Operating System
Quiz : [11]

[CSL301]
Synchronization
Time: 20 min

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Questions : [1-2]

Q.1 The synchronization primitives used to solve the Reader-Writer problem are typically semaphores and _____.

Short Descriptive Question

Q.2 Give one method to avoid deadlock in the Dining Philosophers problem.

Question : 3

Consider a multi-threaded program with two threads `T1` and `T2`. The threads share two semaphores: `s1` (initialized to 1) and `s2` (initialized to 0). The threads also share a global variable `x` (initialized to 0). The threads execute the code shown below:

Thread T1

```
1 wait(s1);
2 x = x + 1;
3 print(x);
4 wait(s2);
5 signal(s1);
```

Thread T2

```
1 wait(s1);
2 x = x + 1;
3 print(x);
4 signal(s2);
5 signal(s1);
```

Which of the following outcomes is/are possible when threads T1 and T2 execute concurrently?

a. T1 runs first and prints 1, T2 runs next and prints 2

b. T2 runs first and prints 1, T1 runs next and prints 2

c. T1 runs first and prints 1, T2 does not print anything (deadlock)

d. T2 runs first and prints 1, T1 does not print anything (deadlock)

Question : 4

Consider two routines operating on shared variable X (initially 10):

incr:

```
1 wait(s);
2 X = X + 1;
3 signal(s);
```

decr:

```
1 wait(s);
2 X = X - 1;
3 signal(s);
```

There are 5 threads each invoking `incr` once and 3 threads each invoking `decr` once. Two implementations of semaphore `s` are considered:

I-1: s is a binary semaphore, initialized to 1.

I-2: s is a counting semaphore, initialized to 2.

Let V_1 and V_2 be the final values of X after all threads complete under I-1 and I-2 respectively. Find the minimum possible values of V_1 and V_2.

a. 15, 7
b. 7, 7
c. 12, 7
d. 12, 8

Questions : [5]

Numerical Answer Question

Consider the following solution to the producer-consumer synchronization problem. The shared buffer size is N. Three semaphores empty, full and mutex are defined with respective initial values of 0, N and 1. Semaphore empty denotes the number of available slots in the buffer, for the consumer to read from. Semaphore full denotes the number of available slots in the buffer, for the producer to write to. The placeholder variables, denoted by P, Q, R and S, in the code below can be assigned either empty or full. The valid semaphore operations are: wait() and signal().

Producer:	Consumer:

do{
wait(P);
wait(mutex);
//Add item to buffer
signal(mutex);
signal(Q);
}while(1);
	do{
	wait(R);
	wait(mutex);
	//Consume item from buffer
	signal(mutex);
	signal(S);
	}while(1);

Identify valid assignments to P, Q, R and S will yield the correct solution (in terms of full and empty)?

Answer Key

Q.1 Mutex/Mutual Lock
Q.2 One effective method to avoid deadlock in the Dining Philosophers problem is to allow only four philosophers (N1) to sit at the table at the same time if there are five philosophers (N). This ensures that at least one philosopher can successfully pick up both chopsticks and eat, breaking the circular wait condition that leads to deadlock.
Q.3 (B, C)
Q.4 (12, 7)
Q.5 P: full, Q: empty, R: empty, S: full


Thank
You