



Interactive Visualization of Advanced Data Structures

A Project Proposal
for the Degree of

MASTER OF SCIENCE

by

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to

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Abstract

Visualization is any method that is used to create images, diagrams, or animations to convey a message. Since the beginning of human existence, visualization through the utilization of visual imagery has been a powerful method to pass on both abstract and concrete information. Examples from history include cave paintings, Egyptian hieroglyphs, Greek geometry, and Leonardo da Vinci's revolutionary methods of technical drawing for engineering and scientific purposes. In today's world, visualization has growing applications in fields like science, education, interactive multimedia, medicine, and many others. The aim of this project is to use visualization, in the form of an interactive web application, to capture the attention of students so as to help them better understand the concepts of a particular course. This project will describe the adoption of a developed web application as an effective tool for visual learning. The application focuses on the visualization of some advanced data structures such as "Splay Trees", "Red-Black Trees", "B Trees" and their associated insertion and deletion operations.

1 Introduction

Instructors in lecture based courses in introductory computer science have an expectation that the material presented in class is reinforced via textbook reading, lab exercises, assigned homeworks or quizzes. Given the rapid increases in the CS population over the past few years [10], these courses are large, and making the class and course interactive to students is a challenge. This has resulted in new ways of teaching such courses, broadly classified as active learning techniques, that can include any combination of lab-based instruction, flipped classroom settings, gamification, peer-learning, or use of multimedia content [11, 12], all of which attempt to better engage students

Advanced Data Structures is a course which requires a lot of abstract thinking. It would be very helpful if there were a visualization tool of advanced data structures such splay trees, b tress, red-black trees, for students to experiment with. The tool would allow students to see the workings of common insert/delete operations inform of changes that take place to the corresponding data structure. This project is intended to create such an exploration environment, in which students can learn through experimentation.

2 Background

A large body of work has focused on visualization of algorithms and data structures for improved student engagement [1, 2, 3]. More recently, work by Burlinson et al. [4] combined the use of real-world data and data structure visualizations to improve student engagement. Bart et al. [5–7] have focused on curating a large number of interesting datasets for use in introductory courses in computer science. The use of visual programming (e.g., Scratch and Alice) [8, 9] has shown promise for making the first programming steps easier and more engaging. In addition to providing a graphical interface for piecing together programs; these systems let students build graphically interesting programs and encourage them to explore, experiment, and play.

The development of technologies and the evolvement of the World Wide Web have influenced education. Instructional Web sites and courses on the Web have grown dramatically. Web-based courses that consist of the syllabus, assignments and lecture notes are now widely used. Instructional Web sites that are dedicated to Advanced Data Structures can be easily found by using Search Engines. However, The majority of the instructional web sites explored during this project proposal lack interactive multimedia.

3 Project Description

The goal is build a web tool which uses a backend and frontend to show the visualizations of a given Data Structure. The web tool will be an interactive website which will take inputs from the users and according to the inputs the final visualizations will be shown on the website. These visualizations include all the basic functionalities of a given data structure like Addition, Deletion, Find. This tool can be used as an effective supplement to the traditional classroom education and text-books for Advanced Data Structures courses. The web tool will have the following functionality.

- Provides complete visualization for the widely known advanced data structures such as Splay Trees, B Trees, Red-Black Trees.
- Provides the animation of common operations associated with the data structures, such as inserting an element into and deleting an element from the specified data structures
- Provides animation of simple user-defined algorithms.

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