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Master in : Computer science

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By :

Amrouche Soulaf

Ben djenidi Faiza

Title of the thesis

Clustering of urban taxi trajectory networks
Case study: City of M'sila

Under the supervision of

Dr. Mehenni Tahar

Composition of the jury

Dr.	**Brahimi Mahmoud**	University of Msila	President
Dr.	**Bouguerra Abdelbaki**	University of Msila	Examiner

2023/2024

On the occasion of my graduation I dedicate this work to my dear family. All my teachers and all my friends because without these people I wouldn't be where I am today, I love you all. » On the occasion of my graduation I dedicate this work to my dear family. All my teachers and all my friends because without these people I wouldn't be where I am today, I love you all. »

Ben djenidi Faiza

I dedicate my graduation and the harvest of what I sowed over many years for the sake of knowledge to my great parents who worked hard and made every effort to continue my education until I reached this precious moment, and to my friends and everyone who contributed to my arrival to this moment

Amrouche Soulaf

Acknowledgement

First of all, we would like to express our gratitude to**Mr. Mehenni Tahar** for his commitment, help and valuable advice. This period of time. These are the people who contributed to the solid foundation of the countryFoundation stone. Sincere thanks to all the professors, speakers and all the people who made it possible, we use their words, writings, advice, and critics to do our work.

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General Introduction

Transportation and delivery applications are witnessing rapid growth in the modern era, as this sector meets the increasing needs of individuals and companies alike in daily transportation and providing services easily and effectively. From this standpoint, the new transportation application seeks to be a strong competitor to applications such as Yassir, as it aims to provide a distinct user experience that combines ease of use, efficiency in service, and innovation in technology to meet the aspirations and needs of users in an innovative and sophisticated way.

To understand and improve urban transportation systems, it is essential to study and analyze movement patterns within the city. One promising method to achieve this is through the analysis of taxi trajectories. Taxi trajectory data is a rich source of information about how people move within the city, reflecting daily movement patterns of residents and changes in transportation demand during different times of the day or specific periods such as holidays and special events. By analyzing taxi trajectory data, urban planners and city management officials can gain valuable insights into how to enhance transportation infrastructure, such as optimizing bus routes, planning the locations of transportation hubs, and alleviating traffic congestion.

Additionally, this data can contribute to developing smart transportation solutions that rely on technology, such as intelligent transportation systems that use real-time data to improve traffic flow and provide accurate travel time predictions. Therefore, the analysis of taxi trajectories is a powerful tool for understanding the complex patterns of urban mobility, helping to create more efficient and sustainable cities.

Enhancing transportation infrastructure and improving traffic management not only contribute to better quality of life for residents but also bolster the city's

capacity for growth and prosperity in the future.

1 Problem Statement

The city of M'sila faces typical mobility challenges such as traffic congestion,and inefficiency of public transport. Population growth and increasing urbaniza-tion are exacerbating these problems, requiring innovative solutions to optimize urban transportation systems. The objective of this study is to carry out an in-depth analysis of taxi trajectory data in M'sila using clustering techniques. More specifically, is it possible to optimize taxi routes to reduce travel time and improve service efficiency?

2 Motivation and Objecticive

Our motivation for creating a taxi application that utilizes urban taxi route aggregation in the city of M'sila stems from the need to address critical urban mobility challenges. By clustering taxi trajectories, we aim to optimize taxi dispatching, reduce travel time, and improve route efficiency, thereby enhancing operational efficiency and user satisfaction. Additionally, this application seeks to provide valuable insights into traffic patterns and congestion hotspots, aiding local authorities in traffic management and urban planning. Ultimately, our goal is to leverage advanced data analysis to create a smarter, more efficient transportation system that benefits both passengers and taxi operators in M'sila.

3 Dissertation Structure

Finally, the content of this thesis is summarized in three chapters: The first chapter contains an analysis of the community's needs, in addition to some information about the transportation route network. The second chapter contains an overview of Data Mining (Clustering K-Means).Chapters three and four are dedicated to implementing our application.

Chapter 1

Transportation Trajectory Network

A transportation path network, also known simply as a transportation network, is a system of interconnected routes or pathways that facilitate the movement of people, goods, or information from one location to another. This network typically consists of nodes (points of origin, destinations, or intermediate stops) and edges (connections between nodes, representing roads, railways, waterways, air routes, etc.) [1].

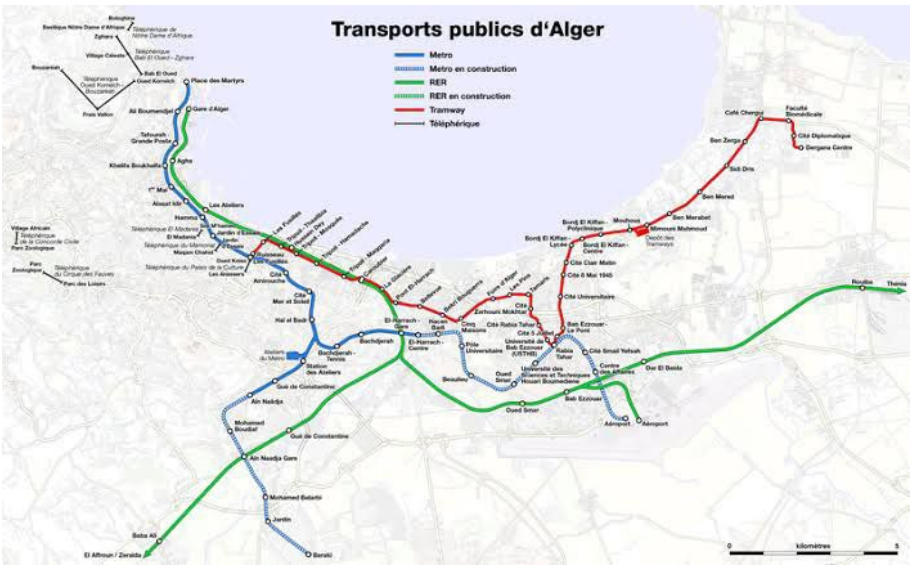

Figure 1.1: Algiers Tram Map.

1.1 Transportation Trajectory Network for Taxis

In modern urban landscapes, efficient transportation systems are paramount for facilitating mobility, reducing congestion, and enhancing overall quality of life. Taxis serve as a vital component of urban transportation networks, offering flexible point-to-point service for commuters and tourists alike. However, the optimization of taxi services to meet the dynamic demands of urban environments presents a significant challenge. [2]

1.2 The importance of developing Transportation

- The development of a Transportation Trajectory Network for Taxis (TTNT) emerges as a promising solution. The TTNT integrates advanced technologies and data-driven approaches to optimize taxi operations, enhance service quality, and improve overall transportation efficiency.

- At its core, the TTNT leverages real-time data streams, including GPS positioning, traffic information, and passenger demand patterns, to dynamically adjust taxi routes and dispatches. By analyzing historical trip data and predictive algorithms, the system can anticipate demand surges, optimize driver assignments, and minimize passenger waiting times.

- Furthermore, the TTNT incorporates machine learning algorithms to continuously improve route recommendations and adapt to evolving transportation patterns. By learning from past experiences and feedback mechanisms, the system can optimize taxi trajectories, reduce travel times, and mitigate traffic congestion.

- Importantly, the TTNT prioritizes passenger experience and safety. Advanced features such as real-time tracking, secure payment systems, and driver rating mechanisms enhance transparency and trust within the taxi ecosystem. Moreover, by optimizing routes and reducing idle time, the TTNT promotes environmental sustainability by minimizing fuel consumption and emissions.

- Through the deployment of the TTNT, urban transportation authorities can harness the power of data-driven optimization to create a more efficient, reliable, and sustainable taxi network. By fostering collaboration between technology developers, transportation agencies, and taxi operators, the TTNT paves the way for a smarter, more connected future of urban mobility.

1.3 Integrated Infrastructure and Digital Platforms in Taxi Transportation Networks

Transportation networks for taxis usually involve a combination of physical infrastructure and digital platforms. Here's a breakdown:

- **Physical Infrastructure:** This includes roads, highways, and streets where taxis operate. Cities often have designated taxi stands or pickup/drop-off points to streamline operations and reduce congestion.
- **Digital Platforms:** Technology plays a crucial role in connecting passengers with taxis. Mobile apps like Uber, Lyft, or local equivalents allow users to request rides, track the location of their assigned taxi, and make payments electronically.
- **GPS and Navigation Systems:** Taxis are equipped with GPS devices and navigation systems to help drivers locate passengers efficiently and find the quickest routes to their destinations.
- **Fleet Management Systems:** Taxi companies use fleet management software to monitor and manage their vehicles. These systems track factors like vehicle location, driver performance, and maintenance schedules.
- **Payment Systems:** Digital payment systems enable cashless transactions between passengers and drivers. These can include credit/debit card payments within the app or digital wallets.
- **Regulatory Frameworks:** Governments and transportation authorities often regulate taxi services to ensure safety, fair pricing, and quality standards.

This may involve licensing requirements for drivers and vehicles, fare regulations, and safety inspections.

- **Integration with Public Transportation:** In some cities, taxi services are integrated with public transportation networks to provide first-mile/last-mile connectivity. This improves accessibility for passengers and enhances overall transportation efficiency. Overall, transportation networks for taxis rely on a combination of physical infrastructure, digital technology, and regulatory frameworks to provide convenient and reliable service to passengers.

1.4 presentation of M'sila

M'Sila is a vibrant city in northern Algeria. Its strategic location at the intersections of major roads connects it to key cities such as Algiers and Batna. The city's modern infrastructure supports various economic activities, thanks to its wide roads and diverse public transportation services, including buses, taxis, Future plans focus on further enhancing urban transportation by expanding the road network, modernizing public transportation, and improving railway services. These efforts aim to achieve sustainable growth, reduce traffic congestion, and improve residents' quality of life. These developments are expected to strengthen .

1.5 Conclusion

Urban mobility is critical to the economic, social, and environmental health of modern cities. Efficient transportation systems not only drive economic productivity but also enhance social cohesion and contribute to sustainability. Analyzing urban mobility through taxi route data provides a powerful way to understand and improve city transportation networks.

In Msila, mobility challenges such as traffic congestion can be addressed by leveraging clustering techniques on taxi route data. This analysis aims to improve taxi routes, reduce travel time, and enhance service efficiency.

Chapter 2

Clustering techniques

2.1 Data Mining

Data mining is the process of analyzing large datasets to discover patterns, trends, and valuable insights.

It integrates techniques from statistics, machine learning, and database systems to extract meaningful information from vast amounts of data, often to support decision-making and predictive modeling. [3]

2.2 Clustering

Clustering is the process of organizing similar data together into groups or subgroups known as “sets” or “subsets.” The goal of segmentation is to divide a data set into groups without imposing any prior classification, such that elements within each group are similar to each other and different from elements in other groups. [4]

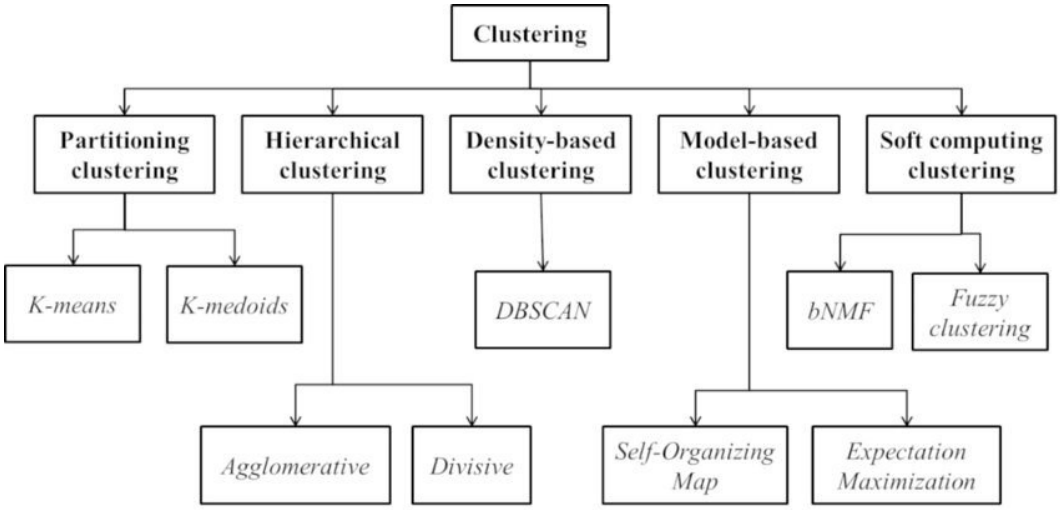

Figure 2.1: Types of Clustering

2.3 K-Means

K-Means is one of the most widely used clustering algorithms due to its simplicity and efficiency. It aims to partition a dataset into k clusters, where k is a user-specified number. The algorithm iteratively assigns each data point to the nearest cluster centroid and recalculates the centroids until convergence. [5]

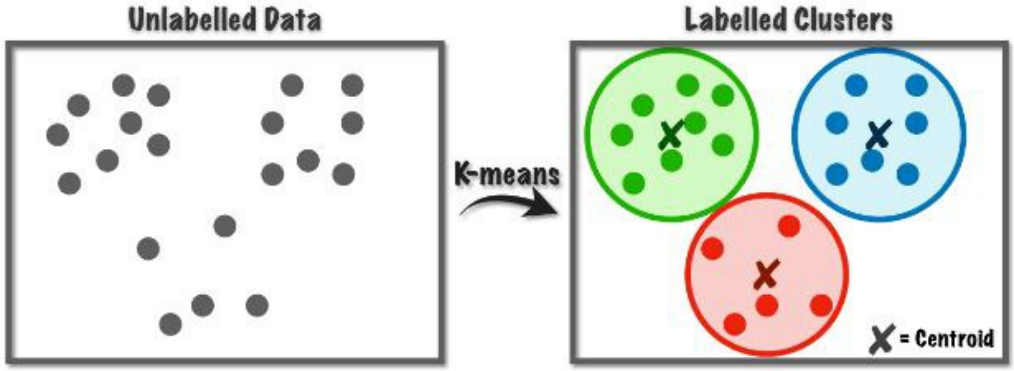

Figure 2.2: Algorithm k-means clustering

2.4 Working method k-means clustering

The flowchart below shows how k-means clustering works

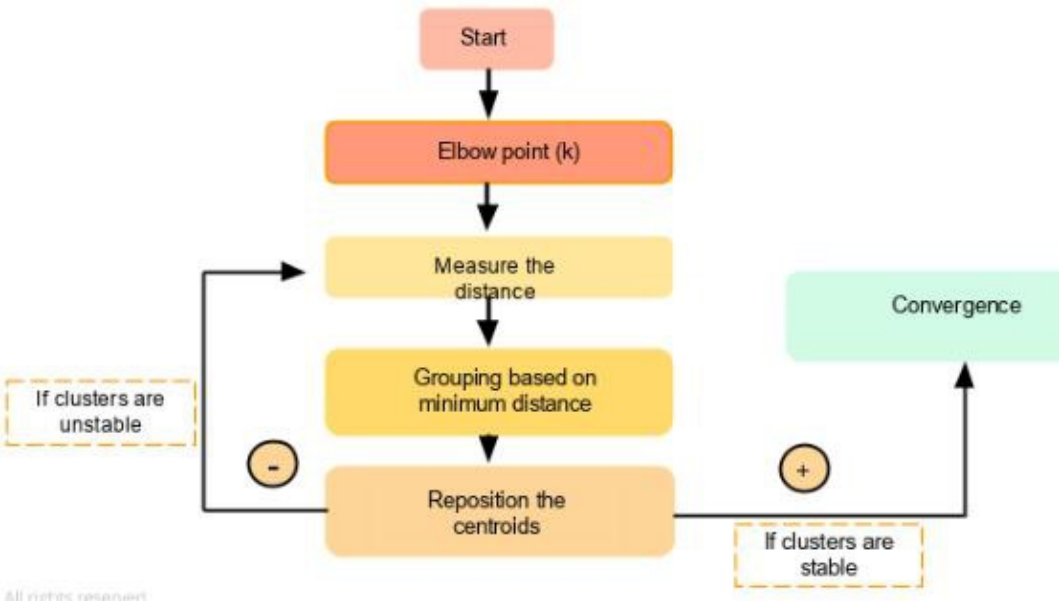

Figure 2.3: representation of Clustering Using K-Means

2.5 Advantages of K-Means

- **Simple and easy to implement:** The K-Means algorithm is easy to understand and implement, making it a popular choice for clustering tasks.
- Fast and efficient: K-Means is computationally efficient and can handle large datasets with high dimensionality.
- **Scalability:** K-Means can handle large datasets with a large number of data points and can be easily scaled to handle even larger datasets.
- **Flexibility:** K-Means can be easily adapted to different applications and can be used with different distance metrics and initialization methods. [5]

2.6 Disadvantages of K-Means

- **Sensitivity to initial centroids:** K-means is sensitive to the initial selection of centroids and can converge to a suboptimal solution.
- **Requires specifying the number of clusters:** The number of clusters k needs to be specified before running the algorithm, which can be challenging in some applications.
- **Sensitive to outliers:** K-means is sensitive to outliers, which can have a significant impact on the resulting clusters. [5]

2.7 Applications of K-Means Clustering

K-Means clustering is used in a variety of examples or business cases in real life, like:

- **Academic performance:** Based on the scores, students are categorized into grades like A, B, or C.
- **Diagnostic systems:** The medical profession uses k-means in creating smarter medical decision support systems, especially in the treatment of liver ailments.
- **Search engines:** Clustering forms a backbone of search engines. When a search is performed, the search results need to be grouped, and the search engines very often use clustering to do this.
- **Wireless sensor networks:** The clustering algorithm plays the role of finding the cluster heads, which collect all the data in its respective cluster. [5]

2.8 Distance Measure

Distance measure determines the similarity between two elements and influences the shape of clusters. K-Means clustering supports various kinds of distance measures, such as: [5]

- Euclidean distance measure
- Manhattan distance measure
- Squared Euclidean distance measure
- Cosine distance measure

2.9 Hierarchical Clustering

Hierarchical Clustering is a statistical method used in data analysis to cluster similar objects together based on their proximity. The goal is to create a hierarchy of clusters that can be represented visually using a tree-like diagram called a dendrogram. This dendrogram illustrates the hierarchical relationships between data points, enabling analysts to understand the hierarchical structure of the data in detail.

- **What is a dendrogram?** A dendrogram is a diagram that shows the hierarchical relationships between objects. This allows us to see the number of clusters that will be used in the next step. [5]

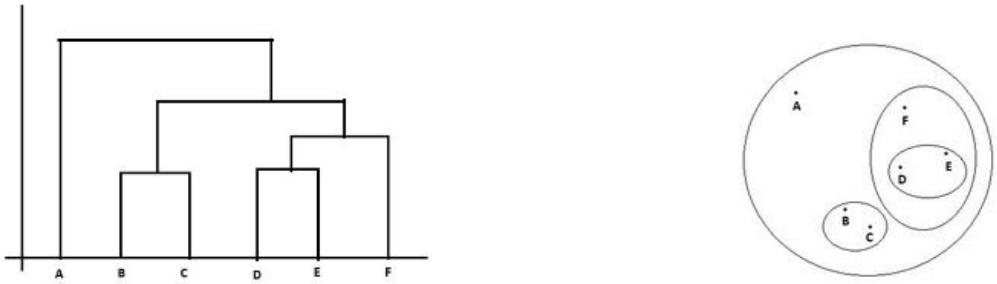

Figure 2.4: Dendrogram representation

2.10 DBSCAN

Is a popular clustering algorithm used in data mining and machine learning. It works by grouping closely spaced data points based on a distance measure and the

minimum number of points required to form a cluster. Points that do not meet these criteria are considered outliers or noise. DBSCAN has two main parameters:

- **Epsilon (eps):** defines the radius to search for nearby points.
- **MinPts:**the minimum number of points required to form a dense region.

The algorithm works by starting from an arbitrary point and expanding its neighborhood until it reaches a point with fewer than MinPt neighbors. At this point, the algorithm considers the current point to be an edge point or an outlier. If a point has MinPts neighbors, it forms a cluster with all neighbor points within the radius eps.compared to other clustering algorithms such as K-Means, DBSCAN is particularly useful for discovering clusters of different shapes and sizes, effectively handling noise, and being more robust to parameter settings. One limitation of DBSCAN is that it has problems handling clusters of varying densities or irregular shapes. Overall, DBSCAN is a versatile and powerful clustering algorithm that is widely used in a variety of applications where detecting clusters in noise is critical. [5]

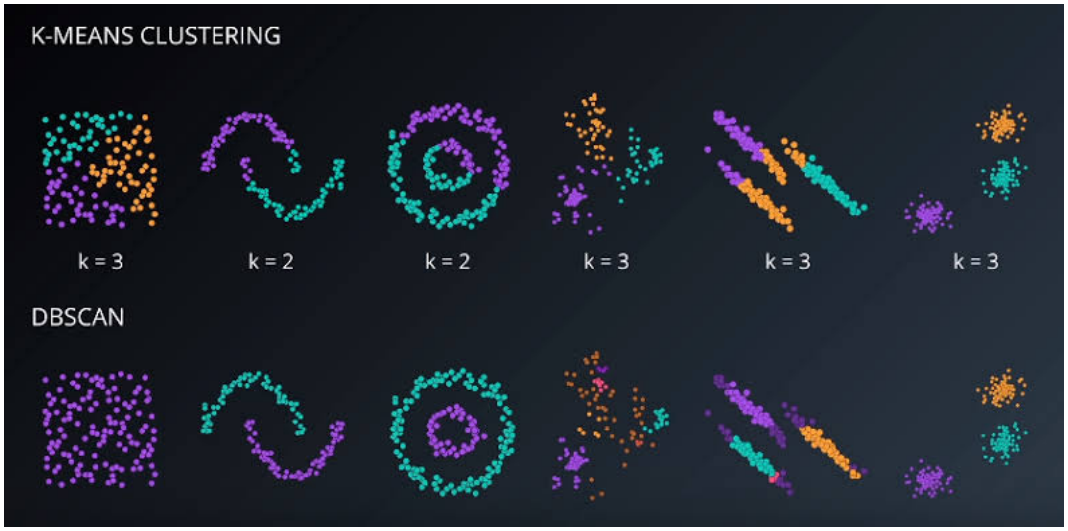

Figure 2.5: difference between how k-means and DBSCAN

2.11 Conclusion

In this chapter, we have provided an overview of the algorithm used to create data mining for this site, which is the K-Means clustering algorithm. The next chapter is devoted to the analysis and design of this site.

Chapter 3

Design of the application

3.1 Application Presentation

In this section we provide an overview of our app, its goals, and how to interact with it. Our app aims to provide fast and efficient transportation services, reduce waiting times, and provide convenient and safe transportation options. In addition, it aims to enhance the user experience by offering an easy-to-use interface and quick interaction with requests. Furthermore, our app supports drivers by providing improved job opportunities and equitable distribution of orders.

3.1.1 Here are the main features of our app:

1. Intelligent Distribution System: Choosing the most appropriate driver for each trip.
2. Excellent user experience: User-friendly interface and smooth interaction.
3. Service: Continuous coverage through driver availability schedules.
4. Instant Notifications: Instant alerts to confirm orders and update flight status.
5. Save time and effort: The driver selection process is fast and accurate.

3.1.2 How to interact with our app:

1. Registration: Download the app and register for both customers and drivers.
2. Submit Requests: Easily submit trip requests via the app.
3. Service activation: Drivers activate the GPS and set their own periods of availability.
4. Interact with notifications: Drivers accept or reject requests and update customers on their status. We are committed to providing the best transportation service and driver support to achieve an exceptional transportation experience.

3.2 Overview

To summarize the details of our application, and the users within our system, and to give a general form as a graphic picture of the interactions between the different elements of the system and how events flow, we present:

3.2.1 Case Diagram

Contrary The following figure represents the general use case diagram of our application.

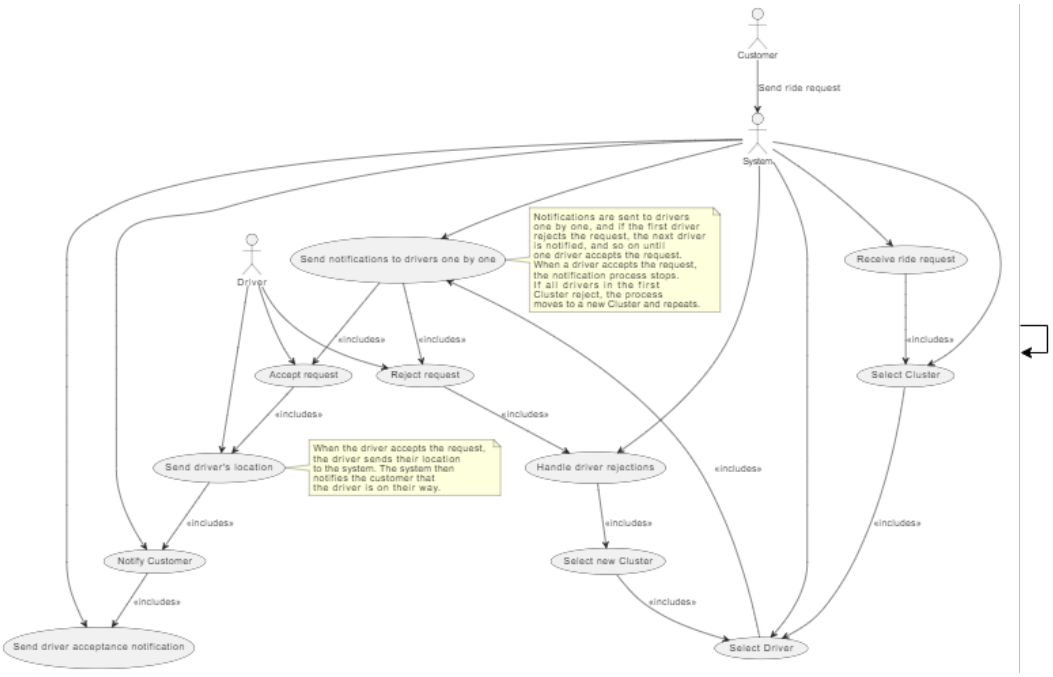

Figure 3.1: General Use case diagram

3.2.2 Text description of use cases

A use case description of the ways in which a user interacts with a system or product. A use case may establish the success scenarios, the failure scenarios, and any critical variations or exceptions. A use case can be written or made visual with the help of a use case model tool. Each possible result of executing a use case is called a scenario, it is a logical path through the use case. A scenario is an instance of use case. A set of scenarios for a use case identifies everything that can happen when this use case is implemented

Use Case Name	Login
Description	This use case allows users to log into the system to access relevant functions according to their roles. The different user roles are driver and customer. To log into the system, all users must enter their email and password. If their account is locked, they will have to connect to the system to unlock it. Upon successful login, the system will display the home page of the relevant user.
Primary Actor	User, Admin
Preconditions	User or Admin has to have a valid account.
Postconditions	The system displays the relevant homepage.

Tableau 3.1: Login Use Case Description

Use Case Name	Register
Description	New user registers in the system. 1. User selects option to register. 2. User enters required information (username, email, password...). 3. User submits information. 4. Display successful registration message. 5. Display option to proceed to login. 6. Return to the login page.
Primary Actor	User, Admin
Preconditions	Login page is displayed.
Postconditions	Login page is displayed.

Tableau 3.2: Register Use Case Description.

Use Case Description	Customer Enters Application
Actor(s)	Customer
Description	Customer launches the application.
Precondition(s)	Customer has the application installed and is logged in.
Trigger	Customer opens the application.
Basic Flow	1. Customer opens the application. 2. Application displays options for entering location, destination, number of passengers, and other details. 3. Customer inputs location, destination, number of passengers, and other required information. 4. Application processes the information and shows available options. 5. Customer selects the desired option. 6. Application confirms the selection and displays the details. 7. Customer confirms the booking and the application processes the payment. 8. Application confirms the booking and provides details of the selected driver.
Alternative Flow(s)	- If there are no available drivers nearby, the application notifies the customer and suggests alternative transportation options. - If the customer inputs invalid information, the application prompts for correction.
Postcondition(s)	Booking is confirmed, and the customer receives details of the driver and the trip.

Tableau 3.3: customer use case description

Use Case Description	Driver Logs In and Responds to Customer Requests
Actor(s)	Driver
Description	Driver logs into the application.
Precondition(s)	Driver has the application installed and is logged in.
Trigger	Driver opens the application.
Basic Flow	1. Driver logs into the application. 2. Upon successful login, a map interface appears displaying the driver's current location. 3. System monitors for incoming customer requests. 4. When a customer request is received, the system sends the driver details of the request, including pick-up location, destination, and other relevant information. 5. Driver reviews the request details and decides whether to accept or reject the request. 6. If the driver accepts the request, the system updates the customer with the driver's details and estimated time of arrival.

Tableau 3.4: driver use case description

3.2.3 Sequence diagrams

Sequence diagrams detail how operations are performed, a line's sequence diagram is striped from above and descended to distinguish a sequence, each object on a message representation diagram between them, and model the interactions between objects in a single use case

- **Sequence diagram for the « Login » use case**

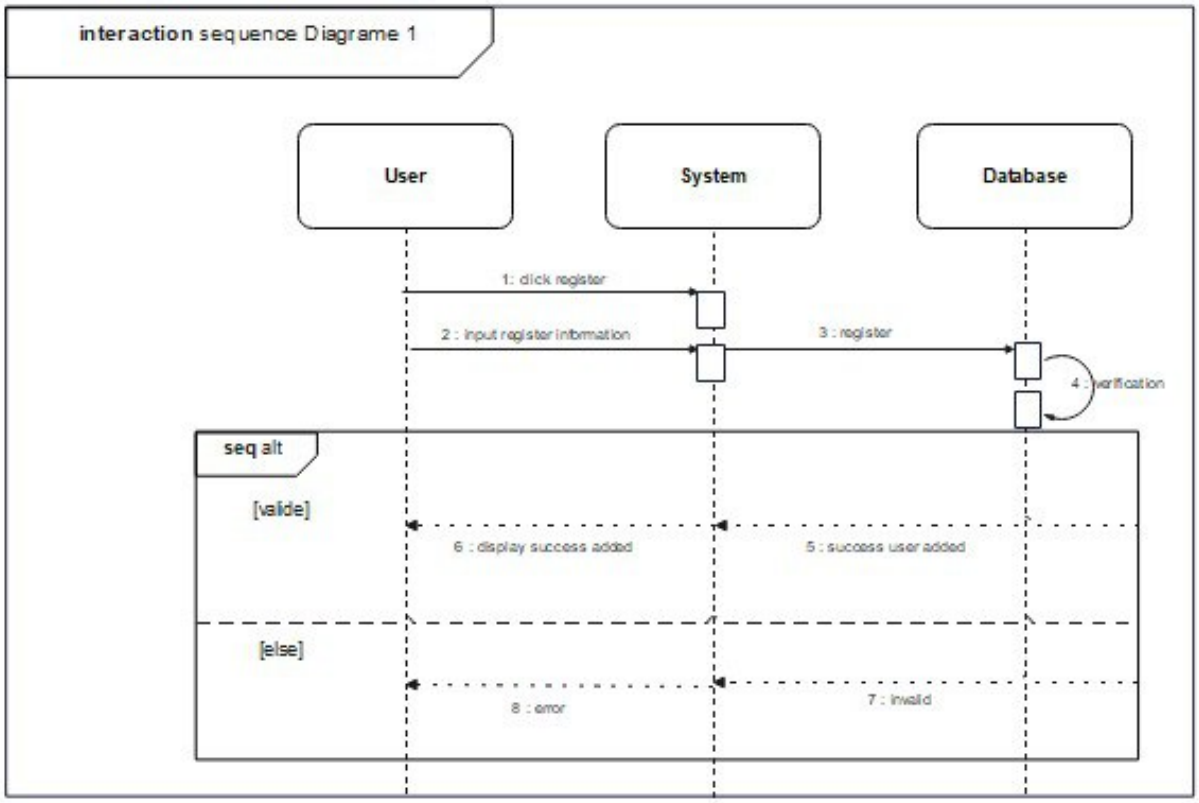

Figure 3.2: Sequence Diagram for Register

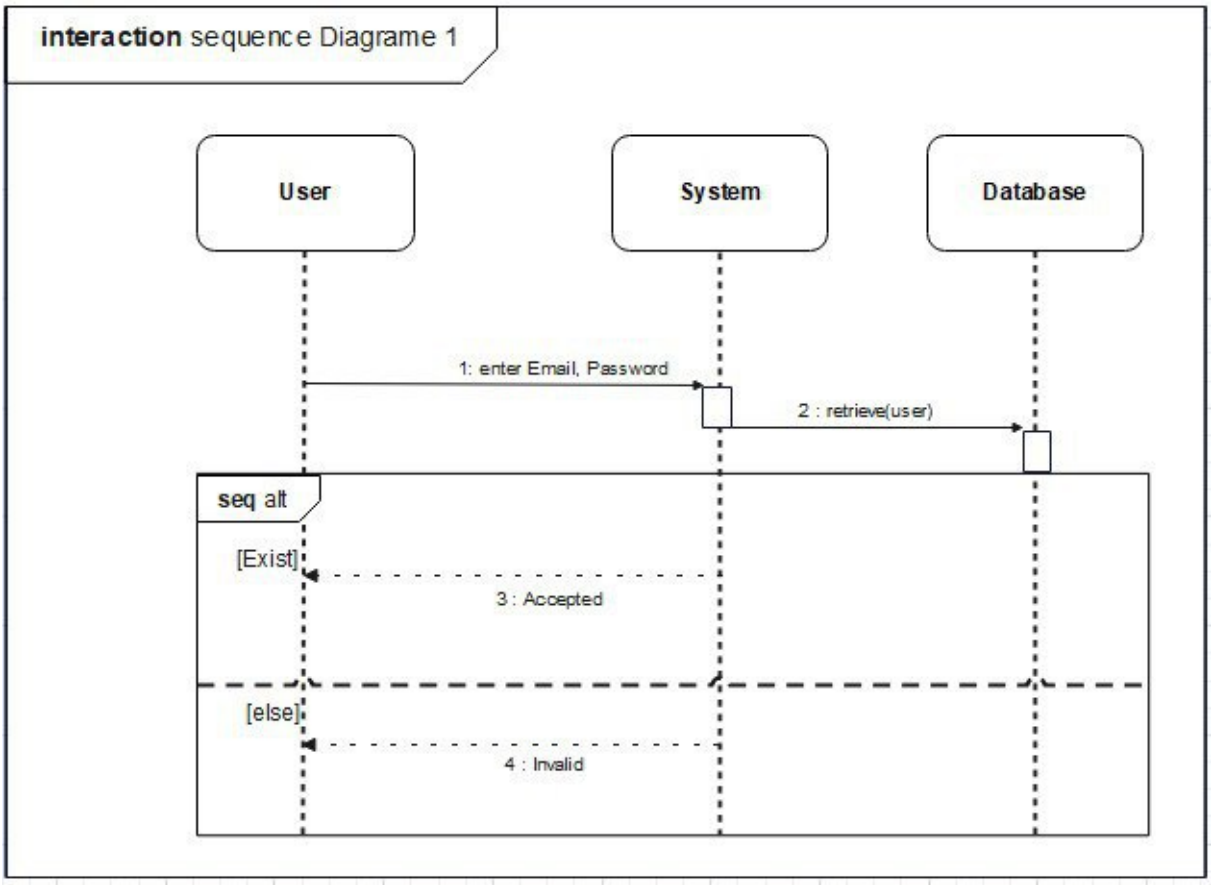

Figure 3.3: Sequence Diagram for login

•Sequence diagram for the « Driver » use case:

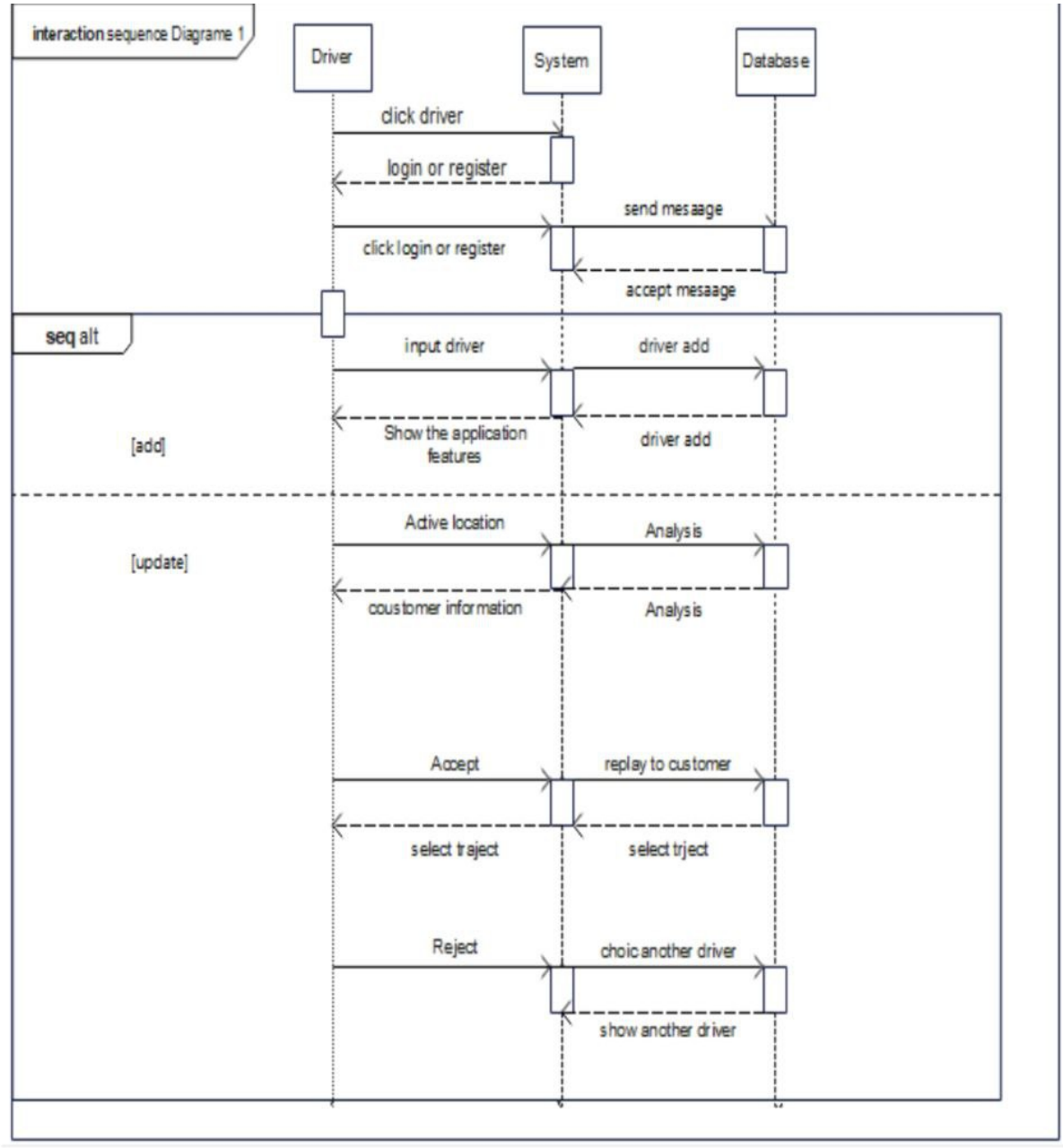

Figure 3.4: Sequence Diagram for Driver

Sequence diagram for the « Customer » use case:

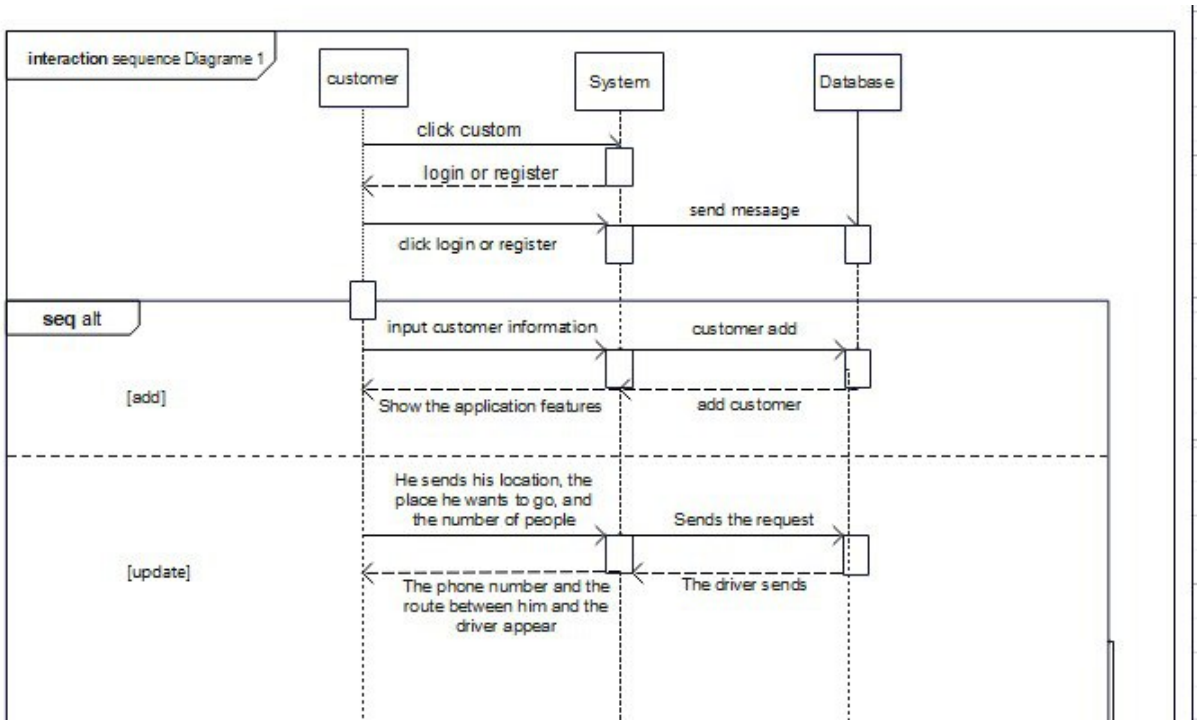

Figure 3.5: Sequence Diagram for Customer

Sequence diagram for the « system and clustering» use case:

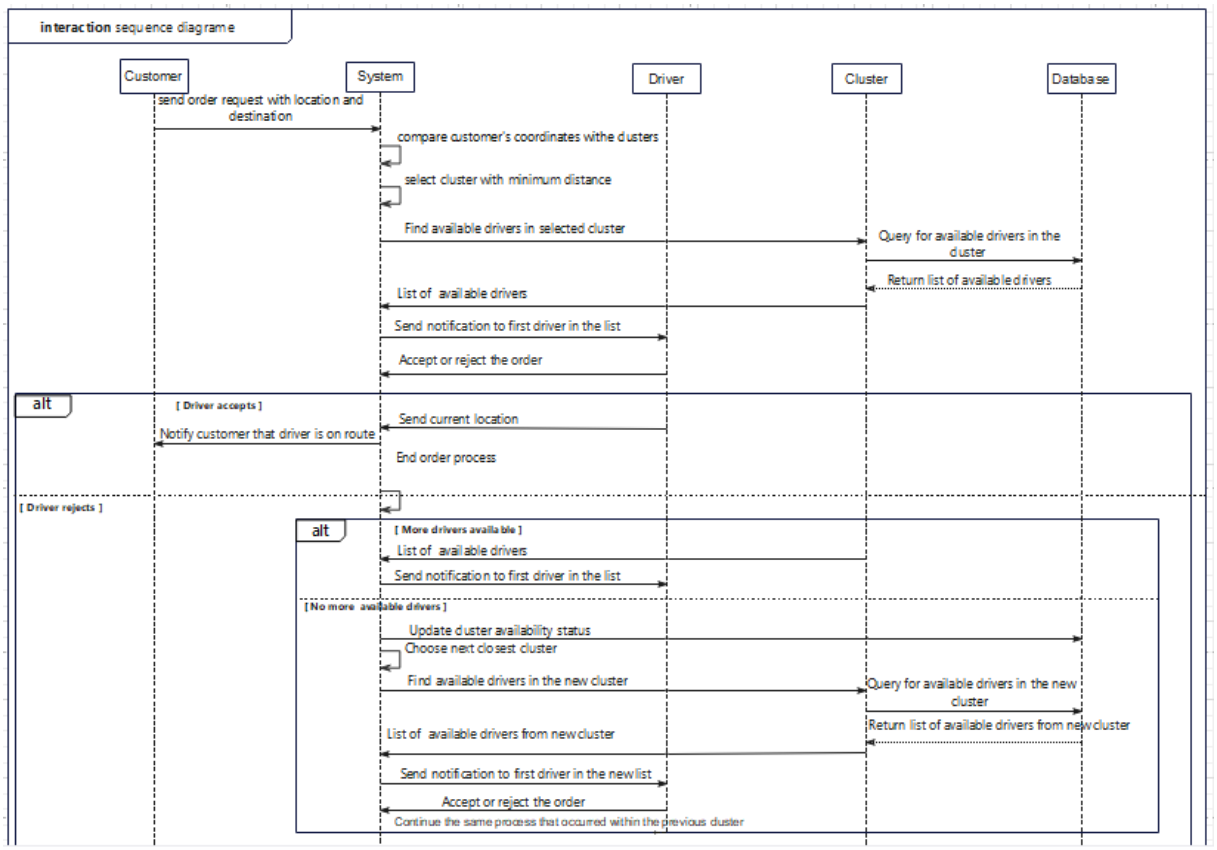

Figure 3.6: General application sequence diagram

3.3 Activity diagrams

The UML activity diagram is another commonly used tool for dynamic modeling, describing the sequence of activities, and simplifying the control from one activity to another. The activity diagram is the basis of the flowchart.Continuation of activity diagram on operations

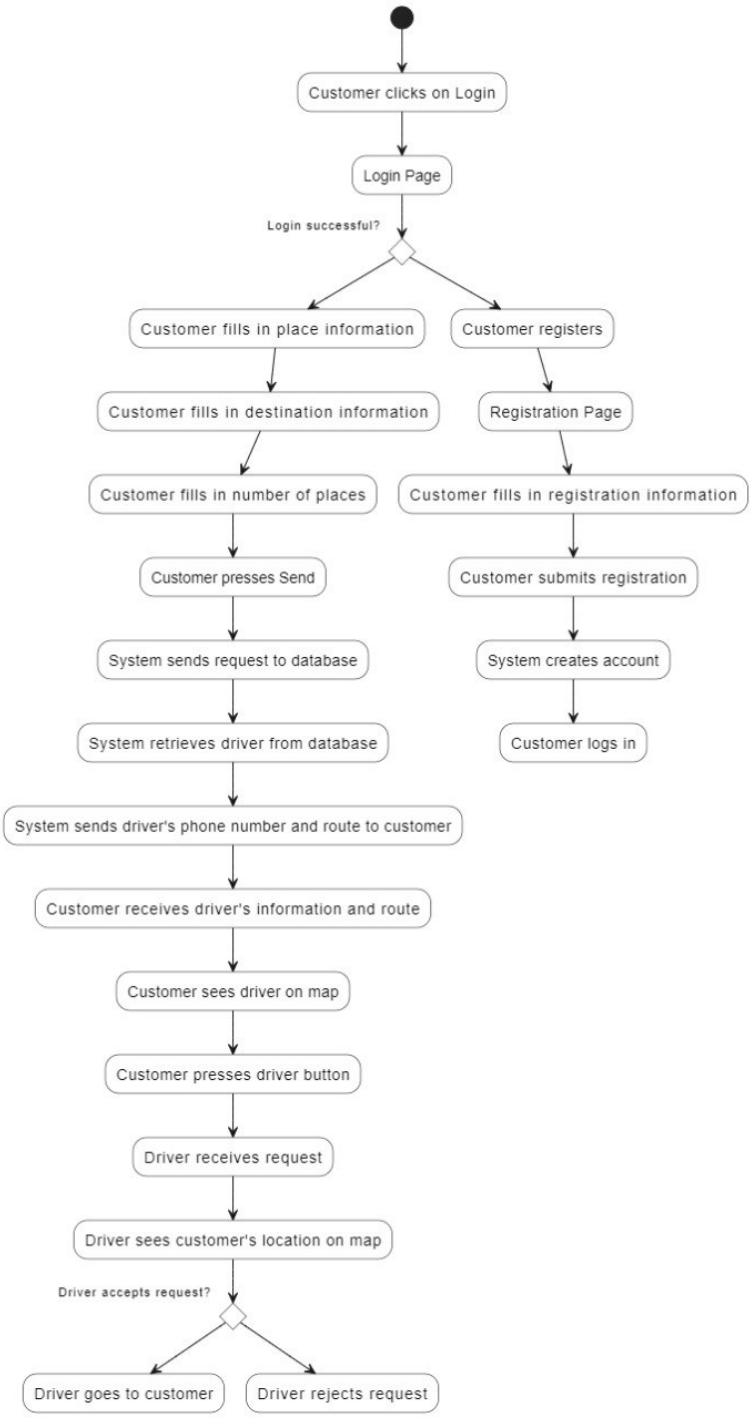

Figure 3.7: Activity Diagram

3.4 Understanding Relational Schemas in Database Management

A relational schema is a set of relational tables and associated items that are related to one another. All of the base tables, views, indexes, domains, userroles, storedmodules, and other items that a user creates to fulfill the data needs of a particular enterprise or set of applications belong to one schema.

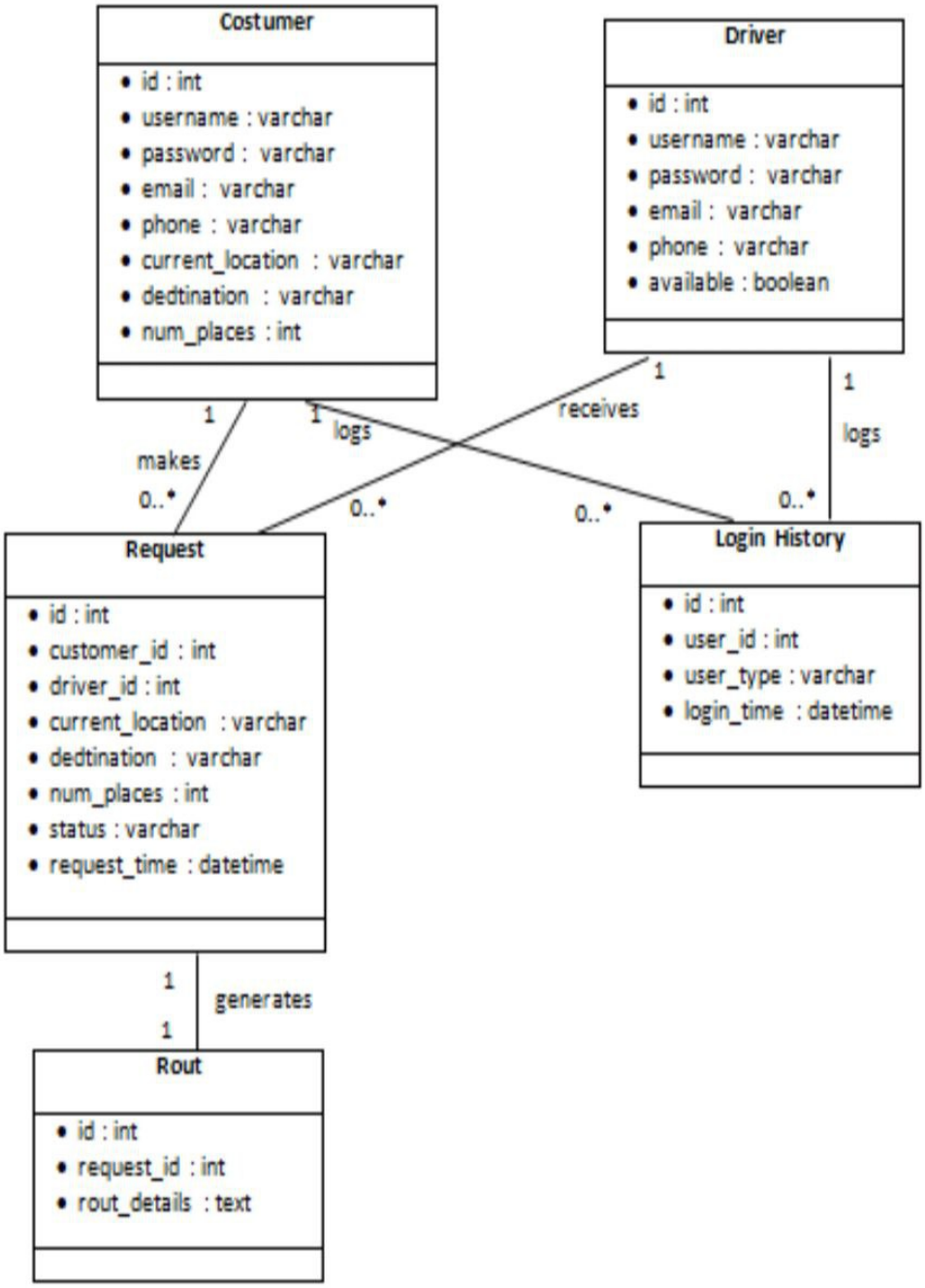

Figure 3.8: Class diagram for application

3.5 Conclusion

In this chapter we presented the conceptual architecture of our website using the nearbyobject, and this with the help of the various tools of modeling of the UML languagewhich facilitates the measurement and production of software. For the analysisphase, we defined the different use cases and then, we translated through theconstruction of sequence diagrams, then we built the activity diagram in the designphase. Finally, we defined the relational model. The following chapter will be devoted tothe implementation and the realization of our website

Chapter 4

Implementation of the application

4.1 Introduction

Implementation is the most important phase after design. The choice of development tools greatly influences the cost of programming time. This phase consists in transforming the conceptual model previously established into software components forming our system. In this chapter, we will start with a description of the work environment and then identify and develop the components of our system

4.2 Number of Clustering

The results in the image show the distribution of taxi drivers into groups based on the places where the driver is most active and present.

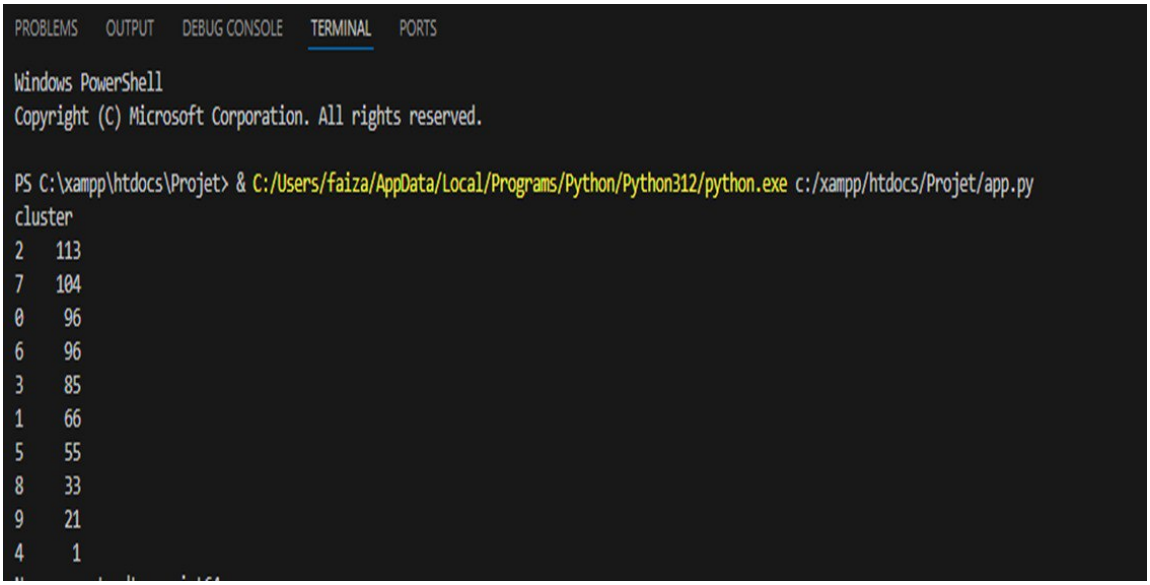

Figure 4.1: Number of Clustering

4.3 For Example:

A particular cluster can represent taxi drivers who work during peak times (such as early morning or end of the day). Another group may represent drivers who work on holidays or at certain times of the week. Analyzing this data can help: Identify times when you need to be reinforced with a larger number of drivers. Understand the most common work patterns among drivers. Improving the distribution of drivers to achieve higher service efficiency. In summary, these results provide insight into how taxi drivers are distributed across different times and dates, which can help improve planning and better manage resources.

4.4 How our application works

1. **Send a request:**The customer sends a request that includes his current location,destination, and number of passengers.

2. **Coordinates comparison:** The system compares the customer's coordinates with the nearest group of drivers.

3. **Driver Selection:** Drivers are selected based on the following order: their availability, and proximity to the customer.

4. **Sending notifications:**The system sends notifications to available drivers one by one until one of them accepts the request (once the driver accepts, notifications to the rest (stop).

5. **Trip confirmation:** When the driver is accepted, the system notifies the customer of the driver's location and direction. We also have a solution in the event that there is a possibility that drivers will not be available in the service within the first cluster, which means that they all respond with rejection. Here, our application works to choose a second cluster with the same conditions. This remains a weak possibility, but it is possible, so we thought about the solution

4.5 Discussion of Results?

We have noticed through data analysis that our application achieves Outstanding work in terms of:

1. User interface development: The application interface has been improved to be more user-friendly, which contributes to improving the users' experience. By using clustering technology, we have been able to achieve tangible improvements in application performance and provide better

2. Increase notification efficiency: Aggregation helps improve the notification system so that the most important alerts reach the right drivers at the right times, making drivers more efficient at responding to requests.

3. Trip pattern analysis: Using aggregation to analyze different trip patterns, such as short versus long trips, and using this analysis to improve pricing strategies and increase revenue

4.6 Used Technologies

4.6.1 Development Environment

1. **VS Code:** Visual Studio Code is a lightweight but powerful source code editor that runs on your desktop and is available for Windows, macOS, and Linux. It comes with built-in support for JavaScript, and has a rich ecosystem of extensions for other languages (such as C++, C, Java, Python, PHP, Go) and runtimes (such as .NET and Unity).

2. **Chrome:** The Google Chrome Web browser is based on the open-source Chromium project. Google released Chrome in 2008 and issues several updates a year. It is available for Windows, Mac OS X, Linux, Android and iOS operating systems. The Google Chrome browser takes a sandboxing-based approach to Web security. Each open website runs as its own process, which helps prevent malicious code on one page from affecting others (or the computer operating system at large). The browser also supports Web standards such as HTML5 and cascading style sheets (CSS). [6]

3. **Xampp:** Is a free and open-source cross-platform web server solution stack package developed by Apache Friends, consisting mainly of the Apache HTTP Server. [7]

4.6.2 Development Tools

1. **HTML:** (Hyper Text Markup Language) is the code that is used to structure a web page and its content. For example, content could be structured within a set of paragraphs, a list of bulleted points, or using images and data tables. As the title suggests, this article will give you a basic understanding of HTML and its functions. [8]

2. **CSS:** Cascading Style Sheets (CSS) is a stylesheet language used to describe the presentation of a document written in HTML or XML (including XML dialects such as SVG, MathML or XHTML). CSS describes how elements should be rendered on screen, on paper, in speech, or on other media. [8]

3. **JavaScript (JS):** is a lightweight, interpreted, or just-in-time compiled programming language with first-class functions. While it is most well-known as the scripting language for Web pages, many non-browser environments also use it, such as Node.js, Apache CouchDB and Adobe Acrobat. JavaScript is a prototype-based, multiparadigm, single-threaded, dynamic language, supporting object-oriented, imperative, and declarative (e.g. functional programming) styles. [9]

4. **PHP:** Hypertext Preprocessor. It is a server-side scripting language that is used for web development. It can be easily embedded with HTML files. HTML codes can also be written in a PHP file. The PHP codes are executed on the server-side whereas HTML codes are directly executed on the browser. [**?**] [10]

5. **API:** Is an abbreviation for Application Programming Interface which is a collection of communication protocols and subroutines used by various programs to communicate between them. A programmer can make use of various API tools to make its program easier and simpler. Also, an API facilitates the programmers with an facilitates the programmers with an efficient way to develop their software programs. [11]

6. **Python:** Python is a high-level, interpreted programming language known for its readability and versatility. It was created by Guido van Rossum and first released in 1991. Python's design philosophy emphasizes readability of code through its notable use of large indentations. It supports multiple programming paradigms, including procedural, object-oriented, and functional programming. Python is widely used in web development, data analysis, artificial intelligence, scientific computing, and automation, among other applications. [12]

7. **Flask:**Flask is a micro web framework for Python. It is designed to be lightweight and

   modular, allowing developers to get applications up and running quickly. Flask is simple

to use but highly extensible, making it a popular choice for web development projects of all sizes.Key Features of Flask, Lightweight and Modular, Flexible, Built-in Development Server: Flask includes a built-in development server and debugger, which aids in developing and testing applications, Templating: Flask uses Jinja2 as its template engine, which allows for the dynamic generation of HTML pages. Routing: Flask provides a simple and intuitive way to map URLs to functions in your code through decorators, Extensions: Flask supports a wide range of extensions that add functionality such as database integration, form validation, authentication, and more, RESTful Request Handling: Flask is well-suited for building RESTful APIs due to its simplicity and flexibility in handling HTTP requests. [12]

Figure 4.2: Development Environment

4.6.3 Presentation of the application (Interfaces)

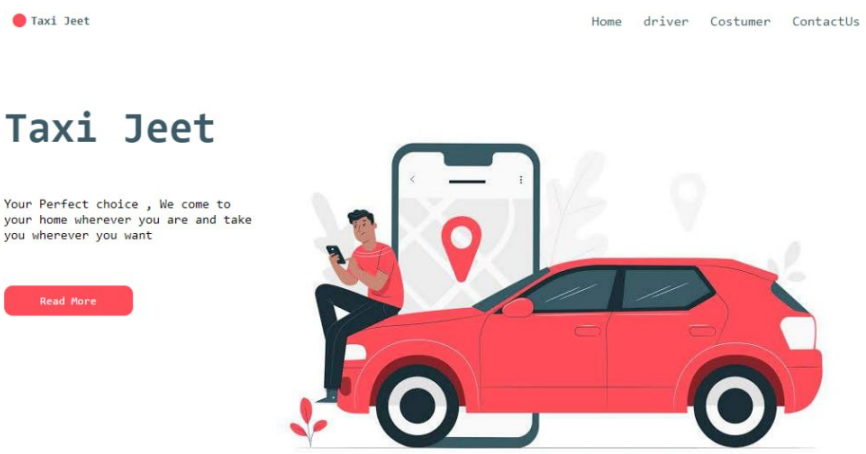

Figure 4.3: Home page of the web application

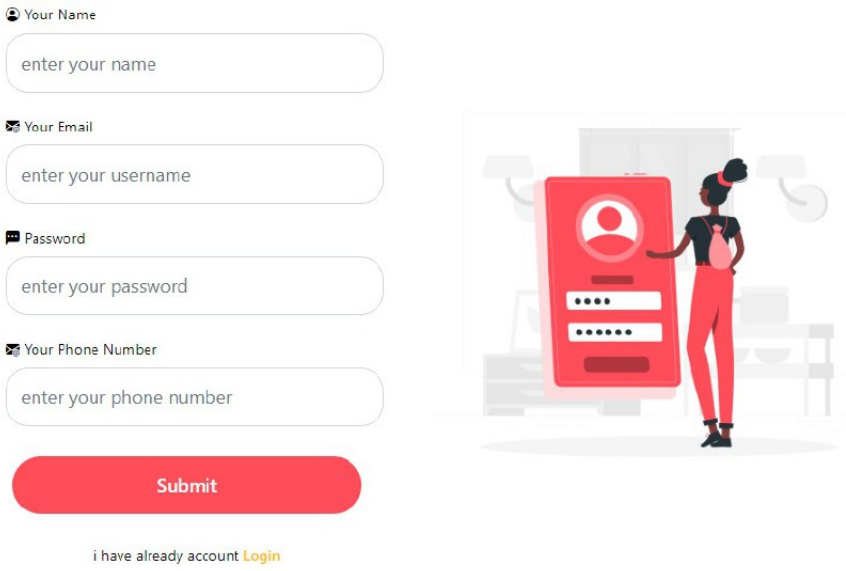

Figure 4.4: user registreation and login

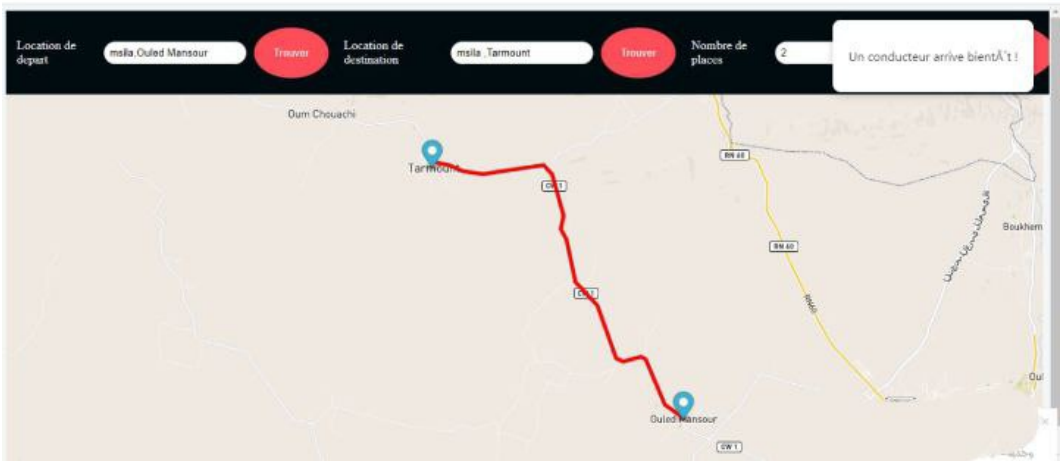

Figure 4.5: Customer Request a Driver

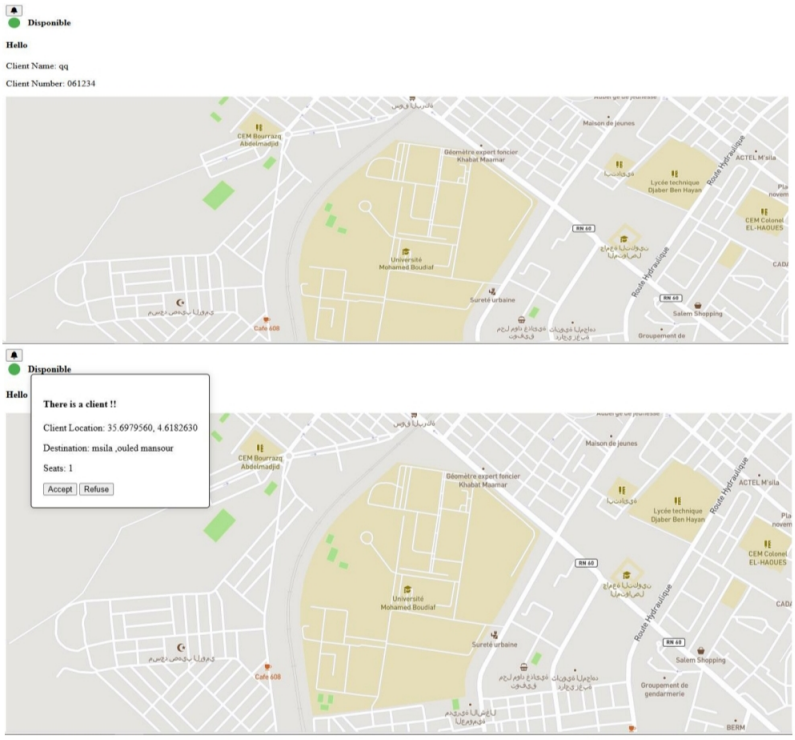

Figure 4.6: Driver Section

4.7 Conclusion

In this chapter, the practical part of our site is done, in addition to the tools and applications used in production

General Conclusion

At the conclusion of this study, our application aims to enhance the user experience of urban taxi services in Msila as a competitor to the Yassir application by implementing clustering techniques. Our main goal is to provide an interactive platform that efficiently groups and identifies drivers in specific geographic clusters, enabling customers to select suitable drivers quickly and effectively. This approach allows us to improve transportation planning and urban transport organization overall, contributing to reducing traffic congestion and enhancing environmental sustainability. Additionally, our application fosters better interaction between drivers and customers, promoting transparency and trust among all stakeholders. We believe that technology can play a pivotal role in addressing urban mobility challenges, and this project underscores our commitment to innovation and delivering contemporary solutions that enhance urban living standards. We hope that our application can positively impact the urban transportation system in Msila and look forward to continuing its development and enhancement through ongoing collaboration with the community and partners in the future.

Bibliography

[1] Hai Yang and Sze Chun Wong. A network model of urban taxi services. *Transportation Research Part B: Methodological*, 32(4):235–246, 1998.

[2] Srushti Rath and Joseph YJ Chow. Worldwide city transport typology prediction with sentence-bert based supervised learning via wikipedia. *Transportation Research Part C: Emerging Technologies*, 139:103661, 2022.

[3] Jeffrey W Seifert. Data mining: An overview. *National security issues*, pages 201–217, 2004.

[4] Tulus Tambunan. Promoting small and medium enterprises with a clustering approach: A policy experience from indonesia. *Journal of Small Business Management*, 43(2):138–154, 2005.

[5] Alireza Latifi-Pakdehi and Negin Daneshpour. Dbhc: A dbscan-based hierarchical clustering algorithm. *Data & Knowledge Engineering*, 135:101922, 2021.

[6] Prateek Mehta. *Creating Google Chrome Extensions*. Springer, 2016.

[7] Insha Mearaj, Piyush Maheshwari, and Maninder Jeet Kaur. Data conversion from traditional relational database to mongodb using xampp and nosql. In *2018 Fifth HCT Information Technology Trends (ITT)*, pages 94–98. IEEE, 2018.

[8] Rob Larsen. *Beginning HTML and CSS*. John Wiley & Sons, 2013.

[9] David Flanagan. *JavaScript: The Definitive Guide*. "O'Reilly Media, Inc.", 2011.

[10] Olivier Heurtel. Php 8. 2002.

[11] Joshua Bloch. How to design a good api and why it matters. In *Companion to the 21st ACM SIGPLAN symposium on Object-oriented programming systems, languages, and applications*, pages 506–507, 2006.

[12] Gareth Dwyer, Shalabh Aggarwal, and Jack Stouffer. *Flask: Building Python Web Services*. Packt Publishing, 2017.

ملخص

الهدف من مشروع نهاية الدراسة المعروض في هذا التقرير هو التصميم والتنفيذ تدير موقعاً إلكترونياً يركز استخدامه على تحليل طرق سيارات الأجرة في المناطق الحضرية في مدينة المسيلة باستخدام تقنيات التجميع لتحسين طرق النقل سيارات الأجرة وتقليل وقت السفر وتحسين كفاءة الخدمة. بالإضافة إلى المظهر التعليمي، تم تطوير عمليات الموقع على ثلاث مراحل: مرحلة التحليل للمشكلة، وجمع معلومات كافية حول الموضوع وصياغتها. ثم إلى مخططات وش‌ش، والمرحلة الثالثة هي البرمجة.

الكلمات المفتاحية: الزبون، السائق، الموقع، تجمع

Abstract

The goal of the graduation project presented in this report is to design and implementing a website whose use focuses on analyzing urban taxi routes in the city of M'sila using clustering techniques to improve taxi routes, reduce travel time, and improve service efficiency. In addition to the educational aspect, Website operations were developed in three stages: Analysis stage the problem, collecting sufficient information about the topic, and formulating this information To UML diagrams, the third stage of programming.

Keywords: customer, driver, GPS, cluster.

Résumé

Résumé de projet de fin d'études présenté dans ce rapport est de concevoir et de mettre en œuvre un site Internet dont l'utilisation se concentre sur l'analyse des itinéraires de taxi urbains dans la ville de M'sila en utilisant des techniques de clustering pour améliorer les itinéraires de taxi, réduire le temps de trajet et améliorer l'efficacité du service. En plus de l'aspect pédagogique, le fonctionnement du site Web a été développé en trois étapes : L'étape d'analyse du problème, la collecte d'informations suffisantes sur le sujet et la formulation de ces informations. Aux diagrammes UML, la troisième étape de la programmation.

Mots Clés: client, chauffeur, GPS, cluster.

<table>
<tr>
<td rowspan="2">7. Key Partners (الشركاء الرئيسيون):

Technology companies to improve algorithms and cloud services.
Local digital advertising and marketing companies in M'sila.
Mapping and geographical location service providers..</td>
<td>5. Key Activities (الأنشطة الرئيسية):

Develop and maintain a web application for clustering urban taxi trajectory networks.
Implement K-means clustering algorithm for analyzing taxi data.
Collect and preprocess taxi trajectory data from various sources.
Process customer requests by comparing coordinates with clusters to select the nearest available drivers.
Manage driver notifications and customer updates.</td>
<td rowspan="2">2. Value Propositions (عرض القيمة):

Providing an efficient and fast local delivery service in the city of M'sila by choosing the closest and most experienced driver.
Improving the customer experience in M'sila through instant notifications about the driver's status.
Reduce waiting time in the city by using an intelligent distribution system based on clustering and geolocation analysis..</td>
<td>3. Customer Relationships (علاقات العملاء):

Customer support in M'sila through 24/7 customer service.
Instant notifications about order status and driver location.
Loyalty programs and special offers for regular customers in M'sila</td>
<td rowspan="2">1. Customer Segments (شرائح العملاء):

Residents of the city of M'sila who need delivery services within the city.
Local institutions in M'sila that require transportation services for their employees.
Tourists and visitors to the city of M'sila who need reliable and fast means of transportation..</td>
</tr>
<tr>
<td>6. Key Resources (الموارد الرئيسية):

Clustering and geographical location analysis algorithms for the city of M'sila.
Database of drivers and customers in M'sila.
Application development and maintenance team.
Customer service and technical support team.</td>
<td>4. Channels (القنوات):

Mobile application dedicated to M'sila residents (iOS and Android).
A local website through which delivery services can be booked.
Local social media marketing and digital advertising in M'sila.</td>
</tr>
<tr>
<td colspan="3">8. Cost Structure (الهيكل التكلفي):

Costs of developing and maintaining the application dedicated to the city of M'sila.
Cloud and database infrastructure costs.
Employee salaries (development, technical support, customer service).
Marketing and advertising costs in M'sila.</td>
<td colspan="3">9. Revenue Streams (مصادر الإيرادات):

Delivery fees paid by M'sila customers.
Monthly or annual subscriptions for local companies and institutions in M'sila.
Partnerships with other companies for in-app advertising.</td>
</tr>
</table>