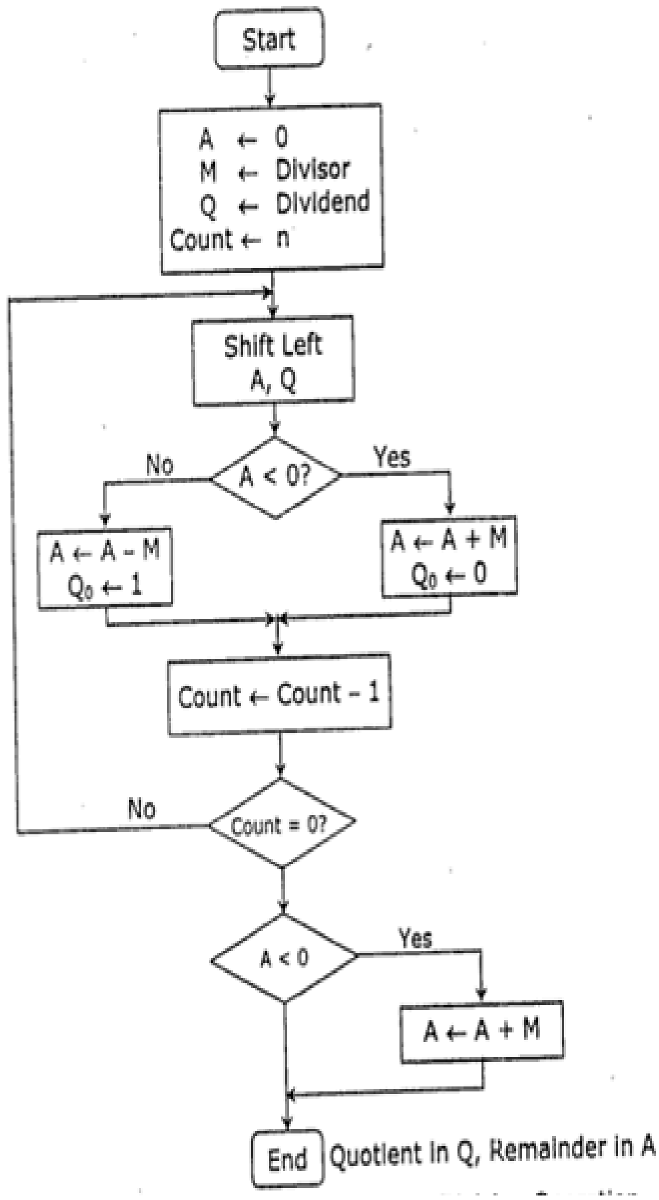
Experiment No. 9
Implement Non-Restoring algorithm using c-programming
Name: Anish Naik
Roll No: 34
Date of Performance: 19/09/24
Date of Submission:

Aim - To implement Non-Restoring division algorithm using c-programming.

Objective -
1. To understand the working of Non-Restoring division algorithm.
2. To understand how to implement Non-Restoring division algorithm using c-programming.

Theory:

In each cycle content of the register, A is first shifted and then the divisor is added or subtracted with the content of register A depending upon the sign of A. In this, there is no need of restoring, but if the remainder is negative then there is a need of restoring the remainder. This is the faster algorithm of division.



Perform 8 ÷ 3 by non-restoring division technique.

	A Register	Q Register	
Initially	0 0 0 0 0	1 0 0 0	First Cycle
Shift	0 0 0 0 1	0 0 0 □	
Subtract	1 1 1 0 1		
Set Q_0	1 1 1 1 0	0 0 0 0	
Shift	1 1 1 0 0	0 0 0 □	Second Cycle
Add	0 0 0 1 1		
Set Q_0	1 1 1 1 1	0 0 0 0	
Shift	1 1 1 1 0	0 0 0 □	Third Cycle
Add	0 0 0 1 1		
Set Q_0	0 0 0 0 1	0 0 0 1	
Shift	0 0 0 1 0	0 0 1 □	Fourth Cycle
Subtract	1 1 1 0 1		
Set Q_0	1 1 1 1 1	0 0 1 0	
		Quotient	
Add	1 1 1 1 1		
	0 0 0 1 1		
	0 0 0 1 0		
	Remainder		

Program -

```
#include <stdio.h>

void binaryPrint(int n, int bits) {
    for (int i = bits - 1; i >= 0; i--) {
        printf("%d", (n >> i) & 1);
    }
    printf("\n");
}

int main() {
    int M, Q, A = 0, count;
    int n;

    printf("Enter the divisor (M): ");
    scanf("%d", &M);
    printf("Enter the dividend (Q): ");
    scanf("%d", &Q);
    printf("Enter the number of bits: ");
    scanf("%d", &n);

    count = n;

    printf("\nInitial values:\n");
    printf("A: ");
    binaryPrint(A, n);
    printf("Q: ");
    binaryPrint(Q, n);
    printf("M: ");
    binaryPrint(M, n);
    printf("\n");

    while (count > 0) {
        A = (A << 1) | ((Q >> (n - 1)) & 1);
        Q = Q << 1;

        printf("After left shift:\n");
        printf("A: ");
        binaryPrint(A, n);
```

```
        printf("Q: ");
        binaryPrint(Q, n);

        if (A >= 0) {
            A = A - M;
            printf("After subtraction (A >= 0):\n");
        } else {
            A = A + M;
            printf("After addition (A < 0):\n");
        }

        printf("A: ");
        binaryPrint(A, n);

        if (A >= 0) {
            Q = Q | 1;
        } else {
            Q = Q & ~(1);
        }

        printf("After updating Q0:\n");
        printf("A: ");
        binaryPrint(A, n);
        printf("Q: ");
        binaryPrint(Q, n);
        printf("\n");

        count--;
    }

    if (A < 0) {
        A = A + M;
        printf("Final correction (if A < 0, add M to A):\n");
        printf("A: ");
        binaryPrint(A, n);
    }

    printf("\nFinal quotient (Q): ");
    binaryPrint(Q, n);
    printf("Final remainder (A): ");
    binaryPrint(A, n);
```

```
    return 0;
}
```

Output:

```
Enter the divisor (M): 4
Enter the dividend (Q): 2
Enter the number of bits: 4

Initial values:
A: 0000
Q: 0010
M: 0100

After left shift:
A: 0000
Q: 0100
After subtraction (A >= 0):
A: 1100
After updating Q0:
A: 1100
Q: 0100

After left shift:
A: 1000
Q: 1000
After addition (A < 0):
A: 1100
After updating Q0:
A: 1100
Q: 1000

After left shift:
A: 1001
Q: 0000
After addition (A < 0):
A: 1101
After updating Q0:
A: 1101
Q: 0000
```

```
Final correction (if A < 0, add M to A):
A: 0010

Final quotient (Q): 0000
Final remainder (A): 0010
```

Conclusion -

In this experiment, we successfully implemented the Non-Restoring Division Algorithm in C to divide two unsigned integers represented in binary form. The algorithm effectively demonstrates the process of binary arithmetic, including addition, subtraction, and bitwise shifting. Through step-by-step execution, we observed how the quotient and remainder are derived based on the initial dividend and divisor. This implementation not only reinforces the understanding of binary operations but also highlights the efficiency of Non-Restoring Division in handling division tasks without requiring restoration in every step. Overall, the experiment provides valuable insights into algorithm design and binary number manipulation in programming.