Assignment 2 – CMPT-300 Fall 2016 D100

Measuring Context Switch Costs (Total : 100 points) :

This is an individual assignment. For many of the following measurements, you will need to repeat the experiment many times and then take the average. You will need to use a high resolution timer, see here: http://linux.die.net/man/3/clock_gettime

The goal is to have **STABLE** measurement results. For some of the questions, we will provide a possible measurement strategy as a hint. You are encouraged to be innovative in designing your own test. For comparison purposes, all measurements **MUST** be done on the **PHYSICAL** machines in the CSIL lab.

- 1: (10 points) Your first task is to learn how to use high resolution timers in Linux and C. Please look at the example code at http://www.sfu.ca/~rws1/cmpt-300/assignments/hr-timer.c and the man page http://linux.die.net/man/3/clock_gettime. In the sample code you will see we have used 4 different counters, please describe what each clock does and where it would be appropriate to use them. Also, please briefly comment the sample code with what each **unique line** does. (Hint: You can use this code to help with the next parts).

- 2: (5 points) Measure the cost of a minimal function call in C/C++ (cost in terms of time taken). The minimal cost can be emulated by measuring a bare function call that neither takes any parameter nor does anything inside the function.

- 3: (5 points) Measure the cost of a minimal system call in C/C++. Unlike a regular function call, a system call traps into the operating system kernel. The minimal cost can be emulated by measuring the cost of getpid() which doesn't really do anything.

- 4, (40 points) Measure the cost of a process switching. A possible measurement strategy (**on a single-processor machine, CSIL are multicore!**) is provided below as a hint:
  - Your test program starts with a main process which then creates two pipes with a read file descriptor and a write file descriptor in each pipe.
  - The main process spawns a child process. Then one of the pipes is used for communication from the main process to the child process. The other pipe is used for communication in the reverse direction.
  - The main process starts with sending the child process a single-byte message and then trying to read back from the child process. The child process starts with trying to read something from the main process and then writing a singe-byte message back. Note that process switches are forced when the main process and the child process alternate executions. This process should be repeated many times to get accurate measurement.

- 5, (40 points) Measure the cost of a thread switching. A possible measurement strategy (**on a**

single-processor machine, CSIL are multicore!) is provided below as a hint:

- Two threads alternate using a shared integer num (set to be 0 initially), a mutex lock and two condition variables. Thread #1 keeps waiting for num to become 1 and then changing it to 0. Thread #1 keeps waiting for num to become 0 and changing it to 1.

Additional note: You should be careful with your measurement methodology. If appropriate, you may want to take into account things like loop overhead and timer overhead (making calls to start and stop the timer can induce costs that are non-negligible when measuring the cost of a single function call).

What to turn in:

Turn-in:

Source code:

You are asked to electronically turn in your source files and a makefile. Attach a README file describing the name of the executable, special compiling instructions, or anything else special you want to let us know. Also include your measurements in this README. The README file should be in **plain text** format. Please turn in at https://courses.cs.sfu.ca/

Report:

For this assignment you will also turn in a **max 2** page report on your findings, in PDF format. You can go over the 2-page limit to include larger figures and citations. Please describe what you have found in part 1, complete with data, interpretations and insights. Also, convey the results as clearly as possible using graphs and tables where appropriate. Further, you must explain your measurement methodology (extra credit may be given for clever measurement methodology).