Ralph L. Wojtowicz, Ph.D.

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Education:

- Doctor of Philosophy in Mathematics. University of Illinois at Urbana-Champaign. 2002
- Master of Science in Aeronautical Engineering. University of Illinois. 1992
- Bachelor of Science in Aeronautical Engineering. Rensselaer Polytechnic Institute. 1988
- Bachelor of Science in Mathematics. Rensselaer Polytechnic Institute. 1988

Employment:

- Associate Professor. Shepherd University. Department of Computer Sciences, Mathematics and Engineering. 2015–present
- Senior Hadoop Analyst. PNC Financial Services. 2015
- Consultant. Flexible Plan Investments, Ltd. 2014–2017
- Assistant Professor. Shepherd University. Department of Computer Sciences, Mathematics and Engineering. 2011–2015
- President, Senior Scientist. Baker Mountain Research Corporation. Yellow Spring, West Virginia. 2011–present
- Analyst. Metron, Inc. Reston, Virginia. 2004–2011
- Assistant Professor. University of Dallas. Dept. of Math and Computer Science. 2001–2004
- Visiting Assistant Professor. Rose-Hulman Institute of Technology. Department of Mathematics. 1999–2001

Select Project Experience:

- Director: Data Analytics Bachelor of Science, Shepherd University. http://www.shepherd/edu/data
  - Established Laboratory for Big Data Analytics in 2012.
  - Set up and maintain local network of commodity hardware running Linux.
  - Installed, maintain, and use Hadoop, MPI, Hive, HBase, and HDFS on the cluster.
  - Developed academic program, new courses, and marketing material.
- Consultant: Financial analysis for Flexible Plan Investments, Ltd. 2014–2017
  - Developed statistical learning and analysis software in `R`, Python and `C`.
  - Researched and developed statistical algorithms for modeling financial markets.
  - Developed demonstrations in Hadoop, Spark, and MPI to compare use of big data technologies to solve computationally-intensive investment strategy problems.
  - Wrote weekly technical reports for client.
  - Tested and compared active trading strategies using different programming languages and big data approaches.

- Principal Investigator: Distributed File System B-Trees for Large-Scale Genomics Research. West Virginia IDeA Network of Biomedical Research Excellence. ($28,369 grant). 2017–2018.
  - Researching implementation of B-trees and related data structures in HDFS for applications to bioinformatics.
  - Exploring new bioinformatics technologies, such as storing data in DNA, that may have applications to big data analytics.
- Principal Investigator: A Comparison of Big Data Analytics Technologies Applied to String-Matching Algorithms.West Virginia NASA Space Grant Consortium ($3000 grant). 2017
  - Explored use of Hadoop, Spark and MPI as platforms for string-matching algorithms.
  - Researched applications in bioinformatics, text processing, abstract algebra and artificial intelligence.
- Consultant: Senior Hadoop Analyst. PNC Bank. May – October 2015
  - Developed and demonstrated financial models in Python and Spark
  - Involved in strategic planning of corporate-level big data infrastructure
- Principal Investigator: A Map-Reduce Implementation of the Carmody-Walters Algorithm. West Virginia NASA Space Grant Consortium ($3000 grant). 2016
- Principal Investigator: Undergraduate Course in Big Data Analytics. West Virginia NASA Space Grant Consortium ($5000 grant). 2015
- Principal Investigator: Applications of Big Data Technologies to Bio-Informatics. West Virginia NASA Space Grant Consortium ($2000 grant). 2014
  - Conducted basic research in big data technologies
  - Prepared and delivered technical talk at annual NASA IV&V workshop
  - Implemented prototype software in Java using Apache Hadoop and Mahout
- Principal Investigator: Hadoop Cluster for Integrating Big Data Concepts and Methods into the Curriculum and Research at Shepherd University ($19K grant). 2012–2013
  - Developed hardware specifications for Hadoop cluster and purchased equipment
  - Installed all computer and networking hardware, all operating systems and software
  - Developed and implemented demonstrations, course and research material involving Apache Hadoop, Mahout, Accumulo and Lucene/Solr
  - Served as system administrator for 20+ machine Linux/UNIX Shepherd University Laboratory for Big Data Analytics
- Principal Investigator: Quantum Kan Extensions and Applications. Intelligence Advanced Research Projects Activity ($105K contract). 2011–2012
  - Implemented quantum algorithms in Haskell and Java
  - Managed all technical and financial aspects of project
  - Conducted basic and applied research involving algorithms for quantum computers
  - Created presentation material and delivered presentations to a government client
  - Reviewed government contract and wrote subcontract for an academic co-investigator
- Principal Investigator: Logic-Based Methods for Assurance of Complex System Performance. West Virginia NASA Space Grant Consortium ($2500 grant). 2012
  - Conducted basic research in the independent verification and validation domain (IV&V)
  - Prepared and delivered technical talk at annual NASA IV&V workshop
  - Implemented software in Java

- Consultant (with faculty from Rensselaer Polytechnic Institute and the University of Illinois at Urbana-Champaign): Great Computational Intelligence. Air Force Office of Scientific Research ($600K grant). 2011–2014
  - Conducted basic and applied research in artificial intelligence
  - Developed novel semantic technologies to support visualization and analysis of multi-sorted, linked data
  - Developed demonstrations in Java involving Jenna, Protégé, and Apache Accumulo
  - Gave research presentations at conferences including Turing Centenary Conference in Cambridge, UK
  - Wrote research articles and developed presentation material for a government client
- Principal Investigator: Quantum Kan Extensions and Applications. Intelligence Advanced Research Projects Activity ($105K contract). 2011–2012
  - Managed all technical and financial aspects of project
  - Conducted basic and applied research involving algorithms for quantum computers
  - Developed software applications Java and Haskell
  - Created presentation material and delivered presentations to a government client
  - Reviewed government contract and wrote subcontract for an academic co-investigator
- Analyst: Wide Aperture Array Passive Sonar Algorithm and System Development. Office of Naval Research. ($1.6M contract). 2010
  - Developed analysis and simulation software in Matlab and Java
  - Analyzed sensor data from defense systems
- Technical Lead: Anomaly Detection Literature Survey for Adversary Detection Applications. Department of Homeland Security. 2010
  - Researched statistical anomaly detection techniques for applications to client systems
- Technical Lead: Network Analysis and Activity Detection. Office of Naval Research ($1.4M contract). 2009–2010
  - Responsible for data collection data and integration
  - Designed, developed and implemented network analysis application in Java
  - Utilized semantic web tools developed by the government and other contractors
  - Wrote monthly technical and financial reports to a government client
  - Demonstrated software system in a live Marine Corps exercise
- Analyst. Trade-Net Integration into Global Trader. Office of Naval Intelligence ($1.9M contract). 2009–2010
  - Responsible for development of methods, algorithms and Java tools to support analysis and visualization of decades of cargo shipping transaction data from large Oracle database
  - Wrote user guides, research articles, technical reports and requirements documents
- Principal Investigator. Categorical Logic as a Foundation for Robust Decision Making. Air Force Office of Scientific Research ($180K grant). 2008–2010
  - Responsible for all technical and financial aspects of the project
  - Conducted basic research in automated uncertainty management
  - Developed and implemented mathematical algorithms in Java
  - Prepared and delivered presentations to government program officers

- Principal Investigator. Categorical Logic as a Foundation for Reasoning Under Uncertainty. Missile Defense Agency ($100K Phase I and $500K Phase II SBIR contracts). 2006–2008
  - Developed and implemented algorithms in Java for integration into defense systems
  - Managed all technical and financial aspects of the project
  - Wrote monthly technical and financial reports and annual reports
  - Prepared and delivered presentations to government program managers
- Principal Investigator. Measures of Effectiveness Sensitivity Calculator. Office of Naval Research ($100K contract). 2006–2007
  - Collected system performance metrics from multiple government and industry sources
  - Developed simulation software in Matlab and Java
  - Conducted numerical experiments over ranges of parameter values
  - Made recommendations for government investment in future technologies
- Analyst: Algorithms for GPS-Denied Localization. Army Research Laboratory. 2004–2005
  - Researched and implemented computational geometry methods in Java and Matlab for applications to group localization in which some nodes lack GPS capabilities

Select Publications:

- R. L. Wojtowicz. Introduction to Data Analytics (in progress)
- R. L. Wojtowicz. Sketch Theory as a Framework for Knowledge Management. *Innovations in Systems and Software Engineering*. Springer-Verlag. **12**(1):69–70. 2016
- R. L. Wojtowicz. Fusion of State Estimates from Regime-Switching Models. Submitted to National Association of Active Investment Managers Wagner Award Competition. 2015.
- R. L. Wojtowicz. Sketches, Views and Pattern-Based Reasoning. Proceedings of the 8th International Conference on Semantic Technologies for Intelligence, Defense and Security (STIDS 2013). George Mason University, November 2013.
- R. L. Wojtowicz and N. Yanofsky. *Quantum Kan Extensions and Their Applications*. IARPA contract D11PC20232 Final Report. 2013.
- R. L. Wojtowicz, S. Bringsjord and J. Hummel. Dynamic Semantics of τN-Theories. Presented at the Turing Centenary Conference held at Cambridge University, UK. 2012.
- S. Bringsjord, J. Taylor, B. van Heuveln, K. Arkoudas, M. Clark and R. L. Wojtowicz. Piagetian roboethics via category theory: moving beyond mere formal operations to engineer robots whose decisions are guaranteed to be ethically correct. *Machine Ethics*. M. Anderson and S. L. Anderson Eds. Cambridge University Press. 2011.
- R. L. Wojtowicz. Non-Classical Markov Logic and Network Analysis. IEEE 12th International Conference on Information Fusion. Seattle, WA. July, 2009.
- R. L. Streit and R. L. Wojtowicz. A General Likelihood Function Decomposition that is Linear in Target State. in IEEE Aerospace Conference Proceedings. 2009.
- R. L. Wojtowicz. On Transformations Between Belief States. In Soft Methods for Handling Variability and Imprecision. D. Dubois, H. Prade, et al. editors. Volume 48 of Advances in Soft Computing. Springer-Verlag. pp. 313–320. 2008. `http://www.adjoint-functors.net/belief.pdf`
- R. L. Wojtowicz. *Categorical Logic as a Foundation for Reasoning Under Uncertainty and as a Guide to Machine Learning Algorithm Development*. SBIR Phase I Final Report. 2005.

- R. L. Wojtowicz. Symbolic Dynamics and Chaos Defined by Right Adjointness. CASYS'03-Sixth International Conference on Computing Anticipatory Systems (Liege, Belgium). D. Dubois, Editor. American Institute of Physics Conference Proceedings. (718):268-281. 2004. http://www.adjoint-functors.net/aipcasys2.pdf
- R. L. Wojtowicz. *On Categories of Cohesive, Active Sets and Other Dynamic Systems*. Ph.D. Thesis. Department of Mathematics, University of Illinois at Urbana-Champaign. 2002.
- R. L. Wojtowicz. *A Numerical Method for Computing Values of Maxwell's Collisions Integral on a Discretized Velocity Space*. M.S. Thesis. Department of Aeronautical and Astronautical Engineering, University of Illinois at Urbana-Champaign. 1992.

Select Awards:

- Shepherd University College of Natural Sciences and Mathematics Faculty Fellow. 2017–2020
- Professional Development Stipend Grant. Shepherd University. 2016
- Outstanding Faculty Award. Shepherd University. Nominated by Dean. 2014
- Entrepreneur Award. CreateWV "Pitch Your Idea" contest. Charleston, WV. 2012
- Merit Award in recognition of exceptional professional development achievement. Shepherd University. 2012–2014
- Best Paper Award. International Conference on Computing Anticipatory Systems. Liège, Belgium. 2003
- University of Illinois College of Liberal Arts and Sciences Luckman Award for Excellence in Undergraduate Education. Nominated 1996
- University of Illinois Department of Mathematics Graduate Teaching Award. 1996
- National Science Foundation Graduate Fellowship. 1988–1992
- Outstanding Senior Award. Presented annually to the six outstanding students in the United States for exceptional academic achievement and participation in extracurricular activities by Sigma Gamma Tau, the national honor society for aerospace engineering. 1988
- Ricketts Prize. Presented by Rensselaer Polytechnic Institute in recognition of outstanding achievement. 1988

Select Presentations:

- Category Theory Octoberfest. Carnegie Mellon University. October 2017
- Big Data and Cybersecurity Workshop. Morgantown, WV. December 2015
- NSF/NAVSEA Big Data and Cybersecurity Summit. Rocket City, WV. September 2015
- Computational Category Theory Workshop. National Institute of Standards and Technology. Gaithersburg, MD. September 2015
- Innovation and Entrepreneurship Day at the State Capitol. February 2015
- West Virginia Higher Education Technology Conference. October 2014
- CreateWV Big Data panel session organizer and speaker. October 2014
- NASA IV&V Workshop. Fairmont, WV. September 2014
- Office of Naval Research Focus Area Forum: Data Science for Decision-Making. June 2014
- Rensselaer Polytechnic Institute Cognitive Sciences Colloquium. May 2014

- 8th International Conference on Semantic Technologies for Intelligence, Defense and Security. George Mason University. November 2013
- NASA IV&V Workshop. Morgantown, WV. September 2012
- IARPA Quantum Computer Science PI Meeting. Princeton, NJ. July 2012
- Turing Centenary Conference. Cambridge University. Cambridge, UK. June 2012
- IEEE 12th International Conference on Information Fusion. Seattle, WA. July 2009
- Air Force Institute of Technology Mathematics Colloquium. Dayton, OH December 2009
- Rose-Hulman Institute of Technology Mathematics Colloquium. October 2009
- Sixth International Conference on Computing Anticipatory Systems. Liège, Belgium. 2003
- Central Texas Algebra Conference. Baylor University. 2003
- AMS Special Session on Discrete Dynamics and Difference Equations. Joint Mathematics Meetings. Baltimore, MD. 2003

Select Courses Taught:

- Big Data Analytics. (Spring 2017 and Spring 2018 (expected)). Course texts: *Hadoop: The Definitive Guide* by White, *Mining of Massive Datasets* by Leskovec, Rajaraman and Ullman, and *Using MPI* by Gropp, Lusk and Skjellum.
- Introduction to Data Analytics. (Fall 2016, 2017). Developed material to introduce students to Python, R, PostgreSQL, time series, visualization, QGIS and OpenStreetMap.
- Introduction to Abstract Algebra (Fall 2017). Course text: *Introduction to Abstract Algebra* by Rotman.
- Operations Research. (Spring 2015, 2016). Course text: *Introduction to Algorithms* by Cormen, Leiserson, Rivest and Stein.
- Operations Research. (Spring 2012). Course text: *Operations Research: A Practical Introduction* by Carter and Price
- Mathematical Modeling (Fall 2015, 2016). Course text: *Introduction to Statistical Learning* by James, Witten, Hastie and Tibshirani
- Mathematical Modeling (Fall 2013, 2014). Course text: *Conceptual Mathematics* by Lawvere and Schanuel
- Probability and Statistics (Fall 2011, Spring 2018 (expected)). Course text: *Probability and Statistics* by DeGroot and supplemental material that I prepared covering the Kalman filter
- Probability and Statistics (Spring 2017). Course text: *The Theory of Probability* by Venkatesh
- Numerical Analysis. (Spring 2014, 2015, 2016). Course text: *Introduction to Algorithms* by Cormen, Leiserson, Rivest and Stein. Supplementary text: *Mining Massive Datasets* by Leskovec, Rajaraman and Ullman.
- Introduction to Statistics. (2011–2012, 2014–2017). Course text: *Statistics* by Freedman, Pisani and Purves
- Linear Algebra. (Fall 2014, 2015, 2016). Course text: *Linear Algebra Done Right* by Axler
- Mathematical Analysis I–II (2003–2004). Course text: *Principles of Mathematical Analysis* by Rudin
- Engineering Statistics (1999–2001)
- Introduction to Probability (2001)

- Introduction to Applied Mathematics I–II (2001–2004)
- Introduction to Differential Equation (2003–2004)
- Calculus I–III (multiple times)
- Pre-calculus (multiple times)
- Mathematics for Liberal Arts Majors (1996–1998)

Directed Undergraduate Research:

- Implementation of B-trees and B*-trees in HDFS. Robert Lyons. 2017
- Estimation of Natural Gas Emission Waste from Satellite Imagery. Daniel Nicholls. 2016
- Retinopathy Classification from Retinal Scans. Kevin Gilbert. 2015
- Shepherd University SPACE micro-satellite project. 2013–2016
- Special Morphisms in the Stochastic Category. Christine Wiesner. University of Dallas. 2003

Select Committee Assignments:

- Shepherd University Strategic Planning Committee (2017–present)
- Shepherd University Curriculum and Instruction Committee (2017–present)
- West Virginia NASA Space Grant Consortium. Shepherd University Representative (2015–present)
- Shepherd University Core Curriculum Committee (2015–present)
- Shepherd University Student Conduct Board (2016–present)
- Shepherd University Faculty Awards Committee (2012)
- Multiple hiring committees in both academics and industry

Software Development Experience:

- Primary programming languages: Java, Python, R and Haskell
- Experience with: C/C++, Android, Hadoop/MapReduce/Spark, Processing, OpenGL, Lisp, MatLab, ML, Maple, PostScript, SQL (Oracle and PostgreSQL), Mathematica and Maxima
- Data analysis tools: Hadoop cluster implementation and management, MapReduce algorithm development and implementation, database management (Oracle, PostgreSQL) and design
- Knowledge of XML, RDF, OWL, Jenna, Protégé and semantic web technologies
- Operating environments: Linux, Unix , MacOSX, and Windows
- Other tools include: Version control (Subversion and CVS), emacs, vi and Eclipse

Business Conferences and Workshops Attended:

- Applications of R in Finance. University of Illinois at Chicago. May 2014
- Appalachian Regional Commission Workshop. Entrepreneurship Transforming Appalachia's Economy. Charleston, WV. November 2013
- Telework West Virginia Conference. Charleston, WV. May 2013
- Biometrics Identification Intelligence Strategic Planning Workshop. Bridgeport, WV. 2013
- I-79 Technology Corridor Biometrics Workshop. Fairmont, WV. January 2013
- Create WV Conference. Charleston, WV. October 2012

- RESA 8 STEM Workshop. Martinsburg, WV. October 2012
- Appalachian Regional Commission Workshop. Charleston, WV. October 2011
- West Virginia Teaming to Win. 2011–2012, 2014
- Shepherd University Grant Workshop. January 2011
- NDIA Business Development Workshop. 2007
- Small Business Administration: Beyond Phase II Business Development Workshop. 2006

Other Experience:

- Contract and grant management
- Non-profit 501(c)3 management
- West Virgnia University College Business Plan Competition Judge. 2014–present
- Shepherd University micro-satellite student project manager. 2013–present
- Shepherd University Department of Computer Sciences, Mathematics and Engineering hiring committee. 2012–2014
- Shepherd University Department of Psychology hiring committee. 2012–2013
- Proposal Reviewer for Air Force Office of Scientific Research. 2012–present
- Reviewer: CogSci 2011, CogSci 2012 and CogSci 2013 conferences
- Extensive proposal writing and marketing experience with diverse clients
- Recruiting at American Mathematical Society Joint Mathematics Meetings 2006, 2008–2009
- Technical report writing in LaTeX

Online Coursework Completed:

- Electronic Interfaces. edX. 2016
- Mining Massive Datasets. Completion. Coursera. 2014
- R Programming. Completion with Distinction. Coursera. 2014
- Introduction to Data Science. Completion with Distinction. Coursera. 2013

Citizenship: USA