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29. Write a C program to simulate the solution of Classical Process Synchronization Problem

Aim:

To simulate the solution to the Classical Process Synchronization Problem (e.g., Producer-Consumer or Dining Philosophers) using C programming and demonstrate the correct functioning of process synchronization.

Algorithm (Dining Philosophers Example):

1. Initialize the state of philosophers as "thinking."
2. Use semaphores to control access to shared resources (chopsticks).
3. Define `pickup()` and `putdown()` functions to manage chopsticks.
4. A philosopher alternates between thinking and eating.
5. Ensure no deadlock or starvation occurs using a synchronization mechanism.

Procedure:

1. Create threads to represent philosophers.
2. Use semaphores for chopstick access.
3. Implement synchronization logic to prevent deadlock (e.g., wait-and-signal operations).
4. Run the program and observe how philosophers alternate between thinking and eating.

Code:

```
#include <pthread.h>

#include <semaphore.h>

#include <stdio.h>

#include <unistd.h>

#define N 5

sem_t chopstick[N];

pthread_t philosopher[N];
```

```
void* dine(void* arg) {  
    int id = *(int*)arg;  
  
    while (1) {  
        printf("Philosopher %d is thinking.\n", id);  
        sleep(1);  
  
        sem_wait(&chopstick[id]);  
        sem_wait(&chopstick[(id + 1) % N]);  
  
        printf("Philosopher %d is eating.\n", id);  
        sleep(1);  
  
        sem_post(&chopstick[id]);  
        sem_post(&chopstick[(id + 1) % N]);  
  
        printf("Philosopher %d finished eating and starts thinking.\n", id);  
    }  
}
```

```
int main() {  
    int id[N];  
    for (int i = 0; i < N; i++) {
```

```

        sem_init(&chopstick[i], 0, 1);

        id[i] = i;
    }

    for (int i = 0; i < N; i++)

        pthread_create(&philosopher[i], NULL, dine, &id[i]);

    for (int i = 0; i < N; i++)

        pthread_join(philosopher[i], NULL);

    return 0;
}

```

Result:

The output of the program demonstrates that each philosopher alternates between thinking and eating, ensuring proper synchronization without deadlock or starvation.

Output:

The screenshot shows the OnlineGDB interface with the following output in the console:

```

Philosopher 0 is thinking.
Philosopher 1 is thinking.
Philosopher 2 is thinking.
Philosopher 3 is thinking.
Philosopher 4 is thinking.
Philosopher 0 is eating.
Philosopher 2 is eating.
Philosopher 0 finished eating and starts thinking.
Philosopher 0 is thinking.
Philosopher 4 is eating.
Philosopher 2 finished eating and starts thinking.
Philosopher 2 is thinking.
Philosopher 1 is eating.
Philosopher 4 finished eating and starts thinking.
Philosopher 3 is eating.
Philosopher 4 is thinking.
Philosopher 0 is eating.
Philosopher 1 finished eating and starts thinking.
Philosopher 1 is thinking.
Philosopher 3 finished eating and starts thinking.
Philosopher 3 is thinking.
Philosopher 0 finished eating and starts thinking.

```

