

```
1 #----- NAIR PROGRAM -----
2
3 data = input("Enter the data bits (e.g., 1011): ")
4
5 # Step 1: Calculate required parity bits
6 p = calc_parity_multiset(data)
7
8 #----- OUTPUT: DESIGNED: 10100111011
9
10 Microsoft Windows [Version 10.0.20348.7019]
11 (c) Microsoft Corporation. All rights reserved.
12
13 C:\Users\Afrah M\Desktop>python.exe "c:/Users/Afrah M/Desktop/cn/hamming_code.py"
14 Enter the data bits (e.g., 1011): 1011
15
16 Data with parity placeholders: 11001100
17 Encoded data (Hamming code): 11001100
18
19 Enter bit position to flip (0 for no error): 3
20 Received data: 11000100
21 X Error detected at bit position: 3
22 Corrected data: 11001100
23
24 C:\Users\Afrah M\Desktop>
```

Result

A program to implement the Hamming Code was successfully written. The program demonstrated the ability to detect and correct a single-bit error in the transmitted data stream.

EXP:07

Flow control at Data Link Layer

Aim

To write a program to implement flow control at the data link layer using the **Sliding Window Protocol** and simulate the flow of frames from one node to another.

Algorithm / Procedure

1. **Define** the window size for the sender and receiver.
2. **Implement** the sender logic:
 - Maintain a sending window of sequence numbers.
 - Send frames within the window limit.
 - Start a timer for each unacknowledged frame.
3. **Implement** the receiver logic:
 - Maintain a receiving window.
 - Accept frames in order and send cumulative acknowledgments (ACKs).
 - Discard out-of-order frames (or buffer, depending on the specific protocol variant).

4. **Simulate** the flow of frames, including scenarios for successful transmission, lost frames, and lost ACKs, to demonstrate the flow control mechanism.

Code

```
import random
import time

# -----
# Sliding Window Protocol (Go-Back-N) Simulation
# -----

def sliding_window_simulation(total_frames, window_size):
    print("\n--- Sliding Window Protocol Simulation ---")
    print(f"Total Frames to Send: {total_frames}")
    print(f"Window Size: {window_size}\n")

    sent = 0 # Number of frames sent so far

    while sent < total_frames:
        # Determine frames in the current window
        window_end = min(sent + window_size, total_frames)
        current_window = list(range(sent + 1, window_end + 1))
        print(f"Sender: Sending frames {current_window}")

        # Simulate sending each frame in the window
        acked = True
        for frame in current_window:
            # Randomly simulate frame loss (20% chance)
            if random.random() < 0.2:
```

```
        print(f"Frame {frame} lost during transmission!")
        acked = False
        break
    else:
        print(f" Frame {frame} received successfully by Receiver")
        time.sleep(0.3)

    if acked:
        # All frames acknowledged → Slide window forward
        print(f"Receiver: ACK {window_end} received by Sender")
        sent = window_end
    else:
        # Go-Back-N retransmission
        print(f"Receiver: No ACK for Frame {frame}, retransmitting from Frame {frame}
onwards...")
        time.sleep(1)
        # Sender will retransmit from the lost frame
        sent = frame - 1

    print("-" * 55)
    time.sleep(0.5)

    print("\nAll frames transmitted successfully!\n")

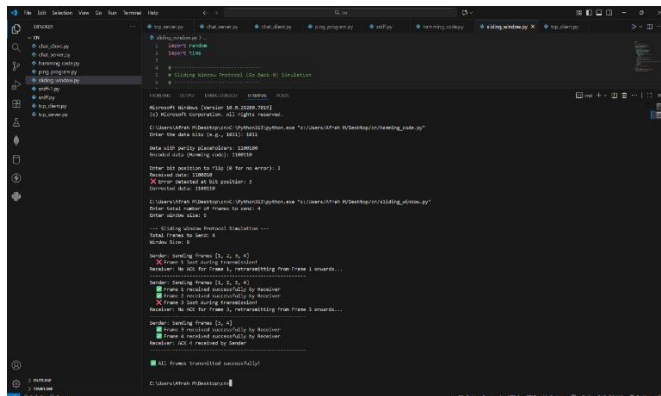
# -----
# MAIN PROGRAM
# -----
if __name__ == "__main__":
```

```
total_frames = int(input("Enter total number of frames to send: "))
```

```
window_size = int(input("Enter window size: "))
```

```
sliding_window_simulation(total_frames, window_size)
```

Output:



```
Microsoft Windows [Version 10.0.22000.748]
(c) Microsoft Corporation. All rights reserved.

C:\Users\Hrithik>cd Desktop\sliding_window.py
Enter the data size (a,b,c, MBit): 8M

Data will be sent in packets of size 100000
Number of packets (a/b/c) : 100000

Enter the packet size (a/b/c) : 1
Number of packets : 100000
Error occurred as the packet size is not a power of 2
Number of packets : 100000

C:\Users\Hrithik>cd Desktop\sliding_window.py
Enter the data size (a,b,c, MBit): 8
Enter the packet size (a/b/c) : 1

Sliding window simulation ----
Data size is 8
Window size is 4

Sender: Sending Frames [1, 2, 3, 4]
Receiver: No ACK for Frame 1, retransmitting from Frame 1 onwards...
Sender: Resending Frames [1, 2, 3, 4]
Receiver: Frame 1 received successfully by Receiver
Receiver: Frame 2 received successfully by Receiver
Receiver: Frame 3 not received by Receiver
Receiver: No ACK for Frame 3, retransmitting from Frame 3 onwards...
Sender: Resending Frames [3, 4]
Receiver: Frame 3 received successfully by Receiver
Receiver: Frame 4 received successfully by Receiver
Receiver: All 4 received by sender

All frames transmitted successfully
```

Result

A program simulating the Sliding Window Protocol was successfully implemented. The simulation demonstrated effective flow control by managing the rate of frame transmission between the sender and receiver.