NLTHP - User Manual

CA400 Year 4 Project

Members: Immanuel Idelegbagbon (17393433) & Stefano Puzzuoli (17744421)

Supervisor: Dr. Mark Roantree

Project Title: No-Limit Texas Hold'em Poker AI

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Abstract

This project consists of an easy to use web application that allows users to test their Texas Hold'em Poker skills against 5 Artificial Intelligence Agents in a game of No-Limit Texas Hold'em Poker. Users are able to select from 4 different levels of difficulty and train and assess their skills according to their desired challenge magnitude.

The user interface consists of a user-friendly web UI which users can access through their web browsers. This UI allows the users of the application to visualise the Poker game, with the table, opponents, cards and all the possible accepted commands when playing each hand. The application also includes a sign up/log in functionality which allows users to keep track of their game statistics (e.g. winning percentage). Users which do not want to avail of this functionality have the option to play games as guests, which will not involve any statistics recording. Since with No-Limit Texas Hold'em Poker there are 10^{71} possible game states, the web application makes use of a personally implemented poker hand evaluation library, which is lightweight and fast. This evaluation library handles 5, 6 and 7 card hand lookups and all lookups are done with bit arithmetic and dictionary accesses.

The models (different models for different difficulties) consist of Reinforcement Machine learning models with Gradient Boosting Regressors that allow each Artificial Intelligence Agent to try to predict the maximum expected return value on each different game state throughout a game. These AI Agents are trained repeatedly with the final objective of generating interesting and viable poker winning strategies, allowing users to test and improve their Texas Hold'em Poker skills.

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1. Introduction

1.1. App Logo

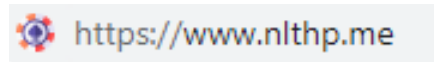

NLTHP

1.2. Recommended Browsers

NLTHP is compatible with the numerous diverse Operating Systems, devices, and Internet browsers that are available. While we want every user to have the best possible experience, we recognize that it is impossible to develop applications that work identically, efficiently, and effectively with all browsers and versions. We also recognize that testing on every browser version and device combination is no longer possible as many new browser versions are deployed on aggressive weekly or bi-weekly schedules. NLTHP has been tested on and supports the following Web Browsers:
- Chrome
- Microsoft Edge
- Firefox
- Safari
- Internet Explorer
- Opera

2. User Guide
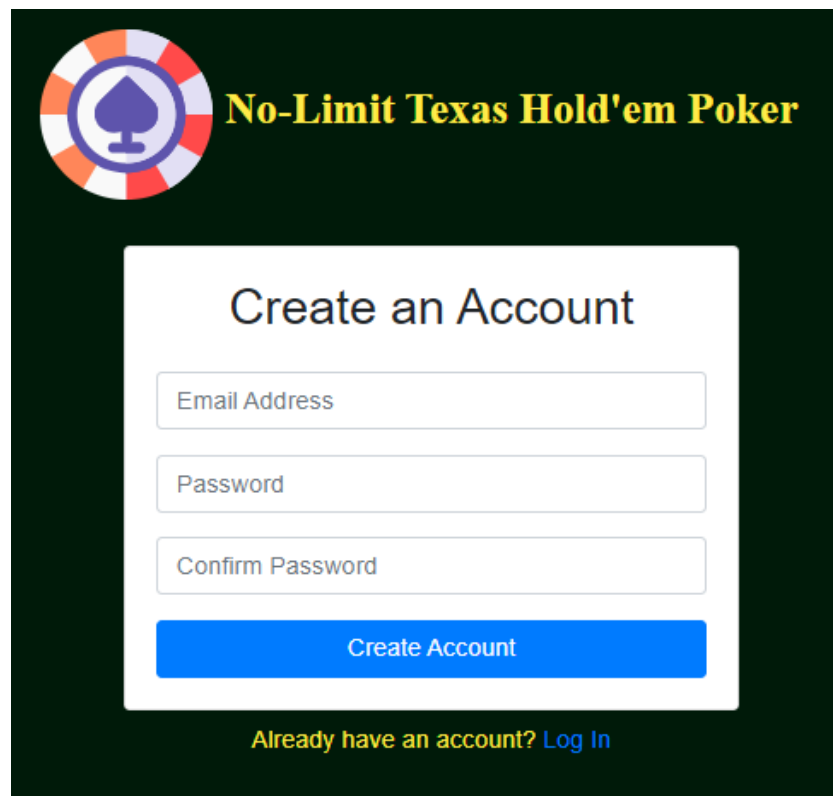
2.1. Accessing the Application

To access the NLTHP web application, ensure that you are on a device with internet access and a modern web browser (e.g. Google Chrome). In the selected web browser of your choice, enter the URL 'https://www.nlthp.me' and hit enter to access the application. The NLTHP URL can also be seen in the below image:

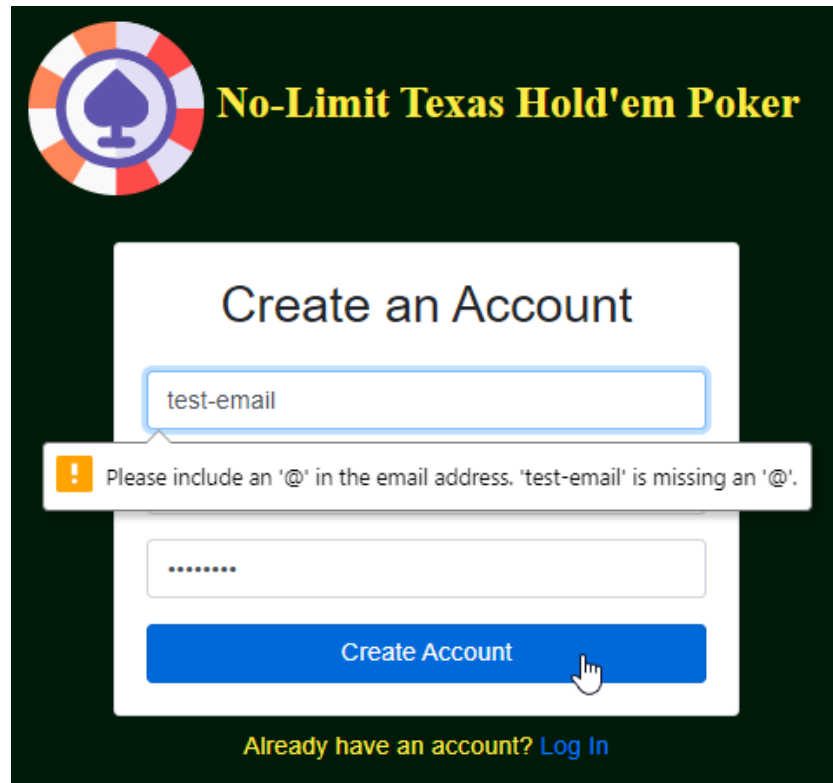NLTHP URL in Google Chrome browser

2.2. Sign up (Create an Account)

If using the NLTHP app for the first time, the URL suggested in section 2.1 will redirect you to a Sign Up page. One of the functionalities of the NLTHP web application includes the possibility to record user game statistics, allowing each user to keep track of their performances, by knowing their win percentages at each different level of difficulty. To avail of such a functionality users are required to sign up and create accounts with an email address and password which are credentials they will then have to use to log in (see section 2.3) to allow this performance tracking functionality. Alternatively, if users do not want their results saved, they can simply play games as guests which will not impact their record.

NLTHP Sign up (Create an Account) page

When on the sign up page above, if you desire to create an NLTHP account in order to play NLTHP and record your statistics, then you must enter a valid email address, a password and a matching confirmation password before clicking "Create Account" to successfully create a new NLTHP account.

The sign up page also performs some form validation upon the clicking of "Create Account" to assure that it is dealing with valid entries.

Sign up Email address validation

Sign up Password matching validation

Once a sign up (e.g. NLTHP account creation) is successful, the user is automatically logged in and is redirected to the NLTHP Dashboard which is discussed in section 2.5.

2.3. Log in

If you are a user that already has an existing NLTHP account, meaning that you have followed the steps in section 2.2 that shows how to sign up for an NLTHP account, then you simply need to enter your email address and password credentials on the Log in page of the app in order to access the functionalities of the NLTHP app. The Log in page can be accessed by clicking on the "Log in" link on the Sign up page, where below the create account form there is the message "Already have an account? Log in" as can be seen below.

Log in link on Sign up page
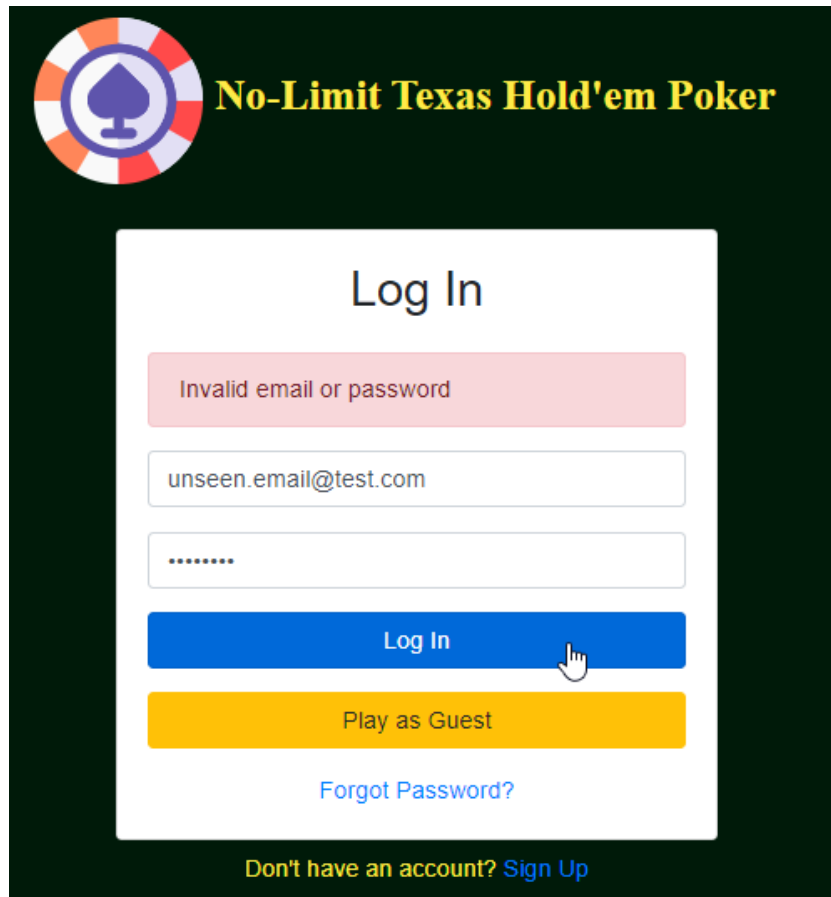
NLTHP Log in page

Once on the Log in page, to access the NLTHP functionalities, you can either log in with your account credentials (email address and password with which you signed up), or you can log in as a Guest user which allows to avail of all the NLTHP features except for the game statistics recording.

Note that, when trying to log in with an email address and a password, form validations occur here too and if the credentials entered are not found in the database (have no matching previously signed up account), the form will catch this, prevent the log in and inform the user through an error message as we can see below:

Log in credentials validation
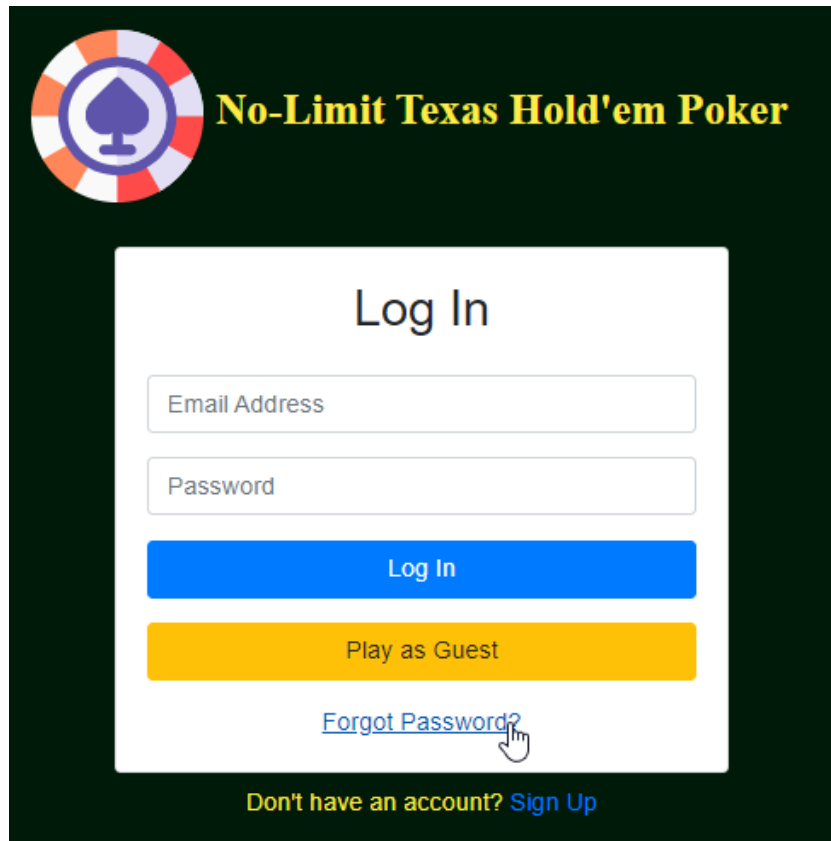
Alternatively, if the log in occurs successfully, you will be redirected to the NLTHP Dashboard which will be discussed in section 2.5.

2.4. Forgot Password
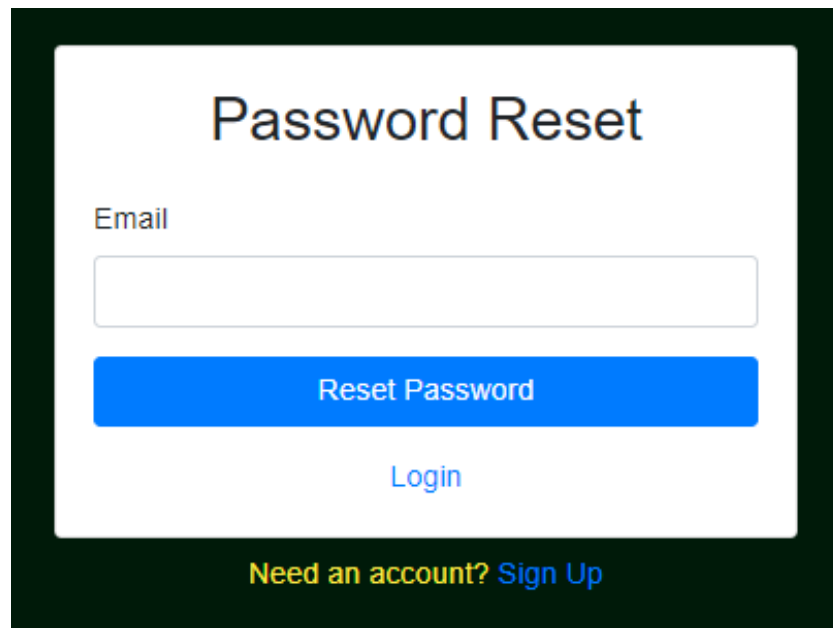
If you have previously signed up (e.g.created an NLTHP account) as described in section 2.2 and at a later stage forget the password associated to your account, the NLTHP app provides a Password recovery/change feature which can allow to simply solve this problem.

This functionality can be found on the NLTHP Log in page under the "Play as Guest" button as the link "Forgot Password?" as we can see below:

"Forgot password?" link on NLHTP Log in page

Once the "Forgot Password?" link is clicked, you are redirected to Reset Password page in which you can enter your NLTHP account email address to reset its corresponding password.
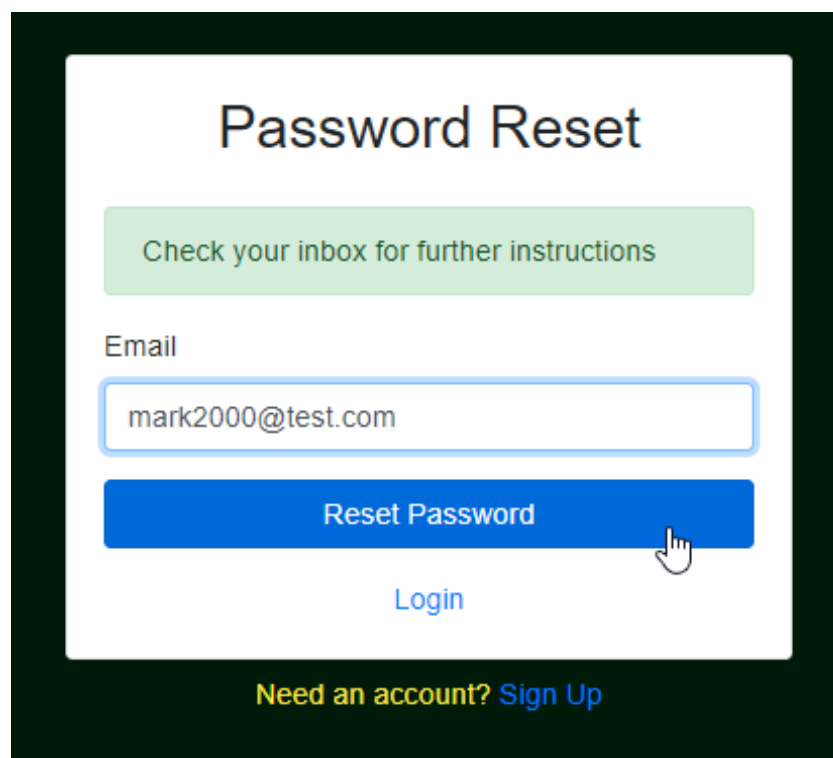
NLTHP Password Reset page

Once the email address for which you are resetting the password is entered and the "Reset Password" button is clicked, a message informing you to check your email inbox for further instructions will appear.

Password Reset success message

After this occurs, you can check your email inbox and an email from noreply@poker-auth-development.firebaseapp.com will have the instructions to follow to reset the password for your NLTHP account. Once the new password is reset, you can log in to your NLTHP account with the new reset password.

2.5. NLTHP Dashboard

Once the instructions from Section 2.3 regarding a user log in are followed (either via account credentials or as a guest), you will be given access to the NLTHP Dashboard. From the Dashboard you will be able to join No-Limit Texas Hold'em Poker tables where you can compete against our trained AI Agents of different levels. The table difficulty levels to select between from the NLTHP Dashboard are Beginner, Intermediate, Expert, and Ultimate Poker Pro. Additionally, from this Dashboard you can also access your personal statistics (if not logged in as a guest) or log out of your account which will redirect you to the NLTHP Log in page.
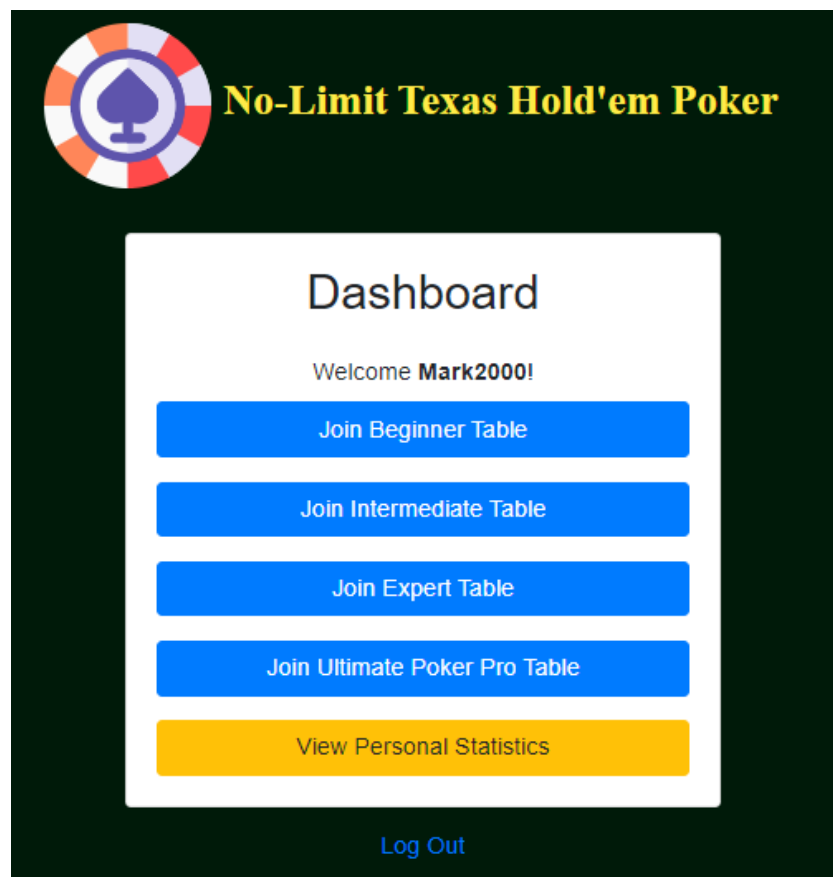
NLTHP Dashboard page

2.6. NLTHP Personal Statistics

From the NLTHP Dashboard, as mentioned in Section 2.5, you can access your NLTHP account personal statistics page, which allows you to see your overall number of games and number of wins at each different level of difficulty, aside from a total games and total wins statistic.

To access this page, you have to click on the "View Personal Statistics" button on the NLTHP Dashboard page.
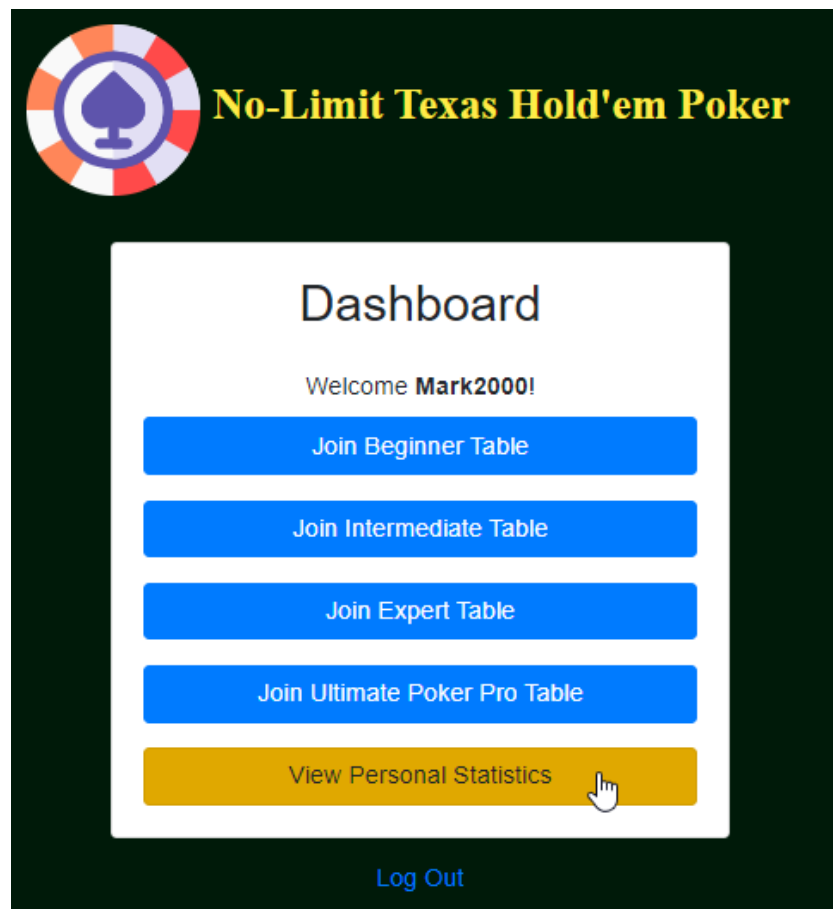
"View Personal Statistics" button on NLTHP Dashboard

After said button is clicked, you will be able to view all your personal NLTHP statistics in a table where the first column represents the number of games played, the second column the difficulty level at which the games were played, and the third column the number of games won. This can be seen below:
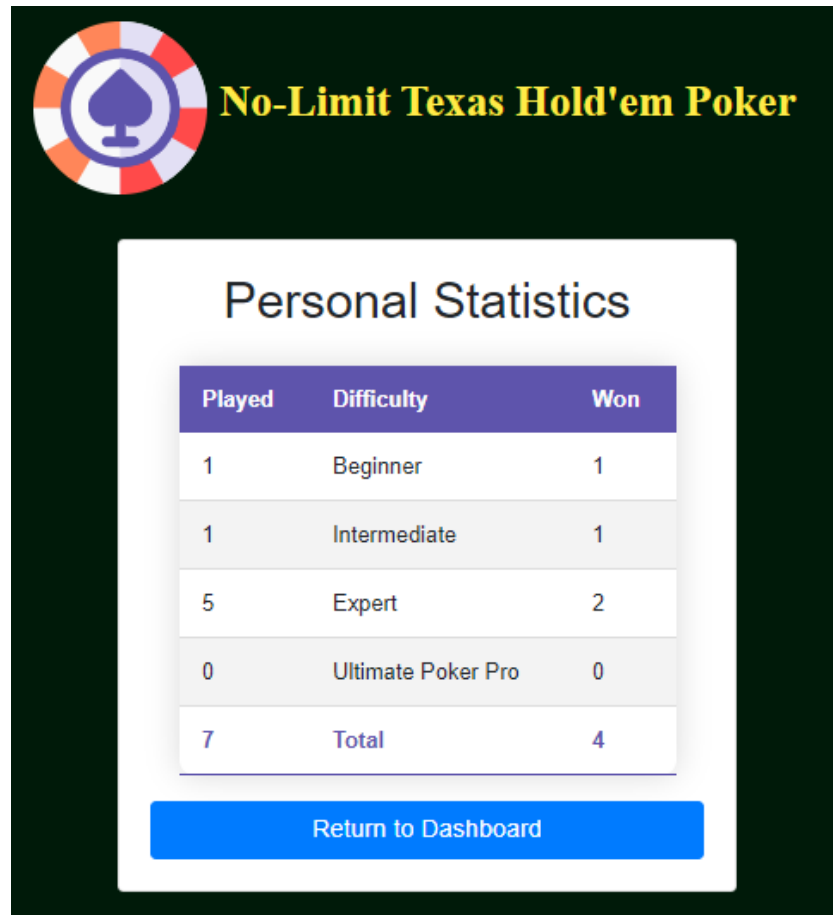
NLTHP Personal Statistics page

Finally, when you are done viewing your statistics and want to return to the NLTHP Dashboard, you can do so by clicking the "Return to Dashboard" button.

2.7. NLTHP Game

From the NLTHP Dashboard, as discussed earlier, you can join a Poker table where you can compete against our trained AI Agents of Beginner, Intermediate, Expert, or Ultimate Poker Pro difficulty levels. By clicking one of the various options, you will join a table in which a game of No-Limit Texas Hold'em Poker against 5 Artificial Intelligence Agents of the selected difficulty will begin.

NLTHP Game page

2.7.1. NLTHP Game Components

2.7.1.1. Player Icon
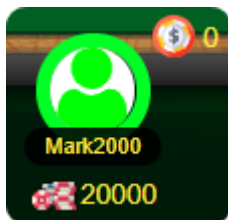
Player icons allow you to see the name of each player at the table (Mark2000), the colour of the icon representing each player (green), the current stack of the player (20000) and amount of chips bet in the current hand round (0).

It is important to also note that the green thick border around the player icon indicates that said player is active and it is currently their turn. Active players take turns in a clockwise direction around the table.

Additionally, when a player's stack reaches 0, they are removed from the table and are no longer part of the game.

2.7.1.2. User Private Cards
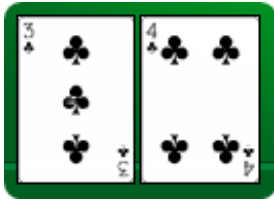
Above your icon will be your two private cards (3 of clubs and 4 of clubs). These are "visible" only to you as the AI Agents are unaware of what private cards you have.

2.7.1.3. Agent Private Cards
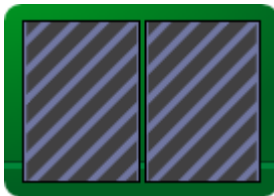
Above each AI Agent player icon will be their respective two private cards (hidden). These are private to each Agent, thus you and other AI Agents are unaware of what private cards the other Agents have.

2.7.1.4. Table Community Cards
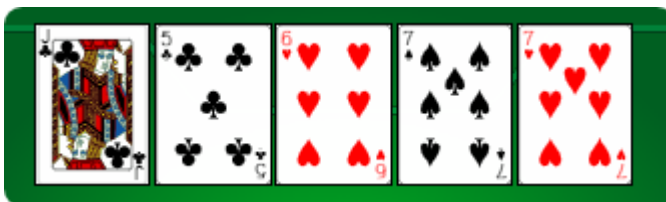
With Texas Hold'em Poker the goal is to use your two private cards in combination with the community cards to make the best possible five-card poker hand. These community cards are visible to all players and are dealt on the table in three stages:

- **The Flop:** the first three community cards (J of clubs, 5 of clubs, 6 of hearts).

- **The Turn:** the fourth community card (7 of spades).

- **The River:** The fifth and final community card (7 of hearts).

2.7.1.5. Dealer Button

As mentioned, active players take turns in a clockwise direction around the table. Who the first player to take action during each hand is determined by the Dealer button. The play moves clockwise around the table, starting with action to the left of said button. The Dealer button is a round disc that is located in the front-left of a player and is rotated one seat to the left every hand.

The first two players sitting to the immediate left of the button are required to post a 'small blind' and a 'big blind' to initiate the betting.

The player with the button, or last active player closest to the button receives the last action on all post-flop streets of play.

2.7.1.6. Pot

At the center of the table is the current pot of each hand (120). At the end of each hand the player with the best combination of five cards wins the pot which is added to their total stack.

2.7.1.7. Fold Button

If you are an active player in the current hand and it is your turn, two action buttons and a raise bar will appear at the bottom of the screen. One of said buttons is the fold button which, if clicked, causes you to throw your current cards away and leave the current hand in play. If this occurs, you are out of the game and no longer eligible to win the current hand.

2.7.1.8. Check/Call/Raise/All-in Button

In addition to the "Fold" action button, there is another button for which the functionality changes according to the current state of the game. The 4 possible functionalities said action button can have are:

- "Check" : A player has the option to "check" if no betting action has occurred beforehand. A check simply means to pass the action to the next player in the hand.
- "Call" : A player has the option to "call" if at least one other active player in the hand has bet more chips than him. A call simply matches the highest amount bet by other active players in the hand and allows you to stay in the hand.
- "Raise" : A player has the option to "raise" almost at any time in the game where they still have a stack that is lower than the maximum bet in the current hand. A raise basically consists of an increase of the highest bet in the current hand. The action button becomes a "raise" button when you increase the amount you want to bet on the Raise bar which is discussed in section 2.7.1.9.
- "All-in" : A player has the option to go "All-in" almost at any time in the game where they still have a stack that is lower than the maximum bet in the current hand. An "All-in" is basically a "raise" with the only difference being that you are betting your entire stack in the hand.

2.7.1.9. Raise Bar

As mentioned above, when you are active and it is your turn, aside from the two action buttons appearing, a raise bar also appears next to them. This bar allows you to control the amount of chips you want to raise by, if you want to perform a raise at all. The yellow slider on the bar can be moved from left to right and from right to left and the value below it indicates the raise amount (20 above).

2.7.1.10. Menu Button
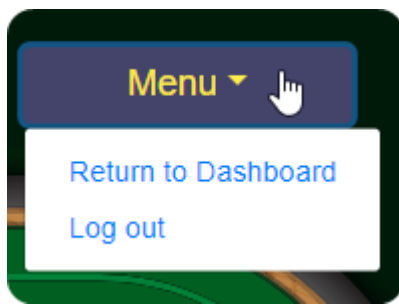
Next to the NLTHP logo, there is a Menu button which when clicked, gives two options:

- "Return to Dashboard" : exits the current game and returns you to the NLTHP Dashboard page. If this occurs, the current game is ignored and not saved as a played game (will not be in your statistics).
- "Log out" : logs you out of your currently logged in NLTHP account and redirects you to the Log in page. As for the "Return to Dashboard" action, this also ignores the current game and does not impact your statistics.

2.7.1.11. Showdown

After all betting actions have been completed, if more than one player remains, the private cards of the remaining players are revealed and their hands are compared to determine the winner (or winners) of the pot. This is called the "Showdown".

A showdown can involve anywhere from two players to the entire table, depending on how many players stayed in the game up to this point.

Ties can also occur, thus If two (or more) players tie a hand, they "split the pot" depending on how the pot should be divided amongst the players.

When a Showdown occurs during a NLTHP game, for each active player in the hand the following are displayed:

- Player Name
- Private Cards
- Best Hand (best 5-card combination of their private cards and the community cards)
- Hand Ranking
- Win/Loss

In the above example, both players (Agent 1 and Agent 3) have a "Pair" hand ranking but Agent 1 wins (takes the pot) as his best hand (pair of J's) is better than Agent 3's best hand (pair of 2's). Overall Agent 1 wins 14040 chips while Agent 3 loses 5376 chips.

After each Showdown, to allow the game to proceed and start the next hand, you must click the yellow "Next Hand" button visible in the Showdown page.

2.7.1.12. Win Page
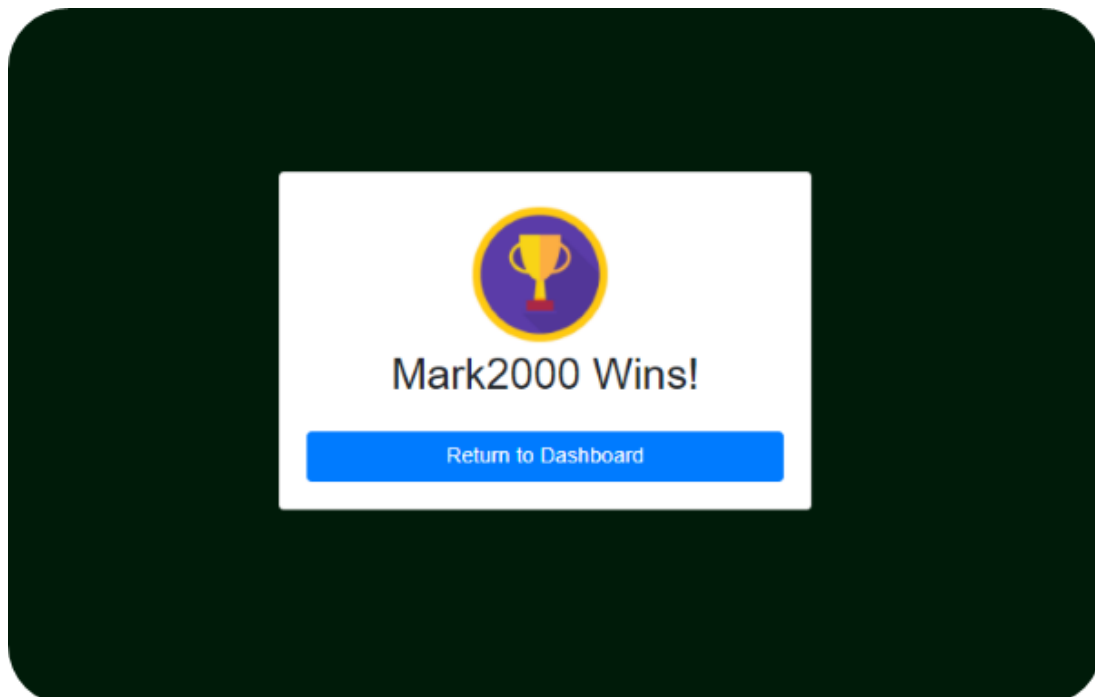
As mentioned, when a Player's stack reaches 0, they are eliminated from the table. When all but one Player lose their entire stack, that one player is the winner of the game.

When the end of the game is reached, you are redirected to a Player Win page which informs you about who the winner is.

In the above example, Mark2000 (the human user) is the winner of the game and thus the message "Mark2000 Wins!" appears. From this page it is possible to return to the NLTHP Dashboard where you can play another game, view statistics, or perform any other task described in section 2.5.

3. Supporting Information

3.1. Texas Hold'em Poker Ruleset

The following table represents a comprehensive list of all Texas Hold'em Poker hand rankings (Rank 1st being the best hand):

Rank	Hand Name	Description
1st	Royal Flush	Ten, Jack, Queen, King and All all of the same suit.
2nd	Straight Flush	Five cards in sequence all of the same suit.
3rd	Four of a Kind	Four cards of the same denomination.
4th	Full House	Three cards of one denomination and two cards of another denomination
5th	Flush	Five cards all of the same suit
6th	Straight	Five cards of any suit in sequence
7th	Three of a Kind	Three cards of the same denomination and two unmatched cards
8th	Two Pairs	Two sets of two cards of the same denomination and any fifth card
9th	Pair	Two cards of the same denomination and any three unmatched cards
10th	High Card	Card of highest denomination when all five cards are unmatched

Note: In Texas Hold'em Poker players use their two in hand cards in combination with the community cards to make the best possible five-card Poker hand.

To learn more about how to play No-Limit Texas Hold'em Poker visit https://www.pokernews.com/poker-rules/texas-holdem.htm where you can find all the rules and hands that you will want to be familiar with to compete against our skilled NLTHP AI Poker Agents.