

Dining Philosophers Problem

Consider five philosophers who spend their lives thinking and eating. The philosophers share a circular table surrounded by five chairs, each belonging to one philosopher. In the centre of the table is a bowl of rice, and the table is laid with five single chopsticks.

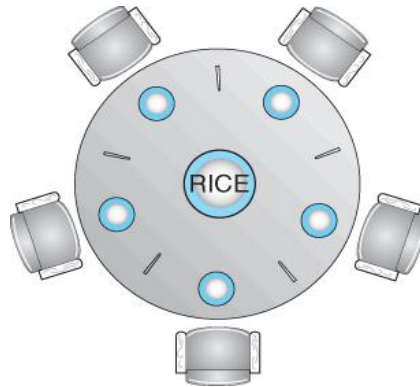


Figure: The situation of the dining philosophers

When a philosopher thinks, she does not interact with her colleagues. From time to time, a philosopher gets hungry and tries to pick up the two chopsticks that are closest to her (the chopsticks that are between her and her left and right neighbours). A philosopher may pick up only one chopstick at a time. Obviously, she cannot pick up a chopstick that is already in the hand of a neighbour. When a hungry philosopher has both her chopsticks at the same time, she eats without releasing her chopsticks. When she is finished eating, she puts down both of her chopsticks and starts thinking again.

The dining-philosophers problem is considered a classic synchronization problem. It is a simple representation of the need to allocate several resources among several processes in a deadlock free and starvation free manner.

Solution

Represent each chopstick with a semaphore. A philosopher tries to grab a chopstick by executing a *wait* () operation on that semaphore; she releases her chopsticks by executing the *signal* () operation on the appropriate semaphores.

Shared data

semaphore chopstick [5];

Initially

All value are 1

The Structure of philosopher i

```
do
{
    wait (chopstick [i]) ;
    wait (chopstick [(i+1) % 5]) ;
    ...
    //eat
    ...
}
```

```
signal (chopstick [i]) ;  
signal (chopstick [(i+1) % 5]) ;  
...  
//think  
...  
} while (true);
```

This solution guarantees that no two neighbours are eating simultaneously.

Deadlock

Suppose that all five philosophers become hungry simultaneously, and each grabs her left chopstick. All the elements of chopstick will now be equal to 0. When each philosopher tries to grab her right chopstick, she will be delayed forever.

Solution to deadlock

- Allow at most four philosophers to be sitting simultaneously at the table.
- Allow a philosopher to pick up her chopsticks only if both chopsticks are available.
- Use an asymmetric solution; that is, an odd philosopher picks up first her left chopstick and then her right chopstick, whereas an even philosopher picks up her right chopstick and then her left chopstick.

A deadlock free solution does not necessarily eliminate the possibility of starvation.

Questions asked in semester exam:

Question: What is Dining Philosophers Problem? Discuss the solution to Dining philosopher's problem using monitors.

[2017-2018][7 Marks]

Question: Write short note on Dining Philosopher Problem.

[2008-2009] [2.5 Marks]