ADITI MALLAVARAPU

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Learning Technologies Group
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https://aditimallavarapu.github.io/aditi-portfolio/#/

RESEARCH INTERESTS

Learning Analytics, Data Mining and Machine Learning applied to data from Educational Environments
Human-Computer Interaction
Learning in Open-ended Learning Environments and Complex System Environments
Computer Supported Collaborative Learning
Complex Systems

EDUCATION

Aug 2016 – Present	**PhD Candidate**	**Computer Science** Human-Computer Interaction, Learning Analytics, and Educational Data Mining Advisor: Leilah Lyons University of Illinois at Chicago (UIC), Chicago, IL, USA (Expected Graduation: May 2021)
Aug 2012 – Oct 2014	**MS**	**Computer Science** Educational Data Mining Concentration Advisor: Leilah Lyons University of Illinois at Chicago (UIC), Chicago, IL, USA MS Thesis Title: *Developing Computational Methods to Measure and Track Learner's Spatial Reasoning*
Aug 2007 – May 2011	**BE**	**Computer Engineering** University of Pune, India

RESEARCH EXPERIENCE

July 2021 - Present	**Learning Sciences and Technology Post-Doctoral Researcher** Digital Promise, San Francisco, CA
July 2021- Present	**Artificial Intelligence in Education Post-Doctoral Researcher** University of Pittsburgh, Pittsburgh, PA

Dec 2020 – Jan 2021	**Data Mining and Visualization Research Assistant**
May 2020 – Aug 2020	New York Hall of Science, Queens, NY
Dec 2019 – Jan 2020	
June 2019 – Aug 2019	
Jul 2017 – Aug 2017	

TEACHING EXPERIENCE

Jan 2018 – Present	**Graduate Teaching Assistant,** Programming Design II (CS 141), Dr. Dale Reed, Dr. Joe Hummel, University of Illinois at Chicago, Chicago, IL
Jun 2018 – Aug 2018	**Adjunct Professor,** Discovering Computer Science (CS 100), University of Illinois at Chicago, UIC Chance, Chicago, IL (Class size: 30)
Jan 2018 – April 2018	**Instructor,** Computer Science Elective: Discovering Computer Science (CS 100), University of Illinois at Chicago, Saturday College UIC Chance, Chicago, IL (Class size: 30)
Jan 2017 – Dec 2017	**Graduate Teaching Assistant,** Discovering Computer Science (CS 100), Dr. Dale Reed, University of Illinois at Chicago, Chicago, IL
Aug 2016 – Dec 2016	**Graduate Teaching Assistant,** Discrete Mathematics (CS 151), Dr. Bhaskar Dasgupta, University of Illinois at Chicago, Chicago, IL

PUBLICATIONS

Book Chapters

In press

Beheshti, E., Lyons, L., **Mallavarapu, A.,** Thompson, W., Wallingford, B., & Uzzo, S. (in press). Co-designing Learning Dashboards for Informal Educators in H. Ba, K. McMillan Culp, and M. Honey (Eds.), *Design Make Play for Equity, Inclusion, and Agency*, Routledge.

Journals

Published

Mallavarapu, A., Lyons, L., Slattery, B., Shelley, T., Minor, E., & Zellner, M. (2015) Developing Computational Methods to Measure and Track Learners' Spatial Reasoning in an Open-Ended Simulation. *Journal of Educational Data Mining 7*(2), 49-82.

Lyons, L., & **Mallavarapu, A.** (2021). Collective Usability: Using Simulation Tools to Explore Embodied Design Challenges in Immersive, Shared Mixed-Reality Experiences. Journal of Educational Technology & Society, 24(2).

In press

Mallavarapu, A., Lyons, L., Uzzo, S., Exploring the Utility of Social-Network-Derived Collaborative Temperature Readings for Co-located Large-Group Collaboration. *Journal of Learning Analytics (Special Issue: Networks in Learning Analytics)*

Mallavarapu, A., Lyons, L., Uzzo, S., Formative Fugues: Reconceptualizing Formative Feedback for Complex Systems Learning Environments. *Submitted to the International Journal of Complexity in Education.*

In Preparation

Mallavarapu, A., Lyons, L., Behesheti, E., Wallingford, B.,Thompson, W., Uzzo, S., "We'll get there together": Fostering Agency in the Co-Design of a Data-Driven Dashboard. *To be submitted to the Journal of Learning Analytics.*

Mallavarapu, A., Lyons, L., Zheleva, E., Uzzo, S., Causal Modeling of Open-Ended Learning Environments for Generating Formative Feedback. *To be submitted to the Journal of Learning Analytics.*

Mallavarapu, A., Lyons, L., Uzzo, S., Breadcrumbs of Creativity: Lag Sequential Analysis to Understand Creativity in Open-ended Problems. *Journal of Educational Data Mining*

Reviewed Conference Papers, Full

Published

Mallavarapu, A., Lyons, L., Uzzo, S., Thompson, W., Levy-Cohen, R., & Slattery, B. (2019). Connect-to-Connected Worlds: Piloting a Mobile, Data-Driven Reflection Tool for an Open-Ended Simulation at a Museum. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems* (pp. 1-14). ACM Press.

Mallavarapu, A., & Lyons, L. (2020) Exploration Maps, Beyond Top Scores: Designing Formative Feedback for Open-Ended Problems. In *Proceedings of the International Conference on Educational Data Mining* (EDM) (6 pages).

In press

Levy-Cohen, R., **Mallavarapu, A.,** Lyons, L., & Uzzo, S. Coding Scheme for Shared Regulation in a Synchronous Museum Simulation. International Society of the Learning Sciences (ISLS).

Reviewed Conference Papers, Short

Beheshti, E., Lyons, L., **Mallavarapu, A.,** Wallingford, B., & Uzzo, S. (2020, April). Design Considerations for Data-Driven Dashboards: Supporting Facilitation Tasks for Open-Ended Learning. In Extended Abstracts of the 2020 CHI Conference on Human Factors in Computing Systems (pp. 1-9).

Reviewed Conference Abstracts

Beheshti, E., Lyons, L., Thompson, W., **Mallavarapu, A.** & Uzzo, S. M. (2020, Apr 17 - 21) Human-in-the-Loop: Supporting Facilitators' Scaffolding of Visitor Engagement and Learning in Science Museums [Roundtable Session]. AERA Annual Meeting San Francisco, CA http://tinyurl.com/vl69qvq (Conference Canceled)

Levy-Cohen, R., Mallavarapu, A., Lyons, L., Thompson, W., & Uzzo, S. (2021). Studying Collective Problem Solving Regulation in an Immersive Open-Ended Museum Exhibit. In AERA '21.

HONORS AND AWARDS

Dec 2020	Work shortlisted for Schimdt Futures Tools Competition for initial seed grant
Jun 2019	2018-2019 Teaching Assistant Award, Computer Science, UIC
Mar 2019	ACM SIGCHI student travel grant to attend the ACM SIGCHI 2019 in Glasgow, UK
Jan 2018	UIC Chance Program Scholarship, University of Illinois at Chicago, IL
Aug 2016, Jan 2017	Peter and Deborah Wexler Graduate Student Award Scholarship, University of Illinois at Chicago, IL
Jun 2015	Conference paper selected to become journal article, International Conference of Educational Data Mining, Madrid, Spain June 25-30, 2015
Jun 2015	Professor Ram Kumar Scholarship to attend the International Conference of Educational Data Mining Madrid, Spain
Apr 2015	Computer Research Association for Women (CRA-W) Travel Scholarship, San Francisco, CA
Oct 2014	Grace Hopper Celebration Scholarship for Grace Hopper Celebration Conference (GHC 2014), Phoenix, AZ

CONFERENCE ACTIVITY/ PARTICIPATION

Conferences Organized

Virtual Conference Chair, MobileCHI 2020, Expanding the horizons of mobile interactions.

Papers Presented

2020	Formative Fugues: Helping Learners Understand Complex Systems through Causal Inference and Lag Sequential Analysis. 5th Conference on Complex Systems, Satellite Symposium on Complex Systems and Education: Research and Practice, 2020
2019	Connect-to-Connected Worlds: Piloting a Mobile, Data-Driven Reflection Tool for an Open-Ended Simulation at a

Museum. In *2019 CHI Conference on Human Factors in Computing Systems*

2015 Developing Computational Methods to Measure and Track Learners' Spatial Reasoning in an Open-Ended Simulation. *Journal of Educational Data Mining*

TECHNICAL SKILLS

Programming Languages:	C, C++, Java , Python
Version Software:	Git (Version Software), SVN (Version Software)
Data Mining Libraries:	Scikit Learn (Sklearn Python Package), R, DoWhy (Causal Inference Python package)
Visual Analytics:	OpenPose, OpenCV
Network Analysis:	NetworkX (Python SNA package), Gephi
Scripting Languages:	Shell scripting, HTML , JavaScript, CSS, D3 JavaScript Library, React
Databases:	Oracle, MySQL, SQL, PL/SQL, PHP, MongoDB

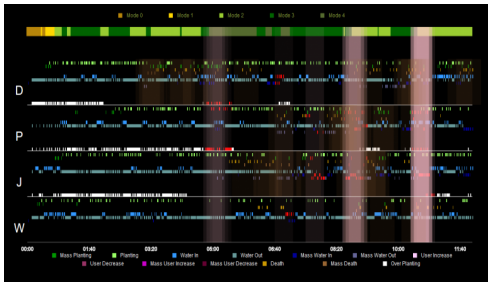
PROFESSIONAL EXPERIENCE

Feb 2015 – Aug 2016	**Technical Consultant** Perficient Inc, Chicago, IL
Jun 2013 – Dec 2013	**Network Software Intern** Tarana Wireless Inc., Santa Clara, CA
Aug 2011 – Jul 2012	**Programmer Analyst Trainee, Banking and Finance Sector** Cognizant Technology Solutions, Pune, India

PROJECTS

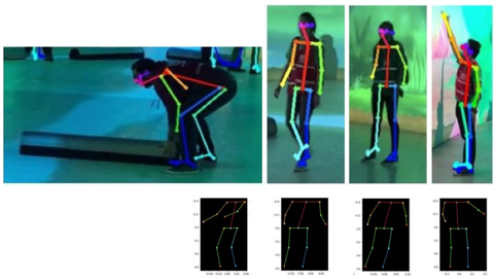
Lag Sequential Analysis for Tipping Point Analysis

Implemented Lag Sequential Analysis of the various events (micro and macro events) in Connected Worlds museum exhibit. The lag sequential analysis allowed us to identify certain events preceding and succeeding critical states of the system (tipping points) which were difficult to diagnose during the visitor interaction. These sequences can be used to support visitors to prevent critical events (like droughts, floods, or die-offs in the simulation) and improve their exhibit experience. (Mallavarapu, Lyons, & Uzzo, in preparation).



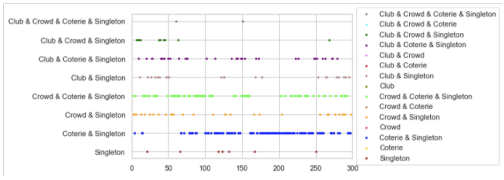
OpenPose and Clustering to Extract Action Poses from Video Data for Studying Embodied Collaboration

Collaboration often is studied in terms of the action contributions each individual provides towards the collective task. In fully-virtual learning environments log files can capture learner actions, but in mixed-reality, embodied learning environments, many physical actions go unlogged. We used OpenPose algorithm to detect skeletal postures of co-located museum visitors collaborating on a problem-solving task, to assign action labels to understand their contribution to the group task and also the division of labor within the group.



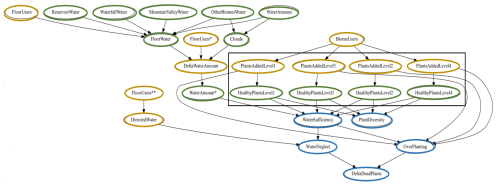
Social Network Analysis for Gauging "Collaborative Temperature"

Constructed a low-cost, low-effort, ethical method to detect ephemeral social configurations in a co-located museum environment, captured through video data. For each frame a network was constructed using the principles of proxemics. Social network analysis was used to extract features of collaboration, which were then clustered using K-means algorithm to decipher social configurations. The combinations of different social configurations determines the "collaborative temperature" of visitors' interactions in the exhibit, and were used to study the impact of an educational intervention. Additionally, this passive method of studying collaboration preserves the privacy of visitors. (Mallavarapu, Lyons, & Uzzo, in preparation).



Causal Modeling for Generating Formative Feedback

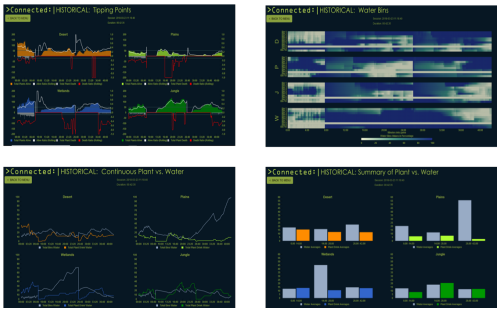
Constructed a causal graphical model of Connected Worlds museum exhibit to generate formative feedback for visitors using their interactions and system events triggered by their collective actions. This involved constructing outcome metrics to evaluate the state of the complex-system environment, selecting the granularity and treatments applied to the visitor action nodes, and computing appropriate time lags to accurately understand the effect of visitors' interactions on the outcomes. (Mallavarapu, Lyons, Zheleva, & Uzzo, in preparation).



Data-Driven Dashboard Participatory Design Sessions

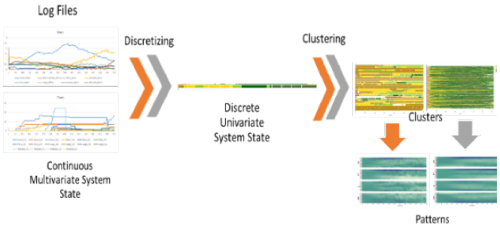
Data-driven dashboards are being integrated into various contexts as a way of informing ongoing processes, allowing a ``human-in-the-loop'' to use the dashboard to reflect on and guide activities. Embedding non-expert practitioners in the design process is critical for producing designs that they will actually use. I helped design a novel participatory methodology that helps practitioners unfamiliar with data mining to meaningfully incorporate data analytics and visualizations into their brainstorming. The study involved co-designing a data-driven dashboard for an immersive educational simulation. (Beheshti et al, 2020; Mallavarapu, Behesheti, Wallingford, Thompson, & Uzzo, in preparation).

Connect-to-Connected Worlds, a Data-Driven Dashboard



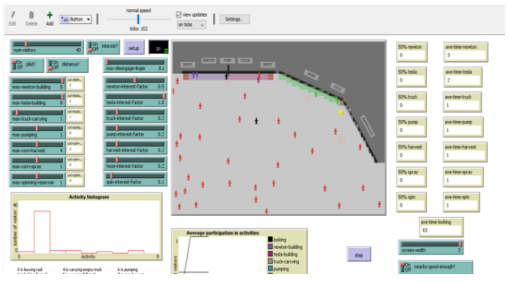
Created web-based tablet support for facilitators, researchers and visitors to the New York Hall of Science's Connected Worlds immersive simulation exhibit. This involved creating architecture to scrape live data from the exhibit while it is in use, deliver it to a database, and visualize the results in an on-demand fashion on tablets carried within the exhibit. These live, dynamic data visualizations can help visitors understand how their manipulations affect the simulated ecosystem's sustainability.

Mining Connected Worlds



Developed methods to analyze visitors' collective learning trajectories in Connected Worlds, an open-ended, collaborative ecosystem simulation exhibit. This was accomplished via data mining and developing custom visualizations. Results will be used to tune the simulation settings used to run the exhibit, to improve visitors' educational experience.

Modeling Connected Worlds to Promote Collective Usability



Created a data-driven model of how museum visitors moved around within and made use of a pilot version of the Connected Worlds exhibit. Used a complex system simulation tool (NetLogo) to model the layout and movement of visitors and the space, as informed by real-world measurements of visitor movements and engagement. Ran dozens of different permutations to understand which changes to the exhibit design could

improve the collective usability of Connected Worlds. (Lyons & Mallavarapu, under review)

EcoCollage

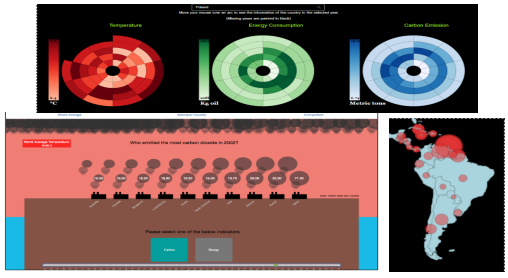
Designed metrics to evaluate and track the learners' spatial reasoning skills when using an Urban Planning simulation. Used spatial metrics like Ripley's K and diversity metrics to derive a measure for spatial reasoning and applied regression to characterize the different spatial arrangements as good or bad strategies relative to simulation outcomes. The results were used to examine if the user interface design affected the way in which learners approached exploring the problem space: did they use different spatial strategies, or discover them more quickly or more slowly, when using different user interfaces? (Mallavarapu, Lyons, Slattery, Shelley, Minor, & Zellner, 2015)

Empirical Analysis of Data-Driven Formative Feedback

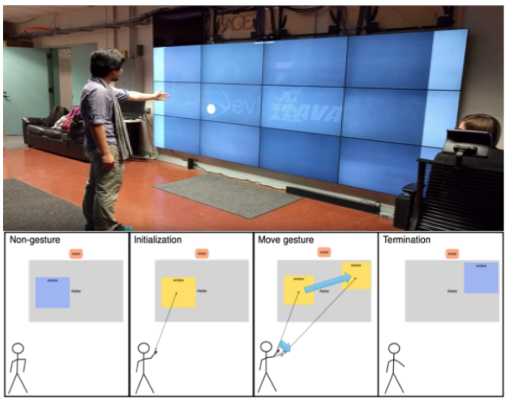
To understand the empirical effect of data-driven reflective formative feedback on visitors' collective actions in an open-ended simulation exhibit, we used visitors' interaction data to provide reflection opportunities to the visitors. We used case-study approach, with two visitor groups, one group reflected with the data-driven tool and other only verbally reflected their experiences. The group who reflected using the data-based feedback were able to more playfully and consciously modify their strategies to engage with the exhibit. (Mallavarapu, Lyons, Uzzo, Thompson, Levy-Cohen, & Slattery, 2019)

World Climate Change Dashboard

The past few decades have seen adverse climate changes as a result of carbon dioxide being generated by humans around the globe. Knowing how to set policies can be difficult without knowing how carbon generation is distributed across human activities, and across geographic locations. We have created a dashboard that allows juxtaposing, comparing and understanding the progression of climate change due to carbon footprints around the world.

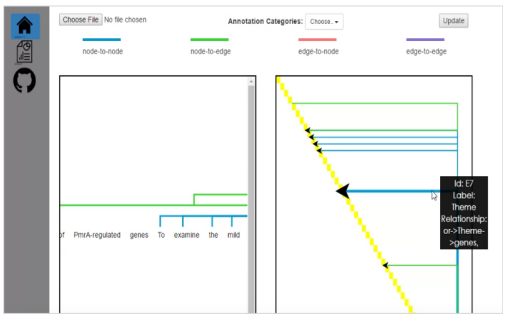


Gesture Segmentation Data using Skeleton Tracking and Machine Learning



Large and high-resolution display environments, such as tiled display walls or large-scale immersive environments, present a variety of benefits for visual data analysis. Recent touchless sensors and image processing tools have enabled tracking human movements unobtrusively but designing collaborative interaction modalities for large display environments remains a significant challenge and an important research area. We created a machine learning based algorithm to interpret data from these sensors and to segment the stream of movements into discrete input gestures. This allows for one to seamlessly collaborate on large screen displays with mid-air gestures.

Text annotation Visualizer



Language hides some inherent relations among its constituents. With the increasing amount of data being collected rapidly, NLP software are expected to be robust and comprehensive. Aiding the analysts with proper tools to visualize and to analyze these complex relations is necessary. Having a good analysis tool would also help NLP expand to other technical domains such as biology, chemistry and many others. The tool that we have developed helps in analyzing the relationship among words and among words with other components like phrases, or sentences etc. in the text by annotating the relations between these components.

SERVICE & VOLUNTEER EXPERIENCE

Reviewer

2020	CHI Conference on Human Factors in Computing Systems.

Community Service

March 2018	**Judge**, 2018 CPS Exhibition of Student STEM Research
Jan 2017 – Dec 2017	**Volunteer Mentor** for the Girls Who Code UIC division.
Dec 2016	**Volunteer** for Hour of Code at the Skinner North Elementary School, IL
Aug 2015	**Volunteer**, Millet Project at University of California Berkeley, CA for Plant and Microbiology Department.
Aug 2012 – Present	**Member**, Women in Computer Science at UIC.

REFERENCES

Leilah Lyons
Adjunct Research Associate Professor
Department of Computer Science and Learning Sciences,
University of Illinois at Chicago
Director of Digital Learning at New York Hall of Science
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