CAPSTONE PROJECT 1
Activity Log

Evaluation of Nature-inspired Optimisation Algorithms in Solving Versus Tetris

by

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Contents

1 Timeline

In this chapter, the project's progression is meticulously documented. In these pages, the critical stages of the project are depicted, each accompanied by a concise description illuminating the strategies and rationales behind the allocated times.

Furthermore, the week-by-week tasks undertaken are outlined within these sections. Thus, offering a granular insight into the day-to-day endeavours taken to propel the project towards its culmination.

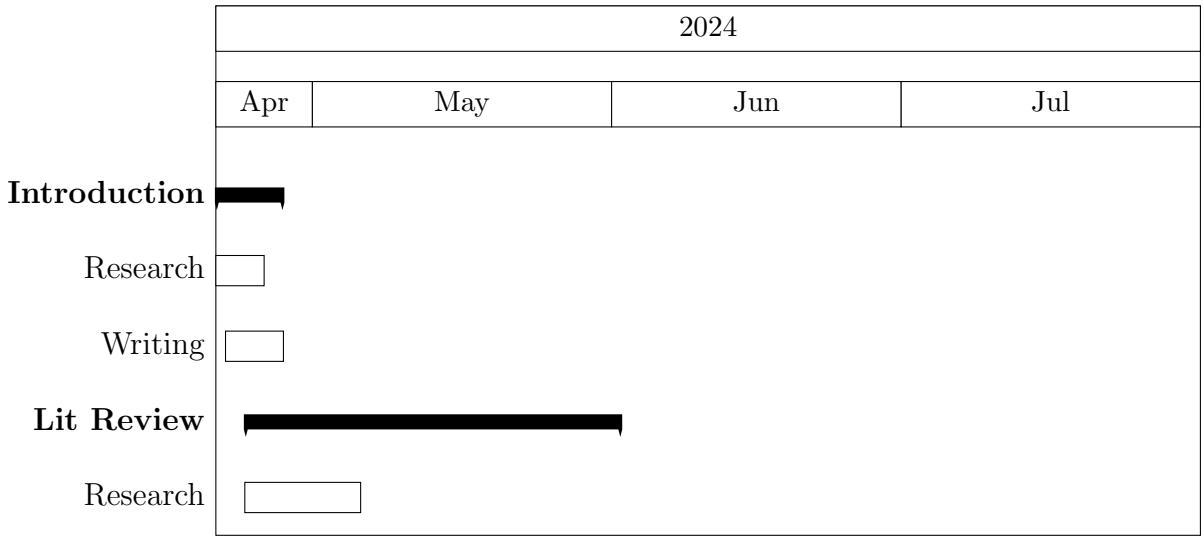

Figure 1.1: Gantt Chart of Timeline

1.1 Writing an Introduction

The introduction serves as the project's foundation, providing essential background information, introducing the topic, and articulating the project's objectives. Recognising its pivotal role, **one week** of time was allocated for its composition. This deliberate time-frame aimed to allow ample time for thoroughness, ensuring no essential elements were overlooked in writing a comprehensive and compelling introduction.

1.1.1 Week 1

This week, a significant portion of my time was dedicated to researching resources for the introduction section of the project. I looked into various academic papers and online resources to gather insights and background information relevant to the topic. Utilising databases such as IEEE Xplore and Google Scholar, I sought to familiarise myself enough

with existing research on Tetris, nature-inspired algorithms and NP-completeness to write a compelling introduction.

The latter part of the week was primarily focused on drafting and refining the introduction section. After seeking feedback from Dr Richard, he provided me constructive critiques on my initial motivation and challenged me to think deeper about the broader significance of the project. His feedback encouraged me to explore avenues beyond the mere identification of a research gap.

After several iterations, I believe the introduction is now in a more robust and coherent state, with a clearer articulation of the project's motivation and objectives. Dr Richard's guidance helped me realise the importance of grounding the project in broader contexts and considering its potential implications beyond academic research.

1.2 Conducting the Literature Review

The literature review is one of the chapters that will take up a lot of space in the planning document. It is important to be thorough and correct about the information written on these pages. As such, a generous time of **seven weeks** were allocated to research and write this section.

1.2.1 Week 1

While writing the introduction, I found numerous papers that could be used for the literature review section of the project. I tried to read up on and digest information on NP-completeness, proving a problem is NP-complete, multi-objective functions and nature-inspired algorithms.

1.3 Coming Up With a Technical Plan

1.4 Making Revisions

2 Bibliography

[1] Tetris Inc., *About Tetris*, https://tetris.com/about-us, [accessed Apr. 22, 2024].

In this webpage, the game of Tetris is described as an addictive puzzle game, there are references to some rules of the game, which includes the clearing of lines and the losing condition. There is also a section on the creator of Tetris as well as a section on the psychological event deemed the 'Tetris Effect'. As this is the 'About Us' page of the official Tetris website, this is treated as a credible source. This source will be used to introduce the Tetris game. It gives readers a good amount of information without being too overwhelming.

[2] E. D. Demaine, S. Hohenberger, and D. Liben-Nowell, "Tetris is hard, even to approximate," in *Computing and Combinatorics*, T. Warnow and B. Zhu, Eds., Berlin, Heidelberg: Springer Berlin Heidelberg, 2003, pp. 351–363, ISBN: 978-3-540-45071-9.

In their paper, Demaine et al. mathematically proves that the natural objectives of Tetris - minimising the height of an occupied square, maximising the number of pieces placed, maximising the number of cleared rows and maximising the number of Tetrises (clearing four lines in a row) are NP-complete. This paper is credible because rigorous mathematical proof is used to come to its conclusions. This source will be used to introduce the NP-completeness of Tetris, a central motivation behind the project.

[3] J. Brzustowski, "Can you win at tetris?" Master's Thesis, University of Waterloo, 200 University Ave W, Waterloo, ON N2L 3G1, Canada, 1988.

[4] H. Burgiel, "How to lose at tetris," *The Mathematical Gazette*, vol. 81, no. 491, pp. 194–200, 1997. DOI: 10.2307/3619195.

[5] M. Sipser, "Np-completeness," in *Introduction to the Theory of Computation*, Cengage Learning, 2013.

[6] V. Lesch, M. König, S. Kounev, A. Stein, and C. Krupitzer, "A case study of vehicle route optimization," *CoRR*, vol. abs/2111.09087, 2021.

[7] J. D. Ullman, "Np-complete scheduling problems," *Journal of Computer and System sciences*, vol. 10, no. 3, pp. 384–393, 1975.

[8] J. Arle and K. Carlson, "Medical diagnosis and treatment is np-complete," *Journal of Experimental & Theoretical Artificial Intelligence*, vol. 33, pp. 1–16, Mar. 2020. DOI: 10.1080/0952813X.2020.1737581.

[9] L. Davis, "Job shop scheduling with genetic algorithms," in *Proceedings of the First International Conference on Genetic Algorithms and Their Applications*, 1985, pp. 136–140.

[10] W. Korani and M. Mouhoub, "Review on nature-inspired algorithms," *Operations Research Forum*, vol. 2, Jul. 2021. DOI: 10.1007/s43069-021-00068-x.

[11] J. Lewis, "Playing tetris with genetic algorithms,"

[12] L. Langenhoven, W. S. van Heerden, and A. P. Engelbrecht, "Swarm tetris: Applying particle swarm optimization to tetris," in *IEEE Congress on Evolutionary Computation*, 2010, pp. 1–8. DOI: 10.1109/CEC.2010.5586033.

3 Meeting Records

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF COMPUTING AND INFORMATION SYSTEMS

SUPERVISION MEETING RECORD

Meeting 1

Date: 22 April 2024
Time: 05:00 pm - 06:00 pm
Student: Yap Wei Xiang
Supervisor: Dr Richard Wong Teck Ken

Items Discussed this Meeting:

- The 'Introduction' chapter of the planning document was discussed.
  - ❖ Focus more on using academic language instead of using fancy words.
  - ❖ Try to find a better motivation for the project, find real world problems that are semi-parallel to the game or find a way to fit NP-completeness into the picture.

Work for the Coming Meeting:

- Make necessary adjustments to the Introduction.
- Complete Introduction.
- Start reading literature.

Supervisor Signature:

Student's Signature: