

# TRISTAN THRUSH

RESEARCH ASSOCIATE, MIT DEPARTMENT OF BRAIN AND COGNITIVE SCIENCES

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## EDUCATION

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### Massachusetts Institute of Technology

2017 - 2019

Master of Engineering, Artificial Intelligence. Department of Electrical Engineering and Computer Science. Thesis: SAL: a Self-Aware Learning system. Supervisor: Patrick Winston, Ford Professor of Artificial Intelligence and Computer Science. GPA: 5.0/5.0.

### Massachusetts Institute of Technology

2015 - 2019

Bachelor of Science, Computer Science and Engineering. Minor in Mathematics. Minor in Linguistics. GPA: 4.7/5.0.

### Relevant Courses

Computational Psycholinguistics [1]. The Human Intelligence Enterprise [1]. Automata, Computability, and Complexity. Statistics for Applications. Statistical Learning Theory [1]. Computational Cognitive Science [1]. Syntax. Phonology. Aspects of a Computational Theory of Intelligence (listener) [1]. Language Acquisition. Semantics and Pragmatics. Advanced Natural Language Processing [1]. Machine Learning [1]. Intro to Neuroscience (listener). Seminar in Advanced Undergraduate Research. Probability and Random Variables. Applied Machine Learning/Intro to Machine Learning. Robotics: Science and Systems. Computer Systems Engineering. Intro to Linguistics. Artificial Intelligence. Design and Analysis of Algorithms. Special Subject in EECS (a course in computational linguistics). The Philosophy of Mathematics. Computation Structures. Intro to Algorithms. Software Construction. Intro to Software Engineering in Java. Intro to C and C++. Intro to EECS. Mathematical Reasoning (proofs, Set Theory, Number Theory) [2]. Linear Algebra [2]. Vector Calculus (multivariable) [2]. Differential Equations [2]. Calculus and Analytic Geometry for Science and Engineering (multivariable) [2]. Calculus for Science and Engineering (integral) [2]. Calculus for Science and Engineering (differential) [2].

[1] *Graduate-level course.*

[2] *Took all of the science and engineering math series courses, and additional theoretical math, at UC San Diego (7 courses with 3.9/4.0 GPA) and was accepted to MIT, from age 15 to 16. Graduated high school one year early as valedictorian.*

## LANGUAGES AND FRAMEWORKS

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Python [3]. Cython. C++ [3]. C. Java [3]. JavaScript. Lua. R. MATLAB. WebPPL. Assembly. SQL. YAML. Batch Files. Shell Scripts [3]. XML-ish (HTML, URDF, SDF). Cluster Computing and Machine Learning [3]. ROS. Drake. LCM. PyTorch [3]. Torch. Keras. TensorFlow. OpenCV. OpenAI Gym. Pandas. scikit-learn. NumPy. SciPy. GNU/UNIX [3]. Android. LIBVISO2. Linguistic Research Databases (e.g. CHILDES, Treebanks) [3].

[3] *Most salient.*

## EXPERIENCE

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### Positions

Independent AI Research Consultant. Research Associate [4]. Teaching Assistant for MIT's Graduate Computational Cognitive Science class; supervised a number of graduate-level NLP projects. Research Assistant [5]. Master's Researcher [5]. Undergraduate Researcher [5] [6]. Remote Affiliate [7]. Research Intern [7]. Research Extern [8].

## Honors

Grant funding [4]. Author of three separate research proposals accepted for sponsored funding [5]. AFOSR funding to speak at Advances in Cognitive Systems (presented first author journal paper) [5]. PhD candidate level of research funding (as undergraduate) [7]. Certificate in Advanced Undergraduate Research in Artificial Intelligence and Machine Learning [5]. MIT EECS Undergraduate Research and Innovation Scholar [5]. Contributor to paper awarded Best Paper in Cognitive Robotics at IROS [8]. Author of research proposal accepted for institute funding [6].

- [4] *Computational Psycholinguistics Group, MIT Department of Brain and Cognitive Sciences. Supervisors: Roger Levy and Josh Tenenbaum. 2019-2020.*

Developing new constraints and algorithms for neural machine translation, syntactic parsing, semantic parsing, and unsupervised grammar induction. Contributing to group software engineering efforts with code to analyze state of the art transformer language models.

- [5] *Genesis Group, MIT Computer Science and Artificial Intelligence Laboratory. Supervisor: Patrick Winston. 2016-2019.*

Developed state of the art neural reinforcement learning algorithms for a multi-step question answering system. Also conducted work on lattice learning and backward chaining.

- [6] *Robot Locomotion Group, MIT Computer Science and Artificial Intelligence Laboratory. Supervisor: Russ Tedrake. 2017.*

Integrated a state of the art belief space planner with control primitives in the Drake simulation and control toolbox. Integrated the planner with a language production system. Contributed to the Drake software engineering effort.

- [7] *Computer Vision Group, Caltech/NASA Jet Propulsion Laboratory. Supervisor: Renaud Detry. 2018.*

Developed a stereo visual odometry algorithm for localization that was a significant improvement over the state of the art. Involved work on neural dense segmentation and feature extraction modules. The algorithm has impacted the group's approach to autonomously recovering the first sample tubes from Mars.

- [8] *RoboSimian Laboratory, Caltech/NASA Jet Propulsion Laboratory. Supervisor: Renaud Detry. 2017.*

Integrated inverse kinematics, motion planning, and vision system for visual scene understanding research with a robot arm.

## PAPERS

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Available at [www.tristanthrush.com](http://www.tristanthrush.com).

### Working (titles and authors may change)

Thrush, T. (2019). Compositional neural machine translation by removing the lexicon from syntax. Unpublished Manuscript, Department of Brain and Cognitive Sciences, Massachusetts Institute of Technology, Cambridge, CA.

Detry, R., Thrush, T. and others. High-accuracy stereo pose estimation with robust visual odometry features and dense segmentation for autonomous recovery of sample tubes on mars. Unpublished Manuscript, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA.

## Peer-Reviewed Journal and Conference Publications, Talks, and Contributions; Thesis

Thrush, T. (2019). SAL: a Self-Aware Learning system (Master's thesis). Computer Science and Artificial Intelligence Laboratory, Massachusetts Institute of Technology, Cambridge, MA.

Thrush, T., and Winston, P. (2018). The partial mental state inducer: Learning intuition with few training examples and k-line theory. *Advances in Cognitive Systems*, 7, 97-116.

Thrush, T. (2018, November). A neural model for learning a humanlike vowel feature space. Paper presented at the 12th annual meeting of Northeastern Computational Phonology, Cambridge, MA.

Thrush, T. (2018, August). The partial mental state inducer: Learning intuition with few training examples and k-line theory. Paper presented at the 6th annual meeting of Advances in Cognitive Systems, Stanford, CA.

(Acknowledgement) Detry, R., Papon, J., and Matthies, L. (2017). Task-oriented grasping with semantic and geometric scene understanding. *Proceedings of the 2017 International Conference on Intelligent Robots and Systems*. Vancouver, Canada: IEEE/RSJ.

## Reports

Thrush, T. (2018). Convolutions inspired by the human retina enable learning of more robust features. Department of Brain and Cognitive Sciences, Massachusetts Institute of Technology, Cambridge, MA.

Thrush, T. (2018). A computational model for unsupervised vowel acquisition. Department of Linguistics and Philosophy, Massachusetts Institute of Technology, Cambridge, MA.

Buhai, R., and Thrush, T. (2017). Machine learning approaches to capture the reliability of news articles. Department of Electrical Engineering and Computer Science, Massachusetts Institute of Technology, Cambridge, MA.

Thrush, T. (2017). A self-aware and hypothetical question-answering BHPN with drake control. Computer Science and Artificial Intelligence Laboratory, Massachusetts Institute of Technology, Cambridge, MA.

Thrush, T. (2016). Probabilistic lattice learning and backward chaining. Computer Science and Artificial Intelligence Laboratory, Massachusetts Institute of Technology, Cambridge, MA.

## PERSONAL AND CLASS PROJECTS

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Self-Driving Racecar. Transfer Learning GAN StackExchange Answer Selector. Neural Fake News Generator/Classifier. Maze-Solver App. 3D-Printed Arm with Vision Algorithm for Playing Catch. Sentiment Analyzer. Census Data Clusterer. Artist Classifier. Genetic Neural Net Trainer. Probabilistic Control Simulator for Motion Planning and Counterfactual Physical Reasoning.