

Real-World Problems, Data, and Visualizations Using BRIDGES PreConference Workshop

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Abstract

The huge rise in CS enrollments in the past few years has also resulted in more diverse population of learners that have different expectations, motivations and interests, making it especially important to provide relevant learning materials in early foundational courses. Grounding Computer Science concepts in reality by solving important real-world problems or fun problems are keys to increasing students' motivation and engagement in computing, which may provide a path to improving student retention and success. This workshop provides instructors with a hands-on introduction to BRIDGES, a software infrastructure for programming assignments in early computer science courses, such as CS1,

CS2, data structures, and algorithm analysis. BRIDGES provides the infrastructure for creating more engaging programming assignments, including: (1) a *simplified API for accessing real-world data*, such as those from social networks, entertainment (songs, movies), science, engineering (USGIS Earthquakes, elevation maps), geographic (OpenStreet maps), and literature (Project Gutenberg), (2) interesting *visualizations* of the data, and, (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 with multiple datasets and will have the opportunity to discuss the challenges they face in their own courses, and how BRIDGES can be used in their own courses.

Using BRIDGES in data structures, algorithms, and other courses have shown improved retention of CS knowledge and better student performance in follow-on courses, when compared to students from other sections of the same course. BRIDGES has impacted nearly 2000 students across nearly 15 institutions since its inception 5 years ago. A repository of BRIDGES assignments is now maintained for instructors using BRIDGES in their classes. Example BRIDGES visualizations are illustrated in Fig. 1.

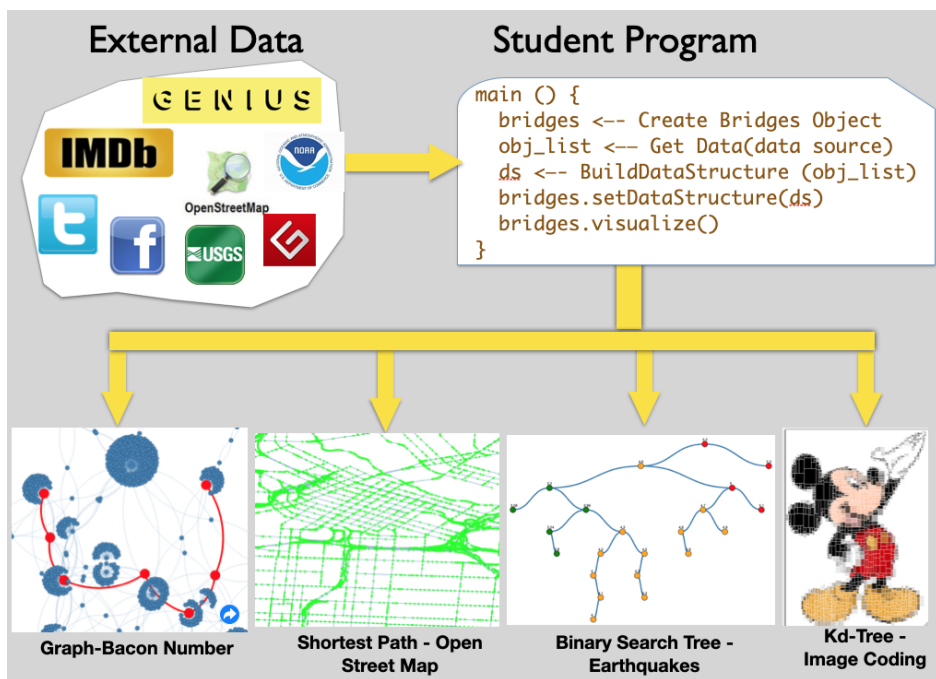


Figure 1: BRIDGES Program Structure and Examples. Four example BRIDGES outputs are shown, (1) Bacon number path between two actors (graph), (2) Shortest path using OpenStreet map data, (3) binary search tree ordered by earthquake magnitude, (4) representing images using a K-D tree structure.

Workshop Agenda. Participants will be provided accounts on Cloud9, with all needed software installed ahead of the workshop for the 3 programming languages (Java, C++, Python). They will be able to run a variety of BRIDGES examples to demonstrate its capabilities.

- **BRIDGES Overview, Design [10 min]**
- **Setup [10 min]:** Cloud 9 login; execute a simple BRIDGES program
- **Hands-on Experience 1 [20 min]:** Go through a scaffolded example of a simple BRIDGES program, make minor changes

and explore visualizations of output.

- **Break [5 min]**
- **Hands-on Experience 2 [30 min]:** Participants in each group will choose from a set of 3-4 example problems (a game, algorithm benchmarking problem, or a data structure with a chosen dataset); code provided, but small changes to be made to see changes in output.
- **Participant Discussion [20 min]:** Each group of participants through a discussion of (1) difficulties faced in creating examples and assignments in early CS courses, (2) opportunities for the use of BRIDGES to address these issues, and (3) challenges in using instructor like BRIDGES.
- **Surveys and Closing Remarks [10 min]**

A/V and Computer Requirements Workshop attendees should bring their own laptops. Access to power outlets and WiFi for attendees are needed to support hands-on activities, and a projector for presentation.