



Evolution & Visualization of Various Searching and Sorting Algorithms

Nayan Kamal Verma¹, Shreya Verma², Sapna Roy³, Om Prakash Barapatre⁴

^{1,2,3}B.Tech. C.S.E., Bhilai Institute of Technology Raipur, Chhattisgarh India

⁴Assistant Professor, Department of Computer Science & Engineering, Bhilai Institute of Technology Raipur, Chhattisgarh India

ABSTRACT –

Visualizations of algorithms demonstrate how algorithms and data structure work in a graphical way. It mainly aims to simplify and easily understand the data structures & algorithms operations. In the paper, we explore the potential of using algorithm visualizations as a means of improving traditional methods of teaching data structure and algorithms. As a solution we have introduced a web application for visualizing algorithms, focused on enhancing user experience and interaction.

Key Words : Data Structure & Algorithm, React, Firebase, Web Development, App Development.

1. INTRODUCTION

Data structures and algorithms provide a set of approaches for handling data efficiently. So, a programmer must know DSA fundamentals to write efficient and correct code. This subject is at the heart of several real-life applications. If we observe closely, application programming interfaces (API) hide implementation details, which uses the concept of DSA. So, a good programmer should know the use cases and applications of DSA to make the correct decisions.

But the truth is that most programmer faces challenges in learning data structures and algorithms. Some of these challenges are popular. If we analyze reality, it is much more than coding. For example, look around us. Thousands of data-intensive applications are powered by efficient algorithms and use cases of various data structures. So here to visually understand the algorithms we made an internet tool that explains how algorithms remodel and prepare sets of data.

We've observed and endured as well that scholars struggle to understand the working and perpetration of algorithms while learning them in a class. Indeed if they are successful in applying and running the algorithm virtually, they might not understand what really goes on in the processing part when they're trying to run that algorithm. The dry runs can only be effective to a limit. Also, it isn't possible to make dry runs for each replication of every algorithm. Adding to it, due to the covid epidemic, nearly the whole world shifted to online learning mode. Drawing and explaining the algorithms using dry run system was veritably delicate. Hence, to fight these problems to make literacy easier and to encourage digital literacy we've come up with this idea.

2. PROBLEM STATEMENT

Programmer faces challenges in learning data structures and sorting algorithms. One Major issues in learning system of data structure and algorithms is Data Structure and algorithms topics are relying on each other, and programmers often learn concepts in a complex order. Programmers often get confused in difficult words and theories not having proper explanation. Sometimes they go through identical idea again and again and skip the topic without exploring the concept. It creates some critical challenges:

1. Wastage of precious resources: time!
2. Poor subject interest.
3. The habit of memorization or complex explanations.

The idea would be simple: We must follow a well-designed curriculum organized in the proper order with minimum dependencies. It's not like just going through theory and expected to write same in exam. There should be a way for students to learn with and teachers to teach with the use of these advanced technologies instead of using pen and paper.

3. LITERATURE REVIEW

In paper [1], the authors create a website that allows users to use customized input and different animations to show the stages and iterations involved in Data Structures and Algorithms. Depending on how many inputs the user wants to submit, the programme is menu-driven to match his needs and

implement his preferred algorithm. The website also aspires to develop into a useful teaching resource. They have examined performance indicators like speed and accuracy and have provided a brief overview of comparisons between the various online tools.

Sorting is the essential element of information structures and algorithms, and this is the paper's [2] main goal. Whatever the case, it is complex, and we were unable to decipher the complete calculation and coding the first time. So, there are several prevalent understandings of instruction when using this programme. The main goal of this research is to help novice sorters see the computations so that their brains may grasp them more quickly and retain them more effectively. Together, improve your comprehension of fundamental concepts.

In this study [3], the authors algorithm visualization uses graphics to show how algorithms operate. It primarily seeks to deepen and simplify our understanding of how algorithms work. They discuss the potential for adding algorithmic visuals to the existing techniques of teaching algorithms. They take a step in this approach by introducing the algorithm visualizer platform, sharing their real-world experiences, and outlining potential future directions based on their observations and research via a straightforward questionnaire.

Paper [4] cites Visualizing the algorithm makes learning it much simpler. A React-based web application called Algorithm Visualizer was created. It transforms commands into visualizations and has user interface components. An alluring use case for visualization is algorithms. They don't just measure the data in a chart to illustrate an algorithm; there is no main database. The visualization of the algorithm may be unusual for this reason, as designers are attempting to develop fresh formats for improved communication. The major goal of this is to guarantee reliable and efficient methods of detecting different algorithms. Anyone can quickly and simply study algorithms by using this web application. The authors have examined how long-running various algorithms are.

The author of this paper [5] frequently fails to comprehend the fundamental concept of a particular algorithm because she is unable to visualize how algorithms operate. Students can be easily motivated to learn and comprehend through visualization. The sorting algorithm visualization tool ViSA is described in this paper. ViSA is a fully automatic, easy-to-use visualization system that compares and explains sorting algorithms step by step. The visualization system's design principles and technical structure, as well as its practical implications and educational benefits, are discussed.

4. METHODOLOGY

Web based algorithm visualizer is an application in which we have appeared the data of algorithm as well as looking technique. There's a navigation bar within the application to select the technique which one need to memorize rather than looking over down to look the technique compositely. We have include the note to save the notes in the notes module rather than utilizing paper to note the things. The foremost portion of this application is that client can see the sorting/searching of the cluster within the visual format which implies we are showing the visualization of the algorithm and looking techniques (like how the techniques works) and there's a textbox where we can manually input data cluster through which client can create their own cluster (if they needs to) to perform the algorithm and see visualization on their own created array.

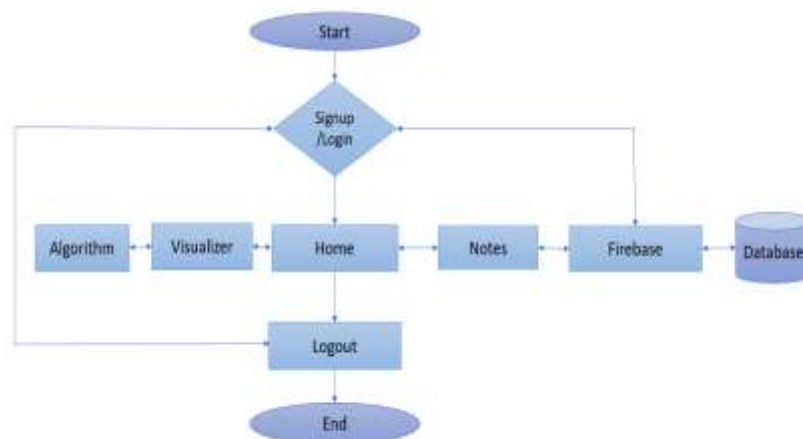


Figure 4.1 : Visualizer Flowchart

In the above Figure 4.1 – Visualizer Flowchart is a graphical representation of process or system of our project. We explain the working of our project as step by step as we start the project in our signup/login page through user id-password, after login we reach in the Home Page where we can see directly the list of algorithm visualization study content that are Visualizer page ,in which we have the content or study materials of Data Structure that is Types of Sorting Algorithms, MCQ question-answer part and etc. then we can also choose the My Notes page to create any kind of notes or writing down important things while studying for future references. after study we can logout from our user id and password. All Modules and Data will be saved in our firebase system that is our database system of this project.

We have divided our project in different modules such as home module, user module, visualization module, notes module and information module. We have made a single page application using react in frontend (i.e., for visualization we used HTML, CSS and JavaScript) due to which we have dynamic and more interactive UI and firebase in our backend to handle authentication to store user information and cloud storage service of firebase to handle notes module.

5. RESULTS AND DISCUSSIONS



Figure 5.1 : Home Page

5.1 Home Page :

The Home Page contains study contents of different algorithms and data Structures and we can directly visualize respective on clicking them. We can navigate to different module using nav bar.



Figure 5.2 : Visualizer Page

5.2 Visualizer :

Visualizer is further listed into various algorithms and sorting visualization categories.



Figure 5.3 : My Notes Page

5.3 My Notes Page :

Learners can create their personal notes and save that notes during their learnings for their future references. All notes will be saved in our database which is provided by firebase.



Figure 5.4 : MCQ's Pattern

5.4 MCQ's :

In this, Learners can get MCQ's while studying on the basis of study contents in random time intervals and on the basis of user answers he/she will receive points, which will help them to claim badges. They can share it on socials.

6. CONCLUSION AND FUTURE SCOPE

In conclusion, Algorithm Visualizer is a free, open-source learning tool that enables the teachers to teach data structures conveniently and the learners to learn data structures easily while promoting remote and digital learning.

As a future scope, more data structures & Algorithms can be added along with the improve in the UI/UX of the website. Apart from that we will add various features that will ease the work of students as well as teachers to empower learning of the learner concept. We can add an upload option, in which learners can visualize big data sets by importing any CSV file.

ACKNOWLEDGEMENT

We take the opportunity to thank our project guide Prof. Om Prakash Barapatre from Bhilai Institute Of Technology, Raipur for the most effective and valuable guidance. They have always been up front to motivate and encourage us for bringing out this project successfully. We sincerely thank them for their numerous suggestions and commend their patience. It was an honor to have them as our project guide.

REFERENCES

1. Gábor Törley: "Algorithm Visualization in Teaching Practice".
2. Christopher D. Hundhausen, Robert Patterson Jonathan Lee Brown, Sean Farley: "The Effects of Algorithm Visualizations with Storylines on Retention: An Experimental Study".
3. Slavomír Šimonák: "Using algorithm visualizations in computer science Education"
4. Aditya, Shipra Srivastava, Gulshan Gupta, Bilal Ibrahim, Jatin Kumar : " Algorithms Visualizer application" <https://ijert.org/papers/IJERT2204656.pdf>
5. Lanjewar, R., Mehra, N., Doshi, A., & Mane, Y. (2022). Algovis–An Enhanced Way to Visualize Algorithms. In ITM Web of Conferences (Vol. 44, p. 03013). EDP Sciences.
6. KUMARI, A., MITTAL, M., JHA, V., SAHU, A., KUMAR, M., SANGWAN, N., & BOHRA, N. (2022). ALGORITHM VISUALIZATION-MODERN WEB-BASED VISUALIZATION OF SORTING AND SEARCHING ALGORITHMS.
7. <https://www.math.nyu.edu/media/mathfin/publications/TR1999-778.pdf>
8. Karavirta, V., & Shaffer, C. A. (2013, July). JSAV: the JavaScript algorithm visualization library. In Proceedings of the 18th ACM conference on Innovation and technology in computer science education (pp. 159-164).

9. "Algorithm Visualizer" by Barnini Goswami, Anushka Dhar, Akash Gupta, Antriksh Gupta, Volume 3 Issue 03 March 2021, International Research Journal of Mordernization in Engineering Technology and Science.
10. Jain, H., Sharma, S., Arora, P., & Kumar, K. (2021). Howsort: Algorithm visualizer application. *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.3849936>
11. Yadav, N., Dhameja, K., & Chaubey, P. (2021). Path finding visualizer application for Shortest Path algorithm. *2021 3rd International Conference on Advances in Computing, Communication Control and Networking (ICAC3N)*. <https://doi.org/10.1109/icac3n53548.2021.9725716>
12. Goswami, B., Dhar, A., Gupta, A., & Gupta, A. (2021). Algorithm visualizer: Its features and working. *2021 IEEE 8th Uttar Pradesh Section International Conference on Electrical, Electronics and Computer Engineering (UPCON)*. <https://doi.org/10.1109/upcon52273.2021.9667586>
13. Shukla, G., Chavan, A., Khan, A., Sonawane, H., & Shintre, P. A. (2023). Algorithm visualizer. *INTERANTIONAL JOURNAL OF SCIENTIFIC RESEARCH IN ENGINEERING AND MANAGEMENT*,07(03). <https://doi.org/10.55041/ijrem18343>