GW2-SRS

powered by LaTeX

Daniel Lopez: **Project Documentation**

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I wanted to briefly explain why I started this project, since it is also important to know why people do what they do. I started SRS when I started my first Big Data course, I was quite fascinated since I've been always engaged with data, what it says of us and how the world is actually going towards use of data more and more to make choices. GW2-SRS is not only a project build to train Data Engineering techniques but also a tribute to one of my favorite MMOs and the people I met playing it.

GW2-System for Raid Study is my approach to analyze game data in Raids and make decisions based on what players do, play and how they perform overall.

1.0 EXTRACT

1.1 Introduction

As the first part of the **ETL** it's important to have in mind our data sources. When I began with the project I only had one way of getting logs, and they were all coming from friends. This meant I had to manually parse them with EliteInsights[1].

This process was extremely slow, and when at first it was viable due to having few logs, it started being quite useless when the project meant to have lots of logs to analyze. The best option then was thinking on using web-scraping or an API connection; and thankfully we have a web-page available, thanks to *Johannes Pfau*, where people can upload their logs.

GW2-Wingman is probably the best approach I made to this project, not only in efficiency, but also in learn curve. Scraping was something I craved for since I started focusing on the Data Engineering route. It taught me a lot of things and problems I could solve, some easier, some harder, but all of them were at the end solved.

[1]EliteInsights it's an app designed to parse *.zevtc* files into JSON, HTML or CSV files.

1.2 About GW2-Wingman architecture

As I was learning to scrape the web-page I realized something wasn't right, and it made the scrape a bit harder when I understood the data was stored inside an **iframe tag**[2], so it was a matter of getting to the actual web-page.

It was quite simple in the end, the iframe had an **href** tag containing the actual path, which only added */logContent* before the log name.

This is a comparison of the actual URL showed, with the nested one:

```
1    https://gw2wingman.nevermindcreations.de/log
2
3    https://gw2wingman.nevermindcreations.de/logContent
4
```

1.3 JSON data gathering

Extract algorithms are rather simple once you understand what you need to find, and that was the hardest part, since it required looking into the actual HTML code. I tackled the extraction with BeautifulSoup[3] by passing an URL and the needed headers.

After that I just needed to get the correct script and extract the JSON. This required a bit of research; the JSON was nested on a JavaScript variable, which I had to strip off, and save only the JSON data.

```
1    response = requests.get(url=url,headers=HEADERS)
2    soup = BeautifulSoup(response.content,'html.parser')
3
4    data = soup.find_all('script')[8]
5    dataString = data.text.rstrip()
6
```

[2] An iframe is a nested web inside the main website

[3] As well as Selenium, BeautifulSoup let us extract information from any web-page.

Last thing I needed to do is set up an algorithm, or in this case, a class, that help us know the boss Name and create a tag with it. This will make the further processes so much agile:

```
    class boss:

        def __init__(self, url: str) -> str:
            self.url = url

        def getBossName(self) -> str:
            url = self.url
            urlLines = url.split('/')
            if len(urlLines) < 5:
                bossName = urlLines[3]
            elif len(urlLines) == 5:
                bossName = urlLines[4]
            return bossName

        def getBossTag(self, bossName: str) -> str:
            bossTag = bossName.split('_')
            nameTag = bossTag[1]
            return nameTag

```

1.4 URL copy code

Ending with the extraction part of the project, I will explain a quite relevant part here. Normally we could extract information URL by URL, but it is not really convenient when we have, like in this case, more than 100 logs. Therefore, best option is creating a script that copy and write down this URLs for us on a text file we can later read.

- I set the search method to scope the 'a' tags, so I only had to just take the href of each one and add the url_str and have the complete link for a later iteration.
- Nonetheless, the 'a' tag contains about 5-6 lines that are not log hrefs, instead, they show an apikey href and JavaScript void hrefs, so I just omitted them and set a new line for each one the script finds.

- Finally, I wrote it down on a .txt file; however I realized that, at first I was using 'w' mode, but it ended being quite inefficient since it constantly overwrites the file. To avoid this, I just simply changed the 'w' mode to 'a'[4] mode, this way we can just append the information and not worry about it overwriting over and over again.

This is how the code looks like:

```
fh = open(path,'a')

for link in soup.find_all('a'):
    url_str = 'https://gw2wingman.nevermindcreations.de'
    data = link.get('href')

    try:
        log_str = url_str+data
        if log_str.endswith('apikey'):
            log_str.replace('apikey','\n')
        elif log_str.endswith('void(0)'):
            log_str.replace('void(0)','\n')
        else:
            fh.write(log_str)
            fh.write('\n')
    except Exception as e:
        print('Error: ', str(e))

```

[4]An 'a' stands for append, and will add new data without overwriting the existing one

2.0 TRANSFORM

2.1 Introduction

After completing the data extraction, it was needed to do a deep cleaning on the files. The extracted data was displayed on the HTML source as a JSON type, it as well contained lots of information that is entirely related to the statistics in-game. Whether is true that statistics showed player names, player accounts, DPS[5], etc. It also showed information that wasn't needed at all, where we could find EliteInsights information about it's version, release and EVTC[6] version as well.

Therefore, I only wanted to gather clear stats data that could help me in the further analysis. The data I decided to aim for was:

- Player name
- Player Account
- Player Profession/Class
- Player DPS Statistics

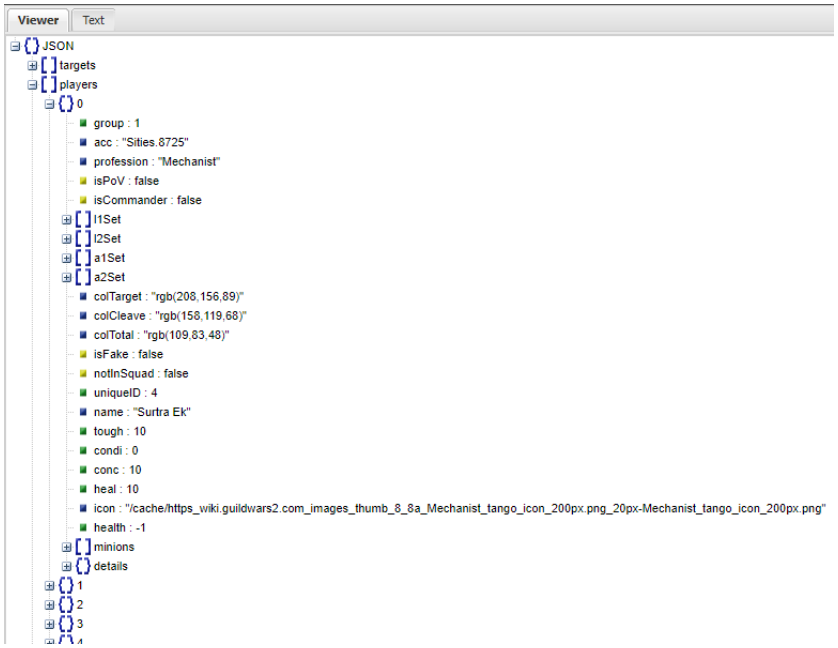
	Player's Name	Player's Account	Player's Class	Player's DPS
1	John_Doe	johndoe.9752	Catalyst	35867.43
2	...			
3				

[5]Damage Per Second
[6]Unique log filetype from ArcDPS app

2.2 In-depth data explanation

2.2.1 JSON format

In order to understand the data, I had to read and investigate the JSON files lots of times. Due to the JSON files size, I decided to use a JSON Viewer[7] to help me with this task.



(a) JSON Viewer formatted schema

(b) Raw JSON view

[7] http://jsonviewer.stack.hu/

Using this method made the search of information extremely easy, for the most part, the essential player data like names, accounts and professions was pretty much finding each player and this data by it's index. I applied a zipped For loop to do the aggregation on SQL databases and on No-SQL databases I used a simple dictionary I created and then passed as a JSON dictionary.

```
        for player in data['players']:
            player_group.append(player['group'])
            player_acc.append(player['acc'])
            player_names.append(player['name'])
            player_classes.append(player['profession'])

```

Listing 1: **Basic player data loop**

```
        stats_dict = {
                'boss': target,
                'players':{
                    'group': player_group,
                    'account': player_acc,
                    'names': player_names,
                    'profession': player_classes,
                    'phase_1_dps': player_dps1,
                    'phase_2_dps': player_dps2,
                    'phase_3_dps': player_dps3
                }
            }

```

Listing 2: **Custom Python stat dictionary**

```
        for (name,acc,profession) in zip \
        (player_names,player_acc,player_classes):

```

Listing 3: **Zipped data for SQLite query**

It was important using a zipped For loop since the query need to be executed for every player. This is indeed not efficient if we look into the repetition of the same query for a simple operation but since there are only 10 players per boss fight, it ended up being rather useful.

2.2.2 DPS data

Finding each boss DPS data was indeed a quite difficult task. In order to get deeper in this topic I must explain a few concepts from Guild Wars 2 game itself.

Guild Wars 2 is an MMO, and have different classes or profession that the player can create, however, in raid, strikes and fractals, we must have in mind that classes have two kind of damage: Condition damage and Power damage. This is important to understand since the DPS on each boss, and for each player, is divided between Condition and Power as well as it has a combination of both.

Every class in the game can deal both Power and Condition, but some classes are more suitable to deal Power damage and some other classes are more suitable to deal Condition damage.

Once explained this, we can get a bit deeper into the data. As I said before, the DPS data has three values per phase:

- Power + Condition
- Condition
- Power

There is more data stored in the JSON, but what I needed is essentially this. I used the combined one, and you may wonder why not use the specific damage for each class. This not only could be extremely inefficient in the long run, but also, damage is also affected but extra aspects and boons added by other classes, so even if you are a Power class, you could get a buff from a Thief class making your attacks deal Poison damage which is considered a Condition. Therefore, using the combined one is rather a better option.

Another important fact to know is that, each boss has different phases. It's true that some bosses share same phases and same index, but this does not represent the majority of the bosses. Therefore, each boss needs its own index finder. It looks like this in the actual code:

```
    if nameTag == 'vg':

            # Phase_1
            phase1 = data['phases'][1]['dpsStats']

            phase1_time_raw = data['phases'][1]['duration']
            phase1_time = round(phase1_time_raw/1000,1)

            for dps in phase1:
                dps1_raw = dps[0]
                player_dps1.append(round(dps1_raw/phase1_time
    ,2))

            # Phase_2
            phase2 = data['phases'][6]['dpsStats']

            phase2_time_raw = data['phases'][6]['duration']
            phase2_time = round(phase2_time_raw/1000,1)

            for dps in phase2:
                dps2_raw = dps[0]
                player_dps2.append(round(dps2_raw/phase2_time
    ,2))

            # Phase_3
            phase3 = data['phases'][12]['dpsStats']

            phase3_time_raw = data['phases'][12]['duration']
            phase3_time = round(phase3_time_raw/1000,1)

            for dps in phase3:
                dps3_raw = dps[0]
                player_dps3.append(round(dps3_raw/phase3_time
    ,2))

```

We are applying several things here. For instance, every boss has between 3 and 6 phases where you can actually damage it, this doesn't mean that there are no extra phases, but the damage there is really not that important or substantial to have it in mind for an analysis. Therefore, I picked the main phases and made a set of operations over it:

- I applied a For loop on every phase, so it saves the damage dealt for every player.
- This information is appended to an empty list.
- Finally, but really important, all the damage is divided by the time phase.

If we look at the JSON file, it's easy to see that all phase timestamps are written like a single int number (i.e: 190s = 190000), this was actually problematic when trying to divide the phase dmg numbers. So the best option I found to deal with this problem was dividing it by 1000 so it shows time in seconds and therefore division could be executed better. To end with this data, I just applied a **round** operation.

3.0 LOAD

3.1 Introduction

The last part concerning the ETL process is loading the results into a database. In this case I decided going for MongoDB and SQLite. The reason behind this decision was storing big JSON files in a suitable database like MongoDB, while maintaining an space for structured tables on SQLite that I built with queries.

Now the key part here, is that at first I was saving entire JSONs on MongoDB, and while this is the purpose of a No-SQL database, I preferred just uploading the dictionaries I created manually within the ETL code. As for SQLite, there are two main queries, one for dps data and one for users.

3.2 SQLite Queries

In order to have every boss classified, I created a table for each boss, so the data loading was a matter of inserting the data within the ETL, therefore I needed a connection with the database.

I used Python and sqlite3[8] to set up the connection and execute the queries. The main connection can be set up using the following:

```
1         conn = sqlite3.connect("Your_database_path")
2         cur = conn.cursor()
3
```

Listing 4: SQLite Connection

From this line, we can easily execute any query inside the database by calling the cursor:

```
1         cur.execute(
2             f"INSERT INTO vg_dps(phase1_dps,phase2_dps,
    phase3_dps,FK_player_id) \
3             VALUES({dps1},{dps2},{dps3},'{acc}')"
4         )
5
```

Listing 5: Query example

[8]sqlite3 is a Python library used to work with SQLite database

3.3 MongoDB Connection

As for MongoDB, the connection is quite simple as well. I chose to use PyMongo library and a MongoDB Atlas Cluster to help me out. I used the local cluster, but this process could also be made on the cloud cluster as well. The connection would look like the following:

```
1         client = pymongo.MongoClient('mongodb://localhost
      :27017/')
2
```

Listing 6: MongoDB Connection

```
1         db = client['GW2_SRS']
2         collection = db['players_info']
3
4         collection.insert_one(json_data)
5         print('MongoDB load done!')
6
```

Listing 7: MongoDB data load

4.0 DATA MODELLING

4.1 Introduction

4.1.1 Dates and Data

All the data used in this study is based on the class performance between May and September. This means that, with future nerfs and buffs to classes, values can easily vary. Therefore, this information is only relevant in those months. Nonetheless, some classes does not change a lot, so not every value has a chance to change.

4.1.2 Model explanation

This project data was easier to store on MongoDB than it was on SQL, therefore, a data model was needed not only to connect data between tables, but also to have a data schema and keep everything ordered.

The basic structure of data on MongoDB was explained on the previous EXTRACT part, as the info was saves with that specific schema. In SQLite, I needed to create several tables:

- Player's info
- Boss names
- Profession names
- DPS Tables for each boss

The first table in the list contains names, accounts and two more columns, one of the columns contains a Foreign Key (**FK**) that connects to Boss Names by its Primary Key (**PK**), as for the second one, it contains another FK that connects to Profession names PK. Boss Names and Profession Names are two tables that only contains a PK and the names respectively. This was designed this way to prevent data repeating over and over when using a PK and FK was by far, the best option.

Inside the DPS Tables, I had quite a few problems linking data between tables. The DPS tables stored data based on an ID as well, but if *John-Doe.9100* had ID 30 on the players table and his damage in Vale Guardian corresponds to ID 2 it wouldn't work at all, there was no connection and therefore it leads to error.

The solution was not what I would have done if I had other options in mind, however, it worked fine. I created a FK for every dps table that contained the user account, this way we could just refer the FK to the players table and get the connection done. I thought on doing it with the boss number, but it could also resulted in some problems.

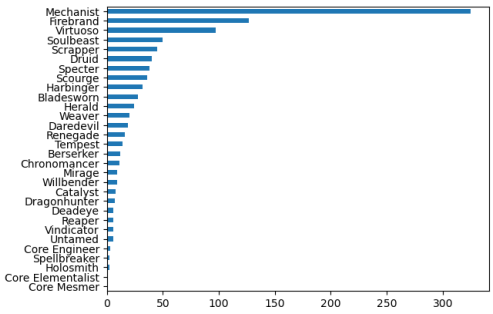
This choice was mainly done because we use ID as a unique value that represents something, and actually, in a game, your account name is already a unique value that identifies the player and it's also **immutable**.

4.2 Results, Graphs and Analysis

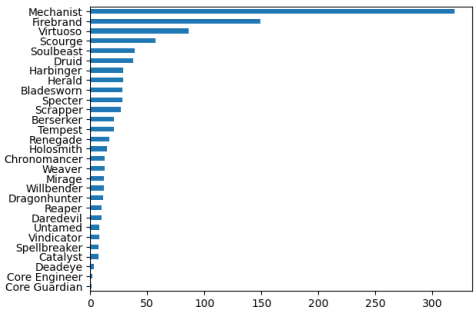
The analysis on the project has two main objectives:

- Profession/Class Usage per boss
- DPS done per class on each boss

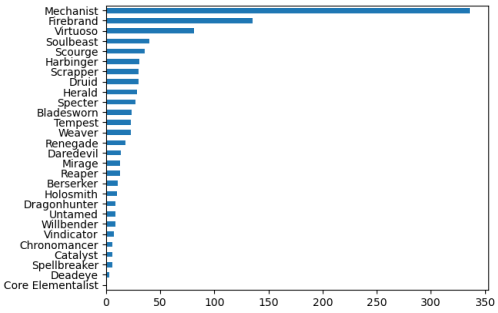
4.2.1 Profession/Class Usage



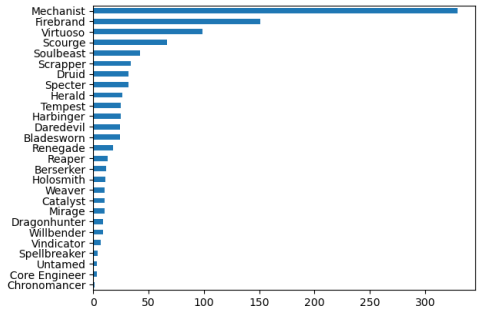
(a) W1: Vale Guardian Graph



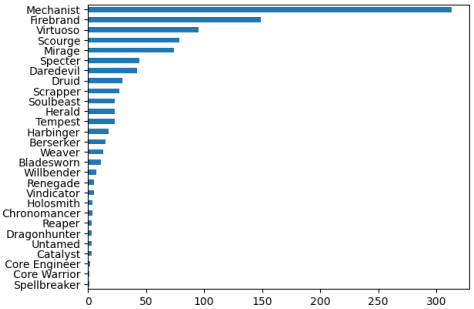
(b) W1: Gorseval Graph



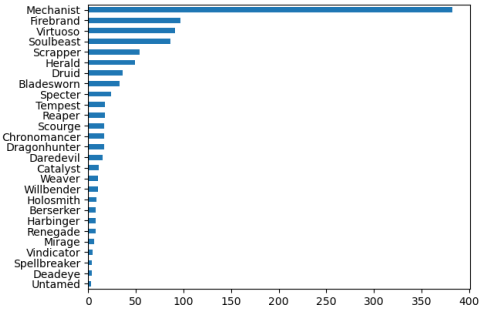
(a) W1: Sabetha Graph



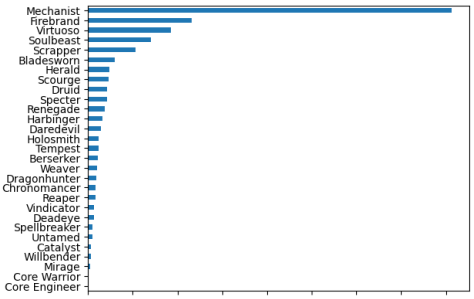
(b) W2: Slothasor Graph



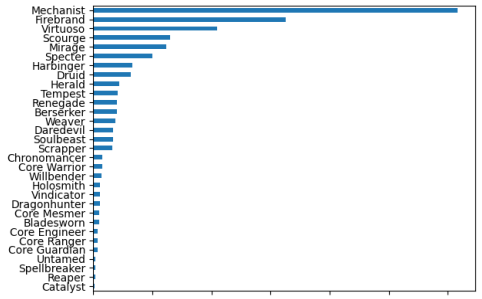
(c) W2: Matthias Gabrel Graph



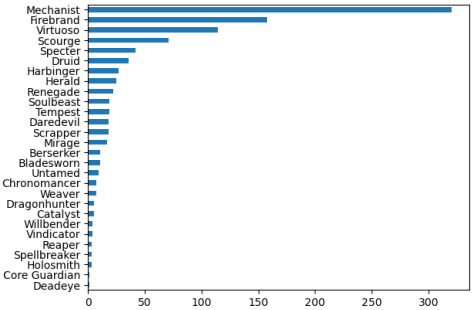
(d) W3: Keep Construct Graph



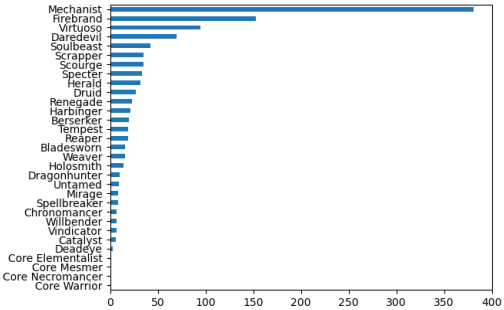
(e) W3: Xera Graph



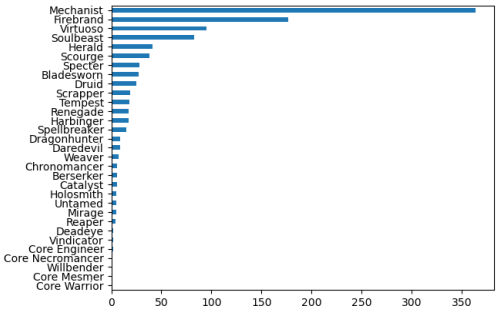
(f) W4: Cairn Graph



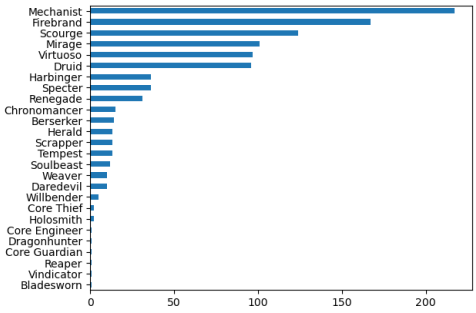
(g) W4: Mursaat Graph



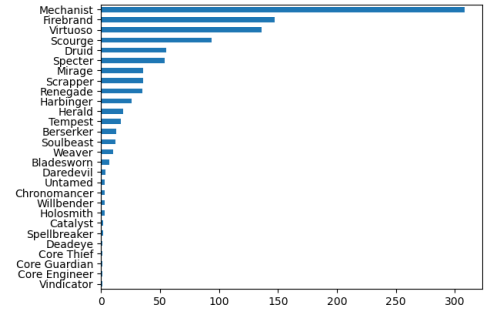
(h) W4: Samarog Graph



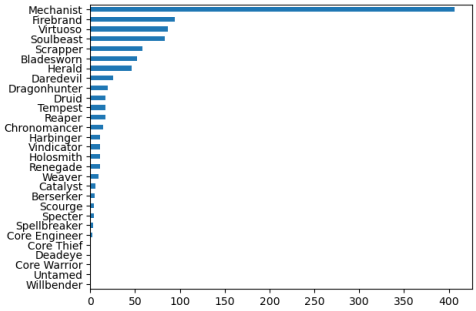
(a) W4: Deimos Graph



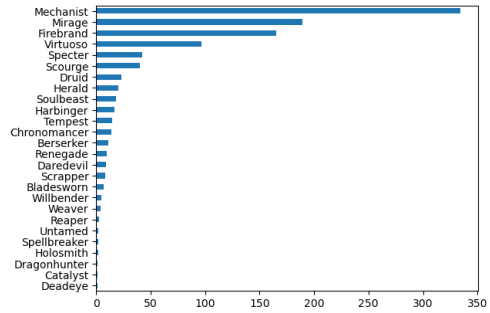
(b) W5: Soulless Horror Graph



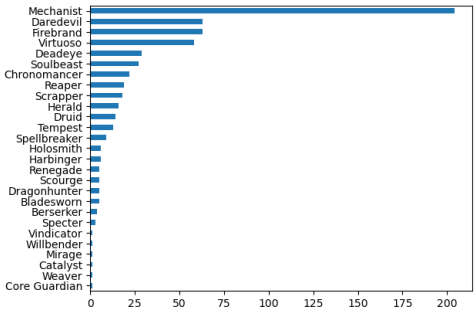
(c) W5: Dhuum Graph



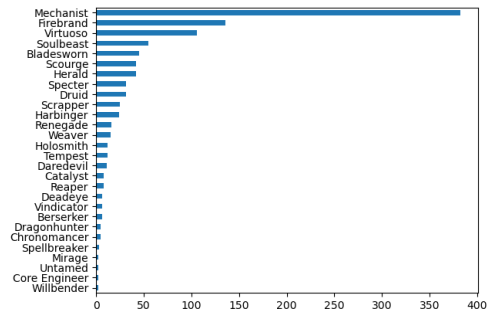
(d) W6: Conjured Amalgamate Graph



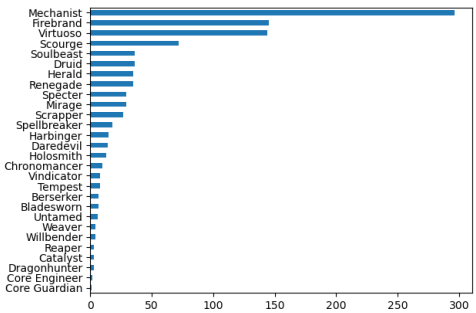
(e) W6: Twin Largos Graph



(f) W6: Qadim Graph



(g) W7: Cardinal Adina Graph



(h) W7: Cardinal Sabir Graph

All this graphs represent the class usage in each boss, and it stands out that the usage of the Mechanist class is huge. Just to be clear, **all this analysis is made from data between May and September 2022**, therefore, during this period, Mechanist was a rather new class since Guild Wars 2: End of Dragons came out in February 2022.

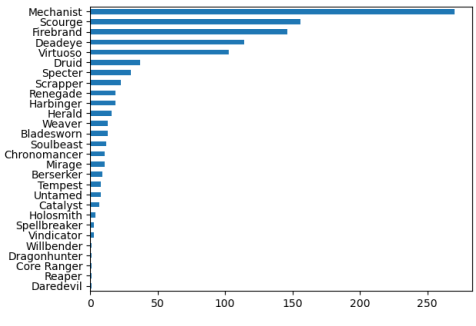


Figure 5: W7: Peerless Qadim Graph

Since the release of the Mechanist, as well as other classes, it became one of the best choices because it could be either support or dps, and it's results in raid were extremely good. We can also see that other classes such as Firebrand is also quite high on the graph, and this is also due to Firebrand's versatility. Guild Wars 2 is a game where versatility in terms of raid and fractals is really important, abilities that can provide **aegis**, **alacrity** and **quickness** are three of the key support buffs, while **power** and **fury** are two of the key damage buffs. This is why classes like Guardian and Engineer are always on top of the usage graphs.

Each boss also has certain classes that perform better than others, as some bosses are weaker to condition damage and other bosses to power damage. On top of that, each boss also has certain mechanics, which normally needs certain classes to perform those specific roles; as an example, Peerless Qadim has the **Pylon** mechanic, and it's normally performed by Deadeyes or Scourges.

4.2.2 DPS Data Graphs

Now that class usage have been seen, it's time to focus a little on dps data. This time, as earlier, I did a series of graphs that represent the damage done per class in each boss and on each phase. DPS stats seen in graphs are a mean of all the 1000+ rows on each boss table.

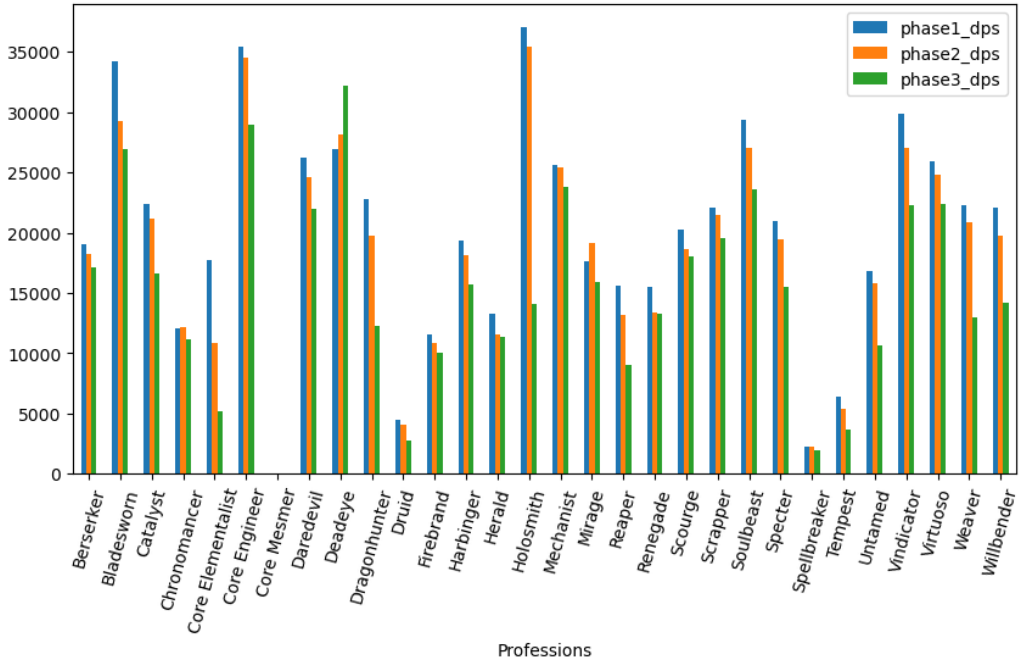


Figure 6: Vale Guardian

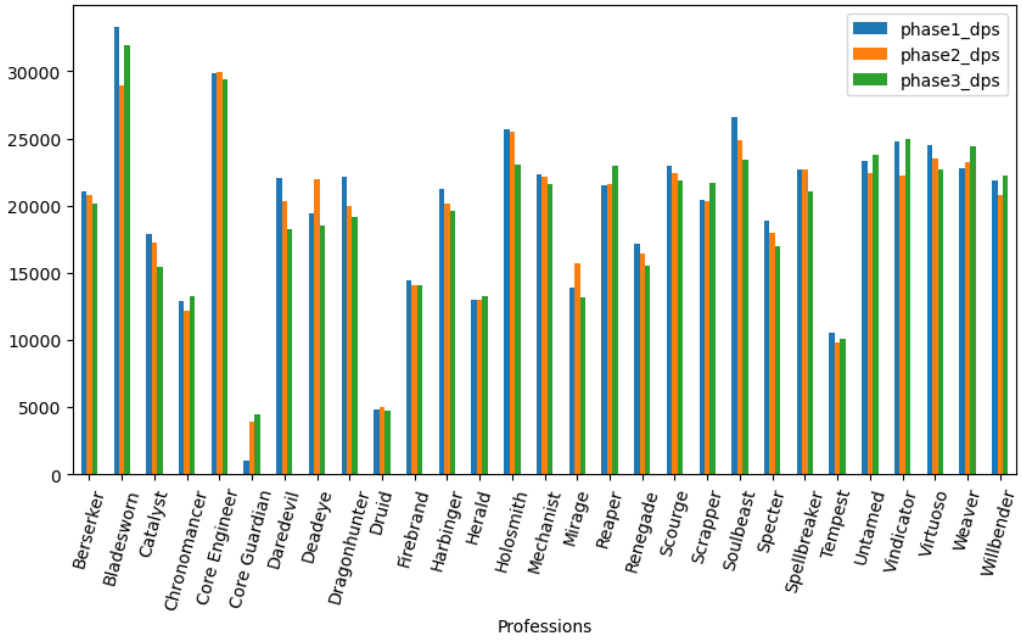


Figure 7: Gorseval The Multifarious

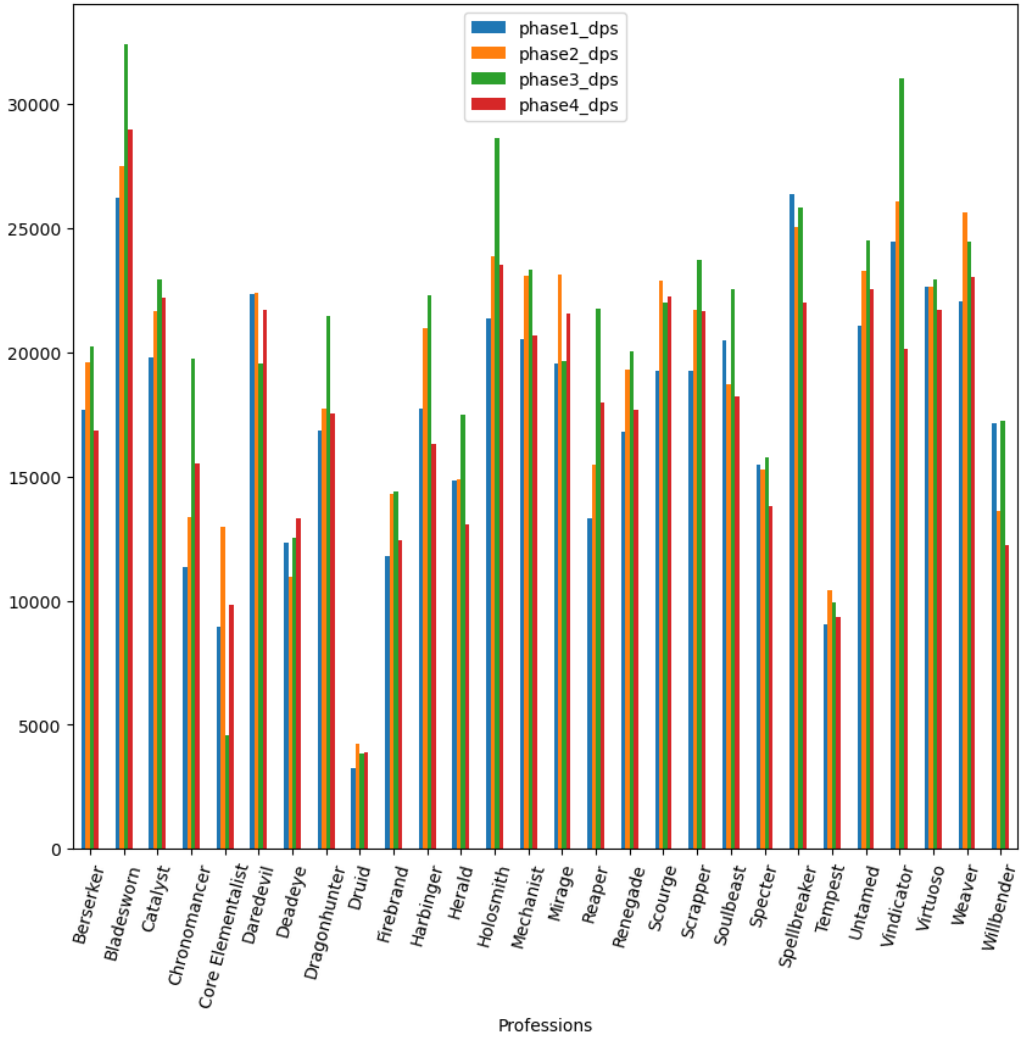


Figure 8: Sabetha The Saboteur

Some plots had to be adjusted due to bosses having too many phases, normally bosses have few phases, however, I had to adapt the phase system EliteInsights have, which is mainly obtained from the game itself.

In Sabetha's battle, there is a main mechanic consisting on destroying cannons that continuously attack the battle platform. If the platform falls due to damage, it will destroy and the battle will be lost. Therefore, two players are focused on destroying those cannons in an specific timing, while the rest of the team fights Sabetha and her minions.

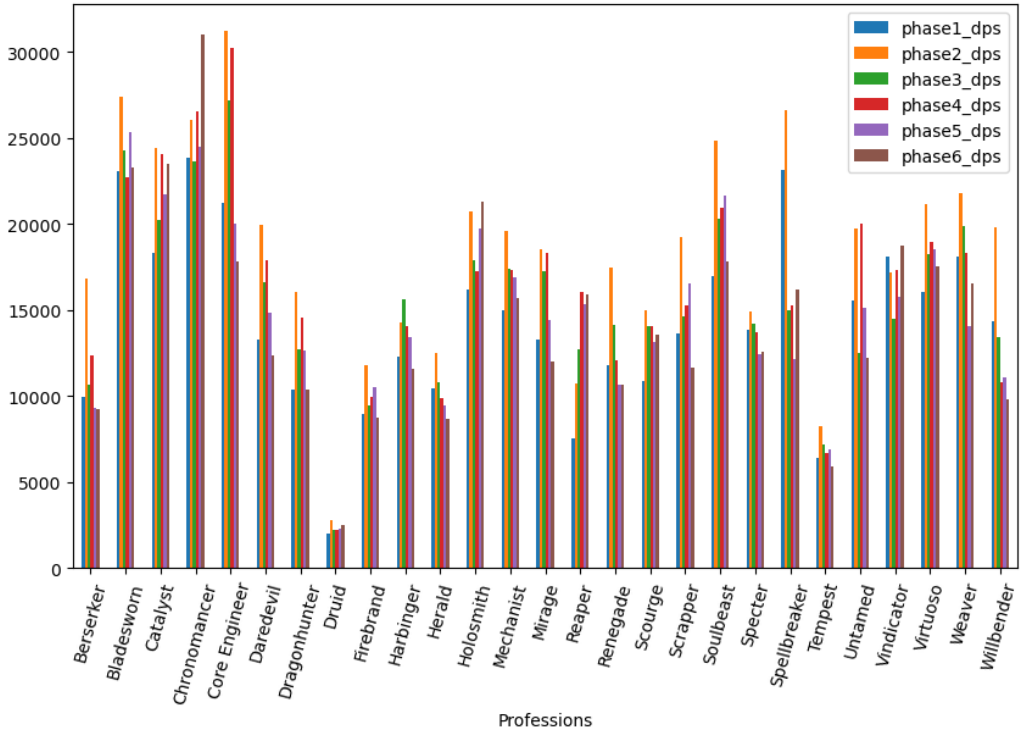


Figure 9: Slothasor

Slothasor is a boss with many phases due to his main mushroom mechanic. It consists of four mushrooms that need to be picked in order to clean areas and avoid stepping into venomous floor that kills the player slowly. When you pick this mushrooms, your character will stop doing damage to the boss and it will turn an enemy target for anyone on your team, therefore, players must be careful not to kill the teammate doing this mechanic.

Added to this mechanic, Slothasor will shake his body from time to time causing several conditions on players that must be cleaned. Slothasor will also smash the ground and create three blue areas that players need to dodge or else, they will be stunned for a while.

Last mechanic is an active ability that will appear on a random player, this ability is a poison that will drain player's life until he release the ability, and this must be done out of the group as it creates a venomous pool that will also damage other teammates.

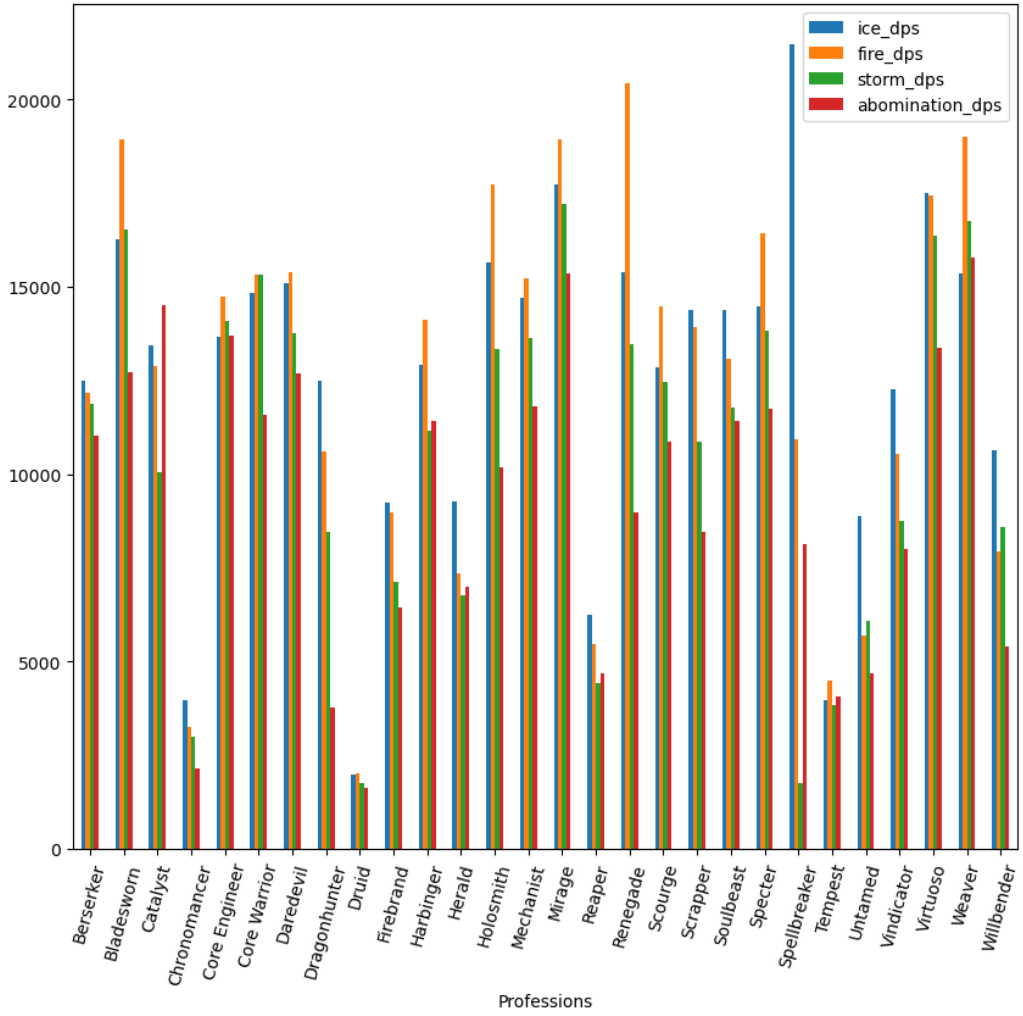


Figure 10: Matthias Gabrel

Matthias battle is quite special, as its phases are based on a weather happening on the battlefield and it affects players as well: ice will slow players, fire will create tornados damaging and stunning players... The abomination phase is the one that combines every effect happening before plus, Matthias becomes a bigger creature that will have the same movements as the original Matthias.

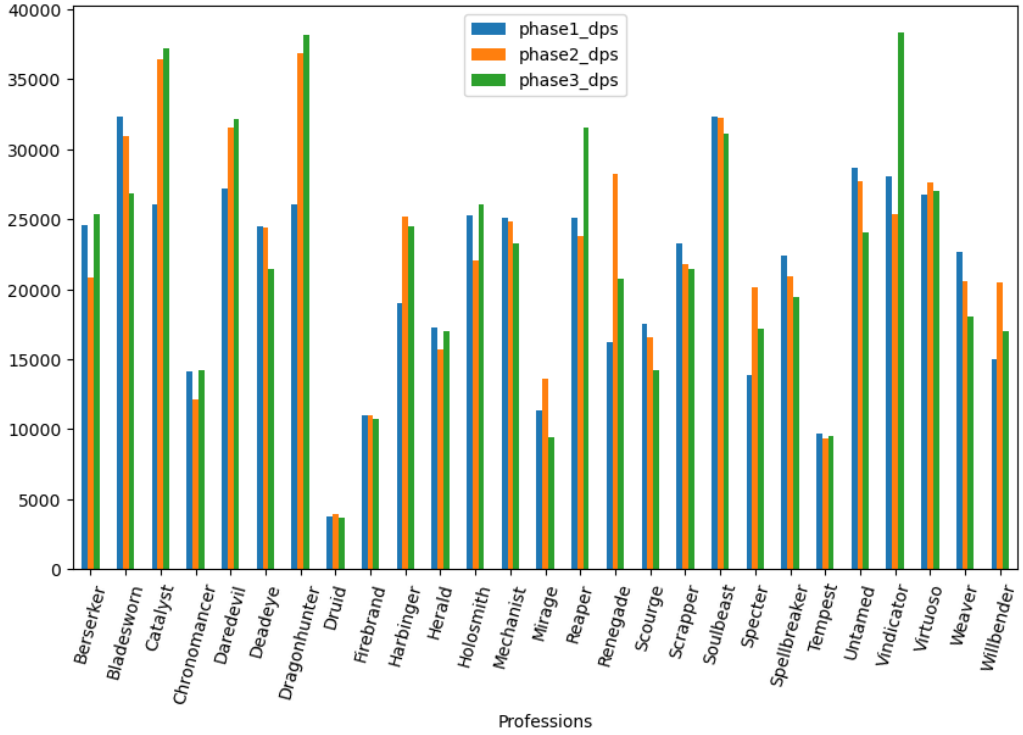


Figure 11: Keep Construct

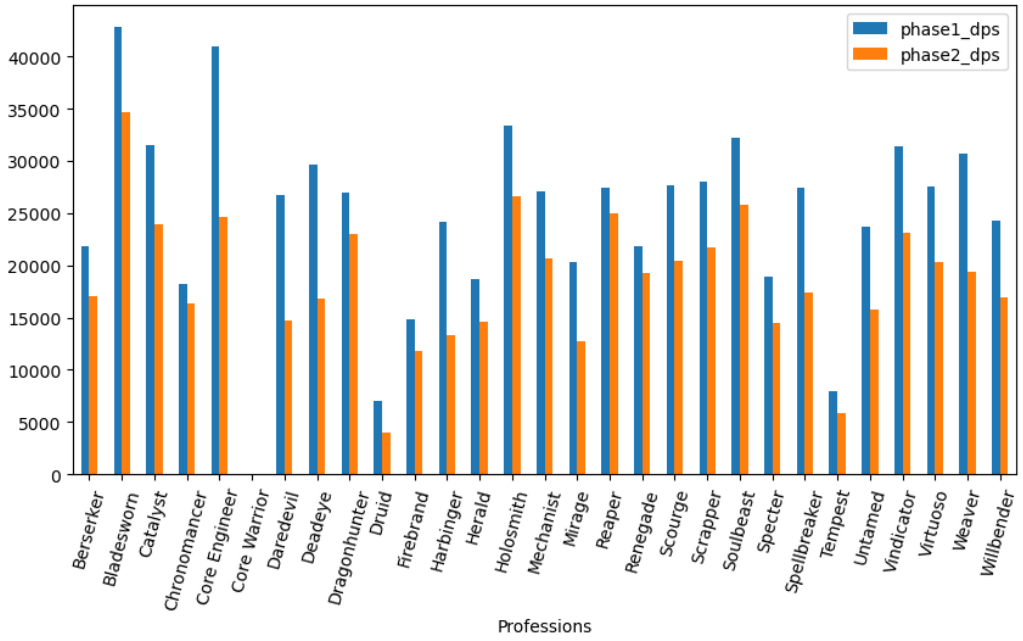


Figure 12: Xera

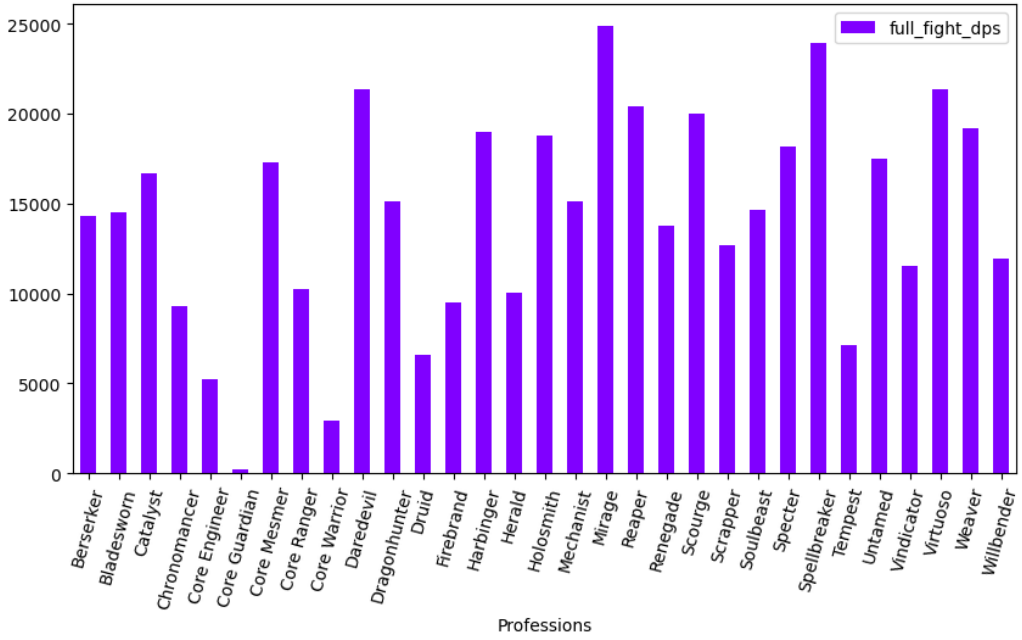


Figure 13: Cairn The Indomitable

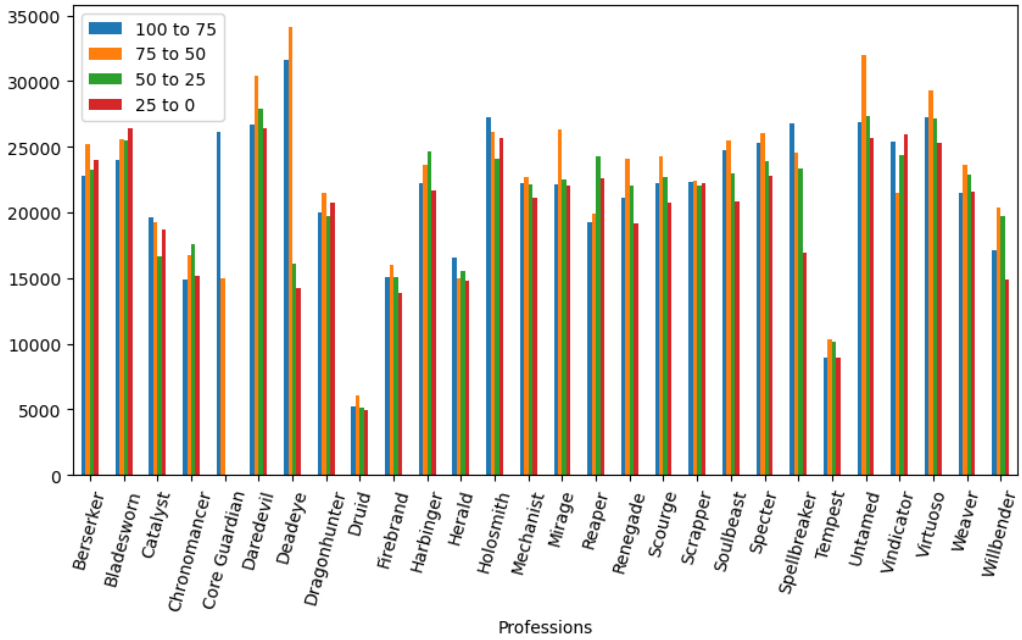


Figure 14: Mursaat Overseer

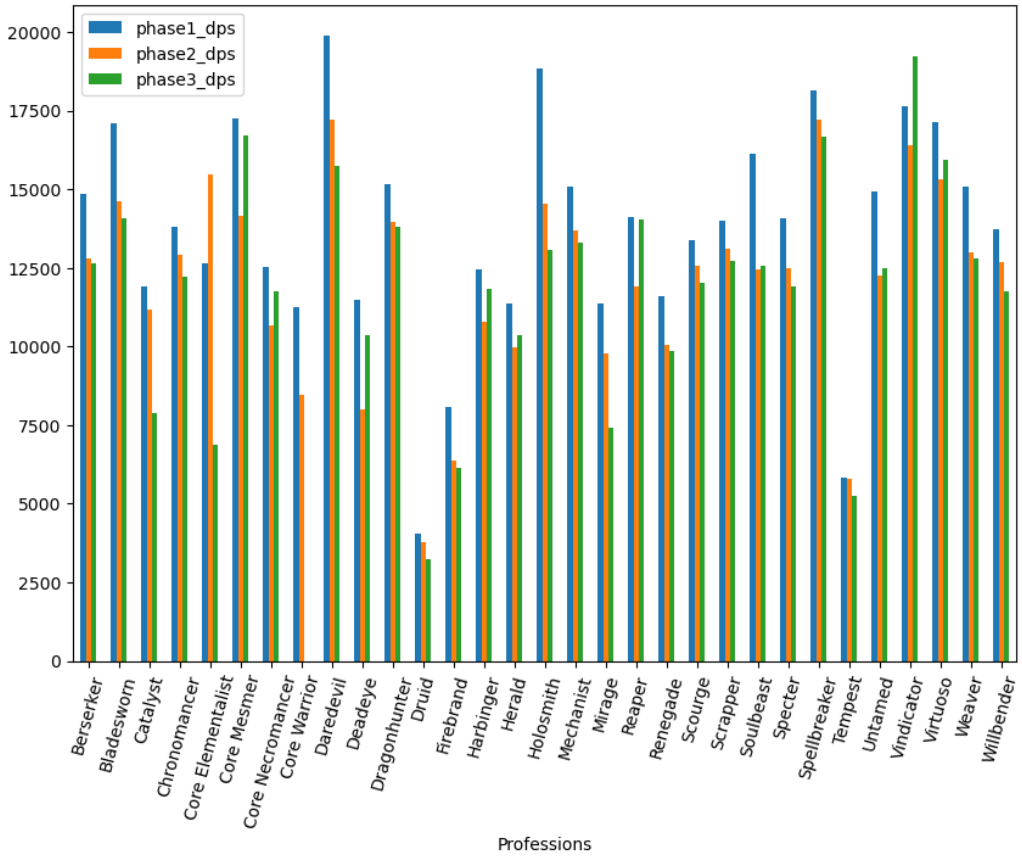


Figure 15: Samarog

As seen before, there are also bosses like Cairn that have a single phase, and this is due the kind of battle it has. Cairn battle it's based on a 100 to 0 battle, it has certain mechanics that everyone needs to do, but those mechanics doesn't stop some players from doing damage or being outside of the group needing to have in certain objectives in mind. A way to explain this would be Samarog; his battle is quite straight-forward, but, at every 33% HP lost he will exit the battlefield and another fight phase with two other enemies will began.

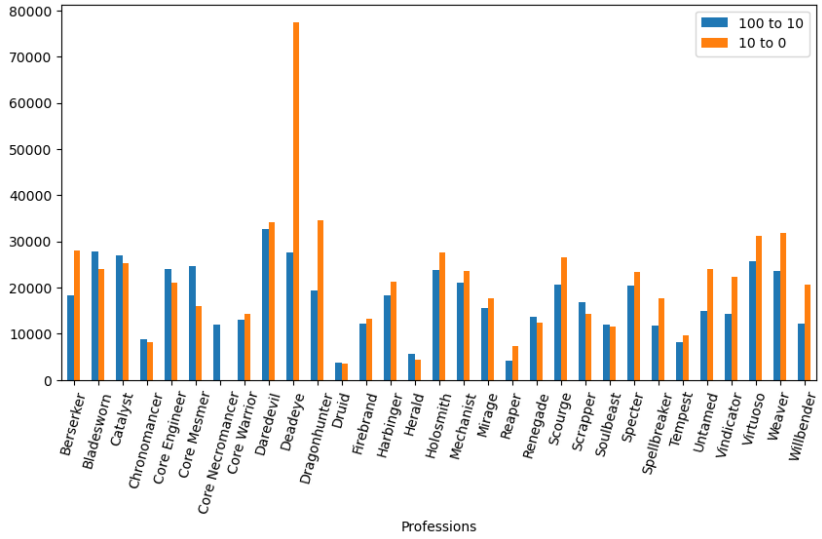


Figure 16: Deimos

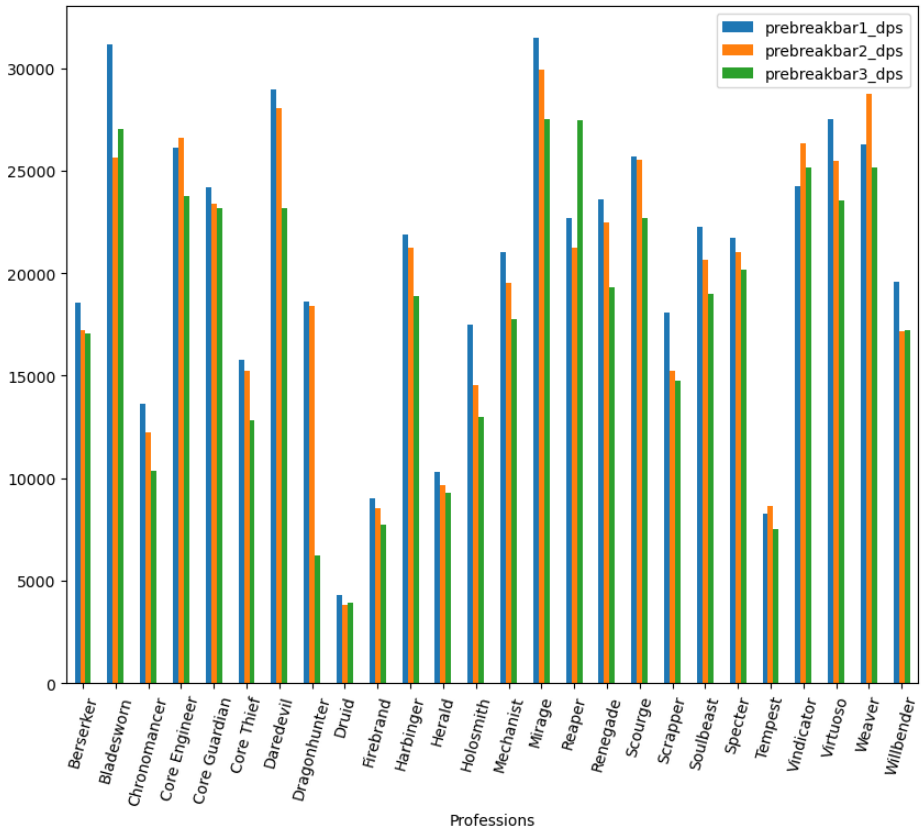


Figure 17: Soulless Horror

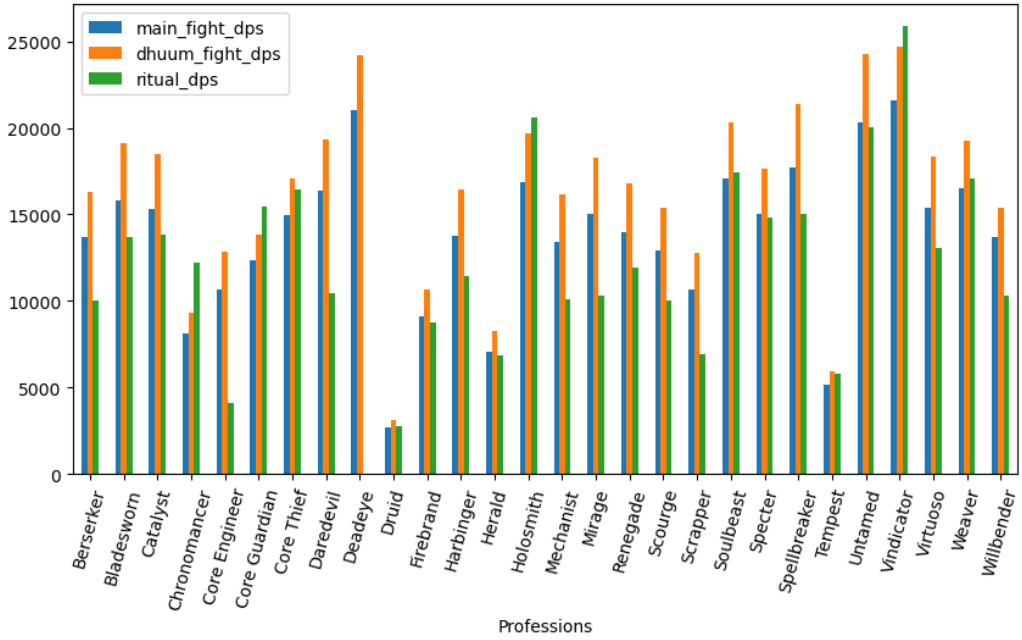


Figure 18: Dhuum

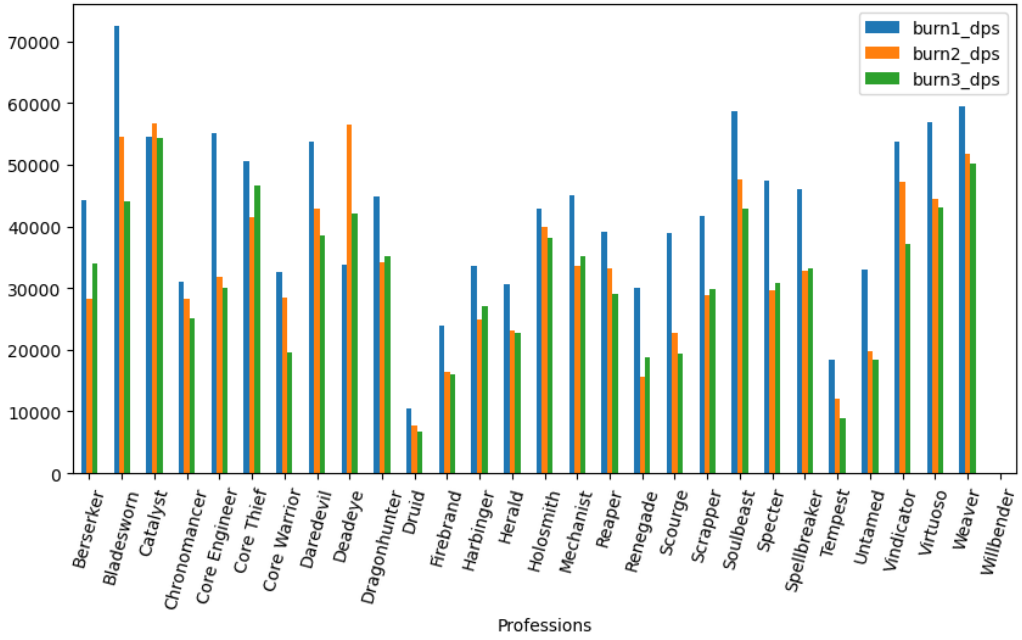


Figure 19: Conjured Amalgamate

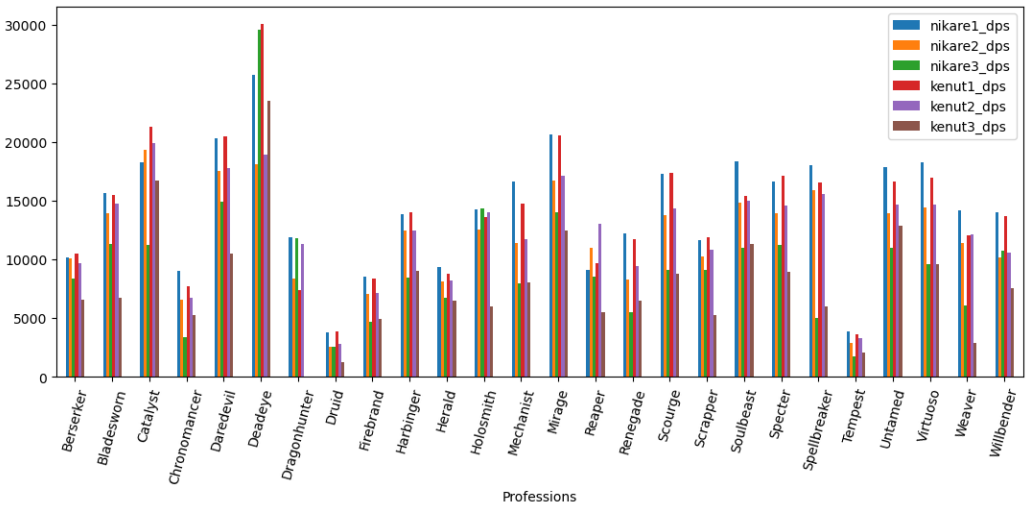


Figure 20: Twin Largos

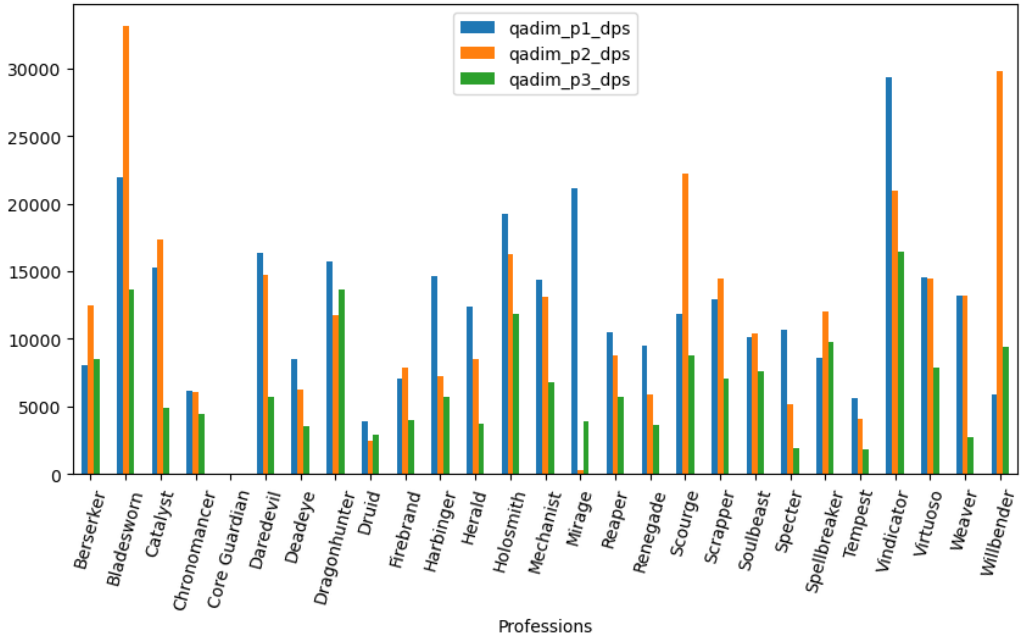


Figure 21: Qadim

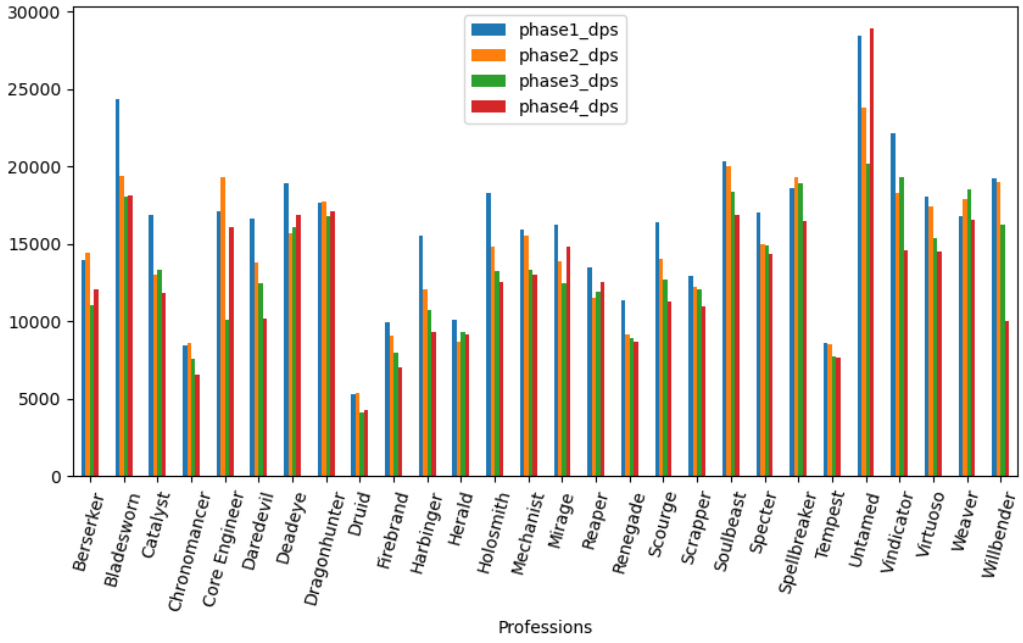


Figure 22: Cardinal Adina

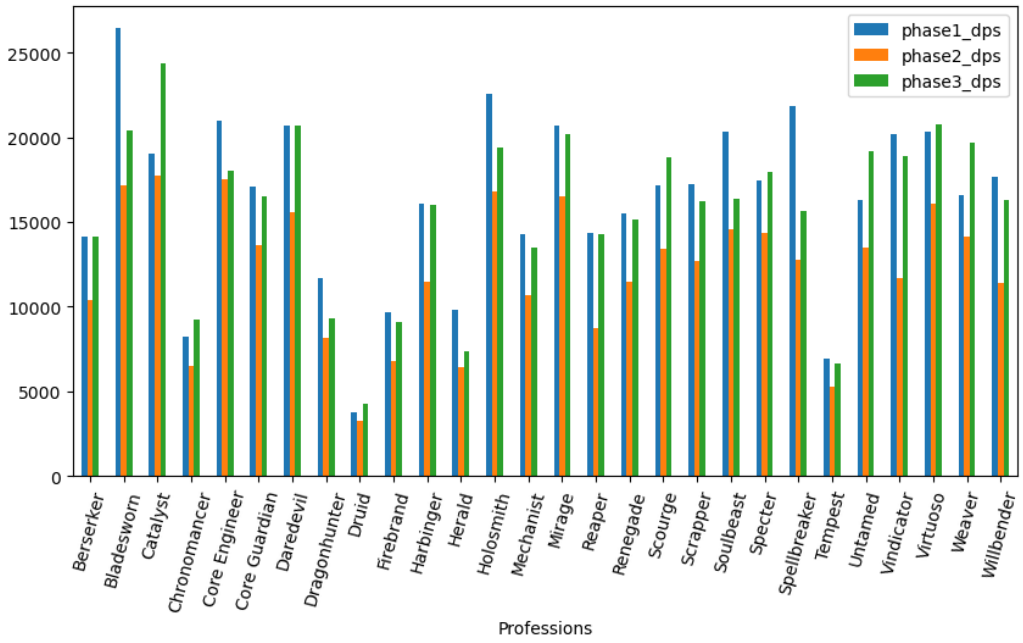


Figure 23: Cardinal Sabir

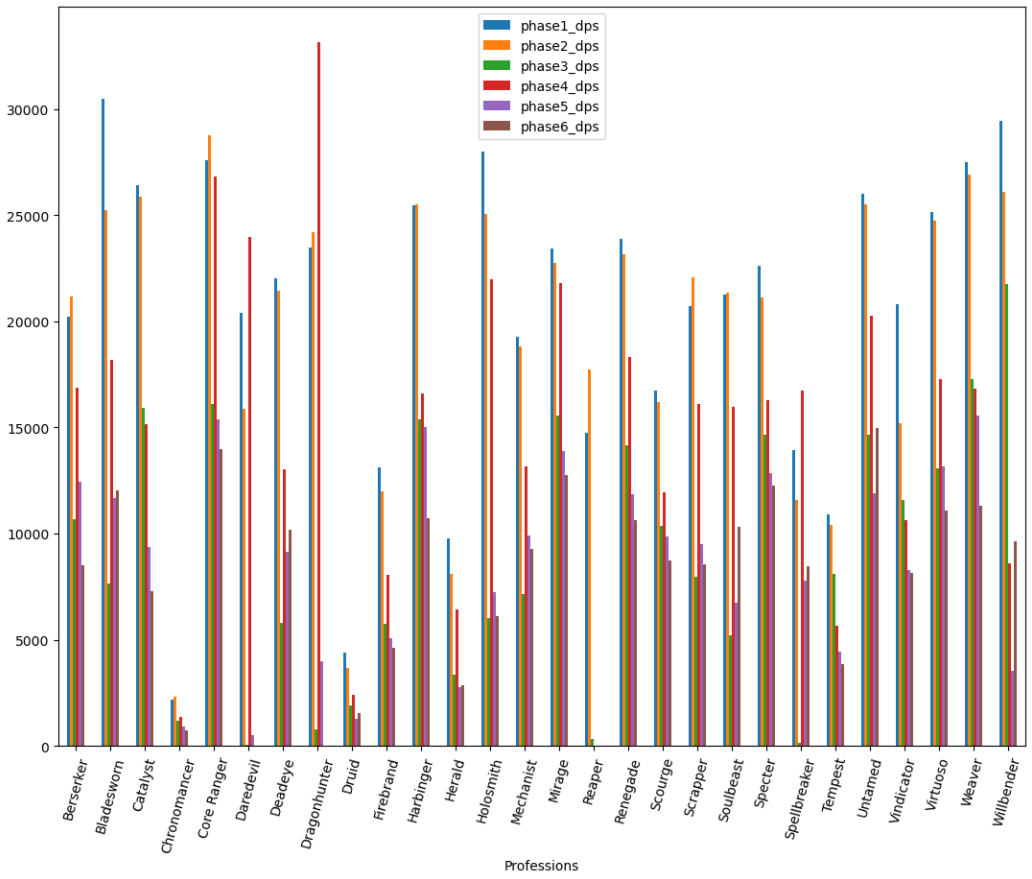


Figure 24: Qadim The Peerless

Twin Largos is a really special boss, because it actually contains two bosses in one fight, however, it is separated between extremely clear phases that, in game, are specified by platforms. Each boss, Nikare and Kenut, have three platforms each, which define their phases quite well.

As for Qadim The Peerless, classes like Scourges and Deadeyes are the ones playing a **Pylon** role and therefore, they are used almost a 90% of the times.

4.2.3 Analysis

After seeing all the previous graphs is quite obvious how some classes are used a lot more than others. This changes a lot as it is important to know that buffs and nerfs get done within the game after some time, which in the end keeps the game balanced.

Important: This whole project data analysis was made using the May to September 2022 status of the game, therefore, with future changes and also, more data, it's highly probable that results change.

On this side figure, I wanted to show data in a more understandable format. All this results are based on a global table and, as it portrays, **Mechanist** and **Firebrand** are the two classes with higher usage on a global percentage. As I explained earlier, Mechanist is one of the most versatile classes the game ever had, and yes, other classes like Firebrand is also quite versatile. In terms of damage, this also varies from encounter to encounter but some professions still stand out more since they can have an easier burst damage, which is essentially based on the class rotation.

	professions
Mechanist	0.32503%
Firebrand	0.1383%
Virtuoso	0.09851%
Scourge	0.05562%
Soulbeast	0.04016%
Druid	0.03439%
Specter	0.03125%
Mirage	0.03077%
Scrapper	0.02967%
Herald	0.02784%
Harbinger	0.02155%
Daredevil	0.02045%
Bladesworn	0.01961%
Renegade	0.01809%
Tempest	0.01657%
Berserker	0.01132%
Weaver	0.01122%
Chronomancer	0.00954%
Deadeye	0.00949%
Reaper	0.00792%
Holosmith	0.00755%
Dragonhunter	0.00687%
Willbender	0.00524%
Spellbreaker	0.00509%
Vindicator	0.00498%
Catalyst	0.00493%
Untamed	0.0044%
Core Engineer	0.00131%
Core Warrior	0.00068%
Core Guardian	0.00052%
Core Mesmer	0.00042%
Core Ranger	0.00026%
Core Thief	0.00021%
Core Elementalist	0.00016%
Core Necromancer	0.0001%

Rotations are the main damage source classes have, as guild webpages like **Snowcrows** or **LuckyNoobs** made sure to optimize this so every player can make use of the class full potential by applying the correct ability order that creates several effects such as buffs, field effects and combos.

Extra:
To understand what **Snowcrows** and **LuckyNoobs** does, I will leave links to the pages but also, explain what they do and contribute to the Guild Wars 2 community. Since Fractals and Raids were release as new PvE modes, some guilds and players tried to find ways to optimize how this stages could be cleared. This is how this guilds were born, but they are not something new as they always existed on other games like World Of Warcraft for PvP.

What they give to players are builds adapted to the current meta-game and they also revise them from time to time so all build are also up-to-date with new changes that Guild Wars team release into the game.

- SnowCrows **here**.
- LuckyNoobs **here**.

Conclusion

This project helped me to understand a lot more how to work with data, from building my own algorithms and functions, to clean and extract important information from big chunks of data. I enjoyed this project a lot and I will keep enjoying it as this don't end just yet. I have in mind doing several optimizations to the code and also, building a Machine Learning algorithm to recommend new players the best class to use on each boss. I quite ambitious with what this project can lead to and I will expect developing more functionalities.