

Computer Games Development

Project Report

Year IV

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[Date of Submission]

**Contents**

Acknowledgements

Project Abstract

Project Introduction and/or Research Question

Literature Review

Evaluation and Discussion

Conclusions

References

Appendices

# **Acknowledgements**

Use this template when writing your research report. As a rule of thumb, the report should be of the order of 10 pages (about 250 words/page).

# **Project Abstract**

The problem domain that I have chosen for this project is to be able to have an Artificial Intelligence be able to play the game of go or any other similar problem that requires the AI to search through a large search space to be able to figure out the best solution to the problem.

For this project, I would like to try and implement a version of Monte Carlo tree search such that I can create an AI that is able to efficiently solve a board state of the game of go. I would also like to test my application against a simpler algorithm such as minimax to compare how much quicker it is able to solve a position and against a stronger AI as well to see the difference between using it by itself as well with other algorithms that would help the tree search to find even better moves.

I might also try and research the use of neural networks alongside the Monte Carlo technique which aid the tree search in being able to find even better moves in the allotted time that the algorithm has to be able to find the optimal move.

# **Project Introduction and/or Research Question**

Replace this text with an appropriate Project Introduction.

Present relevant background or contextual material and define any terms or concepts when necessary.

Here you present to the audience what you are doing and why it is important. In essence, please provide an introduction to the project, why was it chosen, the potential impact of this research. You should state a research question (if any) and present the project objectives. This will most likely be a concrete question probably from one specific area, such as AI, Networking, Graphics etc.

E.g., Research Question Example (Networking): What is the effect of threshold size in the dead reckoning approach on player performance and player experience?

Summarize the main contributions of the project.

Go is a two-player board game in which the aim is to surround more territory than the opponent.[[1]](#footnote-0) The game of go is usually played on a board that is 19x19 in size but can also be played on different sized smaller boards. For a 19x19 board, there is approximately 250 moves that each player can possibly play. If a game continues for 150 turns (average turn count), then there would be around 250150 possible moves. Given the possible moves each player can make per turn, it quickly becomes too much to be able to search through. If we use a game tree to describe how a normal game of go could develop, we would use the 250 possible moves as the branching factor, and use the formula bd where b is the branching factor and d is the required depth to find how many leaf nodes there are or how many different possible board states there could be.[[2]](#footnote-1)

1. 250
2. 62,500
3. 953,674,316,406,250,000,000,000

There are a few different types of questions that I find could be interesting to look at when trying to implement the algorithm as efficiently as possible:

* How well does the Monte Carlo tree search do when compared with other more naive approaches to implementing an algorithm to solve the game of go.
* What other algorithms can we use alongside the algorithm to improve the speed and quality of move given.
* How can the Monte Carlo Tree search be used alongside neural networks or other AI techniques to make an AI that can play the game well.

# **Literature Review**

Replace this text with an appropriate Literature Review.

The literature review places your research in context.  You aren’t the first person to investigate or research a particular topic.  Present a short literature review with the following goals:

· Give the reader a good overview of the key concepts;

· Describe the most relevant work (in your own words) that other people have done in this area;

· Use proper academic writing with references.

· Show how the existing work influenced your project.

Game Trees:[[3]](#footnote-2)Each node of a game tree represents a particular position or state in a game. Whenever a player makes a move, such as placing a piece in go, this move will make a transition to one of the child nodes from the current state node. This is similar to decision trees where nodes with no children are referred to as leaf nodes.

# The Monte Carlo tree search is a smarter kind of search when compared against an *uninformed search.*

Uninformed search: an uninformed search just searches through the search space without any knowledge of what the goal state is. As such, they will search through the entire tree before coming to a conclusion as to what the best way to traverse the tree is.

Two examples of uninformed searches are depth-first search and breadth-first search.

# **Evaluation and Discussion**

Replace this text with Results and Discussion.

Describe the results using diagrams such as graphs etc. as appropriate, and discuss what the results mean.

Example: Results indicate that once the threshold gets over a certain point it significantly reduces player performance and player experience

# 

**Project Milestones**

Replace this text with Project Milestones.

Key project milestone dates and measurement on schedule, was project schedule adhered to, effectively planned for delivery on-time or ahead of schedule if appropriate.

**Major Technical Achievements**

What are your major technical achievements?

**Project Review**

What went right? What went wrong? What (if anything) is still outstanding/missing (i.e., still left to do)?  If starting again, how would you approach this project differently? What advice would you have for someone attempting a similar project in the future? Were your technology choices the right or wrong ones? If you chose the wrong technology, provide justifications for why you think this. What were the implications of your technology choices?

# **Conclusions**

summarise your work and findings.

**Future Work**

Indicate what might be some next steps to try (if a student next year was going to undertake a project in this area what might be an interesting thing for him/her to examine?).

# **References**

# <https://www.youtube.com/watch?v=UXW2yZndl7U&t=625s>

<https://www.youtube.com/watch?v=lhFXKNyA0QA&t=7s>

<https://www.youtube.com/watch?v=l-hh51ncgDI>

<https://www.youtube.com/watch?v=62nq4Zsn8vc>

<https://en.wikipedia.org/wiki/Go_(game)>

<https://arxiv.org/abs/1611.00625>

# **Appendices**

Replace this text with Appendices.

This might include ethics application and other relevant material e.g. copy of any questionnaires used.

1. https://en.wikipedia.org/wiki/Go\_(game) [↑](#footnote-ref-0)
2. https://towardsdatascience.com/monte-carlo-tree-search-an-introduction-503d8c04e168 [↑](#footnote-ref-1)
3. <https://www.analyticsvidhya.com/blog/2019/01/monte-carlo-tree-search-introduction-algorithm-deepmind-alphago/> [↑](#footnote-ref-2)