CS241 Lawrence Angrave L14 – The Critical Section Problem

Some more C functions for you:

sigprocmask pthread\_sigmask pthread\_self() atexit sigaction

The big problem: How to implement the mutex lock

**Hardware CPU instruction simplified solution**

(‘*Atomic\_Exchange’* swaps values at two addresses as an *uninterruptable* operation)

typedef p\_mutex\_t int;

pthread\_mutex\_init(p\_mutex\_t\* m) { \*m = 1; }

pthread\_mutex\_lock(p\_mutex\_t\* m) { int local=0;

do {

ATOMIC\_EXCHANGE(m, &local);

} while(!value);

}

pthread\_mutex\_unlock(p\_mutex\_t\* m) { \*m = 1; }

**C-Code Candidate** # 0 (Review) Protect our critical section with a mutex. But how should it work!?

pthread\_mutex\_lock(p\_mutex\_t\* m) { while(m->lock) {}; m->lock = 1;}

pthread\_mutex\_unlock(p\_mutex\_t\* m) { m->lock = 0; }

Problems?

**Psuedo code Candidate** # 1

|  |  |
| --- | --- |
| wait until your flag is lowered  raise my flag  // *Do Critical Section stuff*  lower my flag | wait until your flag is lowered  raise my flag  // *Do Critical Section stuff*  lower my flag |

// Threads do other stuff and then will repeat at sometime in the future

Problems with 1b? Fix?

**Candidate** #2

|  |  |
| --- | --- |
| raise my flag  wait until your flag is lowered  // *Do Critical Section stuff*  lower my flag | raise my flag  wait until your flag is lowered  // *Do Critical Section stuff*  lower my flag |

// Threads do other stuff and then will repeat at sometime in the future

Problems with 2?

**Candidate** #3

|  |  |
| --- | --- |
| wait until my turn (turn==id?)  // *Do Critical Section stuff*  turn = *yourid* | wait until my turn (turn==id?)  // *Do Critical Section stuff*  turn = *yourid* |

// Threads do other stuff and then will repeat at sometime in the future

Problems with 3?

Three desirable properties of the solution to the Critical Section Problem?

//Ex 1 Make these functions thread-safe

// int thread\_mutex\_lock(pthread\_mutex\_t \*mutex); ("p\_m\_lock")

// int pthread\_mutex\_unlock(pthread\_mutex\_t \*mutex); ("p\_m\_unlock") will be useful

// Compile with -pthread

// Create a mutex that is ready to be locked!

pthread\_mutex\_t m = PTHREAD\_MUTEX\_INITIALIZER;

float sensor[2];

float old\_vals[2];

void on\_sensor\_update(float x,float y) {

// memcpy - fastest way to copy memory regions that do not overlap.

memcpy( old\_vals, sensor, sizeof( sensor ) );

sensor[0]=x;

sensor[1]=y;

}

float moved2() {

float dx = (sensor[0] - old\_vals[0]);

float dy = (sensor[1] - old\_vals[1]);

return dx\*dx + dy\*dy;

}

//#Ex 2

// Use a counting semaphore to ensure a maximum of 20 threads are running at a time. Threads that cannot acquire a music pass must wait (block) until one is released.

// hint: int sem\_init(sem\_t \*sem, int pshared, unsigned int value);

// int sem\_destroy(sem\_t \*sem); "The effect of destroying a semaphore upon which other threads are currently blocked is undefined."

// int sem\_post(sem\_t \*sem);

// int sem\_wait(sem\_t \*sem); will be useful

sem\_t s;

void init() { ?

void acquireMusicPass() { ?

void releaseMusicPass() { ?

//Ex3 Carefully explain when and how the following code can copy more than size+1 bytes to the target address

// when used with more than one thread. Your answer should include the interleaving of the two threads' actions.

char \*buffer = calloc(1,1);

size\_t size =1;

void append(char c) { buffer = realloc(buffer, ++size); buffer[size-2] = c; buffer[size-1]='\0'; }

**Candidate** #4

|  |  |
| --- | --- |
| raise my flag  if your flag is raised, wait until my turn  // *Do Critical Section stuff*  turn = *yourid*  lower my flag | raise my flag  if your flag is raised, wait until my turn  // *Do Critical Section stuff*  turn = *yourid*  lower my flag |

// Threads do other stuff and then will repeat at sometime in the future

Problems with 4?

**Candidate** #5

|  |  |
| --- | --- |
| raise my flag  while(your flag is raised) :  if it's your turn to win :  lower my flag  wait while your turn  raise my flag  // *Do Critical Section stuff*  set your turn to win  lower my flag | raise my flag  while(your flag is raised) :  if it's your turn to win :  lower my flag  wait while your turn  raise my flag  // *Do Critical Section stuff*  set your turn to win  lower my flag |





