Complimenting Interactive Visualization of High-Performance Scientific Application with Hardware Utilization Dashboard

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Introduction

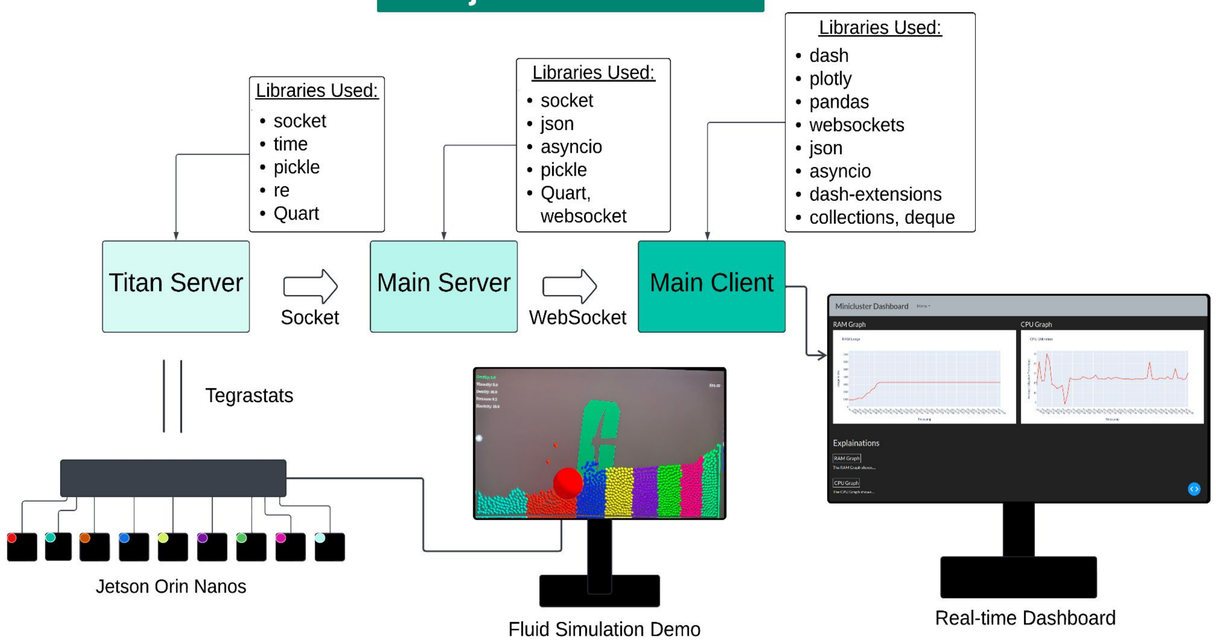
- Active visualization can aid in creating student engagement and developing a more comprehensive understanding of advanced High-Performance Computing (HPC) topics.
- To accomplish this goal, we have created a real-time dashboard that presents live data (tegrastats) collected from a cluster of Jetson Orin Nanos as it completes a fluid simulation.
  - Jeton Orin Nanos are small-scale computing devices. →

- Visualizing hardware utilization side-by-side with interactive applications enables students to connect performance to hardware concepts (such as RAM or CPU usage).

Motivation

- This dashboard visualizes how the hardware is used and how work is distributed.
- It enables students to interact with a miniaturized Supercomputing system, while also visually displaying the "under-the-hood" utilization of the computing hardware.
- Connecting the fluid simulation performance to the hardware's performance can allow students to better understand what is happening in the hardware as the simulation performs successfully or has some malfunctions.
- The stats plotted on the dashboard will show this connection. Any abnormalities in the simulation will be reflected in the graph.

Project Architecture



Methods

Titan Server

Purpose

- The Titan Server works to take in the tegrastats, parse it, and organize it into a dictionary.
- The server then pulls values from the dictionary and creates another dictionary with the value and its corresponding timestamp to be sent through a socket.

Tech Stack

- Python
- Socket
- Github Project → tegrastats_parser (ssaraff98)
- Quart Framework

Main Server/Client

Purpose

- The Main Server works to receive the tegrastats from the Titan Server and send it to the Main Client through a websocket.
- The Main Client displays a webpage with graphs that plot data every few seconds.

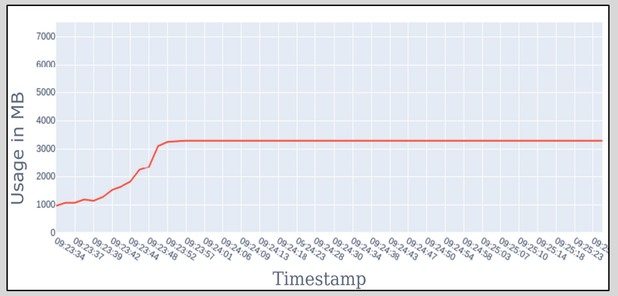
Tech Stack

- Python
- Socket
- Websocket
- Quart Framework
- Plotly Dash
- HTML/CSS (Bootstrap)
- DashProxy Framework

Results

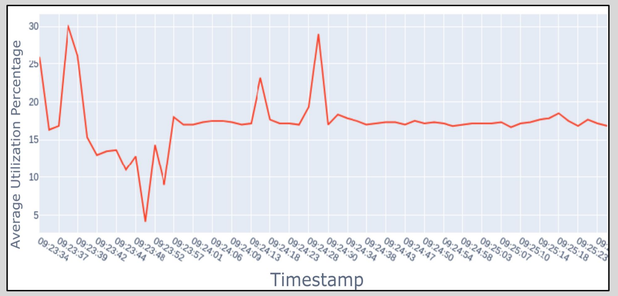
Tegrastat Example:

06-25-2024 14:07:56 RAM 5475/7621MB (lfb 6x2MB) SWAP 38/3811MB (cached 0MB) CPU [4%@883,17%@883,1%@883,0%@883,0%@729,3%@729] GR3D_FREQ 7% cpu@48.5C soc2@47.906C soc0@47.218C gpu@48.468C tj@48.5C soc1@47.875C VDD_IN 5462mW/5462mW VDD_CPU_GPU_CV 716mW/716mW VDD_SOC 1634mW/1634mW



RAM Usage Graph

This graph shows the amount of RAM in use in MB out of about 7GB of Total RAM.



CPU Utilization Graph

This graph shows the average utilization percentage of the 6 CPU cores.

Future Work

- This project is a standing demo that will be available in Woodward Hall.
- It will first be evaluated in the classroom setting to see if it accomplishes our goals of enhancing student engagement.
- We aim to discuss with the Discovery Place about doing a segment there in the future.