

Brian Christian DuSell

CONTACT INFORMATION	bdusell1@nd.edu bdusell.com
RESEARCH INTERESTS	Natural Language Processing, Neural Networks, Formal Languages
EDUCATION	University of Notre Dame , Notre Dame, IN Aug 2016 to present Ph.D., Computer Science Advisor: David Chiang, Ph.D. University of Notre Dame , Notre Dame, IN Aug 2009 to May 2013 B.S., Computer Science, <i>magna cum laude</i>
RESEARCH PROJECTS	Nondeterministic Stacks in Neural Networks Drawing inspiration from formal language theory, we augment neural networks with nondeterministic stacks, theoretically giving them the ability to recognize all context-free languages and to model syntactic ambiguity. We hypothesize that such models well-suited for learning natural language syntax, which has applications to language modeling and machine translation. We have demonstrated the effectiveness of this approach on formal languages, including syntactically ambiguous context-free languages and even some non-context-free patterns such as cross-serial dependencies. We have also adapted this approach for efficient use on natural language and are working on integrating it with diverse neural architectures such as RNNs, transformers, and CRFs.
PUBLICATIONS	Brian DuSell and David Chiang. 2022. The surprising computational power of nondeterministic stack rnns . Under review. Alexandra Butoi, Brian DuSell, Tim Vieira, Ryan Cotterell, and David Chiang. 2022. Algorithms for weighted pushdown automata. In <i>Proceedings of the 2022 Conference on Empirical Methods in Natural Language Processing</i> , Abu Dhabi, UAE. Association for Computational Linguistics. To appear. Brian DuSell and David Chiang. 2022. Learning hierarchical structures with differentiable nondeterministic stacks . In <i>International Conference on Learning Representations</i> . Spotlight paper. Brian DuSell and David Chiang. 2020. Learning context-free languages with nondeterministic stack RNNs . In <i>Proceedings of the 24th Conference on Computational Natural Language Learning</i> , pages 507–519, Online. Association for Computational Linguistics. Accept rate: 23%. Kenton Murray, Brian DuSell, and David Chiang. 2019. Efficiency through auto-sizing: Notre Dame NLP’s submission to the WNGT 2019 efficiency task . In <i>Proceedings of the 3rd Workshop on Neural Generation and Translation</i> , pages 297–301, Hong Kong. Association for Computational Linguistics.

RESEARCH EXPERIENCE	<p>Research Assistant Aug 2016 to present Natural Language Processing Group Department of Computer Science and Engineering University of Notre Dame Supervisor: David Chiang, Ph.D.</p> <p>Research Assistant Sep 2011 to May 2013 Cooperative Computing Lab Department of Computer Science and Engineering University of Notre Dame Supervisor: Douglas Thain, Ph.D. Summary: Contributed to BioCompute, a distributed computing environment for bioinformatics accessible via a web interface.</p>
TEACHING EXPERIENCE	<p>Instructor of Record Spring 2022 CSE 30151: Theory of Computing Department of Computer Science and Engineering University of Notre Dame Designed and led an in-person course in formal language and complexity theory for a class of about 80 undergraduate students. I received a median course instructor feedback score of 4, on a scale from 0 to 5.</p> <p>Teaching Assistant Fall 2018 CSE 40657/60657: Natural Language Processing Instructor: David Chiang, Ph.D. Department of Computer Science and Engineering University of Notre Dame</p> <p>Teaching Assistant Spring 2017 CSE 30151: Theory of Computing Instructor: David Chiang, Ph.D. Department of Computer Science and Engineering University of Notre Dame Received the department's Outstanding Graduate TA award.</p> <p>Teaching Assistant Fall 2016 CSE 30151: Theory of Computing Instructor: Peter Kogge, Ph.D. Department of Computer Science and Engineering University of Notre Dame Received an Honorable Mention for the department's Outstanding Graduate TA award.</p> <p>Teaching Assistant Fall 2012 CSE 30331: Data Structures Instructors: Paul Brenner, Ph.D. and Raul Santelices, Ph.D. Department of Computer Science and Engineering University of Notre Dame</p> <p>Tutor Spring and Fall 2012 Academic Services for Student-Athletes University of Notre Dame Tutored a student-athlete for the courses CSE 30151: Theory of Computing and CSE 40113: Design and Analysis of Algorithms.</p>
INDUSTRY EXPERIENCE	<p>Applied Scientist Intern, Amazon Web Services Jun to Sep 2021 Team: Amazon Translate Mentors: Xing Niu and Anna Currey Manager: Georgiana Dinu</p>

- Applied Scientist Intern**, Amazon Web Services Jun to Sep 2020
 Team: Amazon Translate
 Mentors: Xing Niu and Greg Hanneman
 Manager: Georgiana Dinu
- Software Developer**, Oak Financial Software Corp May 2014 to Aug 2016
 Developed Chapulín, a hybrid mobile and web application for executing international money transfers to Latin America. Implemented frontend and contributed to backend functionality, tools for analytics, and test automation. Technologies used: JavaScript, Cordova, Python, Node.js.
- Member of Technical Staff**, NetApp, Inc. Jul 2013 to May 2014
 Performed quality assurance for data replication software included in the Data ONTAP storage OS. Technologies used: Perl, Jenkins.
- Software Engineer, Intern**, Wolverine Trading, LLC Summer 2012
 Developed a high-performance Syslog daemon with a configurable message handling system and real-time GUI client. Achieved 300-fold improvement in message processing rate over previous tool. My code was deployed to 80 production servers within the next two months. Technologies used: C++, C#, WPF, XAML.

PROGRAMMING SKILLS Proficient in Python, PyTorch, Bash scripting, Docker, JavaScript/Node.js, frontend/backend web development.
 Very familiar with C, C++, Java, PHP, SQL, MXNet, DyNet.

SOFTWARE

- GitHub Profile (<https://github.com/bdusell>)**
 Features my open-source work.
- Nondeterministic Stack RNN (<https://github.com/bdusell/nondeterministic-stack-rnn>)**
 PyTorch implementation of our Nondeterministic Stack RNN model, as well as other Stack RNN models.
- Semiring Einsum (<https://bdusell.github.io/semiring-einsum/>)**
 Efficient PyTorch implementation of einsum (a generalization of matrix multiplication) in different semirings.
- Jishosen (jishosen.com)**
 A Japanese-English dictionary website based on freely available data.

- SERVICE**
- Seminars on Formal Languages and Neural Networks: Oct 2022
 “Nondeterministic Stacks in Neural Networks”
 URL: https://www.youtube.com/watch?v=tkj6E9_n82U
 - Reviewer, EMNLP 2022 2022
 - Reviewer, EMNLP 2021 2021
 - XSEDE Campus Champions Tech Talk: May 2019
 “How to Install Literally Anything: A Practical Guide to Singularity.”
 URL: <https://github.com/bdusell/singularity-tutorial>
 - Graduate Orientation Ambassador 2017-2019
 Organized the orientation program for incoming graduate students at the University of Notre Dame.
 - Graduate Representative 2019
 Recruited fellowship awardees for the Notre Dame Graduate School.
 - CSE Peer Mentor 2018-2019
 Mentored first-year graduate students in the Computer Science and Engineering Department at Notre Dame.
 - Organizing Committee for Midwest Speech and Language May 2018
 Days (MSLD) 2018

- AWARDS
- Notebaert Premier Fellowship 2016
 University of Notre Dame Graduate School
 A competitive fellowship funded through the largest single gift bestowed upon the university for graduate education.
 - First Place, Chinese Speech Contest (2nd Year Chinese) April 2019
 University of Notre Dame Department of East Asian Languages
 - Outstanding Graduate Teaching Assistant Spring 2018
 Department of Computer Science and Engineering
 University of Notre Dame
 - Honorable Mention, Outstanding Graduate Teaching Assistant Spring 2017
 Department of Computer Science and Engineering
 University of Notre Dame
 - Member, Tau Beta Pi Engineering Honor Society 2012 to present
 - Member, Upsilon Pi Epsilon Computing Honor Society 2012 to present
 - College of Engineering Dean's List Fall 2010 to Spring 2013
 University of Notre Dame

LANGUAGES English (native), Japanese (basic), Mandarin (basic)

- REFERENCES
- David Chiang, Ph.D.
 Associate Professor E-mail: dchiang@nd.edu
 Department of Computer Science and Engineering
 University of Notre Dame
- Peter Kogge, Ph.D.
 McCourtney Professor of CSE E-mail: kogge@nd.edu
 Department of Computer Science and Engineering
 University of Notre Dame
- Douglas Thain, Ph.D.
 Professor and Associate Chair E-mail: dthain@nd.edu
 Department of Computer Science and Engineering
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