PYTHON

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Under the guidance of Bijen Singha sir.

Creator of Python - *Dutchman Guido van Rossum*

STRUCTURE

- input
- algorithm
- output

INPUT

they are of 2 types

1. **Run time/dynamic**(if the error occurs during run time it is said to be run time error)
2. **Compile time/static**(if the error occurs due to syntactical errors or spelling mistakes then it is called as compile time error)

- In python if input() - is a default function for string
  n=input()// n stores data in string format
  n==int(input())//n stores data in integer format
- Python doesn't use braces, it uses the concept of indentation
- Colon is used in conditional statements

> *Some important things to remember:*

OPERATORS

1. MEMBERSHIP OPERATOR ⇒in

only works with strings

checks if first thing is present in second

```
#ex 1
if 'hi ' in 'hi,hello':
    print("hi")
else:
    print("bye")
print("abc")

#prints bye abc because 'hi ' as has space in it

#ex 2
if 1 in 123:
       print(1)
elif 1 in '123':
       print(2)
else:
       print(3)

#membership operator only works on strings and not on integers
```

2. IDENTITY OPERATOR ⇒is

checks if both are identical are not

```
if not true is true:
      print(true)
elif not true is false:
       print(false)
else:
       print("error")

#o/p: false
```

3. TERNARY OPERATOR

SYNTAX : <expression>if<if condition>else<else condition>

```
x=y=10
z=1+(x if x>y else y)+2
print(z)

#ans=13



#ex:1
age =20
x 'can vote' if age>18 else 'cannot vote'
print(x)

#o/p:can vote

#ex 2:
x=y==10
z= 1+(x if x>y else y)+2

#o/p:13
```

~Derived Datatypes

List	Tuple	Dictionary	Set
a collection of different datatypes	tuple doesn't allow the data to be changed it is immutable.	in python dictionary contains key and values	set only shows unique values
empty list - a=[ ]	empty tuple - a=( )	empty dictionary - a={ }	empty set - a=set( )

a[ ]
print(type(a))
o/p:
<class 'list'>
	a()
	print(type(a))
	o/p:
	<class 'tuple'>
		a{}
		print(type(a))
		o/p:
		<class 'dictionary'>
			a=set()
			print(type(a))
			o/p:
			<class 'set'>

list rep:
a=["hey","h",3.09,9]
o/p:
["hey","h",3.09,9]
	tuple rep:
	a=("hey","h",3.09,9)
	o/p:
	("hey","h",3.09,9)
			a="bijen"
			a[0]=p
			print(a)

always represented by index value			#this only prints bijen as string is not mutable
list is mutable			

- just extra

```
#ex 1
if 3 and 0 or 2:
    print("true")
else:
    print("false")

    #prints true

 #ex 2
 if 3>7:
     if -3>-6:
           print("nested if")
     else:
           print("nested else")
else:
       print("else")
#o/p: else

#ex 3
if 11>15 or 12<15:
      if true and false:
             if not false:
                    print(1)
                         if 101 and 543:
                                print(2)
                         else:
                               print(3)
               else:
                      print(4)
```

- all non zero integers will return true in python and only zero will return false

```
if 999:
    print("hi")

   #this prints hi as 999 is a non zero integer
```

- condition is a statement which will return in true or false

```
if print("hello"):
    print("hi")

    #this prints only hello as - if print("hello") is a statement and not
```

```
while print("hi"):
    print("hello")

    #prints hi
```

```
while 999:
    print("hello")

    #prints hello n number of times
    #if while 0: then it prints no output
```

- Python stores variables with same value in the same location
- checking location of a variable : use id()

```
a=1
b=1
print(id(a),id(b))

#prints the location of the variable
```

- else can be used inside loops only (only when there's no break inside loop i.e. for/while will run completely)

```
for i in range(3):
   print(i,"i am sorry")
   #break(if used prints "0 i am sorry"
else:
 print("not sorry")
```

o/p:

0 i am sorry
1 i am sorry
2 i am sorry
not sorry

- continue will skip the lines below it and go to next statement or loop
- compile time error : syntax or mistake in program
- run time error : error after running
- default datatype - string

basically concatenates ex : n=2 then n+n=22

```
n=int(input())
ans=n+n
print(ans)
```

o/p:
4
8

- python doesn't have concept of braces it uses indentation
- use colon(:) -to represent end of condition

  -after else:

- flag-uses binary digits, used when there are only two conditions

2 MAIN CONCEPTS OF PROGRAMMING

CONDITIONAL

-if: (exactly one condition)

```
#ex1
n=int(input())
if n%2==0:
     b=7
            print(n, b)  #program doesn't execute because of indentation

#ex2
```

```
if n%2==0:

        b=7
        print(n, b)
```

-if else: (exactly 2 conditions)

```
n=int(input())
if n%2==0:
        b=7
        print(n, b)
else:
        print(b)      #doesn't get printed as b is defined in if block not

#o/p: name b is not defined//run time error
```

-**elif**(no limit to no of conditions)

example:

```
n=int(input())
if n>0:
  print("positive")       #(indendation is important in the next statement
elif n<0:
  print("negative")
else:
  print("0")
```

-nested if (all conditions need to be satisfied)

```
if height<5.5
 if weight==65
  if gender==female
    print("All conditions satisfied")
```

-dictionary(switch can be implemented in python using dictionary(switcher.get() is the function used to get the value from switcher)

CONTROL

-for

-

while loop -*while loop doesn't work if it equal to zero or if it starts from zero*

-no do while loop in python

-

break

-

continue

-

pass : has no effect on the program

*programs done using for loop or while loop can also be done using recursion

FOR LOOP

*reduces one by default. if 10 is given it'll run up to 9

SYNTAX : for i in range():

inside range we have ~initialization

~number of times to iterate

~step(basically skipping)

example :

```
n=input()
for i in range(1,10,2):
   print(n)
```

*try (-1,-10,-2) (1,-10,-2) (10,-1,-2) so on...

*in order to get the values of i or know how many times the loop is getting executed we can write the program like this

```
n=input()
for i in range(10):
print(i,n)
```

o/p:

0 i am sorry
1 i am sorry
2 i am sorry
3 i am sorry
4 i am sorry
5 i am sorry
6 i am sorry
7 i am sorry
8 i am sorry
9 i am sorry

Extra examples:

```
n=input()
for i in range(1,10,2):
        print(i, n)
```

//range is 1 to 10 and it'll jump by 2
so output will be
1 sorry
3 sorry
5 sorry
7 sorry
9 sorry

```
n=input()
for i in range(1,10,-2):
         print(i, n)
```

no o/p is generated as range is 1 to 10 but step is -2 which means move behind which can't be done

```
n=input()
for i in range(-10,1,-2):
```

```
          print(i, n)
```

no o/p as -10-2 is -12 which means to move behind
it can't be done

```
n=input()
for i in range(10,-1,-2):
          print(i)
```

o/p
8
6
4
2
0

In python loops can be executed along with conditional statements which cant be done in c

example:

```
#ex1
n=input()
for i in range(3):
      print(i, n)
else:
      print("not sorry")


#ex2
n=input()
for i in range(3):
        print(i ,n)
        break
else:
        print("not sorry")

#o/p: 0 i am sorry
#since break is given else part is not executed

#ex3
n=input()
```

```
for i in range(3):
        print(i)
        continue
        print("hi")
else:
        print("not sorry")
```

ex3 o/p:
0
1
2
not sorry

#after continue the lines which will be written those will be skipped where as break will break the entire loop

> ***Imp:***
> Continue break or pass must be used only inside the loops
> If there is conditional part along with the loop we can't use continue break or pass inside the conditional part

> ***~QUESTIONS***

1. check for leap year

year

if divisible by 4

check if divisible by 100

check if divisible by 400

if satisfies all conditions then LEAP YEAR

```
year=int(input())
if year%4==0:
 if year%100==0:
  if year%400==0:
   print("leap year")
  else:
   print("not leap")
 else:
  print(" leap")
else:
 print("not leap")
```

2. prime number

- prime number is a number which is divisible by itself and 1

ex: 17

17 must not be divisible by any number b/w 1-17

- range starts from 2 because 1 is divisible by all numbers

```
n=int(input())
for i in range(2,n):       #(2,n//2)
if n%i==0:
   print("not prime")
else:
  print("prime")
```

*using flag:

```
n=int(input())
flag=0
for i in range(2,n):
 if n%i==0:
  flag=1
  break
if flag==1:
  print("not prime")
else:
  print("prime")
```

3. Greatest common divisor(GCD)

- min()- determines the smallest number b/w a and b
- g- will be the least gcd i.e.1 because 1 is a divisor for all numbers and will iterate to i
- range lies b/w 1 and smallest number in all cases

ex: 12 - 1 2 3 4 6 12

 36 - 1 2 3 6 9 12 18 36

ans=12

```
a=int(input())
b=int(input())
m=min(a,b)
g=1
for i in range(1,m+1):
  if a%i==0 and b%i==0:
    g=i
print(g)
```

4. Least Common Multiple(LCM)

*max()

*g not equal to 1 but bigger number

*limit starts from max no because bigger no can be multiple of small but not vice versa

ex: 6 is multiple of 3

 3 is not multiple of 6

```
a=int(input())
b=int(input())
m=max(a,b)
g=m
for i in range(m,(a*b)+1):
    if i%a==0 and i%b==0:
     g=i
     break
print(g)
```

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5. Find reverse of a number

ex: n=1234

→rev=0 stores the result

→divide 1234 by 10 to get remainder as 4 and store it in rem

rem=n%10

→rev=rev*10+rem

→then update the n from 1234 to123 then 12 then 1 so on

n=n//10 this will give us 123.4 but as we used // we ignore the decimal part

```
n=int(input())
rev=0
while n>0:                  #while n!=0
    rem=n%10
    rev=rev*10+rem
    n=n//10
print(rev)
```

6. Find multiplication of all the digits in a number

```
n=int(input())
rev=1
while n>0:
    rem=n%10
    rev=rev*rem
    n=n//10
print(rev)

#ans will be multiplication of all numbers
```

7. Find the addition of all the digits in a number

```
n=int(input())
rev=0
while n>0:
    rem=n%10
    rev=rev+rem
    n=n//10
print(rev)

#ans will be addition of all numbers
```

8. Find if a number is palindrome or not

Palindrome is a number read same forward and backward

→store the number in different variable as n will be updated and end value will be 0

→so to compare it with the reverse number we need the original value

so store n in m

```
n=int(input())
m=n
rev=0
while n>0:
    rem=n%10
    rev=rev*10+rem
    n=n//10

if m==rev:
    print("palindrome")
else:
    print("not palindrome")
```

9. Find the number of digits in a number

```
n=int(input())
r=0
while n>0:
    r=r+1
    n=n//10
print(r)
```

10. Find number of even and odd numbers

```
n=int(input())
even=0
odd=0
while n>0:
 rem=n%10
 if rem%2==0:
    even=even+1
 else:
   odd=odd+1
 n=n//10
print(even)
print(odd)
```

11. Find factorial of a number

```
n=int(input())
fact=1
for i in range(1,n+1):
    fact=fact*i
print(fact)
```

12. Find fibonacci series

0 1 1 2 3 5 8 13 21

→assume 2 numbers 0 and 1

```
n=int(input())
a=0
b=1
print(a,b,end=" ")
for i in range(3,n+1):
    c=a+b
    print(c ,end=" ")
    a=b
    b=c
```

13. PATTERNS (20)

1.

```
n=int(input())
for i in range(0,n):
    for j in range(1,n+1):
        print(j,end=" ")
    print()
```

o/p:

```
1 2 3
1 2 3
1 2 3
```

2.

```
n=int(input())
for i in range(0,n):
    for j in range(1,n+1):
        print(j*2-1,end=" ")
    print()
```

o/p:

1 3 5

1 3 5

1 3 5

3.

```
n=int(input())
for i in range(1,n+1):
    for j in range(i,n+i):
        print(j,end=" ")
    print()
```

o/p:

1 2 3

2 3 4

3 4 5

4.

```
n=int(input())
for i in range(0,n):
    for j in range(i,n+i):
        print(chr(65+j),end=" ")
    print()
```

o/p:

A B C

B C D

C D E

5.

```
n=int(input())
for i in range(1,n+1):
    for j in range(1,i+1):
        print(j,end=" ")
    print()
```

o/p:

1

1 2

1 2 3

6.

```
n=int(input())
for i in range(1,n+1):
    for j in range(i,i+i):           #(i,2*i)
        print(j,end=" ")
    print()
```

o/p:

1

2 3

3 4 5

7.

```
n=int(input())
for i in range(1,n+1):
    for j in range(i,2*i):
        print(j*2-1,end=" ")
    print()
```

o/p:

1

3 5

5 7 9

8.

```
n=int(input())
for i in range(0,n):
    for j in range(n,i,-1):
        print(j,end=" ")
    print()
```

o/p:

```
3 2 1
3 2
3
```

9.

```
n=int(input())
for i in range(0,n):
  if i==0 or i==n-1:
    for j in range(1,n+1):
      print("*",end=" ")
    print()
  else:
   for j in range(0,n):
      if j==0 or j==n-1:
        print("*",end=" ")
      else:
         print(" ",end=" ")
   print()
```

```
o/p: * * * *
    *      *
    *      *
    * * *  *
```

10.

```
n=int(input())
for i in range(0,n):
  if i==0 or i==n-1 or i==n-1 or i==n-2:
    for j in range(1,n+1):
      print("*",end=" ")
    print()
  else:
   for j in range(0,n):
      if j==0 or j==1 or j==n-1 or j==n-2 :
        print("*",end=" ")
      else:
        print(" ",end=" ")
   print()
```

o/p:
```
*  *  *
*  *  *
*   *  *
```

11.

```
n=int(input())
for i in range(n):
  if i==0 or i==n-1:
    for j in range(n):
      print("*",end=" ")
    print()
  elif i==n//2:
        for j in range(n):
           if j==0 or j==n//2 or j==n-1:
            print("*",end=" ")
           else:
            print(" ",end=" ")
        print()
  else:
     for j in range(n):
      if j==0 or j==n-1:
        print("*",end=" ")
      else:
        print(" ",end=" ")
     print()
```

o/p:

```
5
*   *   *   *   *
*              *
*       *       *
*               *
*   *   *   *   *
```

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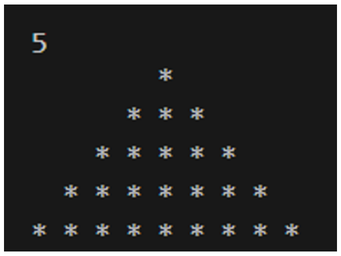
12.

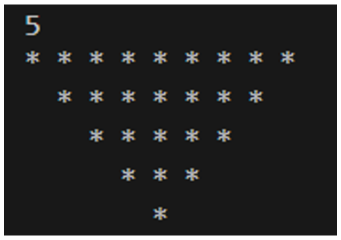
```
n=int(input())
for i in range(1,n+1):
    for j in range(1,n-i+1):
        print(" ",end=" ")
    for j in range(0,2*i-1):
        print("*",end=" ")
    print()
```



```
5
        *
      * * *
    * * * * *
  * * * * * * *
* * * * * * * * *
```

13.

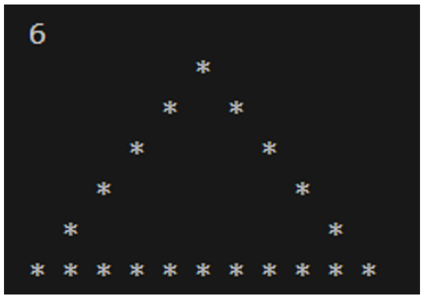
```
n=int(input())
for i in range(n,0,-1):
    for j in range(1,n-i+1):
        print(" ",end=" ")
    for j in range(0,2*i-1):
        print("*",end=" ")
    print()
```



```
5
* * * * * * * * *
  * * * * * * *
    * * * * *
      * * *
        *
```

14.

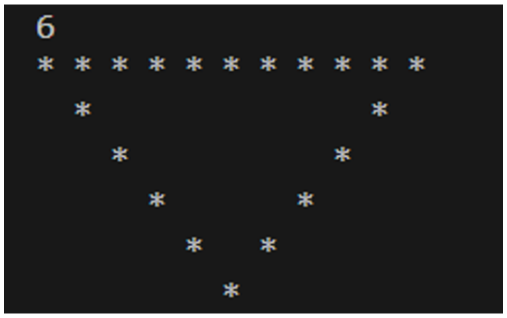
```
n=int(input())
for i in range(1,n+1):
  if i==1 or i==n:
     for j in range(1,n-i+1):
      print(" ",end=" ")
     for j in range(0,2*i-1):
      print("*",end=" ")
     print()

  else:
     for j in range(1,n-i+1):
      print(" ",end=" ")
     for j in range(0,2*i-1):
      if j==0 or j==2*i-2:
       print("*",end=" ")
      else:
        print(" ",end=" ")
     print()
```



```
6
          *
        *   *
      *       *
    *           *
  *               *
* * * * * * * * * * *
```

15.

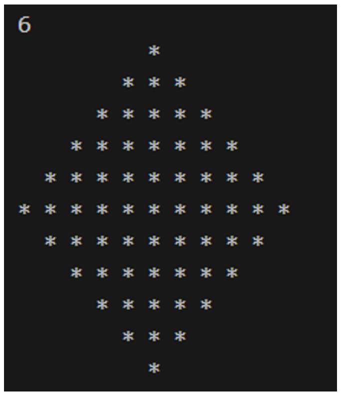
```
n=int(input())
for i in range(n,0,-1):
 if i==0 or i==n:
    for j in range(1,n-i+1):
        print(" ",end=" ")
    for j in range(0,2*i-1):
        print("*",end=" ")
    print()
 else:
    for j in range(1,n-i+1):
        print(" ",end=" ")
    for j in range(0,2*i-1):
     if j==0 or j==2*i-2:
        print("*",end=" ")
     else:
         print(" ",end=" ")
    print()
```



```
6
* * * * * * * * * * *
  *               *
    *           *
      *       *
        *   *
          *
```

16.

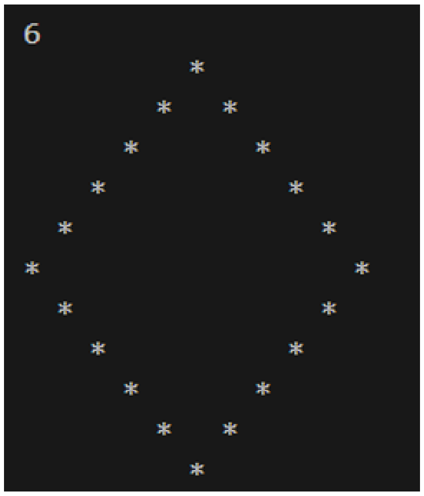
```
n=int(input())
for i in range(1,n+1):
    for j in range(1,n-i+1):
        print(" ",end=" ")
    for j in range(0,2*i-1):
        print("*",end=" ")
    print()
for i in range(n-1,0,-1):
    for j in range(1,n-i+1):
        print(" ",end=" ")
    for j in range(0,2*i-1):
        print("*",end=" ")
    print()
```



```
6
          *
        * * *
      * * * * *
    * * * * * * *
  * * * * * * * * *
* * * * * * * * * * *
  * * * * * * * * *
    * * * * * * *
      * * * * *
        * * *
          *
```

17.

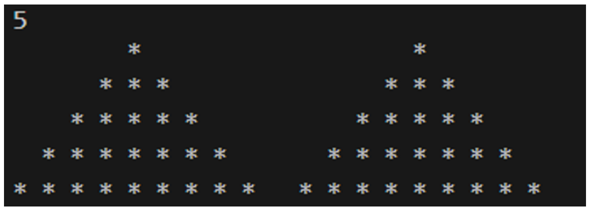
```
n=int(input())
for i in range(1,n+1):
 if i==1:
    for j in range(1,n-i+1):
        print(" ",end=" ")
    for j in range(0,2*i-1):
        print("*",end=" ")
    print()
 else:
    for j in range(1,n-i+1):
        print(" ",end=" ")
    for j in range(0,2*i-1):
     if j==0 or j==2*i-2:
        print("*",end=" ")
     else:
        print(" ",end=" ")
    print()
for i in range(n-1,0,-1):
 if i==1:
    for j in range(1,n-i+1):
        print(" ",end=" ")
    for j in range(0,2*i-1):
        print("*",end=" ")
    print()
 else:
    for j in range(1,n-i+1):
        print(" ",end=" ")
    for j in range(0,2*i-1):
     if j==0 or j==2*i-2:
        print("*",end=" ")
     else:
        print(" ",end=" ")
    print()
```



```
6
          *
        *   *
      *       *
    *           *
  *               *
*                   *
  *               *
    *           *
      *       *
        *   *
          *
```

18.

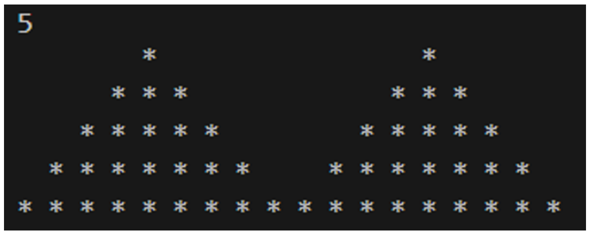
```
n=int(input())
for i in range(1,n+1):
    for j in range(1,n-i+1):
        print(" ",end=" ")
    for j in range(0,2*i-1):
        print("*",end=" ")
    for j in range(1,(n-i+1)*2):
        print(" ",end=" ")
    for j in range(0,2*i-1):
        print("*",end=" ")
    print()
```



```
5
        *                   *
      * * *               * * *
    * * * * *           * * * * *
  * * * * * * *       * * * * * * *
* * * * * * * * *   * * * * * * * * *
```

19.

```
n=int(input())
for i in range(1,n+1):
    for j in range(1,n-i+1):
        print(" ",end=" ")
    for j in range(0,2*i-1):
        print("*",end=" ")
    for j in range(1,(n-i+1)*2):
      if j!=(n-i+1)*2-1:
        print(" ",end=" ")
    for j in range(0,2*i-1):
        print("*",end=" ")
    print()
```



```
5
        *                 *
      * * *             * * *
    * * * * *         * * * * *
  * * * * * * *     * * * * * * *
* * * * * * * * * * * * * * * * * *
```

20. program to print heart

```
n=int(input())
for i in range(1,n+1):
    for j in range(1,n-i+1):
        print(" ",end=" ")
    for j in range(0,2*i-1):
        print("*",end=" ")
    for j in range(1,(n-i+1)*2):
      if j!=(n-i+1)*2-1:
        print(" ",end=" ")
    for j in range(0,2*i-1):
        print("*",end=" ")
    print()

for i in range((2*n-1),0,-1):
    for j in range(1,(2*n)-i):
        print(" ",end=" ")
    for j in range(0,2*i-1):
        print("*",end=" ")
    print()
```

a. Program to print K

```
n=int(input())
for i in range(1,n+1):
    for j in range(n-i+1):
      if j==0 or j==n-i:
        print("*",end=" ")
      else:
         print(" ",end=" ")
    print()
for i in range(n,0,-1):
    for j in range(n-i+1):
       if j==0 or j==n-i:
        print("*",end=" ")
       else:
        print(" ",end=" ")
    print()
```

b. Program to print A

```
n=int(input())
for i in range(0,n):
  if i==0 or i==n-1:
    for j in range(1,n+1):
      print("*",end=" ")
    print()
  else:
   for j in range(0,n):
      if j==0:
        print("*",end=" ")
      else:
         print(" ",end=" ")
   print()

for i in range(1,n):
   for j in range(0,n):
      if j==0 or j==n-1:
        print("*",end=" ")
      else:
         print(" ",end=" ")
   print()
```

c. program to print s

```
n=int(input())
for i in range(0,n):
  if i==0 or i==n-1:
    for j in range(1,n+1):
      print("*",end=" ")
    print()
  else:
   for j in range(0,n):
      if j==0:
        print("*",end=" ")
      else:
         print(" ",end=" ")
   print()

for i in range(1,n):
   for j in range(0,n):
      if j==n-1:
        print("*",end=" ")
      elif i==n-1:
       print("*",end=" ")
      else:
         print(" ",end=" ")
   print()
```

d. program to print T

```
n=int(input())
for i in range(0,n):
  if i==0:
    for j in range(1,n+1):
      print("*",end=" ")
```

```
     print()
   else:
    for j in range(0,n):
       if j==n//2:
         print("*",end=" ")
       else:
          print(" ",end=" ")
    print()
```

FUNCTION

set of instructions that perform particular task

3 aspects of function are:

1. definition
2. call
3. no declaration

SYNTAX: def function_name():

example:

```
def addition():
    a=3
    b=8
    c=a+b
   print(c)
```

4 TYPES:

1. with parameters and with return values:

```
def addition(a,b):
c=a+b
```

```
return c
addition(5,6)
```

2. with parameters and with no return values:

```
def addition(a,b):
c=a+b
print(c)
addition(5,6)
```

3. without parameters and with return values:

```
def addition():
a=4
b=9
c=a+b
return c
print(addition(c))
```

4. without parameters and without return values:

```
def addition():
a=4
b=9
c=a+b
print(c)
addition()
```

LIST

- reversing a list: (2 ways)

i)

l=[1,2,3,4,5]

print(::-1) { reversing a list by slicing} ii)

l=[1,2,3,4,5]

for i in range(len (l)-1,-1,-1):

    print(l[i])

i) maximum:

```
l=[10,3,9,1,0,5,60]
m=l[0]
for i in l:
    if i>m:
        m=i
print(m)
```

or

```
l=[10,3,9,1,0,5,60]
m=l[0]
for i in range(len(l)):
    if l[i]>m:
        m=l[i]
print(m)
```

ii) minimum:

```
l=[10,3,9,1,0,5,60]
m=l[0]
for i in range(len(l)):
    if l[i]<m:
        m=l[i]
print(m)
```

or

```
l=[10,3,9,1,0,5,60]
m=l[0]
for i in l:
    if i<m:
        m=i
print(m)
```

-ve indexing					
-6	-5	-4	-3	-2	-1
10	3	0	8	11	1
0	1	2	3	4	5
+ve indexing					

#finding the second largest from the list

```
l=[10,3,9,1,0,5,60]
p=set(l) #set will sort the elements in the list
q=list(p) #as negative indexing can't be done in set we will convert it in
print(q[-2]) #using negative indexing we will find the second largest numb
```

#finding the second smallest from the list

```
l=[10,3,9,1,0,5,60]
p=set(l) #set will sort the elements in the list
q=list(p)
print(q[1]) #using positive indexing we will find the second largest numbe
```

#finding the index value of the 2 numbers which is equal to the target by adding the contents of the list:

```
nums=[1,4,2,6,3,5]
target=6
def addtwo(nums,target):
    a=[]
    for i in range(len(nums)):
        for j in range(i+1,len(nums)):
                if nums[i]+nums[j]==target:
                        a.append(i)
                        a.append(j)
                        return a

print(addtwo(nums,target))
```

o/p:

[0,5]

#finding the index value of the 3 numbers which is equal to the target by adding the contents of the list:

```
nums=[1,4,2,6,3,5]
target=12
def addthree(nums,target):
    a=[]
    for i in range(len(nums)):
        for j in range(i+1,len(nums)):
            for k in range(j+1,len(nums)):
                if nums[i]+nums[j]+nums[k]==target:
                        a.append(i)
                        a.append(j)
                        a.append(k)
                        return a

print(addthree(nums,target))
```

o/p:

[0,3,5]

#remove duplicates from the list(without using set)

```
l=[1,1,1,2,2,3,3,4]
m=[]
for i in l:
    if i not in m:
        m.append(i)
print(m)
```

o/p:

[1,2,3,4]

OR

```
l=[1,1,1,2,2,3,3,4]
m=[]
for i in l:
    if i in m:
        pass
    else:
        m.append(i)
print(m)
```

#remove duplicates from string

```
s="aaaabbbcd"
s1=[]
for i in s:
    if i in s1:
        pass
    else:
        s1.append(i)
print(s1)
```

o/p:

['a','b','c','d']

#counting how many times each letter is repeated in a string

```
s="aaaabbbcd"
s1=set(s)
for i in s1:
    count=0
    for j in s:
        if i==j:
            count+=1
    print(i,"-",count)
```

o/p:

d-1

c-1

b-3

a-4

#counting how many times each number is repeated in a string

```
l=[1,3,2,4,1,3,2,2,1,4]
l1=set(l)
for i in l1:
    c=0
    for j in l:
        if i==j:
            c+=1
    print(i,"-",c)
```

o/p:

1-3

2-3

3-2

4-2

#sum of all even and odd numbers in list

```
l=[1,2,3,4,5,6,7,8]
even=0
odd=0
for i in l:
    if i%2==0:
        even+=i
    else:
        odd+=i
```

```
print("even sum=",even)
print("odd sum=",odd)
```

even sum=20

odd sum=16

#finding common elements from the list

```
l1=[1,3,2,4,5]
l2=[4,6,7,8,9]
l=[]
for i in l1:
    for j in l2:
        if i==j:
            l.append(i)
print(l)
```

OR

```
l1=[1,3,2,4,5]
l2=[4,6,7,8,9]
l=[]
for i in l1:
    if i in l2:
            l.append(i)
print(l)
```

#finding uncommon elements in the list

```
l1=[1,3,2,4,5]
l2=[4,6,7,8,9]
l=[]
for i in l1:
    if i not in l2:
        l.append(i)
for i in l2:
    if i not in l1:
        l.append(i)
print(l)
```

o/p:

[1,3,2,5,6,7,8,9]

#finding prime numbers from the list

```
def isprime(x):
    for i in range(2,x//2+1):
        if x%i==0:
            return 0
    else:
        return 1
l=int(input())
u=int(input())
for i in range(l,u+1):
    a=isprime(i)
    if a==1:
        print(i)
```

#converting decimal to binary

```
n=int(input())
b=""
while n>0:
    rem=n%2
    b=b+str(rem)
    n=n//2
print(b[::-1])
```

o/p:

10

1010

#check if a number is a perfect square

```
n=int(input())
i=1
while i*i<n:
    i+=1
if i*i==n:
    print("perfect")
else:
    print("not perfect square")
```

o/p:

6

not perfect square

#check if a number is a power of two

```
n=int(input())
i=1
while 2**i<n:
    i+=1
if 2**i==n:
    print(i)
else:
    print("not power of 2")
```

o/p:

5

not power of 2

8

3

#check if a number is Armstrong number

Armstrong number is a number when each digit of the number powered to the length of the number and added together gives the same number

ex: 371

3^3+7^3+1^3=371

*first find the length of the number i.e. c

*a is to store the result

*the original number is stored in m as it'll be reduced in n=n//10

*later m is compared with a if it is equal then prints Armstrong or else not

```
n=int(input())
c=len(str(n))
```

```
a=0
m=n
while n>0:
    a=a+((n%10)**c)
    n=n//10
if a==m:
    print("armstrong")
else:
    print("not armstrong")
```

#check whether a number is a perfect number

▼ If sum of the divisors of the given number is less than that of the given number, then that number is called as perfect number

▼ If sum of the divisors of the given number is less than that of the given number, then that number is called as perfect number

```
n=int(input())
m=n
sum=0
i=1
while i<n: #for i in range(1,n):
    if n%i==0:
        sum=sum+i
    i+=1
if sum==m:
    print("perfect number")
else:
    print("not perfect number")
```

o/p:

6

perfect number

8

not a perfect number

#check whether the number is abundant number

▼ If the sum of all the divisors of the given number if greater than the number itself. Then that number is called as abundant number

```
n=int(input())
sum=0
i=1
while i<n: #for i in range(1,n):
    if n%i==0:
        sum=sum+i
    i+=1
if sum>n:
    print("abundant number")
else:
    print("not abundant number")
```

o/p:

12

abundant number

6

not abundant number

STRINGS:

converting a list into string:

→split(" ") is used to convert a string into list

→it separates the words in a string with spaces into each element in a list.

→join() is used to convert all the elements of the list into string.

→var="".join(name of var to be converted)

ex1:

```
s="hey you are idiot"
l=list(s.split(" "))
l=(l[::-1])
s=" ".join(l)
print(s)
```

ex2:

```
s="hey you are idiot"
l=list(s.split(" "))
s=""
for i in l:
    s=s+i[::-1]+" "
print(s)
'''o/p:
yeh ouy era toidi'''
```

#checking if a word is palindrome or not

```
s="Madam"
s1=s.upper()
if s1==s1[::-1]:
    print("palindrome")
else:
    print("not palindrome")

'''o/p:
palindrome'''
```

#check whether the given word is anagram or not

```
a=input()
b=input()
s1=set(a) #to get the unique elements of a
s2=set(b)
if s1==s2:        #checks whether the unique elements are same, if they're
    for i in s1:  #to run the unique elements'''
        if a.count(i)!=b.count(i):
            print("not anagram")
            break
    else:
        print("anagram")
'''o/p:
dog
god
anagram'''
```

RECURSION:

a function which calls itself repeatedly until certain condition is satisfied is called as recursive function.

This process is called as ***recursion***

difference between recursion and loop is:

→a loop will run infinitely
→but by default recursion runs for 0-999 times

a function recurs based on the limit given for recurring.

ex:

```
def recur(x):
    print(x)
    x+=1
    recur(x)
recur()
```

rules for writing recursive func:(format)

1. define function
2. base condition must be given (in 4 to 1, 1 is base condition:1 to 4, 4 is base condition
3. call the function again

#factorial of a number

```
def fact(n):
    if n==1:
        return n
    else:
        return n*fact(n-1)
x=int(input())
print(fact(x))
```

#reverse of a number using recursion

```
def reverse(x,res):
    if x<=0:
        return res
    else:
        rem=x%10
        res=res*10+rem
        return reverse(x//10,res)
    return rev
n=int(input())
rem=0
res=0
print(reverse(n,res))
```

#Fibonacci series using recursion

```
def fib(n):
    if n<=1:
        return n
    else:
        return fib(n-1)+fib(n-2)
x=int(input())
print(fib(x))
```

OOPS!

Class:

a=[]

print(type(a))

o/p:

<class 'list'>

- In python, everything will viewed in the form of class and objects.
- List is stored in different locations even if the contents of list are same, because list is mutable and list is viewed as object
- And if we check the id of the contents of 2 lists then it'll be stored in the same location as the contents of list can't be changed.

- CLASS is a user-defined datatype.
- There are few in-built classes such as list, tuple and dictionary.
- Whenever we refer class, we refer collectively
- maybe animals ,students, places etc.
- When we refer an object, we refer a particular thing
- maybe a person's name, animals name etc.

> Attributes and Behavior:

attributes: variables.

Behavior: functions.

collectively writing attributes and behavior forms class.

how to define class:

class class_name:

ex:

def __init __(self,x,y,z): { self is object, create a constructor and initialize 3 values which will be initialized below}

self.nickname=x

self.rollno=y

self.height=z

def run(self):

print(”i can run”, self.height, self.roll) { self is object that we are passing}

harsha=person(”chintu”,78,6) {person() is a constructor)

anjali=person(”mary”,89,5.6)

harsha.run()

anjali.run()

o/p:

i can run chintu 78

i can run mary 89

#if we don’t create a constructor the contents will be common for all the objects.

constructor will initialize objects that are created.

difference between function and method:

method is also a function which is written inside a class
method is accessed using objects where function is directly accessed

Abstraction:

- it’s an idea which is not implemented.
- it is used to hide the unnecessary data and show only necessary data.
- in python logically abstraction, polymorphism and encapsulation does not work.

abstract method:

it is a method which doesn’t contain any body.

class person:

    def mobile():

        pass

```
'''abstraction'''
class mobile: #abstract class
    def functions(self): #abstract method
        pass
class iphone: #class
    def functions(self):
        print("This is iphone")
class samsung:
    def functions(self):
        print("This is samsung")
iphone13=iphone()
iphone13.functions()
samsungs3=samsung()
samsungs3.functions()
```

#polymorphism

class mobile: #abstract class

    def functions(self): #abstract method

        pass

    def functions(self,camera,display,battery):

        self.camera=camera

        self.display=display

        self.battery=battery

        print(self.camera)

        print(self.display)

        print(self.battery)

iphone=mobile()

iphone.functions(”12mp”,”4k”,”60mh”)

samsung=mobile()

samsung.functions(”24mp”,”6k”,”80mh”)

abstract class:

it is a class that contain abstract method.

#inheritance:

```
class mobile: #abstract class
    def functions(self): #abstract method
        pass
class iphone(mobile): '''passing the idea'''
    def functions(self):
        print("This is iphone")
class samsung(mmobile):
    def functions(self):
        print("This is samsung")
iphone13=iphone()
iphone13.functions()
```

```
samsungs3=samsung()
samsungs3.functions()
```

Encapsulation:

if anything is private we cant access them directly instead we access then using methods.”

“_” =private variables.

“__”=protected variables.

in python we can change the private variables using a public variable(loophole)

```
class car:
    _engine="v8"
    _wires="blue"
bmw=car()
bmw._engine="v9"
```

encapsulation can be implemented using getter and setter methods

methods are always public

variables can be either private, protected or public

```
class car:
    _engine="v8"
    _wires="blue"
    def getter(self):
        print(self._engine)
        print(self._wires)
    def setter(self,engine,wires):
        self._engine=engine
        self._wires=wires
bmw=car()
```

```
bmw.setter("v9","red")
bmw.getter()
```

```
class person:
   def __init__(self,x,y,z):      #self is object, create a cons
        self.nickname=x
        self.rollno=y
        self.height=z
   def run(self):
       print("i can run",self.height, self.roll)    #{ self is c
harsha=person("chintu",78,6)                         #{person()
anjali=person("mary",89,5.6)
harsha.run()
anjali.run()
```

Inheritance:

1. single
2. multiple
3. multilevel
4. hierarchical
5. hybrid

1. single

inheriting from one single class

```
class parents:
    def coolness(self):
        print("parents are cool")

class child(parents):
    def coding(self):
        print("i know coding")
yashu=child()
yashu.coolness()
yashu.coding()
```

2. multilevel

a class(child2) is inherited from another class(child) but that class(child) is inherited from its parent class(parents)

```
class parents:
    def coolness(self):
        print("parents are cool")
class child(parents):
    def coding(self):
        print("i know coding")
class child2(child):
    def singing(self):
        print("i can sing")
yashu=child2()
yashu.coolness()
yashu.coding()
yashu.singing()
```

3.multiple:

a child will inherit from 2 parents

```
class dad:
    def coolness(self):
        print("parents are cool")
class mom:
    def coding(self):
        print("i know coding")
class child(dad,mom):
    def singing(self):
        print("i can sing")
yashu=child()
yashu.coolness()
yashu.coding()
yashu.singing()
```

4. hierarchical:

```
class grandfather:
    def coolness(self):
        print("parents are cool")
class father(grandfather):
    def coding(self):
        print("i know coding")
class daughter(father):
    def singing(self):
        print("i can sing")
yashu=daughter()
yashu.coolness()
yashu.coding()
yashu.singing()
```

5. hybrid:

```
class grandfather:
    def coolness(self):
        print("i'm cool")
class father(grandfather):
    def coding(self):
        print("i know coding")
class mother(grandfather):
    def cooking(self):
        print("i can cook")
```

```
class daughter(father,mother):
    def singing(self):
        print("i can sing")
yashu=daughter()
yashu.coolness()
yashu.coding()
yashu.cooking()
yashu.singing()
```

Polymorphism:

poly: many

morphism: forms

overloading:

same name and different parameters.

```
class add:
    def sum(self,x,y):
        print(x+y)
    def sum(self,x,y,z):
        print(x+y+z)
i=add()
i.sum(10,8)
i.sum(10,8,1)
```

o/p:

error

```
class add:
    def sum(self,x,y):
        print(x+y)
class child(add):
    def sum(self,x,y,z):
        print(x+y+z)
i=add()
i.sum(10,8)
```

o/p:

```
18
```

overriding:

DATA STRUCTRES!

Use:

It reduces time and space complexity.

LINEAR SEARCH:

searching the value one by one. it requires more time.

```
l=[1,2,3,4,5,6,7,8,9,10]
for i in l:
    if i==7:
        print("found")
        break
else:
    print("not found")
```

BINARY SEARCH:

→use 2 pointers to search

→one pointing to first number(left) - increment it

i=0   #left=0

→another to the last one(right) - decrement it

*for loop : when we know how many times to run it

*while loop : we do not know how many times but know the condition

*when we use elif : only one condition will run

*when we use multiple if : all conditions will run

```
l=[1,17,3,4,10,8,12,22]
l.sort()
print(l)
s=8
i=0
j=len(l)-1
while i<j:
    mid=i+j//2
    if l[mid]==s:
        print(mid,"found")
        break
    elif l[mid]>s:
        j=mid-1
    else:
        i=mid+1
else:
    print("not found")
```

TIME COMPLEXITY:

1. Best [O(1)]:

searching in the first and getting the first value.

2. average [O(n)]

it depends the value of n

3. Worst [O(n)]

only one loop is used

SPACE COMPLEXITY: O(1)

memory space will be fixed.

O(log(n)):

is used when the size is decreasing by half.

n is number of elements.

SORTING:

the 5 sorting techniques are:

1. bubble
2. merge
3. quick
4. selection
5. insert

1. BUBBLE SORT:

best case scenario for sorting is when the list of elements are already sorted.

- the greater number will move to the last

```
l=[9,7,78,10,5,1,0]
for i in range(0,len(l)-1):
    for j in range(0,len(l)-i-1):
        if l[j]>l[j+1]:
            l[j],l[j+1]=l[j+1],l[j] #swap {a,b=b,a}
print(l)
```

2. SELECTION SORT:

```
b=[2,6,8,4,19,5,44]
for i in range(0,len(b)-1):
    m=i
    for j in range(i+1,len(b)):
        if b[m]>=b[j]:
            m=j
    b[i],b[m]=b[m],b[i]
print(b)
```

3. INSERTION SORT:

→always starts with second number

while sorting:

→the sorted array will be on left(backward)

→unsorted array will be on right(forward)

⇒i will be all the forward elements

⇒j will be all the backward elements

```
b=[2,6,8,4,19,5,44]
for i in range(1,len(b)):
    j=i-1
    a=b[i]
    while j>=0 and b[j]>a:
        b[j+1]=b[j]
        j-=1
    b[j+1]=a
print(b)
```

4. MERGE SORT:

- works on divide and conquer rule.

→break the given array by dividing it until we get a singular element

this is done by using the condition beginning<ending (base condition)

```
#merge sort
def merge(arr,mid,beg,end):
    n1=mid-beg+1
    n2=end-mid
    i=j=0
    left=arr[beg:mid+1]
    right=arr[mid+1:end+1]
    k=beg
    while i<n1 and j<n2:
        if left[i]<right[j]:
            arr[k]=left[i]
            i+=1
        else:
            arr[k]=right[j]
            j+=1
        k+=1
    while i<n1:
        arr[k]=left[i]
        k+=1
        i+=1
    while j<n2:
        arr[k]=right[j]
        k+=1
        j+=1
```

5. QUICK SORT:

it is the most effective sorting technique.

follows 2 pointer approach (start and end pointers)

```
def partition(arr,low,high):
    pivot=arr[low]
    start=low+1
    end=high
    while True:
        while start<=end and arr[start]<=pivot:
            start+=1
        while start<=end and arr[end]>pivot:
            end-=1
        if start<end:
            arr[start],arr[end]=arr[end],arr[start]
        else:
            break
    arr[low],arr[end]=arr[end],arr[low]
    return end
def quicksort(arr,beg,end):
    if beg<end:
        p=partition(arr,beg,end)
        quicksort(arr,beg,p-1)
        quicksort(arr,p+1,end)
a=[8,7,6,1,4,5,2,3]
b=0
e=len(a)-1
quicksort(a,b,e)
print(a)
```

STACKS AND QUEUES:

STACKS:

stacks and queues can be implemented using list.

stacks and queues are implemented using oops concept.

for implementing stack we should create a class and inside a class constructor is used.

terminologies for implementing stack:

push, pop, and peek(topmost element of stack)

code for implementing stack:

```
class stack:
    def __init__(self):
        self.top=-1 #top value can also be given using negative
        self.size=5 #just like how we give MAX in C
        self.list=[]
    def push(self,a):
        if len(self.list)>=5:
            print("list is full")
            return 0
        self.top+=1
        self.list.append(a)
    def pop(self):
        if len(self.list)==0:
            print("list is empty")
            return 0
        self.top-=1
    def peek(self):
        print(self.list)
        if len(self.list)==0:
            print("list is empty")
            return 0
        elif self.top>5:
            print("out of index")
        else:
            print(self.list[self.top])
s=stack()
s.push(1)
s.push(2)
s.push(3)
s.push(4)
s.peek()
s.pop()
s.peek()
```

```
s.pop()
s.peek()
```

QUEUES:

```
class queue:
    def __init__(self):
        self.front=-1 #top value can also be given using negati
        self.rear=-1
        self.size=5 #just like how we give MAX in C.
        self.list=[]
    def enqueue(self,a):
        if len(self.list)>=5:
            print("list is full")
            return 0
        self.rear+=1
        self.list.append(a)
        if self.front==-1:
            self.front=0
    def dequeue(self):
        if len(self.list)==0:
            print("list is empty")
            return 0
        elif self.front>self.rear:
            print("list is empty")
        else:
            self.list.pop(0)
            self.front+=1
        print(self.list)
    def display(self):
        print(self.list)
        if len(self.list)==0:
            print("list is empty")
            return 0
```

```
s=queue()
s.enqueue(1)
s.enqueue(2)
s.enqueue(3)
s.enqueue(4)
s.enqueue(5)
s.display()
s.dequeue()
s.dequeue()
s.dequeue()
s.dequeue()
s.dequeue()
```

#evaluation of postfix expression:

```
s="5678+-*"
s1=[]
for i in s:
    if i.isdigit():
        s1.append(int(i))
    else:
        op2=s1.pop()
        op1=s1.pop()
        if i=="+":
            s1.append(op1+op2)
        elif i=="-":
            s1.append(op2-op1)
        elif i=="*":
            s1.append(op1*op2)
        elif i=="/":
            s1.append(op1/op2)
print(s1)
```

#Implement queue using stack:

in queue we delete elements from 0th index but in stack we delete from the top.

```
l=[1,2,3,4]
s=[]
def pop():
    for i in range(len(l)):
        s.append(l.pop())
    s.pop()
    for i in range(len(s)):
        l.append(s.pop())
pop()
pop()
print(l)
```

OR

```
class MyQueue:
    def __init__(self):
        self.s1=[]
        self.s2=[]
    def push(self, x: int) -> None:
        self.s1.append(x)
    def pop(self) -> int:
        for i in range(len(self.s1)):
            self.s2.append(self.s1.pop())
        a=self.s2.pop()
        for i in range(len(self.s2)):
            self.s1.append(self.s2.pop())
        return a
    def peek(self) -> int:
        return self.s1[0]
    def empty(self) -> bool:
        return len(self.s1)==0
```

LINKED LIST:

Linked lists:
why linked list when there is set, list etc.?

1. time complexity
2. space complexity

linked list is represented by nodes
node contains 2 sections:

1. data section
2. address section(address of next node)

#insert beginning and delete beginning

```
class Node:
    def _init_(self,v):
        self.data=v
        self.next=None #NULL
        #make sure u understand each and every line sowmyaa!!!!
class linkedlist:
    def _init_(self):
        self.head=None
    def insertbeg(self,v):
        nn=Node(v)
        if self.head==None:
            self.head=nn
        else:
            nn.next=self.head
            self.head=nn
    def delbeg(self):
        if self.head==None:
            print("list empty")
        else:
            temp=self.head
            self.head=temp.next
    def display(self):
        curr=self.head
        while curr!=None:
            print(curr.data)
            curr=curr.next
        print("null")
l=linkedlist()
l.insertbeg(10)
l.insertbeg(2)
l.insertbeg(8)
l.display()
l.delbeg()
l.display()
```

#insert end and delete end

```
class Node:
    def __init__(self,v):
        self.data=v
        self.next=None #NULL
        #make sure u understand each and every line sowmyaa!!!!
class linkedlist:
    def __init__(self):
        self.head=None
    def insertend(self,v):
        nn=Node(v)
        if self.head==None:
            self.head=nn
        else:
            curr=self.head
            while curr.next!=None:
                curr=curr.next
            curr.next=nn
    def delend(self):
        if self.head==None:
            print("list empty")
        else:
            curr=prev=self.head
            while curr.next!=None:
                prev=curr
                curr=curr.next
            prev.next=None
    def display(self):
        curr=self.head
        while curr!=None:
            print(curr.data,"->",end=" ")
            curr=curr.next
        print("null")
l=linkedlist()
l.insertend(10)
l.insertend(2)
l.insertend(8)
l.insertend(11)
l.display()
l.delend()
l.display()
```

#insert anywhere and delete anywhere

```
class Node:
    def _init_(self,v):
        self.data=v
        self.next=None #NULL
        #make sure u understand each and every line sowmyaa!!!!
class linkedlist:
    def _init_(self):
        self.head=None
    def insertend(self,v):
        nn=Node(v)
        if self.head==None:
            self.head=nn
        else:
            curr=self.head
            while curr.next!=None:
                curr=curr.next
            curr.next=nn
    def insertany(self,v,k):
        nn=Node(v)
        if self.head==None:
            print("list is empty")
        else:
            curr=self.head
            while curr!=None:
                if curr.data==k:
                    nn.next=curr.next
                    curr.next=nn
                    break
                curr=curr.next
    def search(self,k):
        curr=self.head
        while curr!=None:
            if curr.data==k:
                print("found")
                break
            curr=curr.next
        else:
            print("not found")
    def delany(self,k):
        if self.head==None:
            print("list empty")
        else:
            curr=prev=self.head
            while curr!=None:
                if curr.data==k:
                    prev.next=curr.next
                    break
                prev=curr
                curr=curr.next
            else:
                print("key not found")
    def display(self):
        curr=self.head
        while curr!=None:
            print(curr.data,"->",end=" ")
            curr=curr.next
        print("null")
l=linkedlist()
l.insertend(10)
l.insertend(2)
l.insertend(8)
l.insertend(11)
l.insertany(17,2)
l.display()
l.search(8)
l.delany(8)
l.display()
```

#insert at middle of the list using count

```
class Node:
    def __init__(self,value):
        self.data=value
        self.next=None
class linkedlist:
    def __init__(self):
        self.head=None
    def insertatbeg(self,value):
        newnode=Node(value)
        if self.head==None:
                self.head=newnode
        else:
                newnode.next=self.head
                self.head=newnode
    def insertmid(self,value):
        newnode=Node(value)
        c=0
        if self.head==None:
            self.head=newnode
        elif self.head.next==None:
             self.head.next=newnode
        else:
            curr=self.head
            while curr!=None:
                c+=1
                curr=curr.next
            curr=self.head
            for i in range(c//2):
                 curr=curr.next
            newnode.next=curr.next
            curr.next=newnode
    def printlist(self):
        curr=self.head
        while(curr!=None):
                print(curr.data,"->",end="")
                curr=curr.next
        print("null")
l=linkedlist()
l.insertatbeg(1)
l.insertatbeg(2)
l.insertatbeg(3)
l.insertatbeg(8)
l.insertmid(4)
l.printlist()
```

#insert at middle of the list without using count

```
def insertmid(self,val):
        newnode=node(val)
        if self.head==None:
            self.head=newnode
        elif self.head.next==None:
            self.head.next=newnode
        else:
            fast=self.head
            slow=self.head
            while fast.next!=None and fast.next.next!=None:
                fast=fast.next.next
                slow=slow.next
            newnode.next=slow.next
            slow.next=newnode
```

#reverse of a linked list

Trees:

#creating a node in a normal tree

```
class node:
    def __init__(self,v):
        self.left=None
        self.right=None
        self.data=v
def inorder(root):
    if root:
        inorder(root.left)
        print(root.data)
        inorder(root.right)
```

```
r=node(1)
r.left=node(2)
r.right=node(3)
r.left.left=node(4)
r.left.right=node(5)
inorder(r)
```

we create a function to print the contents of the tree instead of method because:

since there is no root inside node class, for traversing we need to pass root as parameter hence we create a function for traversing not a method.

Binary search tree:

```
class node:
    def __init__(self,v):
        self.left=None
        self.right=None
        self.data=v
class trees: #in trees root is the only variable we can have
    def __init__(self):
        self.root=None
    def insert(self,value):
        nn=node(value)
        if self.root is None:
            self.root=nn
        else:
            curr=self.root
            while True:
                if value<=curr.data:
                    if curr.left==None:
                        curr.left=nn
                        break
                    else:
                        curr=curr.left
                else:
                    if curr.right==None:
                        curr.right=nn
                        break
                    else:
                        curr=curr.right
    def preorder(self,root):
        if root:
            print(root.data)
            self.preorder(root.left)
            self.preorder(root.right)

def inorder(root):
    if root:
        inorder(root.left)
        print(root.data)
        inorder(root.right)
def postorder(root):
    if root:
        postorder(root.left)
        postorder(root.right)
        print(root.data)
r=trees()
r.insert(2)
r.insert(8)
r.insert(1)
r.preorder(r.root)
print(" ")
inorder(r.root)
print(" ")
postorder(r.root)
```

Graphs:

It is a non primitive no linear data structure which contains edges and vertices.

Applications of graphs:

1. maps
2. social media apps

#adjacency matrix

```
class Graph:
    def __init__(self):
        self.matrix=[[0]*5 for i in range(5)]
        print(self.matrix)
    def addvertex(self,a,b):
        self.matrix[a][b]=1
    def print(self):
        for i in self.matrix:
            print(i)
g=Graph()
g.addvertex(1,2)
g.addvertex(4,2)
g.addvertex(1,4)
g.addvertex(2,3)
g.addvertex(4,3)
g.print()
```

O/P:

```
[[0, 0, 0, 0, 0], [0, 0, 0, 0, 0], [0, 0, 0, 0, 0], [0, 0, 0, 0, 0], [0, 0, 0, 0, 0]]
[0, 0, 0, 0, 0]
[0, 0, 1, 0, 1]
[0, 0, 0, 1, 0]
[0, 0, 0, 0, 0]
[0, 0, 1, 1, 0]
```

#adjacency list using dictionary

```
class Graph:
    def __init__(self):
        self.matrix={}
    def addvertex(self,a,b):
        if a not in self.matrix:
            self.matrix[a]=[b]
        else:
            self.matrix[a].append(b)
    def print(self):
        print(self.matrix)
g=Graph()
g.addvertex(1,2)
g.addvertex(4,2)
g.addvertex(1,4)
g.addvertex(2,3)
g.addvertex(4,3)
g.print()
```

O/P:

{1: [2, 4], 4: [2, 3], 2: [3]}

#bfs

```
class Graph:
    def __init__(self):
        self.matrix={}
    def addvertex(self,a,b):
        if a not in self.matrix:
            self.matrix[a]=[b]
        else:
            self.matrix[a].append(b)
    def print(self):
        print(self.matrix)
    def bfs(self,data):
        v=[]
        q=[data]
        while q:
            vertex=q.pop(0)
            print(vertex)
            if vertex in self.matrix:
                for i in self.matrix[vertex]:
                    if i not in v:
                        v.append(i)
                        q.append(i)
g=Graph()
g.addvertex(1,2)
g.addvertex(4,2)
g.addvertex(1,4)
g.addvertex(2,3)
g.addvertex(4,3)
g.print()
g.bfs(1)
```

#dfs

```
class Graph:
    def __init__(self):
        self.matrix={}
    def addvertex(self,a,b):
        if a not in self.matrix:
            self.matrix[a]=[b]
        else:
            self.matrix[a].append(b)
    def print(self):
        print(self.matrix)
    def dfs(self,data):
        v=[]
        q=[data]
        while q:
            vertex=q.pop()
            print(vertex)
            if vertex in self.matrix:
                for i in self.matrix[vertex]:
                    if i not in v:
                        v.append(i)
                        q.append(i)
```

```
g=Graph()
g.addvertex(1,2)
g.addvertex(4,2)
g.addvertex(1,4)
g.addvertex(2,3)
g.addvertex(4,3)
g.print()
g.dfs(1)
```

LEETCODE PROBLEMS:

10. Faulty Keyboard

```
class Solution:
    def finalString(self, s: str) -> str:
        l=""
        for i in s:
            if i!="i":
                l+=i
            else:
                l=l[::-1]
        return l
```

32. Check the given string is PANGRAM or not

```
class Solution:
    def checkIfPangram(self, sentence: str) -> bool:
        a="abcdefghijklmnopqrstuvwxyz"
        for i in a:
            if i not in sentence:
              return False
        else:
          return True
```

57. Reverse words in a string III

```
class Solution:
    def reverseWords(self, s: str) -> str:
        a=""
        l=s.split(" ")
        for i in range(len(l)):
            if i==len(l)-1:
                a=a+l[i][::-1]
            else:
                a=a+l[i][::-1]+" "
        return a
```

28. Check if a String is an Acronym or not

```
class Solution:
    def isAcronym(self, words: List[str], s: str) -> bool:
       if len(words)!=len(s):
            return False
       else:
            for i in range(len(s)):
                if s[i]!=words[i][0]:
                    return False
       return True
```

04. Unique Morse Code Words

```
class Solution:
    def uniqueMorseRepresentations(self, words: List[str]) -> i
        n=[".-","-...","-.-.","-..",".","..-.","--.","....","..
        a="abcdefghijklmnopqrstuvwxyz"
        p=[]
        ans=[]
        for q in words:
            b=""
            for i in q:
                b+=n[a.index(i)]
            p.append(b)
        for q in p:
            if q not in ans:
                ans.append(q)
        return len(ans)
```

15. Count Asterisks

```
class Solution:
    def countAsterisks(self, s: str) -> int:
        n=""
        c=0
        t=0
        for i in s:
            if i=="|":
                t=t+1
            elif t%2==0:
                c+= i=="*"
        return c
```

44. Maximum number of String pairs

```
class Solution:
    def maximumNumberOfStringPairs(self, words: List[str]) -> in
        c=0
        for i in range(len(words)):
            for j in range(i+1,len(words)):
                if words [i][0]==words[j][1] and words[i][1]==wo
                    c+=1
        return c
```

67. Number of strings that appear as substrings

```
class Solution:
    def maximumNumberOfStringPairs(self, words: List[str]) -> i
        c=0
        for i in range(len(words)):
            for j in range(i+1,len(words)):
                if words [i][0]==words[j][1] and words[i][1]==w
                    c+=1
        return c
```

19. Count the key Changes

```
class Solution:
    def countKeyChanges(self, s: str) -> int:
        n=s.lower()
        c=0
        for i in range(len(n)-1):
            if n[i]!=n[i+1]:
                c+=1
        return c
```

44. Reverse String

```
class Solution:
    def reverseString(self, s: List[str]) -> None:
        s[:]=s[::-1]
```

10. Score of a String

```
class Solution:
    def scoreOfString(self, s: str) -> int:
        a=0
        for i in range(1,len(s)):
            a+=abs(ord(s[i])-ord(s[i-1]))
        return a
```

18. Sort the People

```
class Solution:
    def sortPeople(self, names: List[str], heights: List[int])
        a=[]
        for i in range(len(names)):
            a.append([heights[i],names[i]])
        a.sort(reverse=True)
        b=[]
        for i in range(len(names)):
            b.append(a[i][1])
        return b
```

1. Two Sum

```
class Solution:
    def twoSum(self, nums, target):
        a=[]
        for i in range(len(nums)):
            for j in range(i+1,len(nums)):
                if nums[i]+nums[j]==target:
                    a.append(i)
                    a.append(j)
                    return a
        return(twosum(nums,target))
```

58. Length of Last Word

```
class Solution:
    def lengthOfLastWord(self, s: str) -> int:
        l=s.split()
        a=len(l[-1])
        return a
```

59. Sorting the sentence

```
class Solution:
    def sortSentence(self, s: str) -> str:
        l=s.split(" ")
        d={}
        for i in l:
            d[i[-1]]=i[:-1]
        s=""
        for i in range(1,len(l)+1):
            if i==len(l):
                s=s+d[str(i)]
            else:
                s=s+d[str(i)]+" "
        return s
```

20. Valid Parenthesis

```
class Solution:
    def isValid(self, s: str) -> bool:
        a=[]
        for i in s:
            if i=="(" or i=="{" or i=="[":
                a.append(i)
            elif (i==")" or i=="}" or i=="]")and len(a)==0:
                return False
            else:
                if i==")" and a[-1]=="(":
                    a.pop()
                elif i=="}"and a[-1]=="{":
                    a.pop()
                elif i=="]" and a[-1]=="[":
                    a.pop()
                else:
                    a.append(i)
        if len(a)==0:
            return True
        else:
            return False
```

29. Concatenation of Array

```
class Solution:
    def getConcatenation(self, nums: List[int]) -> List[int]:
        return 2*nums
```

70. Shuffle the Array

```
class Solution:
    def shuffle(self, nums: List[int], n: int) -> List[int]:
        n=[]
        h=len(nums)//2
        for i in range(len(nums)//2):
            n.append(nums[i])
            n.append(nums[i + h])
        return n
```

;72. Richest Customer Wealth

```
class Solution:
    def maximumWealth(self, accounts: List[List[int]]) -> int:
        maxw=0
        for i in range(len(accounts)):
            t=sum(accounts[i])
            maxw=max(maxw,t)
        return maxw
```

'98. Number of employees who met the target

```
class Solution:
    def numberOfEmployeesWhoMetTarget(self, hours: List[int], ta
        c=0
        for i in hours:
            if i>=target:
                c+=1
        return c
```

·31. Kids with Greatest number of candies

```
class Solution:
    def kidsWithCandies(self, candies: List[int], extraCandies:
        maximum=max(candies)
        r=[]
        for i in range(len(candies)):
            t=candies[i]+extraCandies
            r.append(t>=maximum)
        return r
```

24. Count pairs whose sum is less than target

```
class Solution:
    def countPairs(self, nums: List[int], target: int) -> int:
        c=0
        for i in range(len(nums)):
            for j in range(i+1,len(nums)):
                if nums[i]+nums[j]<target:
                    c+=1
        return c
```

80. Running Sum of 1D Array

```
class Solution:
    def runningSum(self, nums: List[int]) -> List[int]:
        for i in range(1,len(nums)):
            nums[i]+=nums[i-1]
        return nums
```

74. Minimum number game

```
class Solution:
    def numberGame(self, nums: List[int]) -> List[int]:
        nums=sorted(nums)
        for i in range(0,len(nums),2):
            nums[i],nums[i+1]=nums[i+1],nums[i]
        return nums
```

88. Sum of Odd Length Subarrays

```
class Solution:
    def sumOddLengthSubarrays(self, arr: List[int]) -> int:
        r=0
        for i in range(len(arr)):
            for j in range(i,len(arr),2):
                r+=sum(arr[i:j+1])
        return r
```

32. Implement Queue using Stack

```
class MyQueue:

    def __init__(self):
        self.s1=[]
        self.s2=[]

    def push(self, x: int) -> None:
        self.s1.append(x)



    def pop(self) -> int:
        for i in range(len(self.s1)):
            self.s2.append(self.s1.pop())
        a= self.s2.pop()
        for i in range(len(self.s2)):
            self.s1.append(self.s2.pop())
        return a
    def peek(self) -> int:
        return self.s1[0]

    def empty(self) -> bool:
        if len(self.s1)==0:
            return True
        else:
            return False
```

25. Implement of Stack using Queues

```
class MyStack:

    def __init__(self):
        self.q1=[]
        self.q2=[]

    def push(self, x: int) -> None:
        self.q1.append(x)

    def pop(self) -> int:
        for i in range(len(self.q1)):
            self.q2.append(self.q1.pop())
        a=self.q2.pop(0)
        for i in range(len(self.q2)):
            self.q1.append(self.q2.pop())
        return a

    def top(self):
        return self.q1[-1]

    def empty(self):
        if len(self.q1)==0:
            return True
        else:
            return False
```

26. Remove Duplicates from the Sorted Array

```
class Solution:
    def removeDuplicates(self, nums: List[int]) -> int:
        s=set(nums)
        l=list(s)
        l.sort()
        for i in range(len(l)):
            nums[i]=l[i]
        return len(l)
```

58. Length of Last Word

```
class Solution:
    def lengthOfLastWord(self, s: str) -> int:
        c=0
        i=len(s)-1
        while i>=0 and s[i]==' ':
            i-=1
        while i>=0 and s[i]!=' ':
            c+=1
            i-=1
        return c
```

42. Valid Anagram

```
class Solution:
    def isAnagram(self, s: str, t: str) -> bool:
        sorted_s=sorted(s)
        sorted_t=sorted(t)
        return sorted_s==sorted_t
```

58. Add Digits

```
class Solution:
    def addDigits(self, num: int) -> int:
        if num>=10:
            output=num//10+num%10
            if output<10:
                return output
            else:
                return self.addDigits(output)
        else:
            return num
```

76. Middle of the Linked List

```
# Definition for singly-linked list.
# class ListNode:
#     def __init__(self, val=0, next=None):
#         self.val = val
#         self.next = next
class Solution:
    def middleNode(self, head: Optional[ListNode]) -> Optional[
        temp=head
        c=0
        while temp!=None:
            c+=1
            temp=temp.next
        temp=head
        for i in range(c//2):
            temp=temp.next
        return temp
```

06. Reverse Linked List

```
# Definition for singly-linked list.
# class ListNode:
#     def __init__(self, val=0, next=None):
#         self.val = val
#         self.next = next
class Solution:
    def reverseList(self, head: Optional[ListNode]) -> Optional
        prev=None
        next=None
        curr=head
        while curr!=None:
            next=curr.next
            curr.next=prev
            prev=curr
            curr=next
        head=prev
        return head
```

21. Merge Two Sorted Lists

```
# Definition for singly-linked list.
# class ListNode:
#     def __init__(self, val=0, next=None):
#         self.val = val
#         self.next = next
```

```
class Solution:
    def mergeTwoLists(self, list1: Optional[ListNode], list2: Op
        curr1=list1
        curr2=list2
        curr3=None
        while curr1!=None and curr2!=None:
            if curr1.val<=curr2.val:
                newnode=ListNode(curr1.val)
                temp=curr3
                if temp==None:
                    curr3=newnode
                else:
                    while (temp.next!=None):
                        temp=temp.next
                    temp.next=newnode
                curr1=curr1.next
            else:
                newnode=ListNode(curr2.val)
                temp=curr3
                if temp==None:
                    curr3=newnode
                else:
                    while temp.next!=None:
                        temp=temp.next
                    temp.next=newnode
                curr2=curr2.next
        while curr1!=None:
            newnode=ListNode(curr1.val)
            temp=curr3
            if temp==None:
                curr3=newnode
            else:
                while temp.next!=None:
                    temp=temp.next
                temp.next=newnode
            curr1=curr1.next
        while curr2!=None:
            newnode=ListNode(curr2.val)
            temp=curr3
            if temp==None:
                curr3=newnode
            else:
                while temp.next!=None:
                    temp=temp.next
                temp.next=newnode
            curr2=curr2.next
        return curr3
```

60. Intersection Of Two Linked Lists

```
# Definition for singly-linked list.
# class ListNode:
#     def __init__(self, x):
#         self.val = x
#         self.next = None

class Solution:
    def getIntersectionNode(self, headA: ListNode, headB: ListN
        a=headA
        b=headB
        c=0
        while a!=b:
            a=a.next
            b=b.next
            if a==None:
                a=headB
                c+=1
            if b==None:
                b=headA
                c+=1
            if c>=3:
                return None
        return b
```

:34. Palindrome Linked List

```
# Definition for singly-linked list.
# class ListNode:
#     def _init_(self, val=0, next=None):
#         self.val = val
#         self.next = next
class Solution:
    def isPalindrome(self, head: Optional[ListNode]) -> bool:
        curr=head
        newnode=ListNode(curr.val)
        a=newnode
        curr=curr.next
        while curr!=None:
            new=ListNode(curr.val)
            a.next=new
            curr=curr.next
            a=a.next
        prev=None
        next=None
        curr=head
        while curr!=None:
            next=curr.next
            curr.next=prev
            prev=curr
            curr=next
        head=prev

        curr=head
        a=newnode
        while curr!=None:
            if curr.val!=a.val:
                return False
            curr=curr.next
            a=a.next
        else:
            return True
```

83. Remove Duplicates From the List

```
# Definition for singly-linked list.
# class ListNode:
#     def __init__(self, val=0, next=None):
#         self.val = val
#         self.next = next
class Solution:
    def deleteDuplicates(self, head: Optional[ListNode]) -> Opt
        curr=head
        next=None
        if head==None:
            return None
        while curr.next!=None:
            next=curr.next
            if curr.val!=next.val:
                curr=curr.next
            else:
                curr.next=next.next
        return head
```

.41. Linked List Cycle

```
# Definition for singly-linked list.
# class ListNode:
#     def __init__(self, x):
#         self.val = x
#         self.next = None

class Solution:
    def hasCycle(self, head: Optional[ListNode]) -> bool:
        if head==None:
            return False
        fast=head
        slow=head
        while fast.next!=None and fast.next.next!=None:
            fast=fast.next.next
            slow=slow.next
            if fast==slow:
                return True
        return False
```

03. Remove Linked List Elements

```
# Definition for singly-linked list.
# class ListNode:
#     def __init__(self, val=0, next=None):
#         self.val = val
#         self.next = next
class Solution:
    def removeElements(self, head: Optional[ListNode], val: int
        temp=ListNode
        curr=temp
        temp.next=head
        while curr.next!=None:
            if curr.next.val==val:
                curr.next=curr.next.next
            else:
                curr=curr.next
        return temp.next
```

:37. Delete Node in a Linked List

```
# Definition for singly-linked list.
# class ListNode:
#     def __init__(self, x):
#         self.val = x
#         self.next = None

class Solution:
    def deleteNode(self, node):
        """
        :type node: ListNode
        :rtype: void Do not return anything, modify node in-plac
        """
        node.val=node.next.val
        node.next=node.next.next
```

2. Add Two Numbers

```
# Definition for singly-linked list.
# class ListNode:
#     def __init__(self, val=0, next=None):
#         self.val = val
#         self.next = next
class Solution:
    def addTwoNumbers(self, l1: Optional[ListNode], l2: Optional
        s=""
        s2=""
        while l1!=None:
            s=s+str(l1.val)
            l1=l1.next
        while l2!=None:
            s2=s2+str(l2.val)
            l2=l2.next
        s=s[::-1]
        s2=s2[::-1]
        a=int(s)+int(s2)
        a=str(a)
        a=a[::-1]
        q=str(a)
        z=ListNode()
        curr=z
        for i in q:
            new=ListNode(int(i))
            curr.next=new
            curr=curr.next
        return z.next
```

45. Binary Tree Postorder Traversal

```
# Definition for a binary tree node.
# class TreeNode:
#     def _init_(self, val=0, left=None, right=None):
#         self.val = val
#         self.left = left
#         self.right = right
class Solution:
    def postorderTraversal(self, root: Optional[TreeNode]) -> Li
        s=[]
        def order(root,s):
            if root:
                order(root.left,s)
                order(root.right,s)
                s.append(root.val)
        order(root,s)
        return s
```

94. Binary Tree Preorder Traversal

```
# Definition for a binary tree node.
# class TreeNode:
#     def _init_(self, val=0, left=None, right=None):
#         self.val = val
#         self.left = left
#         self.right = right
class Solution:
    def preorderTraversal(self, root: Optional[TreeNode]) -> Lis
        s=[]
        def order(root,s):
            if root:
                    s.append(root.val)
                order(root.left,s)
                order(root.right,s)
        order(root,s)
        return s
```

44. Binary Tree Inorder Traversal

```
# Definition for a binary tree node.
# class TreeNode:
#     def _init_(self, val=0, left=None, right=None):
#         self.val = val
#         self.left = left
#         self.right = right
class Solution:
    def inorderTraversal(self, root: Optional[TreeNode]) -> List
        s=[]
        def order(root,s):
            if root:
                order(root.left,s)
                s.append(root.val)
                order(root.right,s)

        order(root,s)
        return s
```

.04. Maximum Depth of Binary Tree

```
class Solution:
    def maxDepth(self, root: Optional[TreeNode]) -> int:
        def height(root):
            if root:
                leftnode=height(root.left)
                rightnode=height(root.right)
                return max(leftnode,rightnode)+1
            else:
                return 0
        a=height(root)
        return a
```

.11. Minimum Depth of the Binary Tree

```
# Definition for a binary tree node.
# class TreeNode:
#     def __init__(self, val=0, left=None, right=None):
#         self.val = val
#         self.left = left
#         self.right = right
class Solution:
    def minDepth(self, root: Optional[TreeNode]) -> int:
        def height(root):
            if root:
                if root.left is None:
                    return height(root.right)+1
                if root.right is None:
                    return height(root.left)+1
                leftnode=height(root.left)
                rightnode=height(root.right)
                return min(leftnode,rightnode)+1
            else:
                return 0
        a=height(root)
        return a
```

.00. Same Tree

```
# Definition for a binary tree node.
# class TreeNode:
#     def __init__(self, val=0, left=None, right=None):
#         self.val = val
#         self.left = left
#         self.right = right
class Solution:
    def isSameTree(self, p: Optional[TreeNode], q: Optional[Tree
        def same(p,q):
            if p is None and q is None:
                return True
            if p is None or q is None:
                return False
            if p.val!=q.val:
                return False
            return same(p.left,q.left) and same(p.right,q.right
        return same(p,q)
```

.01. Symmetric Tree

```
# Definition for a binary tree node.
# class TreeNode:
#     def _init_(self, val=0, left=None, right=None):
#         self.val = val
#         self.left = left
#         self.right = right
class Solution:
    def isSymmetric(self, root: Optional[TreeNode]) -> bool:
        def same(p,q):
                if p is None and q is None:
                    return True
                if p is None or q is None:
                    return False
                if p.val!=q.val:
                    return False
                return (p.val==q.val) and same(p.left,q.right) a
        return same(root.left,root.right)
```

.08. Convert Sorted Array to Binary Search Tree

222. Count Complete Tree Nodes

```
# Definition for a binary tree node.
# class TreeNode:
#     def __init__(self, val=0, left=None, right=None):
#         self.val = val
#         self.left = left
#         self.right = right
class Solution:
    def countNodes(self, root: Optional[TreeNode]) -> int:
        s=[]
        def order(root,s):
            if root:
                order(root.left,s)
                s.append(root.val)
                order(root.right,s)
        order(root,s)
        return len(s)
```

27. Remove Elements

```
class Solution:
    def removeElement(self, nums: List[int], val: int) -> int:
        n=0
        for i in range(len(nums)):
            if nums[i]!=val:
                nums[n]=nums[i]
                n+=1
        return n
```

28. Find the Index of the First Occurrence in a String

```
class Solution:
    def strStr(self, haystack: str, needle: str) -> int:
        for i in range(len(haystack)-len(needle)+1):
            if haystack[i:i+len(needle)]==needle:
                return i
        return -1
```

83. Move Zeroes

```
class Solution:
    def moveZeroes(self, nums: List[int]) -> None:
        left=0
        for right in range(len(nums)):
            if nums[right]!=0:
                nums[right],nums[left]=nums[left],nums[right]
                left+=1
        return nums
```

68. Missing Number

```
class Solution:
    def missingNumber(self, nums: List[int]) -> int:
        n=len(nums)
        expected_s=n*(n+1)//2
        actual_s=sum(nums)
        missing_num=expected_s-actual_s
        return missing_num
```

48. Sum of Unique Elements

```
class Solution:
    def sumOfUnique(self, nums: List[int]) -> int:
        c=[]
        for i in nums:
            if nums.count(i)>1:
                continue
            else:
                c.append(i)
        return sum(c)
```

51. Count Negative Numbers in a Sorted Matrix

```
class Solution:
    def countNegatives(self, grid: List[List[int]]) -> int:
        c=0
        for i in grid:
            for j in i:
                if j<0:
                    c+=1
        return c
```

'16. Minimum String Length

```
class Solution:
    def minimizedStringLength(self, s: str) -> int:
        a=""
        for i in s:
            if(i not in a):
                a+=i
        return len(a)
```