

# Tyler L. HAYES

## PERSONAL DATA

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CITIZENSHIP: United States of America

## RESEARCH INTERESTS

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Lifelong Machine Learning, Computer Vision, Deep Learning

## EDUCATION

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AUG. 2016 - Doctor of Philosophy in IMAGING SCIENCE  
DEC. 2021 **Rochester Institute of Technology**, Rochester, NY  
Advisor: Dr. Christopher Kanan  
GPA: 3.81/4.0

JAN. 2015 - Master of Science in APPLIED AND COMPUTATIONAL MATHEMATICS  
MAR. 2017 **Rochester Institute of Technology**, Rochester, NY  
Advisor: Dr. Nathan Cahill  
GPA: 4.0/4.0

SEPT. 2011 - Bachelor of Science in APPLIED MATHEMATICS  
MAY 2014 **Rochester Institute of Technology**, Rochester, NY  
GPA: 3.65/4.0, *Magna Cum Laude*

## PEER-REVIEWED CONFERENCE PAPERS

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- ICRA T.L. Hayes, N.D. Cahill, and C. Kanan. Memory efficient experience replay for streaming learning. *In: Proc. IEEE International Conference on Robotics and Automation*, 2019
- CVPR-W T.L. Hayes, R. Kemker, N.D. Cahill, and C. Kanan. New metrics and experimental paradigms for continual learning. *In: CVPRW: Real-World Challenges and New Benchmarks for Deep Learning in Robotic Vision*, 2018
- CVPR N.D. Cahill, T.L. Hayes, R.T. Meinhold, and J.F. Hamilton. Compassionately conservative balanced cuts for image segmentation. *In: Proc. IEEE Conference on Computer Vision and Pattern Recognition*, 2018
- AAAI R. Kemker, M. McClure, A. Abitino, T.L. Hayes, and C. Kanan. Measuring catastrophic forgetting in neural networks. *In: AAAI*, 2018

## PAPERS UNDER REVIEW

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R. Roady, T.L. Hayes, R. Kemker, A. Gonzales, and C. Kanan. Are out-of-distribution detection methods effective on large-scale datasets? *arXiv*, 2019

T.L. Hayes\*, K. Kafle\*, R. Shrestha\*, M. Acharya, and C. Kanan. Remind your neural network to prevent catastrophic forgetting. *arXiv*, 2019

T.L. Hayes and C. Kanan. Lifelong machine learning with deep streaming linear discriminant analysis. *arXiv*, 2019

## ABSTRACTS AND POSTERS WITHOUT PROCEEDINGS

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**T.L. Hayes** and C. Kanan. Lifelong machine learning with deep streaming linear discriminant analysis. *Western NY Signal Processing Workshop, Rochester, NY*, 2019

**T.L. Hayes** and C. Kanan. Lifelong machine learning with deep streaming linear discriminant analysis. *DARPA L2M PI Meeting, Chicago, IL*, 2019

**T.L. Hayes**, N.D. Cahill, and C. Kanan. Memory efficient experience replay for streaming learning. *Western NY Signal Processing Workshop, Rochester, NY*, 2018

**T.L. Hayes**, R. Kemker, N.D. Cahill, and C. Kanan. New metrics and experimental paradigms for continual learning. *CVPR Workshop: Real-World Challenges and New Benchmarks for Deep Learning in Robotic Vision, Salt Lake City, UT*, 2018

R. Kemker, M. McClure, A. Abitino, **T.L. Hayes**, and C. Kanan. Measuring catastrophic forgetting in neural networks. *Conference on Data Analysis (CoDA), Santa Fe, NM*, 2018

R. Kemker, M. McClure, A. Abitino, **T.L. Hayes**, and C. Kanan. Measuring catastrophic forgetting in neural networks. *Western NY Signal Processing Workshop, Rochester, NY*, 2017

## CONFERENCE PAPERS

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**T.L. Hayes**, R.T. Meinhold, J.F. Hamilton, and N.D. Cahill. Piecewise flat embeddings for hyperspectral image analysis. In: *Proc. SPIE DCS Defense and Security: Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery XXIII*, 2017

R.T. Meinhold, **T.L. Hayes**, and N.D. Cahill. Efficiently computing piecewise flat embeddings for data clustering and image segmentation. In: *Proc. IEEE MIT Undergraduate Research and Technology Conference*, 2016

## THESIS

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**T.L. Hayes**. Compassionately conservative normalized cuts for image segmentation. *MS Thesis, Rochester Institute of Technology*, 2017

## TALKS

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**T.L. Hayes**. Memory efficient experience replay for mitigating catastrophic forgetting. *RIT AI Seminar Series, Rochester, NY*, 2019 [**Invited Talk**]

**T.L. Hayes** and N.D. Cahill. Piecewise flat embeddings for hyperspectral image analysis. *SPIE DCS Defense and Security Conference, Anaheim, CA*, 2017

## RESEARCH EXPERIENCE

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AUG. 2017 - PRESENT	GRADUATE RESEARCH ASSISTANT Machine and Neuromorphic Perception Laboratory (kLab) <b>Rochester Institute of Technology</b> , Rochester, NY <b>Topics:</b> Lifelong Machine Learning, Deep Learning, Streaming Learning
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JUNE 2017 - AUG. 2017	<p>GRADUATE RESEARCH INTERN</p> <p>Naval Research Enterprise Internship Program (NREIP) by the American Society for Engineering Education (ASEE)</p> <p><b>U.S. Naval Research Laboratory (NRL)</b>, Washington, DC</p> <p><b>Tasks:</b> Assessed the validity of the manifold hypothesis within deep neural networks. Utilized dimensionality reduction and intrinsic dimension estimation techniques to characterize feature manifolds.</p>
JAN. 2016 - MAY 2017	<p>GRADUATE RESEARCH ASSISTANT</p> <p>Image Computing and Analysis Laboratory (ICAL)</p> <p><b>Rochester Institute of Technology</b>, Rochester, NY</p> <p><b>Tasks:</b> Developed a new cut cost and optimization algorithm for graph-based image segmentation with ties to manifold learning.</p>

## WORK EXPERIENCE

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JUNE 2015 - AUG. 2015	<p>IMAGE SCIENCE INTERN</p> <p><b>UTC Aerospace Systems</b>, Westford, MA</p> <p><b>Tasks:</b> Implemented Non-Linear Least Squares optimizer to fit functions to edge spread data. Derived metrics from fitted edge data to evaluate resolution sharpness metrics of airborne sensors and quantified confidence estimates using bootstrap resampling.</p>
OCT. 2014 - JAN. 2015	<p>STAFFING COORDINATOR</p> <p><b>Durham Staffing</b>, Depew, NY</p> <p><b>Tasks:</b> Contacted employees regarding job opportunities and answered employee and client questions via phone. Administered and organized application materials. Maintained notes on applicants in database.</p>
JUNE 2014 - SEPT. 2014	<p>IT ANALYST - TECHNICAL DEVELOPMENT PROGRAM</p> <p><b>Liberty Mutual Insurance</b>, Portsmouth, NH</p> <p><b>Tasks:</b> Led case study presentations. Coordinated process improvement project to improve productivity trackers. Created workflow diagrams and traceability matrices for process improvement projects.</p>
MAY 2013 - AUG. 2013	<p>INFORMATION TECHNOLOGY INTERN</p> <p><b>Liberty Mutual Insurance</b>, Portsmouth, NH</p> <p><b>Tasks:</b> Researched and compiled presentations on statistical models and statistical software used for predictive analytics. Developed use cases involving loss triangling methods and fraud detection techniques.</p>

## TEACHING EXPERIENCE

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AUG. 2016 - MAY 2017	<p>GRADUATE TEACHING ASSISTANT</p> <p>Chester F. Carlson Center for Imaging Science</p> <p><b>Rochester Institute of Technology</b>, Rochester, NY</p> <p><b>Classes:</b> Deep Learning for Vision (Grad.), Image Processing and Computer Vision (Grad.)</p> <p><b>Tasks:</b> Graded and assisted students with homework, proposals, projects, and presentations.</p>
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JAN. 2015 - MAY 2016	GRADUATE TEACHING ASSISTANT School of Mathematical Sciences <b>Rochester Institute of Technology</b> , Rochester, NY <b>Classes:</b> Calculus (B, C, I, II) <b>Tasks:</b> Assisted students with in-class workshops and graded homework assignments.
JAN. 2014 - MAY 2014	LEARNING ASSISTANT School of Mathematical Sciences <b>Rochester Institute of Technology</b> , Rochester, NY <b>Class:</b> Mathematics of Graphical Simulation <b>Tasks:</b> Created notes and graded group worksheets. Held recitation sessions for assistance with homework and class concepts.
SEPT. 2012 - DEC. 2013	GRADER School of Mathematical Sciences <b>Rochester Institute of Technology</b> , Rochester, NY <b>Classes:</b> Multivariable Calculus, Differential Equations, Probability and Statistics <b>Tasks:</b> Graded homework assignments.

## TECHNICAL SKILLS

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**Deep Learning Frameworks:** PyTorch, TensorFlow, Keras  
**Scientific Computing Packages:** Numpy, Scipy, Scikit-learn  
**Competent in Programming:** Python, MATLAB  
**Also Familiar With:** Java  
**Operating Systems:** Linux (Ubuntu), Microsoft Windows  
**Applications:** Git, Bash Scripting,  $\text{\LaTeX}$ , Microsoft Office, Word, Excel, Outlook

## SCHOLARSHIPS AND AWARDS

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2016 RIT Graduate Student Honor Roll (4.0/4.0 GPA)  
2016 RIT Student Achievement Honors for Outstanding Teaching Assistant  
2015 RIT Graduate Student Scholarship  
2014 Alpha Sigma Lambda Honorary Society  
2014 RIT Student Achievement Honors for Best Mathematical Modeling Project  
2013 RIT Student Achievement Honors for Best Grader  
2012 RIT Named Scholarship  
2011 RIT Merit Scholarship

## INTERNS SUPERVISED

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2019 Hitesh Vaidya (MS Student) - co-supervised with Ryne Roady  
2019 Xuexun Xiao (MS Student)  
2018 Michael Geraci (HS Student) - co-supervised with Kushal Kafle

## REVIEWER

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2018 IEEE International Symposium on Biomedical Imaging (ISBI) [Delegate Reviewer]  
2017 IEEE International Conference on Image Processing (ICIP)