

Operating Systems

(Homework 1)

Multi-threaded programming

These lecture materials are modified from the lecture notes written by A. Silberschatz, P. Galvin and G. Gagne.

Outline

- 1. Objectives
- 2. How to write a program ?
- 3. First program
- 4. Second program
- 5. Schedule



- Writing two multi-threaded programs using the following functions;
 - pthread_create
 - pthread_join
 - pthread_exit

How to write a program?

- POSIX thread programming (1)
 - Thread creation
 - 1> Prototype
 - #include <pthread.h>
 - int pthread_create(pthread_t* tid, pthread_attr_t *attr, (void *) f, void *arg);
 - Roles
 - Creates a new thread and runs the thread routine f with an input argument of arg
 - When pthread_create returns, argument tid contains the ID of the newly created thread



POSIX thread programming (2)

- Terminating the threads
 - Prototype
 - #include <pthread.h>
 - int pthread_exit(void *thread_return);
 - Roles
 - Terminating the thread with a return value of thread_return that will be transferred to pthread_join

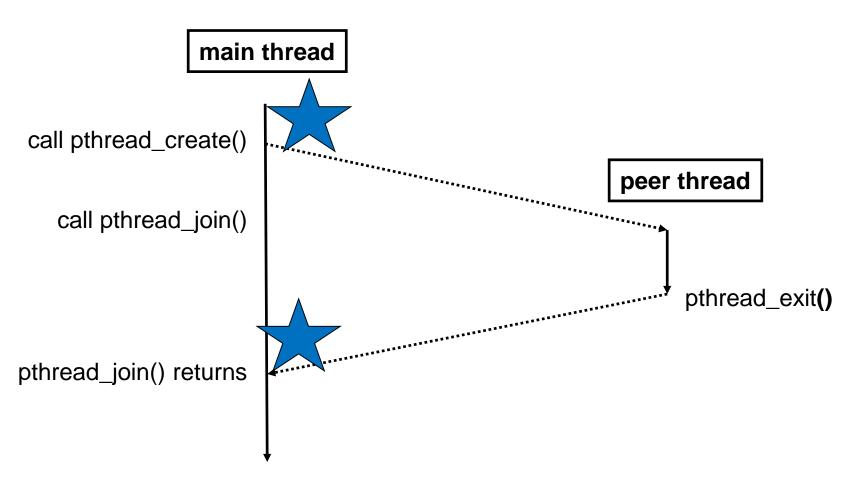


POSIX thread programming (2)

- Reaping terminated threads
 - Prototype
 - #include <pthread.h>
 - int pthread_join(pthread_t tid, void *thread_return);
 - Roles
 - pthread_join function blocks until thread tid terminates
 - It is similar to wait function but can only wait for a specific thread to terminate



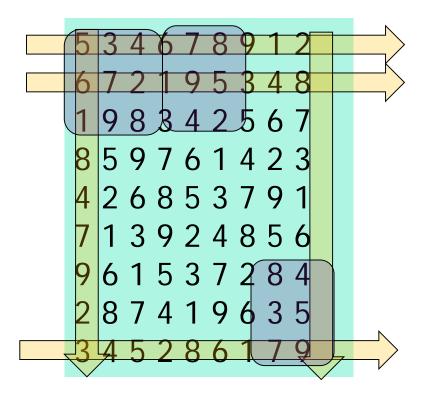
S/W architecture





First program

Sudoku solution validator





Requirements

- 11개 thread 생성
 - 1. A thread to check that each column contains the digit 1 through 9
 - 2. A thread to check that each row contains the digits 1 through 9
 - 3 ~11. Nine threads to check each of the 3 X 3 subgrids contains the digits 1 through 9
- 반드시 보고서에 11개의 쓰레드가 제대로 동작함을 기술할 것
- 모든 thread 는 valid 여부를 parent thread에게 return 하여야 함



Requirements

• file 로 Sudoku puzzle 의 숫자를 입력받을 것

	5	3	4	6	/	8	9	1	2
input.txt	6	7	2	1	9	5	3	4	8
	1	9	8	3	4	2	5	6	7
	8	5	9	7	6	1	4	2	3
	4	2	6	8	5	3	7	9	1
	7	1	3	9	2	4	8	5	6
	9	6	1	5	3	7	2	8	4
	2	8	7	4	1	9	6	3	5
	3	4	5	2	8	6	1	7	9



■ 실행 예>

- Sudoku input.txt
 - Sudoku 모든 조건을 만족하였을 경우
 - Valid result!
 - Sudoku 모든 조건을 만족 못 하였을 경우
 - Invalid result!

실행화일연



Second program

Generation of Fibonacci sequence

$$Fib_0 = 0$$

 $Fib_1 = 1$
 $Fib_n = Fib_{n-1} + Fib_{n-2}$

- Goal
 - Input: 6
 - Output: 0,1,1,2,3,5



Requirements

- 1. On the command line, the user will enter the number of Fibonacci numbers
- 2. The program will then create a separate thread that will generate the Fibonacci numbers, placing the sequence in data that can be shared by the threads
- 3. When the thread finishes execution, the parent thread will output the sequence generated by the child thread

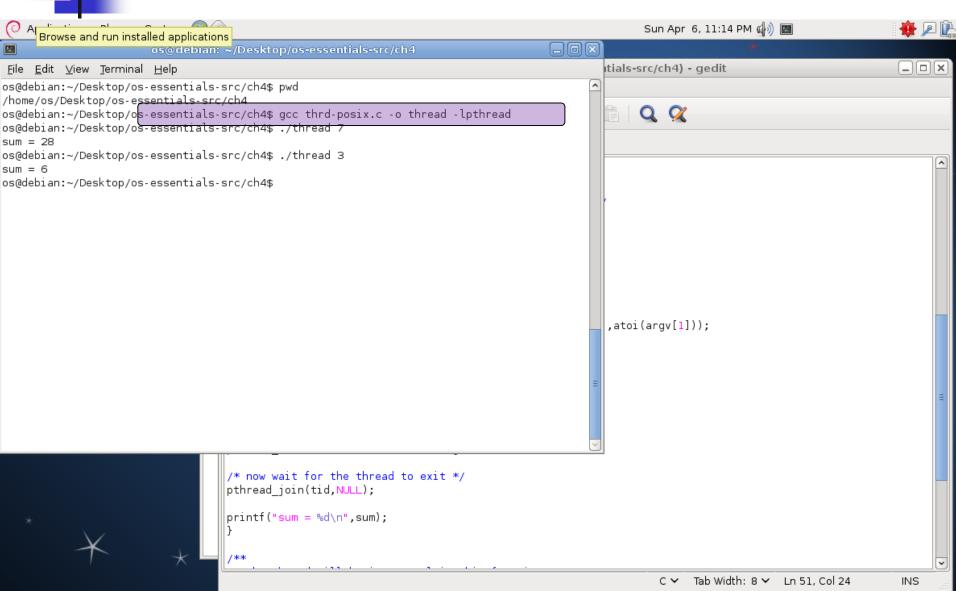


How to pass parameters to threads?

int pthread_create(pthread_t* tid, pthread_attr_t *attr, (void *) f, void *arg);



http://people.westminstercollege.edu/faculty/ggagne/osc/vm/index.html



Schedule

- 데드라인
 - 데드라인: 4월 23일 오후 23:59
 - 실제로는 4월 22일 오후 23:59 임
 - 이후에는 어떤 경우에도 안 받으니, 하루 전에 미리 제출할 것을 권유함
- What to submit ?
 - 보고서
 - 별도 평가 예정이니, 자세히 쓸 것
 - source file, 출력 image