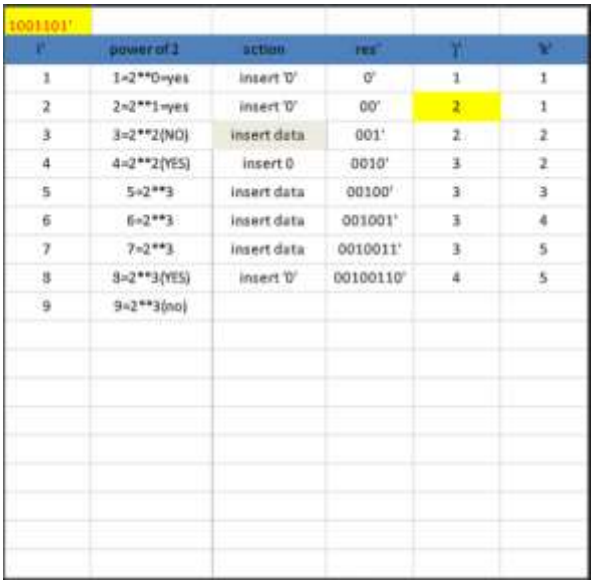
EXPERIMENT – 6

AIM: - Write a program to implement error detection and correction using HAMMING code concept. Make a test run to input data stream and verify error correction feature.



1001101'					
i'	power of 2	action	res'	j'	k'
1	1=2**0=yes	insert '0'	0'	1	1
2	2=2**1=yes	insert '0'	00'	2	1
3	3=2**2(NO)	insert data	001'	2	2
4	4=2**2(YES)	insert 0	0010'	3	2
5	5=2**3	insert data	00100'	3	3
6	6=2**3	insert data	001001'	3	4
7	7=2**3	insert data	0010011'	3	5
8	8=2**3(YES)	insert '0'	00100110'	4	5
9	9=2**3(no)				

CODE: -

```
def calcRedundantBits(m):
    # Use the formula 2 ^ r >= m + r + 1
    for i in range(m):
        if(2**i >= m + i + 1):
            return i

def posRedundantBits(data, r):
    # Redundancy bits are placed at the positions
    j = 0
    k = 1
    m = len(data)
    res = ''
    # If position is power of 2 then insert '0' Else append the data
    for i in range(1, m+r+1):
        if(i == 2**j):
            res = res + '0'
            j += 1
        else:
            res = res + data[-1 * k]
            k += 1
    # The result is reversed since positions are counted backwards. (m + r+1
... 1)
    return res[::-1]
```

```
def calcParityBits(arr, r):
    n = len(arr)
    # For finding rth parity bit, iterate over


# 0 to r - 1
    for i in range(r):
        val = 0
        for j in range(1, n + 1):

            # If position has 1 in ith significant
            # position then Bitwise OR the array value
            # to find parity bit value.
            if(j & (2**i) == (2**i)):
                val = val ^ int(arr[-1 * j])
                # -1 * j is given since array is reversed

        # String Concatenation
        # (0 to n - 2^r) + parity bit + (n - 2^r + 1 to n)
        arr = arr[:n-(2**i)] + str(val) + arr[n-(2**i)+1:]
    return arr

def detectError(arr, nr):
    n = len(arr)
    res = 0

    # Calculate parity bits again
    for i in range(nr):
        val = 0
        for j in range(1, n + 1):
            if(j & (2**i) == (2**i)):
                val = val ^ int(arr[-1 * j])

        # Create a binary no by appending
        # parity bits together.

        res = res + val*(10**i)

    # Convert binary to decimal
    return int(str(res), 2)


# Enter the data to be transmitted
data = '1011001'

# Calculate the no of Redundant Bits Required
m = len(data)
r = calcRedundantBits(m)

# Determine the positions of Redundant Bits
arr = posRedundantBits(data, r)
```

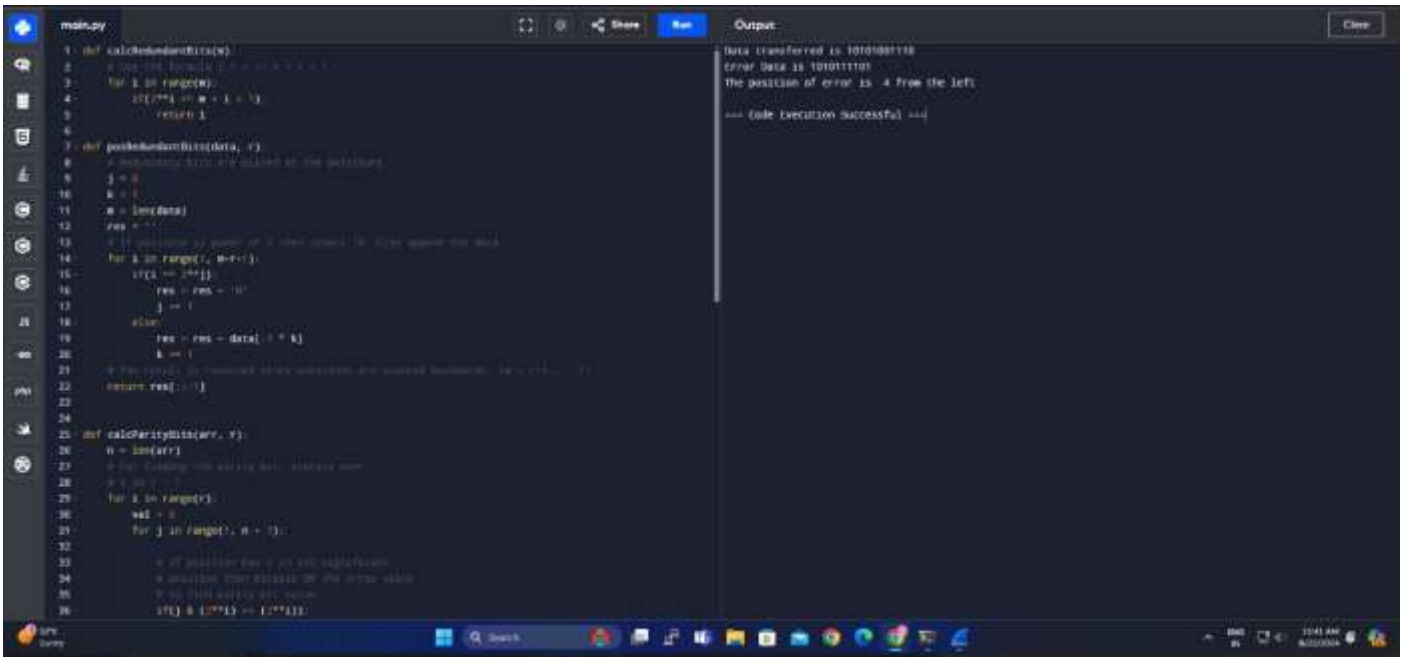
```
# Determine the parity bits
arr = calcParityBits(arr, r)

# Data to be transferred
print("Data transferred is " + arr)

# Stimulate error in transmission by changing
# a bit value.
# 10101001110 -> 11101001110, error in 10th position.

arr = '10101001110'
print("Error Data is " + arr)
correction = detectError(arr, r)
if(correction==0):
    print("There is no error in the received message.")
else:
    print("The position of error is ",len(arr)-correction+1,"from the left")
```

OUTPUT: -



RESULT: -

The code for HAMMING CODE have been executed successfully and the output is verified.