Initial Plan

Gomoku AI Player

CM3203	One Semester Individual Project
Author	Daniel Ford
Supervisor	Yukun Lai
Credits	40

Table of Contents

Project Description

Gomoku is a strategy board game, also known as Connect 5 or Five in a Row. It is played on a Go board which can be of varying intersection sizes, such as 19 x 19 or 15 x 15.

The black player will usually play first unless the white player has just won, then the white player will go first. Each player will alternate in placing a stone of their own colour on an empty intersection. The player who wins will have an unbroken row of five either horizontally, vertically or diagonally.

The main aim of this project will be to research and implement an AI algorithm for playing the game with the user. As well as this, I am creating the interactive Gomoku GUI that both the user and AI player can interact with.

Gomoku is already considered a solved game in terms of artificial intelligence, by this I mean that a winning strategy has already found. Knowing that it is already a solved game, this is where I will begin my research. I will use this to research which algorithms have been appropriate to use within the game. If I have enough time and I find that there are multiple approaches, I could implement multiple approaches and compare them against each other.

Another area of research that I could look into is that there is a competition known as the 'Gomocup' which is where AI players for Gomoku are made and played against each other. Research into this area might be useful as it might lead to useful information such as specific standards for creating Gomoku boards or AI players.

Project Aims and Objectives

Background Research

- Research existing implementations of the Go board, see if there is anything to learn going forward in my own implementation
- Compare different existing solutions and approaches to creating the game of Gomoku
- Research and compare different algorithms for creating AI players for the game Gomoku
    - Important initial algorithms to look into may include threat space search and the monte carlo tree search
- If necessary, research the use of possible different data structures or approaches to the problem which may improve the performance of the game and /or AI player
- Research more about the Gomocup as this may reveal relevant, useful information

Implementation

- Choose a language to implement the game and AI player
- Design areas of the system prior to implementation to ensure that the project and code is kept clean and maintains a logical flow
    - This could be done using e.g. class diagrams
- Implement the board game Gomoku
- Implement AI player for the game Gomoku

Tests

- Use the practice of Test Driven Development to ensure that each feature implemented into project will be stable and backed up by tests
    - For example, it may be worth attempting to get full test coverage when writing unit tests using a framework such as jUnit
- If enough time, test implemented algorithm against other existing ones

Performance Enhancements

If what I have implemented doesn't appear to be very performant, I will research different methods of improving performance in the project. This may involve a variety of techniques to research including:

- Using different heuristics
- Using different data structures
- Improving the code base

Extra Work

After I have finished the main research and implementation, if time permits, I could look into implementing another approach and see how it performs and works in comparison. This will help and lead to a broader critical appraisal of the approach to the problem, provide a different view on how things could be done and perhaps open up another angle of looking at AI players for the game of Gomoku.

Work Plan

Looking forwards in the project, I think that one of the main approaches I will take to planning is that I will not only do research at the beginning of the project but also throughout. I think that this approach will be for the best as at the beginning of the project I may find some applicable research, however, as I continue I may find other materials which may be of use for analysis and comparison.

The dates used in the work plan are as guidance and refer to the Monday beginning of that week. For example, the supervisory meetings may happen any day within that week. For the design of the following Work Plan, I have used a Gantt Chart and will also go into detail about what each stage will entail.

Research

The research stages of my work plan will involve the researching of various areas of the project. This will include literature reviews and researching the language to use, testing, performance, Go boards and Gomoku.

This research will most likely span the entirety of my project as I think it will be necessary to do research throughout.

Implementation

For the implementation part of my project, this will most likely involve implementing the Go board, Gomoku rules and a UI to represent the game. As well as this, the main part of my project will involve the research and implementation of an AI player. This may involve the implementation of several different players which can be compared against each other and perhaps 'switched' in the UI.

As such, the implementation stage will most likely span the longest amount of time throughout the project.

Tests

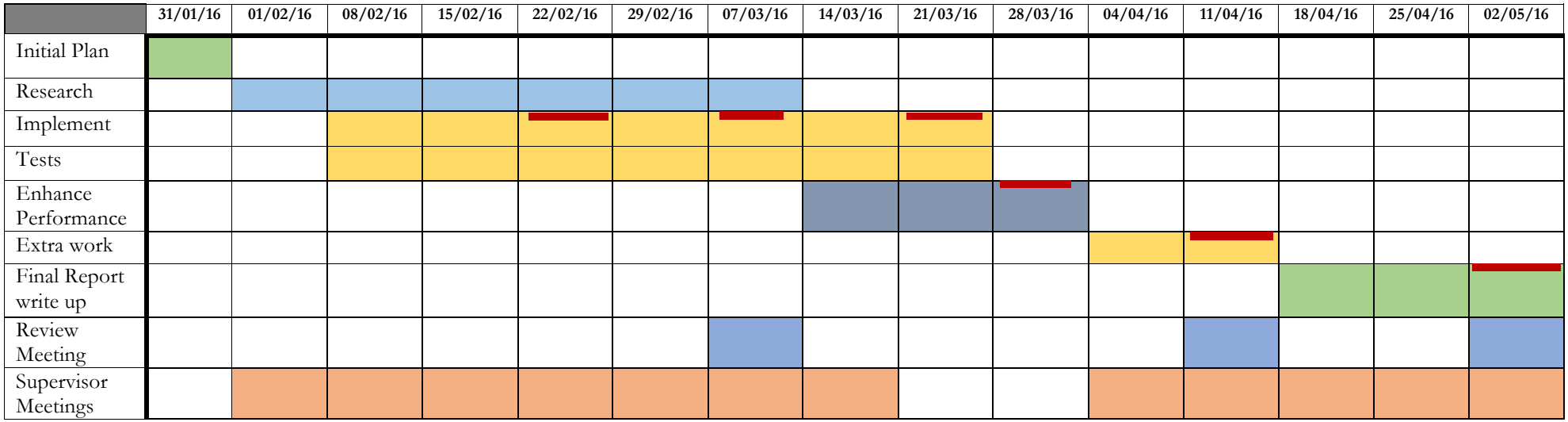
For the project, I would like to look into the practice of test driven development. I believe this will help to keep the code stable as well as maintaining a logical flow. As such the test part of my project will span as long as the implementation part as I will be writing tests to cover my work throughout. Another area I could test would be the algorithm which I could compare to already existing algorithms found whilst researching.

Performance Enhancements

In the project, I have allocated 3 weeks towards the end of the implementation phase to look at performance enhancements. I think that this would be necessary as it may be that what I have implemented does not necessarily perform the best however, I will be keeping an eye on this throughout the project. The performance enhancements may be directly related to the code or may involve looking at things such as the use of different heuristics / optimisation techniques.

Extra Work

If everything goes to plan, I have allocated 2 weeks to look at bonus 'work' to the project. This may include looking at the project from another angle and researching if another approach may be suitable or other general research. If there is enough time perhaps it might even lead to going further than extra research e.g. doing pseudo code or implementation.



Milestones and reviews

Week of 22/02/16 – *Milestone and review*
- 2 player Gomoku game finished
- **Review Meeting**

Week of 07/03/16 – *Milestone and review*
- Initial AI player finished
- **Review Meeting**

Week of 21/03/16 – *Milestone and review*
- Implementation finished with AI player(s)
- Tests finished to provide full coverage of implementation
- **Review Meeting**

Week of 28/03/16 – *Milestone*
- If necessary, any performance enhancements have been finished

Week of 11/04/16 – *Milestone*
- Extra research and implementations finished

Week of 02/05/16 – *Milestone*
- All work and final report hand in

References

Gomoku – Wikipedia, the free encyclopaedia. 2016. *Gomoku* – Wikipedia, the free encyclopaedia. [ONLINE] Available at: https://en.wikipedia.org/wiki/Gomoku. [Accessed 28 January 2016].