

## Individual Writing Exercise - 0800899g

The Main goal of this project is to implement an algorithm to calculate which teams in a given sports league, are incapable of winning the league when given the leagues current standings and remain schedule.

Many sports commentators often perform simple calculations like this daily to help the general public, and fans, quickly grasp the position of their favourite team, & the current league standings. The goal of this project is to show how more advanced calculations can be used to give reliable analysis, earlier on in the season, than many simplistic approaches.

The corner stone of the project is the Ford-Fulkerson algorithm. The Ford-Fulkerson algorithm can be used to perform network flow analysis, on a constructed directed graph of other teams in the league, & remaining matches, to effectively calculate which teams are incapable of finish top of their league.

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### Preliminaries

Any previous experience of graph theory, optimisation theory or network flow analysis could prove beneficial in grasping the main concepts of this project, however this not a required preliminary for understanding this document. All jargon and technical terms will be fully explained before there use in this text.

The main aim of the project is to build a desktop-based & Web-based application to allow Major League baseball fans to determine which of their favourite teams have no possible chance of winning their related league. The scope of the project will cover both the Nation and American Major Leagues and their related East, West and Central divisions. The sport of baseball was chosen for the project due to the fact that it lends itself well to the Algorithm the project will be using, with a scoring system using one point for a win, zero points for a loss, and each game must have a winner with no draws allowed it allows the elimination problem to be solved in polynomial time & is there for not a NP-Complete problem.

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### Motivations

One of the main motivations of this project would be to encourage the average sports fan not shy away from experimenting and/or cultivating any interest in other areas of study related to their favourite sport. One would hope that any spark of interest, that leads on to an enjoyment and understanding of another unrelated field, would be beneficial to any fan.

At a deeper level, a further motivation of the project is to investigate the use of the Ford-Fulkerson algorithm as an efficient way to calculate the maximum flow through a single source – single sink directed graph. The algorithm is able to do such a calculation in polynomial time based on input size, a far more efficient method as opposed to some more naïve algorithms such as a brute force approach.

This project was composed by, overseen and made possible by Dr. David Manlove ~~MA PhD PGCAP FHE~~. The project uses as a source for inspiration the "Riot baseball Project" by Professor Dorit S. Hochbaum<sup>1</sup> at the University of California-Berkeley.

The structure of this report will proceed as follows :

After a brief introduction the text shall cover the elimination problem being set out in terms of graph theory. We will explain the problem in terms of mathematical structures, which can be used to model pairwise relations between objects in the league. This section explain the use of a directed graph with a single & sink node, a column of nodes representing all games left in the season which the team under analyse do not take part in, and second column of nodes representing the other teams in the league that the elimination calculation is not being performed on.

After this the text shall go on to discuss in detail the Ford-Fulkerson algorithm, mentioning its benefits compared to more primitive techniques, the method it uses to calculate the maximum flow through a single-source, single sink graph directed graph with weighted edges(flow network), & the process of how this is achieved in is polynomial time based on input size.



After explain the elimination problem being addressed in terms of graph theory & covering the Ford-Fulkerson algorithm and its use in a flow network graph, the document shall move on to cover the projects implementation of the desktop based sports elimination algorithm application.

This section will be broke in 3 parts . Its shall start off by discussing the process of building a prototype desktop based application and the gathering of the primary secondary and tertiary functional requirements for the prototype and the final application itself. The second part will comment on the implementation of user interface of the java based desktop application in Swing and related design decisions of its implementation. And finally we shall cover the implementation the file parser, which takes in the relative standings & fixtures for each team, & organise it into the appropriate league and division data structures for the algorithm to operate on.

Moving on from the implementation of the desktop application the text shall discuss the design choices and tools used in the building of the web based application. This section shall cover the use both back end and front end technologies, such as SQL database in use by the server and PHP, CSS and HTML code in use to display the web app.