

AI Pathfinding Research Proposal - By Mateusz Jadasz

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AI PATHFINDING

RESEARCH PROPOSAL

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GORDON DICKERS

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INTRODUCTION

Pathfinding algorithms have been around since the 1950s, when Edsger Wybe Dijkstra invented the Dijkstra pathfinding algorithm. Since then, more and more algorithms were created, like the commonly used A* search algorithm. The purpose of this research is to experiment with and explore the capabilities of some of the most well-known pathfinding methods such as A*, Dijkstra and BFS. Furthermore, while considering that the field or research I have chosen to pursue is Game Development, I believe that concepts such as Artificial Intelligence and Pathfinding are amongst the many things at the core of the subject, because they are very broad and they cover or relate to many smaller concepts, which makes them such a large part of the Game Development process in almost every modern game.

RESEARCH BACKGROUND

Fortunately, because search algorithms have been around for so long, many good pieces of literature have been written regarding the topic in one way or another. One very good piece of such literature is the Mathematics Journal "Numerische Mathematik" [1] first published in December 1959, which featured "A note on two problems in connexion with graphs" by Edsger Dijkstra. In the journal he writes about two problems: the first is the problem with the actual construction of a node tree with any number of nodes while trying to maintain a minimum total length between said nodes in the tree, and the second problem occurs when trying to find the shortest path between any two nodes in the tree. He then follows up with the step-by-step guide on how to solve the problems, where the solutions that he provides are the key concepts behind the Dijkstra pathfinding algorithm.

AIM & OBJECTIVES

The overarching aim of my research is to review the existing pathfinding methods, to test different approaches to the problem based on things like a specific game genre, as well as to implement the different types of pathfinding algorithms into a Unity project for a much better visualisation of the process and results. Furthermore, after the results are collected, I will evaluate each of them, in order to conclude whether the A* pathfinding method specifically, is truly the most optimal search algorithm.

- My first objective will be to research and review the different pathfinding methods, to determine how they work, as well as what their differences are in terms of the process and functionality.
- My second objective will be to develop different versions of the pathfinding algorithm, where each version will simply be a different pathfinding method. The search algorithms I will explore will be the A*, Dijkstra, Depth-First Search, Breadth-First Search, and the Greedy Best-First Search algorithms.
- My third objective will be to critically evaluate the effectiveness of each pathfinding algorithm by measuring the completion rate of the algorithm, the algorithm's code execution speed, as well as the amount of moves it takes the character to get through a dynamically changing environment.



DATA EVALUATION

The data that will be collected, will not only be evaluated as a base average for a certain number of runs, but also on an individual basis. Visualising the average values will prove relatively straight forward. However, when it comes to analysing the results on an individual basis, it will require me to manage many results, because of the number of tests I intend to run to get the most accuracy overall. I believe a good solution will be to split up each pathfinding method into a its own chart, then for each method, plot a scatter graph based upon the starting position of the character and the amount of time it will take said character to complete the run through the environment.

RISKS & LIMITATIONS

<i>Risk</i>	<i>Solutions</i>
<i>Eyesight Strain</i>	• Wearing Blue Light filtering glasses • Reduce daily screen time and work often but for a limited amount of time to ensure breaks
<i>Fatigue</i>	• Ensure to take frequent breaks throughout the day to relax and avoid burning out
<i>Project File Corruption</i>	• Test the program frequently to ensure there are no major bugs that could potentially break the entire project • Save the project frequently • Create new project backups at least once a day
<i>Software Crashes</i>	• Frequent project saves • Frequent creation of project backups
<i>External Factors (i.e. Power turning off)</i>	• Frequent project saves • Frequent creation of project backups

Table 1

ETHICAL ISSUES

Fortunately, because this research project is not conducted on any participants, it means that I am able to avoid many of the implications and ethical problems that usually stem from working with other people, especially when that group of people is considered as vulnerable in any way. The only real ethical implications that may be brought to question when it comes to this project is the use of electrical equipment like monitors, a computer and all the peripherals connected to the computer, purely because of global warming and the emissions of greenhouse gases by the electrical companies.

RESOURCES & PLANNING

RESOURCES REQUIRED

I will require access to research materials, such as:

1. Books
2. Reports
3. Journal Articles
4. Online Articles

HARDWARE RESOURCES

The hardware resources I will require for this research are as follows:

1. A computer
2. Computer peripherals
 - a. Mouse
 - b. Keyboard
 - c. Monitor
 - d. A pair of Headphones
 - e. A graphic design Tablet

SOFTWARE RESOURCES

The software I intend on utilising in this project will include:

1. Unity Engine
2. Visual Studio
3. Photoshop CS6
4. Adobe Acrobat
5. Microsoft Word
6. Microsoft PowerPoint
7. Microsoft Excel

OTHER RESOURCES

Some miscellaneous resources include:

1. Pens
2. Pencils
3. Paper

PLANNING CHART

<i>Planned Project Task</i>	<i>Planned Start Date</i>	<i>Planned Finish Date</i>
<i>Research source searching and reviewing</i>	14/11/2022	14/04/2023
<i>Constructing a suitable testing framework for all pathfinding methods</i>	14/11/2022	23/11/2022
<i>Creating basic assets for algorithm visualisation</i>	24/11/2022	03/12/2022
<i>Researching and Writing about the different pathfinding methods</i>	04/12/2022	09/12/2022
<i>Writing the A* Pathfinding Algorithm</i>	10/12/2022	13/12/2022
<i>Writing the Dijkstra Pathfinding Algorithm</i>	14/12/2022	17/12/2022
<i>Writing the BFS Pathfinding Algorithm</i>	18/12/2022	22/12/2022
<i>Writing the DFS Pathfinding Algorithm</i>	10/01/2023	13/01/2023
<i>Writing the Greedy BFS Pathfinding Algorithm</i>	14/01/2023	17/01/2023
<i>Testing every algorithm and fixing any bugs</i>	18/01/2023	27/01/2023
<i>Running through each algorithm 100 times for a good sample</i>	28/01/2023	30/01/2023
<i>Analysing and writing about the results and the project in the final report</i>	15/02/2023	14/04/2023

Table 2

Table 2 shows my ideal set of time frames for each task I am anticipating I will have to do; however, I have decided not to account for any delays from things such as more university work or personal life events and holidays (apart from Christmas).

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GRADEMARK REPORT

FINAL GRADE

68/100

GENERAL COMMENTS

Instructor

The focus of the proposed project is reasonably well defined but I think you will need to tune your aims and objectives somewhat as there are potentially several disparate routes that your project can take, still (refer to our discussions in our previous project supervision sessions where we dealt with this).

Regarding the related work and lit review, you have identified Dijkstra's work and related algorithms - good but you will need to also identify further existing games and other related scenarios where short path searches are implemented together with alternate approaches.

Please make use references more. Eg where you discuss a paper, an algorithm, Game Engine, also when you assert something or are for or against an idea, etc. Use the Schools agreed standard here. Check the formatting of your references too. Overall, references a little light here.

A table has been provided outline key dates, etc but a Gantt chart would show this in a more readable way - especially where several parallel tasks are taking place.

Over all a good effort.

Are there any ethical concerns here?

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