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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:

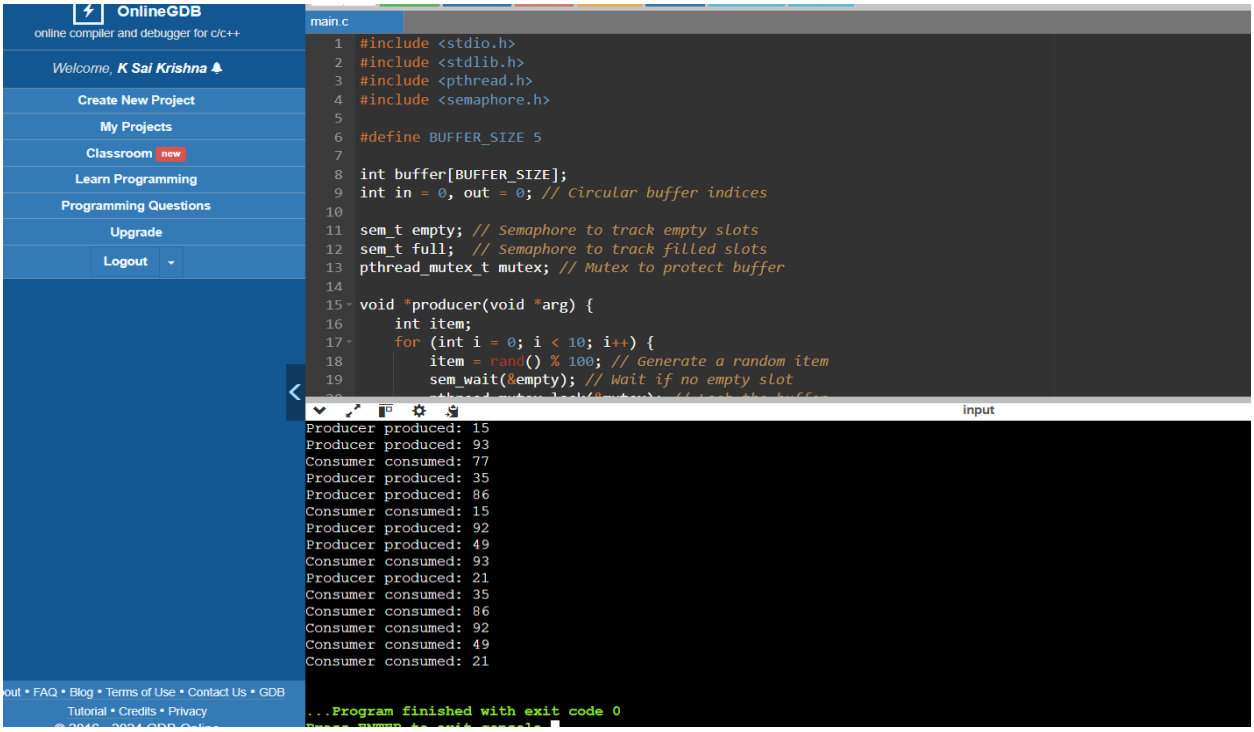
```
#include <stdio.h>

#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;
}
```

Output:



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.