

Motivating CS Majors Using Real-World Data, Games and Visualizations Using BRIDGES*

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Abstract

Despite increasing enrollments in CS in recent years, retention of CS majors to meet current and future workforce needs remains a major concern. Grounding Computer Science concepts by solving important real-world problems or fun problems can be keys to increasing students' motivation and engagement in computing, and may provide a path to improving retention in CS programs. This tutorial provides instructors with a hands-on introduction to BRIDGES, a software infrastructure for programming assignments in early computer science courses, including introductory programming (CS1, CS2), data structures, and algorithm analysis. BRIDGES provides capabilities for creating engaging programming assignments, including: (1) a *simplified API for accessing real-world data sets*, including social networks; scientific, government, and civic organization data; and movie, music, and literature collections; (2) interesting *visualizations* of the data, (3) an easy to use API that supports *creation of games*, and, (4) *algorithm benchmarking*. Workshop attendees will engage in hands-on experience with BRIDGES and will have the opportunity to discuss how BRIDGES can be used in their own courses.

Using BRIDGES in data structures, algorithms, and other courses have shown better student outcomes in follow-on core CS courses, when compared to students from other sections of the same course. BRIDGES has impacted over 2000 students across 20 institutions since its inception 6 years ago. A repository of BRIDGES assignments is now maintained

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for use by BRIDGES users. Example BRIDGES visualizations are illustrated below.

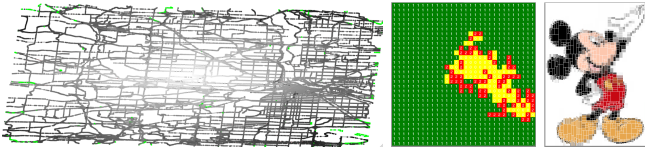


Figure 1: BRIDGES Examples. [Left:] Dijkstra's shortest path algorithm applied to the streets of Minneapolis using Open Street Map data in a data structures course (lighter gray values are close to the source and darken with distance), [Middle:] Exploring arrays and control structures in a simple fire spreading simulation exercise for use in CS1/CS2., Right: Representing an image with Spatial Tree Structure (Kd-Tree in this example)

Agenda. Participants will require a laptop and a modern browser to participate and view BRIDGES examples.

- Introduction (Participant Intros, BRIDGES Overview[20 min])
- A first BRIDGES Example [15 min]
- A Tour of BRIDGES : Demonstrations, hands on experiences with BRIDGES [25 min]
- **Break [5 min]**
- Discussions (How can BRIDGES help you?) [20 min.]
- Workshop Survey, Opportunity to Participate [5 min]

Expertise of Presenters:

Kalpathi Subramanian is an Associate Professor of Computer Science at the University of North Carolina at Charlotte. He is the PI on multiple NSF IUSE awards, including *Retaining and Engaging Computer Science majors by Solving and Visualizing Algorithmic Problems on Real-world Data Sets*, along with Co-PIs Jamie Payton and Erik Saule.

Jamie Payton is an Associate Professor and Chair of Computer and Information Sciences at Temple University. She is the PI of the STARS Computing Corps, an NSF-funded alliance of 50 colleges and universities that aims to broaden participation in computing.

Erik Saule is an Associate Professor of Computer Science at the University of North Carolina at Charlotte. His educational research interests include the education of parallel computing, data structures, and algorithms. He served as the Program Chair of the 2018 Workshop on Education for High-Performance Computing (EduHPC-18) and is co-PI of the NSF IUSE award and a recipient of an NSF CAREER award.