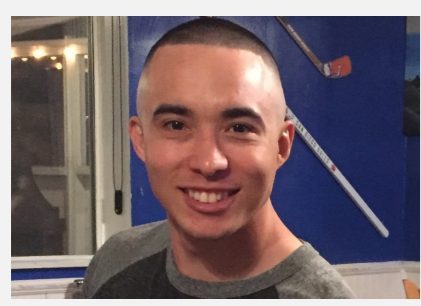


Dane Fairchild<sup>1</sup>, Ryan Grant<sup>1</sup>, Vaughn Ganem Haka<sup>1</sup>, Tuan Nguyen<sup>1</sup>, Yajush Sharma<sup>1</sup>, Prabhjot Singh Saluja,<sup>2</sup> Christopher Paolini,<sup>1</sup> Peter Blomgren,<sup>1</sup> Barbara Bailey,<sup>1</sup> Jeremy Evert,<sup>2</sup> and Mary Thomas.<sup>1</sup>

<sup>1</sup>San Diego State University, <sup>2</sup>Southwestern Oklahoma State University

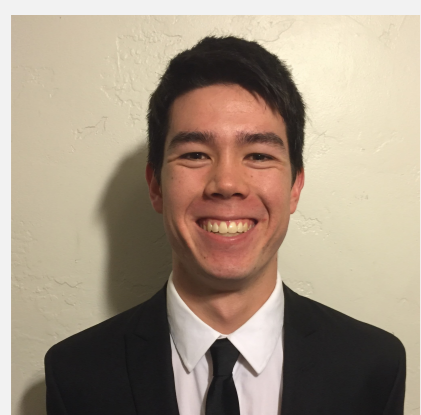
## ABOUT OUR TEAM

Our team has depth, strength, diversity, and a sense of fun:



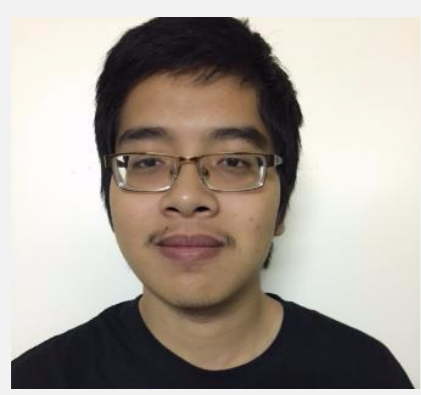
**Dane Fairchild** *Team Captain Application - LINPACK Benchmark*

I am an EE major, the team captain, and system administrator. I am interested in HPC, applied mathematics, and VLSI system design.



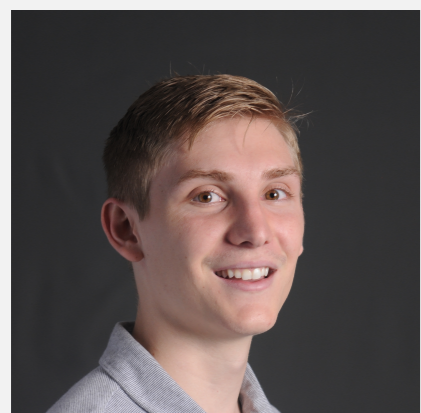
**Ryan Grant** *Power Management*

I am an EE student with an emphasis on communications and signal processing. When I'm not studying, I like to build and customize my own computers.



**Tuan Nguyen** *Application - Mr.Bayes*

I'm a senior CS student and minor in maths. I'm interested in HPC, applied mathematics and compiler optimization.



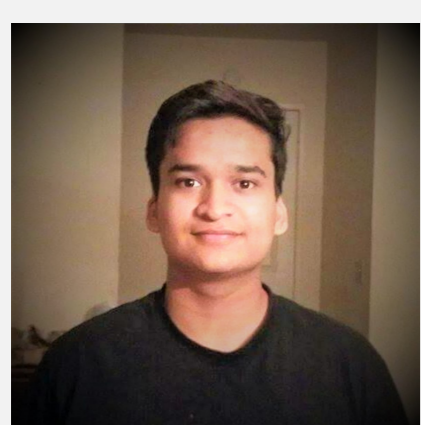
**Vaughn Ganem Haka** *Application - Reproducibility Challenge*

I'm a CE/CS student that's passionate about distributed computing, data engineering, machine learning, and memes. In my free time I'm surfing the net or seeking out my long lost evil twin.



**Prabhjot Singh Saluja** *Application - Born.*

I am a CS major at SWOSU with an interest in HPC. I am active in the College Activities Board, work in the library, manage our Luminous cluster, and mentor undergraduate student researchers in the Blue Thunder Alley Lab.

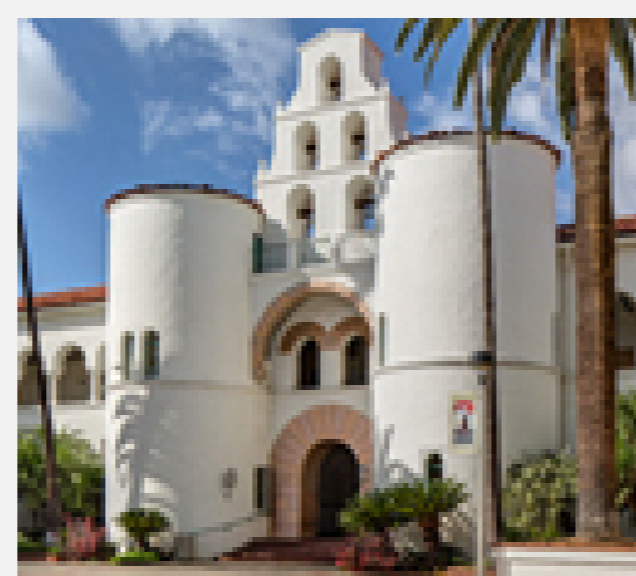


**Yajush Sharma** *Application - HPCG Benchmark*

I'm a Computer Science Student at SDSU. I am interested in Computer Vision, Parallel Programming, Machine Learning, and data science.

## ABOUT SDSU

Founded in 1897, San Diego State University (SDSU) is the largest and oldest institution of higher learning in San Diego County. It is a lively campus located in San Diego, California, USA and is home to the Computational Science Research Center (CSRC) which has provided the mentorship and funds that have allowed this team to exist.



## ABOUT SWOSU

Southwestern Oklahoma State University (SWOSU) was founded in 1901 and is located in Weatherford, Oklahoma, USA. SWOSU is primarily an undergraduate institution, serving under-represented populations, with a 18:1 student-to-faculty ratio, and an average class size of 20. SWOSU was ranked in the nation's top 25 universities by MSN.



## COMPETITION PREPARATION

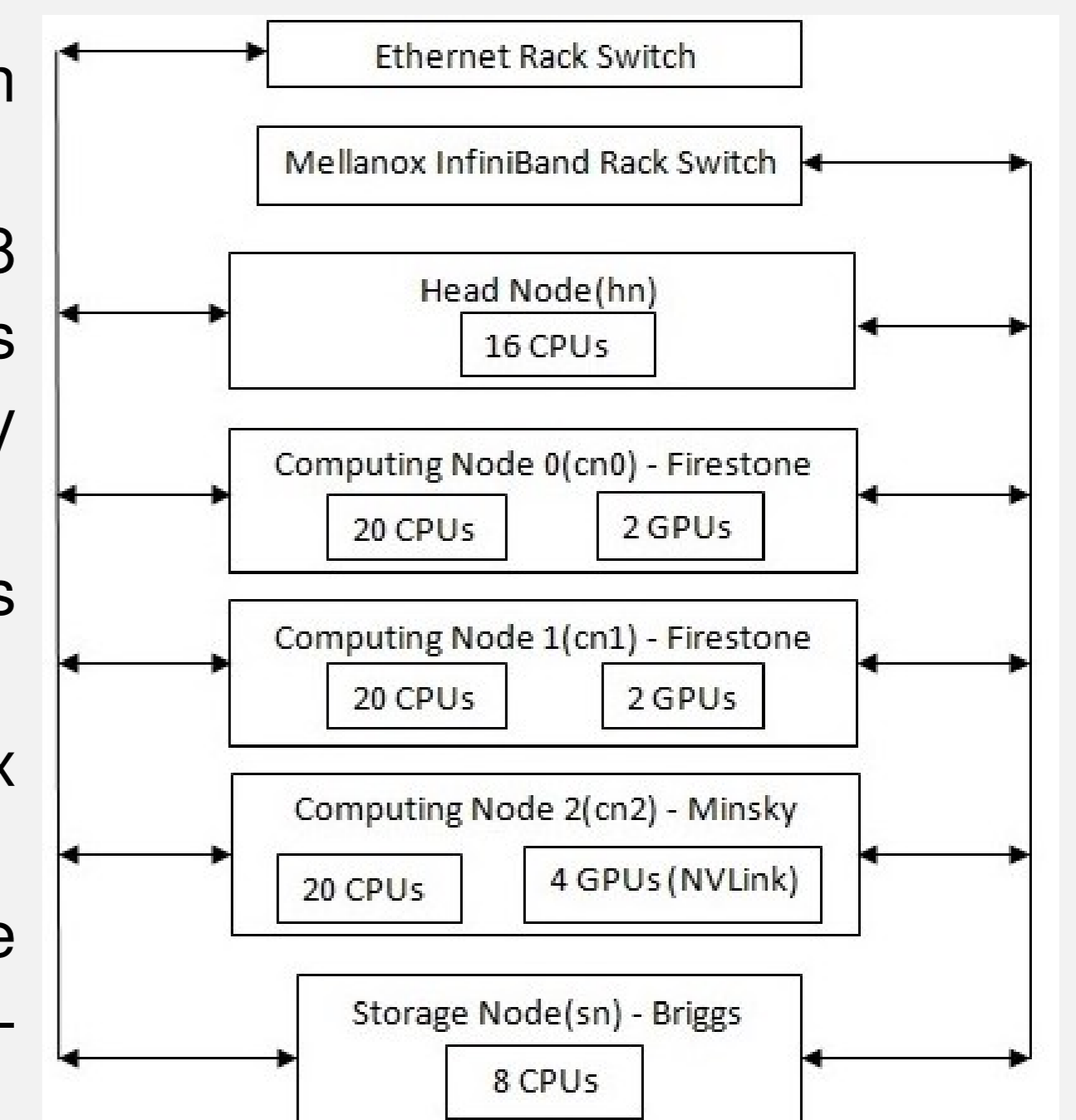
To prepare for the SCC competition, the team met throughout the summer focusing on key HPC topics. We discussed our progress every week and discussed any issues we had with our applications. Chris Paolini helped us tremendously with setting up the cluster, running applications, and systems administration. Peter Blomgren dedicated his time to CycleCloud and Barbara Bailey assisted with the mathematical theory behind MrBayes. Mary Thomas coordinated the schedule and made sure we were on task. There were lectures covering these topics:

- ▶ UNIX Systems Administration
- ▶ Open MPI, CUDA Programming, and Bash Programming
- ▶ How to use IBM Spectrum LSF Suite
- ▶ How to program and edit files in Emacs, Vim, and Vi

## ABOUT THE CLUSTER

### Hardware Configuration

- ▶ **Head node:** IBM Power8 Stratton Server - 16 Cores 128 Threads
- ▶ **Compute nodes:** 2 x IBM Power8 Firestone Servers - Each 20 Cores 160 Threads IBM Power8 Minsky Server - 20 Cores 160 Threads
- ▶ **Storage node:** IBM Power8 Briggs Server - 8 Cores 64 Threads
- ▶ **GPU:** 4 x NVIDIA Tesla V100, 4 x NVIDIA Tesla P100 with NVLink
- ▶ **Networking and Connectivity:** The system uses both GigE and InfiniBand networks.



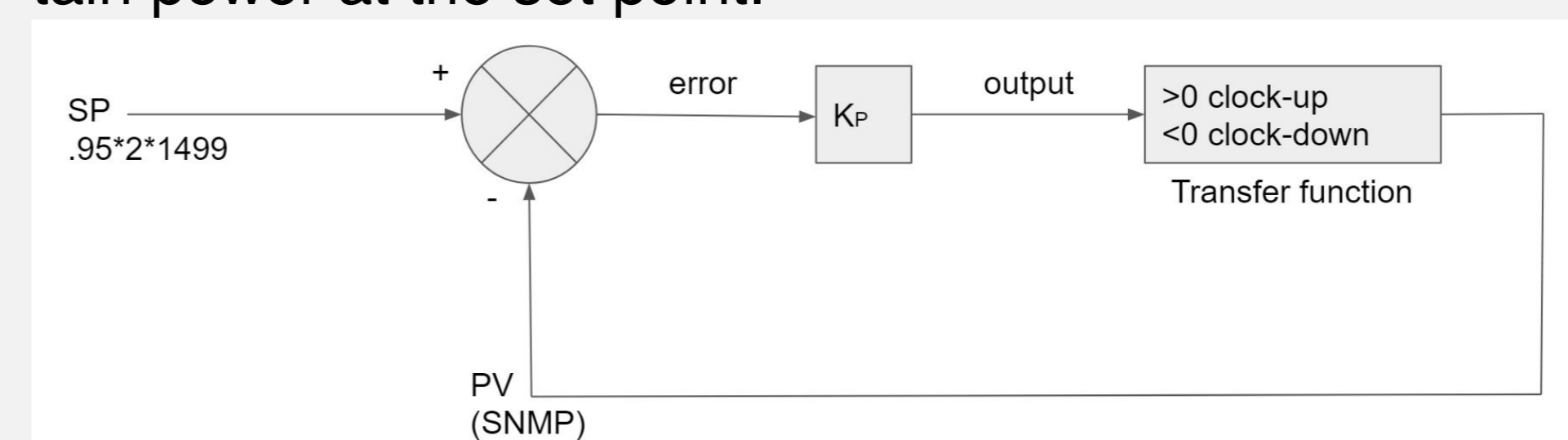
### Software Configuration

- ▶ We used Ubuntu 16.04.2 LTS since it supports NVIDIA libraries and the IBM PPC64EL architecture. We used these compilers and libraries: IBM XL C/C++ Compiler, IBM XL Fortran Compiler, IBM ESSL, Open MPI v2.1.2, CUDA Toolkit 8.0 for Minsky and CUDA Toolkit 9.0 for Firestone, and Allinea DDT.



## STRATEGIES FOR RUNNING AND OPTIMIZATION

- ▶ **Benchmarks**  
Using the binary codes provided by NVIDIA, we were able to obtain a score over 29 TFLOP/s for LINPACK and 750 GFLOP/s for HPCG.
- ▶ **Mr.Bayes**  
Since we had no knowledge of the actual dataset competition tried different installation options of Mr.Bayes, simulated countless runs with different dataset size and parameters to determine the optimal way to run it. We believe that we will produce a good consensus tree, with reasonable standard deviation and PSRF values.
- ▶ **Power Usage**  
We have developed a proportionality controller to manage our power usage. The controller adjusts core frequencies proportional to the error between the apparent power usage and a desired set point in an attempt to maintain power at the set point.



## WHY WE WILL WIN!

With the support from SDSU, SWOSU, and our sponsors we have learned a lot and applied our knowledge to the cluster. We had incredible advisors and mentors. Each application had their own advisor to provide guidance and mentorship. Our team is a diverse group of CS, CE, and EE students each with a burning passion for distributed computing and HPC.

## MANY THANKS TO OUR SPONSORS!

