Research Experiences using Raspberry Pi

Suzanne Matthews, West Point
Joel Adams, Calvin College
Richard Brown, St. Olaf College
Elizabeth Shoop, Macalester College

Research with Pis at West Point

- We have used Raspberry Pis for the last three years for various research projects.

- Year 1 and Year 3 involved students. Year 2 was a faculty collaboration.

- To date, the projects have yielded two peer reviewed publications.

- Cluster case design open-sourced by Matthews and Blackmon in 2015. http://www.thingiverse.com/thing:892959

Year 1: ROAMS (2014-2015)

- 21-node Raspberry Pi B+ cluster
- Simulated a "smart" mortar system with 20 rounds in the magazine and a "magazine server"
- Server communicates with "smart rounds" using MPI

- [2015 Journal Paper](#) with two faculty and one student co-author
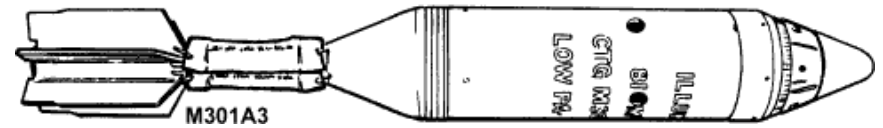
Year 2: Password Cracking (2016)

- 128-core Raspberry Pi 2 cluster (32 nodes)
- 128-core Parallella cluster (8 nodes)
- Compared performance of password cracking on each cluster using JtR+MPI hybrid
- Also used high-end laptop for performance analysis
- Pi and Parallella cluster outperformed laptops. Perhaps can be used for other Cyber operations?
- [2016 conference paper](#) with 3 faculty co-authors
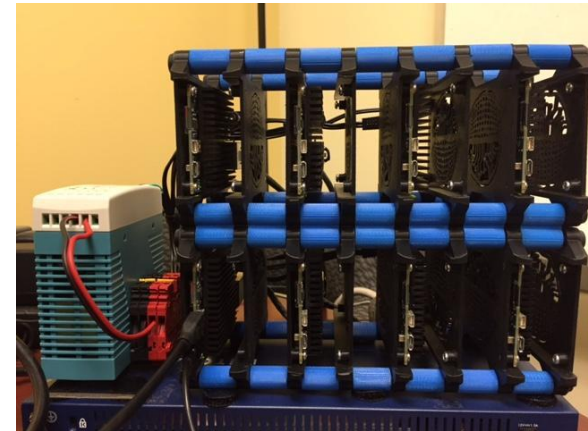
Year 3: Power Grid Anomaly Detection

- 128-core Raspberry Pi 2 cluster (32 nodes)

- Data is gathered from a 1000:1 scale emulation power grid

- Using Pi cluster to detect fluctuation in data using custom algorithm

- Pthreads+MPI hybrid

- Ongoing research with two faculty and two cadets. Paper in the works.
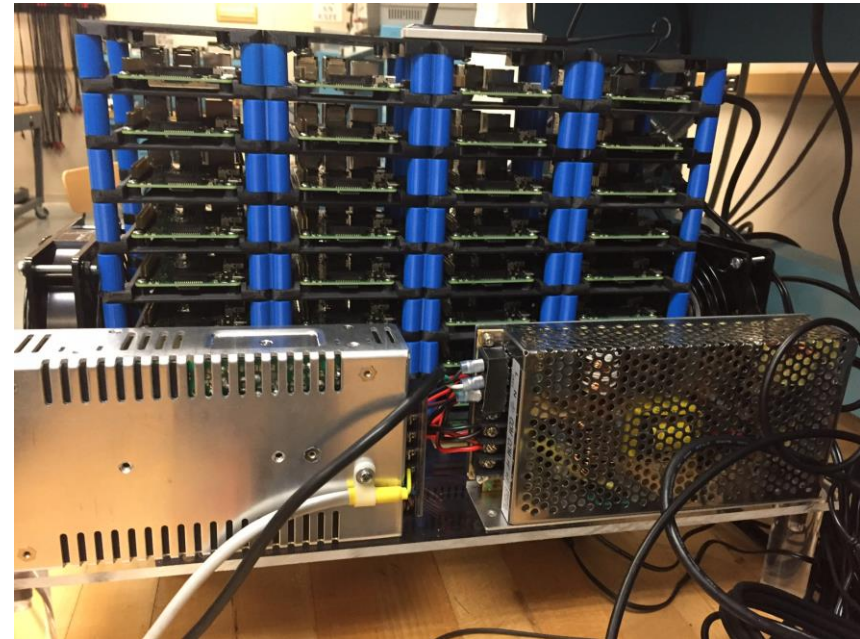
Reflection

- Projects have produced two papers with 3 distinct faculty co-authors and 1 student co-author.

- Great system to drive home networking principles along with parallel programming.

  – Students have to deal with NFS issues, ensuring there is connectivity to all devices, and other types of hardware issues, in addition to learning parallel programming.

  – This can be a double-edged sword!

- Students and faculty alike enjoy the "hands-on" aspect

  – Clusters have a definite "cool" factor that seems to attract students.