

Algorithm Visualization Using CI/CD

Anjali Kumari, Sankalp Dwivedi*, Vikrant Chauhan, Shreya Sharma

Abstract

The visualization of algorithms demonstrates how algorithms work more efficiently. Essentially, it seeks to simplify and automate the visualization of the algorithm. Using algorithm visualizations, we have discussed how standard algorithms can be taught more effectively and efficiently with automation and further can be used as open source. Our aim is to present a way to deploy our project using CI/CD which will be a far more efficient platform. Therefore, to achieve this, we are using Amazon Web Service to not only automate but it will be also used for hosting website. Elastic Beanstalk will be utilised as a manager and will take care of everything from building an EC2 instance to deploy a service on an EC2 instance, as well as monitoring, scaling, updating, and management. Elastic Beanstalk is a service of AWS which is used to host dynamic website like a website which will use node image to be hosted. It is the fastest way to get web application running on AWS. As we can have integrated it with GitHub webhook so that any merges in branch will trigger to latest deployment itself. We can also create different environment for testing so that it will lead to more stability in release, and we can get notified by SNS service of AWS which will send a mail regarding the triggered pipeline. This project not only helps in visualization but also how to automate or work using different services, which is beneficial for us and helps in improving our release of product.

Keywords: Algo viz, animation platform, online learning tool, CI/CD, EC2 instance

INTRODUCTION

Algorithms and data structures are an essential part of knowledge in a layout of computer science and have their vital steady position in computer science curriculum; being a computer science trainee or an enthusiast, every programmer should have the knowledge from this area. Algorithms can be studied using a variety of methods, including mathematics and empirical analysis. It is called visualization of algos and can be defined as the use of visual images or graphical representation to give information regarding an algorithm more efficiently and effectively.

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Received Date: April 29, 2022

Accepted Date: May 02, 2022

Published Date: May 06, 2022

Citation: Anjali Kumari, Sankalp Dwivedi, Vikrant Chauhan, Shreya Sharma. Algorithm Visualization Using CI/CD. Journal of Computer Technology & Applications. 2022; 13(1): 37-42p.

That info can be a visual illustration of an algo operation, it can perform on different inputs, or its execution speed versus that of other algorithms for the similar problem. Whereas CI/CD helps in automating the repetitive endless number of tasks which will not only help in resource consumption but also time which is involved in manual deployment and manual seething up of the infrastructure [1].

ALGORITHM VISUALIZER

By visualizing abstract concepts and revealing the underlying logic of an algorithm under study,

Algorithm Visualization (AV) systems aim to fulfil this need by aiding students to construct multiple mental models, connect construct hierarchies, and generalize problem-solving patterns. There are two types of algorithm visualizations in the literature: static and dynamic. The difference between the two is the degree of interactivity and the ability of students to experiment with the visualization (i.e., the ability to change input data and algorithm code, and implement various visual representations of the visual objects) [2].

Overall Goals of the System

- Teaching and Exploring Concept: a tutor could use this visualization as a part of a lecture. These AVs tend to be conceptual instead of focused on implementation. As students gain knowledge about the concept, this visualization may be wont to experiment on their own without explicit direction.
- Lecture Aid: The AV is best used during lectures by a tutor who is using it; let us say an algorithm that he or she is simultaneously explaining to the category.
- Self-Study: The AV provides a supplementary way and explanation of the algorithm other than textbooks.
- Automated Platform: After development, the whole process will be automated which will be configured through CI/CD which will be hosted on an EC2 instance [3].

LITERATURE REVIEW

- Algo Viz tools have been made over the last decade, and educators and researchers alike are becoming increasingly interested in them. HTML language and its capabilities of displaying graphics in browsers have led to the creation of web-based applications running on any platform or device, including personal computers and mobile devices such as smartphones and tablets. Increasingly, online learning has a significant impact on education since the browser has become the universal platform for a range of software [4].
- “University of San Francisco” researchers have created a web-based AVM tool called Data Structure Visualization (DSV). With interactive animations and visuals, students can better grasp complex data structures. This tool was created using JavaScript and HTML5, and it can be accessed via numerous modern browsers, including iPhones and iPads. Students can choose the algorithm they wish to visualize when using Vrachnos *et al.*'s Dynamic Algorithm Visualization Environment. Through this web-based tool, you can customize how arrays are visualized. It allows users to edit some parts of the code while simultaneously viewing the corresponding visualization during the execution of the algorithms. The students will be able to explore the functionality of the algorithm and identify critical logical steps and their structure by using the dynamic features above. A few more influential AV tools include JSAMBA, Animal, Jawa, Joliot, JHavé, Trakla2 and Alvis. By focusing on abstractions of their behaviour rather than their specific structures, these systems aim to demonstrate the fundamentals of basic algorithms [5].
- In support of online learning, researchers have attempted to identify key features of the audio-visual system. In Salaiya, a set of AV features are presented that include the ability to change the display speed and provide a good data set that meets all special situations needed to assist students in understanding a new algorithm. An AV program with a few features that focus on logical algorithm steps will suffice to understand the algorithm itself, says the author. Students may benefit from additional features, such as a tutorial that explains how the algorithm works and allows them to analyse their own work, as well as a pseudocode display of the algorithm, but that is a very challenging objective. Hundhausen *et al.* indicates that the purpose of AV is to encourage student engagement and assessment, as well as to promote the construction of mental models about intangible systems and algorithms, and to foster computational thinking and problem-solving abilities [6].
- By changing the values of variables, AV systems have demonstrated their ability to demonstrate algorithm and data structure in animation step by step. In practice, it is impossible

to convey the concept behind an algorithm simply by showing how variables change over time. For students to understand how a particular algorithm is created, appropriate visual presentations are needed.

- Over the past few years, several experiments have been performed on visual aids. Overall, the stats indicates that animation or visualization of algorithms had little effect on student learning, due to the low level of student interaction. Hundhausen *et al.* conducted a review of the teaching success of AV tools. Their meta-analysis of 24 published studies on AV tools concluded that the way students use visuals is more important than their own perceptions and AV scenarios work best only when students are busy in the learning process [7].

RESEARCH METHODOLOGY

System Features

Algorithm visualization is an automated source that will help in the visualization of data structure algorithm, it will be automatically deployed after changes will be made and reviewed. This can be used in lecture aid as well as to promote automation using continuous integration and continuous deployment [8].

Software Quality Attributes

- *Usability*: how easy and effective it is to understand.
- *Effectiveness*: performance.
- *Maintainability*: how easy it is to maintain a software.
- *Portability*: Can the program be simply transported to a different environment.

Modules

Algorithm visualization is an online website that visualises the five categories of algorithms as shown in Figure 1 [9].

Algorithms used in Algoviz are:

- Search Algo,
- Sort Algo,
- Path finding Algo,
- CPU scheduling Algo, and
- N-Queen Algo.

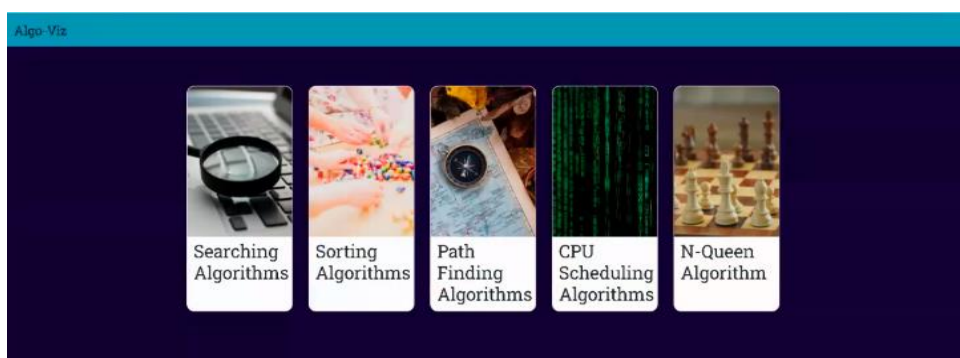


Figure 1. Snapshot of the Algos used in Algoviz.

Searching Algorithms

These algorithms are designed to locate an element in any data structure or to retrieve an element from a data structure.

- Sequential Search,
- Binary Search, and
- Interpolation Search.

Sorting Algorithms

Using a Sorting Algorithm, elements of an array or list will be arranged in specific manner or order according to the need of user.

- Insert Sort,
- Select Sort,
- Bubble Sort,
- Merge Sort,
- Quick Sort, and
- Heap Sort.

Path Finding Algorithms

Using a computer software, finding of path is the process of finding the shortest distance between two points. It is a more practical approach to solving mazes [10].

- Dijkstra,
- Breadth First Search,
- Depth First Search, and
- Greedy Best First.

CPU Scheduling Algorithms

CPU scheduling determines which process will use CPU resources during a wait period while another process is executed as shown in Figure 2.

- FCFS,
- SJF,
- Shortest Remaining First, and
- Round Robin.

N-Queen Algorithm

Basically, n-queens are the arrangement of queens on an $n \times n$ chessboard in such a manner that no two queens come in contact each other.

Tools and Technology used in Project

Organizations may use CI/CD to ship software rapidly and efficiently. CI/CD enables an efficient procedure for bringing products to market faster than ever before, continuously sending code into production, and ensuring a continuous flow of new features and bug fixes via the most efficient delivery method as shown in Figure 3.

- AWS,
- VS CODE,
- EC2,
- GITHUB and GITHUB Actions, and
- CI/CD.

The Technology used in Project

- **HTML:** “Hyper Text Markup Language” is what HTML stands for. A markup language is a technical term that specifies how raw text is structured and presented. When wrapped in HTML elements, raw text can be interpreted by the computer. A hypertext link is a text displayed on a computer or device that provides access to other texts via links.
- **CSS:** If you have more than one style rule, CSS stands for cascading style sheet, which refers to the technique that determines which style will apply to which part.
- **EJS:** (Embedded JavaScript) is a framework for node js. It is a simple templating language to create HTML file.
- **YAML:** “Yet another multicolumn layout” is what YAML stands for. The YAML CSS framework is a column-oriented web layout that is modular. YAML is a modular CSS layout for reliable, flexible, accessible and responsive web pages.

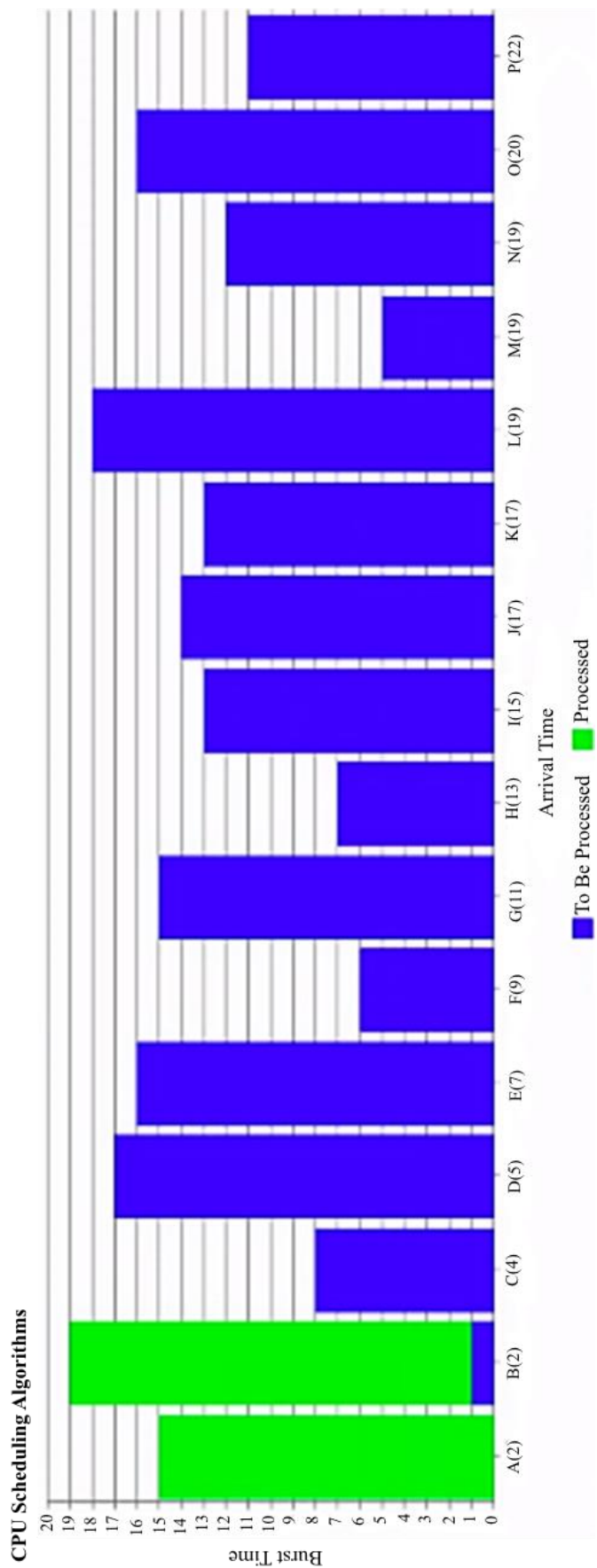


Figure 2. Snapshot of visualization of algo in algoviz.

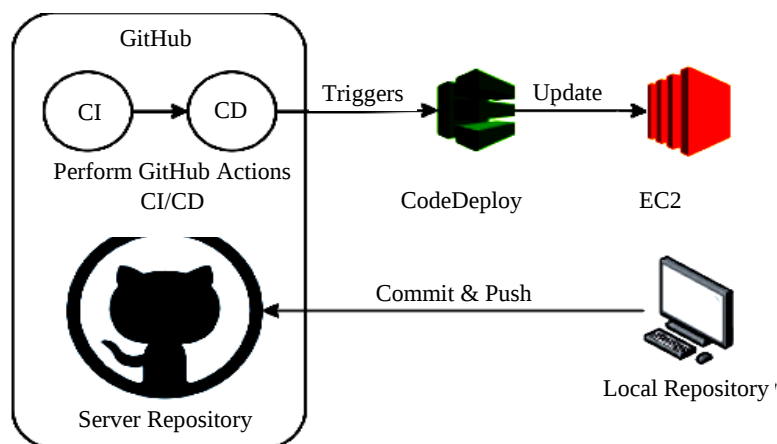


Figure 3. Functioning of CI/CD.

- *Shell Scripting:* A shell script is a file having lines of code for the shell to execute. Shell scripts can be used for Interactive Debugging, adding additional features to the shell, admin backups, system monitoring, and avoiding repeated tasks.

CONCLUSION

In our research, we developed an educational tool that would engage users in the process of learning, helping them getting knowledge about various algorithms. The algorithm visualization offers animation control as well as the explanation and detailed analysis of algorithms. It should be much easier to learn and understand with algorithm visualization. Students are able to interact with algorithms without the need to write any programming code, reducing their fear of coding. When students are familiar with the algorithm, they can approach programming much more confidently. The findings of our pilot study indicate that algorithm visualization is perceived as an educational tool that is helpful and easy to use, leading to a positive attitude and behaviour regarding its use.

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