

Homework 2. Classical algorithms for mutual exclusion

The program in the attachment consists of two threads. One repeatedly increments a shared variable s , the other one repeatedly decrements s . The value of the variable n specifies the number of repetitions in both the threads. The initial value of s is 0, hence the expected final value of s is also 0. The pthread library is used to start one of threads, but no means of mutual exclusion are used to prevent the threads from concurrent access to s . Note the use of symbols `MUTEX_NONE`, `MUTEX_DEKKER` and `MUTEX_PETERSON` in `Makefile` and `concurrency.c` (`Makefile` produces 3 executables which differ only in code fragments surrounded by corresponding `#ifdef ... #endif`).

a) Prove the correctness of Peterson's algorithm for mutual exclusion of 2 threads. (Formulate the requirements to the problem of mutual exclusion, and prove that Peterson's algorithm fulfills them.)

b) In the designated places in the attached source code, implement Dekker's and Peterson's algorithms to prevent simultaneous access of the threads to s (do not use any additional libraries functions, do not change the rest of the source file). Count the number of the idle repetitions in the entry protocol (the number of executions of the busy waiting loop) in the variables $c1$ and $c2$ ($c1$ for one thread, $c2$ for the other thread). Make sure that there are 0 errors and 0 warnings reported by the compiler/linker.

c) Measure the performance with `-DMUTEX_NONE` for $n=2^i$ for $i=0, 1, \dots, 29, 30$. Repeat the measurement 10 times for each i . Measure the performance of Dekker's and Peterson's algorithms (i.e with `-DMUTEX_DEKKER` and `-DMUTEX_PETERSON`, respectively) for $n=2^i$ for $i=0, 1, \dots, 29, 30$. Repeat the measurement 10 times for each i .

Discuss the results of your measurements for the 3 cases above (no mutual exclusion, Dekker's algorithm, Peterson's algorithm). Also report the number of processors and the highest value of signed integer in your system (the latter can be probably found as the value of `INT_MAX` in `/usr/include/limits.h`).

Hand out a ZIP file `hw2.zip` containing source files and a report `hw2.pdf`.