William Bernardoni

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EDUCATION	**Case Western Reserve University**	Sep 2020 – Ongoing

Ph.D. Candidate in Mathematics

Johns Hopkins University — Aug 2016 – Apr 2020
Cumulative GPA: 3.57 / 4.0

B.S. in Computer Science and Mathematics with honors in Computer Science
Computer Science GPA: 3.84 / 4.0

College of Dupage - Early Admissions Student — Aug 2015 – Jan 2016
Cumulative GPA: 4.00 / 4.00

Batavia High School — Aug 2012 – May 2016
Cumulative GPA: 4.375 / 4.375

INTERNSHIPS AND WORK

Case Western Reserve University
Instructor of Record, Graduate Student — 2021 – Present
- Taught undergraduate classes at Case Western Reserve in addition to research work.

NASA
SIP Intern at SCaN — Summer 2022, 2023
- Developed a mathematical framework to study and develop algorithms for parameterized routing problems, particularly with applications towards space networking.
- Developed a semiring which encapsulates the behavior of satellite networking
- Used that mathematical model to determine the maximum data throughput in proposed satellite network architectures, as well as the minimal storage requirements in the network necessary to attain that throughput.

Johns Hopkins University
Computer Science Course Assistant — 2018 – 2020
- Graded and held review sessions for the undergraduate second year class on Computation Theory.

Dynamic Systems and Controls Lab at Johns Hopkins University
Computer Science Intern — 2018
- Designed and created controls system for ROVs used in the lab using C++ in Robot OS.
- Created simulations of robots in order to aid testing designs of the robots and their control systems.

Fusiform (Baltimore Technology Startup)
Backend Server Engineer — 2016 – 2017
- Created and maintained several distributed serverlettes using Nodejs; routing encrypted user data to our secure databases, and retrieving and formatting data on request for our client modules in real time.

Illinois Institute of Technology Robotics Lab
Summer Intern — 2015
- Aided in creating an experiment to quantify the effect on multirotor stability at lower heights, to create model to allow multirotor crafts to remain stable in confined spaces.

SKILLS

Programming Languages:
C++ (Expert in C++11), Javascript (Expert), Java (Proficient), Python (Proficient)

Computer Programming Design Paradigms:
Object Oriented, Embedded Systems, Event Driven, Parallel, and Procedural

Proficiency in:
IPC, multithreaded programming, distributed server design, 3-D printing, basic 3-D modelling and design, electronic soldering, basic MIG welding.

Environments Worked In:
Windows and Linux environments, ROS, as well as NI cRIO, Raspberry Pi, and Arduino Controllers.

NOTABLE PROJECTS

Network Analysis of Delay Tolerant Networks via Semiring Geometry — 2023

Created computable semirings to encapsulate the behavior of satellite networks as well as a novel algebraic model of delay tolerant networking. Using these semirings and geometric methods I developed computational methods to determine the minimal amount of storage needed in a satellite network to attain desired levels of throughput. These methods were demonstrated in internal presentations at NASA Glenn, and will be presented at the IEEE AeroConf in 2024.

Generalized Parameter Space Decompositions for Routing Problems 2022

Created an approach using a generalization of Tropical Geometric methods which allows for the parameterization of *any* routing problem and decomposition into optimal substructures, allowing for methods such as Joswig's Algorithm to be generalized to complicated network structures, such as satellite networks.

Tree Search Acceleration for Games of Imperfect Information 2019

Worked on a novel application of CountSketch and MinHash to eliminating redundant nodes during Alpha-Beta or other deterministic tree searches. A full write-up can be found on my webpage here https://cplusgears.com

JHUAPL Reconnaissance Blind Chess Competition Bot 2019

Competed in the JHUAPL Reconnaissance Blind Chess Competition, creating a bot to play a version of chess with imperfect information. The bot finished fifth out of 22 in the final tournament after finishing first in the first test tournament and second in the second. The bot's performance can be seen on the competition's page https://rbc.jhuapl.edu under the name wbernar5. A detailed writeup of the methods used and the code is available on my webpage.

Equi – Parallel Programming Language 2019

Created an interpreted programming language with inbuilt parallelism, with the goal of making distributed scientific computing as easy as a single function call. Details will be available on my webpage www.cplusgears.com, and the code is available on the open source github at: https://github.com/wrbernardoni/Equi

Nonlinear Word Embedding Transformation Learning with Elastic Maps 2018

Created a nonlinear mapping algorithm for use on mapping word embeddings between languages and attained a lower l_2 error than currently used methods. Paper is available on my webpage www.cplusgears.com

TEACHING

Case Western Reserve:

Math 125 - Math and Calculus Applications for Life, Managerial, and Social Sciences I	Spring 2023
Tropical Geometry Seminar - Hosted and lectured for a weekly graduate seminar on Tropical Geometry	Fall 2022
Math 224 - Elementary Differential Equations	
Math 126 - Math and Calculus Applications for Life, Managerial, and Social Sciences II	Fall 2021
Math 120 - Elementary Functions and Analytic Geometry	Summer 2021

PAPERS

Semirings and Space Networking Applications

W. Bernardoni, *Applications of generalized universal valuations*, 2023

W. Bernardoni, R. Cardona, J. Cleveland, J. Curry, R. Green, B. Heller, A. Hylton, T. Lam, and R. Kassouf-Short, *Algebraic and geometric models for space networking*, 2023

TALKS

Developments in Modern Mathematics, University of Göttingen — September 2023

"Applications of Generalized Universal Valuations"

Talk given on original work in generalizing valuation theory to a non-commutative setting.

NASA, Glenn Research Center — July-August 2023

"Network Storage Analysis via Semiring Geometry"

Talk given on original work on deriving the minimal amount of storage needed in a satellite network to attain the maximum throughput using algebraic and geometric methods.

"Algebraic Path Problem, Semirings, and Contact Graph Routing"

Talk given on original work on developing a semiring which encapsulates Contact Graph Routing, and using it to derive routing plans and storage requirements for a satellite network.

14th Ukraine Algebra Conference, Sumy State Pedagogical University (Virtual) — July 2023

"Applications of Generalized Universal Valuations"

Talk given on original work on generalizing valuation theory to non-commutative settings and deriving classifying objects for non-commutative geometric structures.

BUGCAT 2022, Binghampton University — November 2022

"The Semiring Geometry of Routing Problems"

Talk given on original work in parameterized routing

NASA, Glenn Research Center — August 2022

"Decomposition in Space: How dynamic satellite configurations affect network optimality"

Talk given on original work in parameterized routing

"Tropical Geometry, Matroids, and recent advances in Tropical Ideals"

Survey lecture on various new developments in the field of tropical geometry which could be applicable to the problem of mathematically modelling satellite networks.

Cleveland State University — January 2022

Week-long refresher course on Discrete Math for incoming masters students

Case Western Reserve University — August 2021

Organized week-long lecture series for incoming PhD students

Lectured on Galois Theory and Axiom of Choice

Reconnaissance Blind Chess Workshop, NEURIPS December 2019
  Invited by JHUAPL to present in competition workshop on methods used in algorithm development for reconnaissance blind chess competition.

RELEVANT COURSEWORK

Case Western Reserve:

Mathematics
  Real Analysis I + II, Abstract Algebra I + II, Topology, Algebraic Topology, Convexity and Optimization, Dynamical Systems for Biology, Differentiable Manifolds

Johns Hopkins:

Mathematics – Theory
  Representation Theory, Honors Real Analysis I and II, Honors Complex Analysis, Honors Abstract Algebra I and II, Topology, Discrete Mathematics

Mathematics – Computation
  Mathematical Game Theory, Probability and Statistics, Linear Algebra, Calculus 3, Differential Equations and Applications

Computer Science
  Algorithmic Game Theory, Randomized and Big Data Algorithms, Object Oriented Software Engineering, Parallel Programming, Machine Translation, Algorithms, Automata and Computation Theory, Information Retrieval and Web Crawling Agents

INTERESTS   Semiring Geometry, Tropical Geometry, Representation Theory, Algorithmic Game Theory

REFERENCES   Available upon request