CA400 – Final Year Project

Functional Specification

Title: Heads Up Computer Poker

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Blog Link: https://gitlab.computing.dcu.ie/saccarn2/2017-ca400-saccarn2/blob/master/docs/blog/blog.md

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1. Introduction

1.1 Overview

The system provides a way for a user to play No Limit Heads Up Texas Hold 'Em poker against a 'computer' in a web browser. Potential users would use this in order to improve their general poker playing ability, particularly their Heads Up playing.

Users will be able to sign up and log in with a user name. They will then be able to initiate a game against the computer player. When the game is started, both the user and the computer player will be both be given a set number of chips and begin playing each other.

1.2 Glossary

- Texas Hold 'Em: This is the variant of poker that this project will focus on.
- No Limit: This means that a player can raise by any amount above the minimum bet.
- Heads Up: Form of poker that is played only between two players.
- Computer Player: In this document this refers to the A.I. that will be making decisions and playing against the user.
- Pot: The pot is what a player will win if they win a hand. Players take from their own chips and add to the pot throughout the game.
- Bet: Placing a number of chips into the pot. The minimum bet would be the value of the big blind.
- Check: Checking can be seen as the equivalent of betting 0.
- Call: Matching the other players bet.
- Fold: Giving up the hand.
- Raise: Betting on top of the players bet.

1.3 Poker Rules Gameplay

- Dealer: The dealer is the player who has the dealer chip.
- Round of Betting: The round of betting begins with the player who is left of the dealer. In Heads Up poker, this will be the other player in the game. Players will have the option to check, bet, raise or fold their hand.
- Small Blind Chip: the player who has the small blind chip must place the value corresponding to the small blind into the pot.
- Big Blind Chip: the player who has the big blind chip must place the value corresponding to the big blind into the pot.
- Small Blind: an amount that will increase throughout the game
- Big Blind: Double the value of the small blind.
- Stages of hand: Heads Up Poker has three main stages of the game –
    - Preflop: This is when all players have placed their small/big blind into the pot and received two cards. A round of betting takes place here.
    - Flop: Three community cards are turned over and a round of betting takes place.
    - Turn: A community card is turned over and a round of betting takes place.
    - River: The final community card is turned over and a round of betting takes place. The players reveal their cards and the player with the best hand combination wins the pot.
    - If a player folds at any stage in the game, the other player wins the pot.
- Poker Hand Rankings: A full list can be found here - http://www.cardplayer.com/rules-of-poker/hand-rankings.

2. General Description

2.1 Product/System Functions

User Functionality:

Firstly, the user will sign up using a unique username and password. Once they have signed up they will be able to sign in at any time in the future, and play against the computer player. When signing in, the user name and password will be authenticated server side against a database which will contain user login information.

Once a game has started, users will start to play hands against the computer player. Depending on the stage of the hand, the user will be able to complete either one of the following actions sets:

- Fold, Check, Bet
- Fold, Call, Raise

Again, depending on the stage of the game the computer player will also be given the option to complete either of the action sets.

Throughout the game, the chip counter for both players will be visible to the user so that the user can keep track of how many chips that they have left, and how many chips that the computer player has left. The user's actions will be recorded server side in a database.

2.2 User Characteristics

This project will appeal to users who have an interest in playing poker. They may be interested in attempting to improve their Heads-Up poker playing or even just may want to play for fun. These users are not technical, so they require a system with an interface that it is easy to use and they need to be clear about what is happening on the screen, otherwise they may get frustrated with the system and not continue to use it.

These users would access the system through a web browser on their personal machine (laptop or tablet). As such, the interface needs to work across a variety of different screen sizes and across a variety of browsers. The interface for the system also needs to be designed to be accessible for all groups of users – e.g.) the visually impaired – making sure that the user interface can be read with a screen reader and also to into account colour blindness.

2.3 Operational Scenarios

User sign up

A user will be given the option to sign up, if they do not have a pre-existing login username. They will supply a unique username and a password. If the username has already been taken by another user, a message will appear on the screen to inform them of this, and that they need to choose a different username.

User Login

If the user has a username already, they will be given the option to log in. The user needs to be logged in to play against the computer player. The user will then supply their username and password. If they have correctly done so, then the user will then be given an option to play against

the computer player. If they have not, a message will appear informing them that they have entered the incorrect username/password, and that they should try again.

User Playing - Overview

Once the user has correctly logged in to the system, they will have the option to play against the computer player. Throughout the game the user will be given the option to either check, bet or fold or will be given the option to call, raise or fold.

For the options, there will be clearly labelled buttons that will execute the actions when clicked on. If bet or raise is clicked, then an input box will appear so that the user can specify the number of chips that they want to raise or bet by.

Throughout the game, the number of chips both players have will be visible to the user. The game ends when either player runs out of chips. If the user runs out of chips, then a message will come up informing the player that the user has lost. If the computer player runs out of chips, then a message will come up congratulating the player on their victory. In both cases, an option to play again or to quit the game will appear to the user.

User Action – Check

The user will be given the option to check, when they are first in the round of betting. The user will know that they have the option to check, as a button labelled 'Check' will become active and clickable on the user interface.

User Action – Bet

The user will be given the option to bet, when they are first in the round of betting. The user will know that they have the option to bet, as a button labelled 'Bet' will become active and clickable on the user interface. An input box will also become active. Here the user will enter the number of chips they wish to bet. If the number is below the minimum bet stake, or the number is greater than the number of chips that they have, an appropriate message will appear informing the user that they can not carry out this action either because the bet stake is too low, or the amount they are trying to bet is greater than the amount of chips they currently have.

An all in option will also be available at this point in user play.

User Action – Call

The user will be given the option to call if the computer player has either raised or bet immediately before them in the round of betting. The user will know that they have the option to call, as a button labelled 'Call' will become active and clickable on the user interface.

When call is clicked, an amount matching the amount that had been bet or raised by the computer player will be added to the pot, and the round of betting will end.

User Action – Raise

The User will be given the option to raise, when they are second in the round of betting, or if they were first in the round of betting and the computer player has subsequently raised.

The user will know that they have the option to raise, as a button labelled 'Raise' will become active and clickable on the user interface. An input box will also become active. Here the user will enter the number of chips they wish to raise with. If the number is below the minimum bet stake, or the number is greater than the number of chips that the computer player has, an appropriate message will appear informing the user that they can not carry out this action either because the stake is too

low, or the amount they are trying to raise with is greater than the amount of chips the computer player currently has.

An all in option will also be available at this point in user play.

User Action – Fold

The user will be given the option to fold, when the computer player has either bet or raised the users bet. The computer player will win the pot and it will be added to their own chip stack if the user folds.

The user will know that they have the option to check, as a button labelled 'Fold' will become active and clickable on the user interface.

User Action – All in

Where an all in option is available, n 'All In' button will also be provided to the user. This is so users will be able to bet all their chips easily, without having to type the number of chips they have into the input box. A confirmation dialogue will appear on the interface, asking the user if they would really like to carry out this action. This is in case the user has accidently clicked this button.

If this all in is confirmed, the user will bet all their chips if the user has an equal or less number of chips than the computer player, else the user will bet the amount of chips that the computer player has.

2.4 Constraints

Speed Requirements

The Computer player must be able to make its decision fairly quickly, otherwise the user of the system may grow impatient and frustrated while waiting to play. Leaving the user regularly waiting for more than ~10 seconds or so would not be acceptable.

Browser Requirements

The client side poker game will be written using HTML and AngularJS, so it is assumed that users will use a fairly new and modern browser -anything from Internet Explorer 9, Mozilla Firefox Google Chrome and Safari should be supported but the game may not work in other browsers.

Time constraints:

This project must be completed by the 22nd May 2017, so all important components must be complete and tested by that date. Time must be taken into account for second semester modules and examinations.

Computational Constraints:

The computational constraint of running the A.I. behind the computer player on the server must also be considered – it is important to consider memory usage, and that it is not too high that it cannot run the hardware it is running on.

Hardware Constraints:

The project must be run and developed on either a lab machine or my own personal laptop as this is the only appropriate hardware available to me to use

3. Functional Requirements

3.1 Computer Player Functionality

Description

This is the functionality that allows the user to play against the computer. It will need to be able to provide a sufficient challenge to the user, otherwise the user may become disinterested in using the system.

Criticality

This is essential to the system. Without it, the user will not be able to play poker, and the system would be pointless.

Technical Issues

The main issues here are to do with the A.I. behind the computer player being able to correctly identify what action to carry out.

Dependencies on other Requirements

There is a dependency here on the web browser interface, as without it, the user would not be able to play against the computer player in a user-friendly way.

3.2 Web browser interface

Description

This is the point of contact where the user will interact with the system. The interface will be written using HTML, CSS and AngularJS. It should be straight forward and easy to use. The users should always know what stage of the game they are currently at, and when it is their turn to play.

Criticality

This part is important to the whole system, as this is what users will see the whole system as, and how they will interact with the system. Therefore, it is important that they get a good impression of the interface, in order for them to want to use the system to play poker.

Technical Issues

The interface should be as simple and as minimal as possible in order to be as clear as possible. Another issue to factor is the issue of accessibility, making sure that particular user groups (e.g. the visually impaired) needs are catered for and can use the interface successfully.

Dependency on other Requirements

As this is the only point of contact between users and the system, all other functionality depends on this being complete in order for users to use the system in a user-friendly way.

3.3 Sign up/ Log in

Description

The user will have to create a unique username and password in order to log in and be able to play against the A.I. This is necessary in order to keep track of users actions in the player database.

Criticality

This is important to keep track of a players' actions and how they have played. It is not too important in terms of how a user would perceive the system. They would still be able to play against the computer player using the web interface if the log in system was incomplete, however having a record of how the player plays may help the computer player creating a sufficient challenge.

Technical Issues

The main issue is that all usernames used for logging in should be unique. The username must also correctly identify the players' actions in the database.

Dependency on other Requirements

There is a dependency on the web interface for this functional requirement. The web interface should provide a suitable user friendly HTML form for signing up and logging in to the system.

3.4 Log out

Description

Once logged in, the user will be able to log out at any time, including during a game. This is to allow users to be able to stop playing and log out gracefully, without having to close the browser window.

Criticality

This requirement is not extremely important to the project – however having a log out option could help create a better impression of the system with the user, and as such, make them want to come back and play poker with this system again.

Technical Issues

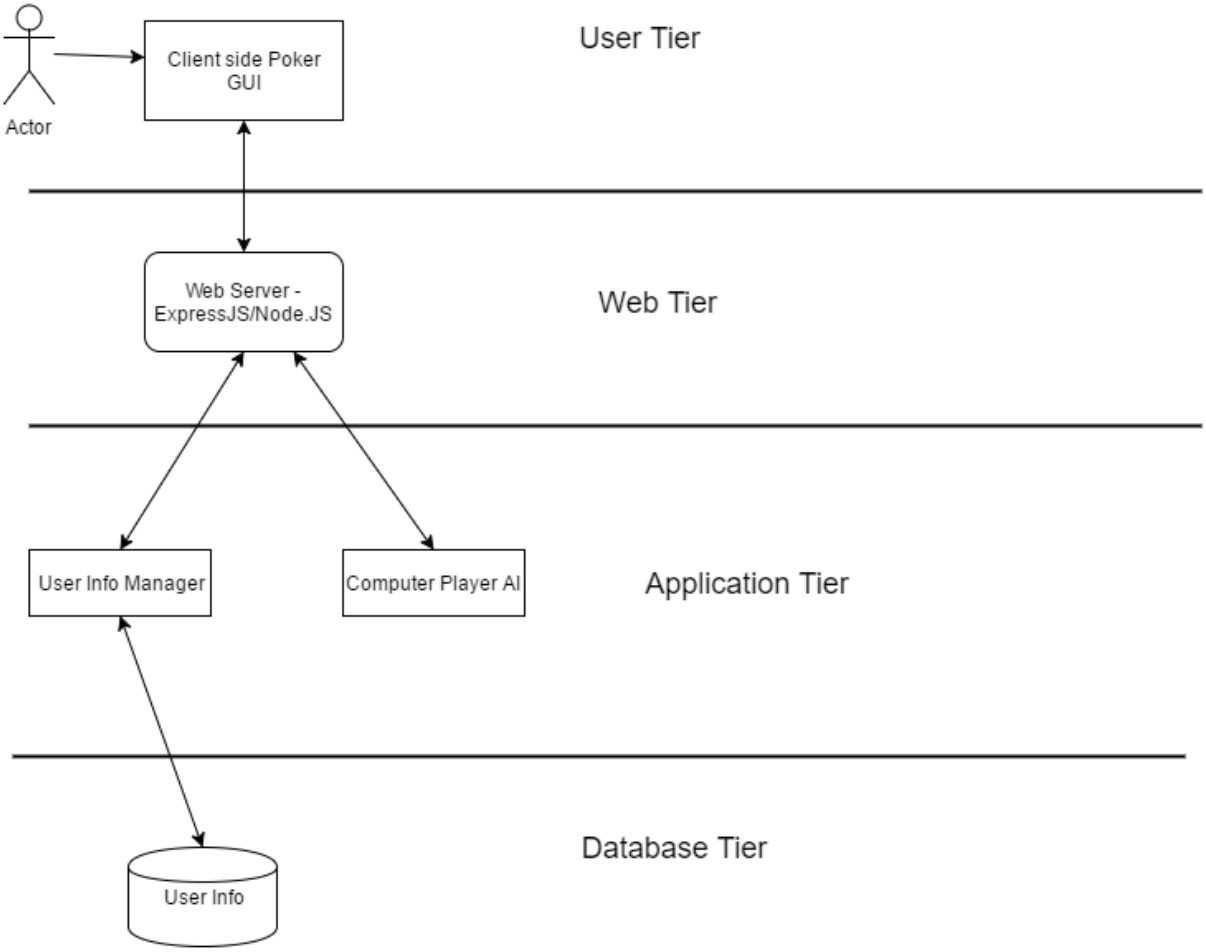
The main issue would be making sure that once a user is logged out, they are completely logged out from the system and that a different user would then be able to log in once they have successfully logged out.

Dependency on Other Requirements

There is a dependency on creating the logging in system first (this is more important) and also for the web interface to provide a suitable user friendly method to log out at any point through out the game.

4. System Architecture

4.1 Diagram



4.2 Client Side Poker GUI

The Poker GUI is what the user will see. It will be written with HTML, CSS, and AngularJS. It is their single point of contact with the system, and will be presented in a user-friendly way.

4.3 Web Server

The web server will handle all requests from clients, and make calls to the User Manager or Computer Player AI as appropriate. It will be written using JavaScript, with Node.JS and ExpressJS.

4.4 User Manager

The User Manager is an interface to the user database. The web server will call the user manager to do the following:

- Check a user credentials
- Store and update the user's previous actions in the database.

4.4 User Database

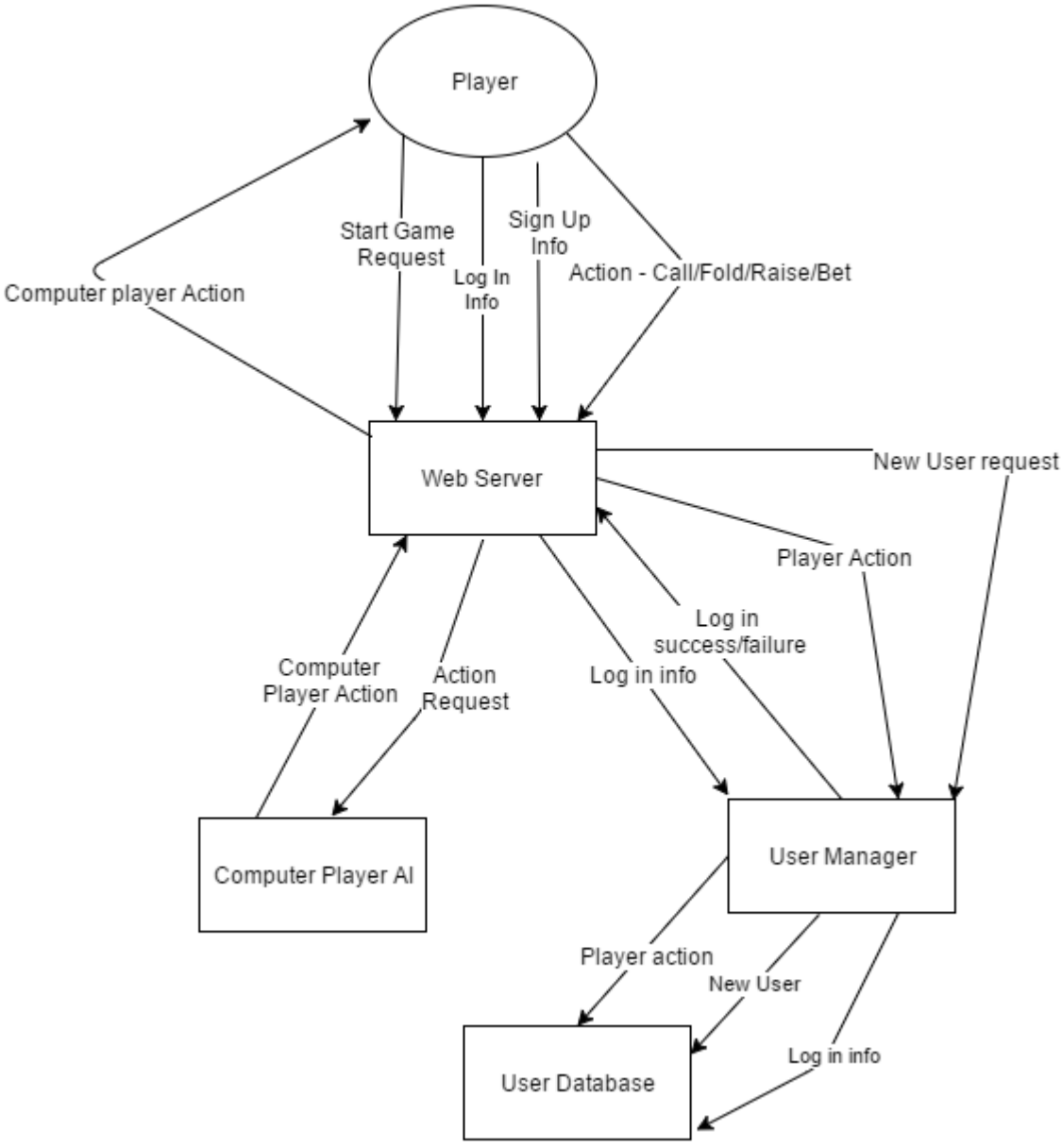
The users database will contain player information such as username, password, and the users' previous actions.

4.5 Computer Poker Player A.I.

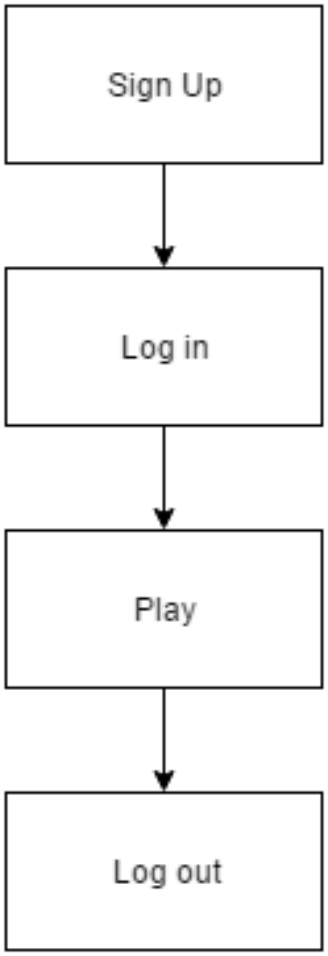
This will determine the actions the computer player should play. It is called from the web server.

5.0 High Level Design

5.1 System Context Diagram



5.1 High level Design Diagram - User



5.2 High level Design – User Diagram Description

Sign Up

This is where a user must a create a log in. They must choose a unique username and a password. They will use this to log in to the system.

Log in

Logging in to the system using the unique username chosen at sign up is required to play poker on the system.

Play

This is the main point of interaction with the system that the user will have. Here they will play against the computer player and attempt to beat it.

Log out

At any point while a user is logged in, they may choose to log out of the system. Log out will be either the user clicking the log out button, or them closing the browser window.

6.0 Preliminary Schedule

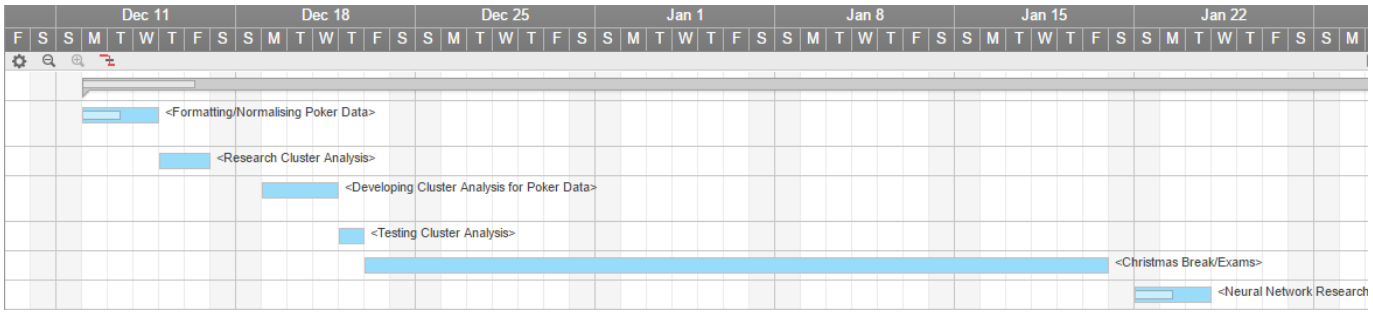
6.1 Tasks

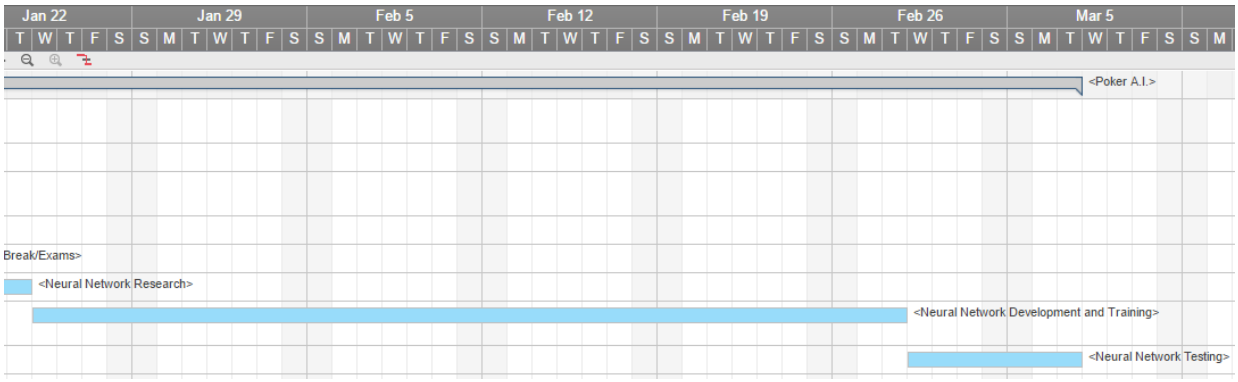
	Task Name	Start Date	End Date	Status	Duration
1	**<Poker A.I.>**	**12/12/16**	**03/07/17**	**Not Started**	**62d**
2	<Formatting/Normalising Poker Data>	12/12/16	12/14/16	Not Started	3d
3	<Research Cluster Analysis>	12/15/16	12/16/16		2d
4	<Developing Cluster Analysis for Poker Data>	12/19/16	12/21/16		3d
5	<Testing Cluster Analysis>	12/22/16	12/22/16		1d
6	<Christmas Break/Exams>	12/23/16	01/20/17		21d
7	<Neural Network Research>	01/22/17	01/24/17	Not Started	3d
8	<Neural Network Development and Training>	01/25/17	02/28/17		25d
9	<Neural Network Testing>	03/01/17	03/07/17		5d
10					
11	**<User Interface>**	**03/12/17**	**03/22/17**	**Not Started**	**9d**
12	<Prototyping>	03/12/17	03/12/17	Not Started	1d
13	<Researching AngularJS/Javascript Library>	03/13/17	03/13/17	Not Started	1d
14	<developing U.I>	03/14/17	03/20/17	Not Started	5d
15	<Writing U.I. tests>	03/21/17	03/22/17		2d
16	**<Web Server + Application Server>**	**03/24/17**	**05/22/17**	Not Started	**42d**
17	<Reasearching Node.JS/ExpressJS>	03/24/17	03/24/17	Not Started	1d
18	<Developing Web Server>	03/26/17	03/27/17	Not Started	2d
19	<Database set up>	03/28/17	03/29/17		2d
20	<Developing SQL queries to authenticate user, store user actions>	03/30/17	03/30/17	Not Started	1d
21	<Database testing>	03/31/17	03/31/17		1d
22	<Researching Java Server Technologies>	04/03/17	04/03/17	Not Started	1d
23	<Developing app server to host A.I.>	04/04/17	04/06/17	Not Started	3d
24	<Clustering and Neural network integration>	04/10/17	04/12/17		3d
25	<Testing of integration>	04/13/17	04/17/17		3d
26	<Integration of poker AI, web server, U.I.>	04/18/17	04/21/17		4d
27	<Automated test/manual testing of full integration>	04/22/17	04/27/17		5d
28	<Documentation - user manual and Tech specification>	04/28/17	05/01/17		2d
29	<Exam study period/ exam period>	05/01/17	05/19/17		15d
30	<Submission>	05/22/17	05/22/17		1d

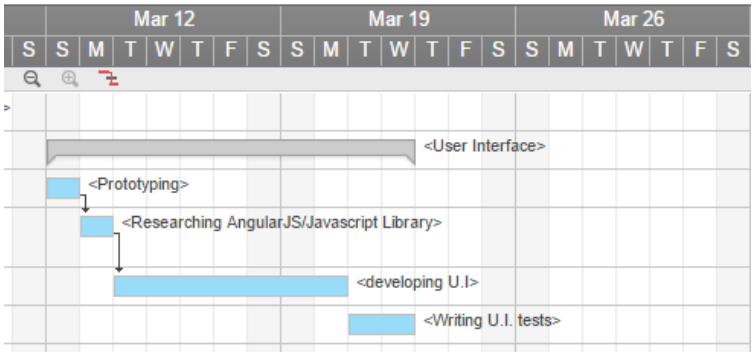
6.2 Gant Chart Representing Tasks

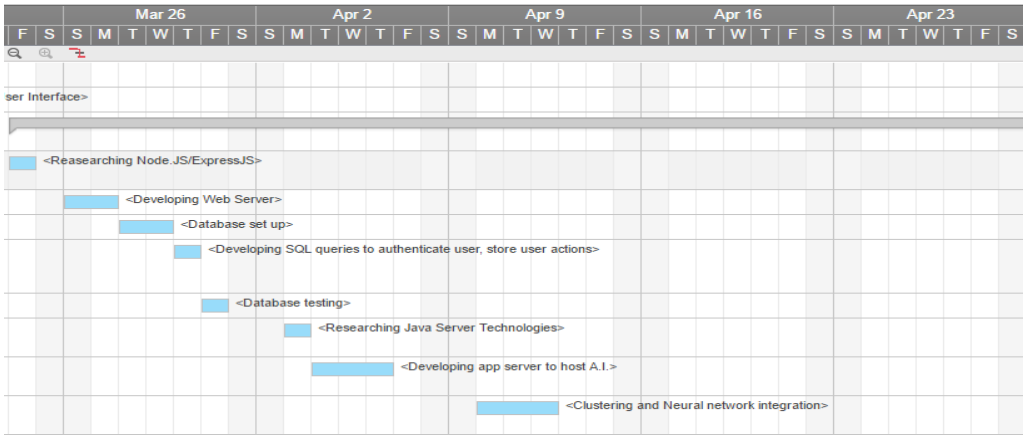
Please note the dates are in the American Date format.

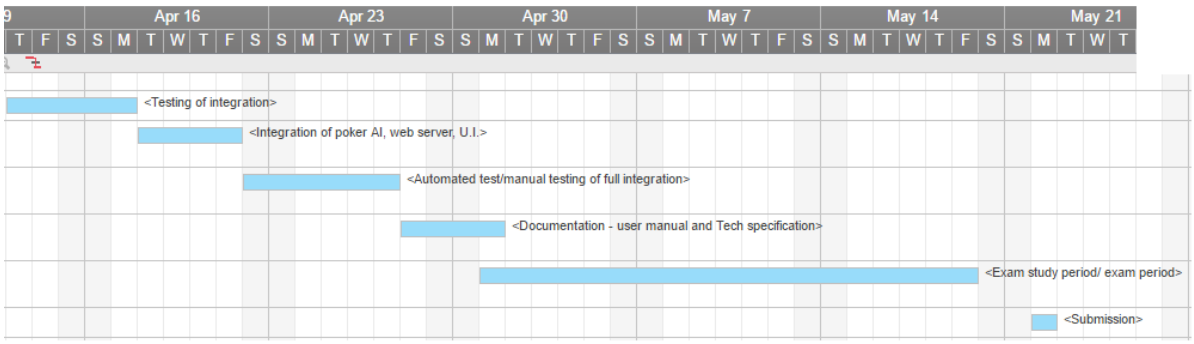
No specific hardware or software for this project is required.











7.0 Appendices

7.1 Resources

- http://www.pokerlistings.com/poker-rules-texas-holdem
- http://www.cardplayer.com/rules-of-poker/hand-rankings
- http://www.pokerology.com/lessons/poker-playing-styles/
- http://stevenmiller888.github.io/mind-how-to-build-a-neural-network/
- http://poker.cs.ualberta.ca/
- http://computing.dcu.ie/~humphrys/Notes/Neural/single.neural.html
- http://www.statstutor.ac.uk/resources/uploaded/clusteranalysis.pdf