

Brian Christian DuSell

CONTACT INFORMATION	Email Home Page Google Scholar GitHub	bdusell1@nd.edu bdusell.com https://scholar.google.com/citations?user=1AkLaFIAAAAJ https://github.com/bdusell
RESEARCH INTERESTS	Natural Language Processing, Neural Networks, Formal Language Theory	
EDUCATION	University of Notre Dame , Notre Dame, IN M.S. and Ph.D., Computer Science Dissertation: <i>Nondeterministic Stacks in Neural Networks</i> Advisor: David Chiang, Ph.D.	Aug 2016 to May 2023
	University of Notre Dame , Notre Dame, IN B.S., Computer Science, <i>magna cum laude</i>	Aug 2009 to May 2013
RESEARCH PROJECTS	Nondeterministic Stacks in Neural Networks My PhD thesis addressed limitations in the abilities of widely-used neural network architectures (RNNs and transformers) to learn syntax. We did this by incorporating differentiable stacks into neural networks, drawing inspiration from theoretical connections between syntax and stacks. Whereas prior work employed deterministic stacks, ours was the first to use nondeterministic stacks, which are important for handling syntactic ambiguity and recognizing arbitrary context-free languages, not just deterministic ones. Empirically, neural networks with nondeterministic stacks learn context-free languages much more effectively than prior stack-augmented models, including a language with theoretically maximal parsing difficulty. Our nondeterministic stack RNN also outperforms prior stack RNNs on natural language modeling. This work represents an important step toward building systems that use syntax in more human-like fashion.	
PUBLICATIONS	Brian DuSell . <i>Nondeterministic Stacks in Neural Networks</i> . PhD thesis, University of Notre Dame. 2023. Brian DuSell and David Chiang. The Surprising Computational Power of Nondeterministic Stack RNNs. In <i>Proc. ICLR</i> . 2023. 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	Oct 2022

- “Stack Nondeterminism in Neural Networks” Nov 2021
Notre Dame NL+
URL: <https://nlp.nd.edu/nlplus/2021/11/10/dusel1.html>
- “How to Install Literally Anything: A Practical Guide to Singularity.” May 2019
XSEDE Campus Champions Tech Talk
Recording: <https://www.youtube.com/watch?v=D5pe4ewtDe8>

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	Applied Scientist Intern , Amazon Web Services	Jun to Sep 2021
	Team: Amazon Translate Mentors: Xing Niu and Anna Currey Manager: Georgiana Dinu	
	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 Chapulfn, 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	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.	
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	<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>	

kgreek (<https://github.com/bdusell/kgreek>)

Java library for dealing with orthography in ancient Greek.

xlator (<https://github.com/bdusell/xlator>)

Programmable machine translation system based on syntactic transfer.

PROFESSIONAL SERVICE	<ul style="list-style-type: none">• NeurIPS 2023, Reviewer• ACL 2023, Reviewer• EMNLP 2022, Reviewer• EMNLP 2021, Reviewer• Organizing Committee for Midwest Speech and Language Days	May to Aug 2023 Feb to Apr 2023 Jun to Aug 2022 Jun to Aug 2021 May 2018
LEADERSHIP AND MENTORING	<ul style="list-style-type: none">• Mentor, Graduate Resilience Alliance at Notre Dame• Graduate Orientation Ambassador, University of Notre Dame• Graduate Representative, University of Notre Dame• CSE Peer Mentor, University of Notre Dame	Jan to Apr 2023 2017 to 2019 2019 2018 to 2019
AWARDS	<ul style="list-style-type: none">• Notebaert Premier Fellowship• First Place, Chinese Speech Contest (2nd Year Chinese)• Outstanding Graduate Teaching Assistant• Honorable Mention, Outstanding Graduate Teaching Assistant• 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	2016 Apr 2019 May 2018 May 2017 2013 2012 2012 Fall 2010 to Spring 2013
LANGUAGES	English (native), Japanese (basic), Mandarin (basic)	