On Being a Research Computer Scientist

or what it's like to be a lifelong learner

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Introduction

What People Think I 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

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

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

Undergraduate Education

Slippery Rock University of Pennsylvania

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

Slippery Rock University of Pennsylvania

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Undergraduate Computer Science

- Computer Science is NOT making video games
- Computer Science *is*
  - Algorithms
  - Data structures
  - Software Engineering
  - Operating Systems
  - Artificial Intelligence
  - Mathematical
  - ...
  - *Social*

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

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
- *OPQ Cloud: A scalable software framework for the aggregation of distributed power quality data*

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)

How to get on your TA's good side?

- Show up to lab (and participate)
- Show up to office hours
- Ask questions

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

Characteristics of Big Data

- Volume
- Variety
- Velocity
- Value

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 <20 Hz
- Generated by large movements of air
  - Volcanoes
  - Explosions
  - Storms
  - Aircraft
  - Rockets

Infrasound Network

Lokahi Framework

- Data acquisition
- Data storage
- Data analysis
- Reporting
- Privacy / security

Figure 1- Diagram of the interconnected technologies that make up the Lokahi framework

A. Distributed Sensors
B. Time Synchronization
C. Distributed Data Acquisition
D. Distributed Data Buffer
E. Distributed Persistence (Meta-Data)
F. Distributed Persistence (Payload)
G. Web Server/System Health Metrics
H. Distributed Analysis
J. Legacy Sensors

Lokahi Framework - Sensor Details I

RedVox | System Status | RedVox Groups | Downloads | RedVox Reports | Generate RedVox Report | Privacy Policy | achriste@hawaii.edu

1637160009	2017/11/13 23:00 UTC	0	28.39, -80.67	453790	81481	800	iOS	800	Details
1637165001	2017/11/13 22:59 UTC	0	19.72, -156.06	523166	91321	80	iOS	800	Details
1637165002	2017/11/13 23:00 UTC	0	19.72, -156.06	305332	51276	80	iOS	800	Details
1637169001	2017/11/13 23:00 UTC	0	19.70, -156.03	88079	13939	800	iOS	800	Details
1637634001	2017/11/12 12:05 UTC	2095	19.72, -156.07	91265	0	800	Android	800	Details
1637635001	2017/11/13 23:00 UTC	0	19.73, -156.05	136220	0	80	Android	800	Details
1637650001	2017/11/13 23:00 UTC	0	19.72, -156.04	224088	201945	800	Android	800	Details
1637650002	2017/11/13 07:13 UTC	946	19.74, -156.06	246658	222014	800	Android	800	Details
1637650003	2017/11/13 23:00 UTC	0	19.72, -156.04	268092	235435	800	Android	800	Details
1637650004	2017/11/13 22:59 UTC	0	19.72, -156.04	91479	66688	800	Android	800	Details
1637650005	2017/11/13 22:59 UTC	0	19.72, -156.04	97147	78424	800	Android	800	Details
1637650006	2017/11/13 22:59 UTC	0	19.71, -156.04	79349	60729	800	Android	800	Details
1637650007	2017/11/13 22:59 UTC	0	19.71, -156.04	81651	66012	800	Android	800	Details
1637650008	2017/11/13 23:00 UTC	0	19.72, -156.04	111649	82192	800	Android	800	Details
1637650009	2017/11/13 23:00 UTC	0	19.72, -156.06	86730	62484	800	Android	800	Details
1637650010	2017/11/07 22:15 UTC	8684	19.71, -156.04	39355	35240	800	Android	800	Details
1637660001	2017/11/12 12:04 UTC	2095	19.71, -156.03	202559	192171	800	Android	800	Details
1637660002	2017/11/13 23:00 UTC	0	19.73, -156.05	208567	200908	80	Android	800	Details
1637660003	2017/11/13 22:59 UTC	0	19.72, -156.05	187605	174884	80	Android	800	Details
1637660004	2017/11/13 23:00 UTC	0	19.72, -156.05	140300	128898	80	Android	800	Details
1637660005	2017/11/13 22:59 UTC	0	19.73, -156.06	37087	32286	80	Android	800	Details

Lokahi Framework - Sensor Details II

Redvox Device Details (1637650004)

Device Id	1637650004
Truncated UUID	1836348359
Last Received	2017/11/13 23:12 UTC
Min Ago	0
Location	19.71, -156.03
Altitude (m)	21.0
Speed (m/s)	0.0
# Mic	91498
# Bar	66703
Mic Sample Rate	800
Bar Sample Rate	1
Operating System	Android
Device Name	Nexus 5X/1.06C4/8.0.
Mic Sensor Name	INTERNAL MIC
Bar Sensor Name	BMP280 pressure
Time Sync Server	192.168.0.105:9875
Data Server	redvox.io:9000

Last refreshed: 2017-11-13T23:12:40.995Z

Device Location

Lokahi Framework - Sensor Details III

Lokahi Framework - Sensor Details IV

Lokahi Framework - Report I

RedVox Report [Edit Report Metadata] [Rerun Report] [Sanitize Report] [Print View]

Report Title	SpaceX CRS-11 Dragon 170603
Report Description	SpaceX Dragon Launch and First Stage Landing, 3 June 2017. Scheduled launch window: 2107 GMT (5:07 p.m. EDT) LC-39A, Kennedy Space Center, Florida (28.6083° N, 80.6041° W)
Report Id	57eb164c7f0f40cc83d9694ba30c5b3c
Created On	Sat Jun 03 22:01:50 UTC 2017
Event Origin Time UTC	1970-01-01T00:00Z **Seconds from the Epoch UTC:** 0
Report Start UTC	2017-06-03T21:05Z **Seconds from the Epoch UTC:** 1496523900
Report End UTC	2017-06-03T21:20Z **Seconds from the Epoch UTC:** 1496524800
Event Origin Location	28.608389, -80.604333
Event Origin Height Meters	0.00 meters
Report Publicly Listed	true
Device	1637160006 (iPhone6R6) **Distance to Event Origin Kilometers:** 22.95 **Back Azimuth to Event Origin:** 76.94°
Device	1290171668 **Distance to Event Origin Kilometers:** 24.58 **Back Azimuth to Event Origin:** 15.81°
Device	1243070058 **Distance to Event Origin Kilometers:** 24.59 **Back Azimuth to Event Origin:** 15.79°
Device	1637160009 (iPhone6R9) **Distance to Event Origin Kilometers:** 24.59 **Back Azimuth to Event Origin:** 15.80°
Device	218588107 (Android_SamsungG7) **Distance to Event Origin Kilometers:** 46.99 **Back Azimuth to Event Origin:** 7.41°
Device	1637050072 (iPodR72) **Distance to Event Origin Kilometers:** 52.40 **Back Azimuth to Event Origin:** 6.48°
Device	460610038 (iPhone) **Distance to Event Origin Kilometers:** 52.64 **Back Azimuth to Event Origin:** 357.86°
Device	1637050071 (iPodR71) **Distance to Event Origin Kilometers:** 60.67 **Back Azimuth to Event Origin:** 1.77°
External Link	SpaceX Mission

Last refreshed: 2017-11-13T23:18:36.975Z

Lokahi Framework - Report II

Average Location of Devices During Report

Device Activity Over Report Duration

Lokahi Framework - Report III

Just a Digital Plumber

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 Fransisco, California
- Raleigh, North Carolina

Ph.D.

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

Computer Science Fields

Computer Science Fields I

- Artificial Intelligence
- Computer Architecture
- Compiler Design
- Computer Graphics and Visualization
  - Augmented / Visual Realty
- Computer Networks
- Computer Security

Computer Science Fields II

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

Computer Science Fields III

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

Thank You!

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