Nagar Yuwak Shikshan Sanstha's

Yeshwantrao Chavan College of Engineering

(An Autonomous Institution affiliatedtoRashtrasantTukadojiMaharajNagpur University)
Hingna Road, Wanadongri, Nagpur - 441 110
Ph.: 07104-237919, 234623, 329249,329250Fax:07104-232376,Website:www.ycce.edu

Department of Computer Science and Engineering (IOT)

YCCE

Vision

"To become the most preferred institution providing innovative, research and value based, professional education for the society at large".

Mission

YCCE is committed to
- Attract besttalent and create learning ambience
- Practice Innovative teaching-learning & research
- Integrate Industry-Institute Collaborations
- Nurture students towards holistic development and choicest career

Department

Vision of the Department

To be a well-known center for pursuing computer education through innovative pedagogy, value-based education and industry collaboration.

Mission of the Department

To establish learning ambience for ushering in computer engineering professionals in core and multidisciplinary arena by developing problem-solving skills through emerging technologies.

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23CT1402		Lab: Operating Systems
Name of the Student: Parth Bhedurkar		Semester/ Section: 5 A
Roll No: 52		Enrollment Number: 23071495

Sr. No.	COs	Course Outcomes	POs											PSOs	
			1	2	3	4	5	6	7	8	9	10	11	PSO 1	PSO2
1	CO1	Demonstrate the ability to execute Linux process management, memory management, and shell commands to manage system resources efficiently.	3	3	3	-		-	-	-	-	-	3	3	
2	CO2	Develop programs utilizing system calls, thread programming, and page replacement algorithms to simulate and analyze operating system functionalities.	3	3	3	-	-	-	-	-	-	-	3	3	
3	CO3	Design and implement process scheduling, memory allocation, and deadlock to detection algorithms address real-world operating system challenges.	3	3	3	-		-	-	-	-	-	3	3	
		Avg		3	3	-		-	-	-	-	-	3	3	

Operafting Systems Lab 25-26 CSE(IOT)

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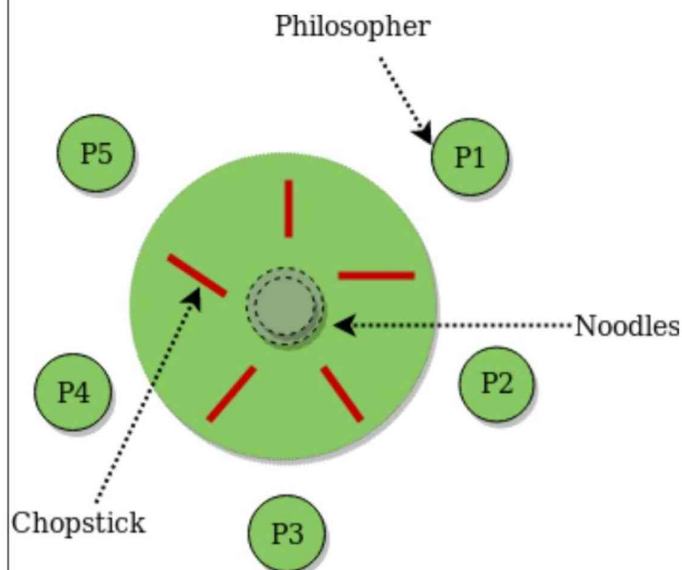## Department of Computer Science and Engineering (IOT)

Practical No. 8

Aim: Develop a program to provide synchronization among the 5 philosophers in Dining Philosophers problem using semaphore

Theory:

Dining Philosopher Solution using Semaphores

Problem Statement
- K philosophers sit around a circular table.
- Each philosopher alternates between thinking and eating.
- There is one chopstick between each philosopher (total K chopsticks).
- A philosopher must pick up two chopsticks (left and right) to eat.
- Only one philosopher can use a chopstick at a time.

The challenge: Design a synchronization mechanism so that philosophers can eat without causing **deadlock** (all waiting forever) or **starvation** (some never get a chance to eat).

Issues in the Problem
1. **Deadlock:** If every philosopher picks up their left chopstick first, no one can pick up the right one circular wait.
2. **Starvation:** Some philosophers may never get a chance to eat if others keep eating.
3. **Concurrency Control:** Must ensure no two adjacent philosophers eat simultaneously.

Semaphore Solution to Dining Philosopher
We use **semaphores** to manage chopsticks and avoid deadlock.
Algorithm

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- Each chopstick is represented asa binary semaphore(mutex).
- Philosopher must acquire both left and right semaphores before eating.
- After eating, the philosopher releases both semaphores.

```cpp
Code: #include <iostream>

#include <pthread.h>

#include <semaphore.h>

#include <unistd.h>

using namespace std;


#define NUM_PHILOSOPHERS 5


sem_t chopstick[NUM_PHILOSOPHERS];


void* philosopher(void* num) {

  int id = *(int*)num;


  while (true) {
```

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```cpp
    cout << "Philosopher " << id << " is thinking..." << endl;

    sleep(1);


    if (id % 2 == 0) {

      sem_wait(&chopstick[id]);

      sem_wait(&chopstick[(id + 1) % NUM_PHILOSOPHERS]);

    } else {

      sem_wait(&chopstick[(id + 1) % NUM_PHILOSOPHERS]);

      sem_wait(&chopstick[id]);

    }


    cout << "Philosopher " << id << " is eating " << endl; sleep(2);


    sem_post(&chopstick[id]);

    sem_post(&chopstick[(id + 1) % NUM_PHILOSOPHERS]);


    cout << "Philosopher " << id << " has finished eating and put down
chopsticks.\n" << endl;

    sleep(1);

  }

  return nullptr;
```

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```
}


int main() {

  pthread_t philosophers[NUM_PHILOSOPHERS];

  int ids[NUM_PHILOSOPHERS];



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

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



  for (int i = 0; i < NUM_PHILOSOPHERS; i++) {

    ids[i] = i;

    pthread_create(&philosophers[i], nullptr, philosopher, &ids[i]);

  }



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

    pthread_join(philosophers[i], nullptr);



  for (int i = 0; i < NUM_PHILOSOPHERS; i++)
```

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```
        sem_destroy(&chopstick[i]);


    return 0;

}
```

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OUTPUT (SCREEN SHOT) IF ANY:

main.cpp

```cpp
1  #include <iostream>
2  #include <pthread.h>
3  #include <semaphore.h>
4  #include <unistd.h>
5  using namespace std;
6
7  #define NUM_PHILOSOPHERS 5
8
9  sem_t chopstick[NUM_PHILOSOPHERS];
10
11 void* philosopher(void* num) {
12     int id = *(int*)num;
13
14     while (true) {
15         cout << "Philosopher " << id << " is thinking..." << endl;
16         sleep(1);
17
18         if (id % 2 == 0) {
19             sem_wait(&chopstick[id]);
20             sem_wait(&chopstick[(id + 1) % NUM_PHILOSOPHERS]);
21         } else {
22             sem_wait(&chopstick[(id + 1) % NUM_PHILOSOPHERS]);
23             sem_wait(&chopstick[id]);
24         }
25
26         cout << "Philosopher " << id << " is eating 🥢" << endl;
27         sleep(2);
28
29         sem_post(&chopstick[id]);
30         sem_post(&chopstick[(id + 1) % NUM_PHILOSOPHERS]);
31
32         cout << "Philosopher " << id << " has finished eating and put down chopsticks.\n" << endl;
33         sleep(1);
34     }
35     return nullptr;
```

```
Philosopher 1 is thinking...
Philosopher Philosopher 2 is thinking...
Philosopher 3 is thinking...
Philosopher 4 is thinking...
0 is thinking...
Philosopher 1 is eating 🥢
Philosopher 4 is eating 🥢
Philosopher 1 has finished eating and put down chopsticks.

Philosopher 2 is eating 🥢
Philosopher 4 has finished eating and put down chopsticks.

Philosopher 0 is eating 🥢
Philosopher 1 is thinking...
Philosopher 4 is thinking...
```

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Conclusion: Develop a program to provide synchronization among the 5 philosophers in Dining Philosophers problem using semaphore is done successfully