Name: P.MAL REDDY

Reg-No: 192372015

18.Construct a C program to simulate producer-consumer problem using semaphores.

Aim:

The aim of the program is to simulate the producer-consumer problem using semaphores. The producer creates data and puts it in a buffer, while the consumer consumes the data from the buffer. Semaphores are used to synchronize access to the shared buffer.

Algorithm:

1. **Initialization:**
   - Initialize two semaphores: `empty` (to track the number of empty slots) and `full` (to track the number of full slots).
   - Initialize a mutex semaphore for mutual exclusion.
2. **Producer:**
   - Wait on the `empty` semaphore (to ensure there is space).
   - Wait on the mutex semaphore (for mutual exclusion).
   - Add an item to the buffer.
   - Signal the `full` semaphore (indicating a full slot).
   - Signal the mutex semaphore to release mutual exclusion.
3. **Consumer:**
   - Wait on the `full` semaphore (to ensure there is data).
   - Wait on the mutex semaphore (for mutual exclusion).
   - Consume an item from the buffer.
   - Signal the `empty` semaphore (indicating an empty slot).
   - Signal the mutex semaphore to release mutual exclusion.

Procedure:

- The producer creates data and puts it into the buffer.
- The consumer retrieves data from the buffer and consumes it.
- The semaphores ensure that the buffer is accessed in a synchronized manner.

Code:

```
#include <stdio.h>
```

```
#include <stdbool.h>
int main() {
    int n, m, i, j, k;
    printf("Enter number of processes: ");
    scanf("%d", &n);
    printf("Enter number of resources: ");
    scanf("%d", &m);
    int Allocation[n][m], Maximum[n][m], Need[n][m], Available[m];
    printf("Enter Allocation matrix:\n");
    for (i = 0; i < n; i++)
        for (j = 0; j < m; j++)
            scanf("%d", &Allocation[i][j]);
    printf("Enter Maximum matrix:\n");
    for (i = 0; i < n; i++)
        for (j = 0; j < m; j++)
            scanf("%d", &Maximum[i][j]);
    printf("Enter Available resources:\n");
    for (j = 0; j < m; j++)
        scanf("%d", &Available[j]);
    for (i = 0; i < n; i++)
        for (j = 0; j < m; j++)
            Need[i][j] = Maximum[i][j] - Allocation[i][j];
```

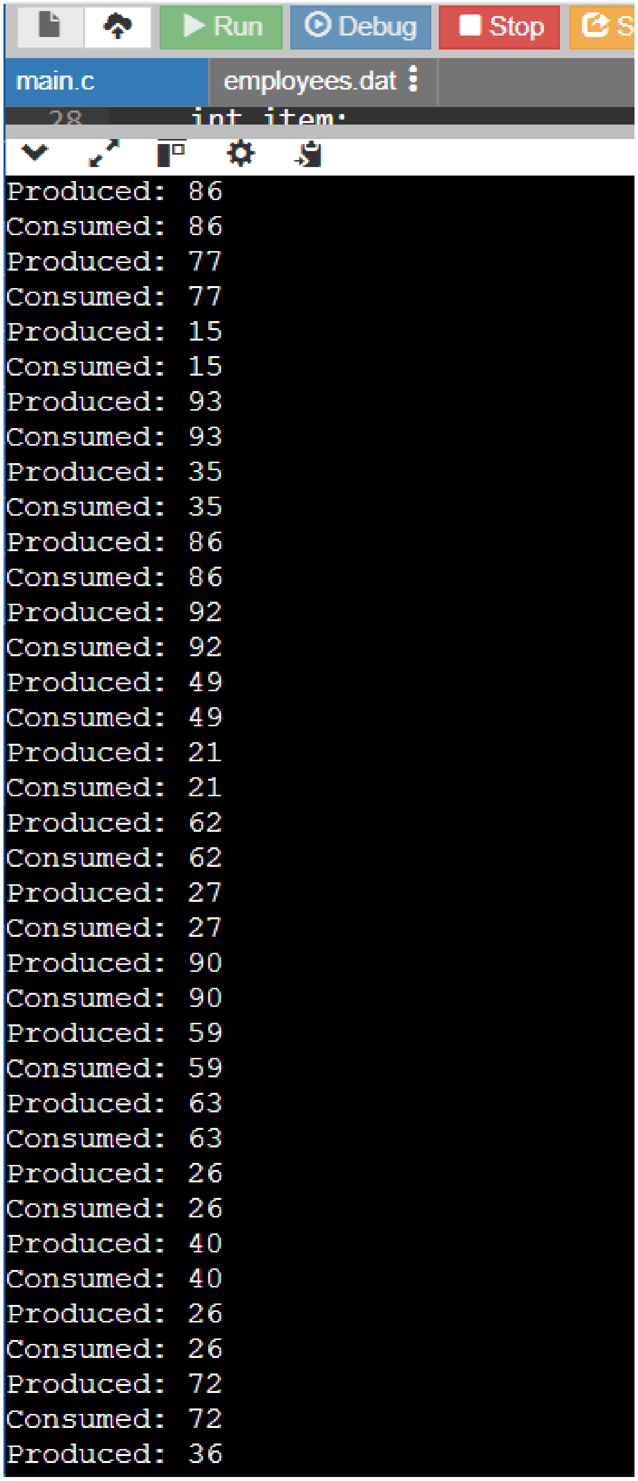
```
bool Finish[n];
for (i = 0; i < n; i++)
    Finish[i] = false;
int SafeSequence[n], work[m];
for (j = 0; j < m; j++)
    work[j] = Available[j];
int count = 0;
while (count < n) {
    bool found = false;
    for (i = 0; i < n; i++) {
        if (!Finish[i]) {
            for (j = 0; j < m; j++)
                if (Need[i][j] > work[j])
                    break;
            if (j == m) {
                for (k = 0; k < m; k++)
                    work[k] += Allocation[i][k];
                SafeSequence[count++] = i;
                Finish[i] = true;
                found = true;
            }
        }
    }
```

```
        if (!found) {

            printf("System is in an unsafe state.\n");

            return 0;

        }

    }

    printf("System is in a safe state.\nSafe sequence is: ");

    for (i = 0; i < n; i++)

        printf("%d ", SafeSequence[i]);

    printf("\n");

    return 0;

}
```

Result:

- The producer generates random numbers and places them in the buffer.
- The consumer retrieves and consumes these numbers.
- The semaphores ensure that the producer and consumer operate without conflicts, and the buffer is accessed safely.

Output:



```
28        int item;
```

```
Produced: 86
Consumed: 86
Produced: 77
Consumed: 77
Produced: 15
Consumed: 15
Produced: 93
Consumed: 93
Produced: 35
Consumed: 35
Produced: 86
Consumed: 86
Produced: 92
Consumed: 92
Produced: 49
Consumed: 49
Produced: 21
Consumed: 21
Produced: 62
Consumed: 62
Produced: 27
Consumed: 27
Produced: 90
Consumed: 90
Produced: 59
Consumed: 59
Produced: 63
Consumed: 63
Produced: 26
Consumed: 26
Produced: 40
Consumed: 40
Produced: 26
Consumed: 26
Produced: 72
Consumed: 72
Produced: 36
```