CS344: Operating Systems Lab

Lab # 10 (1 Questions, 72 Points)
Held on 07-Nov-2023
Lab Timings: 09:00 to 12:00 Hours Pages: 2
Submission: 12:00 Hrs, 07-Nov-2023
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a. This assignment is based on chapter 4, `Threads` in the book `Operating System Principles, Abraham Silberschatz, Peter Baer Galvin, and Greg Gagne`.

b. In order to perform this assignment, understanding of system calls `pthread_create, pthread_attr_init, pthread_join, pthread_exit` are essential.

c. Carefully read the manual pages for the above system calls.

Question 1: (72 points)

Suduko: Write three C programs one for each method described below

Problem Description: A Sudoku puzzle uses a 9×9 grid in which each column and row, as well as each of the nine 3×3 sub-grids, must contain all of the digits $1 \cdots 9$. Table below presents an example of a valid Sudoku puzzle. Design a multithreaded application that determines whether the solution to a Sudoku puzzle is valid or not valid.

6	2	4	5	3	9	1	8	7
5	1	9	7	2	8	6	3	4
8	3	7	6	1	4	2	9	5
1	4	3	8	6	5	7	2	9
9	5	8	2	4	7	3	6	1
7	6	2	3	9	1	4	5	8
3	7	1	9	5	6	8	4	2
4	9	6	1	8	2	5	7	3
2	8	5	4	7	3	9	1	6

Adopt the following methods:

Method 1

a. (5 marks) Create one thread to check that each column has digits 1 through 9.

b. (5 marks) Create one thread to check that each row has digits 1 through 9.

c. (5 marks) Create nine threads to check that each 3×3 subgrids contains the digits 1 through 9.

Method 2

a. (5 marks) Create one thread per column to check that the column has digits 1 through 9.

b. (5 marks) Create one thread per row to check that the row has digits 1 through 9.

c. (5 marks) Create one thread to check each of the 3×3 subgrid contains the digits 1 through 9.

Method 3

a. (5 marks) Create one thread per column to check that the column has digits 1 through 9.

b. (5 marks) Create one thread per row to check that the row has digits 1 through 9.

c. (5 marks) Create nine threads to check that each 3×3 subgrids contains the digits 1 through 9.

Passing Parameters to Each Thread: (5 marks) The parent thread will create the worker threads, passing each worker the location that it must check in the Sudoku grid. This step will require passing several parameters to each thread. Adopt the approach of creating the below data structure using a `struct`. For example, a structure to pass the row and column where a thread must begin validating would appear as follows:

```
 /* structure for passing data to threads */
typedef struct
{
   int row;
   int column;
}parameters;
```

Fill the appropriate values and pass them to the thread creation function.

Returning Results to the Parent Thread

(5 marks) Each worker thread is assigned the task of determining the validity of a particular region of the Sudoku puzzle. Once a worker has performed this check, it must pass its results back to the parent.

Declare an `int` array that is visible to each thread. The i^{th} index of the array corresponds to the i^{th} worker thread.

i^{th} workers sets 1 to indicate that its region is valid and 0 to indicate its region is not valid.

(5 marks) When all worker threads have completed, the parent thread checks each entry in the result array to determine if the Sudoku puzzle is valid.