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20. Construct a C program to simulate Reader-Writer problem using Semaphores.

Aim:

The aim of the Reader-Writer problem is to manage access to a shared resource where multiple readers can access it simultaneously but writers need exclusive access. We use semaphores to synchronize the readers and writers.

Algorithm:

- Readers: Can read simultaneously, but if a writer is writing, they must wait.
- Writers: Must have exclusive access to the resource, meaning no readers or other writers can access it during writing.

Procedure:

1. Initialize semaphores:
    - `mutex` for mutual exclusion (to control access to shared data).
    - `write_lock` to ensure exclusive access to the resource for writers.
    - `read_count_lock` for synchronization of the reader count.
2. Readers:
    - Increment the reader count.
    - If it's the first reader, wait for writers.
    - After reading, decrement the reader count.
    - If it's the last reader, signal the writers to proceed.
3. Writers:
    - Wait for the `write_lock` to get exclusive access.
    - Perform writing.
    - Signal after writing is done.

Code:

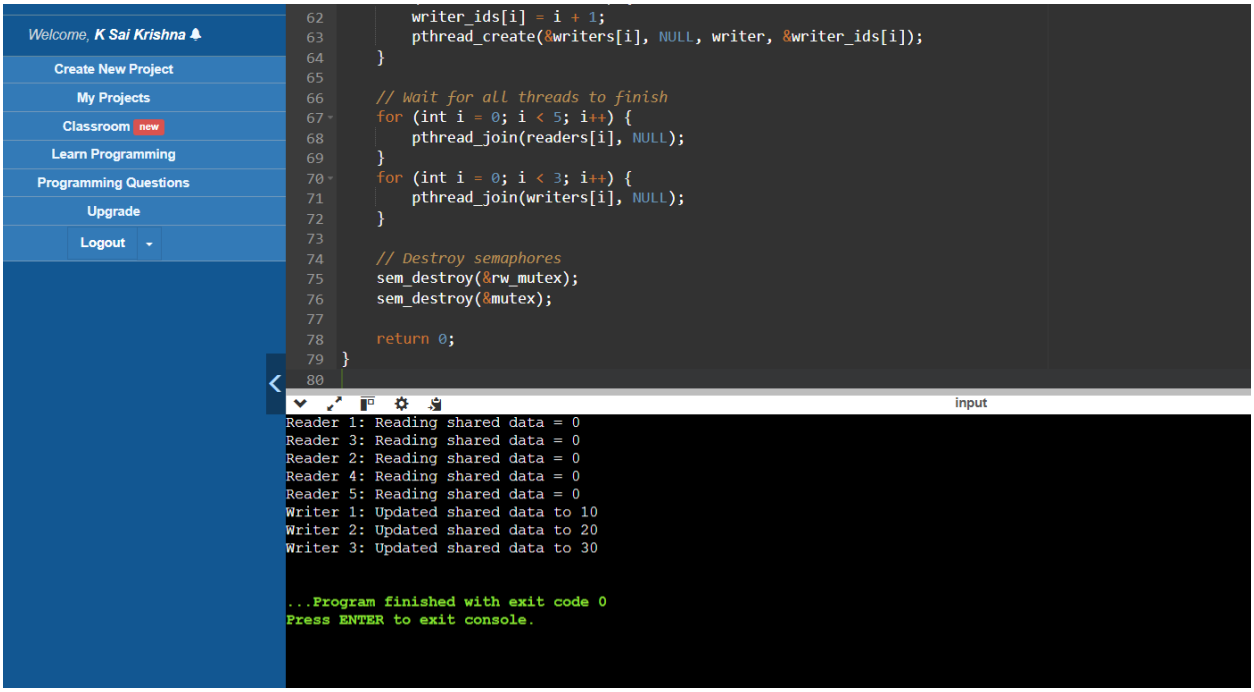
```
#include <stdio.h>

#include <pthread.h>

#include <semaphore.h>



sem_t mutex, write_lock, read_count_lock;

int read_count = 0;
```

```
void* reader(void* arg) {
    sem_wait(&read_count_lock);
    read_count++;
    if (read_count == 1)
        sem_wait(&write_lock);
    sem_post(&read_count_lock);

    printf("Reader is reading\n");

    sem_wait(&read_count_lock);
    read_count--;
    if (read_count == 0)
        sem_post(&write_lock);
    sem_post(&read_count_lock);

    return NULL;
}

void* writer(void* arg) {
    sem_wait(&write_lock);

    printf("Writer is writing\n");
```

```
    sem_post(&write_lock);

    return NULL;
}

int main() {
    pthread_t r[5], w[5];

    sem_init(&mutex, 0, 1);
    sem_init(&write_lock, 0, 1);
    sem_init(&read_count_lock, 0, 1);

    for (int i = 0; i < 5; i++) {
        pthread_create(&r[i], NULL, reader, NULL);
        pthread_create(&w[i], NULL, writer, NULL);
    }

    for (int i = 0; i < 5; i++) {
        pthread_join(r[i], NULL);
        pthread_join(w[i], NULL);
    }
```

```
    sem_destroy(&mutex);
    sem_destroy(&write_lock);
    sem_destroy(&read_count_lock);

    return 0;
}
```

Output:



Result:

The program simulates multiple readers and writers. It ensures that:

- Multiple readers can access the resource simultaneously.
- A writer has exclusive access, blocking readers when writing.
- Once writing is finished, readers can resume.