PES UNIVERSITY

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Department of Computer Science

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UE19CS254: Operating Systems

Assignment2

1. Write a multithreaded C program that calculates various statistical values for a list of numbers. This program will be passed a series of numbers on the command line and will then create three separate worker threads. One thread will determine the average of the numbers, the second will determine the maximum value, and the third will determine the minimum value. For example, suppose your program is passed the integers 90 81 78 95 79 72 85. The program will report:
The average value is 82
The minimum value is 72
The maximum value is 95
The variables representing the average, minimum and maximum values will be stored globally. The worker threads will set these values, and the parent thread will output the values once the workers have exited.

2. a. Write a C Program to simulate race condition in Producer Consumer Problem.

Note: Implement a main program that creates two threads: producer and consumer threads which execute producer and consumer functions, respectively. The producer should produce an item and update the buffer. The consumer should consume an item and update the buffer. You can use bounded buffer and both the producer and consumer threads can be infinite loops. Show how race condition occurs between producer and consumer without mutual exclusion.
b. Write a C program to implement Producer Consumer problem using Semaphores.

Note: Implement a main program that creates two threads: producer and consumer threads which execute producer and consumer functions, respectively. The producer should produce an item and update the buffer. The consumer should consume an item and update the buffer. Use Semaphores to enclose the critical sections in both producer and consumer so that only one of them can update the buffer at a time and prevent race condition as shown in the sample output below. Consumer should wait if buffer is empty and producer should signal when the buffer has at least one item. You can use bounded buffer.
3. Implement deadlock detection algorithm that is applicable to a system with resources having multiple instances. The algorithm employs several time-varying data structures,
Available: A vector of length *m* indicates the number of available resources of each type.
Allocation: An $n \times m$ matrix defines the number of resources of each type currently allocated to each process.
Request. An $n \times m$ matrix indicates the current request of each process.
If ***Request***$[i][j]$ equals k, then process Pi is requesting k more instances of resource type Rj .

You need to print the safe sequence if the system is deadlock free, otherwise print a suitable message.

Questions

1. Consider a counting semaphore with initial value 10. Six P(wait) operations and four V(signal) operations were performed on this semaphore, respectively. What is the resulting value of semaphore?
a. 10
b. 8
c. 0
d. None of the given

2. …… refers to the ability of multiple processes or threads to share code, resources, or data in such a way that only one process has access to shared objects at a time.
a. Synchronization
b. deadlock
c. mutual exclusion
d. starvation

3. The wait and signal operations of the semaphores work on the basic …….. and ……. System calls.
a. stop() and continue()
b. block() and wakeup()
c. block() and start()
d. wait() and wakeup()

4. Each process Pi, i = 0,1,2,3,……,9 is coded as follows:
while(true)
{
wait(mutex)
{Critical Section}
signal(mutex)
}
The code for P10 is identical except that it uses signal(mutex) instead of wait(mutex). What is the largest number of processes that can be inside the critical section at any moment (the mutex being initialized to 1)?
a. 3
b. 2
c. 1
d. None of the mentioned

5. What is true about pipes in Unix?
A. Pipe can connect two commands together so that the output from one program becomes the input of the next program.
B. To make a pipe, put a hash (#) on the command line between two commands.
C. Pipe is a type of semaphore.
D. Both A and C

Additional Material

1. https://computing.llnl.gov/tutorials/pthreads/#Abstract

2. https://www.cs.cmu.edu/afs/cs/academic/class/15492-f07/www/pthreads.html