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Nelson Abdiel Colón Vargas, Ph.D.

(Nel Abdiel)

EDUCATION

University of Iowa, Iowa City, Iowa.
Ph.D., Mathematics
Thesis Title: Localized Skein Algebras As Frobenius Extensions.
Advisor: Dr. Charles Frohman
M.Sc., Mathematics

University of Northern Iowa, Cedar Falls, Iowa.
M.A., Mathematics
Research Paper: Discrete Subgroups of $SL_2(\mathbb{R})$.
Advisor: Dr. Min Ho Lee

University of Puerto Rico, Rio Piedras Campus, San Juan, Puerto Rico.
B.Sc., Mathematics

The Data Incubator, Washington, D.C.
Certificate in Data Science
Selected as a Fellow among the less than 4% of +1900 applicants.

Berklee School of Music, Boston, Massachusetts.
Professional Certificate in Songwriting
Advanced Professional Certificate in Music Production & Technology - In Progress

PUBLICATIONS

- **The Localized Skein Algebra is Frobenius**, Nel Abdiel and Charles Frohman, *Algebraic and Geometric Topology* Volume 17, Issue 6, October 2017.

- **Frobenius Algebras Derived From The Kauffman Bracket Skein Algebras**, Nel Abdiel and Charles Frohman, *Journal of Knot Theory and its Ramification*, Volume 25, Issue 04, April 2016.

EXPERIENCE

Defense Digital Service - Department of Defense, Washington, DC

AI Cybersecurity - *Digital Service Expert, November 2021–Present*
Details of projects and performance limited due to the sensitive nature of the work in regard to national security.
Selected Projects:

- *Leading the creation of the Data Science Community of Practice across the Office of the Chief Digital AI Officer.*
- *Serving the National Cyber Investigative Joint Program Office (FBI - NCIJPO) as a Subject Matter Expert on AI & Identity Management.*
- *Supporting the Defense Counterintelligence and Security Agency (DCSA) as a Subject Matter Expert on AI & Cyber for Insider Thread Detection product development.*

White House Presidential Innovation Fellows, Washington, DC

AI Innovation Lead - Entrepreneur In Residence, January 2019–October 2021
Summary*: Senior Advisor helping the Federal Government develop strategy and policy for AI Innovation, Cybersecurity, and cutting edge research and technologies.*
Selected Projects:

- *Led a multidisciplinary team on the development of the Claims Attributes API, the first AI API deployed at the Department of Veterans Affairs. It uses Natural Language Understanding to analyze the information a Veteran provides in a Benefit Claim (526), infers the proper medical condition and automatically routes the claim to a specialist. Key Results:*
  - *10 million dollars per year in recurrent saving to the Department of Veterans Affairs.*
  - *Reduced Veteran's decision wait time by 5-7 days.*
  - *Increased claim establishment by 27x.*
  - *Special Act Award - Technology Transformation Services*
- *Work with NSF Program Directors in formulating research strategies, developing collaboration and cooperation across the Foundation and among government, academe and industry, fostering outreach to underrepresented groups, and providing leadership within NSF and the innovation community. Some numbers:*
  - *Assist in the coordination and development of four NSF workshops with a budget of 100,000 USD each. Each with a core team of more than 15 members and more than 400 participants.*
  - *Serve as a Junior Program Director to the 30 Phase I funded projects (27 million USD portfolio) by Convergence Accelerator in Track C (AI for Innovation) and D (Quantum Technology), as well as for Track F (Trust & Authenticity in Communication Systems).*
  - *Serve in review panel for Workshops, Phase I, Phase 2 proposals.*
- *Fraud, Waste & Abuse Subject Matter Expert for United States Digital Service and the Department Of Labor assisting with Unemployment Insurance Fraud Investigations, as well as with facilitating collaborations with the Fraud Investigations team at the Department of Treasury.*

- *Cybersecurity AI/ML Product Subject Matter Expert assisting Defense Digital Service with the technical planning of an AI driven solution for Protective DNS.*
- *Coordinated the modernization efforts of Fraud Waste & Abuse operations at the Department of Veterans Affairs, from postmortem investigations to real-time detection and prevention. Collaborated with Microsoft to redesign a scalable cloud systems infrastructure that allows existing AI predictive models to be used on demand, as well as developing a cloud migration plan.*
- *Draft AI, and Cybersecurity Strategies and Policies for the Intelligent Transportation Systems Joint Program Office at the Department of Transportation.*
- *Serve as Subject Matter Expert in review panels for contracts related to Data Quality, Natural Language Processing, Automation, Artificial Intelligence, and Fraud Waste & Abuse Investigations at the Department of Veterans Affairs.*
- *Serve as Subject Matter Expert in Data and Artificial Intelligence for the Office of American Innovation and the Office of Science & Technology Policy at the White House, the AI COP at GSA/TTS, and NASA.*
- *Assisted in the creation of the AI Community of Practice at the Technology Transformation Services at General Services Administration. The AI Community of Practice has more than 500 active members from more than 50 government agencies.*

Microsoft, Redmond, WA / Humacao, P.R.

Data & Applied Scientist II - Anti Piracy Services, February 2018–January 2019
Responsibilities:

- *Meet weekly with Forensic Investigators and Risk Managers to discuss new trends seen in attack vectors and the thought process that lead to the detecting them.*
- *Turn the information gathered in meetings into quantifiable features and test the validity of said features and the detection logic.*
- *Build the Artificial Intelligence portion of automated solutions and present said solution to both the Development and Analytics teams.*
- *Present KPI measurements of newly deployed automated solutions to stakeholders.*

Projects:

- *Develop algorithms to detect suspicious activations based on time and geospatial data using Topological Data Analysis and Anomaly Detection techniques.*
- *Build and maintain Machine Learning models to detect malicious and scripted registrations with False Positive and False Negative rates of less than 2.5%, reducing manual revision by 87%.*
- *Develop string matching algorithms to efficiently query entries in a database by similarity in fields of unstructured text, for example, columns corresponding to residential addresses.*
- *Perform statistical analysis to determine correlation among different vector attacks.*
- *Created predictive models to detect and prevent scripted attacks.*
- *Designed and built data pipelines with the use of Python and Azure to automate the ETL and analysis of data related to newly discovered fraudulent accounts.*
- *Automated daily data analysis revision reducing investigator's time from 30-45mins to under a minute.*

Metric Geometry & Gerrymandering Group, Boston, MA

Data Developer, Feb 2018–September 2018

- *In charge of testing, deploying and managing services and application in Microsoft Azure.*
- *Contribute to the development of open source data visualization tools for geo-spatial data.*
- *Contribute to the development of open source tools and algorithms for determining if a district have been Gerrymandered.*
- *Data Science Advisor at the Voting Rights Data Institute summer program (July, 09-13, 2018), run by MGGG. Helped students turn their projects into production ready solutions to be deployed in the cloud.*

Soteria - Security Consulting & Data Analytics, Charleston, S.C.

Lead Data Scientist, June 2016–January 2018

Data Science and Analytics Projects:

- *Developed predictive models to detect Phishing emails and websites based on content and attributes using Python packages such as Scikit-Learn, NLTK and Pandas.*
- *Built algorithms to detect large scale phishing campaigns with the use of clustering techniques and Natural Language Processing.*
- *Concocted machine learning classifiers from Scikit-Learn to detect and correctly identify different phishing techniques such as Typosquatting, Spoofing, Whaling and Spear Phishing among others.*
- *Created ranking system algorithms to prioritize human revision of current threats.*
- *Developed text classification models to assess risk of brand infringement with the use of Python packages like NLTK and WordNinja.*
- *Wrote MapReduce jobs to detect patterns in daily and historical domain name registrations.*
- *Used statistical analysis on usability data to better understand and enhance user engagement and user story.*
- *Develop predictive model to automate the detection of malicious websites with a 97% accuracy.*
- *Develop probabilistic model to predict the outcome of ping pong matches in the office.*

Python Development Projects:

- *Designed auto generated, data-oriented marketing material for social media with the use of Python, LaTeX and the Twitter API.*
- *Engineered and maintain analytics API with the used of Cassandra and Python packages like Pandas, Flask.*
- *Developed pipelines to autogenerate reports using Bash, Python and LaTeX.*
- *Developed model for detecting anomalous behavior based on user's historical data with the use of FFT.*
- *Engineered in-house SaaS analytics solutions to detect Spear Phishing, Whaling and other types of phishing.*
- *Built dashboards for internal use using Python, Flask, Django, HTML5/CSS3, Bootstrap, Bokeh and D3.js for analysts to interact with data from OSSEC and other services in a more visual matter.*

- *Created software for feature extraction from unstructured data from +30000 websites a day.*
- *Devised Python pipeline to automate the classification of +30000 websites received per day.*
- *Involved in the decision making and engineering of technologies and infrastructure for ETL.*
- *Contributed to the analysis and writing in forensic investigation reports.*
- *Ameliorated solutions by redesigning ETL and data analytics to function as a Linux service.*
- *Installed and configured OSSEC on servers, and designed and implemented new OSSEC rules to improve efficiency in data collection.*

K2 Data Science, New York City, N.Y.

Data Science Curriculum Consultant, December 2016–July 2017

- *Designed and developed assignments with detailed solutions for the the following subjects: Data Cleaning and Preprocessing, Exploratory Data Analysis, Regression, Classification.*
- *Helped plan and develop comprehensive learning material to aid students with assignments and to prepare them for their future roles as Data Scientists.*

The Data Incubator, Washington, D.C.

Data Scientist Fellow, Winter 2016
***Capstone Project**: http://iokilos.herokuapp.com*

- *Analyzed the distribution of world records in Olympic Weightlifting using the Naive Bayes Classifier from Scikit-Learn.*
- *Developed an app for strength athletes' training cycles using Clustering Algorithms. The data was scraped from over a thousand pages from various websites.*

***Other Projects**:*

- *Conducted open-ended analysis of user behaviors on 9+GB of StackOverFlow XML data using Scala, and Spark.*
- *Analyzed 10+GB of XML data from Simple English and Thai Wikipedia with MapReduce.*
- *Web scraping and social graph analysis of more than 100,000 photo captions from NYC Social website using Python (Networkx, BeautifulSoup, and Pandas).*
- *Developed pipelines with Python (Scikit-Learn) for predicting star reviews for businesses based on Yelp's academic dataset.*
- *Performed Natural Language Processing analysis on Yelp's academic dataset, 325+MB of json data, with Python (NLTK and Scikit-Learn).*
- *Developed Time Series model for weather data to predict temperature.*
- *Analyzed New York food inspection reports for the last 4 years, approximately 530,000 records, using advanced SQL and Python (Pandas).*

Topology Research, University of Iowa

Graduate Research Student, August 2012-May 2016
Professor Charles Frohman

- *Developed a method for reducing the exponential time of Skein computations in Quantum Topology to linear time.*
- *Provided the first equation to produce actual examples of the existence of torsion in the Kauffman bracket skein algebra.*

University of Iowa

Independent Instructor (responsible for all course duties)

- *22M:009 Elementary Functions, Fall 2015*
- *22M:008 College Algebra, Summer 2015 & Spring 2014*
- *22M:125 Qualifying Exam in Topology Preparation Seminar, Summer 2014 (Graduate course)*

Teaching Assistant (led discussions, graded homework & quizzes, held office hours)

- *22M:133 Manifolds, Spring 2014 (Graduate course)*
- *22M:132 Point Set Topology, Fall 2013 (Graduate course)*
- *22M:016 Calculus For The Biological Science, Spring 2015, Spring 2012 & Fall 2011*

Florida State University

Teaching Assistant (led discussions, graded homework & quizzes, held office hours)

- *MGF1107 Math for Liberal Arts, Spring 2011*
- *MGF1106 Math for Liberal Arts, Fall 2010*

University of Northern Iowa

Research Assistant, Summer 2010

- *Supervised a group of undergraduate researchers working towards generalizing the Black-Scholes model.*

University of Northern Iowa

Researcher in Number Theory, Spring 2010

- *Studied the relation between discrete subgroups of $SL_2(\mathbb{R})$ and arithmetic functions in number theory.*

University of Puerto Rico, Rio Piedras Campus

Teaching Assistant (led discussions, graded homework & quizzes, held office hours)

- *Mate3028 Precalculus I-II Summer 2008, 2009*
- *Mate3024 Precalculus II, Summer 2004*
- *Mate3023 Precalculus I Summer 2003, Summer 2005*

University of Puerto Rico, Center for Biostatistics And Bioinformatics

Researcher in Biostatistics and Bioinformatics, Fall 2008 - Spring 2009

- *Responsible for analyzing data and creating statistical models with R.*

University of Puerto Rico, Biochemistry and Biophysics Lab

Researcher in Biochemistry and Data Analyst, Fall 2007 - Spring 2009.

- *Responsible for collecting data by ways of experimentation and the mathematical analysis of such data.*

Tutoring Experience

- *Mathematics Tutorial Lab at University of Iowa, Fall 2011 - Spring 2012, Fall 2014*
- *Mathematics Tutorial Lab at University of Northern Iowa, Fall 2009 - Spring 2010*
- *Mathematics Tutorial Lab at the University of Puerto Rico, Rio Piedras Campus, Fall 2003 - Spring 2005, Fall 2007 - Spring 2009*

Grading Experience

- *Grader for Linear Algebra at University of Iowa, Fall 2015.*
- *Grader for Ordinary Differential Equations at University of Northern Iowa, Spring 2010.*
- *Grader for Math and Decision Making at University of Northern Iowa, Fall 2009.*
- *Grader for Calculus I at University of Northern Iowa, Fall 2009.*

PRESENTATIONS

Talks & Panels

- *Panel: "Ethical Uses of AI in the Federal Government," ATARC, August 2022*

- *Panel: "AI & Data Roundtable: Can AI Help Increase Fairness and Equity?", ATARC, June 2022*
- *"From Academia to Data Science", Francis Marion University, April 2022*
- *"From Academia to Data Science", Skidmore College, April 2022*
- *Panel: "STEM and Race: Can We talk?", University of Iowa, March 2021*
- *Panel: "AI Innovation in the Federal Government", Digital Transformation Summit 2021, ACT-AIC, March 2021*
- *"AI to Accelerate Benefit Processing", ASAM Roundtable - Partnership For Public Service, June 2020*
- *"Reducing Veteran's wait time with the use of AI", Digital Transformation Summit, GSA, January 2020*
- *"Exploring the Data Space of the Space Data Explorers", NASA Glenn Research Center, October 2019.*
- *"Machine Learning and Data Science Explained", American Society of Quality, November 2018.*
- *"A Brief Introduction to Data Science with Python", Microsoft Operations Puerto Rico, September 2018.*
- *"The Localized Skein Algebra as a Frobenius Extension", Joint Mathematics Meetings AMS Special Session on Topological Representation Theory, Seattle, January 2016.*
- *"The Localized Skein Algebra is Frobenius", USTARS, Florida Gulf Coast University, April 2015.*
- *"The Localized Skein Algebra is Frobenius", Oklahoma State University, Topology Seminar, March 2015.*
- *"The Localized Skein Algebra is Frobenius", University of Iowa, Topology Seminar, March 2015.*
- *"Chain Complex and Intersection Homology", University of Iowa, Topology Reading Seminar, January 2015.*
- *"A Brief Introduction To Geometric Group Theory", University of Iowa, Graduate And Undergraduate Student Seminar, November 2014.*
- *"2-TQFT and Frobenius Algebras", University of Iowa, Graduate And Undergraduate Student Seminar, September 2014.*
- *"Examples Of Finitely Generated Skein Algebras", University of Iowa, Topology Seminar, Spring 2014.*
- *"Groups Acting on Hyperbolic Spaces", University of Iowa, Topology Reading Seminar, Fall 2013.*
- *"Existence And Uniqueness of Prime Decompositions Of 3-Manifolds", University of Iowa, Topology Reading Seminar, Spring 2013.*
- *"The Geometry And Topology Of 3-Manifolds", University of Iowa, Topology Reading Seminar, Fall 2012.*
- *"A Brief Introduction to TQFT, University of Iowa", Underground Topology Seminar, Fall 2012.*
- *"The L-Function Of An Automorphic Form", University of Iowa, Representation Theory Seminar, Spring 2012.*
- *"Eisenstein Series And The Sum of Divisors Function", University of Iowa, L-Function Seminar, Fall 2011.*
- *"A Brief Introduction To Modular Forms", University of Puerto Rico, Rio Piedras Campus, Undergraduate Seminar, Spring 2011.*
- *"Modular Forms/Functions And Their Relation With Arithmetic Functions In Number Theory", Florida State University, Algebra Seminar, Fall 2010.*

Guest Lecturer

- *"Rank Vs Genus of 3-Manifolds", University of Iowa, Math Department, Fall 2013.*
- *"Representations of Knot Groups", University of Iowa, Math Department, Fall 2013.*
- *"Fundamental Groups of (p,q)-Torus Knots", University of Iowa, Math Department, Fall 2012."*

Posters

– *"Computations in the Relative Skein of a Local Annulus," USTARS (Underrepresented Students in Topology and Algebra Research Symposium), University of California, Berkeley, CA, April 2014.*

CONFERENCES/WORKSHOPS ATTENDED

– *Microsoft AI+ Tour Conference, Puerto Rico, 28-29 November 2018.*
– *Machine Learning, AI, and Data Science Conference, Microsoft Main Campus, 12-14 November.*
– *AGMA Conference, Raleigh North Carolina, 1-2 March 2018.*
– *USTARS, Florida Gulf Coast University, 18-19 April 2015.*
– *GSTGC, University of Illinois, Urbana-Champaign, 28-29 March 2015.*
– *52nd Texas Geometry And Topology Conference, UT Austin, November 14-16 2014.*
– *The 10th William Rowan Hamilton Geometry And Topology Workshop, The Hamilton Institute at The University of Dublin, August 26-30 2014.*
– *Workshop on Contact Geometry in Dimension Three And Higher, University College London, July 28 - August 1 2014.*
– *Cube Complexes and Groups, Centre For Symmetry And Deformation, July 7-11 2014.*
– *The 31st Annual Workshop in Geometric Topology, UWM, June 12-14 2014.*
– *Gear Junior Retreat, University of Michigan, May 23-June 1 2014.*
– *Georgia Topology Conference, UGA, May 21-25 2014.*
– *RTG Workshop on Geometric Structures And Discrete Groups, UT Austin, May 2-4 2014.*
– *USTARS, UC Berkeley, April 11-13 2014.*
– *GSTGC, University of Texas, Austin April 2-4 2014.*
– *Physics and Mathematics of Link Homology, CRM, June 24-July 5 2013.*
– *Cube Complexes and 3-manifolds, University of Illinois at Chicago, May 20-30 2013.*
– *The Topology of 3-dimensional Manifolds, CRM, May 6-17 2013.*
– *USTARS, Purdue, April 19-21 2013.*
– *GSTGC, Notre Dame, April 6-7 2013.*

SERVICE

Referee

AMS proceedings on Topological Phases of Matter and Quantum Computation, August 2018.

The Data Incubator, DC

- *Social Chair, Winter 2016*

University of Iowa

- *University of Iowa Math Department Graduate Program Recruiter*
  - *SIDIM Conference, University of Puerto Rico, Mayagüez Campus, February 2015*
- *Faculty Mentoring Workshop Panelist, November 2014*
- *Iowa Math Modeling Competition Judge, Fall 2014*
- *Graduate Student Senate*
  - *International Committee Member, Spring 2012 - Spring 2014*
- *COGS Steward, Fall 2012 - Spring 2013*
- *TAPE Orientation for International Students Panelist, February 2012*

United Ways of East Central Iowa

- *Volunteer Translator, July 2014*

SELECTED AWARDS AND HONORS

- *Federal Leadership Nominee - FedScoop 50 Awards 2020*
- *Disruptor of the Year Nominee - FedScoop 50 Awards 2019*
- *Special Act Awards - Technology Transformation Services, GSA*
- *Data Science Fellowship at the Data Incubator D.C.*
- *Ballard Seashore Fellowship at the University of Iowa.*
- *GAANN Fellowship at the University of Iowa.*
- *Latin American-Caribbean Scholarship at Florida State University.*
- *AGEP Scholarship at the University of Northern Iowa.*

PROFILES

- *https://linkedin.com/in/nelabdiel*
- *https://github.com/nelabdiel*
- *https://medium.com/@nelabdiel*

- *https://medium.com/data-science-nel*
- *https://www.kaggle.com/nelabdiel*
- *https://twitter.com/nelabdiel*

PROFESSIONAL MEMBERSHIPS

- *Geometric Structures And Representation Varieties (GEAR), 2014-Present.*
- *American Mathematical Society (AMS), 2009-Present.*

REFERENCES

Available upon request.

Last updated: August 11, 2022