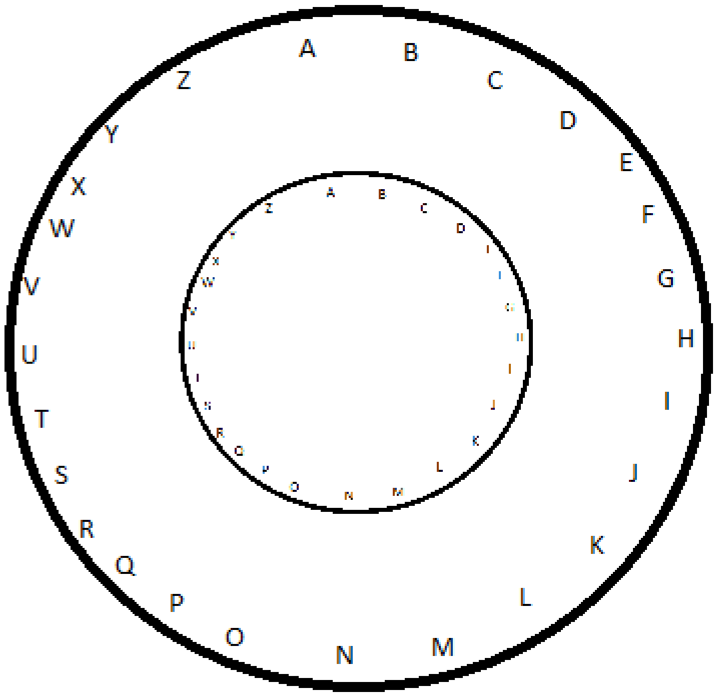
The Caesar Cipher

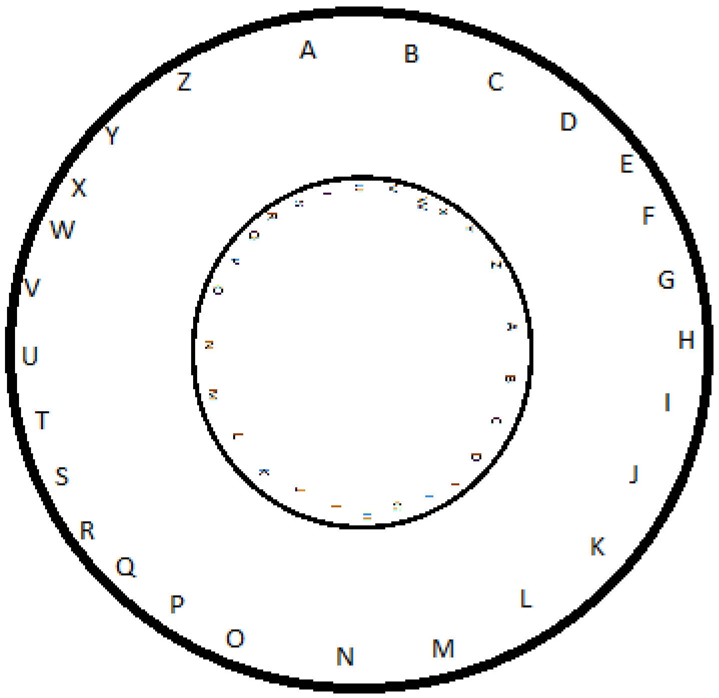
I. Encrypting a message using the Caesar cipher.

In order to encrypt a message using the Caesar cipher, one makes use of 2 disks,



in which the inner one is rotated clockwise by some angle to get some configuration.

The angle may be measured by the *number of characters* it rotates by, and is called the *shift*. For instance, it may be rotated by 7 *characters*, and this corresponds to *shift*=7. The disks then have a configuration as in the figure (below). Then, each character on the outer disk is matched to the character on the inner disk by drawing a line to the centre.



Mathematically, this corresponds to performing modular arithmetic, *modulo* 26.

```
c= (c + shift)%26;
```

It is said that we are *shifting* the characters by a factor of **`shift`**.

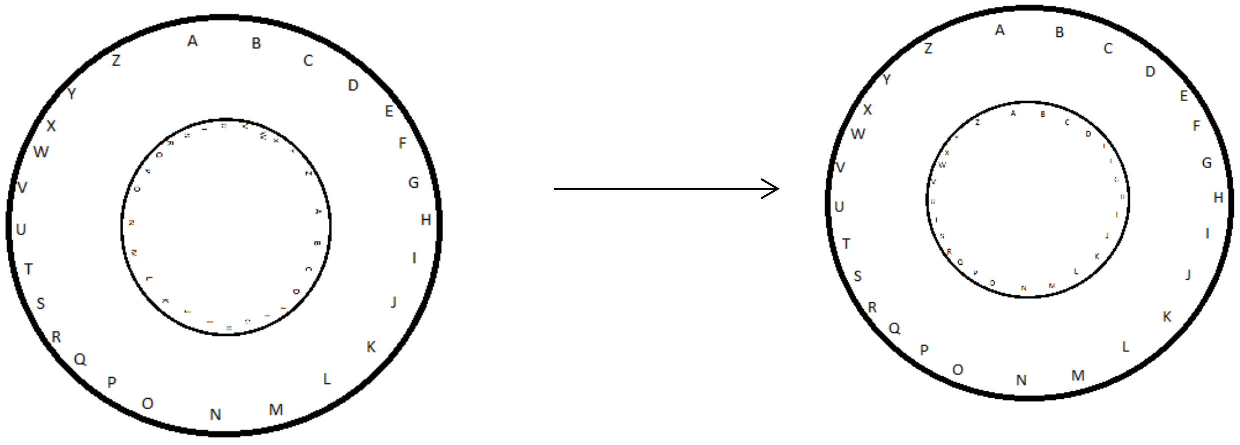
This transformation is used to encrypt the message M by treating it as an array of numbers (**a**-0, **b**-1, **c**-2, **d**-3, etc.) and matching each number to its *shifted* value.

```
String Message= br.readLine();
int[]M=
{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};//Memory initially blank
//Convert message into integer array
//(assuming all lowercase characters.)
for( i=0; i< Message.length(); i++ )
{
 M[i]= (int) Message.charAt(i)-97;
}
```

This array M itself may be transformed by shifting each number.

```
//Encryption
for( i=0; i< Message.length(); i++ )
{ M[i]= ( M[i]+shift )%26 +97; }
```

For decryption, the simplest method is to shift every number *back* by the shift amount. This will have the effect of rotating the smaller disk *anti-clockwise* to produce the original values.


A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

It is directly achieved as:

```
//Decryption
for( i=0; i< Message.length(); i++ )
{ M[i]= ( M[i]-97-shift )%26 + 97; }
```

APPENDIX.

A. Input/Output- characters vs integers

The input and output must be done via characters- **a**, **b**, **c**, **d** ...etc. But these are stored in memory as integers via the ASCII encoding. By this encoding, the characters are encoded as: **a**-97, **b**-98, **c**-99, **d**-100, etc.

In order to convert this to the more convenient numbering of letters, i.e. **a**-0, **b**-1, **c**-2, **d**-3, etc., we must *subtract* 97 from each of the characters. It is for this reason that we *subtract* 97 for calculation purposes (eg. for `c= (c + shift)%26`) and we *add* 97 to get back the ASCII encoding in order to display the output in characters.

Since Java has the facility of *explicit casting*, we may directly convert numbers to characters for the sake of printing the output using:

```
//Convert back:
    char[]_M=
     {'_','_','_','_','_','_','_','_','_','_
     ','_','_','_','_','_'};
    for( i=0; i<Message.length(); i++ )
```

```
   { _M[i]= (char)M[i]; }
```

B. Full Program.

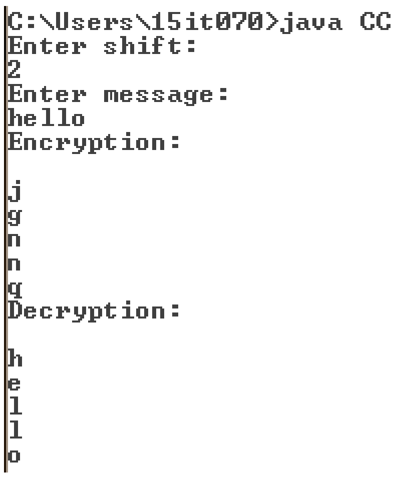
The above code can be used in a Java program as below.

```
import java.io.*;
public class CC
{
 public static void main( String a[] )
throws Exception
 {
   BufferedReader br=
   new BufferedReader(
   new InputStreamReader( System.in )
   );

   int i,shift;
```

```
System.out.println("Enter shift:");
shift= Integer.parseInt(br.readLine());

System.out.println("Enter message:");

//1.Convert to int-array (see above)
//2.Encryption (see above)
//2.1.Convert back

//2.2.Print result:
System.out.println("Encryption:\n");
for( i=0; i<Message.length(); i++ )
 { System.out.println( _M[i] ); }

//3.Decryption (see above)
//3.1. Convert back

//3.2.Print result:
    System.out.println("Decryption:\n");
    for( i=0; i<Message.length(); i++ )
    { System.out.println( _M[i] ); }

  }
}
```

C. Sample Output

A test run:



```
C:\Users\15it070>java CC
Enter shift:
2
Enter message:
hello
Encryption:

j
g
n
n
q
Decryption:

h
e
l
l
o
```