HPC in High School: Teaching and Mentoring (and funding it) And From the Student's Perspective

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Louisiana School for Math, Science, and the Arts

2 October 2013

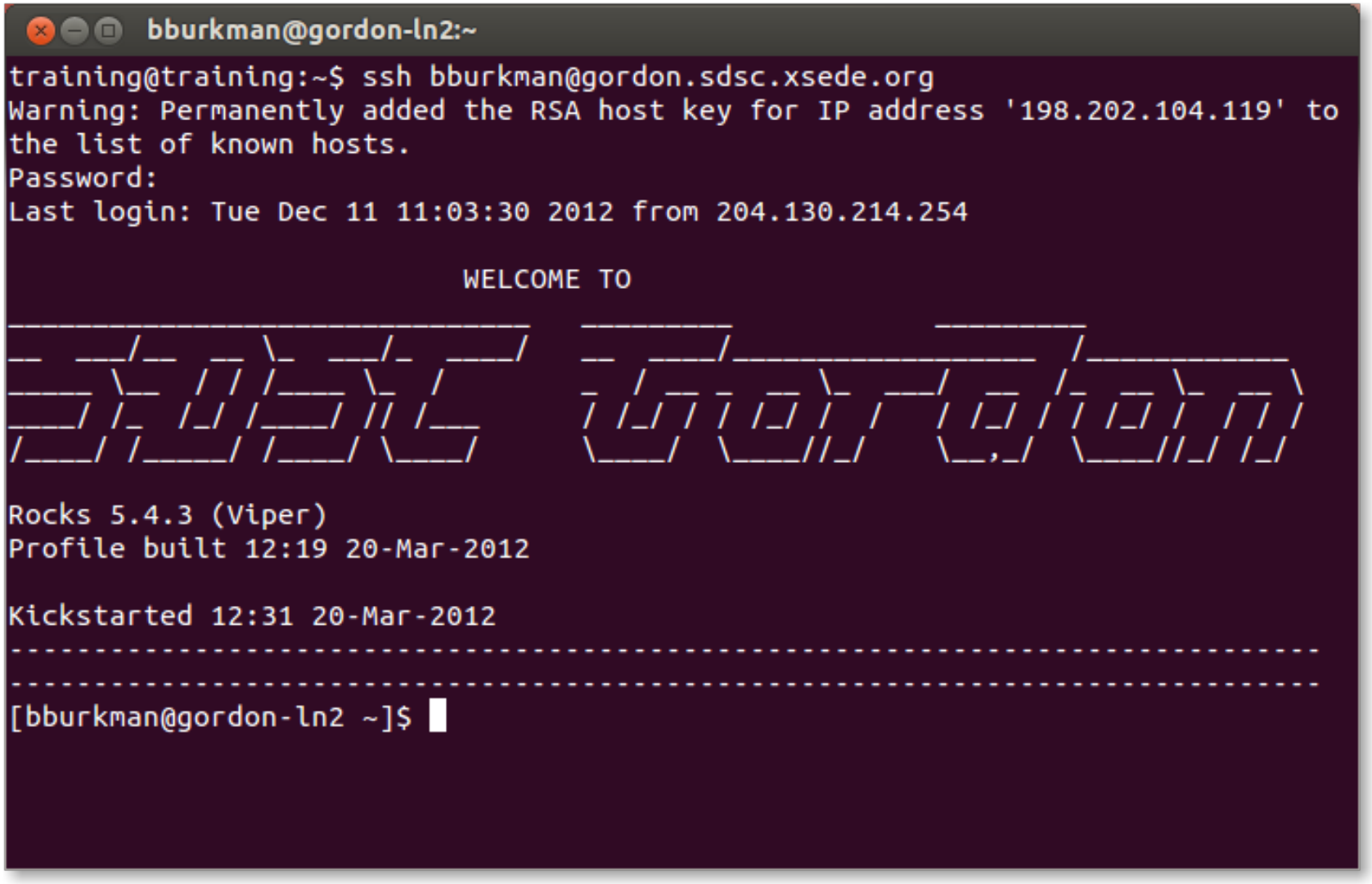
www.lsmsa.edu

NAK-ə-təsh

Big Ideas

1. Big Users from Little Users Grow
2. To solve a compelling problem,
   students will develop the necessary skills
3. Computing is ~~NOT~~ important in every discipline
4. Student interest follows faculty passion

Big Users from Little Users Grow

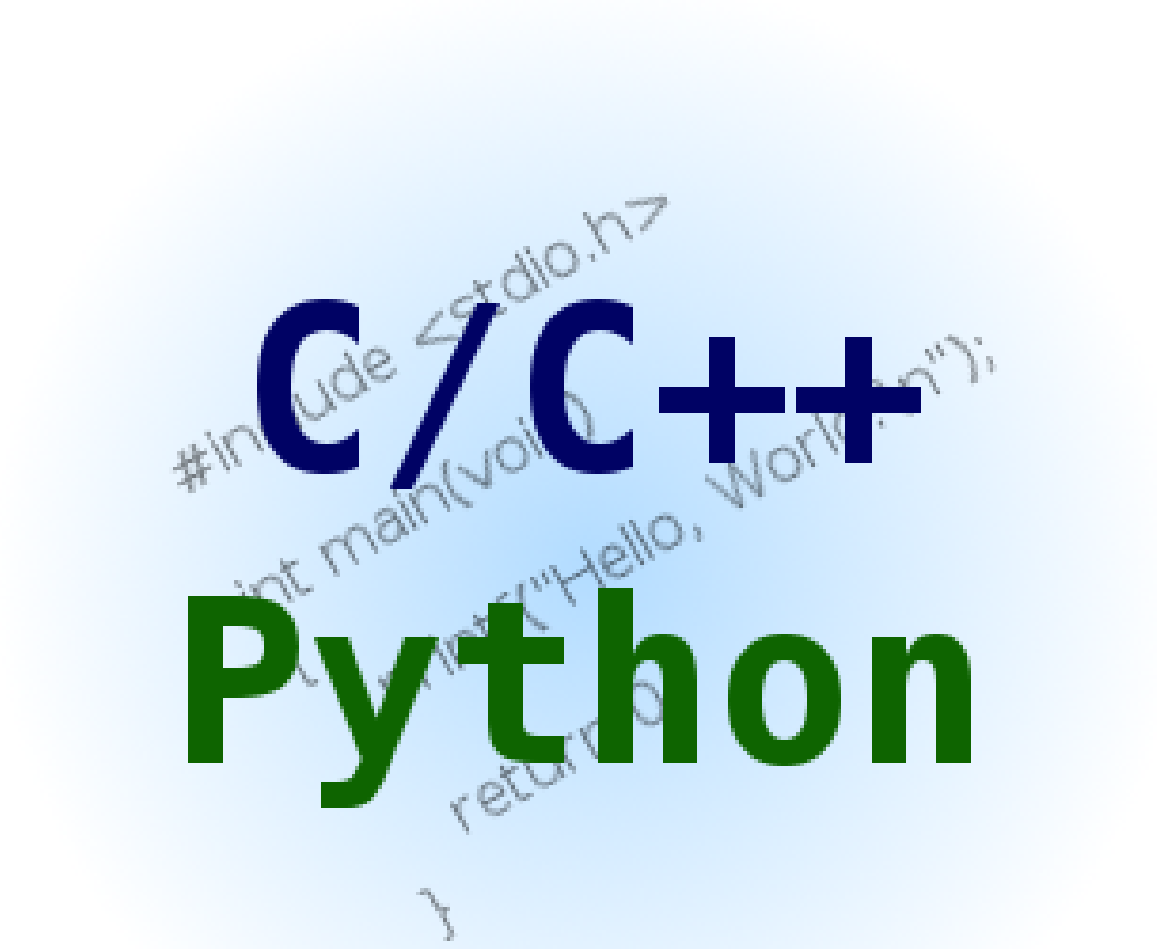


Big Users from Little Users Grow

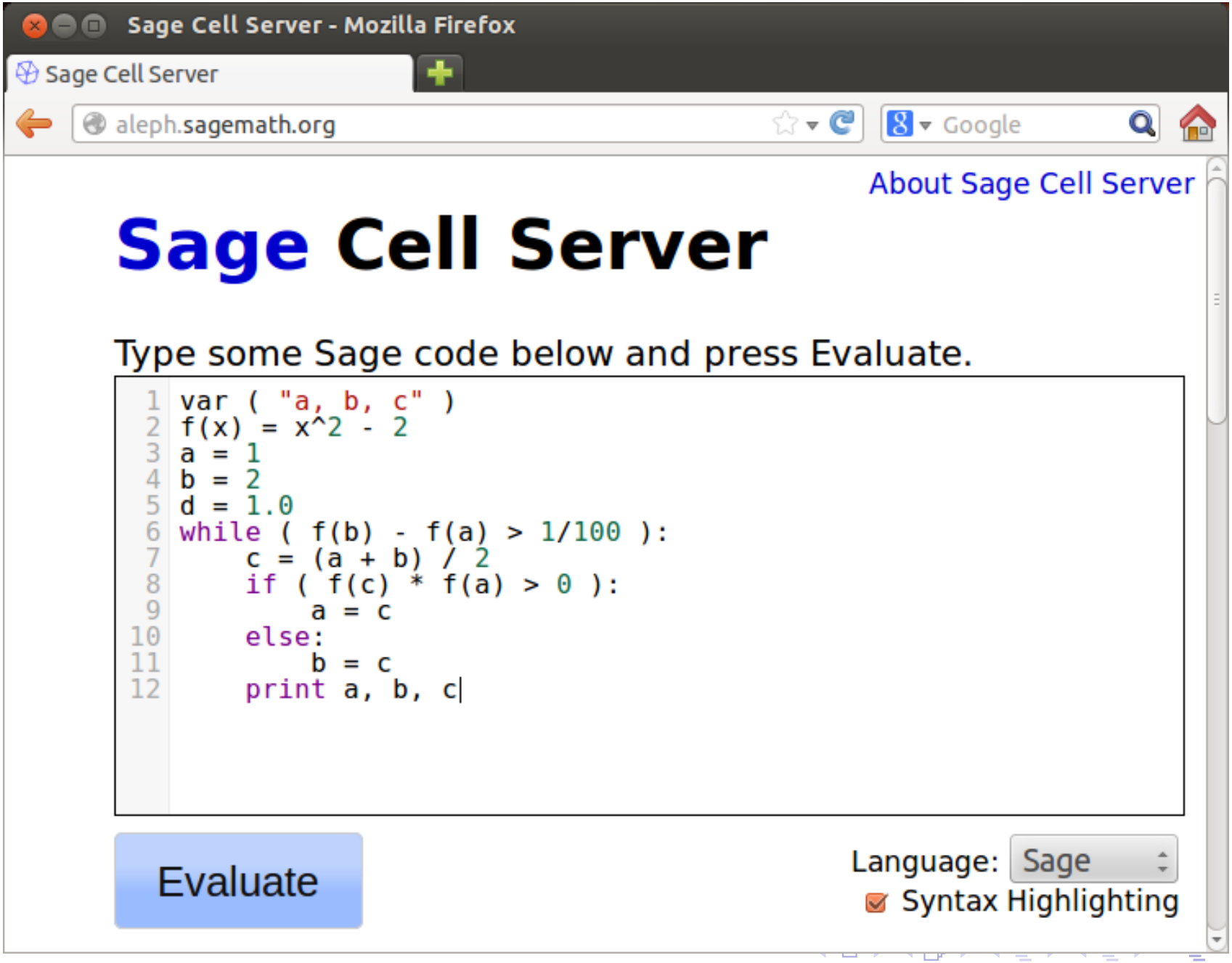
NVIDIA GPGPU Accelerator

Intel Many-Integrated-Core Coprocessor

Big Users from Little Users Grow



Big Users from Little Users Grow



Big Users from Little Users Grow

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Two Types of Students

1. The Coder
2. The User

Digital Humanities

A Council on Library and Information Resources (CLIR) study of projects funded under the "Digging Into Data Challenge" found that the issues and opportunities presented by "big data" in the humanities and social sciences require basic changes in academic methods and scholarly practices.

"How was Lincoln influenced by his Southern upbringing?"

"How can I develop a new text-mining algorithm to examine Lincolns writings to look for Southern influences?"

Source: NEH Office of Digital Humanities

3D Printing

NPR Sunday Puzzle

Think of a word starting with G.

Change the G to a T and rearrange the letters after the T.

The result will be a new word
with the same meaning as the original word.

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giant titan

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giant titan

garishly trashily

Given a genome sequence starting with guanine,
change the first base to thymine
and permute some of the other bases.

The result will be a known sequence
with the same genetic function.

NPR Sunday Puzzle

a
aah
aahed
aahing
aahs
aardvark
aardvarks
aardwolf
ab
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aback
abacus
abacuses
abaft
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abbes

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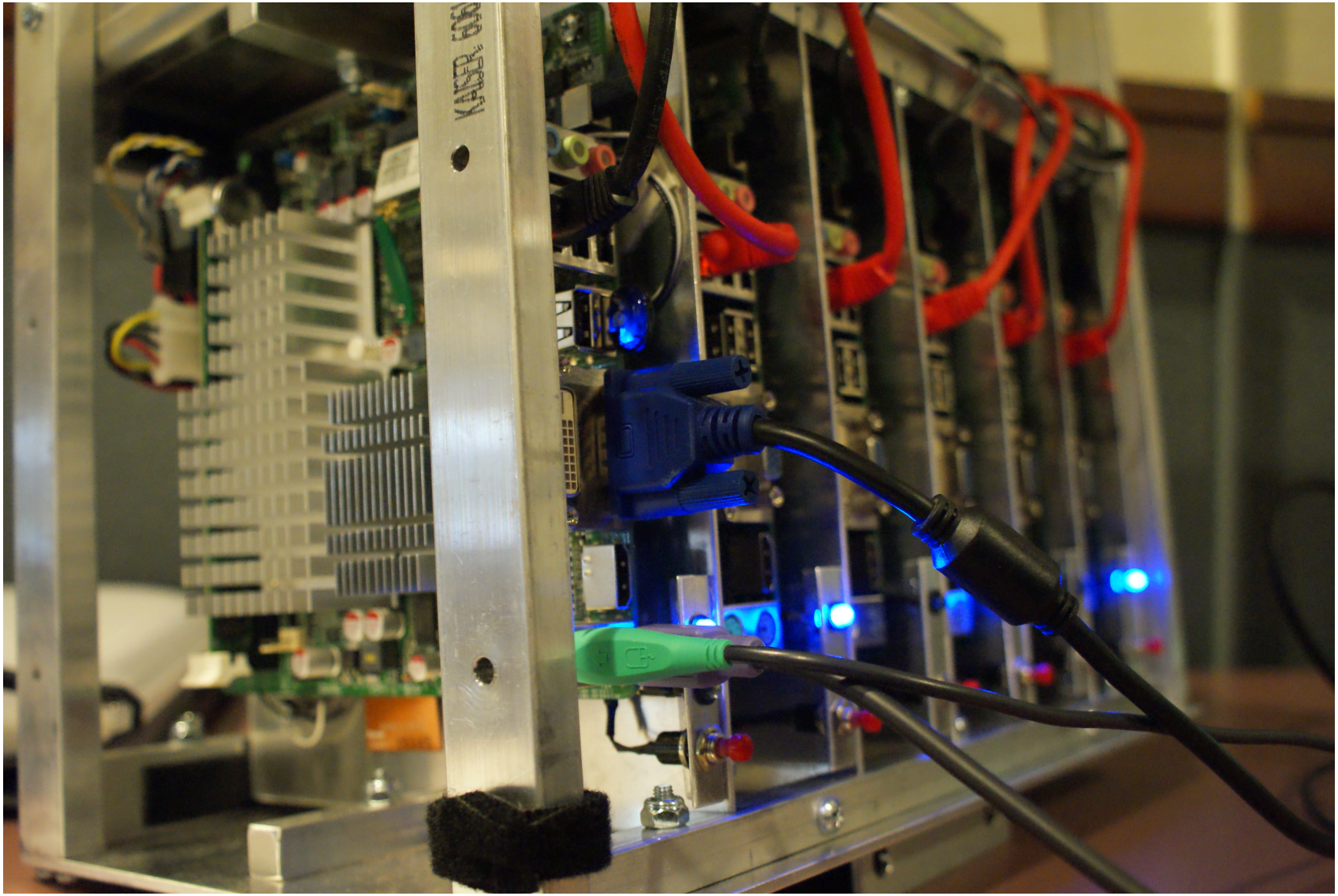
Faculty Passion

Me	Search Algorithms, Data Visualization
Chemist	Visualization
Historian	“I have seen the future!”
Biologist	Computational Genetics

Courses

- Python
- C++
- Data Structures
- Java
- Mobile Apps Development
- Linear Algebra
- DiffEQ
- Vector Calculus
- Scientific Visualization

Computational Resources: LittleFe Cluster



Educational Resources: Henry Neeman

Educational Resources: LA-SiGMA REU/RET

Educational Resources: LA-SiGMA REU/RET

Computational and Educational Resources: TACC

Summer 2013

Two teachers in LA-SiGMA RET
    (Research Experiences for Teachers)

One student supported by LA-SiGMA
    Load Balancing with MIC on Stampede

Three students in computational labs at LSU and Southern
    Worked to incorporate HPC into their advisors' work

Three students to XSEDE'13 in San Diego
    Two gave a poster

Funding

- Louisiana School Foundation
- Research Assistantships for High-School Students (RAHSS)
- REU for Recent Alumni
- Outreach sections of Domain-Science Grants
- NSF/IEEE TCPP Undergraduate Curriculum Early Adopter Award
- EPSCoR Proposal under Review

Annalise and Kat:

HPC from the Perspective of a High School Student

Objective for this Project

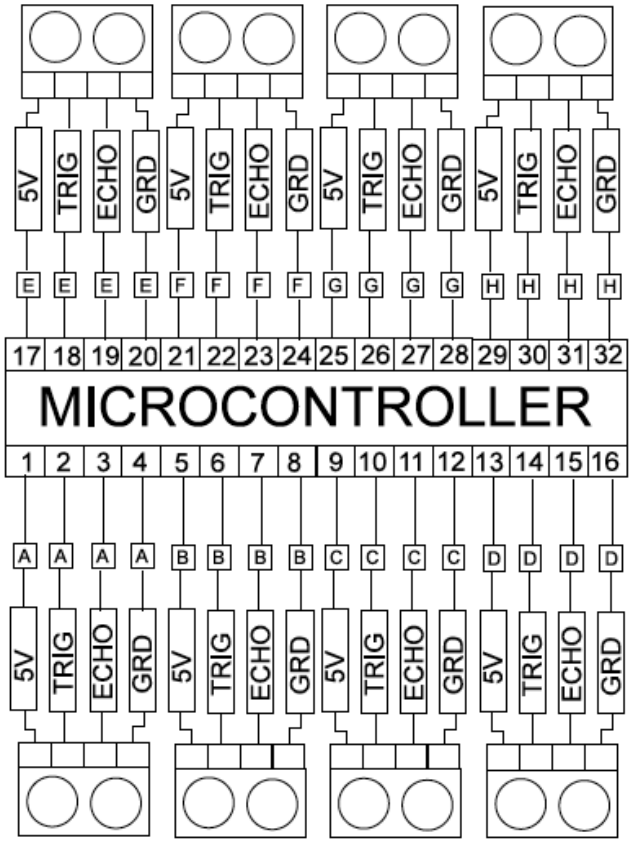
To create an ultracovert mechanism to take a picture of an intruder

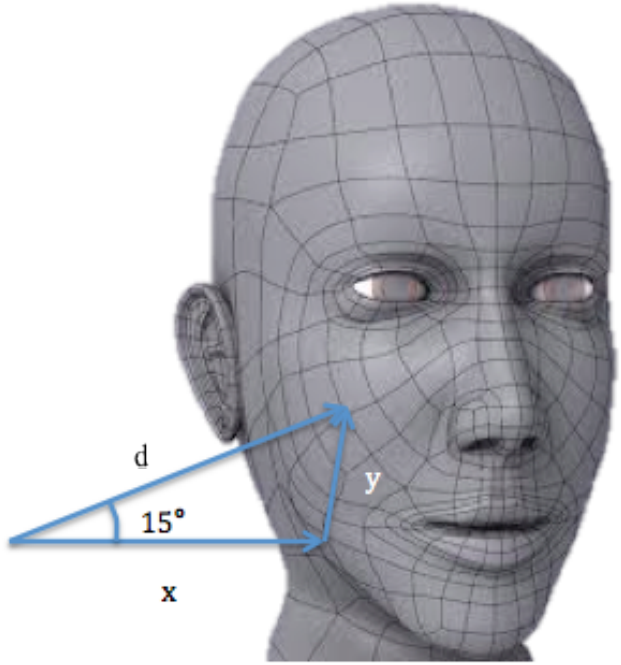
Added benefits of:

- Collecting our own data
- Experimenting with OpenMP

Safe With Sound Alarm System - Engineering Component

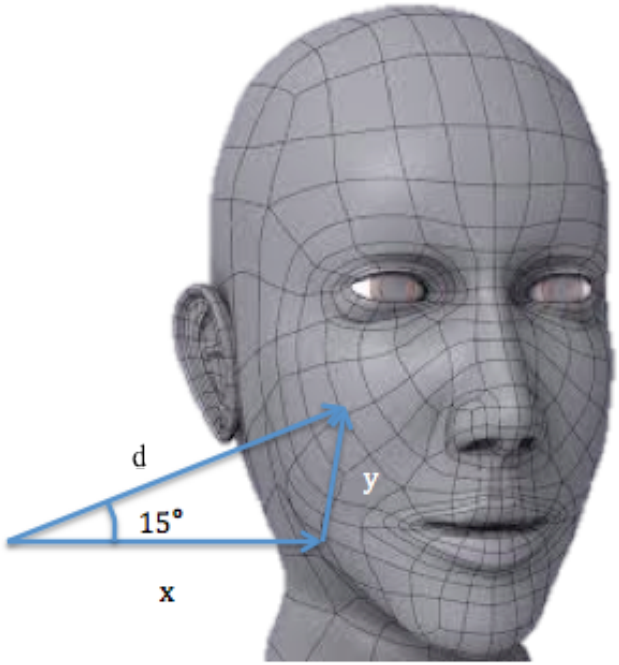
Circuitry Wiring/Processing Language





Safe With Sound Alarm System - Caculating Gradient

Rule: For each height, the gradient decreases (becomes darker) as x decreases and y increases, and while the rate of change in x decreases and rate of change in y increases.

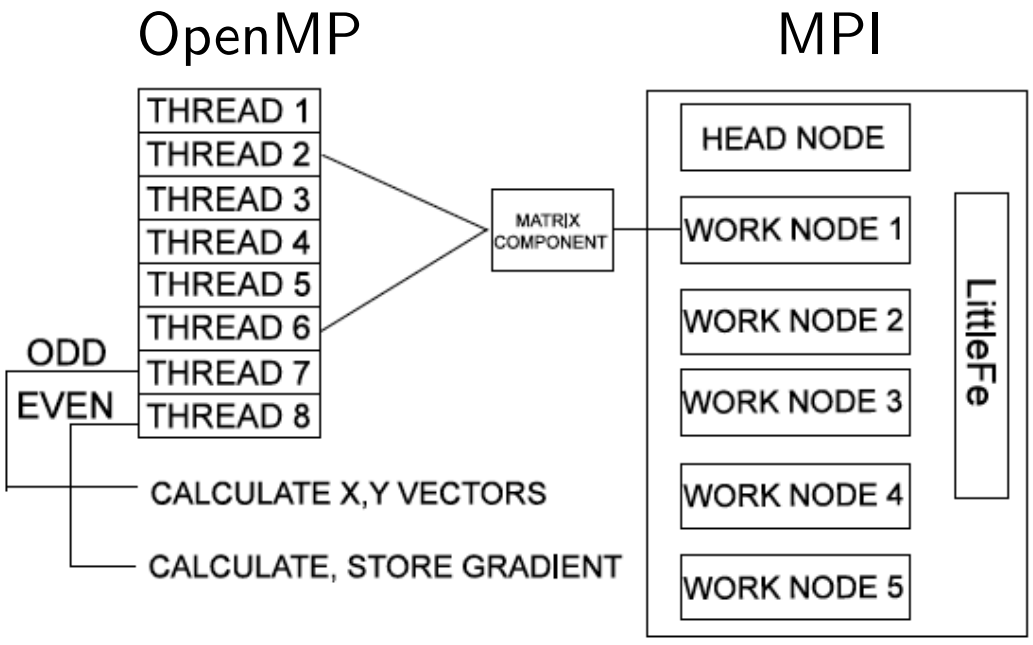


$$x_n = d\cos\theta \tag{1}$$

$$y_n = d\sin\theta \tag{2}$$

$$g = 255 - \frac{255(\sum \Delta x - \sum \Delta y)}{n} \tag{3}$$

Safe With Sound Alarm System - HPC



HEAD NODE:
SPLITS DATA MATRIX INTO 5 PIECES
MPI_SEND TO EACH WORK NODE

WORK NODE:
SPLIT MATRIX INTO 4 PIECES
SEND PIECE TO THREADS 1&2, 3&4, AND SO ON
ODD NUMBER THREADS FIND DISTANCES
THEN PASS ON TO NEXT THREAD, WHICH
CALCULATES GRADIENT

HEAD NODE:
COLLECTS GRADIENTS THEN DRAWS

Future Work

To reduce noise:

- Create our own sensors
- Vibration Isolation

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Patent?

Future Work

To reduce noise:

- Create our own sensors
- Vibration Isolation

Patent?

Create a mesh from the 3D data to create a face that can be digitally manipulated with 3D software

How did we do it?

This Past Summer - Gaining Skills and Pursuing Interest

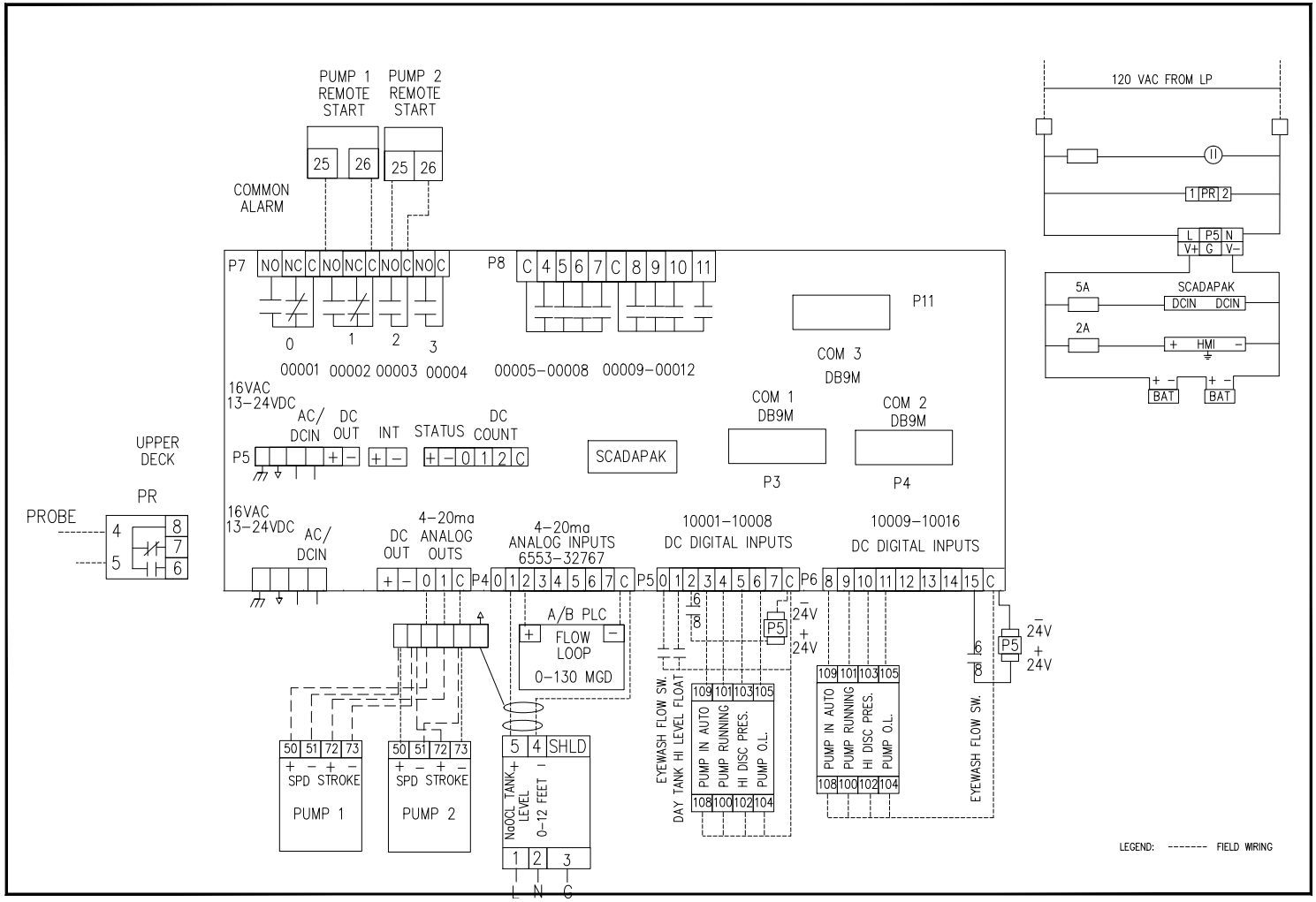
Katherine

- Parallelizing the Digital Reassembly of 3D Skull Fragments
- Learning MPI
  - Shodor Workshop

Annalise

- High Temperature Desulfarization of Biogassifer Effluents
- Learning G Programming

Learning Engineering - Wastewater Treatment Plant



QDS SYSTEMS, INC.
Process Control Systems - Variable Speed Drives
BATON ROUGE, LOUISIANA

PROJECT: SOUTH WWTP IMPROVEMENTS-PH. 1 BATON ROUGE, LOUISIANA
DESCRIPTION: RIO-1 PANEL DIGITAL INPUTS – R1, S5

CUSTOMER: BRASFIELD & GORRIE, LTD.
CUSTOMER P.O.

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DATE: 7/18/12
JOB NO.: 30473
SHEET NO.: 2HO

Our Experience with HPC

Last year's Supercomputing Symposium

- Optimization of Matrix Multiplication with the LittleFe

XSEDE'13 Supercomputing Convention

- Programming Competition

Conclusion

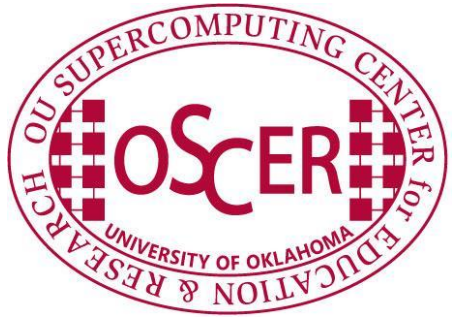
- Physics and Linear Algebra
- Mr. Burkman with Numerical Analysis
- Summer Jobs and Research

The key was **Exposure**

Our motto is: "It's possible, so we're going to do it."

This project will never be finished.

Acknowledgements



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