Arda Çimen 332 lab 3

Q1:  
shmkey for p = 92275021

p=0 is allocated in shared memory.

semaphore initialized.

Child(0) is in critical section.\*p=0.

Child(0) new value of \*p=1.

Child(1) is in critical section.\*p=1.

Child(1) new value of \*p=2.

Child(2) is in critical section.\*p=2.

Child(2) new value of \*p=3.

Child(3) is in critical section.\*p=3.

Child(3) new value of \*p=4.

Child(4) is in critical section.\*p=4.

Child(4) new value of \*p=5.

Parent: All children have exited.

Saving session...

...copying shared history...

...saving history...truncating history files...

...completed.

Q2:

2.1  
 shmkey for p = 92275021

p=0 is allocated in shared memory.

semaphore initialized.

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Child(0) new value of \*p=1.

Child(1) is in critical section.\*p=1.

Child(1) new value of \*p=2.

Child(2) is in critical section.\*p=2.

Child(2) new value of \*p=3.

Child(3) is in critical section.\*p=3.

Child(3) new value of \*p=4.

Child(4) is in critical section.\*p=4.

Child(4) new value of \*p=5.

Parent: All children have exited.

2.2

shmkey for p = 92275021

p=0 is allocated in shared memory.

semaphore initialized.

Child(0) is in critical section.\*p=0.

Child(0) new value of \*p=1.

Child(1) is in critical section.\*p=1.

Child(1) new value of \*p=2.

Child(2) is in critical section.\*p=2.

Child(2) new value of \*p=3.

Child(3) is in critical section.\*p=3.

Child(3) new value of \*p=4.

Child(4) is in critical section.\*p=4.

Child(4) new value of \*p=5.

Parent: All children have exited.

2.3

shmkey for p = 92275021

p=0 is allocated in shared memory.

semaphore initialized.

Child(0) is in critical section.\*p=0.

Child(0) new value of \*p=1.

Child(1) is in critical section.\*p=1.

Child(1) new value of \*p=2.

Child(2) is in critical section.\*p=2.

Child(2) new value of \*p=3.

Child(3) is in critical section.\*p=3.

Child(3) new value of \*p=4.

Child(4) is in critical section.\*p=4.

Child(4) new value of \*p=5.

Parent: All children have exited.

2.4

shmkey for p = 92275021

p=0 is allocated in shared memory.

semaphore initialized.

Child(0) is in critical section.\*p=0.

Child(0) new value of \*p=1.

Child(1) is in critical section.\*p=1.

Child(1) new value of \*p=2.

Child(2) is in critical section.\*p=2.

Child(2) new value of \*p=3.

Child(3) is in critical section.\*p=3.

Child(3) new value of \*p=4.

Child(4) is in critical section.\*p=4.

Child(4) new value of \*p=5.

Parent: All children have exited.

2.5

shmkey for p = 92275021

p=0 is allocated in shared memory.

semaphore initialized.

Child(0) is in critical section.\*p=0.

Child(0) new value of \*p=1.

Child(1) is in critical section.\*p=1.

Child(1) new value of \*p=2.

Child(2) is in critical section.\*p=2.

Child(2) new value of \*p=3.

Child(3) is in critical section.\*p=3.

Child(3) new value of \*p=4.

Child(4) is in critical section.\*p=4.

Child(4) new value of \*p=5.

Parent: All children have exited.

Q3:

Semaforlar kaldırıldığında, çocuk işlemler aynı anda paylaşılan değişkene erişmeye çalışır. Bu da race condition’a yol açar ve her çalıştırmada farklı sonuçlar oluşur.

**UPDATED SOURCE CODE:**

/\*

Derlemek icin:

gcc -pthread semaphore.c -o semrun

\*/

#include <stdio.h> /\* printf() \*/

#include <stdlib.h> /\* exit(), malloc(), free() \*/

#include <sys/types.h> /\* key\_t, sem\_t, pid\_t \*/

#include <sys/shm.h> /\* shmat(), IPC\_RMID \*/

#include <errno.h> /\* errno, ECHILD \*/

#include <semaphore.h> /\* sem\_open(), sem\_destroy(), sem\_wait().. \*/

#include <fcntl.h> /\* O\_CREAT, O\_EXEC \*/

#include <unistd.h> /\* fork(), sleep() \*/

#include <sys/wait.h> /\* waitpid() \*/

int main (int argc, char \*\*argv){

int i; /\* loop variables \*/

key\_t shmkey; /\* shared memory key \*/

int shmid; /\* shared memory id \*/

sem\_t \*sem; /\* synch semaphore \*//\*shared \*/

pid\_t pid; /\* fork pid \*/

int \*p; /\* shared variable \*//\*shared \*/

unsigned int n; /\* fork count \*/

unsigned int value; /\* semaphore value \*/

/\* initialize a shared variable in shared memory \*/

shmkey = ftok ("/dev/null", 5); /\* valid directory name and a number \*/

printf ("shmkey for p = %d\n", shmkey);

shmid = shmget (shmkey, sizeof (int), 0644 | IPC\_CREAT);

if (shmid < 0){ /\* shared memory error check \*/

perror ("shmget\n");

exit (1);

}

p = (int \*) shmat (shmid, NULL, 0); /\* attach p to shared memory \*/

\*p = 0;

printf ("p=%d is allocated in shared memory.\n\n", \*p);

/\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*/

n = 5; // Fork count

value = 1; // Semaphore initial value

/\* initialize semaphores for shared processes \*/

sem = sem\_open ("pSem", O\_CREAT | O\_EXCL, 0644, value);

/\* name of semaphore is "pSem", semaphore is reached using this name \*/

sem\_unlink ("pSem");

/\* unlink prevents the semaphore existing forever \*/

/\* if a crash occurs during the execution \*/

printf ("semaphore initialized.\n\n");

/\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*/

/\*\*\*\*\*\*\*\* PARENT PROCESS ENTERS CRITICAL SECTION FIRST \*\*\*\*\*\*\*\*/

/\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*/

pid = fork(); /\* first fork for parent \*/

if (pid != 0){ /\* parent process \*/

/\* parent enters critical section 5 times BEFORE creating rest of children \*/

for (int j = 0; j < 5; j++) {

sem\_wait(sem); /\* P operation \*/

sleep(1); /\* simulate work \*/

printf("Parent is in Critical section\n");

\*p -= 1; /\* decrement \*p by 1 \*/

printf("Parent: new value of \*p = %d\n", \*p);

sem\_post(sem); /\* V operation \*/

}

/\* fork remaining child processes (excluding first) \*/

for (i = 1; i < n; i++){

pid = fork();

if (pid < 0) /\* check for error \*/

printf ("Fork error.\n");

else if (pid == 0)

break; /\* child processes \*/

}

/\* wait for all children to exit \*/

while ((pid = waitpid(-1, NULL, 0)) > 0) {

if (errno == ECHILD)

break;

}

printf ("\nParent: All children have exited.\n");

/\* shared memory detach \*/

shmdt(p);

shmctl(shmid, IPC\_RMID, 0);

/\* cleanup semaphores \*/

sem\_destroy(sem);

exit(0);

}

/\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*/

/\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* CHILD PROCESS \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*/

/\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*/

else{

sem\_wait (sem); /\* P operation \*/

printf (" Child(%d) is in critical section.\*p=%d.\n", i, \*p);

\*p += 1; /\* increment \*p by 1 \*/

sleep (1);

printf (" Child(%d) new value of \*p=%d.\n", i, \*p);

sem\_post (sem); /\* V operation \*/

exit (0);

}

}

Q5:  
  
ardcmn@Arda-MacBook-Air lab 332 % ./semrun

shmkey for p = 92275021

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Child(3) is in critical section.\*p=3.

Child(3) new value of \*p=4.

Child(4) is in critical section.\*p=4.

Child(4) new value of \*p=5.

Parent: All children have exited.

ardcmn@Arda-MacBook-Air lab 332 % ./semrun

shmkey for p = 92275021

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Child(3) new value of \*p=4.

Child(4) is in critical section.\*p=4.

Child(4) new value of \*p=5.

Parent: All children have exited.

ardcmn@Arda-MacBook-Air lab 332 % ./semrun

shmkey for p = 92275021

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Child(4) is in critical section.\*p=4.

Child(4) new value of \*p=5.

Parent: All children have exited.