Parker L. Murray

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Research Interests

• Deep Learning, Computer Vision, Dynamic Systems, Information Geometry

Education

B.S. Computer Science, Data Science Emphasis • Brigham Young University Provo, UT • Fall '17 - Winter '22

- Minors: Physics, Korean
- <u>GPA</u>: 3.89
- Dean's List: 2 Semesters

Academic Papers

Expected: G. Holt, P. Murray, D. Grimsman, and S. Warnick, "Construction of Real-Time Honeybee Waggle Dance Translator".

• Submitting to IEEE Transactions on Control Systems Technology by Apr. 2022

Expected: P. Murray, M. Transtrum, D. Grimsman, "Sloppy Model Analysis of Deep Neural Networks".

• Submitting to NeurIPS by May 2022

Significant Undergraduate Course Projects

P. Murray, "Modeling the Death of a Main Sequence Star," Physics 230 Computational Physics, Expected Dec. 2021.

P. Murray, "A Deep Learning-Based Approach to Playing Minecraft," C S 474 Deep Learning, Aug. 2020.

• Paper Available: <u>https://students.cs.byu.edu/~pmurray1/minecraft.pdf</u>

P. Murray, T. Huang, C. Wong, "Chinese Character Recognition Using Machine Learning Techniques," C S 472 Machine Learning, Jan. 2020.

• Paper Available: <u>https://students.cs.byu.edu/~pmurray1/chinese.pdf</u>

P. Murray, D. Clayton, K. Fryer "Inferring Personality Type from Social Media: What Does Your Social Media Say About You?," *C S 580 Theory of Predictive Modeling*, Aug. 2019.

• Poster Available: <u>https://students.cs.byu.edu/~pmurray1/social.pdf</u>

P. Murray, "Deep Learning- Its History, Applications, and Current Limitations," *ENGL 316 Technical Communication*, Aug. 2019.

• Paper Available: <u>https://students.cs.byu.edu/~pmurray1/deephistory.pdf</u>

Research Experience

Administrator of Computational Infrastructure • Information & Decision Algorithm (IDeA) Laboratories, BYU

Data Storage and Intellectual Property Manager • July 2021 - Present

- Lead team of 8 students in architecting an efficient and transferrable system for storage and management of lab datasets and intellectual property
- Designed, purchased, and installed high-capacity (100 TB+) storage system for storage of research data
- Established a data gathering, storage, and access pipeline utilizing a NoSQL database to ensure lab members have high-performance and high-availability data storage for their projects
- Acted as a resource to lab members on proper procedures regarding usage and handling of intellectual property, acting as a liaison with BYU Intellectual Property Services

High-Performance Compute Resource Manager • July 2021 - Present

- Installed, inventoried, and maintained all computing hardware for IDeA Laboratories
- Offered consultation for lab members on how to implement their experimental designs as high performance code, utilizing tools such as CUDA and OpenMP to produce performant and highly parallel designs
- Designed, purchased, and assembled high performance compute nodes for the lab, including high-core count CPUs, high performance GPUs, and high capacity memory pools
- Overhauled IDeA Labs networking infrastructure to enable both internal and external access of compute resources
- Oversaw scheduling of high-performance compute resources for various research endeavors

Research Assistant • Information & Decision Algorithm (IDeA) Laboratories, BYU

Deep Learning Research • Aug 2021- Present

- Initiate research regarding how concepts from information geometry and "sloppy" models inform questions regarding generalization and over-parameterization in deep learning
- Design a range of neural network models for image classification and developed a set of tools for examining the structure of their model manifolds
- Develop methods for pruning "sloppy" parameters from models to compare their performance before and after pruning
- Coordinate with professors from BYU Math and Physics Departments in weekly discussions to give updates on results and propose next steps

Co-Author • Bee Research Team • July 2021 - Present

- Participated in installation of permanent observation beehive- an interdepartmental effort between the Computer Science and Life Science Departments and the first beehive at BYU
- Design and implement hardware and software stack for a computer vision system to monitor and gather data on the colony
- Derive and implement of a mathematical model for detection, tracking, and translation of honeybee "waggle dances" occurring real-time in the hive
- Analyze and annotate videos containing instances of the waggle dance for training data
- Perform weekly care and maintenance for the beehive, as well as more thorough hive-cleaning every three months

Team featured in BYU school newspaper:

- A. O'Rullian, "Students study bees to create waggle dance translator," The Daily Universe, Oct. 11, 2021.
 - Article: <u>https://universe.byu.edu/2021/10/11/students-study-bees-to-create-waggle-dance-translator/</u>
 - Video: <u>https://youtu.be/l6NZ-tboRNc</u>

Sub-Modular Ordering Research • Aug 2021- Present

- Participate in research aimed at determining the optimal ordering for greedy resource selection in a multi-agent system with shared resources
- Examine provable worst-case scenarios where agents select the same action regardless of order
- Develop a test harness for generating resource, agent, and action-set combinations for empirical verification of analytical results
- Draft paper to be submitted to the CDC in March 2022

Autonomy, Software, and Testing Team Lead • Mars Rover Team, BYU

Autonomy and SoftwareTeam Lead • July 2020 - Jan 2021

- Directed team of 9 undergraduate students in developing system software and autonomous driving algorithms to participate in the University Rover Challenge (URC), an international collegiate competition
- Worked together with team leads to coordinate students from varied disciplines to produce a fully operational Mars rover, utilizing the skills of mechanical, electrical, manufacturing, and computer engineers
- Developed software for implementing communication and networking, low-latency video streaming, and gathering IMU and magnetometer data from sensors

- Worked directly with electrical engineers to allow custom motor drivers to interface with the rover's software via a microcontroller
- Implemented a ROS-based autonomous state machine to allow the rover to react to both its surroundings and user input
- Designed a system for fusing sensor data together using an extended Kalman filter in order to get an accurate description of the rover's heading in real time
- Laid the groundwork for a revised obstacle detection system utilizing an onboard stereo camera and deep learning computer vision techniques
- Combined sensor readings, camera streams, and user control into a graphical user interface to be used on a base station connected to the rover
- Extensively documented development of the rover in the form of artifacts written using LaTeX

Testing Team Lead • Jan 2021 - May 2021

- Headed a small interdisciplinary team consisting of members from each of the rover's subsystem engineering teams
- Conducted bi-weekly real-world testing to establish stability of system and identify weaknesses in need of further development
- Met with sub-team leads to communicate issues uncovered during testing and made plans to address them
- Scripted, shot, voiced over, and edited a short video communicating the technical aspects of the rover for submission to the URC for the qualifying round of the competition
 - Link to video: https://www.youtube.com/watch?v=ffzkm2HtlVQ

Work Experience

<u>Software Engineer and Data Warehousing Consultant • Intricity, LLC • New York, NY</u> (Remote)

Data Warehouse Migrations • TJ Maxx, Nationwide Insurance, and Tokyo Electron • May 2019 - Present

- Worked in a team of 10+ consultants to modernize data warehousing systems via migration to Snowflake
- Developed custom Java and Python libraries to bridge functionality between old and new warehousing systems
- Created complex SQL workflows for the integration of data from multiple sources into large databases in Snowflake
- Converted ETL jobs and SQL scripts from old systems to new ones and performed quality assurance testing

Neural Network-Based Customer Information Censor • Sept 2019 - Dec 2019

- Independently utilized a neural network to identify and track strings of text in a video
- Utilized output of model to automate process of censoring customer names and information in lengthy demo videos

ML Identity Resolution • Norwegian Cruise Lines • Jan 2020 - Mar 2020

- In a team of 4 programmers, developed a machine learning-based solution utilizing logistic regression, blocking, and k-means clustering for duplicate recognition in multi-million record databases
- Summarized technical information regarding model into both a technical white paper and presented findings to technical managers at Norwegian

Bladebridge Developer • April 2020 - Present

- Operated as the main contact for feature requests and bug reports for Bladebridge Studio and Converter for several clients, including McKesson Corporation
 - Bladebridge Product Webpage: <u>https://bladebridge.com</u>
- Added support for parsing of new source ETL systems, such as Oracle Data Integrator and IBM SPSS, as well as support for new target conversion systems including Matillion ETL and Pandas
- Directed, trained, and delegated tasks to new developer hires, integrating them into existing workflows

Teaching and Volunteer Work

Cultural Exchange Leader • Taiwan International Youth Exchange Association • June 2018 - July 2018

- Spent two months in Taiwan teaching Math, Science, and English to summer camp groups aged K-12
- Developed lesson plans to teach basic math and science concepts to students, as well as group activities to increase engagement
- Practiced English conversation with students in both group and one-on-one settings, using TOEFL vocabulary lists as a guide
- Planned and participated in "cultural exchange" activities to teach students about the food, music, history, and culture in various western countries

Awards

University Rover Challenge System Acceptance Review • The Mars Society • 2021

• Video and report scored a 90.43 out of a possible 100, qualifying to compete in the University Rover Challenge and placing the BYU Mars Rover Team among the top 10 highest scores worldwide (30 teams qualify out of ~300 schools)

Brigham Young and Regent's Scholarships • Fall 17' - Winter 21'

• Received 2 years of full-tuition and 2 years of half-tuition scholarships from BYU and the state of Utah for outstanding academic achievement

BYU Resident Halls Association Academic Excellence Award • 2018

• Received recognition at the RHA Academic and Awards banquet for academic excellence and service to the oncampus community

2nd Place • Utah Korean Poetry Translation Contest • 2018

• Placed 2nd in the state of Utah for outstanding memorization, recitation, and translation of classical Korean poetry (out of 60 students from 3 universities)

Finalist • Intel International Science and Engineering Fair • 2013, 2014, 2015

• Selected three years in a row as one of 1,500 students worldwide to travel and compete as a finalist at Intel ISEF. Awarded for outstanding research as a high school student in the areas of Computer Science and Energy and Transportation.

Skills and Languages

- C/C++
- Python
 - Numpy
 - Pandas
 - Scikit-Learn
 - PyTorch
 - Tensorflow
- R
- Mathematica

- Java
- Perl
- Swift
- Metal
- CUDA
- GNU/Linux
- Git/Github/Gitlab
- LaTeX
- Snowflake

- English (Fluent)
- Korean (Fluent)
- Mandarin Chinese (Intermediate)

Relevant Coursework (GPA: 3.89)

*Graduate Level Course

Control / Data Science		<u>Physics</u>		
C S 580*	Theory of Predictive Modeling		PHSCS 121	Newtonian Mechanics
C S 474	Deep Learning		PHSCS 123	Waves, Optics, & Thermo.
C S 472	Machine Learning		PHSCS 220	Electricity & Magnetism
C S 412**	Linear Program./Convex Optim.		PHSCS 222**	Modern Physics
C S 498R	Dynamic Systems and Game Theory		PHSCS 230	Computational Physics
C S 498R***	Robust Control			
Mathematics		<u>Statis</u> t	tics	
C S 236	Discrete Mathematics		STAT 121	Principles of Statistics
MATH 314	Multi-Variable Calculus		STAT 330	Regression Analysis
MATH 113	Integral Calculus			
MATH 112	Differential Calculus			
MATH 313	Linear Algebra			
Computer Science		<u>Other</u>		
C S 452**	Database Modeling Concepts		ENGL 316	Technical Writing
C S 324	Systems Programming		C S 404	Ethics in Computer Science
C S 312	Algorithm Design & Analysis			·
C S 240	Advanced Programming Concepts			
C S 235	Data Structures			

C S 224 Computer Systems