## THIS PAGE CAN BE DELETED FROM YOUR FINAL REPORT

GUIDANCE (text in blue can be deleted from your final submission)

##### Report Layout and Style

A template will be provided on Moodle to support your work. However, the following guidelines

**must** be adhered to:

* All **text will be black** in the report unless in very exceptional circumstance.
* Main body text must be at least **11pt font** using either **Arial or Calibri** font.
* Main body text will have **1.5 line spacing**.
* **Margins** will be a minimum of **2 cm on each side**.
* All **pages** will be **numbered consecutively**.
* **Figures** must have **captions** and be **numbered** (e.g., Figure 1).
* **Tables** must have **captions** and be **numbered** (e.g., Table 1).
* **Figures** may be **black and white**, or **colour**.

##### Word Count

There is a **10,000-word limit** for the project. Do not see this as a target, but rather a limit to the number of words we expect a project to have. All words in the main body, excluding words in figures and tables, will count to your word count. If you think you will go over 10,000 words, you should consider what can be removed from the main body and placed in an appendix.

##### Copyright and Intellectual Property Rights (IPR)

Your report should be written considering that it will be within the public domain. Normally, you retain copyright over your written work and Intellectual Property Rights (IPR) over any technical work. There are situations where this might not be as simple, for example when working with a company or on a larger university project. There are strategies you can utilise:

* You can inform your supervisory team that the project cannot be made available to other students undertaking an BSc Project.
* You can provide a shortened report for sharing that does not contain the protected information.
* You can assign IPR to the external collaborator, although you should take great care when doing so. It is best to speak to your supervisor.
* Non-disclosure agreements can be made between the external collaborator and the supervision team.

THIS PAGE CAN BE DELETED FROM YOUR FINAL REPORT

# The best region and team in pro LoL Esports

### Subtitle if required

#### By

Thamiliniyan Aravinthan

#### Submitted to

**The University of Roehampton**

#### In partial fulfilment of the requirements for the degree of

**BACHELOR OF SCIENCE IN COMPUTER SCIENCE**

# Abstract

Abstract narrative

## Declaration

I hereby certify that this report constitutes my own work, that where the language of others is used, quotation marks so indicate, and that appropriate credit is given where I have used the language, ideas, expressions, or writings of others.

I declare that this report describes the original work that has not been previously presented for the award of any other degree of any other institution.

**Enter your name here Date:** Enter the date here

Signed (apply signature below)

# Acknowledgements

Acknowledgements narrative

# Table of Contents

1. [Introduction vii](#_bookmark0)

[Research Question or Problem that will be Addressed vii](#_bookmark1)

[Aims vii](#_bookmark2)

[Objectives vii](#_bookmark3)

[Legal, Social, Ethical and Professional Considerations vii](#_bookmark4)

[Background vii](#_bookmark5)

[Report overview vii](#_bookmark6)

1. [Literature or Technology Review viii](#_bookmark7)
2. [Design or Methodology ix](#_bookmark8)
3. [Implementation or Results x](#_bookmark9)

[Evaluation x](#_bookmark10)

[Related Work x](#_bookmark11)

1. [Conclusion xi](#_bookmark12)

[Reflection xi](#_bookmark13)

[Future Work xi](#_bookmark14)

1. [References xii](#_bookmark15)
2. [Appendices xiii](#_bookmark16)

## Introduction

GUIDANCE (text in blue can be deleted from your final submission)

An initial paragraph introducing the project context and idea (all projects).

The focus of this project is to visualise data from three regions (LEC – Europe/Middle East/Africa; LCS – North America; and LCK – South Korea)) in the professional League of Legends eSports scene from 2015-2017 and see where teams and regions outperformed one another in aspects of the game. These aspects are the total gold difference in games, the individual gold differences between the roles of the game (top, jungle, mid, bot, and support), kills, and objectives (Baron Nashor, Dragons, Rift Herald). The initial data that was sourced from Kaggle [1] will be used to compare these various aspects and present them on an interactive web page that will allow users to explore the visualisations in different manners that may affect the visualisations.

### Research Question or Problem that will be Addressed

GUIDANCE (text in blue can be deleted from your final submission)

A hypothesis and/or research question(s) (research-based projects)

1. A focus of this project would be to determine which team performs the best within a region based on factors of the game and individual roles.
2. The next question would be which is the best team out of the 3 regions to be compared, which will be judged on the same factors.
3. With this information, the question now would be does it match with the results of the individual regions rankings and their ranking in the global world championship Worlds.

These research questions serve a purpose, as the answers found will show how relevant and impactful the factors of the game as visualised are within the game. It will show whether there is a correlation between these factors and the results of teams and regions or whether there is a need for more factors of the game to be taken into consideration.

### Aims

GUIDANCE (text in blue can be deleted from your final submission)

Aims are broad statements of desired outcomes and intentions.

The first aim of this project would be to implement useful visualisations that users can use to determine factors that teams and regions outperform one another in. These visualisations would answer the first two research questions of this project to determine where teams and regions are strong and where they lack.

This will allow users to make judgements about teams and regions using visualised data that is factual and will encourage them to talk and engage with others within the game’s community. By getting users and the community involved, it helps improve engagement between them, which in turn gets more people involved and interested in the eSports scene. ( join to first para make it not a separate aim but a reason for one of them and just use the first sentence).

Also, for users that are not familiar with or new to the game and eSports scene, the aim would be to make the visualisations useful by introducing them to the strengths and weaknesses of teams and regions. By doing so, it will bring in a new audience to the game and eSports scene, which in turn will build up the community and engagement.

But, if these visualisations are not enough for users to make judgements about teams and regions, it will prove that there is a need to further research other factors of the game, as is the purpose of the third research question.

### Objectives

GUIDANCE (text in blue can be deleted from your final submission)

Objectives are the tangible steps that will be taken to achieve the aims -- tasks that will be done.

1. The first objective is to source the data, which was found on Kaggle [1] and consists of data from 2015-2018 for over 10 different regions in the eSports scene.

* From there, the data is cleaned and selected to focus on what the project entails, where only 3 of the main regions (LEC, LCS, and LCK) are selected, and columns of unnecessary data are filtered out (towers, champions, bans, and address).

1. Next would be to manipulate the data from the dataset to get averages of many games and counts of games to create a new dataset of worked upon data.

* To do this, research would need to be done to find the ideal language and library that can effectively produce the required output. Python seems to be the most ideal, but there may be a more efficient way to do it in another language.

1. The next step would be to create an interactive webpage that will present the visualisations and data.

* To achieve this objective, the focus would be on the method of visualisation used. Where there is experience with Python and Tableau, there is a need to research to see if there is a better method (like d3js). SHOULD BE AN OBJ
* After finding the method of visualisation, there will be a learning curve step where, no matter the chosen method, time will have to be spent on learning it to a satisfactory level. DELETE
* Then there would be a focus on the design and front end of the webpage, as it would allow for a better presentation of the visualisations. DELETE BUT TALK ABOUT IN OBJ 3

1. Then, based on the time constraints and when a finished prototype of the project is ready, there would be the idea to scraping further data into the dataset that focuses on other aspects of the game.

* One of these aspects is the cs (farm), which is the count of minions/creatures killed, which in turn gives gold and experience to level up.

### Legal, Social, Ethical and Professional Considerations

GUIDANCE (text in blue can be deleted from your final submission)

The legal issue this project may face is the sourcing of the data from Kaggle [1], but as it is an open-source dataset, there shouldn’t be an issue. Also, based on objective 4, if there is a process of scraping further data, there is a process of making sure that it is processed legally.

The main ethical issue that links with legality is the fact that initially, the dataset can be considered to have personal data and would therefore have to abide by the GDPR. However, the only sort of data that can be considered as such are the players’ names, but these are, for the most part, pseudonyms, and publicly available data.

A social and ethical issue to consider is that these visualisations may lead users to make judgements about the game and use it to gamble, which is not the intention of the project. However, as the data covered spans from 2015-2017, there will be no such issues unless the project is expanded to use more recent data, where this factor will be taken into consideration.

A professional consideration is to ensure that the visualisations are correct and that there are no errors made during the manipulating stage to provide factual information. Another thing to consider is that there may be teams and players who have performed poorly and wish for their data not to be used. If that is the case, it will be implemented so that it follows their wishes, and we must be sympathetic as it may cause online harassment otherwise.

### Background

GUIDANCE (text in blue can be deleted from your final submission)

You need to convince your examination team that your project is a viable one by answering the question -- **why is this a suitable project for an BSc Project?**

The aim of the background section is to provide the reader with the relevant contextual information necessary to understand your work. This section must be suitably referenced based on the reviews undertaken. There are two reviews that are likely to take place within this section -- a technology review and a literature review. The section concludes with a summary of the findings from the background investigation and how that **justifies** the work undertaken in your project.

What is it that makes this challenging?

New technology?

Bring it all together?

How the project was built up?

Which things are new and difficult?

Give reader the information they need to undersantd the game

Relate to previous courses?

Why use used tech? widely used in industry

Refer to lit and tech section

Why am I interested it? Data sciene, vis, technology

What are the obj in league of legends and why they matter?

Talk about growth in visualisation? Check google trends

### Report overview

Describe the upcoming sections in order -- this provides your reader with a roadmap of the report.

## Literature or Technology Review

GUIDANCE (text in blue can be deleted from your final submission)

**Literature Review** (for research or investigation-oriented projects)

All projects should reference some academic literature, although it is primarily research-orientated projects that will conduct a significant literature review in the background section. As with the technology review, the goal here is to make it clear why the choices were made in the project. It is expected that at least the research methodology and/or evaluation approach is defined from existing sources.

* There was a look at papers relating to League of legends but for the most part there was no relevance into what this project aims for.
* There were some papers that very trying to calculate odds of winning and the different win conditions in various regions, where their results of findings would be very helpful when analyzing the visualisations [2].
* A lot of other papers looking at teamwork and other more probability-based research was unavailable to view due to paywall.

**Technology Review** (for build or investigation-oriented projects)

The technology review focuses on technology that will be and could be used for the project. Typically, it is expected that you have reviewed different technology options for your project and summarised these options here. It should be clear why the technology choices taken were made.

* Github – Used to store and track progress of project and was used due to previous experience and it being easy to integrate version control
* ClickUp - was used to manage the project as a task board to manage and track task and was used compared to alternatives like Trello because it’s very good with many features for free
* Jupyter Notebook - used to test data, manipulate data, and experiment visualization. Was used due to previous experience hence no time needed to familiarize myself with it and because it is simple to use. Pandas and NumPy
* ParseHub - used at start of project to try and scrape data and was the best free tool there was for scraping but unfortunately was decided to come back to due to difficulties.
* D3JS - used to create visualisations and was decided to use rather than python libraries and Tableau as it allowed for greater flexibility and interactivity. Also, as it’s a library of JavaScript it makes making a webpage easier to integrate, code, and implement.
* HTML/CSS – will be used for styling and designing the front end of the webpage and it’s the best to use as the backend is written using JavaScript.

## Design or Methodology

GUIDANCE (text in blue can be deleted from your final submission)

Now you must tell your examination team what you are going by answering the question -- **how are you going to undertake the project?**

The aim of this section is to explain to your reader the work you are going to undertake. Depending on whether the project is more build or research-focused, this section can take one of the following forms.

**Design** (for build or investigation-oriented projects)

If your project is a build focused project, you should provide a design for what your project will build. The nature of this design will depend on your project, but it should provide a complete idea of what you are going to build, including the technologies to be used.

**Methodology** (for research or investigation-oriented projects)

If your project is research-focused, then you need to define the particular research methodology you are using to gather and assess data. Typically, this will involve some sort of data gathering process and statistical analysis of results. However, you should also describe the tools (e.g., technologies) that you will use as well.

* Source the data from Kaggle dataset [1] which was then cleaned in excel by getting rid of unnecessary columns of data (including picks, bans …’to list’) where then the data was narrowed down to focus on 3 of the main regions (list).
* Tried to scrape more data from sites like: “to list” and decided to use ParseHub but was met with difficulties like the difficulty to select the data as you had to navigate through many pages. Also, the tool was weak in the sense as it was the free version trying to scrape larges amount of data causes it to crash. Hence the decision was made to come back to it later once there was a working prototype due to time limitations. However, to gather data from the most recent years would be much easier due to it being much accessible.
* Next the data had to be manipulated to create basic visualisations and this was done using Python done within Jupyter Notebook. This was due to it having many useful libraries that would help perform the calculations and transformations in the easiest manner in both the learning and implementing stages.
* The idea was to get averages of the gold differences of games by a team within a certain region and year. First, pandas was used to create a data frame using the csv file of the cleaned data and the first problem faced was due to the formatting of the data. By simply creating a data frame the data type of the arrays was read as an array of tuples where due to its immutability operations couldn’t be performed. The solution to this was to use a parameter when reading the csv file called ‘converters’ and setting it to ‘pd.eval’ which allows for the data to be formatted so that arithmetic operations can be used.
* Next, it was followed by another problem which was that to get an element wise average of the game didn’t initially work as the arrays of games were of different lengths as not all games have the same time length. To tackle this the arrays of the data was converted to a NumPy array of type object which would allow for the flexibility needed to work with different sized arrays. Then the arrays were made to be of equal lengths by filling ‘Nans’ into shorter length arrays. Then by using a tool called ‘zip\_longest’ the arrays were transformed so that each new array represented each unique minute from the games rather than being arrays of individual games. Then by using the ‘nanmean’ function the goal of getting an element wise average of games was achieved.
* Now that it was possible to get an element wise average this could be then implemented on a few more teams so that then some basic visualisations could be made. Then using the matplotlib library a basic line chart visualisation was made to see the shape of the data and it was then compared to a bar chart race. This comparison was made to see how a more interactive visualisation would represent the results of the data. Although the code was running it did face a few bugs and so could not accurately visualise the data to the full extent.
* It was then decided to use d3js as the method of visualisation after researching alternatives like Tableau.

##### Alternative Approaches

Another important point in this section is to document any alternative approaches you could have taken to complete the project. For example, were there different technology choices, design choices, or methodological choices you could have taken? You should explain why you have taken the approach you have taken rather than these alternatives.

## Implementation or Results

GUIDANCE (text in blue can be deleted from your final submission)

Once the examination team know what you planned to do, you must tell them what happened --

##### What was the outcome of the work you undertook in the project?

A build or investigative project will discuss the implementation. **Do not just paste in lines of code to your report and call that an implementation! Your report should feature minimum code to only discuss points.** The idea for implementation is to describe how the design has actually turned out.

A research or investigative project will present the results from performing the methodology. These results must be correctly presented, using appropriate tables, charts, and statistical tests that suit the nature of the project. Results should be summarised, and any findings clearly presented.

### Evaluation

GUIDANCE (text in blue can be deleted from your final submission)

The examination team now need to know how well the project went -- **How good was the outcome from the project?**

Evaluation is an important element of any project. You must tell your reader how good the final deliverable is. **Your project does not have to be perfect -- indeed the outcomes might have been bad.** The point is you must evaluate the outcome and discuss its strengths and weaknesses.

A key element of this section is a reflection on the aims and objectives set out at the start of the project, and how well these have been met. **Again, it is possible not to achieve an aim or objective.** The point is you evaluate how well you did meet your goals.

### Related Work

GUIDANCE (text in blue can be deleted from your final submission)

Answer the question -- **Who else has done something similar and how does my work compare?**

Another key element of this section is evaluating your work against that of others. How good is your work when compared to other people who have undertaken similar work? It is important to be able to understand how well you have achieved your goals in relation to others, while also considering the time limitations of the project.

## Conclusion

GUIDANCE (text in blue can be deleted from your final submission)

The conclusion summarises the project. You need to highlight your key outputs and/or discoveries. There are some particular subsections that must appear in your conclusion.

### Reflection

GUIDANCE (text in blue can be deleted from your final submission)

You must critically reflect on the entire project process and how well you have worked on the project. What particular things have you learned during the project? Why were you able and unable to meet project goals? What would have you done differently in hindsight?

A common approach many students take in this section is to claim poor time management. **Poor time management is rarely a problem unless you had too much to do in the project.** Normally, what is called poor time management is poor organisation, planning, and motivation. Being honest in your reflection will help you understand how you can improve these issues rather than focusing on time management issues.

### Future Work

GUIDANCE (text in blue can be deleted from your final submission)

Answer the question -- **What next?**

You've completed a significant piece of work -- perhaps the largest piece of work you have ever done. But no project is ever 100% complete, and you will have found new ideas along the way. If someone were to pick up your project, what avenues should be explored next?

## References

GUIDANCE (text in blue can be deleted from your final submission)

In this section, you **must** reference any sources used in your work. Typically, these sources will have come up during the investigation and related work sections. Your referencing must use the IEEE referencing style [IEEE Citation Guidelines2.doc (ieee-dataport.org)](https://ieee-dataport.org/sites/default/files/analysis/27/IEEE%20Citation%20Guidelines.pdf) .

It is **highly** recommended that you use reference management software such as Mendeley or Zotero.

Many students ask how many references are required. That is like asking how long a piece of string is. Your project should have as many references as is required for it. However, having few references indicates that no thorough investigation has occurred.

[1] https://www.kaggle.com/datasets/chuckephron/leagueoflegends

[2] Paper on Logic Mining in League of Legends http://pertanika2.upm.edu.my/resources/files/Pertanika%20PAPERS/JST%20Vol.%2028%20(1)%20Jan.%202020/12%20JST-1649-2019.pdf

[3]

## Appendices

GUIDANCE (text in blue can be deleted from your final submission)

Appendices appear after references. Your appendices depend on the nature of your project. **Do not assume people will read your appendices.** Even if you direct them to do so in your main text, appendices are considered additional information and should not be relied upon to understand your main body of work. Refer readers to an appendix using a phrase such as *see Appendix A for further details*.

The following documents **must** be included as references:

* + Your Project Proposal.
  + Your Progress Review Form.
  + Your original plan and revised plans as your project evolved.
  + A description of how to access any technical output. **It is strongly recommended you use GitHub or something similar to do this.**

Any important communications between you and external stakeholders -- **please ensure private data is removed and communications anonymised.**