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| H446 Programming Project |
| F1 Fantasy League |
| Lord Williams School |
| Tom Draper (Student)  7-7-2021 |

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# Analysis

## Problem and Explanation:

For my project I am planning on making a F1 Fantasy League Game similar in which Fantasy Football works, but for Formula 1 Racing. It works by assigning each player a price based of their performance in the sport, so the user creates a team and the better the team of drivers perform in real life, the more points that team receives. So that you can compare your teams points with your friends and others. I am planning on having a chat built in so that users can talk to each other about their teams or the sport.

## Stakeholders

I have selected a group of F1 fans of ages 16-18 to represent my target audience so that the program matches what they would expect and want out of a F1 Fantasy League, this will help get information on what they would like and dislike when I present prototypes of the program, this will help me stick to what the target audience would want.

Due to the scope of my project my target audience is any enjoyer of Formula 1, and the chat will have a profanity filter option so that any ages can use the program.

## Interview with stakeholders

I asked the stakeholders a few questions so that I know what they want an F1 fantasy league to offer.

Me – “If you were starting a fantasy F1 team what would you expect the service to offer?”

Sam - “A good GUI that shows how points will be attained”

James - “A Chat would be nice so that users could talk to each other”

Me – “What would you expect to change scores?”

James - “Not really sure, but I would expect things like final position to affect scores”

Chris - “I think it would be good if qualifying could affect the scores”

Me – “What do you currently most enjoy about fantasy football?”

Sam - “To compete against others and have the winning team”

Me – “Would you care if the project didn’t have the best looking GUI?”

Chris – “No as long as all that is needed is in it”

James – “But it would be good for it to look nice”

## Research

### API

When thinking of the project I knew I had to find a way to get all the data needed, such as race winners fastest lap and lots of other data to help compile prices and points system. When searching for a way to get this data I came across a website called [Ergast Developer API](http://ergast.com/mrd/), This is a free API that can provide years of data and is updated after new races.

I thought I would try and use the API to make sure it was easy to navigate and easily worked with python (so I got It to retrieve all year’s race results since 2015):

Code:



Defines what years you want to search and how many rounds each year.

Sends an API get request to receive the json data which gets converted into a dictionary data structure.

Shows the position, name, end reason and fastest lap time of each driver.

Shows which race the driver data is coming from.

Console output:

As there was a lot of data outputted this is just a snippet of the output near the end.



Shows each divers position at the end of each race.

Displays the drives name and their reason for ending the race.

It also displays each drivers fastest lap, this will help provide extra points if the data is analysed.

This provided a good insight as it showed that the free API I found, provided all the data I would need and would work perfectly for getting the data needed, that can be processed and stored on the server.

### GUI

I looked at many GUI modules for python or using a web-based interface (Django) .I have been looking at many GUI’s for python and have compared and ranked them.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Rank | Name | Integration with python | Ease of use/ programming | Best looking result |
| 1 | PyQt | 4/5 | 5/5 | 5/5 |
| 4 | Tkinter | 5/5 | 3/5 | 2/5 |
| 3 | easygui | 3/5 | 3/5 | 3/5 |
| 2 | Kivy | 3/5 | 4/5 | 4/5 |

I looked at using Tkinter as I was taught the basics of this GUI module, so I could easily learn the enough to make my project, but I decided against using Tkinter as it had a very old and outdated looking design and code was hard to follow. So instead I looked at PyQt as this looked much better, good support for widgets and it also had build in software (qt Creator) which helps mould the GUI to whatever I need.

I decided to make a simple word processing program to test the viability of using this as my primary GUI tool.

### Client Server Networking

I needed a way to send data to the clients so that the data on the drivers and their team can be transferred from the server to ensure no cheating can occur and also so that a functional chat group could be active and the only way to do this was through a client-server network

#### Program Login

So that users fantasy team data can be accessed from any device wherever, we have to have some kind of login system so that players can save their data to a server, and it be sent back when they login using there unique credentials.

I decided to test if I would be able to make this system, to I made a simple client server login page that asks for a name and pin to access.

**Server.py:**

The server code sets up the connection and waits for an input, to which is processes the result and returns whether it’s a valid login or not.

The server.py as a test only has a 2-dimensional list to store the correct name and pin, this is not secure or efficient for my project but as I was testing whether I could create a system like this using client-server connection it was enough to store the users name and pin to be searched through.

Code:



Send back accepted or denied to the client.

Searches logins for any matches with the data they sent

Defines Host IP and port

Simple client name and pin storage

Accepts connection from client

Console output:



Shows the inputs and the result from the server.

This was the only input to be incorrect and the code spotted this and denied access.

**Client.py:**

Connects with the server and send the inputs it receives, then waits for a response from the server. After which it processes the response and outputs a Boolean True/False response.

Code:



Defines host IP and port that the client needs to connect to.

Sends the name and pin provided, they had to be sent in one string. Then receives the result processes it and returns True or False

The provided test set to see if the program works correctly.

Console output:



The client shows that the last one was denied and the rest where accepted.

#### Chatroom

I decided to add a chatroom so that the users can talk to each other and give more reasons to use my f1 fantasy league rather than alternatives.

I decided to make a mock-up of a quick client-server chatroom to show the basic aspects.

**Server.py:**

The server has to receive each chat message from the clients and redistribute that message to all the clients so they receive what was sent by one user.



Opens a text file that will log all messages received.

Receive code ‘send’ if the client wants to send a message.

If client wants to receive messages, then the sends the last message sent.

Adds to chatlog and updates message variable based of message what’s received.

Defines host IP and port that the client needs to connect to.

**Client.py:**

The client has to send the server each message that the user inputs, and also receive and display any other messages sent.



The message() subroutine sends the initial string to tell the server what the connection is going to be used for, and then sends the server the string that is received by the message\_constant() subroutine.

To run the message() subroutine constantly.

A subroutine which sends out a receive code so that the server sends back the last message it has received, which the client checks if it is a new message before displaying it.

This runs both the message\_constant() and receive\_messages() subroutines at the same time using multiprocessing.

### Encryption

#### Hashing

To prevent potential leakage of password information, you can just never store the actual password in a database, this can be done by making use of a hashing algorithm as you feed your passwords in and the algorithm creates a hash of the password which can then be stored, this means that anytime you must access the database you will not be able to see people’s passwords which further increases security.

When researching I found that there are many types of hashing algorithms that are used. I researched some of the major hashing algorithms that already have some implementation into python and compiled them into small table to compare them.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Hashing Algorithm | Sha256 | Blake2b | Blake3 | Argon2 |
| Speed (MiB/s) | 484 | 1312 | 6164 | 412 |
| Can utilise ‘salt’ | Yes | Yes | Yes | Yes |
| Security | low | medium | medium | Highest |

Due to speed not being a huge issue as it is only being used to hash the passwords when creating and verifying a password, I believe that Argon2 if the best option to use for my project for its high security and easy implementation. Argon2 also won the Password Hashing Competition.

I wanted to see if it was possible to integrate Argon2 into python, so I created a simple script that takes an input and verifies it against a hashed password and outputs True or False based of whether the input matches the password:



This if statement checks If the hash has been created, and if it has not been it creates the hash and saves it to test.txt

Opens test.txt and assigns the hash variable as what’s in the file

Imports the argon2 python module

The contents of test.txt, which stores the hash of the password.

Checks if the hash is out of date and replaces the outdated hash with a new updated hash.

Checks the user input against the stored hash and outputs True or False based of the result.



Using the correct password it outputs True, as expected.

Using the incorrect password it outputs False, as expected.

Console output:

After creating this script and making sure it is easy to integrate into python. I feel comfortable integrating it into my project to store passwords and to increase security.

#### Encrypt network activity

When researching what algorithms or methods I could use to encrypt the network messages I found an encryption algorithm called AES which is a symmetric block cipher.

This algorithm looked promising, so I created a small encrypt/decrypt script:

When creating this script, I decided that it would be more secure if the day, month and current hour are all used to help make the second key or IV.



Imports the AES encryption and datetime python modules.

These are the variables for the Key and IV. The IV (key2) changes based off the Hour, day and month the code is run on, so you never get the same number.

This while statement checks that the message is 16 bytes long as the algorithm requires that, it also records how many padding characters it used so they can be removed after decryption.

The function then returns the encrypted string and how much padding was used.

This decrypts the string and removes all the padding which is then returned.

This runs both the functions with ‘#MesSagE63’ as the message and outputs the values that are returned throughout the process.

Console Output:

This is the encrypted string that would be transmitted and it has 5 padding characters.

It outputted the same value that was encrypted, this shows that it works perfectly.

After creating this script I feel comfortable using the AES algorithm to encrypt the network traffic that will be send back and forth.

### GDPR and Data Protection Act

Due to the new laws in place I need to ask for permission before storing any personal data and be able to remove or locate and send all data linked to them if requested.

As I will not be storing any sensitive data such as credit information or full name, this means that it will not cause me any great issues. To abide by these rules, I will have a tick box to allow me to store their username and password and any messages they send, and if someone requests their data then all databases will be searched with their username and will send it over to them.

## Comparison of Existing Programs

Currently there is a similar [Official Formula 1 Fantasy](https://fantasy.formula1.com/) web application that is similar to what I would like to achieve, I hope to compete with this program in the future.



Shows next race to be held.

Shows your created teams.

Shows each driver’s name what team they are in and a photo of them, to help anyone that may be confused.

Shows how the price/value of that driver has changed recently, to help people make good decisions about their drivers



The Official Formula1 Fantasy program has lots of good features but does not provide a chatroom to be able to talk with other people about the sport or about their program, this is what my project will include to bring to community together.

When browsing the website, I liked the recent price/value change as this helps people make informed decisions to add their drivers, so I have decided to try and add this to my project to show the change in price over 2 races.

I also saw that they have lots of animated graphics that I do not have the skll or time to implement as I will focus on the minimum viable product.

Their website also includes advertisement, many users may find this annoying and intrusive, so my project will not include any advertising or sponsored content as I do not intend to make money from this program at this current time.

## Desired Features

for my project I need to incorporate, for minimum viable product (MVP), in MoSCoW format:

M – A client-server chatroom

M - Server-side web scraping/API usage to get the data needed.

M - A price system that analyses the data from races, to give each driver a price.

M - Get the next race is and when it occurs and display it.

M - A login system so that user’s data can be transferred to different machines.

M – Allow the user to edit and display their team

S – A good-looking GUI to show all the data needed and provide a way around the program

S - Password Hashing so no passwords are stored in databases

C - Encryption of data that is sent between the server and clients.

W – Introduce complicated animated graphics

# Design

## Server Login

For my login page I would like to have a username and password login system so that the username can be used later for the chatroom. I designed a flowchart of what the algorithm will be doing:



This flowchart will help me make the login page and help understand how it needs to work it does not include any encryption on the data before sending it to the server but the actual project should incorporate this.

I have designed a simple design for what the login page would look like on the client side.



Title and Logo to engage the user.

Fields to enter the username and password.

A tick box to accept Terms and conditions which contain how their data will be used so I do not violate any GDPR laws.

When submitted it closes the window and sends the data over to the server.

Currently have no logo or a design choice so the design only consists of what is needed for the login page to function as aesthetics can easily be added or changed in the future. This design was remade in the next part to help match the design of the other pages.

## GUI

From my stakeholder interview the GUI needs to:

* Be easy to navigate.
* Show the users team value and recent changes.
* Provide easy to use chat.

So, I designed a wireframe of what each page would look like to make sure I include all the features that are required:

Menu:



Team edit screen:



Login and register pages:



Recent driver changes page:



This gives me a reference for when I am creating the GUI so that it can be as close to my visions as possible.

**Wireframe Storyboard:**

Making a GUI page diagram will help show how to get to the different pages of the GUI through the button menu. This shows how navigation in my program will work and how to implement it.



## Points System

As the entire project relies on the value of teams and drivers changing and adapting the points need to be allocated correctly and fairly so I have created a points list that can be integrated into the program during development, and they can easily be changed later.

All Drivers and Constructors will start with a base of 250 points, to stop any negative values.

Driver:

Qualifying Points:

Pole position / +3 Points

Second / +2 Points

Third / +1 Point

Made it into Q2 / +5 Points

Made it into Q3 / +5 Points

Qualified better than teammate / +3 Points

Qualified worse than teammate / -2 Points

Race Points:

|  |  |
| --- | --- |
| Race position | Points |
| 1 | 25 |
| 2 | 18 |
| 3 | 15 |
| 4 | 12 |
| 5 | 10 |
| 6 | 8 |
| 7 | 6 |
| 8 | 4 |
| 9 | 2 |
| 10 | 1 |
| 11-20 | 0 |

Race finish / Points as show in table

Fastest Lap / +1 Point

Positions gained from grid / +1 Point per position gained

Positions lost from grid / -1 Point per position lost

Finished above teammate / +3 Points

Finished below teammate / -3 Points

Did Not Finish (DNF) / -25

Constructor:

Qualifying Points:

Driver on pole position / +3 Points

Driver second / +2 Points

Driver Third / +1 Point

Driver made into Q2 / +5 Points per driver

Driver made into Q3 / +5 Points per driver

Both drivers made it into Q3 / +3 Points

Race Points:

Race finish / Points per driver as shown in table

Fastest Lap / +1 Point

Driver positions gained from grid / +1 Point per driver

Driver positions lost from grid / -1 Point per driver

Driver Did Not Finish (DNF) / -25 Points per driver

Finished top 10 / +3 Points

Each user will start with ₤100,000,000 to create their team and to convert the points values above into currency by multiply their point values by 20.

I decided to create a flow chart for the points system so that it would be easier to create:



## Client Server Chat

For the client-server chat I created a flow chart for how it would work on the server and on the client so that it would be easier to properly integrate and add it to my project.

**Server:**



**Client:**



These flowcharts where very helpful as they showed me I would have to make use of multiprocessing in my project to be able to send and receive messages at the same time.

## Class Diagram

ADD

## Database Structure

For my project I will be using SQLite3 as it is very well integrated into python, so will be the most simple to set up.

I will need at least 2 tables, one for login details, and one for the users team data, with the formats below.

Login table:

|  |  |  |
| --- | --- | --- |
| UserID | Username | Password hash |
| Unique Integer | String | String |

Team Data table:

|  |  |  |  |
| --- | --- | --- | --- |
| UserID | Constructor | Remaining Drivers | Remaining cash |
| Unique Integer | string | List stored as a string | Integer |

## Development Method

For my development I will be using modified RAD (Rapid Action Development) methodology so that each iteration I can make a prototype and get feedback from the stakeholders on how to improve or adapt the project to help meet deadlines or to make a better product then initially proposed. This means I may change my project design as development progresses.



Using this diagram I created, at the start of each iteration I will set an expectation list to complete each week then design implement and test the new code then get feedback from stakeholders and evaluate that week to help set the expectation for the next week. This means if I set an expectation that is too much I can move it over to the next iteration and expect a more reasonable amount of work, or if I set my expectation too low I can increase what is expected for the next iteration.

During development I will also be constantly committing my code on GitHub. This will to allow me to have version control, so I can roll back to any point if I create an unwanted error or any other reason.

Testing per iteration:

# Development

## Week 1 – Creating Points Distribution

This week I would like to get a server prototype up and running, to do this I need to:

* Get the server to a connectable status.
* Create a points distribution, a file that contains the point values for different tasks.
* Get the server to fetch and sort the information from Ergast F1 API and store the data for each race that has taken place.
* Use the data to calculate and store the points for each driver and constructor.
* Check if the points system creates fair point distribution.

I started by creating a separate json format python file to store the amounts of points gained and lots through tasks completed by the drivers.

#points\_distribution.py

#Points given for tasks  
assign\_points={  
 'DriverPoints':{  
 'Race':{  
 'Results':{  
 '1':25,  
 '2':18,  
 '3':15,  
 '4':12,  
 '5':10,  
 '6':8,  
 '7':6,  
 '8':4,  
 '9':2,  
 '10':1,  
 'F':-25, #F,D,W,R,N is DNF  
 'D':-25,  
 'W':-25,  
 'R':-25,  
 'N':-25  
 },  
 'fLap':1, #Fastest Lap  
 'PGFG':1, #Points per Position gained From grid  
 'PLFG':-1, #Points per Position lost From grid  
 'FAT':3, #Finished above teammate  
 'FBT':-3, #Finished below teammate  
 },  
 'Qualifying':{  
 'Results':{  
 '1':3,  
 '2':2,  
 '3':1,  
 },  
 'RQ2':5, #Reached Q2  
 'RQ3':5, #Reached Q3  
 'QBT':3, #Quallified Below Teammate  
 'QWT':-3 #Quallified Above Teammate  
  
 },  
 'Constructor':{  
 'Race':{  
 'Results':{  
 '1':25+3,  
 '2':18+3,  
 '3':15+3,  
 '4':12+3,  
 '5':10+3,  
 '6':8+3,  
 '7':6+3,  
 '8':4+3,  
 '9':2+3,  
 '10':1+3,  
 'F':-25, #F,D,W,R,N is DNF  
 'D':-25,  
 'W':-25,  
 'R':-25,  
 'N':-25  
 },  
 'fLap':1, #Fastest Lap  
 'PGFG':1, #Points per Position gained From grid  
 'PLFG':-1, #Points per Position lost From grid  
 },  
 'Qualiflying':{  
 'Results':{  
 '1':3,  
 '2':2,  
 '3':1,  
 },  
 'RQ2':5, #DriverReached Q2  
 'RQ3':5, #Driver Reached Q3  
 'BQ3':3, #Both drivers reach Q3  
 }  
 }  
 }  
  
}

I also created the start of the points recorder for each driver, and it record all driver the names of all f1 drivers

import requests #import needed modules  
import ast  
def get\_drivers():  
 data = requests.get('http://ergast.com/api/f1/drivers.json?limit=1900&offset=30')  
 drivers = ast.literal\_eval(data.content.decode())['MRData']['DriverTable']['Drivers']  
 detail\_driver\_list = []  
 file = open('drivers.txt', 'w+')  
 for driver in drivers:  
 try:  
 driver\_id = driver['driverId']  
 full\_name = f"{driver['givenName']} {driver['familyName']}"  
 nationality = driver['nationality']  
 DoB = driver['dateOfBirth']  
 number = driver['permanentNumber']  
 except Exception:  
 number = 'n/a'  
 detail\_driver\_list.append([driver\_id,full\_name,nationality,DoB,number])  
 file.write(str(detail\_driver\_list))  
  
def get\_race\_data():  
 from datetime import date  
 for year in range(1950,date.today().year+1): #Cycle through all years of f1  
 total\_races\_in\_year = ast.literal\_eval(requests.get(f'http://ergast.com/api/f1/{year}.json').content.decode())['MRData']['total'] #Get all rounds in the year  
 for race in range(1,int(total\_races\_in\_year)+1): #Cycle through all the rounds in the year  
 race\_data = ast.literal\_eval(requests.get(f'http://ergast.com/api/f1/{year}/{race}/results.json').content.decode()) #Get the race data   
 quali\_data = ast.literal\_eval(requests.get(f'http://ergast.com/api/f1/{year}/{race}/qualifying.json').content.decode()) #Get the quali data  
 assign\_driver\_points(race\_data, quali\_data)  
  
def assign\_driver\_points(rData, qData): #use race data to assign points to the driver  
 #print(len(rData['MRData']['RaceTable']['Races'][0]['Results']))  
 for driver in rData['MRData']['RaceTable']['Races'][0]['Results']:  
 driver\_id = driver['Driver']['driverId']  
 finish\_position = driver['position']  
 grid\_position = driver['grid']  
 constructor = driver['Constructor']['name']  
 try: fastest\_lap\_position = driver['FastestLap']['rank']  
 except KeyError: fastest\_lap\_position = 22  
 driver\_points = get\_race\_points(finish\_position ,grid\_position ,constructor ,teammate\_position , fastest\_lap\_position)  
  
def get\_race\_points(fPos, gPos, team, teammatePos, fLapPos): #Get all data required and create  
 points = 0  
 from point\_distribution import assign\_points  
 try: points = points + assign\_points['DriverPoints']['Race']['Results'][fPos] #add points for finishing finishing top 10 or minus 25 for not finishing  
 except KeyError: points = 0  
 points = points + ((int(gPos)-int(fPos)\*assign\_points['DriverPoints']['Race']['PGFG'])) #add points for position gained from grid  
 if fLapPos == 1: points = points + assign\_points['DriverPoints']['Race']['fLap'] #add points for achiving fastest lap  
 if fPos > teammatePos: points = points + assign\_points['DriverPoints']['Race']['FAT'] #add points for finishing above teammate  
 elif fPos < teammatePos: points = points + assign\_points['DriverPoints']['Race']['DBT'] #add points for finishing below teammate  
   
 return points  
  
get\_drivers()  
get\_race\_data()

Due to the research and lack of knowledge the points calculation is taking longer than expected and I was doubting the efficiency due to my program having a Big O notation of O(n2) and as the data sets it has to go through are large and requesting them takes time I was worried about the efficiency of this algorithm before I had finished it, and it would have to include another loop for each team, so I decided to create a new flowchart for my points system which gets each driver of a team’s points at the same time:

This new algorithm uses less loops to bring down the runtime of the points calculator, and will make use of multiprocessing on the subprocess so that it can run even quicker.

This also allows me to calculate each teams’ drivers and calculate the constructor’s points all at once loosing the need for another loop.



## Week 2 – Points Calculation Algorithm

Last week I decided to remake the points calculation algorithm as it did not include a way to calculate constructor’s points and had long runtime due to many nested loops

This week I would like to get the points system up and running, to do this I need to:

* Get the server to fetch and sort the information from Ergast F1 API and evaluate the data for each race that has taken place.
* Use the data to calculate and store the points for each driver and constructor for every race.
* Store this data to an external database/file.
* Check if the points system creates fair point distribution.

I was able to get the points gained and lost for teams and drivers for every race, but this does not make any use of qualifying data which also needs to be included, and it does not store the data to storage yet.

This is the code I have created this week gets data of every year by getting all the race data and process it and return and print point values for every race.



This subroutine cycles through the years, gets the amount of races that year and then cycles through each race that year, where it then gets the race and qualifying data and provides it to the assign\_driver\_points subroutine.



The assign\_driver\_points subroutine uses the data provided to extract the data required including team and create a new data structure which only includes the needed data, and combines drivers based off what team they drive for. It then cycles through each team and provided both drivers data to the get\_points subroutine.



The get\_points Subroutine uses both drivers data to assign points based on tasks they completed and uses the numbers from point\_distribution.py to get the amount of points for each task then returns the point values for each driver and the team.

This code only currently makes use of the race data, so I know next week I need to have it include race data and to save all this data to a file.

## Week 3 – Saving Raw Points

This week I would like to get the points system finally up and running, to do this I need to:

* Use the qualifying data and extract points required to add to the race points.
* Make use of threading to speed up the calculations.
* Make the current year double the points.
* Store this data to an external database/file.
* Check if the points system creates fair point distribution.

When researching to add qualifying data to my program I realised the qualifying result is the same as their starting position on the grid so I can just use the already created gPos variable to assign points

When I started programming I noticed an issue with using the created gPos variable, anyone that took engine penalty’s or other kind of grid penalties would not gain points for their qualifying position, I decided that to help the runtime and ease of code that for now it will use the starting grid position of the drivers, if this creates issues in the results of the points then I can introduce it back at a later date.

I started by adding threading to the code so that all the years would be ran in parallel dramatically decreasing runtime.

It

It creates a thread for every year and then loops through the list of threads and runs them, then it waits for the last thread to finish before continuing the code. This reduced the runtime from about 92 seconds to 21 seconds.

I also added the qualifying points based of the grid position of each driver

This means that it now calculates all the points it needs to.

Then to save them to a file I created a subroutine save\_points that is called in the assign\_driver\_points file after using the data from the get\_points subroutine.



This means that all the points created by the code will be recorded.

I have noticed one issue when I run the code, and that is that the file created is always different sizes, I assume it is due to two threads writing to the file at the exact same time, so I will need to address this next week

## Week 4 – Threading Points Calculation

Last week I added the calculation of qualifying data, and made use of threading to speed up the time in which the code takes to run, but by making use of threading it caused an issue where some data was being deleted.

This week I would like to fix the issues caused by threading, to do this I need to:

* Find an alternative to writing straight to the file.
* Maybe slow down the threads.
* Make sure no data is being deleted

When searching for a solution I found [python queue module](https://docs.python.org/3/library/queue.html) that is a queue data structure that should work well with threaded programming, so I would have to have all the threads add to the queue and a loop running in parallel that takes data from the queue and writes it to the list.

I started integrating the queue module by initialising the queue at the start of the get\_race\_data subroutine



I had to make the “q” and “finished” variables global so that the save\_to\_file loop and each thread could access the data they need.

The save\_points subroutine only had to be changed slightly so that instead of saving to a file it just adds to the queue.



Then the save\_to\_file subroutine has to take the data from the queue and write it to the external data file.



I decided to run it in parallel with the threads by adding it to the list of threads at the start



It also now waits for the save\_to\_file thread to finish before moving on.

But as the bug which deleted some data through threads writing to the same area at the same time did not go away completely, I decided to add a break for every 10 threads so that it has no chance to delete any needed data.

Graphical user interface

Description automatically generated with low confidence

Even with this change it runs much quicker than without threading and barely makes a difference to the total runtime.

## Week 5 – Final Points Calculation

Last week I fixed a major issue with data deletion and implemented a queue system to get that done. This was very helpful and now means I can move on and finish the points calculation and start the user interface and network for the project.

This week I would like to total the points and save them to a file which can easily be navigated, to do this I need to:

* Analise the raw data.
* Total each driver’s points from both driver1 and driver2 data.
* Total each team’s points from the raw data.
* Save each drivers points and team points in an easy to navigate data format.

So I created a subroutine that reads the raw data file and takes the team and each drivers points and groups them with their drivers then totals the points, sorts them and saves the results as a json file and a separate json file for the team points.

Text

Description automatically generated

I noticed I had coded some repetition into my code so I created a list of a list of variable that are used in each loop and then created a loop for each item in the list as shown below.

Text

Description automatically generated

The save\_final\_points subroutine just takes the data and filename in and saves the data into the file and changes all ‘ into “ as required for the json format.

Text

Description automatically generated

This creates two files driver\_points.json and team\_points.json.

A snippet of driver\_points.json looks like this

Text

Description automatically generated

And team\_points.json looks like this

Text, letter

Description automatically generated

The screenshots don’t show all the data but show how the data is stored and how it will be navigated when used later.

When I ran the code I noticed lots of teams that have been in the sport for a long time such as Ferrari and Williams came out as the highest points, so to counter this I decided to x10 all points in the most recent season, I did this buy changing the points just before it is saved.



## Week 6 – Server-User Login

Last week I finished the calculation and recording of team and driver points. So, this week I want to start the server-user login to a base level so that it can be incorporated into the GUI.

To start the code for the client-server login I need to:

* Create a connection between the client and server
* Send the login information to the server
* The server needs to take the data, hash the password compare them and accept or decline the client
* Then both the server and the client need to proceed through their code.

Before I created the client-server login I decided to move all the files that are to do with points calculation into a separate file to keep the project organised

So the project folder looks like this when it is run.



To do this I needed to change all references to other files such that they are placed and looked for inside the points folder. But this will help to keep my project tidy and easy to navigate.

To start the login page I need to create the frame of what the program would need to make use of in the backend.

I started by creating an SQL database for the login information and link it to the python file



This creates a table called logins with 2 coulombs, username and hashpass to store the usernames and passwords and imports the hashing algorithm so that it can verify hashes.

I then created the class that handles each user that logs on.



The ‘Account’ class uses the username and finds the connected password hash if there is one, and the account variable states whether there is an account under this name which can be checked if vaid\_account() is ran. Then if it is a valid account it can run check\_pass() which takes the given password and verifies it against the hash value.

To make use of this class a simple subroutine needs to be created.



I created a login subroutine which uses the account username and the password given and then checks if the username is valid then runs check\_pass() with the given password which can then return a true or false and the false has a reason attached.

I now need to create a subroutine and method to register an account into the database.



This subroutine uses the username to check if there is already an account and if there is not then it runs the create\_record() method.



This method inserts the username and password and also increments until it finds an open ID value. This is only possible because I changed the table initialiser to only accept unique values

This week I was able to complete the server side backend and database that will take and compare and will register new accounts and this can be build off next week to start working on sockets and connecting to the client.

## Week 7 – Networking for login

Last week I created the database and the methods to communicate with it and the hashing algorithm, but I was not able to incorporate networking so that will be done this week.

To continue the code for the client-server login I need to:

* Create a connection between the client and server
* Determine where the user is logging in or registering.
* Take the data and send it to the server.
* Then the server will use last weeks code to send a result back.
* Then both the server and the client need to proceed through their code.

To start I created a host connection from the server.



This opens the server, currently to localhost for testing purposes, then loops and handles multiple clients by creating a thread for each client, then waits for the thread to finish and saves the database.

The handle\_client\_login subroutine splits up the request from the client and runs the login or register method depending on what is needed and sends back true or false and returns true if the client logged in with correct username and password.

I tested my program using a small script

Text

Description automatically generated

This piece of code connected and worked perfectly.

I believe some of the code will need to be moved into a main.py file so that it can be incorporated into the project properly and can easily send the team data needed

This week I was able to complete the server side login and test the client side compatibility

## Week 8 – Create User’s Team Database

Last week I completed the login page but it had no data to send to the client so this week I would like to set up and send and receive team data for each user’s team.

To do this I need to:

* Create a database
* Store each user’s team and 5 players
* After login send the data to the client
* Allow addition of new data via client in the future

I started by creating a sqlite3 database

This creates a database that stores the team and driver data of each user

Now I need to link the different files together, I started with the points recorder



This imports the required modules and then runs the required ones to make the final sorted points files

Now I need to link the login code, so I had to move and adapt some subroutines from network.py into main.py so that the team data could also be sent.

I moved the main() and handle\_client() to the main.py file so that they can easily intergrate with the new database for teamdata this code now will connect to a client get a login or register request and check or append the database, and if the client logged in with the correct login info it will send the relevant teamdata back to the client.

Now that the different code files are linked so all the files are controlled by main.py. This is needed so that only one python file needs to be started to launch the server

My file system looks like this, before running the code



After running the main.py file it creates these files



## Week 9 – Add/ Get Records From Team Database

Last week I created the teamData database and allowed users to get their data from it, but currently there is no way to create new records for the database, so I need to create code that will receive the team data from the client and append this data to the database.

To do this I need to:

* Find a way to receive the data from the user
* Create a record for the data in the teamData database with the same userID
* Test that the network connection works and the data is being saved
* Test the new data is being sent after login

First of all I need to find a way of receiving the data which needs to be added to the database the two options I have are to create a new port and a new connection. or to use the current login connection and add a new code instead of login and register, this method would mean all connection would be done through one port which is easier to manage and understand.

First I added a new task so if the server receives the save\_team request if the username and password are valid it saves the team and drivers data with the same userID.



I created a client test that connects to the server and sends a request to save team data,

A screenshot of a computer

Description automatically generated



The first client test should return false as there is already a record with the username of test, the second should return True if the data has been saved to the database



These results show that the code is working as intended

Now there needs to be a way to send the team data to the client. I need to start by creating a subroutine that can just get the data from the teamData table and return it.



I created this subroutine in main.py that just takes in the userID gets the gets the related data and returns the data.

Now I need to link it to the server connection.



Now after connecting to the server they can request the data if they provide the correct username and password.

I tested this new request from the server with a simple script



This worked and provided the correct data but only if the username and password are correct.

## Week 10 – Login GUI

Last week I finished of the code for the server, so I need to start working on the client. I want to start with the gui for the login as this should be the easiest to make.

To do this I need to:

* Install and set up qt software
* Create a .ui file for the login/ register page
* Link the ui file to python code

To start I installed the Qt creator software which should allow me to start creating the .ui files for my gui.

Now using this new software I have to create these pages from my designs that can be used by the code.



I used the drag and drop interface to help when creating these pages which allowed a GUI to be made.



I used tabs so that the user can either login or register and used a list format to help keep the elements in line.

I created a text box just above the login and register buttons that can be used to display any errors if they occur.



So using these .ui files I now need to link them to some client code. First of all I created a quick piece of code that will just run and show the GUI how a user would see it but without any functionality.

Graphical user interface, text, application, email

Description automatically generated

Now I have the base code that can run the ui file I can now start integrating the buttons and text boxes as inputs and then connect to the server.

## Week 11 – Login Functionality

Last week I created the GUI file and launched it in python, so I need to work on adding use to the buttons and getting the info from the text inputs.

To do this I need to:

* Get the object names
* Link the widgets to the python code
* Links the login and register buttons to methods
* Those methods need to connect to the server
* And verify the username and password

I started by creating the initialiser that would identify all the GUI objectsText

Description automatically generated

This means that any method can call any object it needs and also if the login or register buttons are pressed it runs the corresponding method.

So I need to create the login\_button\_pressed and the register\_button\_pressed methods which are called when the buttons are pressed



This login\_button\_pressed connects to the server if possible and displays an error message if not,, then gets the username and password from the input fields, and then sends a login request to the server which if the result == True then it prints login successful, closes the login GUI and proceeds through the code.

Now I need to create the regiser\_button\_pressed method

This method is run when the register button is pressed it is very similar to the login\_button\_pressed method as it connects to the server gets the username and password but it then sends a register request to the server and if the result == True then the register window will close and the code will proceed.

Now I need to create the connect\_to\_server function that connects to the server using an ip and port that are in the socket\_client list.



This list is stored in a file called connect.private, this is so that the ip and port can be changed in one file and it will effect any code that connects to the server.

The file just contains a list that is split across multiple lines.



Now the login functionality is completed for the server and client, but may need some touching up in the future.

I created some tests to test the code.

Login, is test numbers 4,5,6

Register, is test numbers 7,8,9

And register and login is test number 10

It completed all the tests which means I can now move on to other parts of the client code.

## Week 12 – Main Window

Last week I finished the login process, so I now need to move on and create the main window GUI and add some functionality.

To do this I need to:

* Create a .ui file for the main menu
* Create a class for the menu
* Link the widgets to the python code
* Get the users team and display it
* Add some functionality into the buttons

To start off with I need to create the Qt .ui file



I have the design diagram to help show everything I would need and where to position the widgets. 

In Qt creator I created a basic layout which is not quite the same as the design spec but includes all the functionality required.

I created a small piece of code to get the .ui file and run it to show how It will be seen when its used.





Currently there are a lot of placeholders in the program, as it would need to request the data from the server to write it into the GUI.

Now I need to create some basic functionality I will start with setting up the buttons and setting them to direct towards methods that will then need to be created.



I started by creating the how to play button functionality



I created a small how\_to\_play.ui file that can then be launched when the how to play button is pressed, so I need to incorporate that into my code.

The HTP\_Dialogue\_Box class just loads the .ui file, sets the title and the ok button will close the dialogue box when pressed.

Graphical user interface, text, application

Description automatically generated

This is what the how to play dialogue box looks like and it is shown when the how to play button is pressed.

Now I need to create the How values are calculated button functionality.

I started by creating the .ui file in Qt Creator.

Text

Description automatically generatedI then linked the ui file and replaced the placeholder with this image

Which shows how the points are gained/ lost

Then I linked this class to the main program using a small method. 

Using the new code when the code is ran and the how values are calculated button is pressed it shows this window.

This week I was able to create the main menu and add functionality to the exit, how to play and how values are calculated buttons. I need to now add functionality to the refresh, edit team and recent driver changes buttons, and I need to be able to change the data labels on the gui to show the user the team data.

I created some tests to make sure the features are working as intended, test numbers 11,12,13,14,15

## Week 13 – Edit Team Menu

Last week I started the main window GUI , so I now need to add functionality to the different buttons I want to start with the edit team button, which needs a new menu and functionality for the edit team page.

To do this I need to:

* Create a .ui file for the edit team menu
* Create a class for the menu
* Link the widgets to the python code
* Get the point data from the server
* Allow the user to create a team
* Calculate the value of each driver
* Send the team data to the server

I started by creating the .ui file for the edit team page, with dropdown boxes to choose each player and the constructor and some labels that can be changed during runtime of the code.



After extracting the .ui file I needed to incorporate this into my code.



This class is used for the edit team page It starts by loading the .ui file then assigns local variables, finds the combo boxes and buttons then runs the set\_combo\_box\_data() method.

Now need to create the set\_combo\_box\_data() method



This gets the current drivers and constructors from return\_current\_drivers\_and\_constructors()

Then loops through each combo box and through each driver and adds it to the each combo box with their points using a function called return points, which I will need to create.



This function creates the needed directory if it does not exist, if it does it checks if the data file is older than a day if it is it will get fresh data by running the create\_driver\_file function. Otherwise, it will read the data and return it.



The create\_driver\_file function gets the data from the server and writes it into the correct file.



The return\_points function checks if the file is present and will create the file if not otherwise the data is stored as [date of data,[drivers, constructors]] so it reads the date and if it is not the same day it will fetch new data.



The create\_points\_file gets the data from the server and stores it in a data file.

Now I need to support the commands that are now being used



I added to the current requests to add the two new commands, this means it is quite well integrated.

When I first made the code for the client it did not store the data in files and would fetch it every time, this caused large wait times before the window would open, so made it store a local copy that updates every day to reduce the wait time.

Now that the combo boxes have the correct data in them, I now need the money calculation to constantly update to let the user know how much money they have left to build their team.



This method just loops, gets the user chosen data from each combo box then adds all the points together and sets all the labels with the correct data.

Then I used threading to run it in parallel so the user can still use the window.



Now I need to add functionality to the submit button.



It stops the update label loop then gets all the data from each combo box and sends it to the server along with the username and password and closes the window if the data is received.

Now the edit team window has functionality.

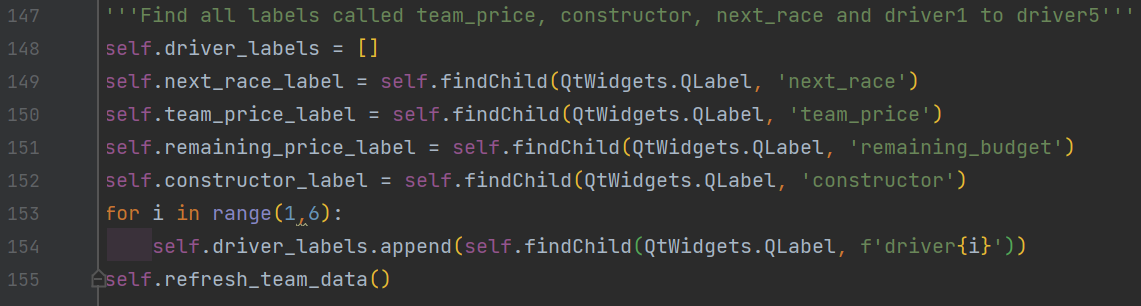
## Week 14 – Main Menu Label Edit

Last week I created the edit team window and added functionality. This week I need to edit the labels on the the main menu screen so that it shows your current team stats

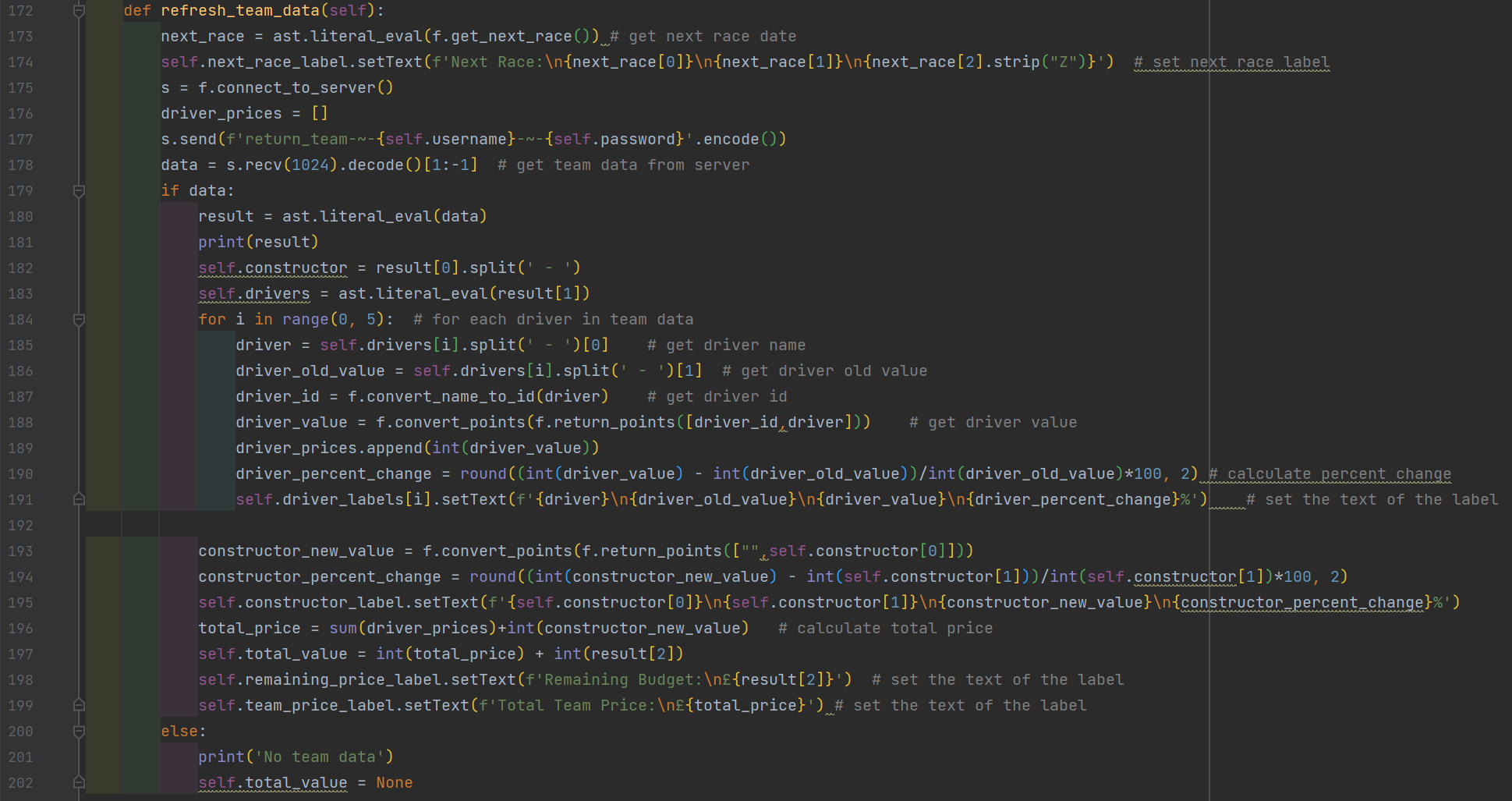
To do this I need to:

* Link labels to python code
* Get the team data from the server
* Update the correct labels
* Link the refresh data button to the process
* Show the price at which the user bought the driver and the current price
* Show the percentage change of each driver in their team
* Colour the label accordingly

To start with I need to locate the labels and store them in the main menu class



So first all the labels are located and saved as private attributes so that they can be used throughout the class. It then calls the refresh\_team\_data() method which will update all the labels with the correct data.

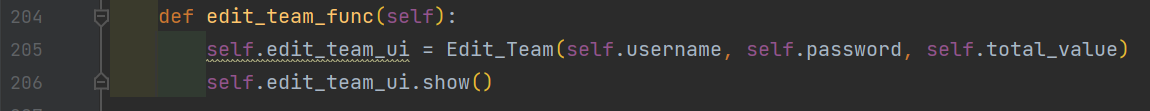


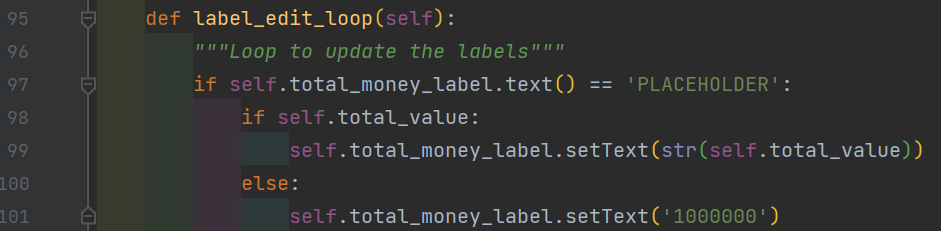
This code first runs the get next race function, then updates the next race label, with the given data.

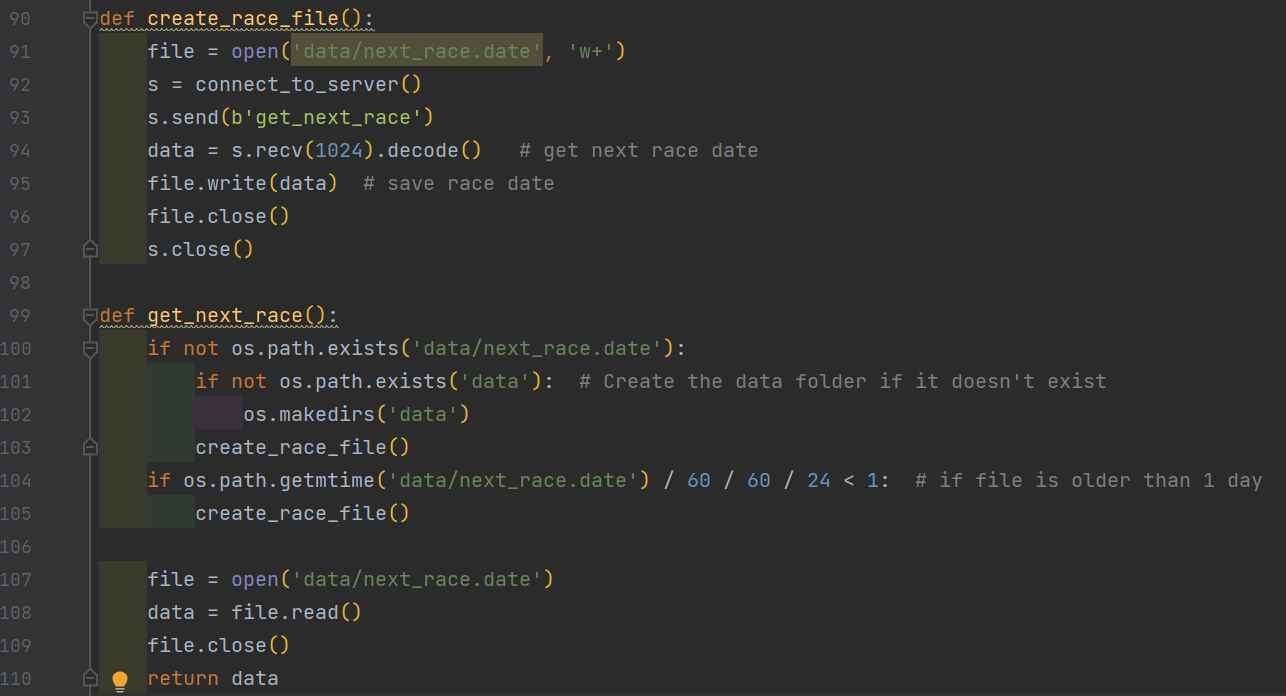
The code then asks the server to return the team, which if there is data will get each drivers name, the value at which the user picked them, the current value and the percentage change between each price, and then updates the corresponding label.

The code gets the current value of their constructor, the old value, and the percentage change and adds them to the constructor label. It then calculates the total value of the team and gets the remaining budget from the server and adds them to their corresponding labels.

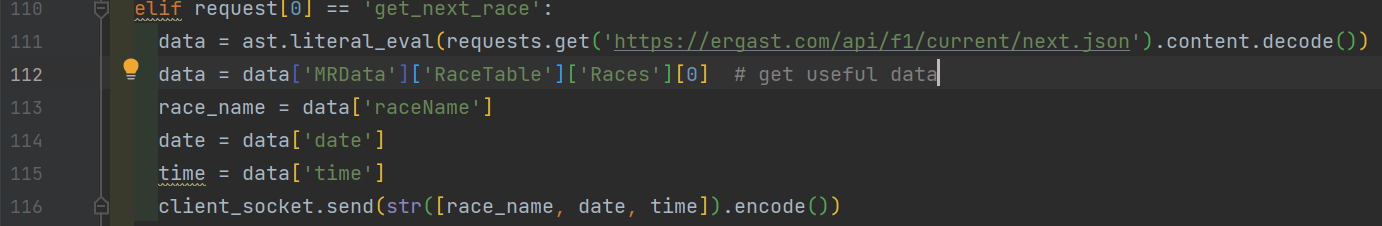
But if no data is present when it is requested then it will just print no team data and set the total\_value attribute to None.

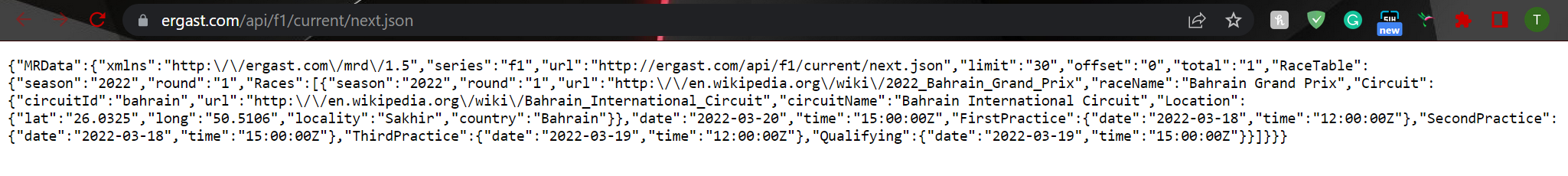


Which is done so that when parsing the data to the edit team window so that it can use that to calculate how much total value they can allocate to the user. So now the user will be able to gain or loose money depending on who they pick.

Now I need to create the get\_next\_race() function so the rest of my code can function. 

The get\_next\_race function is called at the start of the refresh data method, its purpose is just to return the date of the next race when requested. As this date is not going to change very often I made it check if the file was older than a day and if it was it would overwrite the file by requesting for the date again and saving it. To do this, I needed to create a new command on the server.



So now when a client requests the get next race command it gets the data from the api, which returns: This data is then processed to return the name of the next race, the date and time at which it will take place, and it then sends this data to the client.

## Week 15 – Error Handling

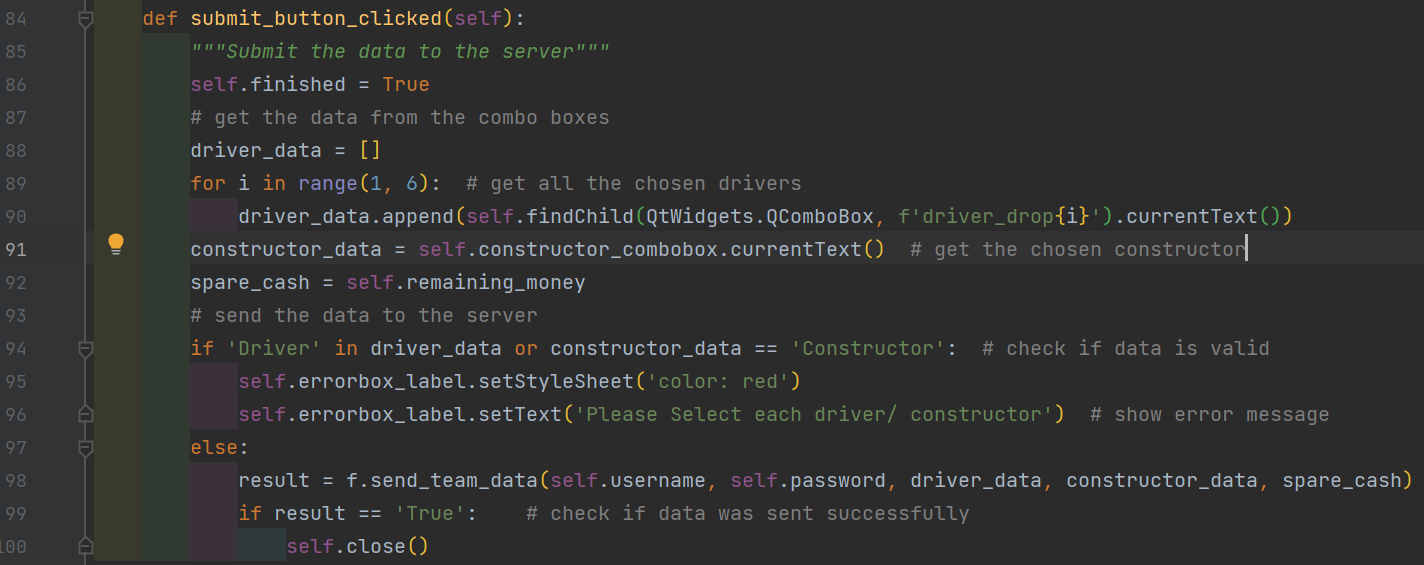
Last week I finished the main menu label edits and parsed and created support for holding the remaining money for each user. This fixed many issues and made my code closer to being finished, but also created a lot of places where the code can error, so this week I aim to prevent these errors or tell the user through the GUI that what they are doing is not supported.

To do this I need to:

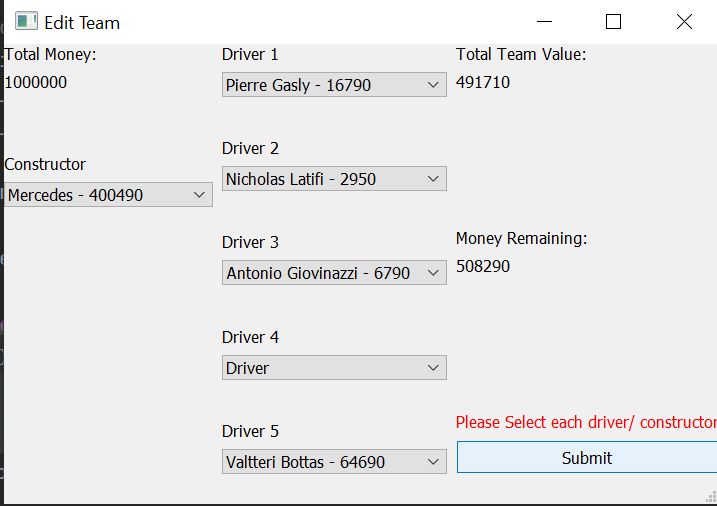
* Find all the places in which the code crashes or behaves as not expected
* Find a fix or workaround
* Implement the fix
* Test each fix

The first error I found was when editing your team if you did not choose a driver or constructor then it would crash whenever you request the data from the server.

This was caused by it trying to split the points and driver/ constructor name and would get an index error, I decided to stop this I would just check if each of the combo boxes have valid data in them when the submit button is pressed.



Now when the submit button is pressed to will collect all the values from the combo box and if any of the boxes still have Driver or Constructor then it displays a red error message to tell the user to pick each driver and constructor, and if all the drivers and constructors are chosen then procced by sending the data to the server.



So now if you attempt to submit your incomplete team then it prompts with this red error message.

I was testing my project and did not find any crashes or major bugs, so I decided to end this iteration of Error Handling early so that I can start on my client server chat.

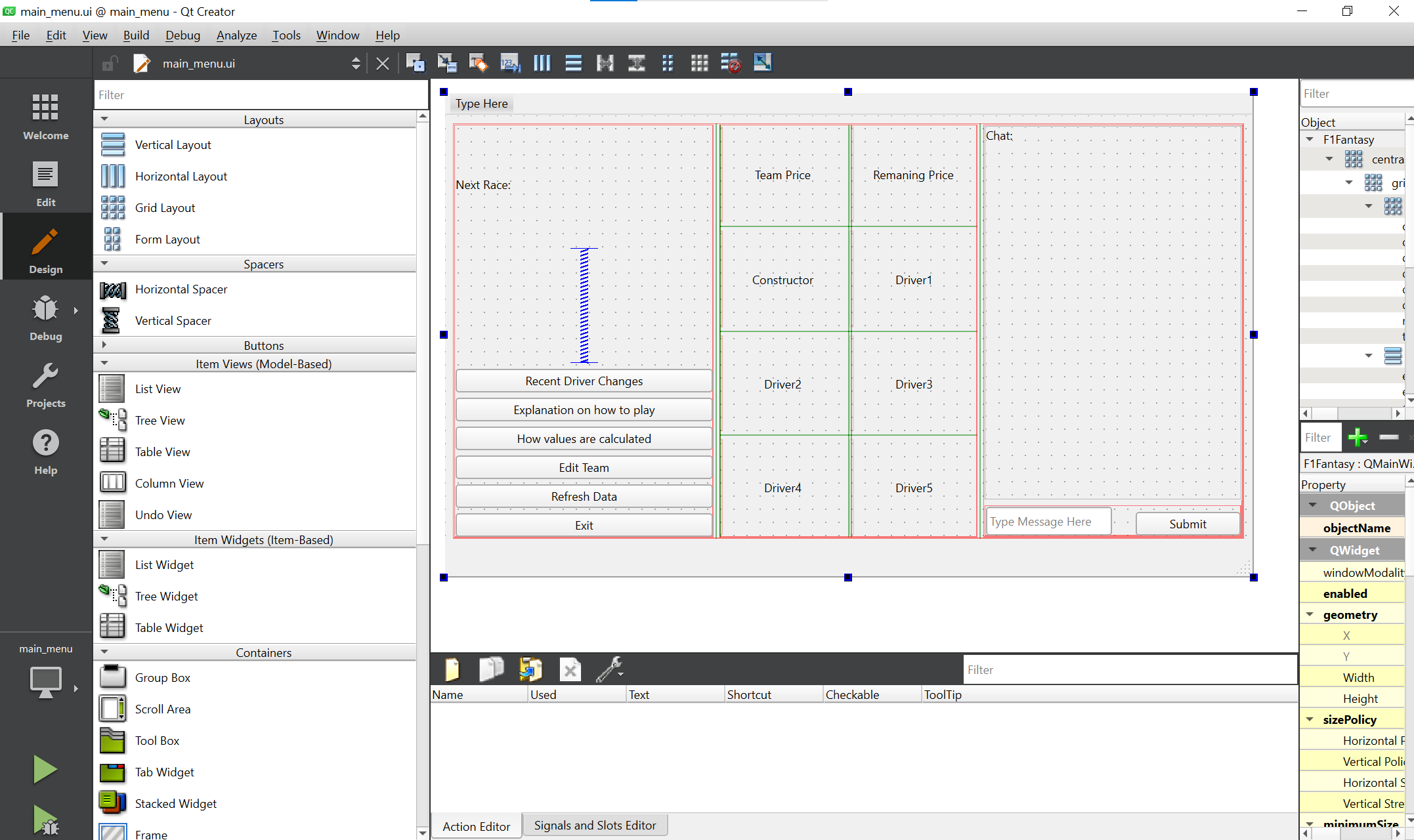
## Week 16 – Chat Room Development

Last week I fixed an error which would cause unexpected crashes, and as no more errors could be found at this current time, I decided to move on to creating the chat room functional.

To do this I need to:

* Open a new port on the server for the chat
* The server needs to receive get or send requests
* Store send requests so that it can reply to get requests
* Client needs to send a user input to the server
* Client code needs to be linked to the GUI
* The GUI needs to show the chats

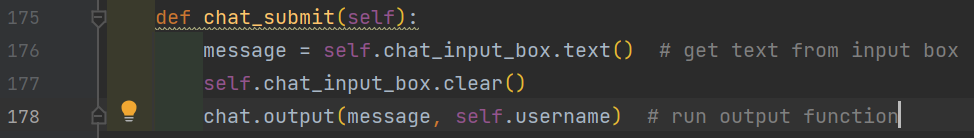
To start with I realised I needed to edit the GUI slightly on the main menu window to add a submit button.



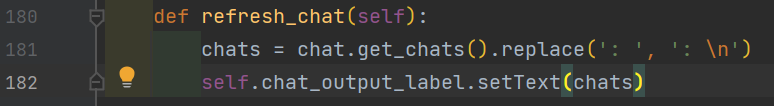
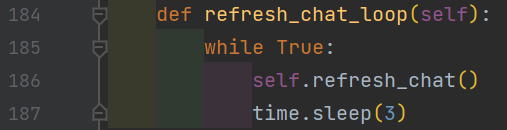
I added a the submit button under the chat next to the input box, so that it can be used to send the messages.

I then had to find the chat elements in the code.

This code just finds all the buttons and labels required to run the chat, it then sets it so when the submit button is pressed the chat submit method is called and it starts a thread for the refresh chat loop so that it can run in parallel.



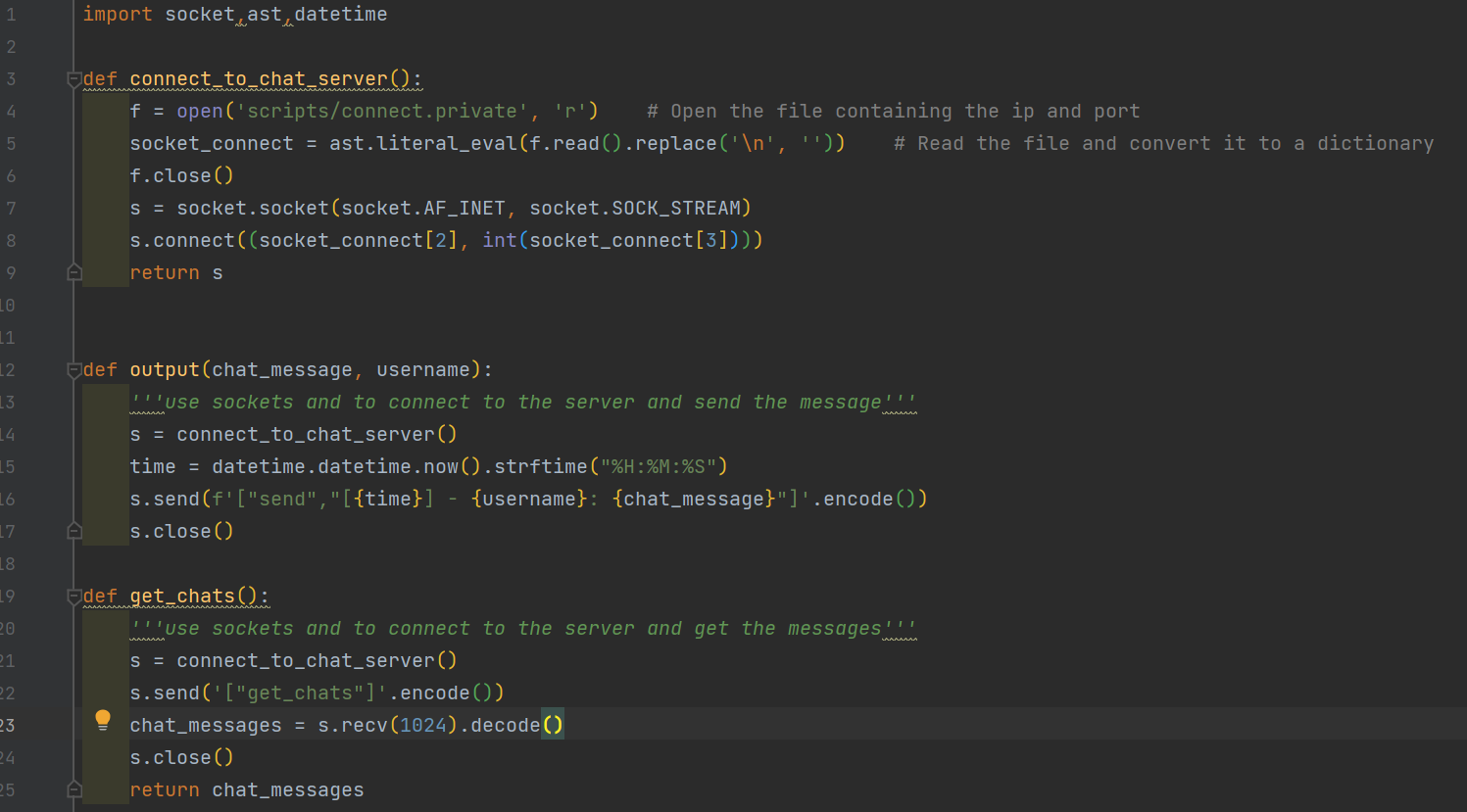
When the chat is submitted it runs this method gets the message from the input box, clears it and passes the users username and the message to the output function.

when refresh chat loop is run in parallel it just runs refresh chat every 3 seconds, and refresh chat just gets the chats from the function get chats and sets it as the chat text.

I decided to write the needed chat functions in a separate python file and import them in.



This imports the chat.py python file and sets it as chat so I can identify when it is being used.

Chat.py:the connect to chat server function, opens the file that includes the required ip and port, and returns the socket connection.

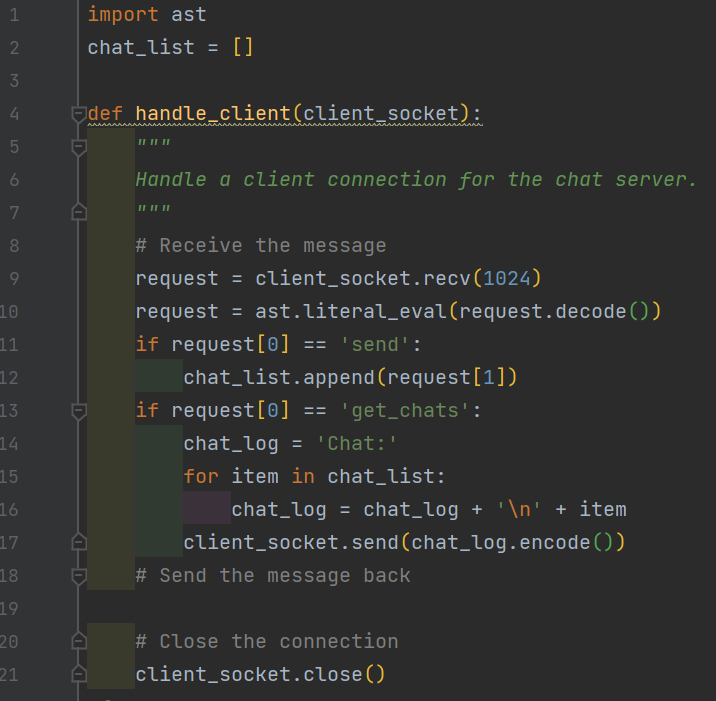
The output function outputs the messages to the server, it connects to the server and sends the request and then the message so the message would look like [time] – username: message, this means you know when the message was sent and by who.

The get chats function connects to the server and sends the get\_chats request and then receives the response from the server and returns it.

Now I need to code the server to support the new port and new requests.

I decided to make this in a new python script to not clutter the main.py, so I created chat\_server.py.

chat\_server.py:



The handle client function takes in the client socket, receives the request, decodes it. It then checks what the request is, if it is send It just saves the message to chat\_list, and if the request is get chats then it creates a string that starts with chat: and adds each message then sends that to the client. When it is finished it closes the connection.

Now I need it to run in parallel with the main server code.



The chat server function just binds to the required port and ip waits for any connections and if a client connects it creates a thread for each client that runs the handle client function.



So now when the server code is run it runs the chat server function as a thread so it can run in parallel.

I have now finished the chat code and it works, it works how you would expect, and runs pretty smoothly.

# Testing

I recorded me testing and running the program and using it as intended.



## Point Tests

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Test No | Test | Input | Expected Output | Actual Output | Video/ Photo Reference |
| 1 | Points |  |  |  |  |
| 2 | Drivers points | Check points of driver Daniel Riccardo | 2745 | 2745 |  |
| 3 |  |  |  |  |  |

## Login Tests

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Test No | Test | Input | Expected Output | Actual Output | Video/ Photo Reference |
| 4 | Login | Username = test  Password = test | True | True |  |
| 5 | Login | Username = test9  Password = test | False | False |  |
| 6 | Login | Username = test  Password = test | False | False |  |
| 7 | Register | Username = test  Password = test | False | False |  |
| 8 | Register | Username = test5  Password = test | True | True |  |
| 9 | Register, then login | Username = testing  Password = test | True, then True | True, then True |  |
| 10 |  |  |  |  |  |

## Main Menu Tests

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Test No | Test | Input | Expected Output | Actual Output | Video/ Photo Reference |
| 11 | Main menu | Login | The main menu GUI to open | True |  |
| 12 | How to Play | Press how to play button | The How to play dialog box to open | True |  |
| 13 | How to Play Ok button | Press Ok Button | Close the dialog box | True |  |
| 14 | Points Value Calculation Box | Press how points values are calculated button | The Points value calculation dialog box to open | True |  |
| 15 | Points Value Calculation ok button | Press Ok Button | Close the dialog box | True |  |

## Edit Team Menu Tests

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Test No | Test | Input | Expected Output | Actual Output | Video/ Photo Reference |
| 16 | Empty fields | Select none of the drivers or constructors and press submit | Error message displayed | Error message displayed |  |
| 17 | Half empty fields | Select half of the drivers and select the constructor and leave the their half, then press submit | Error message displayed | Error message displayed |  |
| 18 | no empty fields | Select data for all combobox’s and press submit | Window closes | Window closes |  |
|  |  |  |  |  |  |

# Evaluation

## Module Dependency Visualization Diagram

I decided to use a Python module dependency visualization program called pydeps which creates a graph of all modules used by my program files.

## Stakeholder feedback

I gave my project to my stakeholders and asked for any feedback. I listed their responses and an explanation attached.

James – “I wish the program menus looked a bit better”

Chris – “”

## Overall Conclusion

## Maintainability and Future of program

I have made the code with lots of comments and spacing to make the code easy to follow by anyone with a decent understanding of python.

### Complexity

To help with maintainability I should record the Big O complexity of my code to see if it could be improved.

Server side points calculation is O(n2), this is due to nested loops used to get each race then each driver

### Future of program

In the future I would like to work on the GUI and make it more user friendly and more appealing to use. I have also been thinking I may convert the python program into a website, this would mean it would be very easy to access