

Guy Davidson

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I am a machine learning and cognitive science researcher, excited about building machine learning systems to solve complex problems, analyzing their behavior in comparison with humans, and deriving insights to improve model performance. My research applies insights from cognitive science to develop more human-like machine-learning methods. My thesis studies how people represent cognitive goals and tasks, combining human experiments, data analysis, and computational modeling to progress toward richer goal representations. I am interested in professional opportunities in research or research engineering to contribute to building machine learning-driven products, deriving useful insights from data, or advancing academic and applied research.

EDUCATION

NYU CENTER FOR DATA SCIENCE

PhD student

New York, NY

2019–Present

Advised by Professors Brenden Lake and Todd Gureckis. My thesis research studies how humans represent cognitive goals and tasks, aiming to build computational models generating human-like goals, to eventually develop richer goal representation for artificial agents. My other primary graduate research project models infant relation categorization with deep neural networks.

BRAINS, MINDS, AND MACHINES SUMMER COURSE

Hosted by the MIT and Harvard Center for Brains, Minds, and Machines

Woods Hole, MA

08/2021

MACHINE LEARNING SUMMER SCHOOL

Hosted by University College London and Imperial College London

London, England

07/2019

MINERVA UNIVERSITY

BSc in Computational Sciences

San Francisco, CA

2015–2019

I graduated summa cum laude with a concentration in Machine Learning **GPA: 3.98/4.0**. In my **capstone project**, I investigated the scaling behavior of different meta-learning algorithms: how quickly new tasks are learned as a function of previous training, using a novel benchmark paradigm inspired by visual question answering (externally advised by Mike Mozer, published at CVPR 2020).

PUBLICATIONS AND PRESENTATIONS

Davidson, G., Orhan, A. E., Lake, B. M. (2024). Spatial Relation Categorization in Infants and Deep Neural Networks. *Cognition*.

Sharma, S. **Davidson, G.**, Khetarpal, K., Kanervisto, A., Arora, U., Hofmann, K., Momennejad, I. (2024). Toward Human-AI Alignment in Large-Scale Multi-Player Games. *ArXiv*.

Davidson, G., Todd, G., Gureckis, T. M., Togelius, J., Lake, B. M. (2023). Generating Human-Like Goals by Synthesizing Reward-Producing Programs. *Intrinsically Motivated Open-ended Learning Workshop @ NeurIPS 2023*.

Davidson, G., Gureckis, T. M., & Lake, B. M. (2022). Creativity, Compositionality, and Common Sense in Human Goal Generation. *Proceedings of the 44th Annual Meeting of the Cognitive Science Society, CogSci 2022*.

Davidson, G., Lake, B. M. (2021). Examining Infant Relation Categorization Through Deep Neural Networks. *Proceedings of the 43rd Annual Meeting of the Cognitive Science Society, CogSci 2021*.

Bennett, D., **Davidson, G.**, & Niv, Y. (2021). A model of mood as integrated advantage. *Psychological Review*.

Davidson, G., Lake, B. M. (2020). Investigating Simple Object Representations in Model-Free Deep Reinforcement Learning. *Proceedings of the 42nd Annual Meeting of the Cognitive Science Society, CogSci 2020*.

Davidson, G., Lake, B. M. (2020). Systematically Comparing Neural Network Architectures in Relation Learning. *Object-Oriented Learning (OOL): Perception, Representation, and Reasoning Workshop @ ICML 2020*.

Davidson, G., Mozer, M. C. (2020). Sequential mastery of multiple visual tasks: Networks naturally learn to learn and forget to forget. *The IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*.

Davidson, G., Radulescu, A., & Niv, Y. (2019). Contrasting the effects of prospective attention and retrospective decay in representation learning. *The 4th Multidisciplinary Conference on Reinforcement Learning and Decision Making*.

Bennett, D., **Davidson, G.**, & Niv, Y. (2019). Momentum and mood in policy-gradient reinforcement learning. *The 4th Multidisciplinary Conference on Reinforcement Learning and Decision Making*.

SKILLS AND TECHNICAL COMPETENCIES

- Neural network research and development (mostly PyTorch)
- Data science and analysis (Numpy, Pandas, Sklearn, Matplotlib)
- Software engineering, architecture design, and testing
- Human participant research experiment design
- Web experiment development (React, vue, tailwind, Firebase)
- Research environment and stimulus design (Unity, Blender)

RESEARCH & PROFESSIONAL EXPERIENCE

MICROSOFT RESEARCH

Research Intern

New York, NY
05/2022–08/2022

Developed methods inspired by the cognitive psychology concept of task-sets (abstract task representations) to analyze and predict behavior in a large-scale gameplay dataset in a multiplayer game. Initial results highlighted consistent differences between players by their propensity to flee or attack in fight-or-flight scenarios. Mentored by Ida Momennejad and Harm van Seijen.

PRINCETON NEUROSCIENCE INSTITUTE

Research Intern

Princeton, NJ
05/2018–08/2018

Interned with Professor Yael Niv's lab, to investigate human reinforcement learning (RL) in multidimensional environments:

- Modeled data from previous experiments, making discoveries regarding the dissociable roles of attention and decay in human RL, and the efficacy of eye-tracking and fMRI-based attention measures. Project presented at RLDM 2019.
- Implemented a reinforcement learning experiment in a customizable web platform, enabling data collection using Amazon Mechanical Turk and building a framework used by several current lab members to develop new experiments.
- Developed a simulation environment for bandit problems to motivate work framing mood as a momentum variable.

AIDOC MEDICAL

Research Engineer

Tel Aviv, Israel
05/2017–11/2017

- Implemented research-supporting tools in Azure cloud environment to facilitate and expedite deep learning experimentation, reducing idea-to-experiment turnaround 10x from 1-2 hours to 5-10 minutes.
- Explored distributed model training frameworks, performed experiments and analyses leading to opt for tool development.

AMAZON PRIME AIR

Software Development Engineer Intern

Seattle, WA
05/2016–08/2016

- Implemented binary image loading solution for proprietary hardware and software platform using C and assembly.
- Contributed to serialization library used in multiple projects across the Prime Air development group.

MINERVA PROJECT

Software Development Engineer Intern

San Francisco, CA
01/2016–05/2016

- Designed and delivered overhaul of invoicing system, transitioning from a fixed to a line-itemized implementation, to allow for improved flexibility, history tracking, and increased robustness, in a Python/Django/MySQL web-stack.

SIMILARWEB

Software Engineer

Tel Aviv, Israel
06/2015–09/2015

- Integrated products with external partners, debugged and solved multiple production issues, in Node.JS, iOS, and Python.

ISRAEL DEFENSE FORCES INTELLIGENCE BRANCH

Team leader, training instructor, software engineer

Israel
08/2008–10/2014

- Team leader: grew team of four software developers to ten, responsible for developing tools to enhance analysis capabilities and solve production issues. Reduced turnaround time more than 2x, contributed to Israel Defense Prize-winning project.
- Instructor: managed two other instructors, training ten pupils in software engineering and computer networking.
- Software engineer: built in-house data ingestion pipelines and analysis tools. Developed primarily in Python and Java and cultivated debugging and fault analysis expertise.

TEACHING

DS-GA 1016: COMPUTATIONAL COGNITIVE SCIENCE

Section leader, grader

NYU
01/2021-05/2021, 01/2022-05/2022

Served as a section leader and grader for graduate-level course focused on computational approaches to modeling cognition.

DS-UA 112: INTRODUCTION TO DATA SCIENCE

Section leader

NYU
09/2019-12/2019

Served as a section leader for new undergraduate course introducing students to NYU's newly approved Data Science major.