Laviers, Kennard R.

CV

April 2019

I have had the fortune to work on a host of large and complex projects that encompass multiple tools working together. As an undergraduate, I developed web software that used an imaging interpreter and Perl to generate the image code scripts. As a game developer, I've programmed my own back-end multi-player game server with PHP acting as an API from my C# games sending requests to the database server for information. As a masters student, I developed in C++ and Java, writing code that had to work together to allow a robot to map an arbitrarily large space and allow the user to see what was happing in real time on a GUI. As a PhD student working on multi-agent learning, I programmed my research software using Java to talk to a C++ simulator server wrapped in a Java middleware utility. These experiences have made me very comfortable with software integration across multiple platforms and software engineering in just about any environment.

I am very interested in research regarding artificial intelligence (AI), multi-agent learning, search algorithms, image processing, using artificial intelligence to augment network security, data visualization, 2D and 3D simulations, data compression and distributed systems. Recently I started working with Tensor Flow and Python to gain more familiarity with current deep learning techniques.

I am very interested in software development at all stages of the application's life-cycle and would enjoy just about any role in a software development team for a large organization.

Experience

Assistant Professor of Computer Science
Sul Ross State University
Dec 2014 – Present
Alpine, TX 79830

Performs research using game technology and artificial intelligence, instructs students in computer science and game programming, and is the computer science advisor for the university. Develops in-class and online courses. Serves on 3 Committees. Spearheaded new Virtual Reality programming class and the Sul Ross Big Data Processing Center. As the computer science program coordinator, reviews and recommends changes to the university computer science program.

Teaches

- Computer Science I
- Computer Science II
- Data Structers
- Intro to Game Programming
- User Interface Programming
- Virtual Reality Programming
- Software Engineering
- Graphics Programming
- Advanced Object Oriented Programming
- Animation Programming
- LINUX
- Operating Systems
- Advanced Database Systems
- Computer Architecture

Assistant Professor of Computer Science
Air Force Institute of Technology
Aug 2011 – Nov 2014
Dayton OH

Performed research on multi-agent learning, intelligent systems, integration of iOS based mobile devices with networks for control and cyber defense, integration of iOS based mobile devices for control of complex remote systems, and integration of cognitive modeling with intelligent interactive systems. Managed, advised, and mentored Masters and Ph.D. students in artificial intelligence and mobile device research for the Air Force and Department of Defense. Developed and instructed grad-level courses in computer science, software engineering, distributed systems, and computer data structures. Lead research for $20K Air Force Space Command sponsored program in mobile sensing research to enhance Air Force situational awareness.
Member of the AFIT Advanced Network Research Group. Provided cutting-edge capabilities to DoD, AF, & industry partners. Led $20K AF Research network operations research--produced novel work in cognitive augmentation--results accepted to international journal. Technical authority on 15 program committees; served on international journal editorial review board. Orchestrated advanced Hadoop virtual network hosting innovative image-based localization student research effort. Expected "big data" solutions to lead the way to reduction in todays crippling war-time bandwidth limited environment. Advanced STEM curriculum with new course development & innovative research--advanced DOD S&T priorities. Initiated collaboration with AFRL in machine translation research effort--working with lab to improve current tech. Stepping-stone to automatic and clear language translation for deployed warfighters in non-English speaking area. Led $40K AFRL network ops research--produced novel work in cognitive augmentation--results accepted to international journal. Secured NRO support to study mobile devices for

RPA control. Developed new course in device trust management--focused on reducing human error--provided direct support to AFRL initiative. See less

Director of Information Technology
58th SOW, Kirtland AFB, United States Air Force
Aug 2007 – Jul 2009
Albuquerque, New Mexico Area

Supervised three SNCOs and one civilian--led 15 military computer administrators and 12 contractors. Managed $4.5M in IT assets, $270K yearly computer lifecycle replacement & $60K annual IT infrastructure budgets. Coordinated computer, LAN and audio/visual equipment requirements for over 2,600 military & civilian personnel. Decision authority for all technology related acquisitions, installations, IT security & IT asset configuration control. Stood up wing's computer helpdesk--reduced manning requirement by four contractors...saved $400K+ yearly. Installed secure LAN for Det 1, MCAS New River NC...provided critical access to parent unit. Built new MS SharePoint collaboration environment for 1,700 users...increased wing's info workflow. Earned Certified Information Systems Security Professional first time testing...level III IA exceeded DOD requirement. Migrated 25 classified network terminals to new regional domain...seamless transition & 0% downtime. Awarded #1 company grade officer on wing staff! Competed against 568 officers and won--Kirtland AFB CGO of the quarter, 4th quarter '07. Key player in 2007 HQ AETC ORI preparation; boosted records compliance 400%...the wing received "Excellent" overall. Implemented web camera system for flight line--boosted situational awareness...security provided for $1.2 Billion in assets. Equipped 11 wing admin offices with high-speed document scanners. Received a stratification of #3 out of 88 officers in the wing.

Chief, Information Security
Air Force Research Lab, Kirtland AFB
Apr 2004 – Jul 2007
Albuquerque, New Mexico Area

Responsible for information security for the Phillips Research Site (Air Force Research Lab in Albuquerque NM) with 2500+ engineers, scientists and support personnel. Responsible for certifying and accrediting new computer based systems not on blanket Air Force certification plan. Responsible for reporting on leaked information and removing leaked data from AFRLs intranet and mail system.

Education

University of Central Florida
Doctor of Philosophy (Ph.D.) , Computer Science
GPA: 3.73
2008 – 2011
Studied opponent modeling and multi-agent learning and published 5 papers during my studies. The dissertation was later published as a book chapter. Implemented prediction models in Java that integrated the Weka Machine Learning toolkit to externally perform learning and classification. Fully funded by the U.S. Air Force as part of a Ph.D. pipeline program. Graduated in 36 months.

U.S. Air Force Institute of Technology
MS Computer Science
GPA: 3.64
2002 – 2004
Studied robot mapping and localization. Integrated C++ based ARIA robotic control software with Java mapping and visualization code to test robot mapping and localization.

The University of Texas at El Paso
BS Computer Science
3.64
1998 – 2000
Air Force ROTC Majored in Computer Science and performed some directed research in Robot programming. I developed an initial set of simulated robots for the university's RoboCup soccer team as a senior. As part of my senior project I implemented a web based image viewing application that integrated IDL imaging software to perform scaling and panning of very large image files to allow web based viewing.

Projects

Mandelbrot Explorer
Nov 2018 – Present
Developed to provide a pedagogical example on visualizing fractals, building a GUI, using multi-threading, and techniques to promote fast image processing. The Mandelbrot provides a beautiful example for students to gain in interest in mathematics as well as the fun we computer scientists have optimizing. Since the Mandelbrot set fractal is completely parallelizable, it provides a perfect domain to demonstrate multi-threading. It also provides a great example to demonstrate the use of large precision numbers and how adding bits of precision allows us to zoom further into the Mandelbrot set.
I provided the full application and source code to allow other professors to use it the same way as well as for artists to explore and print out the beautiful images this

application allows the user to make very easily with no requirement to understand the math underneath the hood.

Card Game Engine
Oct 2013 – Present
Developed a card game framework using the Unity3D game engine. This framework allows script creation of cards using a single atlas and a single draw-call for all the cards. From the ground up the engine was designed to be fast, smooth, very robust and use a very small amount of memory.

Panda-Run
May 2014
We developed this game with a total development time from idea to publication of 14 days. The idea was to make this the first of a handful of "micro-games" to sample game types to see where the public interest is. Panda run is a fun Mario Brothers like game put into a 2D infinite scroller platform. The goal is simply stay alive as long as possible and collect as many coins as you can to beat the high score.
I designed and implemented the game's C# code. The art was purchased from an independent artist and the design was a combination of myself and my business partner.

Push Rummy
Jan 2014 – Apr 2014
Is this new multi-player card game I was fortunate enough to be able to build a turn-based game server to host this first of a new family of card games that we are developing. This is very important as it allows our players to play games against each other, regards of what platform they are using. Someone on an iPhone can play someone else on an Android or Windows device etc.

In addition to the building the game server and all associated APIs I was also responsible for the design and development of the game itself. One of the unique characteristics I was able to bring to the game was a neat AI system which allowed us to introduce over 20 game characters, each with a unique personality and why of playing. Additionally, I added an avatar system that provided initial avatars for the AI players and also allowed users to customize their own avatar that their opponents see while playing. This was a really fun project for me and I am sad that it is almost over.

The primary company assets to came out of this game include
-- a new Finite State Machine (FSM) to control a new state-based controller that is general enough to work in any application,
-- a new theme color manager,
-- the avatar designer, and finally
-- the AI system.

AI Tactical Commander
Sep 2013
Developed Framework to allow machine learning experiments with game play. Tactical Commander allows mobile platform game-play and statistics gathering using the Unity3D game engine.

Publications

(To be published, February 2019).
<Co–authored > "Reimagined Higher Ed Classrooms: Meaningful Learning through Culturally Unbiased Virtual and Augmented Reality" – *Handbook of Research on Innovative Pedagogies and Best Practices in Teacher Education* – IGI Global Publishing.

<Co–authored > "Virtual Learning: A Study of virtual reality for distance education" *July, 2018, Handbook of Research on Blended Learning Pedagogies and Professional Development in Higher Education - IGI Global Publishing, Hershey, PA*

Virtual reality is now becoming a major player in education. When the first schools introduced computer technology and multi-media content to the classroom, students were riveted by its newness and were eager to learn. Over time more and more higher-educational institutions began to use new technologies to offer online or distance classes that students could take from home. Unfortunately, many students have difficulty acquiring the same experience when learning with most Classroom Management Software (CMS) versus being in a traditional classroom setting. Virtual Reality technology is taking user involvement to the next level of immersion and is postured to change the landscape of education in a very significant way. We will investigate methods of employing Virtual Reality (VR) to maximize the benefit of this technology to the student and discuss the advantages and disadvantages inherent in using VR for distance learning. Finally, we will discuss the cutting-edge of technological research in VR and how it is changing, not just the popular and visible applications but also in ways that people can learn and remotely experience the physical world.

<Co–authored >"A Framework to Facilitate Cyber Defense Situational Awareness Modeled in an Emulated Virtual Machine Testbed" *Jul 2015 Journal of Defense Modeling and Simulation*

Modern computer networks and the cyber attacks launched against them grow more complex each year. Analyzing net- work information can be complex and time consuming. Network defenders are routinely unable to orient themselves quickly

enough to determine the expected system impact, much less defend the networks' resources. The network operator's time would be better spent finding and executing event responses to minimize damage. Current automated response systems are mostly limited to scripted responses based on data from a single source. Better automation is required. This paper presents a framework that aggregates data from heterogeneous network sensors, including intru- sion detection systems and network vulnerability assessment tools. An impact rating system is proposed and tested that estimates the feasibility of an attack and its potential impact. The impact assessments allow decision makers to prioritize attacks in real time and attempt to mitigate the attacks in order of their estimated network impact to the network. Experimental results indicated that when administrators are only concerned with high-level attacks, impact assessments could eliminate a mean 51.21% of irrelevant data. When only concerned with high- and medium-level attacks, a mean of 34.03% of the data was irrelevant. This represents a significant reduction in the information administrators must process.

<Co–authored >"Using Opponent Modeling to Adapt Team Play in American Football" *Apr, 2014 Elsevier*

An issue with learning effective policies in multi-agent adversarial games is that the size of the search space can be prohibitively large when the actions of both teammates and opponents are considered simultaneously. Opponent modeling, predicting an opponent's actions in advance of execution, is one approach for selecting actions in adversarial settings, but it is often performed in an ad hoc way. In this chapter, we introduce several methods for using opponent modeling, in the form of predictions about the players' physical movements, to learn team policies. To explore the problem of decision-making in multi-agent adversarial scenarios, we use our approach for both offline play generation and real-time team response in the Rush 2008 American football simulator. Simultaneously predicting the movement trajectories, future reward, and play strategies of multiple players in real-time is a daunting task but we illustrate how it is possible to divide and conquer this problem with an assortment of data-driven models.

<Co–authored >"The Use of Artificial Intelligence for Enhanced Network Defense" *Sep 11, 2012 - Proceedings of the International Defense and Homeland Security Simulation Workshop 2012 ISBN 978-88-97999-08-9; Bruzzone, Buck, Longo, Sokolowski and Sottilare Eds.*

Even after a network intrusion system (IDS) has identified a cyber-attack, network administrators are still faced with the difficult challenge of assessing network health and status in order to appropriately take action to mitigate damage caused by such an attack due to the large amount of data available from the network components. This paper explores the use of auto clustering to abstract network meta-data to form high-level units of information that are more comprehensible for a network administrator or an AI Agent to understand and act on. We perform an empirical analysis to evaluate our approach using the NSLKDD99 dataset for both abstraction

of network log data and attack family classification. By auto-clustering, we significantly increase the classification speed without greatly increasing the error

<Co–authored >"A Real-Time Opponent Modeling System for Rush Football"
Jun 29, 2011 Twenty-Second International Joint Conference on Artificial Intelligence

One drawback with using plan recognition in adversarial games is that often players must commit to a plan before it is possible to infer the opponent's intentions. In such cases, it is valuable to couple plan recognition with plan repair, particularly in multi-agent domains where complete re-planning is not computationally feasible. This paper presents a method for learning plan repair policies in real-time using Upper Confidence Bounds applied to Trees (UCT). We demonstrate how these policies can be coupled with plan recognition in an American football game (Rush 2008) to create an autonomous offensive team capable of responding to unexpected changes in defensive strategy. Our real-time version of UCT learns play modifications that result in a significantly higher average yardage and fewer interceptions than either the baseline game or domain-specific heuristics. Although it is possible to use the actual game simulator to measure reward offline, to execute UCT in real-time demands a different approach; here we describe two modules for reusing data from offline UCT searches to learn accurate state and reward estimators.

<Co–authored >"Identifying and Utilizing Subgroup Coordination Patterns in Team Adversarial Games" *May 2010 - Proc. of 9th Int. Conf. on Autonomous Agents and Multi-agent Systems*

This paper addresses the problem of identifying player coordination patterns in multi-player adversarial games. In the Rush 2008 football simulator, we observe that each play relies on the efforts of different subgroups within the main team to score team touchdowns. We presented a method to automatically identify these subgroups from historical play data based on: 1) mutual information between the offensive player, defensive blocker, and ball location 2) the observed ball work flow. After extracting these subgroups, we demonstrate how subgroups can be used to create new plays by performing play adaptations of existing offensive plays tuned to counter specific defensive plays.

<Co–authored >"Multi-Agent Plan Adaptation Using Coordination Patterns"
Aug 1, 2010 - *Proc. of 9th Int. Conf. on Autonomous Agents and Multi-agent Systems*

One issue with learning effective policies in multi-agent adversarial games is that the size of the search space can be prohibitively large when the actions of all the players are considered simultaneously. In most team games, players need to coordinate to accomplish tasks, either in a preplanned or emergent manner. An effective team policy must generate the necessary coordination, yet considering all possibilities for creating coordinating subgroups is computationally infeasible. I

propose that reusable coordination patterns can be identified from successful training exemplars and used to guide multi-agent policy search. Experiments are conducted within the Rush 2008 football simulator and show how an analysis of mutual information and workflow can be used to identify subgroups of players that frequently coordinate within a particular formation. Using a K* classifier we devised a system to learns a ranking of the impact of subgroups on offensive performance. Results show how we can use knowledge of the top-ranked subgroup to focus search using two different policy generation methods 1) play adaptation and 2) UCT Monte Carlo (MC) planning. Our method produces superior plans which doubles the offensive team's performance in the Rush 2008 football simulator over prior methods.

<Co–authored >"Improving Offensive Performance Through Opponent Modeling" *Oct 2009 - Proceedings of Artificial Intelligence for Interactive Digital Entertainment Conference (AIIDE)*

Although in theory opponent modeling can be useful in any adversarial domain, in practice it is both difficult to do accurately and to use effectively to improve game play. In this paper, we present an approach for online opponent modeling and illustrate how it can be used to improve offensive performance in the Rush 2008 football game. In football, team behaviors have an observable spatio-temporal structure, de- fined by the relative physical positions of team members over time; we demonstrate that this structure can be exploited to recognize football plays at a very early stage of the play using a supervised learning method. Based on the teams' play history, our system evaluates the competitive advantage of executing a play switch based on the potential of other plays to increase the yardage gained and the similarity of the candidate plays to the current play. In this paper, we investigate two types of play switches: 1) whole team and 2) subgroup. Both types of play switches improve offensive performance, but modifying the behavior of only a key subgroup of offensive players yields greater improvements in yardage gained.

<Co–authored >"Exploiting Early Intent Recognition for Competitive Advantage" 2009 *Proceedings of the IJCAI Work- shop on Plan, Activity, and Intent Recognition (PAIR). pp. 58-63.*

In physical domains (military or athletic), team behaviors often have an observable spatio-temporal structure, defined by the relative physical positions of team members over time. In this paper, we demonstrate that this structure can be exploited to recognize football plays in the Rush 2008 football simulator. Although events in the simulator are stochastically generated, we present a method or reliably recognizing football plays at a very early stage using multiple support vector machines; moreover, we demonstrate that having this early information about the defense's intent can be utilized to improve offensive team play. Our system evaluates the competitive advantage of executing a play switch based on the potential of other plays to increase the yardage gained and the similarity of the candidate plays to the current play. Our play switch selection mechanism

outperforms both the built-in offense and a greedy yardage-based switching strategy.

<Co–authored >"Opponent modeling and spatial similarity to retrieve and reuse superior plays" *2009 - Proceedings of the Workshop on Case-Based Reasoning for Computer Games, the International Conference on Case-Based Reasoning*

By analyzing play history, it is possible to gain critical insights about future plays. Plays are sequences of actions to be undertaken by a collection of agents, or teammates. The success of a play depends on a number of factors including, perhaps most importantly, the opponent's play. In this paper, we present an approach for online opponent modeling and illustrate how it can be used to improve offensive performance in the Rush 2008 football simulator. In football, team behaviors have an observable spatio-temporal structure, defined by the relative physical positions of team members over time. We demonstrate that this structure can be exploited to recognize football plays at a very early stage of the play using a supervised learning method. Using the recognized defensive play, knowledge about expected outcomes, and spatial similarity between offensive plays, we retrieve an offensive play from the case base. This play is then (partially) reused to improve an in-progress offensive play. We call this process a play switch. Empirical results indicate that spatial similarity is central to play retrieval, and that substituting only a subset of the current play yields greater improvement over a full play substitution.

<Co–authored >"Cognitive robot mapping with polylines and an absolute space representation" *May 1, 2004 - Robotics and Automation, 2004. Proceedings. ICRA '04. 2004 IEEE International Conference on Robot Automation*

Robot mapping even today is one of the most challenging problems in robot programming. Most successful methods use some form of occupancy grid to represent a mapped region. This approach becomes problematic if the robot is mapping a large environment; the map quickly becomes too large for processing and storage. Rather than storing the map as an occupancy grid, our robot (equipped with sonars) sees the world as a series of connected spaces. These spaces are initially mapped as an occupancy grid in a room-by-room fashion. As the robot leaves a space, denoted by passing through a doorway, the grids are converted to a polygonal representation. This polygonal representation is stored as rooms and hallways as a set of Absolute Space Representations (ASRs) representing the space connections. Using this representation makes navigation and localization easier for the robot to process.