Shiraz University

Parallel Algorithms - Spring 2024
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Teacher Assistant:
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Homework 1
Deadline: 18/12/1402

In this homework, you are going to transpose a matrix and profile its execution time. If you already installed Linux and the required tools like G++ and gprof, you are free to jump to part B.

A. First, you should prepare the environment for homework. We encourage you to use Linux environment.

   Linux comes in different distros, but the most widely used one is Ubuntu.
   If you are already a Linux user, you are free to jump to step 2.

   - **Step 1**: Linux installation
     - If you have an extra computer that you don't use, you can install Linux on it from scratch. This is the complete step-by-step guide from scratch.
     - If your laptop has at least 8 GB of RAM, you can install Ubuntu on a Virtual Machine. Vmvare is a good option. Here is the step-by-step guide.
     - In case none of the previous options work for you, you can use WSL. It lets you have a Linux core on your own Windows. Check it out here.

   - **Step 2**: Required development tools
     As a shortcut, you can use Ubuntu's "build-essential" meta-package. Here is the tutorial. After installation, make sure you have all of these tools installed:
     - Make
     - G++
     - gprof

B. Here, you should implement the transpose of a matrix with dimensions 1024*1024. It is preferred to implement the solution in C/C++. You can use this reference for more information on loop transformation.

- **Step 1:** Try three different data types int, float, and double. Report the execution time of each one using “gprof”
- **Step 2:** Change matrix size to 2048*2048 and 4096*4096. Report the execution time of each one using “gprof”
- **Step 3:** Try the two different possible loop orders and report the execution time for each one using “gprof”
- **Step 4:** Tile loops by tilling sizes 16, 32, and 64.
  You can use section 3.6 of the reference for more information about loop tiling.
  Report the execution time of each one using “gprof”
- **Step 5:** Implement loop unrolling for loops with factors 4 and 8.
  You can use section 4.1 of the reference for more information about loop unrolling.
  Report the execution time of each one using “gprof”

Report Format:
An explanation of how to run your code (Linux command to run your code)
A complete analysis of your profiling
A comparison between the execution time of your code with different parameters.

Reminders:
Each homework has to be done individually.
Send the report and the source code as a ZIP file to saraabbasi847@gmail.com. File’s name and email subject should be like this:
PA-S24-YOUR NAME-YOUR STUDENT NUMBER-HW1

Best of Luck!