

# **On Being a Research Computer Scientist**

or what it's like to be a lifelong learner

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Slippery Rock University of Pennsylvania

# Introduction

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# What People Think I Do

## COMPUTER SCIENCE



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What my friends think I do



What my mom thinks I do



What society thinks I do



What clients think I do



What I think I do



How to java

Google Search

I'm Feeling Lucky

What I really do

# What I actually do

- Working to obtain PhD in Computer Science
  - With an emphasis on Big Data
  - Distributed sensor networks
  - Distributed computing
- Research Assistant for Infrasound Laboratory
  - Design and develop systems for capture, analysis, and reporting of infrasonic signals of interest

## How I Got Here

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# Summary of My Life Until Now

- Graduated High School
  - Somerset, PA 2007
- B.S. in Computer Science (w/ minor in Theatre)
  - Slippery Rock University of PA, 2011
- M.S. in Computer Science
  - University of Hawaii at Manoa, 2015
- Ph.D. in Computer Science
  - University of Hawaii at Manoa, Present

# **How I Got Here**

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**High School**

## High School

- No Formal Education in Computer Science
- Some self taught Python
- Web technologies for cool AIM profiles
- Band Geek
- Theatre Geek

## **How I Got Here**

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### **Undergraduate Education**

# Slippery Rock University of Pennsylvania

- Small class sizes
- *Close to home*
- Ski slope
- State school



# Slippery Rock University of Pennsylvania



# Slippery Rock University of Pennsylvania



# Slippery Rock University of Pennsylvania



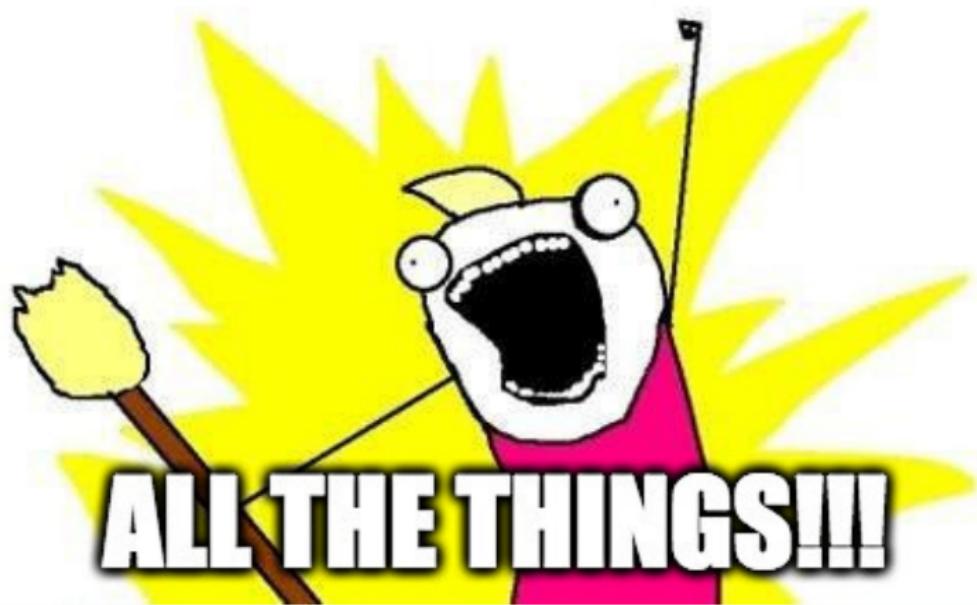
Computer Science is not



# Undergraduate Computer Science

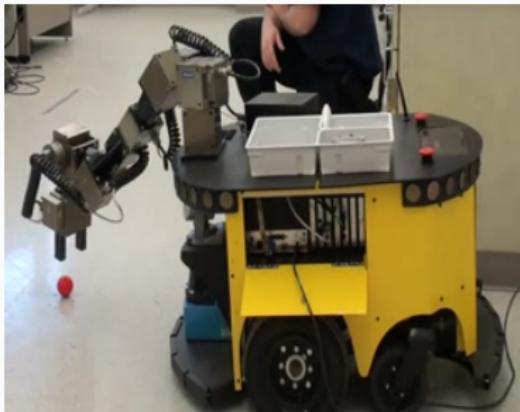
- Computer Science *is*
  - Algorithms
  - Data structures
  - Software Engineering
  - Operating Systems
  - Artificial Intelligence
  - Mathematical
  - ...
  - *Social*

# AUTOMATE



# Artificial Intelligence Robot

- Used genetic algorithms to *teach* a robot to pick up a ball
- Machine vision/image processing utilized to find the ball
- Wrote a script interpreter
  - Programming language for the robot
  - Could perform movements in parallel
- <https://www.youtube.com/watch?v=xoBVfaHHHcI>



# Boulders Computer Cluster

- Used 8 recycled Intel blade servers to build a computer cluster
- A single master server managed all slave nodes
- Operating system loaded on each slave via PXE
- HPC via message passing interface (MPI)
  - MapReduce
  - Apache Spark
  - *...and many more...*

## Other Undergrad Activities

- Vice-president of ΥΠΕ
- President of Computer Technology Club
- Student Advisor to the Dean
- Minor in Theatre



# After Graduation



## **How I Got Here**

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**Graduate School**

# What is Graduate School?

- Education beyond your bachelor's degree
  - Masters, Ph.D., M.D., Ed.D., etc
- Generally funded through teaching/research assistantship
- Specialization of your field
- Research focused
- Expects publishing and attending conferences
- Novel contribution to the field (Ph.D.)

## Master's Degree

- Specialization in your field
- Comprehensive project *or*
- Master's thesis
- Graduate classes

## Teaching Assistantship (TA)

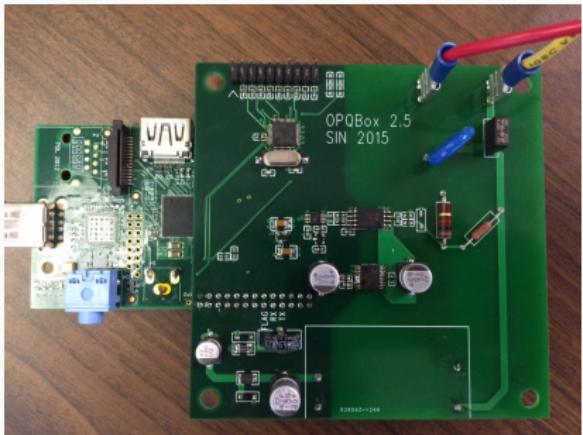
- ICS 211 - Intro. to Programming II
  - 5 Semesters
  - Run programming lab
  - Design homework assignments (sometimes)
  - Grade homework assignments
  - Run lecture (when needed)

## Research Assistantship (RA)

- Paid to perform research
  - Income ~\$25,000/yr
  - Tuition waver ~\$22,000/yr
- Many more opportunities than a TA
- OpenPowerQuality - 1 Semester
- Infrasound Laboratory - Current

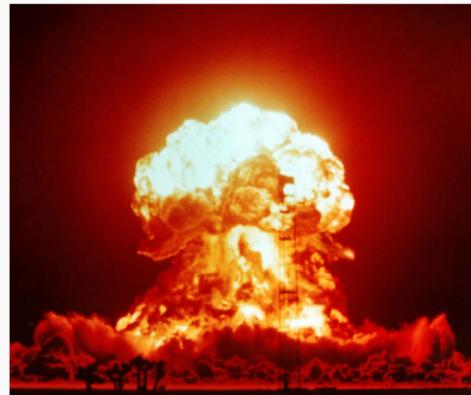
# OpenPowerQuality (OPQ)

- Open source distributed sensors and framework
  - Detects PQ problems
  - Stores raw data in cloud
  - Performs analytics
  - Reports PQ info to users

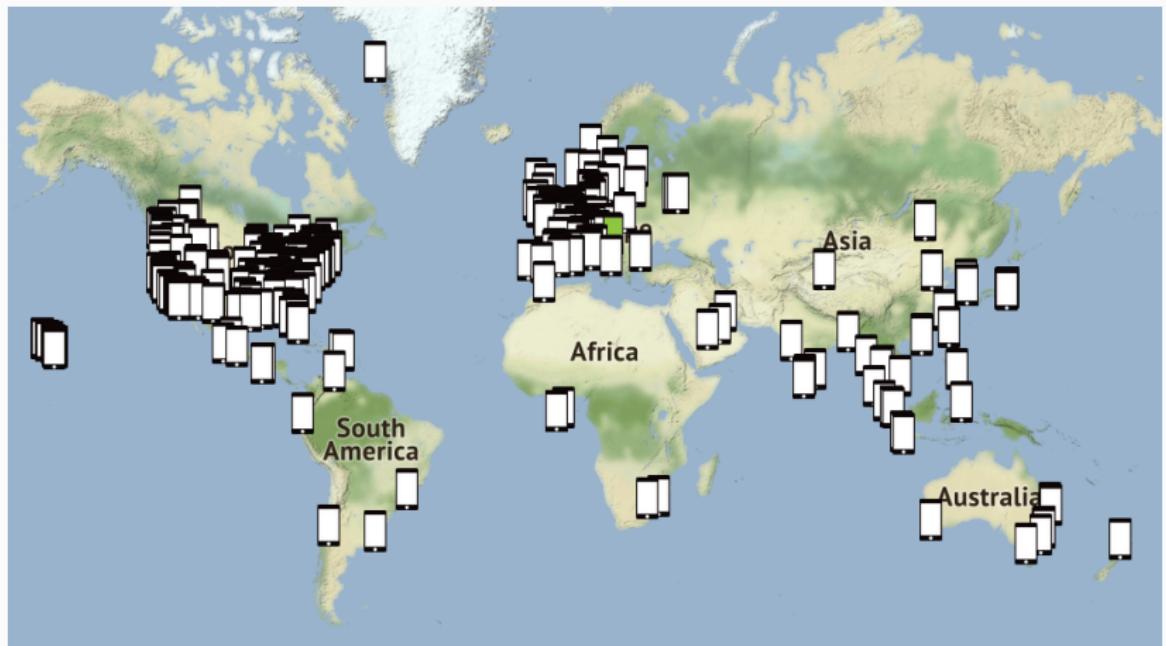


# Infrasound Laboratory

- Sound  $\downarrow$  20 Hz
- Generated by large movements of air
  - Volcanoes
  - Explosions
  - Storms
  - Aircraft
  - Rockets



# Infrasound Network



# National Labs

- Lawrence Livermore National Laboratory
  - Internship
  - National Ignition Facility
- Idaho National Laboratory
  - Got to tour a nuclear reactor
  - Took measurements at Yellowstone National Park
- Sandia National Laboratory

# Conferences

- Ann Arbor, Michigan
- Honolulu, Hawaii
- Minneapolis, Minnesota
- San Francisco, California
- Raleigh, North Carolina



- Requires novel contribution to science
- General Ph.D. timeline
  - Acceptance
  - Qualifying Exam
  - Portfolio
  - **Proposal**
  - Dissertation
  - Defense

# Computer Science

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# Is Computer Science Right for You?

- Strong communication skills?
- Enjoy working in a team?
- Want to work in multiple disciplines?
- Like solving puzzles?
- Mathematically minded?
- Enjoy learning?

# Computer Science is Broad

- Computer science is a broad subject consisting of many and varied subfields....
- Computer science is
  - Theory
  - Application
  - Art

# App Design

- iOS, Android development

# Artificial Intelligence (AI)

- Teaching computers how to learn
- Automatically recognizing patterns in images, sounds, data sets
- Deep learning / Neural networks
- Autonomous robots

# Computer Architecture

- Hardware design
- Processor design
- Microcontrollers
- Electronics

# Compiler Design

- Turn computer code into 1's and 0's that computer hardware understands

# Computer Graphics and Visualization

- Design plots and other visualizations for large data sets
- Virtual Reality / Augmented Reality
- Video games

# Computer Networks

- How computers communicate with each other
- Secure communications
- Distributed sensor networks / mobile networks

# Computer Security

- Both theoretical and practical
- Penetration testing
- Security protocols
- Bug hunting
- Best practices'

## Computer Science Fields II

- Cryptography
- Databases
- Data Science
- Data Structures and Algorithms
- Distributed Systems
- Formal Methods
- Game design

## Computer Science Fields III

- High Performance Computing
- Human Computer Interaction (HCI)
- Image Processing
- Operating Systems
- Programming Languages
- Robotics
- Simulation Modeling
- Software Engineering
- Theory of Computation

# Thank You!

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