

**Title:**

Increasing Student Interest in Data Structures Courses with Real-World Data and Visualizations Using BRIDGES

**Presenters:**

Kalpathi Subramanian (Contact Person)  
Associate Professor  
Computer Science  
The University of North Carolina at Charlotte  
Charlotte, NC 28223 USA  
Phone: 1-704-687-8579  
krs@uncc.edu

Jamie Payton  
Associate Professor  
Computer and Information Sciences  
Temple University  
Phone: 1-215-204-9257  
payton@temple.edu

**Abstract.** This workshop introduces participants to the concepts and use of BRIDGES, a software infrastructure designed to facilitate hands-on experience for solving traditional problems in sophomore level computer science courses (data structures, algorithms) using data from real-world systems that are of interest to students, such as social networks (Twitter, Facebook), scientific or engineering datasets (USGIS Earthquake data), Google Maps, etc. BRIDGES provides easy access (typically function calls) to real-world data sets for use in routine data structures programming assignments, without requiring students to work with complex and varied APIs to acquire such data. BRIDGES also provides *visualization capabilities, allowing the students to visualize the data structure they have created as part of their assignment.* BRIDGES visualizations can be easily *shared, via a weblink,* with peers, friends, and family. Workshop attendees will engage in hands-on experience with BRIDGES and multiple datasets, and will have the opportunity to discuss how BRIDGES can be used to support various introductory computer science courses.

**Significance and Relevance of the Topic.** Despite increasing enrollments, retention of CS majors remains a concern. Many researchers agree that showing relevance and connecting programming courses to the real world are key to increasing students’ motivation and engagement in computing, and may provide a path forward to retaining students in CS degree programs.

BRIDGES provides two key advantages that is readily applicable to data structures and algorithms courses: (1) Minimal effort in using interesting real-world datasets as part of homework assignments, and (2) the ability to visualize the data structures that students create and easily share via a web link (see example of a binary search tree with USGIS earthquake data below (Live example at <http://bridgesuncc.github.io/>). BRIDGES has been used in data structures and algorithm analysis courses at UNC Charlotte for the past two years; the current version is stable and robust, and student feedback have been very positive. BRIDGES supports both C++ and Java and is fully documented. Finally, BRIDGES is ready for use by educators and a workshop to disseminate the system is appropriate at this time.

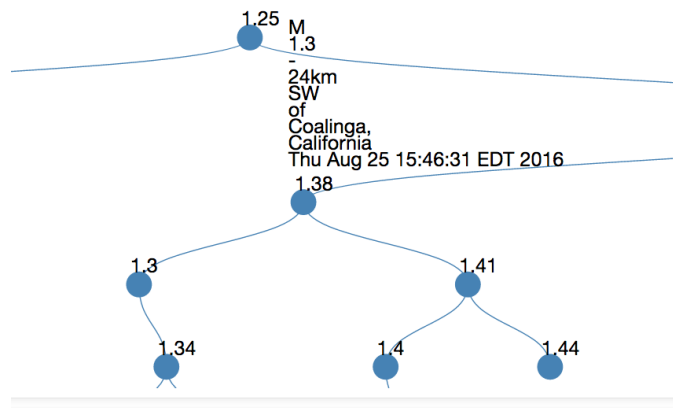


Figure 1: Part of a binary search tree representing earthquake data from USGIS. Nodes are keyed on earthquake magnitude. Figure shows the quake info at the root node

**Expected Audience.** Computer Science educators teaching algorithms or data structures courses who are interested in using real-world datasets and visualizations in course assignments. We expect broad interest in this workshop (25-30 participants)

**Expertise of Presenters:** *Kalpathi Subramanian* is an Associate Professor of Computer Science at the University of North Carolina at Charlotte. He has been a faculty member since 1993 and teaches a range of

computer science courses. He has significant experience in working with CS undergraduate students via senior research that have resulted in numerous publications. He is the PI on the NSF TUES award, *Building BRIDGES Within the Undergraduate Major in Computer Science*, along with Drs. Jamie Payton, Michael Youngblood and Robert Kosara, which is the motivation for this workshop. He received his PhD from the University of Texas, Austin, 1990. *Jamie Payton* is an Associate Professor of Computer Science 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 of underrepresented groups in computing. She is the creator of the Mobile Application Development for Science program, which leverages her research in crowdsensing (i.e., engaging the general public in collecting data using sensors embedded on mobile phones for a civic or scientific purpose) to introduce middle school students to STEM concepts. She is a co-PI on the NSF-funded project, The Connected Learner, which aims to revolutionize CS education by connecting students to their peers, the profession, and a purpose, and is a co-PI on the BRIDGES project.

### **Workshop Agenda**

*Participants will have the needed BRIDGES software and Java or C++ components prior to workshop through distributed materials.*

- BRIDGES project (overview, design, demo) (30 minutes)
- Hands-on Experience 1  
*Participants will use BRIDGES on their laptops to a simple Hello World program and demonstrate an example graph data structure. (30 min)*
- Break (10 min.)
- Hands-on Experience 2  
*Participants will modify a BRIDGES graph example that uses Twitter followers or IMDB actor/movie relationships; the example will highlight the Bacon number path between two actors (see example at <http://bridgesuncc.github.io/>) and/or display Twitter graph of participant from live data. (45 min)*
- Hands-on Experience 3  
*Participants will modify a BRIDGES binary search tree example to insert earthquake data from US GIS Tweet data, highlight quakes based on different criteria(magnitude, location, date, etc). (45 min)*
- Feedback/Discussion (15 min)

### **Audio/Visual and Computer Requirements**

Workshop attendees should bring their own laptops to work through exercises using the BRIDGES software infrastructure (else pairing up is also acceptable). Access to power outlets might be needed depending on the laptop's battery life. WiFi access is needed to support interaction with the BRIDGES server. A projector is needed for presentation to the audience.

**Space and Enrollment Restrictions.** There are no space and enrollment restrictions.

**Other Critical Information** This workshop will advance the goal of finding new and potential adopters of this software system, helping to fulfill the requirements of our NSF TUES project.