COMP 3500: Homework 1

Points Possible: 100
Submission via Canvas

Jacob Knight

Jdk0058

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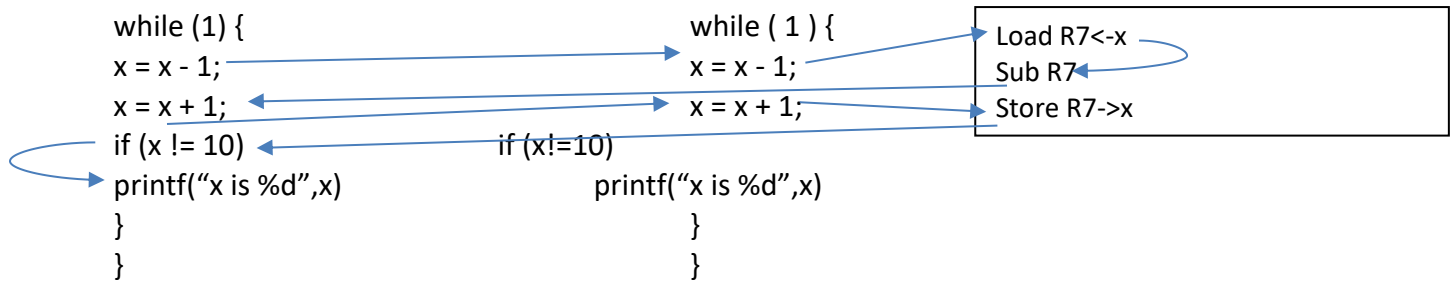
```
P1: {                                    P2: {
Shared int x;                              shared int x;
x = 10;                                    x = 10;
while (1) {                                while ( 1 ) {
x = x - 1;                                 x = x - 1;
x = x + 1;                    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

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

```
P1: {                                    P2: {
shared int x;                              shared int x;
x = 10;                                    x = 10;
```

```
while (1) {                      while ( 1 ) {                 Load R7<-x
x = x - 1;                       x = x - 1;                    Sub R7
x = x + 1;                       x = x + 1;                    Store R7->x
if (x != 10)                     if (x!=10)
printf("x is %d",x)              printf("x is %d",x)
}                                }
}                                }
```

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 semaphore can only take in values 0 and 1 and general semaphores can take in any integer

3. [10 points] What is a monitor?

A software consisting of one or more procedures, an initialization sequence, and local data.

4. [20 points] What operations can be performed on a semaphore?

1. A semaphore may be initialized to a non-negative integer value.

2. The semWait operation decrements the semaphore value. If the value becomes negative, then the process executing the semWait is blocked. Otherwise, the process continues execution.

3. The semSignal operation increments the semaphore value. If the resulting value is less than or equal to zero, then a process blocked by a semWait operation, if any, is unblocked.

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.