Shiraz University

Parallel Algorithms - Spring 2024
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Teacher Assistant:
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Homework 2
Deadline: 24/01/1403

In this homework, you are going to perform some changes on an image, parallelize the code with pthread, and profile its execution time, CPU and RAM usage.

Part 1.

- **Step 1:** Make 4 copies of the given image. Then, create a large image containing those 4 copies. Notice that those copies are placed together like a 2*2 matrix.
- **Step 2:** Convert a large image from RGB to grayscale.
- **Step 3:** Detect the edges of a large image by Sobel Edge Detector.

Part 2.

- **Step 1:** Parallelize the large image creation process, rgb to grayscale conversion and Sobel Edge Detection process with pthread. Make sure to check the return code of pthread_create and increase pthread stack size. Also, you may need to use synchronization primitives to ensure that the output data is correct.
- **Step 2:** Tile loops by tiling sizes 16, 32, and 64 and parallelize your code. Report the execution time of each one using “gprof”
- **Step 3:** Implement loop unrolling for loops with factors 4 and 8 and then parallelize them. Report the execution time of each one using “gprof”
- **Step 4:** Use the best result of step 2 in loop tiling and step 3 in loop unrolling togather and then then parallelize them. Report the execution time of each one using “gprof”.
- **Step 5:** Create a line chart to visualize the results from parts 1, 2, 3, and 4. The x-axis of the diagram should be labeled 'Number of Threads', and the y-axis should be labeled 'Execution Time’. On the chart, plot 7 separate lines in different

colors (one line for part 1, three lines for part 2, two lines for part 3, and one line for part 4)

Part 3.

- **Step 1:** Use the code from part 2 as the base for this step. Repeat all the parts in step 2 and monitor CPU and RAM usage. Report the maximum peak of CPU and RAM usage in each part. You can use the script attach to this doc for monitoring cpu and ram usage.
- **Step 2:** Create two line charts, one for CPU Usage and one for RAM Usage. On each chart, plot 7 separate lines in different colors (one line for part 1, three lines for part 2, two lines for part 3, and one line for part 4). Use 'Number of Threads' for the x-axis on both charts and ‘CPU Usage’ or ‘RAM Usage’ for y-axis.

Report Format:
An explanation of how to run your code (Linux command to run your code).
A complete analysis of your profiling at each step.
Three diagrams that show your results.

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!