, supported by GOOGLE RISE and Computer Society of Sri Lanka.

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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.

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 ("swapping ", 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)
```

```
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)
```

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.

Array Index starts with zero

<i>element</i>	A	L	G	O	H	A	C	K
Index	0			3			6	

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

What is the array index of G

What is index of last element? :

How to access data in arrays?

If we declare is as project

What are the values in project array ?

What will happen with project[8] and project[9] ?

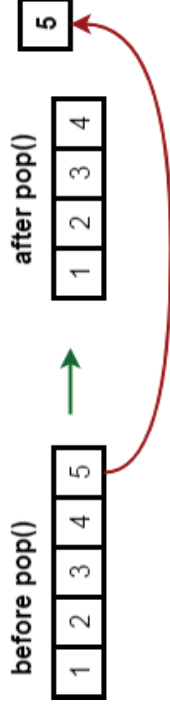
It stores 8 characters in memory.

Why `tuple1[2]=7` gives an **error**?

What will happen with following code?

Pop() method removes and returns last element

before pop()



```
N=list1.pop() # last element 7 removed and
```

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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");
```

```
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 = $\text{sum}/\text{numvalues}$)
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.

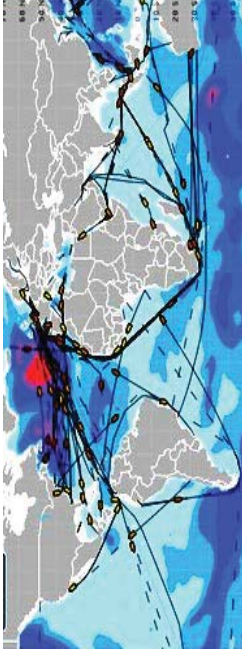
A list is an queue of elements.

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]
```

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"

Inserting Values

What happens when you insert a page to a file.

```
Here we insert 2017 to index 3.  
myList = [123, "xyz", "cat", "alghohack"]  
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.

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

Explain outputs

```
myList=[2,4,7,8,12, 14,3, 3, 45, 24]  
print(myList[3])  
print(myList[2:3])  
print(myList[3:7])  
print(myList[3:])  
print(myList[:3])  
print(myList[:7])  
print(myList[:])
```

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 `print (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) # 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 data types of list elements...