# Christopher Shallue

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## SUMMARY

- **Experienced researcher**: 10+ years across astrophysics, machine learning, and mathematics.
- **Machine learning scientist**: extensive experience designing, implementing, and improving machine learning models for both research and production.
- **Software engineer**: experienced in code design, parallel computing, unit testing, and collaborative coding.

## EMPLOYMENT

**Google DeepMind** **Cambridge, MA, USA**
*Staff Research Engineer* Mar. 2025—present

Developing transformative generative AI models to advance science and help improve people's lives.

**Massachusetts Institute of Technology** **Cambridge, MA, USA**
*Postdoctoral Associate* Feb. 2025—Mar. 2025

Developed machine learning methods to detect exoplanets using data from the NASA Kepler mission.

**Harvard University** **Cambridge, MA, USA**
*Research Assistant* Sep. 2019—Jan. 2025

Developed machine learning and other numerical methods for astrophysics.

**Google Brain Research Team** (now Google DeepMind) **Mountain View, CA, USA**
*Senior Research Software Engineer* Mar. 2016—Oct. 2019

- Designed a machine learning method for detecting extrasolar planets. Discovered the first planet ever found with machine learning, as well as the first extra-solar system with 8 known planets. Integrated the model into the production pipeline for NASA's TESS mission, which has discovered 7000+ new planet candidates to date.
- Co-led a multi-year research program aimed at understanding and improving neural network training. Published 5 papers on data parallelism, optimization methods, and hyperparameter tuning as a primary author.

**Google Display Ads** **Mountain View, CA, USA**
*Software Engineer* Jan. 2014—Mar. 2016

Developed machine learning models for global personalized ad targeting. Personally designed and launched new models with $10M+/year in revenue gains.

## EDUCATION

**Harvard University** **Cambridge, MA, USA**
*PhD in Astronomy & Astrophysics* Sep. 2019—Jan. 2025
*MA in Astronomy & Astrophysics* (*GPA:* 3.81) Sep. 2019—Nov. 2023

- Quad Fellowship (*leaders in STEM committed to innovation and collaboration; 3% acceptance rate*)
- Ardis and Robert James Graduate Fellowship (*exceptional Harvard graduate students*)

**Monash University** **Clayton, VIC, Australia**
*BS (Hons) in Mathematics* (*GPA:* 4.00) Mar. 2009—Jun. 2012

- Carl Moppert Prize for Mathematics (*top mathematics honors student*)
- Monash University Medal for Excellence (*top science student university-wide*)
- Highest Academic Performance in a Science Course (6 time recipient)
- Monash University Scholarship for Excellence

## PUBLICATIONS

**Astrophysics and Cosmology** (selected order)

- **Shallue** and Vanderburg. "Identifying Exoplanets with Deep Learning: A Five Planet Resonant Chain around Kepler-80 and an Eighth Planet around Kepler-90." *The Astronomical Journal*, 155, 94 (2018). *arXiv*
- Dattilo, Vanderburg, **Shallue**, et al. "Identifying Exoplanets with Deep Learning II: Two New Super-Earths Uncovered by a Neural Network in K2 Data." *The Astronomical Journal*, 157, 5 (2019). *arXiv*
- Yu et al, inc. **Shallue**. "Identifying Exoplanets with Deep Learning III: Automated Triage and Vetting of TESS Candidates." *The Astronomical Journal*, 158, 1 (2019). *arXiv*
- de Beurs, Vanderburg, **Shallue**, et al. "Identifying Exoplanets with Deep Learning. IV. Removing Stellar Activity Signals from Radial Velocity Measurements Using Neural Networks." *The Astronomical Journal*, 164, 49 (2022). *arXiv*
- de Beurs et al, inc. **Shallue**. "Characterization of K2-167 b and CALM, a new stellar activity mitigation method." *Monthly Notices of the Royal Astronomical Society*, 529, 2 (2024). *arXiv*
- **Shallue** and Eisenstein. "Reconstructing Cosmological Initial Conditions from Late-Time Structure with Convolutional Neural Networks." *Monthly Notices of the Royal Astronomical Society*, 520, 4 (2023). *arXiv*
- **Shallue** et al. "Warm Hawking Relics From Primordial Black Hole Domination" *Journal of Cosmology and Astroparticle Physics*, 02, 026 (2025). *arXiv*
- **Shallue** and Carroll. "What Hawking Radiation Looks Like as You Fall into a Black Hole" (2025). *arXiv*

**Machine Learning** (selected order)

- **Shallue** et al. "Measuring the Effects of Data Parallelism on Neural Network Training." *Journal of Machine Learning Research*, 20, 112 (2019). *arXiv*
- Choi, **Shallue**, et al. "On Empirical Comparisons of Optimizers for Deep Learning." *Technical report* (2020). *arXiv*
- Dhingra, **Shallue**, et al. "Embedding Text in Hyperbolic Spaces." *Twelfth Workshop on Graph-Based Methods for Natural Language Processing*, 59 (2018). *arXiv*
- Godbole et al, including **Shallue**. "Deep Learning Tuning Playbook." *Field guide* (2023). *GitHub*
- Zhang et al, including **Shallue**. "Which Algorithmic Choices Matter at Which Batch Sizes? Insights From a Noisy Quadratic Model." *Neural Information Processing Systems*, 8194 (2019). *arXiv*
- Choi, Passos, **Shallue**, et al. "Faster Neural Network Training with Data Echoing." *Technical report* (2019). *arXiv*
- Nado, Gilmer, **Shallue** et al. "A Large Batch Optimizer Reality Check: Traditional, Generic Optimizers Suffice Across Batch Sizes." *Technical report* (2021). *arXiv*

**Mathematics**

- **Shallue** and Wanless. "Permutation Polynomials and Orthomorphism Polynomials of Degree Six." *Finite Fields and Their Applications*, 20, 84 (2013). *Publisher*
- **Shallue**. "Permutation Polynomials of Finite Fields." *Honors Thesis* (2012). *arXiv*

## PATENTS

- "Systems and Methods for Reducing Idleness in a Machine-Learning Training System using Data Echoing." *US Patent 11,537,949* (2022).

## OPEN SOURCE CODE

- `AstroNet`: A deep neural network library for identifying exoplanets in stellar light curves. *GitHub*
- `recon-cnn`: A convolutional neural network library for reconstructing cosmological initial conditions. *GitHub*
- `hawking-radiation`: A numerical library for calculating Hawking radiation near a black hole. *GitHub*

## MEDIA AND OUTREACH

### Press Releases

- "Artificial Intelligence, NASA Data Used to Discover Eighth Planet Circling Distant Star." Joint release by NASA, Google, and the University of Texas. Presented in a live teleconference to 44 journalists and 300,000 listeners. Dec. 14, 2017. https://go.nasa.gov/39JuyiI.

### Press Coverage & Interviews

- "Google AI Helped Find the First Solar System Outside Our Own with 8 Planets." Dec. 14, 2017.
  Featured in outlets including the New York Times, Washington Post, CNN, National Geographic, BBC, Wired, Popular Science, and UT Austin's "Research that Changed the World in 2017." Follow up interviews and coverage in Korea (Jan., 2018), Taiwan (Feb., 2018), Japan (Aug., 2018), and China (Sep., 2018).

### TV, Podcast, & Radio Appearances

- "Hunting for Planets with Machine Learning." Televised interview for Cosmic Front on NHK (Japan). Aired Sep. 13, 2018.
- "Detecting Planets with Deep Learning." Practical AI podcast. Aired Jul. 16, 2018.
- "Discovering Exoplanets with Deep Learning." This Week in Machine Learning & AI. Aired Mar. 8, 2018.
- "Discovering Planets with Machine Learning." ABC Australia Radio interview. Aired Dec. 15, 2017.

## TALKS / PRESENTATIONS

- "Machine Learning for Extreme Precision Radial Velocity Researchers." NASA EPRV + Machine Learning Workshop, Jun. 2024.
- "Hawking Relics from Evaporating Primordial Black Holes." University of Texas at Austin, Mar. 2024.
- "Can Deep Learning Help Find Earth Analogues?" Kepler & K2 Science Conference, Mar. 2019.
- "Using Deep Learning to Search for Earths in Kepler and K2 data." University of California Santa Cruz, Nov. 26, 2018.
- "The Effects of Batch Size on Neural Network Training." NASA Frontier Development Lab, Jul. 23, 2018.
- "Hunting for Exoplanets with AI" (*part of Google's keynote*). World AI Conference, Shanghai, Sep. 18, 2018.
- "Hunting for Exoplanets with Machine Learning" (*keynote*). Chicago Booth ML Summit, Apr. 12, 2018.
- "Big Astronomy Begins: Searching for Exoplanets with AI." SETI Talks, Feb. 21, 2018. https://youtu.be/V_rcLEBW1ro.
- "Classifying Kepler Light Curves Using Deep Learning." Bay Area Exoplanet Meeting at NASA, Dec. 1, 2017.
- "Deep Learning for Planet Transits." NASA Frontier Development Lab, Jul. 20, 2017.

## JOURNAL / CONFERENCE REFEREE

- Referee for *Monthly Notices of the Royal Astronomical Society* (2024).
- Referee for *Computational Astrophysics and Cosmology* (2018).
- Referee for the *Astronomical Journal* (2018).
- Referee for *Neural Information Processing Systems* (top machine learning conference) (2019).

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