# Christopher P. Porter

Dept. of Mathematics and Computer Science Drake University 319 Collier-Scripps Hall 2702 Forest Avenue Des Moines, IA 50311 Email: christopher.porter@drake.edu

Web Page: http://www.cpporter.com

# Academic Positions

Assistant Professor, Department of Mathematics and Computer Science, Drake University, August 2016-present.

Postdoctoral Associate, Department of Mathematics, University of Florida, August 2014-August 2016.

National Science Foundation International Research Postdoctoral Fellow, LIAFA, Université Paris Diderot - Paris 7, September 2012-August 2014.

### Education

Ph.D. Mathematics and Philosophy (joint degree), University of Notre Dame, May 2012.

Dissertation: "Mathematical and Philosophical Perspectives on Algorithmic Randomness", co-directed by Peter Cholak, Michael Detlefsen, and Curtis Franks, with committee members Laurent Bienvenu (Paris 7), Julia Knight (Notre Dame), and Timothy McCarthy (UIUC), successfully defended with highest distinction on 4/11/2012.

M.S. Mathematics, University of Notre Dame, 2005.

B.S. Mathematics, Gonzaga University, 2003, summa cum laude.

## **Publications**

### Articles

Key developments in algorithmic randomness (with Johanna N.Y. Franklin). Submitted.

Rank and randomness (with Rupert Hölzl). Submitted.

The interplay of effective notions of randomness and genericity (with Laurent Bienvenu). Forthcoming in *The Journal of Symbolic Logic* 

Biased algorithmic randomness. Forthcoming in Algorithmic Randomness: Progress and Prospects.

The random members of a  $\Pi_1^0$  class (with Douglas Cenzer). *Theory of Computing Systems*, 62(7), pp. 1637-1671, October 2018.

The probability of a computable output from a random oracle (with George Barmpalias and Douglas Cenzer). *ACM Transactions on Computational Logic*, 18(3), pp. 18:1-18:15, August 2017.

Randomness and semi-measures (with Laurent Bienvenu, Rupert Hölzl, and Paul Shafer). *Notre Dame Journal of Formal Logic*, 58(3), pp. 301-328, July 2017.

Randomness for computable measures and initial segment complexity (with Rupert Hölzl). Annals of Pure and Applied Logic, 168(4), pp. 860-886, April 2017.

Random numbers as probabilities of machine behaviour (with George Barmpalias and Douglas Cenzer). *Theoretical Computer Science*, 673, pp. 1-18, April 2017.

Analogues of the Church-Turing thesis in algorithmic randomness. *The Review of Symbolic Logic*, Volume 9, Issue 3, September 2016.

Deep  $\Pi_1^0$  classes (with Laurent Bienvenu). *The Bulletin of Symbolic Logic*, Volume 22, No. 2, June 2016.

The interplay of classes of algorithmically random objects (with Quinn Culver). *The Journal of Logic and Analysis*, Vol. 7, 2015.

Demuth's path to randomness (with André Nies and Antonín Kučera). *The Bulletin of Symbolic Logic*, 21(3), September 2015, pp. 270-305.

Algorithmically random functions and effective capacities (with Doug Cenzer). *Theory and Applications of Models of Computation*, 12th Annual Conference, TAMC 2015, Singapore, May 18-20, 2015, Proceedings (Lecture Notes in Computer Science), pp. 23-37, 2015.

Trivial measures are not so trivial. Theory of Computing Systems, Volume 56 Issue 3, April 2015.

Kolmogorov on the role of randomness in probability theory, *Mathematical Structures in Computer Science*, 24, June 2014.

Strong reductions in effective randomness (with Laurent Bienvenu). *Theoretical Computer Science*, 459, pp. 55-68, June 2012.

#### Books / Edited Collections

Algorithmic Randomness: Progress and Prospects, co-edited with Johanna N.Y. Franklin, under review for publication in the *Lecture Notes in Logic* Series, Cambridge University Press.

*Computability, Forcing and Descriptive Set Theory,* co-edited with Douglas Cenzer and Jindrich Zapletal, under contract with World Scientific.

*Set Theory and the Foundations of Mathematics* (2 volumes), with Douglas Cenzer, Jean Larson, and Jindrich Zapletal, under contract with World Scientific.

#### Reviews

Three books on computability, with a special focus on Turing's legacy. *Historia Mathematica*, August 2018.

Work in progress

Kolmogorov complexity and generalized length functions (with Cameron Fraize).

The V'yugin algebra of non-negligible properties (with Rupert Hölzl).

The average-case use of Turing functionals (with Douglas Cenzer).

Aspects of Bernoulli randomness (with Quinn Culver).

The confluence of definitions of algorithmic randomness.

Random closed sets and random subfractals of self-similar fractals (with Jack Lutz)

Computing members of random closed sets (with Adam Case)

Versions of Chaitin's  $\Omega$  for non-uniform measures (with Will Swanson)

# Grants and Other External Funding

"Algorithmically random walks in Markov chains," (with Drake student Kaela Newman), project supported by the Iowa Space Grant Consortium for AY 2018-2019, \$7,000 scholarship for Newman plus \$2,000 in support of the project.

"Deterministic finite state automata and random error-correcting codes" (with Drake student Carter McCall), project supported by the Iowa Space Grant Consortium for AY 2018-2019, \$7,000 scholarship for McCall plus \$2,000 in support of the project.

"Kolmogorov complexity and error-correcting codes" (with Drake student Carter McCall), project supported by the Iowa Space Grant Consortium for AY 2017-2018, \$7,000 scholarship for McCall plus \$2,000 in support of the project.

"Computer Vision and Robotics: Design, Construction, and Implementation" (with co-PI Eric Manley and Drake student Joel Afriyie), Iowa Space Grant Consortium, AY 2017-2018, \$6,600.

"Algorithmic randomness and the complexity of probability measures," Young Investigators grant supported by the National Security Agency Mathematical Sciences Program for AY 2016-2017 and AY 2017-2018, \$40,000.

"Classification and Compression of Cosmological Data Utilizing Kolmogorov Complexity" (with Drake student David Mascharka), project supported by the Iowa Space Grant Consortium for AY 2016-2017, \$5,000 scholarship for Mascharka plus \$2,000 in support of the project.

"Structure and Randomness in the Theory of Computation" (with Laurent Bienvenu), grant supported by the John Templeton Foundation for AY 2014-2015 and AY 2015-2016, \$200,000.

"Randomness Preservation and Randomness Extraction," grant supported by the National Science Foundation for an NSF International Research Fellowship for AY 2012-2013 and AY 2013-2014, \$141,700.

### Talks

#### 2018

Aspects of Bernoulli randomness; Southeastern Logic Symposium (SEALS), University of Florida, Gainesville, FL, March 3, 2018.

Deep  $\Pi_1^0$  classes; Iowa Colloquium of Information, Complexity, and Logic (ICICL), Iowa State University, Ames, IA, April 5, 2018.

Aspects of Bernoulli randomness; North American meeting of the Association of Symbolic Logic, Western Illinois University, Macomb, IL, May 16, 2018.

Coin tossing, randomness extraction, and algorithmic randomness, General audience talk for the mathematics honor society Kappa Mu Epsilon, Drake University, October 26, 2018.

#### 2017

Rank and randomness; Southeastern Logic Symposium (SEALS); University of Florida, Gainesville, FL, March 5, 2017.

Rank and randomness; Sectional Meeting of the American Mathematical Society, Hunter College, New York, New York, May 7, 2017.

#### 2016

Algorithmic randomness with respect to trivial measures, Part 1 and Part 2; University of Florida Logic Seminar, Gainesville, Florida, February 5 & February 12, 2016.

Random members of a  $\Pi_1^0$  class; Annual Meeting of the Association of Symbolic Logic, University of Connecticut, Storrs, CT, May 5, 2016.

Kolmogorov complexity and generalized length functions; Regional Meeting of the American Mathematical Society, University of St. Thomas, Minneapolis, MN, October 29, 2016.

Kolmogorov complexity and generalized length functions; Iowa Colloquium on Information, Complexity, and Logic (ICICL), Iowa State University, December 1, 2016.

#### 2015

Initial segment complexity and randomness for computable measures; Penn State University Logic Seminar, State College, PA, February 10, 2015.

Algorithmic randomness and non-uniform probability measures, Part 1 and Part 2; University of Florida Logic Seminar, Gainesville, Florida, March 9 & 16, 2015.

Coin tossing, randomness extraction, and algorithmic randomness; University of Florida Graduate Mathematics Association, Gainesville, Florida, March 25, 2015.

Algorithmic randomness for non-uniform probability measures; Logic and Set Theory Seminar, University of California, Irvine, May 11, 2015.

The logical approach to randomness; Logic and the Philosophy of Science Department Colloquium, University of California, Irvine, May 12, 2015.

Mutual information, the Independence Postulate, and depth; Varieties of Algorithmic Information, Heidelberg, Germany, June 15-18, 2015.

The preservation of algorithmic randomness, Part 1 and Part 2; University of Florida Logic Seminar, Gainesville, Florida, August 28 & September 4, 2015.

Deep  $\Pi_1^0$  classes; Connecticut Logic Seminar, University of Connecticut, September 17, 2015.

The logical approach to randomness; UConn Logic Colloquium, University of Connecticut, September 18, 2015.

Defining randomness; General audience talk for the UF Undergraduate Mathematics Society; University of Florida, Gainesville, FL, September 24, 2015.

From algorithmic randomness to dynamical systems; University of Florida Topology and Dynamics Seminar, Gainesville, Florida, October 27, 2015.

#### 2014

Randomness, probability, and computation; ASL-AMS Special Session on Logic and Probability, Joint Mathematics Meetings, Baltimore, Maryland, January 15, 2014.

The algorithmic approach to randomness; Groupe de Travail Mathématiques et Philosophie Contemporaines, Institut de Mathématiques de Toulouse, Université Paul Sabatier, Toulouse, France, March 20, 2014.

The invariant degrees, randomness, and semi-measures; Journées Calculabilités 2014, Université Montpellier 2, Montpellier, France, April 28, 2014.

The invariant degrees, randomness, and semi-measures; Hauptseminar Mathematische Logik und Theoretische Informatik, Universität Heidelberg, Heidelberg, Germany, May 27, 2014.

Effective notions of typicality; "Concepts of genericity in mathematics" (special seminar co-organized with Brice Halimi), Université Paris Diderot, Paris, France, June 13, 2014.

Negligibility, depth, and algorithmic randomness, Part 1 and Part 2; University of Florida Logic Seminar, Gainesville, Florida, September 5 and 12, 2014.

Initial segment complexity and randomness for computable measures; Session on Computability Theory, Winter Meeting of the Canadian Mathematical Society, Hamilton, Ontario, December 7, 2014.

#### 2013

Revisiting Chaitin's Incompleteness Theorem; Cambridge Philosophy of Mathematics Seminar, University of Cambridge, February 21, 2013.

Randomness and semi-measures; Journées Calculabilités 2013, Nancy, France, April 12, 2013.

Algorithmic randomness and probabilistic computation; Séminaire Automates, LIAFA, Paris, France, June 14, 2013.

Demuth's work on randomness and analysis; Algorithmic Randomness and Analysis (ARA) 2013, Nancy, France, June 28, 2013.

Strong difference randomness; Computability in Europe 2013, Milan, Italy, July 4, 2013.

Algorithmic randomness and semi-measures; Logic Colloquium 2013, Évora, Portugal, July 26, 2013.

Deep  $\Pi_1^0$  classes; Seminar Theoretische Informatik und Mathematische Logik, Universität der Bundeswehr München, Munich, Germany, August 7, 2013.

Randomness and accessible objects in mathematics; 5th French Philosophy of Mathematics Workshop (FPMW5), Clermont-Ferrand, France, October 17, 2013.

Von Mises, Church, and the birth of algorithmic randomness; 2nd International Conference on the History and Philosophy of Computing (HaPoC), Paris, France, October 29, 2013.

Effectively closed classes, negligibility, and depth; Logic and Analysis Seminar, Universiteit Gent, Ghent, Belgium, November 6, 2013.

Effectively closed classes, negligibility, and depth; Hauptseminar Mathematische Logik und Theoretische Informatik, Universität Heidelberg, Heidelberg, Germany, November 19, 2013.

Defining randomness; General audience talk for undergraduate students, Warwick University, Coventry, UK, November 28, 2013.

Randomness, probability, and computation; Midlands Logic Seminar, Birmingham University, Birmingham, UK, November 29, 2013.

On analogues of the Church-Turing thesis in algorithmic randomness; Munich Center for Mathematical Philosophy, Munich, Germany, December 4, 2013.

#### 2012

Algorithmic randomness and pathological computable measures; Joint Mathematics Meetings, Special Session on the Life and Legacy of Alan Turing, Boston, MA, January 4, 2012, invited address.

On analogues of the Church-Turing thesis in algorithmic randomness; Workshop on Philosophy and Algorithmic Complexity, Northwestern University, May 5, 2012, invited talk.

Algorithmic randomness and non-uniform measures; Workshop on Philosophy and Algorithmic Complexity, Northwestern University, May 5, 2012, invited talk.

On analogues of the Church-Turing thesis in algorithmic randomness; Computability in Europe, University of Cambridge, June 19, 2012.

Trivial measures are not so trivial; Seventh International Conference on Computability, Complexity and Randomness (CCR 2012), University of Cambridge, July 3 2012.

### Teaching

Courses taught at Drake University

Calculus 1 (Fall 2016, Fall 2017 - 2 sections) Mathematical Reasoning (Fall 2016, Spring 2017) Spirit of Mathematics (Spring 2017, Spring 2018) Discrete Structures: Coding and Information Theory (Spring 2017) Discrete Structures: Network Theory (Spring 2019) Linear Algebra (Spring 2018 - 2 sections, Spring 2019) Calculus 3 (Fall 2018 - 2 sections, Spring 2019) Abstract Algebra 1 (Fall 2018) The Many Faces of Randomness (J-term 2018) Philosophy of Probability (J-term 2017) Computer ethics (online: Summer 2017, Summer 2018; face-to-face: J-term 2019)

Various independent studies (Kolmogorov complexity and data compression, Fall 2016-Spring 2017; Computability theory and algorithmic randomness, Fall 2016; Philosophy of probability, Spring 2017; Kolmogorov complexity and error-correcting codes, Fall 2017-Spring 2018; Finite state automata and random error-correcting codes, Fall 2018; Algorithmically random walks in Markov chains, Fall 2018; Foundations of subjective probability, Fall 2018)

Courses taught at the University of Florida

Mathematical Logic 1 (graduate level), Fall 2015 Mathematical Logic 2 (graduate level), Spring 2016 Calculus 1 (UF Pre-Health Post-Baccalaureate Program), Fall 2015 Foundations of Mathematics, Spring 2015 Sets and Logic, Fall 2014, Spring 2016 Calculus 3, Fall 2014 Various independent studies (Kolmogorov complexity, clustering, and compression, Summer 2015,

Kolmogorov complexity and data compression, Fall 2015; Generalizing Kolmogorov complexity, Fall 2015-Spring 2016; Algorithmic randomness and information theory, Spring 2016)

Courses taught at the University of Notre Dame

Statistics for the Life Sciences, Spring 2012.

Statistics for the Life Sciences, Fall 2011.

Beginning Logic, Spring 2008.

Business Calculus, Fall 2007.

Beginning Logic, Spring 2007.

### Undergraduate Research Projects

"Algorithmically random walks in Markov chains," Kaela Newman, Drake University, Fall 2018.

"Deterministic finite state automata and random error-correcting codes", Carter McCall, Drake University, Fall 2018.

"Kolmogorov complexity and error-correcting codes," Carter McCall, Drake University, Fall 2017-Spring 2018.

"Classification and Compression of Cosmological Data Utilizing Kolmogorov Complexity," David Mascharka, Drake University, Fall 2016-Spring 2017.

"Kolmogorov Complexity and Data Compression," Jason Linehan, University of Florida, Fall 2015-Spring 2016.

"Generalizing Kolmogorov Complexity," Cameron Fraize, Undergraduate Honor's thesis, University of Florida, Fall 2015-Spring 2016

# Organizing Activities

Co-organizer of the Iowa Colloquium on Information, Complexity, and Logic (ICICL), Fall 2016-present.

With Douglas Cenzer, Jean Larson, and Jindrich Zapletal, organizer of Southeastern Logic Symposium, University of Florida, Feb. 28-Mar. 1, 2015.

With Laurent Bienvenu and Wolfgang Merkle, organizer of Varieties of Algorithmic Information, Heidelberg, Germany, June 15-18, 2015.

# Service

Innovation Fellow, Pappajohn Center for Entrepreneurial Outreach, College of Business and Public Administration, Drake University, Fall 2017-Fall 2018.

Faculty advisor for the Drake Innovators student organization, Fall 2018.

Dean's Cabinet, College of Arts and Sciences, Drake University, Fall 2018.

Member of ad hoc committee led by Drake University provost on the role of artificial intelligence in higher education

Ad hoc referee for Information and Computation, Journal of Symbolic Logic, Logical Methods in Computer Science, Minds and Machines, Notre Dame Journal of Formal Logic, Erkenntnis, and Thought.

Contributor to Mathematical Reviews