

Brian Christian DuSell

CONTACT INFORMATION	Email	bdusell1@nd.edu
	Home Page	bdusell.com
	Google Scholar	https://scholar.google.com/citations?user=1AkLaFIAAAAJ
	GitHub	https://github.com/bdusell
RESEARCH INTERESTS	Natural Language Processing, Neural Networks, Formal Language Theory	
EDUCATION	University of Notre Dame , Notre Dame, IN	Aug 2016 to May 2023 (expected)
	M.S. and Ph.D., Computer Science	
	Dissertation: <i>Nondeterministic Stacks in Neural Networks</i>	
	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, I augment neural networks with nondeterministic stacks, giving them the theoretical ability to recognize all context-free languages and to model syntactic ambiguity. Such models are well-suited for learning natural language syntax, which has applications to language modeling and machine translation. I have demonstrated the effectiveness of this approach on formal languages and natural language, including syntactically ambiguous context-free languages and even some non-context-free patterns such as cross-serial dependencies. This approach can be adapted to diverse neural architectures, including RNNs, transformers, and CRFs.	
PUBLICATIONS	Brian DuSell and David Chiang. The Surprising Computational Power of Nondeterministic Stack RNNs. In <i>Proc. ICLR</i> . 2023. To appear.	
	Alexandra Butoi, Brian DuSell , Tim Vieira, Ryan Cotterell, and David Chiang. Algorithms for Weighted Pushdown Automata. In <i>Proc. EMNLP</i> . 2022.	
	Brian DuSell and David Chiang. Learning Hierarchical Structures with Differentiable Nondeterministic Stacks. In <i>Proc. ICLR</i> . 2022. Spotlight paper (awarded to 5% of submitted papers).	
	Brian DuSell and David Chiang. Learning Context-Free Languages with Nondeterministic Stack RNNs. In <i>Proc. CoNLL</i> , 507–519. 2020. Acceptance rate: 23%.	
	Kenton Murray, Brian DuSell , and David Chiang. Efficiency through Auto-Sizing: Notre Dame NLP’s Submission to the WNGT 2019 Efficiency Task. In <i>Proc. Workshop on Neural Generation and Translation</i> , 297–301. 2019.	
INVITED TALKS	<ul style="list-style-type: none">• “Nondeterministic Stacks in Neural Networks” Seminars on Formal Languages and Neural Networks Recording: https://www.youtube.com/watch?v=tkj6E9_n82U• “Stack Nondeterminism in Neural Networks” Notre Dame NL+ URL: https://nlp.nd.edu/nlplus/2021/11/10/dusell.html• “How to Install Literally Anything: A Practical Guide to Singularity.” XSEDE Campus Champions Tech Talk Recording: https://www.youtube.com/watch?v=D5pe4ewtDe8	Oct 2022 Nov 2021 May 2019

RESEARCH
EXPERIENCE

- 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.
- 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.

TEACHING
EXPERIENCE

- 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 over 80 undergraduate students. I received a median course instructor feedback score of 4, on a scale from 0 to 5, which is the unofficial threshold for excellent teaching used in making tenure decisions at Notre Dame.
- 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
- 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.
- 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.
- 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
- 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.

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> <p>Applied Scientist Intern, Amazon Web Services Jun to Sep 2020 Team: Amazon Translate Mentors: Xing Niu and Greg Hanneman Manager: Georgiana Dinu</p> <p>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.</p> <p>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.</p> <p>Software Engineer, Intern, Wolverine Trading, LLC May to Aug 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.</p>
PROGRAMMING SKILLS	<p>Proficient in Python, PyTorch, Bash scripting, Docker, JavaScript/Node.js, frontend/backend web development.</p> <p>Very familiar with C, C++, Java, PHP, SQL, MXNet, DyNet.</p>
SOFTWARE	<p>Nondeterministic Stack RNN (https://github.com/bdusell/nondeterministic-stack-rnn) PyTorch implementation of my Nondeterministic Stack RNN model, as well as other Stack RNN models.</p> <p>Semiring Einsum (https://bdusell.github.io/semiring-einsum/) Efficient PyTorch implementation of einsum (a generalization of matrix multiplication) in multiple semirings.</p> <p>QFunnel (https://github.com/bdusell/qfunnel) Command-line tool for efficiently queueing large numbers of experiments on Notre Dame’s research computing cluster.</p> <p>dockerdev (https://github.com/bdusell/dockerdev) Shell scripts for easily managing development environments in Docker containers.</p> <p>rougescore (https://github.com/bdusell/rougescore) Python implementation of the ROUGE metric.</p> <p>Jishosen (jishosen.com) A Japanese-English dictionary website based on freely available data.</p> <p>pycfg (https://github.com/bdusell/pycfg) Implementation of several context-free grammar algorithms, including Tomita’s GLR parsing algorithm.</p> <p>romaji-cpp (https://github.com/bdusell/romaji-cpp) C++ library for transliterating Japanese phonetic characters to Latin letters.</p> <p>kgreek (https://github.com/bdusell/kgreek) Java library for dealing with orthography in ancient Greek.</p> <p>xlator (https://github.com/bdusell/xlator) Programmable machine translation system based on syntactic transfer.</p>

PROFESSIONAL SERVICE	<ul style="list-style-type: none"> • ACL 2023, Reviewer • EMNLP 2022, Reviewer • EMNLP 2021, Reviewer • Organizing Committee for Midwest Speech and Language Days 	<p>Feb to Apr 2023 Jun to Aug 2022 Jun to Aug 2021 May 2018</p>
LEADERSHIP AND MENTORING	<ul style="list-style-type: none"> • Mentor, Graduate Resilience Alliance at Notre Dame Mentor a group of first-year Notre Dame graduate students. • Graduate Orientation Ambassador, University of Notre Dame Organized the fall orientation program for incoming graduate students. • Graduate Representative, University of Notre Dame Recruited fellowship awardees for the Graduate School. • CSE Peer Mentor, University of Notre Dame Mentored first-year graduate students in the Computer Science and Engineering Department. 	<p>Jan 2023 to present 2017 to 2019 2019 2018 to 2019</p>
AWARDS	<ul style="list-style-type: none"> • Notebaert Premier Fellowship 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) University of Notre Dame Department of East Asian Languages • Outstanding Graduate Teaching Assistant Department of Computer Science and Engineering University of Notre Dame • Honorable Mention, Outstanding Graduate Teaching Assistant Department of Computer Science and Engineering University of Notre Dame • B.S. <i>magna cum laude</i>, University of Notre Dame • Member, Tau Beta Pi Engineering Honor Society • Member, Upsilon Pi Epsilon Computing Honor Society • College of Engineering Dean's List University of Notre Dame 	<p>2016 Apr 2019 May 2018 May 2017 2013 2012 2012 Fall 2010 to Spring 2013</p>
LANGUAGES	English (native), Japanese (basic), Mandarin (basic)	