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## Benchmarking the Flagship Alabama HPC System

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# RCEU 2023 Project Proposal

## Project Title

Benchmarking the flagship Alabama HPC system

## Faculty Information

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# RCEU 2023 Project Proposal

## **I. Project Description**

UAH is scheduled to acquire a powerful high performance computing (HPC) system with over 3000 CPU cores and more than 150,000 GPU (CUDA) cores through the Regional Computing Hub for Alabama Universities (RCHAU) sponsored by the National Science Foundation. For this project a student who was selected, Mr. Kishan Yerubandi, will have an opportunity to benchmark the system using the Linpack test as used by the Top500 website and test the data transfer rates to other Alabama sites using PerfSONAR. Project will also involve testing cluster monitoring solutions and deploying network measurement systems. The student will learn important skills working with modern supercomputers based on hybrid CPU-GPU (graphic processor) architecture and optionally learn CUDA development with NVlink and GPUDirect technologies. The main project outcomes will consist of a detailed network configuration plan within the Science DMZ model, a set of benchmark results submitted to the Top500 list, and a report on the system's performance placed on the future RCHAU website.

## **II. Student Duties, Contributions, and Outcomes**

### *a. Specific Student Duties*

The student will configure and assist with deployment of test local area network (LAN) to simulate the actual cluster usage. The LAN will consist of two nodes, one representing the login node, and the other representing the data storage and a high performance data transfer node (DTN). Kishan will configure this network as a ScienceDMZ deployment, which is a standard network architecture used for HPC systems. He will deploy the PerfSonar monitoring software and measure the data transfer rates between the Hub, the upstream internet provider (SoX/Georgia Tech) and the Alabama universities participating in RCHAU.s

Once the actual system is acquired (expected later during Summer of 2023), the student will participate in performance benchmarking using the GPU enabled Linpack test. He will submit the scores to the Top500 project that records the configuration and performance data of most of the world's supercomputers. The student will assist with creating a web site advertising the capabilities of the new system to potential users and writing the operator's manual.

### *b. Tangible Contributions by the Student to the Project*

*(10% of Review)*

The work performed by Kishan on the simulated ScienceDMZ LAN will be invaluable during the actual cluster deployment. It is expected that significant time and effort by IT personnel would be saved and the system would become operational faster because of the experience gained. The PerfSonar installation will become the second Alabama node to join the one at UAB; this is a global asset allowing network performance testing between sites all around the world. Kishan will also contribute to the writing of the operator's manual that will be used by future sysadmins to deploy, upgrade, and operate the flagship HPC system.

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## *c. Specific Outcomes Provided by the Project to the Student* (30% of Review)

Supercomputer skills are highly sought after across the industry, government, and academia. HPC technologies are used in simulations, automation, data mining, artificial intelligence, cryptography, and multiple other areas. Over the course of this project Kishan will learn networking for HPC applications, performance tuning, network security, data transfer technologies, as well as sharpen his current skills. He will also learn the basics of system administration of HPC systems. A mention of participation in an HPC deployment project makes for a strong statement on a resume. To give an example, our current student system administrator, who is graduating in 2023, has already secured employment with the Chevron company in no small part because of his experience operating our older HPC systems.

Kishan has expressed an interest in pursuing a PhD degree in the future in an area that makes extensive use of numerical computations, such as Space Science. I hope that interactions with myself and other faculty members as well as scientists and graduate students in a highly research-active department such as Space Science will help him make his choice.

### **III. Student Selection Criteria**

The student must be experienced with the Linux OS and have basic skills administering a server enabled system (installing the OS, installing updates, configuring services, configuring network parameters, etc.) Some computer science background is desired, but not strictly required. Experience with programming languages (preferably C or C++) would help in certain tasks, such as benchmarking, but is otherwise optional. A student should have basic technical writing skills. Kishan Yerubandi, who was selected for this project, is a senior majoring in Computer Science and Computer Engineering as separate degrees. Based on Kishan's letter of interest and a meeting in person, it is clear that he satisfies all of those criteria.

## **IV. Project Mentorship** (30% of Review)

While I will be responsible for mentorship, the student will also interact with a team of faculty, staff members, and students directly involved or simply interested in the project. It is expected that the student will learn additional skills by interacting with IT personnel, scientists who use HPC in their research, and graduate students that are often the first adopters of newest technologies, such as GPU networks, hardware composition, or CPU/GPU superchips. An undergraduate student currently working as a sysadmin in the Department will provide training on how to deploy and administer a diskless cluster. A pair of graduate students will mentor Kishan on how to write code for parallel systems and GPUs. Kishan will be encouraged to take part in our daily coffee breaks, which is a great environment for sharing experiences in an informal manner.

Formally, the adviser will hold regularly scheduled face to face meetings with the student. In addition, the student will be invited to participate in telecons with University IT and contribute to the decision making process regarding the cluster acquisition, use policies, security, etc.