Web-based Graph Algorithm Game

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1 Status report

1.1 Proposal

1.1.1 Motivation

Every computer scientist going through university or similar education will likely learn about the graph data structure, and the many things we can use it to represent. Many people learn effectively by 'doing the work themselves', and in the case of graph algorithms I learn effectively when I go through the motions of completing the algorithm, however this can be time consuming - especially when using pen and paper. There are lots of graph visualisation websites that simply go through algorithms like Dijkstra's and Breadth-First search, however, websites that let the user perform the actions themselves are not nearly as widespread (I could not find any examples). I wish to make a website that new computer scientists can use to reinforce their understanding by doing the algorithms themselves.

1.1.2 Aims

This project involves creating a website that novice computer scientists can use to understand Breadth-First search, Depth-First search and Dijkstra's Shortest Path algorithm. The user will be able to step through a visualisation of each algorithm, with the pseudocode step shown, and the changes being reflected on the graph and in the auxiliary data structures (a queue or stack for BFS and DFS respectively). The website will also have the functionality to let the user interactively work through algorithm themselves, deciding which action to take next, and hopefully reinforcing their knowledge of the algorithm. The aim is to improve users' understanding of the chosen algorithms through a hands-on approach. This can be evaluated through user studies with people of varying technical knowledge.

1.2 Progress

- Requirements synthesised
- Research of pedagogical techniques based on self-taught online learning carried out
- Research carried out into existing products that teach graph algorithms, including sites such as VisuAlgo and other UofG honours projects.
- Wireframes and diagrams created to understand what the product will look like, and how the user will interact with the graphs

- GitHub repository made, with quality-of-life features set up for VueJS frontend development, including pre-commit hooks for linting, GitHub actions for CI/CD
- Website created and hosted on GitHub pages. BFS, DFS and Dijkstra's algorithm are all implemented, with an SVG graph that is updated as the algorithm progresses. Users can choose to step through a visualisation, or do the algorithm themselves with (or without) hints being shown as well as the pseudocode
- Website is very bare-bones, and will be fleshed out with content to guide the user through the product. UI will be updated.

1.3 Problems and risks

1.3.1 Problems

- I spent 2 weeks trying to use D3.js to visualise the graphs, however this was a dead end and a waste of time.
- I found myself not managing my time as effectively as I wished, as I found AI and Machine Learning to take up lots of my time as they are incredibly difficult courses for me. I will make up this lost time over the Winter break, and in semester 2, however I am close to where I want to be with the project.

1.3.2 Risks

- I am yet to conduct user studies into the effectiveness of my approach, and the intuitiveness of the UX/UI. If the UX/UI is found to be confusing, I will redesign how users interact with the graph and how the website looks. There is no real way to mitigate this, I just need to get feedback from user studies and act upon it.

1.4 Plan

1.4.1 Winter break

- Run initial user studies to get a sense check on how the website is perceived
- Update website based on findings of above
- Polish website and fill it out with necessary pages, e.g. homepage, about, explanations on how to interpret pseudocode (for beginners), information about the algorithms. ClickUp project management tool has a backlog with the necessary issues.

1.4.2 Semester 2 (11 Weeks, starting 08/01/24)

- Weeks 1-3 - A finished application that meets as many requirements as possible. At least the MVP
- Weeks 4-5 - Have a completed user evaluation using my friends on campus as guineapigs. Analyse the results of the evaluation for use in the dissertation
- Weeks 6-11 Write up dissertation

2 Ethics

This project will involve tests with human users. These will be user studies using standard hardware, and require no personally identifiable information to be captured. I have verified that the experiments I plan to do comply with the Ethics Checklist.