

THE BULLETIN OF SYMBOLIC LOGIC

Edited by

Laurent Bienvenu, *Managing Editor*

Matthias Baaz Ali Enayat

James Cummings Leonid Libkin

Paola D'Aquino Øystein Linnebo

Peter Dybjer

Reviews Editors

Clinton Conley, *Managing Editor for Reviews*

Mark van Atten Bernard Linsky

Benno van den Berg Antonio Montalbán

Thomas Colcombet Rahim Moosa

Samuel Coskey Christian Retoré

Bradd Hart Nam Trang

Thesis Abstracts Editor

Christian Rosendal

VOLUME 25 • 2019

Copyright © 2020 by the Association for Symbolic Logic. All rights reserved.
Reproduction by photostat, photo-print, microfilm, or like process by permission only.



PUBLISHED BY CAMBRIDGE UNIVERSITY PRESS FOR
AND ON BEHALF OF THE ASSOCIATION OF SYMBOLIC LOGIC.

CONTENTS OF VOLUME 25

ARTICLES

BAGARIA, JOAN, KOELLNER, PETER, AND WOODIN, W. HUGH. Large cardinals beyond choice	283
BALDWIN, JOHN T. and LASKOWSKI, MICHAEL C. Henkin constructions of models with size continuum	1
BAZHENOV, NIKOLAY, DOWNEY, ROD, KALIMULLIN, ISKANDER, and MELNIKOV, ALEXANDER. Foundations of online structure theory.....	141
CHASE, HUNTER and FREITAG, JAMES. Model theory and machine learning	319
DOWNEY, ROD. see BAZHENOV, NIKOLAY	
FREITAG, JAMES. see CHASE, HUNTER	
HALEVI, YATIR, HASSON, ASSAF, and JAHNKE, FRANZISKA. A conjectural classification of strongly dependent fields	182
HÄMEEN-ANTTILA, MARIA. Nominalistic ordinals, recursion on higher types, and finitism	101
HASSON, ASSAF. see HALEVI, YATIR	
JAHNKE, FRANZISKA. see HALEVI, YATIR	
KALIMULLIN, ISKANDER. see BAZHENOV, NIKOLAY	
KARAGILA, ASAF. Realizing realizability results with classical constructions.....	429
KLEV, ANSTEN. Eta-rules in Martin-Löf type theory	333
KOELLNER, PETER. see BAGARIA, JOAN	
LASKOWSKI, MICHAEL C. see BALDWIN, JOHN T.	
LUPINI, MARTINO. An invitation to model theory and C^* -algebras	34
MELNIKOV, ALEXANDER. see BAZHENOV, NIKOLAY	
WOODIN, W. HUGH. see BAGARIA, JOAN	

COMMUNICATIONS

DYCKHOFF, ROY. Indirect proof and inversions of syllogisms	196
VÄÄNÄNEN, JOUKO. An extension of a theorem of Zermelo	208

REVIEWS

ABDUL-QUADER, ATHAR, J. H. Schmerl, <i>Subsets coded in elementary end extensions and Minimal elementary end extensions</i>	125
CATTA, DAVIDE. N. FRANCEZ, <i>Proof-theoretic semantics</i>	360

THESIS ABSTRACTS

BAHRAMI, SAEIDEH. <i>Self-embeddings of Models of Peano Arithmetic</i> , Tarbiat Modares University, Iran, 2018. Supervised by Ali Enayat.....	217
BORIČIĆ, MARIJA. <i>Probability Sequent Calculi and Entropy Based Nonclassical Logics Classification</i> , Faculty of Mathematics, University of Belgrade, Serbia, 2016. Supervised by Nebojša Ikodinović and Zoran Ognjanović.....	446
BRODSKY, ARI MEIR. <i>A Theory of Stationary Trees and the Balanced Baumgartner–Hajnal–Todorćević Theorem for Trees</i> , University of Toronto, Canada, 2014. Supervised by Stevo Todorćević.....	219
CAVALLARI, FILIPPO. <i>Regular Tree Languages in the First Two Levels of the Borel Hierarchy</i> , University of Turin, Italy, and University of Lausanne, Switzerland, 2018. Supervised by Luca Motto Ros (Turin) and Jacques Duparc (Lausanne)	221
DANIEL KLAUSNER, LUKAS. <i>Creatures and Cardinals</i> , Technische Universität Wien, Austria, 2018. Supervised by Martin Goldstern	218
FREITAS RAMOS, ARTHUR. <i>Explicit Computational Paths in Type Theory</i> , Universidade Federal de Pernambuco, Brazil, 2018. Supervised by Anjolina G. de Oliveira and Ruy J. G. B. de Queiroz	213

GALEOTTI, LORENZO. <i>The Theory of the Generalised Real Numbers and Other Topics in Logic</i> , Universität Hamburg, Germany, 2019. Supervised by Benedikt Löwe	449
GOH, JUN LE. <i>Measuring the Relative Complexity of Mathematical Constructions and Theorems</i> , Cornell University, USA, 2019. Supervised by Richard A. Shore	447
GORBOW, PAUL K. <i>Self-similarity in the Foundations</i> , University of Gothenburg, Sweden, 2018. Supervised by Ali Enayat (primary), Peter LeFanu Lumsdaine, and Zachiri McKenzie (secondary)	216
JANA, PURBITA. <i>A Study of the Interrelation between Fuzzy Topological Systems and Logics</i> , University of Calcutta, India, 2016. Supervised by Mihir K. Chakraborty	453
MIDENA RAMOS, MARCUS VINÍCIUS. <i>Formalization of Context-Free Language Theory</i> , Universidade Federal de Pernambuco, Brazil, 2016. Supervised by Ruy J. G. B. de Queiroz	214
NOBREGA, HUGO. <i>Games for Functions: Baire Classes, Weihrauch Degrees, Transfinite Computations, and Ranks</i> , Universiteit van Amsterdam, the Netherlands, 2018. Supervised by Benedikt Löwe and Arno Pauly	451
NOQUEZ, VICTORIA. <i>Vaught's Two-Cardinal Theorem and Notions of Minimality in Continuous Logic</i> , University of Illinois at Chicago, USA, 2017. Supervised by David Marker	215
PARENTE, FRANCESCO. <i>Regularity of Ultrafilters, Boolean Ultrapowers, and Keisler's Order</i> , University of East Anglia, UK, 2019. Supervised by Mirna Džamonja and David Asperó	454
SIMMONS, WILLIAM D. <i>Completeness of Finite-Rank Differential Varieties</i> , University of Illinois at Chicago, USA, 2013. Supervised by David Marker	220
TARAFDER, SOURAV. <i>Non-Classical Set Theories and Logics Associated With Them</i> , University of Calcutta, India, 2017. Supervised by Mihir Kr. Chakraborty and Benedikt Löwe	450
THOMAS-BOLDUC, AARON. <i>New Directions for Neo-logicism</i> , University of Calgary, Canada, 2018. Supervised by Richard Zach	219
ULRICH, DOUGLAS. <i>Some Applications of Set Theory to Model Theory</i> , University of Maryland, College Park, USA, 2018. Supervised by Michael C. Laskowski	214
VACCARO, ANDREA. <i>C*-algebras and the Uncountable: A Systematic Study of the Combinatorics of the Uncountable in the Noncommutative Framework</i> , Università di Pisa, Italy – York University, UK, 2019. Supervised by Ilijas Farah and Alessandro Berarducci (cosupervisor)	448
WEISSHAAR, ROSE. <i>Some Results in Computability Theory</i> , University of Notre Dame, USA, 2019. Supervised by Julia Knight	452

MEETINGS OF THE ASSOCIATION FOR SYMBOLIC LOGIC

2018 European Summer Meeting of the Association for Symbolic Logic, Logic Colloquium 2018, Udine, Italy, July 23–28, 2018	223
Association for Symbolic Logic 2019 Winter Meeting, Baltimore Convention Center, Baltimore, MD, USA, January 18–19, 2019	363
Association for Symbolic Logic 2019 Winter Meeting, The Westin Denver Downtown, Denver, Colorado, USA, February 21–22, 2019	372
2019 North American Annual Meeting of the Association for Symbolic Logic, City University of New York Graduate Center, New York, New York, USA, May 20–23, 2019	381
Sixteenth Asian Logic Conference, Nazarbayev University, Nur-Sultan, Kazakhstan, June 17–21, 2019	456
2019 European Summer Meeting of the Association for Symbolic Logic, Logic Colloquium 2019, Prague, Czech Republic, August 11–16, 2019	479

The Annual Conference of the Australasian Association for Logic, University of Wollongong, Australia, July 12, 2019.....	530
---	-----

MEETINGS SPONSORED BY THE ASSOCIATION FOR SYMBOLIC LOGIC

The Fifteenth International Conference on Computability and Complexity in Analysis (CCA 2018), Lake Kochel, Germany, August 5–8, 2018	127
30th European Summer School in Logic, Language, and Information (ESSLLI 2018), Sofia, Bulgaria, August 6–17, 2018	128
Satellite Conference on Mathematical Logic of the International Congress of Mathematicians 2018, Niterói, Brazil, August 10–11, 2018.....	129
Advances in Modal Logic 2018 Logic, Algebra and Truth Degrees 2018, Bern, Switzerland, August 27–31, 2018.....	130
The Proof Society Summer School 2018, Ghent, Belgium, September 2–5, 2018.....	131
Set Theory Today: A Conference in Honor of Georg Cantor, Vienna, Austria, September 10–14, 2018.....	132
From Permutation Groups to Model Theory, Edinburgh, UK, September 17–21, 2018	413
Hilbert–Bernays Summer School on Logic and Computation 2018, Göttingen, Germany, July 22–28, 2018.....	414
Cantor Meets Robinson, Campinas, Brazil, December 12–15, 2018.....	415
Thirteenth International Conference on Computability, Complexity and Randomness (CCR 2018), Santiago, Chile, December 17–21, 2018	416
Syntax Meets Semantics (SYSMICS 2019), Amsterdam, The Netherlands, January 21–25, 2019	417
Ph.D.s in Logic XI 2019, Bern, Switzerland, April 24–26, 2019.....	418
ACM/IEEE Symposium on Logic in Computer Science (LICS 2019), Vancouver, Canada, June 24–27, 2019.....	419
12th Panhellenic Logic Symposium (PLS 12, 2019), Anogeia, Crete, Greece, June 26–30, 2019.....	420
26th Workshop on Logic, Language, Information, and Computation (WoLLIC 2019), Utrecht, The Netherlands, July 2–5, 2019	421
The Sixteenth International Conference on Computability and Complexity in Analysis (CCA 2019), Zagreb, Croatia, July 8–11, 2019	529
CIE 2019: Computing with Foresight and Industry, Durham, UK, July 15–19, 2019.....	532
Association for Symbolic Logic.....	533
Notices	133, 274, 423, 537

ADDENDUM

2018 European Summer Meeting of the Association for Symbolic Logic, Logic Colloquium 2018 - Addendum	542
---	-----

THE BULLETIN OF SYMBOLIC LOGIC (ISSN print: 1079–8986, ISSN online: 1943–5894) is published quarterly, in the months of March, June, September, and December, by the Association for Symbolic Logic, Inc., Department of Mathematics, University of Connecticut, 341 Mansfield Road, U-1009, Storrs, CT 06269-1009, USA. Periodicals postage is paid at Storrs CT and at additional mailing offices. The BULLETIN is distributed with THE JOURNAL OF SYMBOLIC LOGIC. The 2018 annual subscription price for the two journals, in either print or electronic form, is US\$884 or £555; the print/electronic bundle prices are \$985 or £619: <http://journals.cambridge.org/bsl> for more information. **Postmaster:** Send address changes to **Journals Customer Services Department, Cambridge University Press, One Liberty Plaza, New York, NY 10006, USA**. Business correspondence should be sent to the Secretary-Treasurers of the Association, Russell Miller and David Solomon (address below).

Subscription orders for the JOURNAL and BULLETIN, or REVIEW should be sent to subscriptions_newyork@cambridge.org. All orders must be accompanied by payment by check, credit card (Visa, MasterCard, JCB or American Express only), or debit card. To receive a replacement copy of the BULLETIN, please report damaged, defective or missing issues within nine months of the date of publication.

Volumes 1 through 19 of the BULLETIN are available online at JSTOR: volumes 1 through 24 via Cambridge University Press, <http://journals.cambridge.org/bsl> – access to the latter is free to members.

Individual membership in the Association is open to anyone interested in its work. Annual dues for members are US\$102, £78 sterling or €85 (\$51, £39 sterling or €43 for student, emeritus and unemployed members; see <http://www.aslonline.org/membership-individual.html> for more information, including conditions and privileges). Dues include subscriptions to the current volumes of the JOURNAL, the BULLETIN, and the REVIEW.

Institutional membership in the Association is available to any academic institution or department. Annual institutional membership dues for 2019 are US\$1200 (full) or \$790 (basic); privileges include choices of current subscriptions, back volumes, regular individual and student memberships.

Requests for information, applications for *new* membership, renewals of institutional membership, business correspondence, and notices or announcements for publication in the BULLETIN should be sent to **ASL, Department of Mathematics, University of Connecticut, 341 Mansfield Road, U-1009, Storrs, CT 06269-1009, USA**. The electronic mail address of the Association's business office is asl@uconn.edu. Requests for back issues should be sent to **Cambridge University Press**, address above.

POSTMASTER: Individual membership *renewals*, notices of change of address, and dues payments, should be sent to **Association for Symbolic Logic, c/o Journals Customer Services Department, Cambridge University Press, One Liberty Plaza, New York, NY 10006, USA**, USmemberservices@cambridge.org.

The paper used in the BULLETIN is acid-free and falls within the guidelines established to ensure permanence and stability.

The BULLETIN has been registered with the Copyright Clearance Center, Inc. The appearance of a code at the bottom of the first page of an article indicates the copyright owner's consent for copying beyond that permitted by Sections 107 or 108 of the US Copyright Law, provided that the per-copy fee stated in the code is paid directly to **Copyright Clearance Center Inc., 222 Rosewood Drive, Danvers, MA 01923, USA**. This consent does not extend to copying for general distribution, for advertising or promotion purposes, for creating new collective works, or for resale. Specific written permission for such copying must be obtained from the Association.

Cambridge Core

For further information about this journal
please go to the journal web site at:
[cambridge.org/bsl](https://www.cambridge.org/bsl)

CAMBRIDGE
UNIVERSITY PRESS