CS342 Operating Systems - Fall 2017
Project 3: Synchronization, Mutex and Condition Variables

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Assigned: Nov 23 , 2017
Due date: Dec 4, 2017, 23:55

Objective: *Practicing synchronization, mutex and condition variables, multithreaded programming with Pthreads (POSIX threads).*

In this project, you will write a multithreaded program that will implement a version of the producer-consumer problem using *mutex* and *condition variables* of Pthreads library. There will be N threads that will act as producers (producer 0, 1, 2, 3, N-1). Min value of N is 1, max value is 10. There will be one thread that will act as consumer. Between a producer and consumer there will be a bounded buffer of size M (set to 100 by default) items. Hence there will be a total of N buffers. The min value of M is 10, max value is 1000. Each producer will send a sequence of student records (items) of the type shown below through its buffer. The consumer will retrieve those records and will sort them as they arrive and will write them to an output file in sorted order, one record per line.

```
struct  student{
        int  sid;
        char firstname[64];
        char lastname[64];
        double cgpa;
};
```

You will consider synchronization. Access to a buffer should be done in a mutually exclusive manner. If all buffers are empty, consumer will go to sleep. If a buffer is full, the respective producer will sleep.

Name your program as **pcsync**. It will take the following parameters:

pcsync <N> <buffersize> <infilename> <outputfilename>

<N> is the number of producers. <infilename> is the name of the input file that will contain student records. <outfilename> is the name of the output file where sorted records will be written. <buffesize> is the size of the buffer between a producer and consumer. All buffers will be of the same size. Inputfile content will be in the following format:

<producerid> <sid> <firstname> <lastname> <cgpa>

<producerid> is a value between 0 and N-1.

For example:

0 2015008910 Ali Dag 3.45

3 2015008920 Veli Irmak 3.33
2 2015017893 Hakan Cay 3.60

You can assume a student will have just one firstname (hence firstname and lastname are simple one-word strings containing only letters of the English Alphabet). Each producer will read the same input file and will retrieve and send only the records that it is responsible for (i.e., a producer x will process records built from lines starting with x).

Output file content format will be as follows:

<studentid> <firstname> <lastname> <cgpa>

Example:

2015008910 Ali Dag 3.45
2015008920 Veli Irmak 3.33
2015017893 Hakan Cay 3.60

Clarifications:

- You need to learn how to use *Pthreads* mutex and condition variables. There are links to some resources in the References section of the course webpage. You can find additional resources from Internet.
- The project will be done individually.
- Sorting will be done according to Student ID (lowest to highest).
- Buffer size is the maximum number of student records (items) buffer can hold.
- You will start outputing records after all received and sorted.