Indian Institute of Information Technology, Sri City, Chittoor
Computer Science and Engineering

High Performance Computing (HPC-Spring 2024)

Programming Assignment-01 - Application Profiling

Objective: Application profiling to identify performance limitations and bottlenecks.

Learning objective:

- This practical exercise is designed to enhance your skills in profiling applications for improved overall performance.
- The primary objective of this assignment is to get hands-on experience in profiling an application, aiming to identify and address performance limitations and bottlenecks.

Instruction:

- For the assignment, form teams of two individuals. The deadline for the assignment is two and a half weeks from the announcement.
- **The initial submission is due one week after the announcement**. i,e Details about the chosen application and profiling process with the title "Submission of the Assignment."
- **The final submission is two and a half weeks from the announcement**

Assignment Description:

1. **Select an Application or Open-Source Project:** Choose either an existing application, an open-source project, or create a program that is commonly used for conducting simulations on a dataset or performing operations to generate results. Ensure it aligns with the goal of the assignment.

   Define Performance Metrics: Clearly define specific performance metrics to measure, such as `execution time, memory usage, and CPU utilization`. Tailor these metrics to the characteristics critical for optimal performance in your selected application.

2. **Choose Profiling Tools:** Selecting appropriate profiling tools for the task is essential. You have a range of options, including built-in profiling tools in integrated development environments (IDEs), open-source profilers, or command-line tools[refer Appendix-1]. You can also profile a serial application using Nsight Systems/nvprof.

   `Example applications/simulators for profiling`

   - BookSim: A cycle-accurate interconnection network simulator. BookSim GitHub
   - HotSpot: A pre-RTL thermal simulator for early-stage design, supporting 2D and 3D integrated circuits as well as microfluidic cooling. HotSpot Simulator
   - Profiling of Deep Learning Models: If interested in the field of deep learning, consider profiling training on mobile devices as outlined in the paper: Profiling Training Deep Learning Models on Mobile Devices

3. **Implement the chosen profiling tools** to profile your selected application. Capture relevant data and conduct a thorough analysis to identify any performance issues

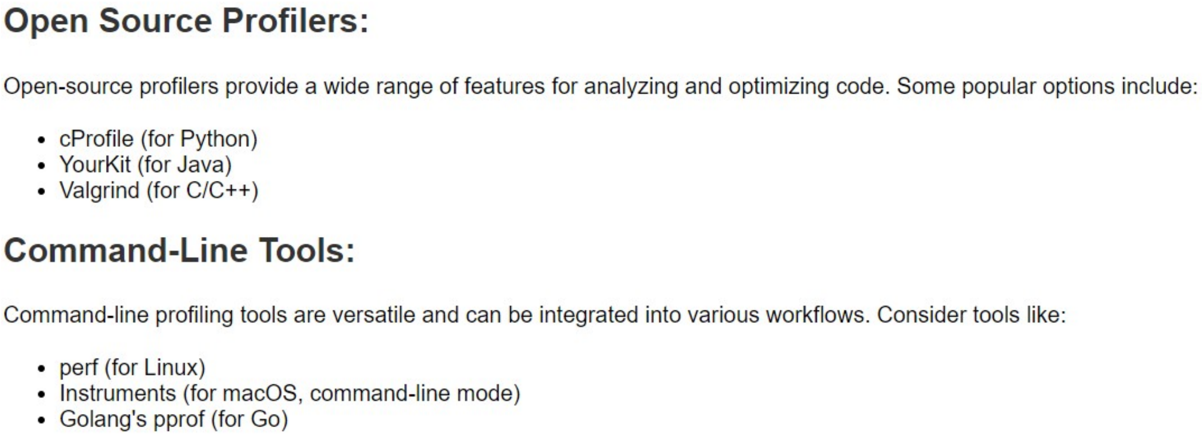
4. **Document Findings:** Prepare a comprehensive report documenting the entire profiling process and its findings. Include details about the selected application, chosen metrics, profiling tools used, and a detailed analysis of identified performance issues. Propose specific recommendations for optimization based on your profiling results.

Submission:

Submit your profiling report along with any relevant code snippets, screenshots, or graphs generated during the profiling process. Include your recommendations for optimization. Seek assistance from your instructor or classmates if challenges arise during the profiling process.
Submissions should be made through the HPC G-classroom

Appendix-02

List of Profiling tools :



Open Source Profilers:

Open-source profilers provide a wide range of features for analyzing and optimizing code. Some popular options include:

- cProfile (for Python)
- YourKit (for Java)
- Valgrind (for C/C++)

Command-Line Tools:

Command-line profiling tools are versatile and can be integrated into various workflows. Consider tools like:

- perf (for Linux)
- Instruments (for macOS, command-line mode)
- Golang's pprof (for Go)

- You can choose any application
- BookSim is a cycle-accurate interconnection network simulator. Originally developed for and introduced with the Principles and Practices of Interconnection Networks book, its functionality has since been continuously extended. `https://github.com/booksim/booksim2`
- Hotspot :HotSpot is a pre-RTL thermal simulator intended for use early in the design process. HotSpot supports simulation of traditional 2D Integrated Circuits (2D ICs) and 3D ICs as well as microfluidic cooling. If this is your first time seeing HotSpot, check out our Getting Started page `\https://lava.cs.virginia.edu/HotSpot/`
- Profiling of any Deep Learning Models
- Profiling Training Deep Learning Models on Mobile Devices `https://arxiv.org/pdf/1906.04278.pdf`

[1] Note: Seek assistance from your instructor or classmates if challenges arise during the profiling process