

# Arthur Stephens Williams

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## EDUCATION

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| <b>Doctor of Philosophy – Computational Science</b><br><i>Middle Tennessee State University, Murfreesboro, TN</i> | Aug. 2022 |
| <b>Master of Science – Computer Science</b><br><i>Middle Tennessee State University, Murfreesboro, TN</i>         | Dec. 2019 |
| <b>Bachelor of Science – Computer Science</b><br><i>Middle Tennessee State University, Murfreesboro, TN</i>       | May 2016  |

## RESEARCH INTERESTS

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My research centers on cognitively inspired machine learning, with a focus on multi-agent reinforcement learning, large language models (LLMs), and multimodal language models, aimed at developing intelligent systems capable of robust reasoning and decision-making in complex real-world environments.

## EXPERIENCE

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| <b>Assistant Professor</b><br><i>Department of Computer Science</i><br><i>University of Texas at Tyler</i> | Aug. 2026 – Present |
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Delivered lectures and created exams, assignments, labs, and quizzes for the following computer science courses:

- **COSC 2336 – Data Structures and Algorithms** – Topics include recursion, the underlying philosophy of object-oriented programming, fundamental data structures (including stacks, queues, linked lists, hash tables, trees, and graphs), secure programming techniques, the basics of algorithmic analysis, and an introduction to the principles of language translation.
- **COSC 3325 – Algorithm Analysis and Foundations** – Introduction to the foundations and formal techniques used to support the design and analysis of algorithms, focusing on both the underlying mathematical theory and practical considerations of efficiency. Topics include asymptotic complexity bounds, techniques of analysis, algorithmic strategies, basic computability, and complexity classes.

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| <b>Lecturer</b><br><i>Department of Computer Science</i><br><i>Middle Tennessee State University</i> | Aug. 2025 – Aug. 2026 |
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Delivered lectures and created exams, assignments, labs, and quizzes for the following computer science courses:

- **CSCI 6020 – Data Abstraction and Programming Fundamentals** – Advanced introduction to data abstraction, problem solving, and programming. Programming language concepts, recursion, program development, algorithm design and analysis, data abstraction, objects and fundamental data structures such as stacks, queues, and trees.
- **CSCI 1170 – Computer Science I** – The first of a two-semester sequence using a high-level language; language constructs and simple data structures such as arrays and strings. Emphasis on problem-solving using the language and principles of structured software development.
- **CSCI 2170 – Computer Science II** – Topics include introductory object-oriented programming techniques, software engineering principles, records, recursion, pointers, stacks and queues, linked lists, trees, and sorting and searching.

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| <b>Postdoctoral Researcher</b><br><i>Center for Applied Scientific Computing</i><br><i>Lawrence Livermore National Laboratory</i> | Aug. 2022 – Aug. 2025 |
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- Developed and evaluated large vision-language and language models for high-resolution satellite image classification, image-grounded conversation generation, and multilingual safety alignment tasks.

- Built tools and pipelines for synthetic data generation, benchmark evaluation, and real-time interaction with vision language models (VLMs) and large language models (LLMs) in a user-facing internal application.
- Fine-tuned multimodal models for information extraction, named entity recognition, and visual question answering on document-based tasks using optical character recognition (OCR) and structured prompting.
- Researched and trained multi-agent reinforcement learning systems using transformers and custom proximal policy optimization (PPO) variants for adversarial and sparse-reward wargaming environments.

## Research Assistant

Jan. 2022 – Aug. 2022

*Department of Computer Science*

*Middle Tennessee State University*

- Designed machine learning algorithms for generating missing remotely-sensed video feeds.
- Contributed expertise to an interdisciplinary project with the aim of applying machine learning to remotely-sensed video data.
- Conducted research both independently and in collaboration with faculty.

## Doctoral Researcher

Jan. 2016 – Aug. 2022

*Department of Computer Science*

*Middle Tennessee State University*

- Developed novel working memory models inspired by the interaction between the basal ganglia and prefrontal cortex.
- Designed deep learning models that utilize indirection for solving partially observable, task-switching reinforcement learning problems.
- Developed algorithms that leverage computer vision techniques to solve visual relational reasoning problems.
- Conducted research in collaboration with Dr. Joshua L. Phillips in the areas of Computational Cognitive Neuroscience, Neural Networks, and Machine Learning.

## Lecturer

Aug. 2017 – Dec. 2021

*Department of Computer Science*

*Middle Tennessee State University*

Lectured and developed test, homework, lab, and quiz materials for the following computer science courses:

- **CSCI 6020 – Data Abstraction and Programming Fundamentals** – Advanced introduction to data abstraction, problem solving, and programming. Programming language concepts, recursion, program development, algorithm design and analysis, data abstraction, objects and fundamental data structures such as stacks, queues, and trees.
- **CSCI 1150 – Computer Orientation** – A general introduction to computers with an emphasis on personal computing, database, word processing, presentation graphics, spreadsheets, and Internet tools.
- **CSCI 1170 – Computer Science I** – The first of a two-semester sequence using a high-level language; language constructs and simple data structures such as arrays and strings. Emphasis on problem solving using the language and principles of structured software development.

## Lab Assistant

Aug. 2016 – Dec. 2021

*Department of Computer Science*

*Middle Tennessee State University*

Assisted students with homework assignments and concepts related to their computer science courses.

Managed the computer lab and provided student assistance. Coordinated with other assistants to fulfill students' needs and university goals. The courses are as follows:

- CSCI 6050 – Computer Systems Fundamentals
- CSCI 1170 – Computer Science I
- CSCI 2170 – Computer Science II
- CSCI 3130 – Assembly and Computer Organization

- Remote-Sensed Data for Vision Language Models** | *LLMs, VLMs* Feb. 2025 - Present  
Lawrence Livermore National Laboratory
- Evaluated the performance of VLMs on high-resolution satellite data for a multi-class classification task.
  - Developed a pipeline for generating synthetic multi-turn conversation data for satellite images.
  - Explored the efficacy of using in-context learning for multi-class classification of images
- Safety Evaluation of LLMs** | *LLMs* Feb. 2025 - Present  
Lawrence Livermore National Laboratory
- Conducted a study on jailbreaking open-sourced models with non-English language tokens.
  - Setup a dataset translation pipeline that utilizes an LLM as the translator.
  - Worked with an expert translator to evaluate the accuracy of machine-translated prompts.
- Large Language Model Laboratory** | *LLMs, VLMs* Nov. 2024 - Present  
Lawrence Livermore National Laboratory
- The Large Language Model Laboratory (LLML) is responsible for creating a user-friendly application for LLM evaluation for internal use at Lawrence Livermore National Laboratory.
  - Created feature that allows users to run metrics on LLM-generated outputs.
  - Developed the tools to allow users to automate the process of running multiple LLMs on benchmark datasets.
  - Setup the feature within the LLML application for users to have real-time interaction with VLMs.
- Data Extraction of Documents** | *LLMs, VLMs, Optical Character Recognition (OCR)* Dec. 2023 - Present  
Lawrence Livermore National Laboratory
- Leveraged a VLM to extract information from oil well reports and designed prompts to return the output in JSON format.
  - For a Vision Question Answering (VQA) task, I fine-tuned a multimodal model that leverages optical character recognition (OCR) to extract a specific field from oil well documents.
  - Fine-tuned a multi-modal model to perform named entity recognition (NER) on documents.
- Agent-based Automated Wargaming** | *Reinforcement Learning* Aug. 2022 - October 2024  
Lawrence Livermore National Laboratory
- Trained an online multi-agent reinforcement learning model that leverages the transformer architecture for improved collaboration of agents.
  - Conducted experiments that show that the addition of a novel reward clipping function in PPO increases a model's performance in sparse reward environments.
  - Trained two adversarial multi-agent transformer RL models on a zero-sum game using iterative best response.
  - Deployed multi-agent reinforcement learning strategies in wargame environments to analyze agent interactions and emergent behavior
- Missing Video Imputation** | *Generative Adversarial Network (GAN)* Jan. 2022 - Aug. 2022  
Middle Tennessee State University
- The objective is to understand the relationship between multiple remotely-sensed video feeds with overlapping fields of view.
  - The goal is to use the overlapping video feeds to generate video frames that are interpolations of neighboring cameras sources.
  - Developed a novel Cycle GAN for video frame generation. Preliminary results show that our model can effectively generate realistic video frames.
- Transfer Reinforcement Learning** | *Reinforcement Learning, Transfer Learning* July 2018 - Dec. 2019  
Middle Tennessee State University
- Created a novel working memory model with the capability to transfer knowledge across similar tasks.
  - Simulates the modulation of dopamine in the brain to solve partially observable tasks.
  - We evaluate the model using a maze task in which an artificial agent learns to store relevant environmental cues into memory to solve a partially observable reinforcement learning problem.
- Multilayer Context Reasoning** | *Reinforcement Learning* Feb. 2017 - Jan. 2018  
Middle Tennessee State University
- The model uses Q-learning, a temporal difference learning algorithm, for action selection.
  - Modified Q-function such that it accounts for working memory as an additional state embodied within the agent.
  - Validation was performed using the AX Continuous Performance Task (CPT), which is a common hierarchical working memory task in the cognitive sciences, and the 1-2-AX-CPT variant.

## PUBLICATIONS

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- Williams, A. S., Maguire, A., Soper, B., & Merl, D. (2024). The Innate Curiosity in the Multi-Agent Transformer. 2024 International Conference on Machine Learning and Applications (ICMLA), 1523–1529. URL: <https://ieeexplore.ieee.org/document/10903510>
- Williams, A. S., & Phillips, J. L. (2020). Transfer reinforcement learning using output-gated working memory. Proceedings of the 34th AAAI Conference on Artificial Intelligence, New York, NY. URL: <https://ojs.aaai.org//index.php/AAAI/article/view/5488>
- Williams, A. S., & Phillips, J. L. (2018). Multilayer Context Reasoning in a Neurobiologically Inspired Working Memory Model for Cognitive Robots. Proceedings of the 40th Annual Meeting of the Cognitive Science Society, Madison, WI. URL: <https://escholarship.org/uc/item/95c1379g#main>

## PRESENTATIONS

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- **An Evaluation of Vision Language Models for High-Resolution Satellite Images**  
The 29th Annual Center for Advanced Signal and Image Sciences (CASIS) Workshop, 2025
- **The Innate Curiosity in the Multi-Agent Transformer**  
The 23rd International Conference on Machine Learning and Applications, 2024
- **Transfer Reinforcement Learning using Output-Gated Working Memory**  
The 34th AAAI Conference on Artificial Intelligence, 2020
- **Multilayer Context Reasoning in a Neurobiologically Inspired Working Memory Model for Cognitive Robots**  
The 40th Annual Meeting of the Cognitive Science Society, 2018