

CS563 Assignment 6: Atomicity and Critical Sections

Instructor: Xinghui Zhao

Due: 11:59pm, March 8, 2020

1 Overview

The purpose of this assignment is to give you some practice on reasoning about atomicity, at-most-once property, and programming critical sections.

2 Atomicity

A process P uses three shared integer variables x , y , and z . The variable x is both read and written by other processes, whereas the variables y and z are read, but not written by other processes. Determine which of the following statements in P can be considered to be atomic, and explain why.

1. $x = x + 1$;
2. $x = y + 1$;
3. $y = z + 1$;
4. $z = x + y$;
5. `await $x == 1$;`
6. `await $x + y + z > 0$.`

3 Critical Sections

Suppose a computer has atomic decrement `DEC` and increment `INC` instructions that also return the value of the sign bit of the result. In particular, the decrement instruction has the following effect:

```
DEC(var, sign):  
    <var = var - 1;  
    if (var >= 0) sign = 0; else sign = 1; >
```

`INC` is similar, the only difference being that it adds 1 to `var`.

Using `DEC` and `INC`, develop a solution to the critical section problem for `n` processes, i.e., implement the `CSenter` and `CSexit` protocols. Analyze if your solution satisfies the following properties:

- **Mutual exclusion:** at most one process at a time is executing its critical section;
- **Absence of deadlock:** if two or more processes are trying to enter their critical sections, at least one will succeed;
- **Absence of unnecessary delay:** if one process is trying to enter its critical section and other processes are executing their non-critical sections or have terminated, the first process is not prevented from entering its critical section;
- **Eventual entry:** a process that is attempting to enter its critical section will eventually succeed.

Note that the “eventual entry” property is not required for this problem, but you should still analyze it.

4 Submission

Submit the following on Blackboard:

1. A text or PDF file, with pseudo code and answers to the questions.

5 Grading Scheme

This assignment will be graded out of 100. For your information, the grading scheme is shown in the following table.

Item	Percentage
Atomicity	30%
Explanation	10%
Critical Section Solution	40%
Analysis	20%

Assignment Project Exam Help

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