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# COMP 3500: Homework 1

Points Possible: 100
Submission via Canvas

**There should be no collaboration among students.** A student shouldn't share any project code with any other student. Collaborations among students in any form will be treated as a serious violation of the University's academic integrity code.

**Goals:**
- To learn multiple processes.
- To understand critical sections.
- To learn the concepts of semaphores and monitors.

**Questions:**

1. [60 points] Consider the following program:

```
P1: {                                P2: {
  shared int x;                        shared int x;
  x = 10;                              x = 10;
  while (1) {                          while ( 1 ) {
     x = x - 1;                          x = x - 1;
     x = x + 1;                          x = x + 1
     if (x != 10)                        if (x!=10)
       printf("x is %d",x)                 printf("x is %d",x)
  }                                    }
}                                    }
```

Note that the scheduler in a uniprocessor system would implement pseudoparallel execution of these two concurrent processes by interleaving their instructions, without restriction on the order of the interleaving.

1.1.  [25 points] Show a sequence (i.e., trace the sequence of interleavings of statements) such that the statement "x is 10" is printed.

<span style="color:red">P1</span>
<span style="color:blue">P2</span>

.

.

.

<span style="color:red">x = x – 1; // x is 9</span>
<span style="color:red">x = x + 1; // x is 10</span>
<span style="color:blue">x = x – 1; // x is 9</span>

if( x != 10)
x = x + 1; //x is 10
printf("x is %d, x)


1.2. [35 points] Show a sequence such that the statement "x is 8" is printed.
P1
P2

- x = x – 1; // x is 9
  - LD R0, x//R0 is 10
  - DEC R0 //R0 is 9
  - STO R0, x // x is 9
- x = x + 1; // x is 10
  - LD R0, x // R0 is 9
  - INC R0 // R0 is 10
- x = x – 1; // x is 9
  - LD R0, x //R0 is 9
  - DEC R0 //R0 is 8
- x = x + 1;// cont.
  - STO R0, x// x is 10
- x = x – 1; //cont.
  - STO R0, x// x is 8
- if( x != 10)
- printf("x is %d, x) // x is 8


You should remember that the increment/decrements at the source language level are not done atomically, that is, the assembly language code:

```
LD R0,X /* load R0 from memory location x */
INCR R0 /* increment R0 */
STO R0,X /* store the incremented value back in X */
```

2. [10 points] What is the difference between binary and general semaphores?

**Binary semaphores can only have the values 0 and 1. General or Counting semaphores can have any value over an unrestricted range.**

3. [10 points] What is a monitor?

**An abstract data type that includes a set of programmer defined operations that are provided with mutual exclusion within the monitor.**

4. [20 points] What operations can be performed on a semaphore?
- **wait()**
  - **decrements the value of the semaphore if it is still available.**

- **signal()**
  - **increments the semaphore**

**Submission:**
- A heading at the top of your file contains your name and your Auburn UserIDs.
- Submit your solution as a single PDF file named as "hw1.pdf" through Canvas
- File formats other than PDF will not be accepted by Canvas.

**Late Submission Penalty:**
- Ten percent (10%) penalty per day for late submission. For example, an assignment submitted after the deadline but up to 1 day (24 hours) late can achieve a maximum of 90% of points allocated for the assignment. An assignment submitted after the deadline but up to 2 days (48 hours) late can achieve a maximum of 80% of points allocated for the assignment.
- Assignment submitted more than 3 days (72 hours) after the deadline will not be graded.

**Rebuttal period:**
- You will be given a period of one week (i.e., 7 days) to read and respond to the comments and grades of your homework or project assignment. The TA may use this opportunity to address any concern and question you have. The TA also may ask for additional information from you regarding your homework or project.