Programming Assignment 4
Implementing TAS, CAS and Bounded Waiting CAS Mutual Exclusion Algorithms

Submission Date: 27th February 2022, 9:00 pm

Goal: The goal of this assignment is to implement *TAS, CAS* and *Bounded Waiting with CAS* mutual exclusion (ME) algorithms studied in the class. Implement these algorithms in C++.

Details. As shown in the book, you have to implement the three mutual exclusion algorithms **in C++**. Each mutual exclusion algorithm has en entry and exit sections.

To test the performance of mutual exclusion algorithms, develop an application, me-test (mutual exclusion test) is as follows. Once, the program starts, it creates n threads. Each of these threads, will enter critical section (CS) k times. The pseudocode of the test function is as follows:

Listing 1: main thread

```
1  void main()
2  {
3      ...
4      ...
5      create n testCS threads;
6      ...
7      ...
8  }
```

Listing 2: testCS thread

```
1
2  void testCS()
3  {
4      id = thread.getID();
5      for (i=0; i < k; i++)
6      {
7          reqEnterTime = getSysTime();
8          cout << i << "th CS Request at " << reqEnterTime << " by thread " << id;
9          entry-sec();      // Entry Section
10         actEnterTime = getSysTime();
11         cout << i << "th CS Entery at " << actEnterTime << " by thread " << id;
12         sleep(t1);        // Simulation of critical-section
13         exit-sec();       // Exit Section
14         exitTime = getSysTime();
15         cout << i << "th CS Exit at " << exitTime << " by thread " << id;
16         sleep(t2);        // Simulation of Reminder Section
```

```
17        }
18  }
```

Here $t1$ and $t2$ are delay values that are exponentially distributed with an average of $\lambda 1, \lambda 2$ seconds. The objective of having these time delays is to simulate that these threads are performing some complicated time consuming tasks.

Input: The input to the program will be a file, named inp-params.txt, consisting of all the parameters described above:$n, k, \lambda 1, \lambda 2$. A sample input file is: 100 100 5 20.

Output: Your program should output to a file in the format given in the pseudocode for each algorithm. A sample output is as follows:

TAS ME Output:
1st CS Requested at 10:00 by thread 1
1st CS Entered at 10:05 by thread 1
1st CS Exited at 10:06 by thread 1
1st CS Requested at 10:01 by thread 2
.
.
.

CAS ME Output:
1st CS Requested at 11:00 by thread 1
1st CS Entered at 11:05 by thread 1
1st CS Exited at 11:06 by thread 1
1st CS Requested at 11:01 by thread 2
.
.
.

Bounded CAS ME Output:
1st CS Requested at 11:30 by thread 1
1st CS Entered at 11:35 by thread 1
1st CS Exited at 11:36 by thread 1
1st CS Requested at 11:32 by thread 2
.
.
.

The output should demonstrate that mutual exclusion is satisfied.

Report: You have to submit a report for this assignment. This report should contain a comparison of the performance of TAS, CAS and Bounded CAS ME algorithms. You must run these algorithms multiple times to compare the performances and display the result in form of a graph.

For performance, you have to specifically measure two metrics: (1) the average time taken by a process to enter the CS (2) the worst case time taken by a process to enter the CS in a simulation. This shows if processes are starving.

You run these algorithms varying the number of threads from 10 to 50 while keeping other parameters same. Please have k, the number of CS requests by each thread, fixed to 10 in all these experiments. The graph in the report will be as follows: the x-axis will vary the number

of threads. The y-axis will show the metrics defined above: (1) average time taken to enter the CS by each thread (2) the worst case time taken by a process to enter the CS in a simulation.

Also ensure that each point of the graph is obtained by **averaging over five runs**. Finally, you must also give an analysis of the results while explaining any anomalies observed.

Deliverables: You have to submit the following:

- Source files: The source file containing the actual programs to execute. Name it as SrcAssgn4-⟨ProgName⟩-⟨rollno⟩.cpp where ProgName is one of the following: tas, cas, cas-bounded.
- Readme: A readme.txt that explains how to execute the program. Please name the files as: Assgn4-Readme-⟨RollNo⟩.txt.
- Report: The report as explained above. Please name it as Assgn4-Report-⟨RollNo⟩.txt

Zip all the three files and name it as ProgAssgn4-⟨rollno⟩.zip. Then upload it on the google classroom page of this course by above mentioned deadline.
We have the following grading policy:

1. Design as described in the report and analysis of the results: 50
2. Execution of the programs based on the description in the readme: 40
3. Code documentation and indentation: 10

As mentioned before, all assignments for this course have the late submission policy of a penalty of 10% each day after the deadline. We will consider a late assignment for a maximum of 6 days. Any submission beyond that will not be considered. **Kindly remember that all submissions are subjected to plagiarism checks.**