

Assignment 5



Exercise:

Write a high performance program!

In fact, write two programs! Program 2 calls program 1 several times. Program 1 should share the work with its copies over shared memory.

Program 1:

Download the assignment template and read and understand the code. Check the TODO's. The program basically multiplies two 10x10 matrices together and prints the result.

The idea is to be able to call this program multiple times at the same time, and each instance of the program shares the matrices and works on a certain part of the matrix multiplication, so that the computational time becomes a fraction in comparison with only one instance.

The program should be called with two arguments: the `par_id` and the `par_count`.

`Par_count` .. how many instances of this program are there?

`Par_id` .. which instance are you?

`Par_id = 0` (first instance) should initialize all necessary shared memory pieces with `shm_open` and the `O_CREAT` flag and also `ftruncate` and `mmap`! All other instances will need to use `shm_open()` (without the `O_CREAT` flag) and `mmap` still!

Write the code for synching! Meaning, no instance should go beyond this point if not all reached this point!

No copy and change the matrix multiplication function, so that different `par_id`'s work on different part of the multiplication. Easiest way: on different rows.

Program 2:

This program gets two arguments:

argv[1]: The program which should be called with execv (name of program1)

argv[2]: How many instances of program one should be called.

For every execv, you need to fork() and call execv in the child, because if successful, execv KILLS the calling process! Call execv for every instance of program 1.

I.e.: if you decide to let program 1 run 4 times in parallel, and program 1 is named "par", then:

\$./program2 par 4

The execv's need to be called now with:

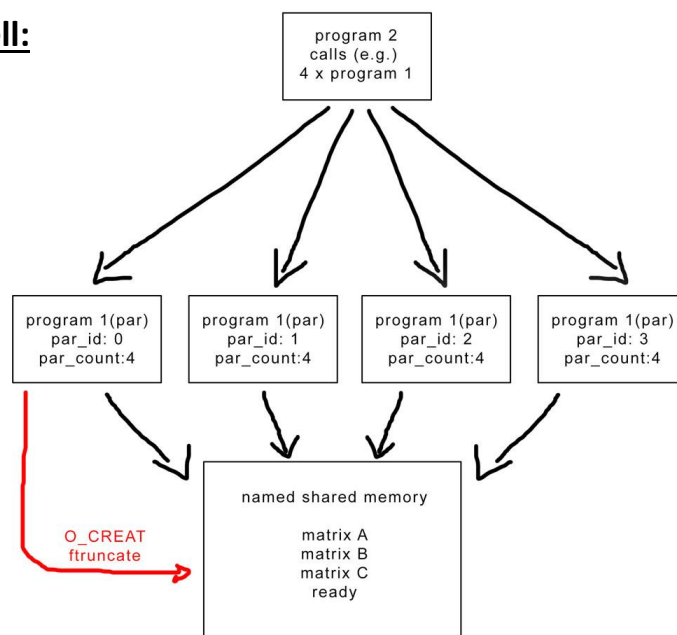
4 times:

```
execv(programstring,args); with  
char *args[4];  
and:  
args[0] = malloc(100);  
args[1] = malloc(100);  
... and so on  
and:  
strcpy(args[0],argv[1]);  
strcpy(args[1], X); //X must be par_id  
strcpy(args[2], Y); //X must be par_count  
NULL //don't forget for args[4]
```

with these different args:

```
". /par", "0", "4", NULL  
". /par", "1", "4", NULL  
". /par", "2", "4", NULL  
". /par", "3", "4", NULL
```

In a nutshell:



command line input:

```
./program2 par 4
```

execv args:

```
.\par 0 4 NULL  
.\par 1 4 NULL  
.\par 2 4 NULL  
.\par 3 4 NULL
```

Compile Flag!

```
-lrt ... for shm_open
#include <sys/mman.h>
#include <sys/stat.h>
#include <fcntl.h>
#include <unistd.h>
```

What for?

Program 2 is professionally called MPI, Message Passing Interface, and one of the most important high performance software out there (along with OpenMP and CUDA). MPI does the calling of your program, and one has to write the program 1 in respect to it: What if program 1 is called one time? What if 16 times? Etc.

How we test

Checking if you actually did the coding and then let the comparison function decide.

Submission:

Submit the source code file(s) and the executables: MYNAME_hpc_ass5.zip

Bonus?

20% on the assignment if you print the time taken for the multiplication.