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Option

Ingénierie des Systèmesd'Informations et Logiciels

Bachelor Thesis

THE DESIGN AND IMPLEMENTATION OF ODROSS

AN INTERACTIVE E-LEARNING WEBSITE

By:

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In front of a jury composed of

-

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Abstract

Online education, also known as e-learning, refers to the delivery and acquisition of knowledge and skills through digital tools and technologies. Unlike traditional classroom, online learning offers increased flexibility and accessibility, allowing students to learn from anywhere in the world. This final year project aims to develop an e-learning website "ODROS" integrated with an intelligent chatbot and XP systems.

Keywords: Online Education, Develop, e-learning website, intelligent chatbot platforms, innovative idea, online learning experience, personal assistance for learners.

Résumé

L'enseignement en ligne, également connu sous le nom d'apprentissage en ligne désigne l'acquisition de connaissances et de compétences par le biais d'outils et de technologies numériques. Contrairement aux méthodes d'enseignement traditionnelles basées sur la salle de classe, l'apprentissage en ligne offre une flexibilité et une accessibilité accrues, permettant aux étudiants d'apprendre à leur rythme et n'importe où dans le monde. Ce projet de fin d'études vise à développer un site web e-learning " ODROSS" intégré du chatbot intelligent.

Mots clé : développer, Site e-learning, chatbot intelligent, plateformes, apprentissage en ligne, accessibilité, d'apprendre

الملخص

التعليم عبر الإنترنت، المعروف أيضًا باسم التعلم الإلكتروني، يشير إلى توصيل واكتساب المعرفة والمهارات من خلال الأدوات والتقنيات الرقمية. على عكس أساليب التدريس التقليدية القائمة على الفصول الدراسية، يوفر التعلم عبر الإنترنت مزيدًا من المرونة وإمكانية الوصول، مما يسمح للطلاب بالتعلم بالسرعة التي تناسبهم ومن أي مكان في العالم. يهدف هذا المشروع إلى تطوير موقع تعليمي إلكتروني "ادرس" متكامل مع روبوت محادثة ذكي.

الكلمات المفتاحية: تطوير، موقع، تعليمي، الكتروني، ريوت محادثة، ذكي، التعلم الإلكتروني، الإنترنت، المرونة.

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General Introduction

In recent years, the landscape of education has undergone a remarkable transformation, largely propelled by the rapid advancement of technology. One of the most notable developments in this evolution is the substantial growth of e-learning platforms. These platforms have gained significant traction, driven by their ability to offer accessible and flexible educational opportunities to learners worldwide

The surge in popularity of e-learning can be attributed to several factors. Firstly, advancements in technology, particularly in the realms of internet connectivity, multimedia capabilities, and digital learning tools, have greatly enhanced the effectiveness and appeal of online education. Learners today have access to a wealth of resources and interactive learning experiences that were previously unimaginable

Secondly, there is a growing demand for education that is not bound by the constraints of time and place. Traditional educational models often struggle to accommodate the diverse needs and schedules of modern learners. E-learning, with its anytime, anywhere accessibility, addresses this challenge by offering unparalleled flexibility to individuals seeking to enhance their knowledge and skills.

Against this backdrop, the primary objective of our project is to capitalize on the momentum of the e-learning revolution and harness the power of technology to revolutionize the way individuals acquire computer science knowledge. We aim to create a dynamic and engaging learning platform that goes beyond the conventional paradigms of online education.

The proposed platform seeks to differentiate itself by offering a wide range of domains and trainings in computer science, organized into modular units. Each module will comprise lessons, hands-on exercises, and assessments, carefully designed to cater to the diverse learning needs of our users. Additionally, our platform will incorporate innovative features such as an experience point (XP) system and an intelligent ChatBot assistant, which aim to gamify the learning process and provide personalized guidance to learners.

To elucidate the objectives and contributions of our work, this document is structured into three main sections:

1. **Existing Studies**: This section provides an in-depth analysis of the e-learning landscape in the context of computer science education. We examine current trends, challenges, and opportunities in the field, drawing insights from existing literature and research.

2. **Conceptual Analysis and Design**: Here, we delve into the conceptual underpinnings of our project, using Unified Modeling Language (UML) modeling techniques to analyze the system architecture and functionality. Through various UML diagrams, we illustrate the interactions and components of the platform, providing a comprehensive overview of its design.

3. **Development and Implementation of the System**: In this section, we detail the development process of our platform, outlining the tools and methodologies used to bring our project to fruition. We provide a detailed description of the system, including its interfaces and functionalities, supplemented by screenshots and caption to facilitate understanding.

I. Overview of E-Learning

Several e-learning platforms have emerged, catering to various academic disciplines and skill development needs. This literature review examines existing solutions in the e-learning landscape, their strengths and limitations, and the unique position of the proposed interactive platform for computer science education.

1) Definition

E-learning [1] is a distance learning process based on multimedia resources that allows one or more people to follow a training course via their computer. The multimedia medium used can combine text, 2D or 3D graphics, sound, images, animation and even video. These materials have the potential to revolutionize teaching methods, using one of the learners, who becomes the pilot of their training.

The objective of E-Learning is to obtain skills or knowledge certificates through certain training courses, but above all to improve one's intellectual capital in a particular field. On the positive side, assessments can be reassessed until the exercise is successful or fully mastered.

2) Literature Review:

It was only in 1999 during a workshop on e-learning systems that the term "e-learning" appeared for the first time. Then, it is defined as online learning or virtual learning (see Figure 1).

Figure 1: History of E-Learning

o Massive Open Online Courses (MOOCs) platforms, such as Coursera, edX, and Udacity, have been at the forefront of the e-learning revolution. These platforms offer a wide range of courses from renowned universities and institutions, providing learners with access to high-quality educational content. However, MOOCs often lack personalized support, interactive learning experiences, and practical coding environments tailored specifically for computer science students [2]

Figure 2: Coursera is platform

Figure 3: UDACITY platform

o Specialized coding platforms, such as Codecademy, FreeCodeCamp, and Plural Sight, have emerged to address the need for hands-on programming education. These platforms offer interactive coding environments, exercises, and projects to enhance practical skills. However, they may lack structured curricula, certified courses, and gamification elements to sustain learner engagement and motivation [3]
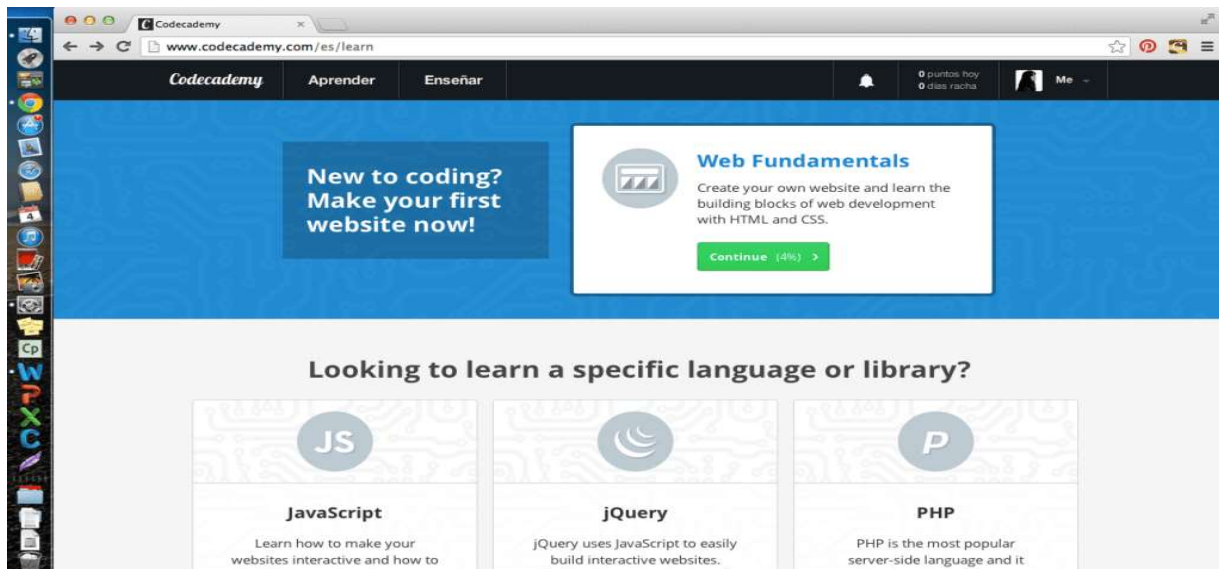
figure 4: Codecademy platform

o Recent research has highlighted the potential of gamification strategies in e-learning platforms to increase learner motivation, engagement, and retention [4]. Gamified elements, such as points, badges, leaderboards, and progress tracking, can foster a sense of achievement and healthy competition among learners. However, effective gamification implementation requires careful design and alignment with learning objectives

3) Advantages and disadvantages of E-Learning:

The When choosing the right type of studies for you, it's important to consider *both* the advantages and disadvantages of online education, as the nature [5]:

➢ Advantages:

- **Flexibility:** includes the ability to attend classes from anywhere and to fit classes into a busy schedule

- **Cost-Effectiveness:** include the potential to save money on textbooks and avoid relocation costs.

- **An Access to a wider range of programs and course offerings:** Many universities and colleges now offer a wide range of online degree programmes, including Bachelor's and Master's degrees, in a variety of fields

- **The ability to learn at your own pace:** Online classes give you the ability to set your own pace, review material as needed and move through the coursework in a way that suits your learning style.

➢ **Disadvantages**

- **Lack of face-to-face interaction:** One of the major disadvantages of online education can be the lack of physical interaction, which can make it more challenging for you to communicate with your fellow students and tutors**.**

- **Difficulty staying motivated:** is the difficulty in maintaining focus when you study on your won. Online education is often done independently, which can make it more challenging to navigate, stay engaged and be motivated.

- **Limited access to resources and support:** it's important to keep in mind that online education sometimes offers limited access to resources and support compared to traditional on-campus classes

- **Technical difficulties:** as internet connectivity issues, software compatibility issues, or issues with your laptop, can hinder your ability to access classes

4) Proposed solution:

we would like to develop a free e-learning website with XP point integrated with AI Assistant. The interactive e-learning platform is designed to provide a comprehensive and engaging online learning experience tailored to the needs of individuals interested in acquiring or enhancing their computer science skills. The platform encompasses a wide range of features and

functionalities to support users, instructors, and administrators in their respective roles.

5) General Platform Overview:

The platform is accessible through a user-friendly web interface, allowing users to enrol in courses seamlessly. The curriculum is structured into modules, each consisting of lessons, hands-on tests, and

assessments, providing a well-rounded learning experience. To foster engagement and motivation, the platform incorporates a gamified learning approach through an experience point (XP) system and leaderboard, where users accumulate points for their progress and achievements. Additionally, an intelligent ChatBot assistant is integrated to provide personalized support and guidance to learners as they navigate through the lessons.

➢ **learner-Side Features:**

- **Registration and User Profile Management**: Users can create personalized accounts, providing basic information and customizing their profiles with photos and contact details. User profiles also display section to track their learning progress and achievements

- **Course Catalog and Enrolment**: The platform offers a comprehensive catalog of computer science Domains structured into trainings videos tests, each accompanied by detailed descriptions

- **AI Chatbot Assistance**: An AI-powered ChatBot is available to assist learners during their lessons, providing explanations, answering queries in real-time, enhancing the overall learning experience

- **XP Point System and Leaderboard**: Users accumulate XP points as they engage with courses, pass evaluations, and reach predefined goals. A leaderboard displays the top 10 users based on their XP points, fostering a sense of friendly competition and motivating learners to continue their educational journey

➢ **Instructor-Side Features:**

- Outline the functionality for instructors to create, manage, and deliver course content such us videos, quizzes, edit his profile

➢ **Admin Features:**

- Describe the administrative capabilities, including user and instructor management, content moderation which is add training and domain, view statistics

II. Analysis and Design

In this section, we will start by conducting an in-depth analysis of the specific needs of users, then we will introduce the architecture of the platform based on software development process and UML diagrams.

1) Software Development Process

A structured set of activities needed to develop software "The quality of software is a direct result of the process used at the time of its creation" [6]

Many different processes exist we list some software development process

> **Waterfall Approach:** Is one of traditional methods which consist of a popular classic approach and it is also a popular version of the software development lifecycle in the field of software engineering [7]
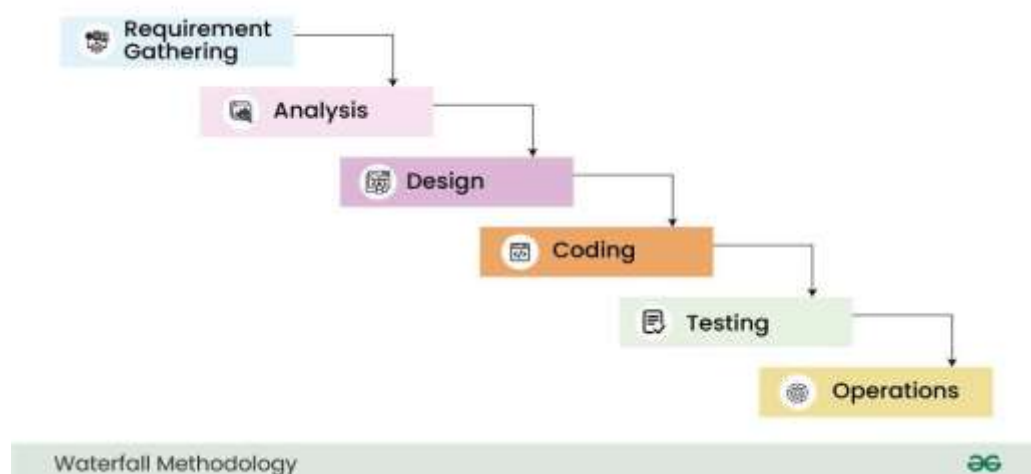
Figure 5: waterfall Methodology

2) Activities related to software development [8]

> **The feasibility studies**: Determine if the proposed development is worth considering implemented, taking into account expectations and the difficulty of development
> **Definition and analysis of needs:** Establish a clear description of what the software should do

like functional needs; non-functional requirements; Constraints

➢ **The design:** During this stage, it is a question of designing the solution to the problem posed we have

General design (or architectural design):

If necessary, it is necessary to start by sketching out several solution variants and

choose the one that offers the best value between costs and

benefits. The solution must then be fixed, described and detailed

➢ **Implementation:** After the detailed design comes the coding phase,

also known as the construction phase, the construction phase

or implementation phase

➢ **Tests:** This phase consists of testing the software on data

to ensure that it works properly

➢ **Delivery:** Provide the customer with a software solution that works

correctly

- ✓ Installation: Get the software up and running at the customer's site
- ✓ Training: teaching users how to use the software
- ✓ Support: Answering user questions

➢ **Maintenance:** After installation, the operation and production phase follow

maintenance. The software is now used in its operating environment, its behaviour is monitored

and, if necessary, it is amended

In this work; we choose V-model to present our conception

3) The UML language

UML [9] is a graphical modelling language for visually representing software systems. It provides standardized notation for creating diagrams that describe the structure, behaviour, interactions, and other aspects of systems. ML offers 14 types of diagrams shown in Figure 6.
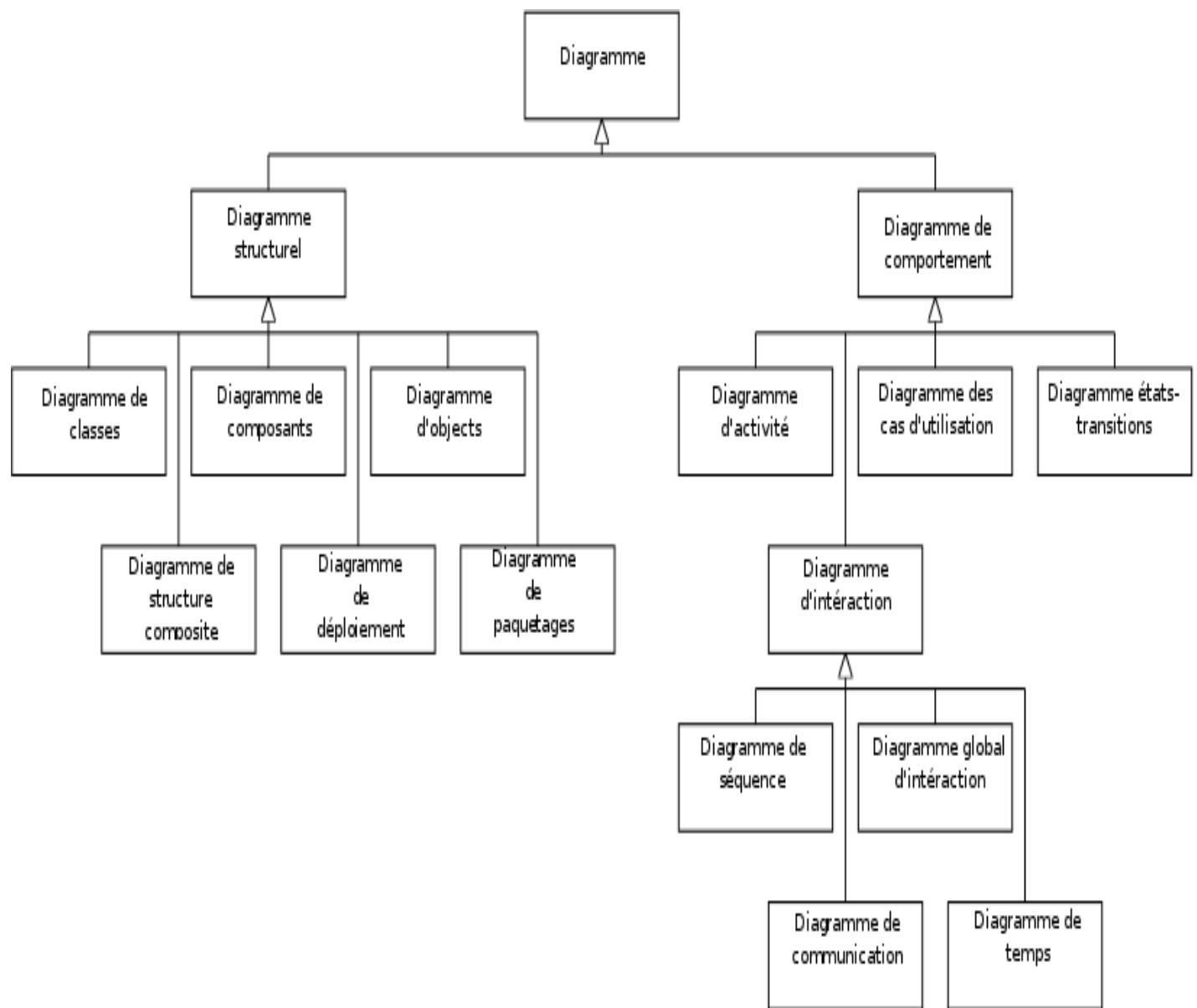
Figure 6: UML Diagrams

4) Use Case Diagram

The use case diagram [10] represents the interactions between actors (users or external entities), showing how the system is used in different scenarios.

➤ **Below we showed our use case diagram**
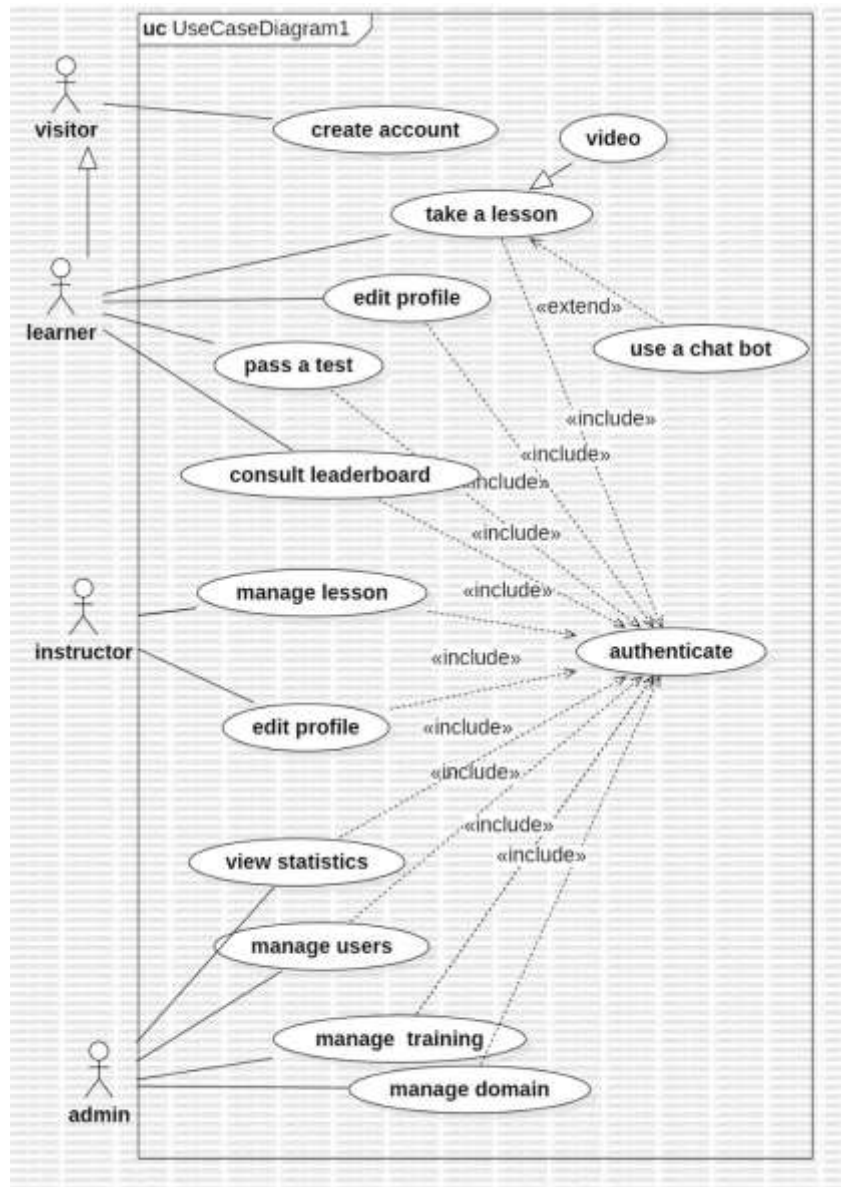
Figure 7: Use Case Diagram

> ➢ **Here we identify our actors:**

- **Visitor**: Persons who access the site without logging in or registering

- **Learner:** The main users of the platform. They are registered and connected to the site to access the training and answer quizzes

- **Mentors:** Those responsible for the creation and management of Courses, Trainings and, they are registered and logged in as teachers

- **Admin**: Who are responsible for administration and overall management of the platform

5) Sequence Diagram

The sequence diagram [11] is used to describe how the elements of the system interact with each other and with the actors, showing the chronological order of the interactions.

- The sequence diagram of adding a teacher
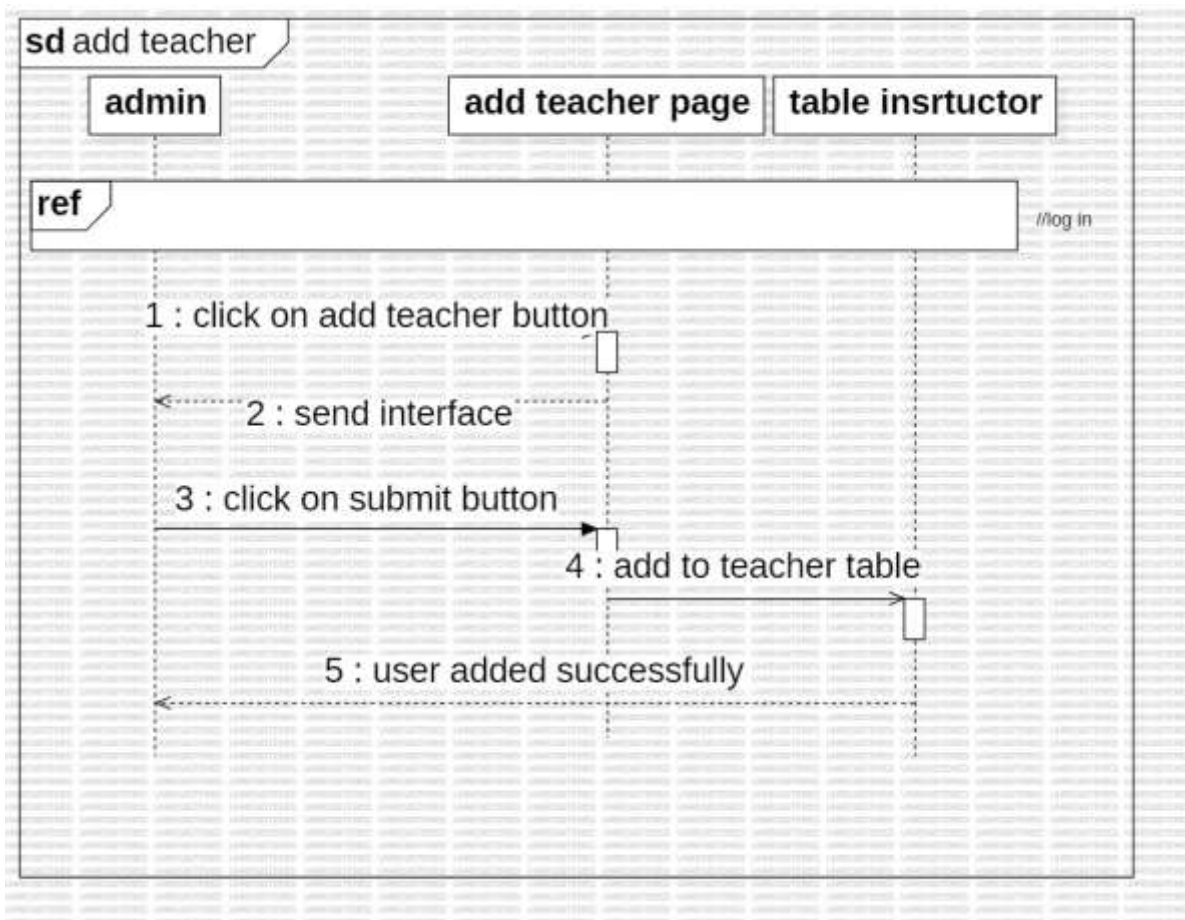
Figure 8: Add teacher sequence diagram

12

- This sequence diagram describe how chat bot works when learner ask question
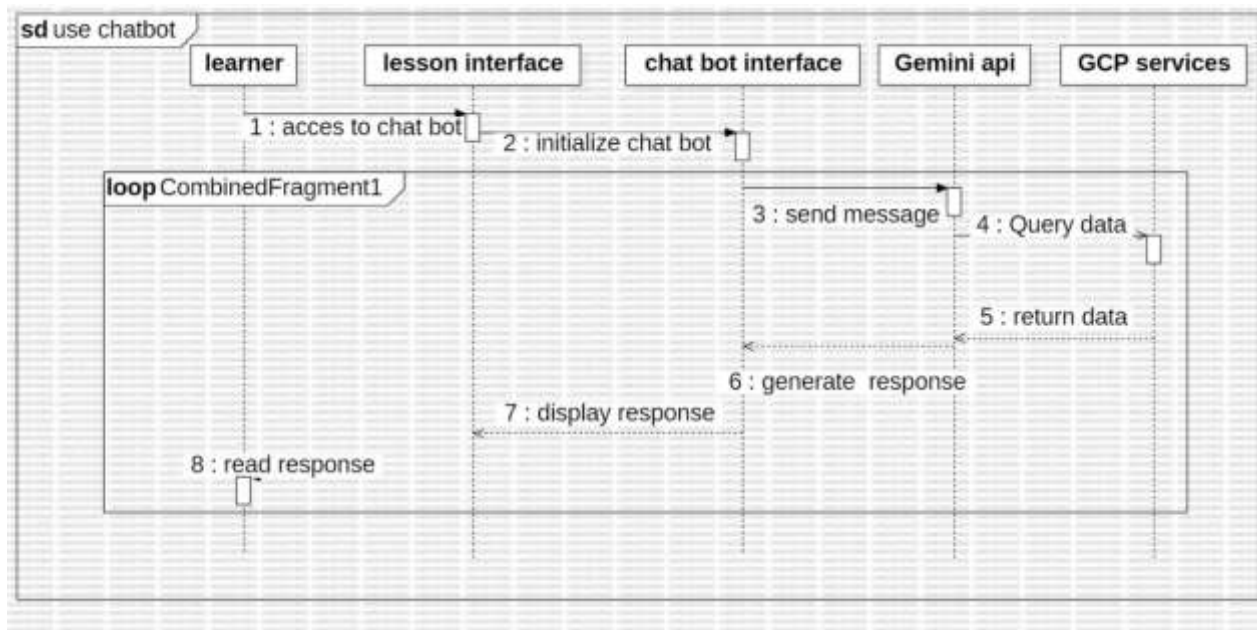
Figure 9: edit profile student sequence diagram

- This figure illustrate how learner edit his profile
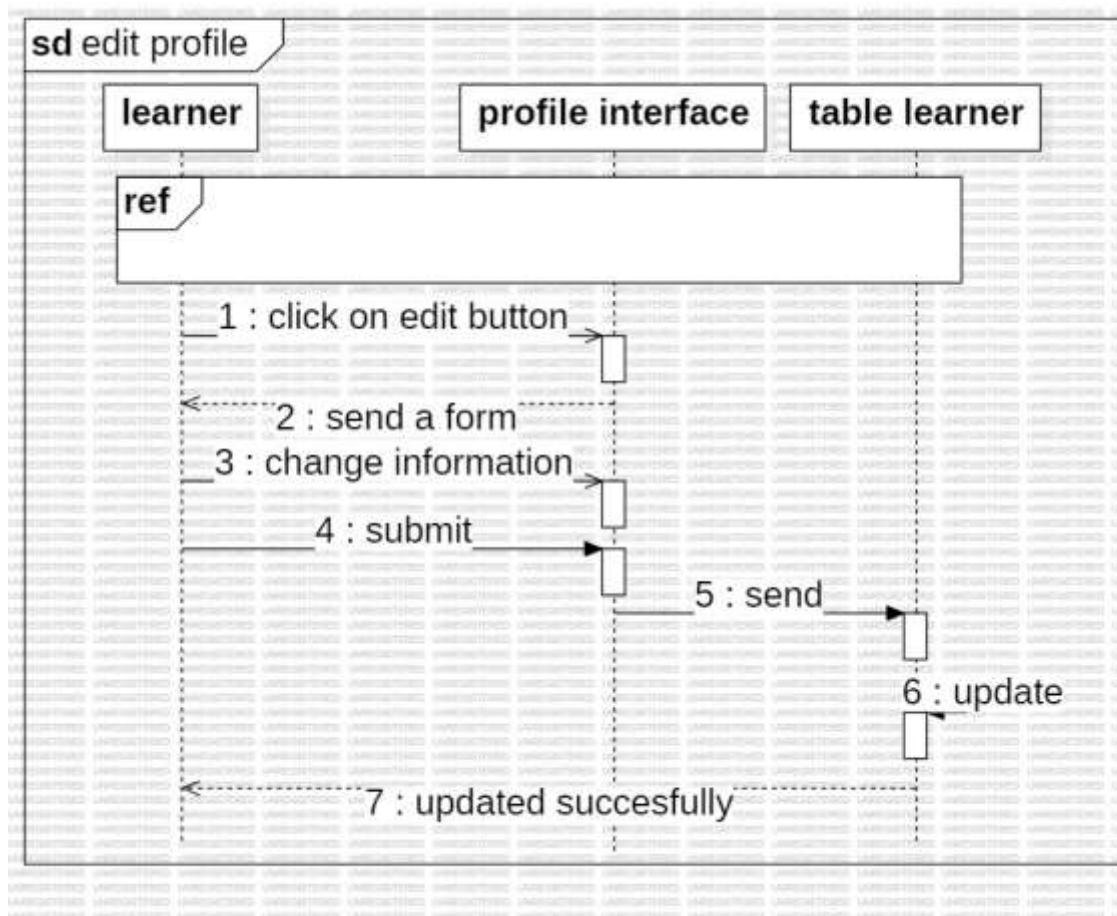
Figure 10: ChatBot sequence diagram

6) Class Diagram

The class diagram [12] provides an abstract representation of the objects in the system that will interact to make the use case diagrams. Here is our class diagram:
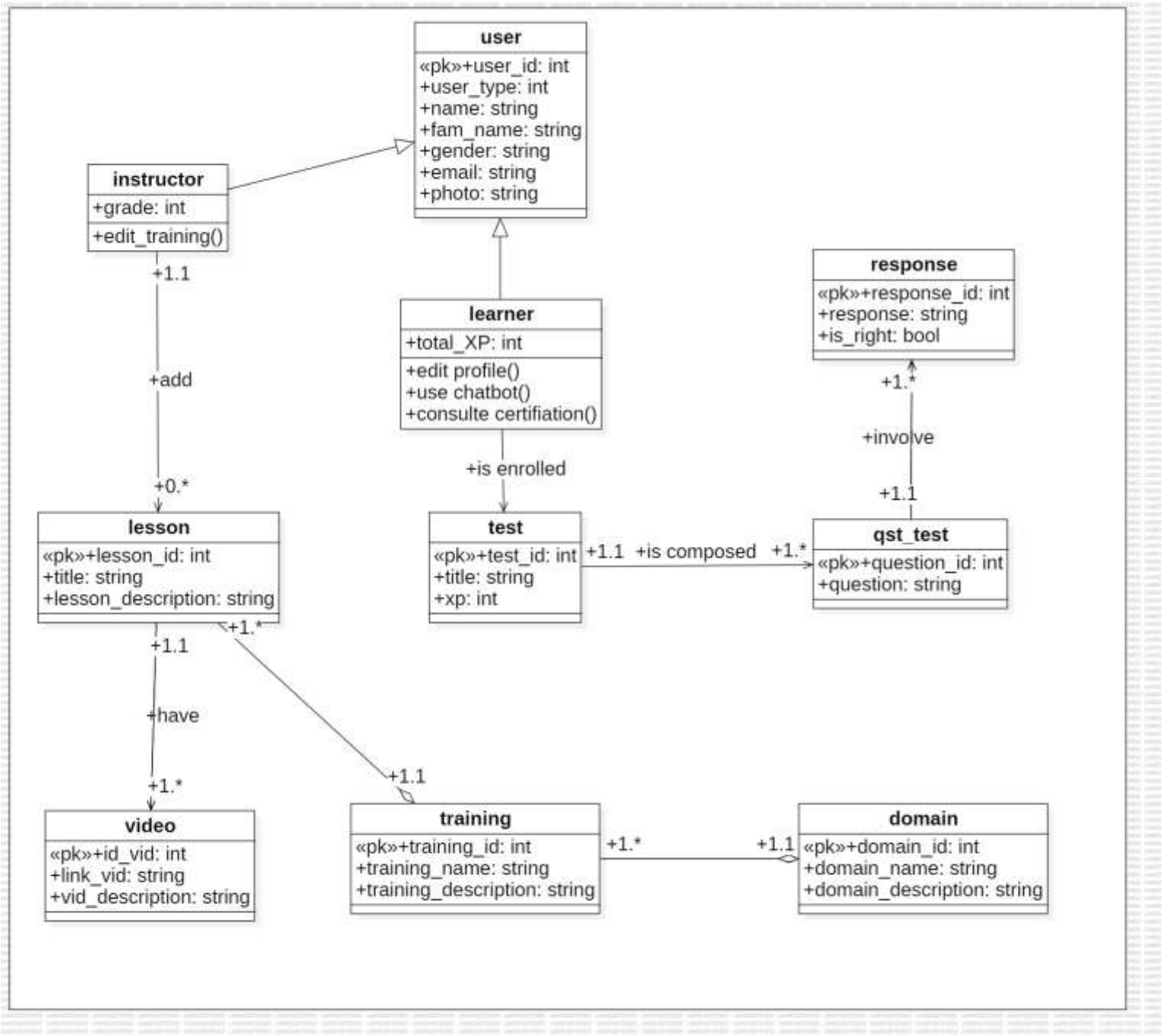
Figure 11: the class diagram

7) Relational Model:

The relational model [13] is a way of modelling the existing relationships between multiple pieces of information and organizing them in a structured manner.

user (user_id, user_type, name, fam_name, gender, email);

Instructor (#user_id, grade);

learner (#user_id, total_XP);

lesson (lesson_id, #training_id, #user_id, title, lesson_description);

training (training_id, #domain_id, training_name, training_descrption);

Domain (domain_id, domain_name, domain_description);

Video (id_vid, #lesson_id, XP_pts, link_vid, video_description);

test (test_id, #question _id, title, xp);

qst_test (test_id, #lesson_id, question);

response (response_id, #question_id, response, is_right);

III. Implementation

It is important to conduct a pre-study phase before initiating a project. The purpose is to explore, describe, and evaluate alternative solutions while assessing the value and feasibility of the concepts. By clearly articulating the reasons and methodologies for project implementation and the anticipated outcomes, a better understanding of the concept can be fostered.

1) Development Environments

1st Computer:

● Operating system: windows11 Home Single Language

　○ Version :23H2

● Processor: Intel Core™ i3-11154G4@3.00Ghz

● Random Access Memory (RAM): 8.00GB

● Hard disk:236 GO SSD +1T HDD

2nd Computer:

- Operating system: Windows 10 Professional

    o Version: 22H2

- Processor: Intel® Core™i5-4200U CPU @ 1.60GHz 2.30 GHz

- Random Access Memory (RAM): 4.00 Go

- Hard disk: 236 Go SSD + 1T HD

2) Development Tools

- **PostgreSQL:** An advanced open-source object relational database management system (ORDBMS) known for its reliability, feature, and performance [14]

- **Vs Code:** Visual studio code is a simplified code editor, which is free and developed as open source by Microsoft. It provides developers with an integrated development environment with tools to advance technical projects, from editing to building and debugging [15]

- **StarUML:** Is a software engineering tool dedicated to UML modelling and published by the Korean company MKLabs offering object-oriented modelling functions based on [16]

- **PyCharm:** A python IDE developed by JetBrains that provides features like code analysis, debugging, testing, version control integration, and web development support with Django [17]

- **Adobe illustrator:** A vector graphics editor from Adobe used for creating logos, icons, illustrations, typography, and scalable graphics. It offers precise drawing tools, text manipulation features, and is popular for various design applications like logo creation, icon design, and print media [18]

- **Postman:** Is an application that acts as an API platform for building and using APIs (Application Programming Interfaces). It simplifies various stages of the API lifecycle, from design and testing to documentation and collaboration, ultimately helping developers create better APIs faster [19]

- **GitHub:** A popular web-based version control system and Git repository hosting service, widely used for software development [20].

3) Programming languages

- **HTML: (Hyper Text Markup Language):** is a markup language for describing web pages. It allows for the presentation of hypertext document intended to be displayed on a web browser. It is a client-side language (alongside CSS and JavaScript). It is supported and developed by W3C [21].

- **CSS (Cascading Style Sheet):** is a computer language used on the internet to style HTML files, include code that manages the design of an HTML page [22]

- **React JS**: A JavaScript library for building user interfaces. It's known for its component-

based approach and virtual DOM, allowing for efficient updates to the UI [23]

- **JAVA Script**: JavaScript *is the Programming Language for the Web*. JavaScript can update and change both HTML and CSS. JavaScript can calculate, manipulate and validate data [24]

- **Django:** A high-level Python web framework that encourages rapid development and clean, pragmatic design [25]

- **Django REST framework:** A powerful toolkit for building web APIs WITH Django. It simplifies the creation of RESTful APIs and leverages Django's strength for Authentification, permissions and features [26]

- **JSX (JavaScript XML):** A syntax extension for JavaScript that allows you to write HTML-like structures within your code. It's primarily used with ReactJS to define the UI components [27]

- **JSON (JavaScript Object Notation)**: A lightweight data interchange format commonly used for data exchange between web servers and web applications. It's a human-readable format based on key-value pairs [28]

- **Gemini API**: Gemini is a collection of large language models (LLMs) hosted on Google Cloud's Vertex AI platform [29]

- **Google Cloud Platform:** is a suite of cloud computing services offered by Google GCP allows businesses to build, deploy, and scale applications, websites, and services on Google's infrastructure [30]

- **SQL (Structured Query Language):** A standardized language for querying and manipulating data in relational databases. It's used to retrieve, insert, update, and delete data within a database [31]

4) Project Presentation

Our project is the development of a platform for computer scientist, here are some overviews of

"ODROSS" interfaces for each feature

 ➢ **Home page**: This is the main page, which contains our most recent trainings and offer

   to visitors to contact us
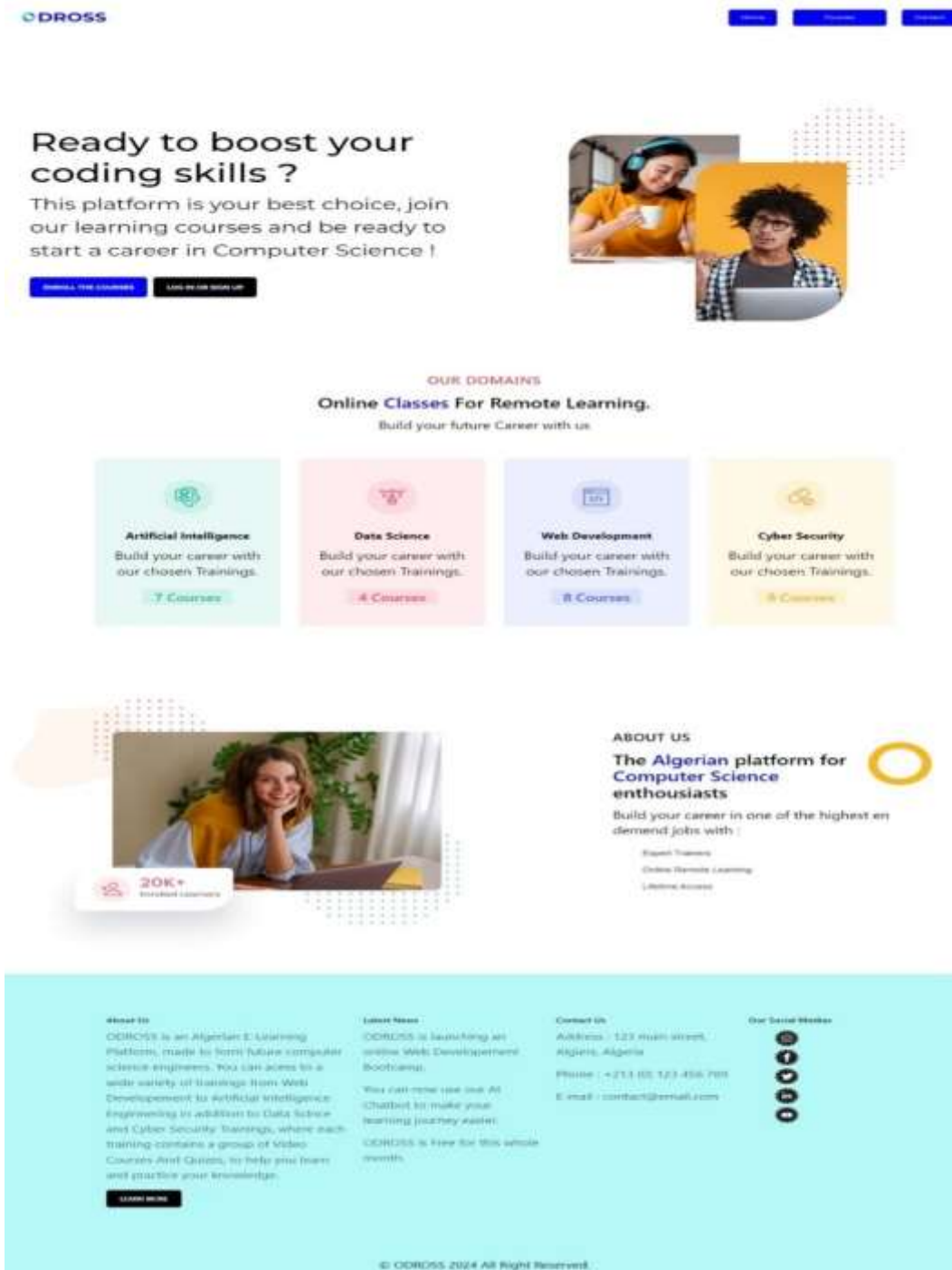
Figure 12: home page interface

➢ **Log in interface**: When the visitor clicks on "connect" a login window appears, if he already has account he can log in as learner or instructor by entering his email and password
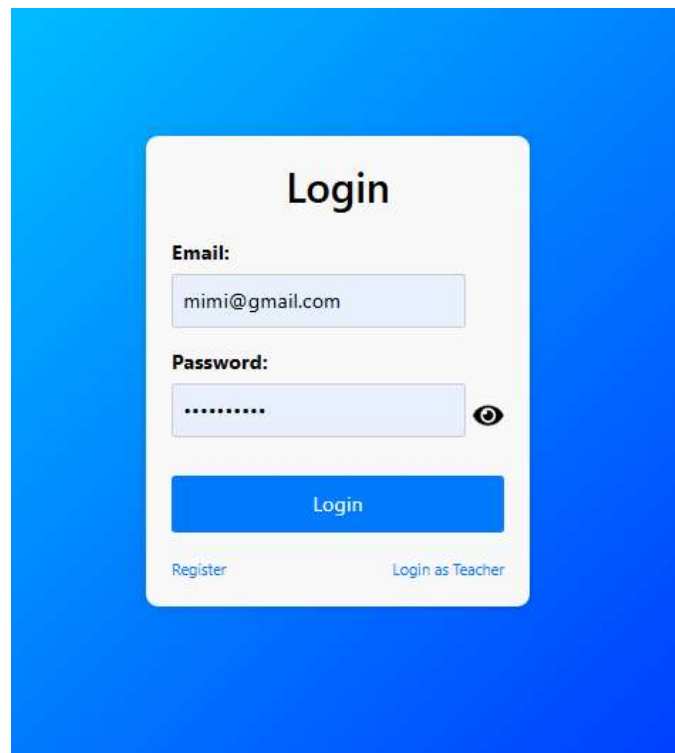
Figure 13 : log in interface

➢ **Courses interface**: it will show a set of courses for each field
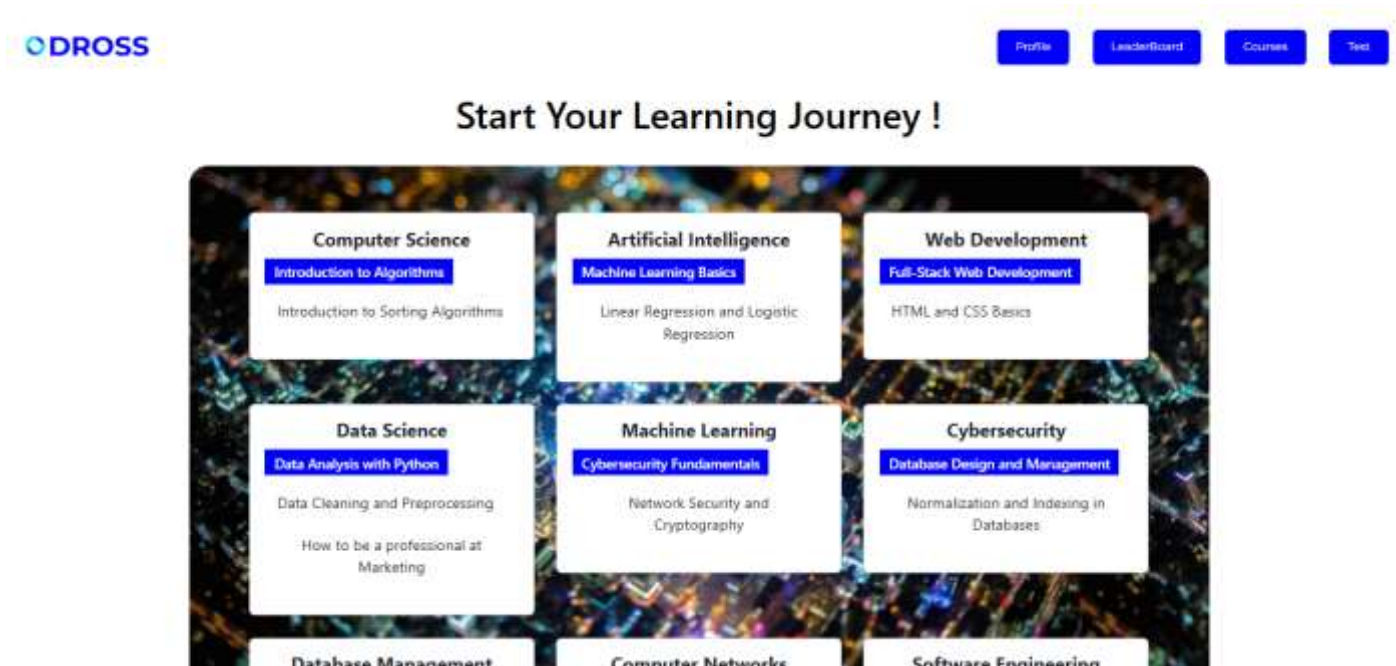
Figure 14: courses interface

➢ **ChatBot interface**: if the learner has a question, he can ask the AI assistant, it will answer him immediately and keep his focus
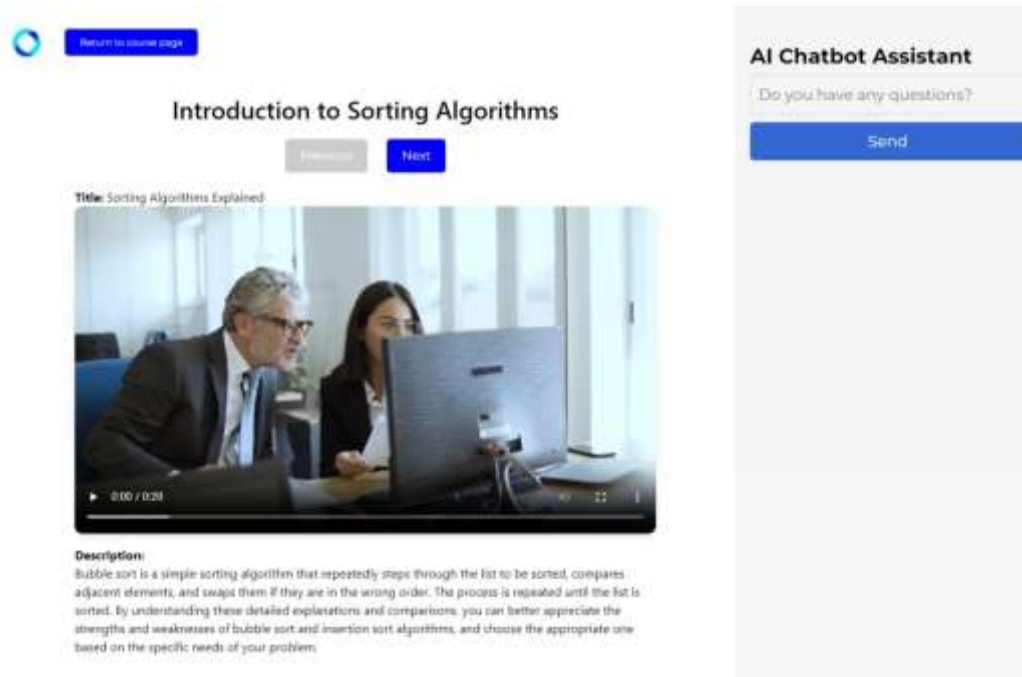
Figure 15: ChatBot interface

➢ This figure shows the response of chatbot
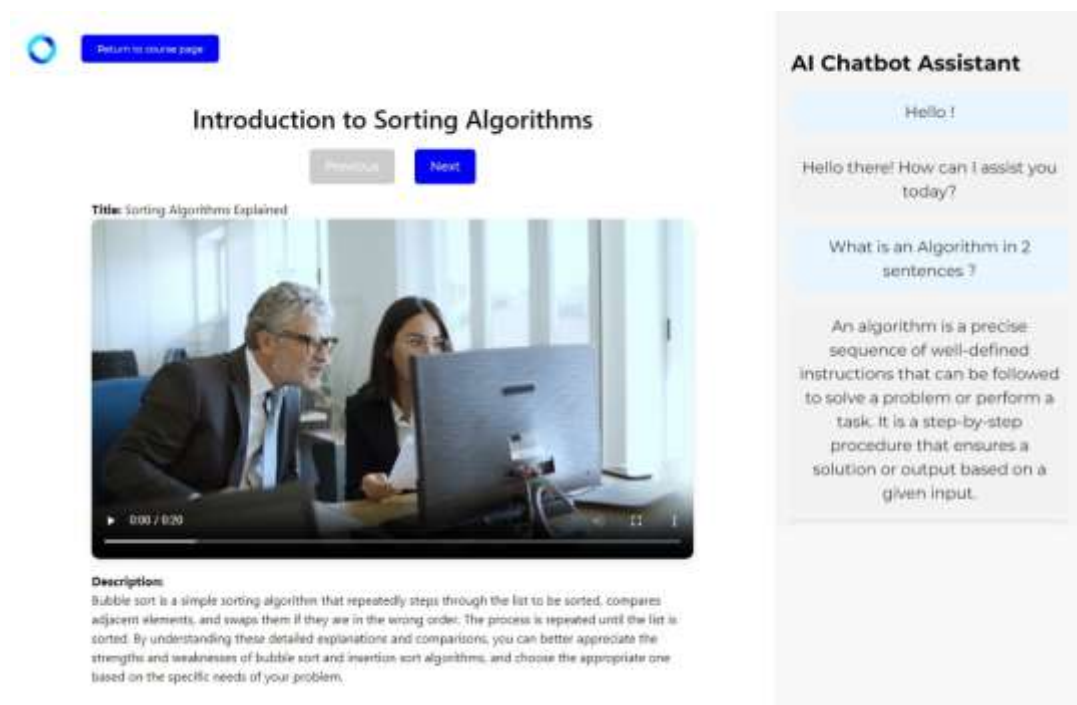
Figure 16 : ChatBot response interface

➢ **Pass Quiz interface**: a series of test to evaluate learners

Figure 17: pass Quizzes interface

➢ **Leaderboard interface:** it gives the learner the active members in the platform

Figure 18: top leaners interface

- This interface display when teacher add a new Quizz

Figure 19 : add Quizz interface

➢ **Statistics interface:** It gives the admin a detailed view of the content of his platform, the student effect, the teacher
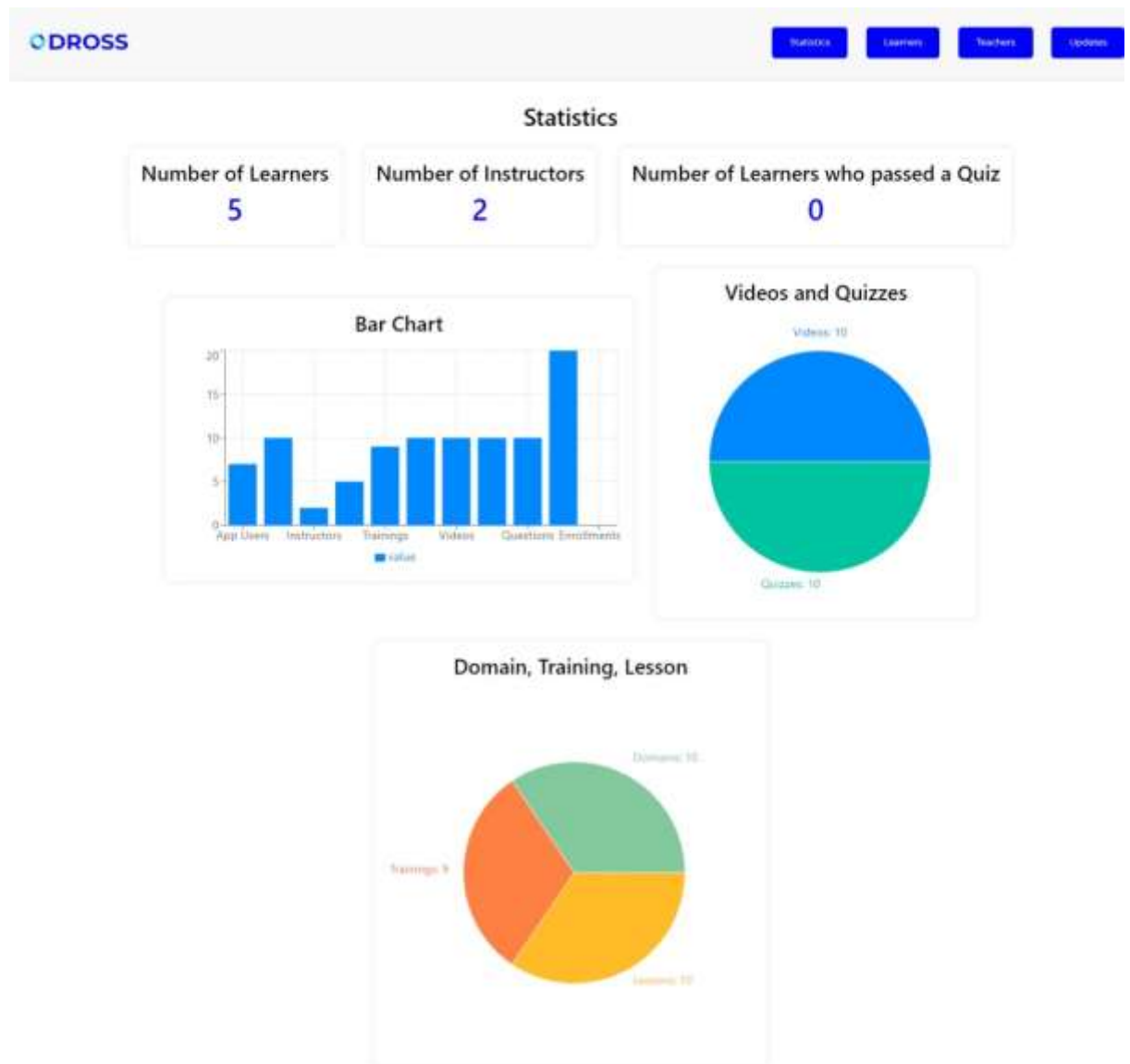

Figure 20: Statistics interface

General Conclusion

In this report, we have meticulously detailed our project in two key sections: Design, where we elucidate the comprehensive organizational structure of the ODROSS web application, and Implementation, which encapsulates the practical realization of our project.

As we navigate the landscape of e-learning platforms, it's evident that while several options exist globally, they often come with a price tag and lack a focused approach tailored to computer scientist learners. With pride, we present ODROSS, the inaugural Algerian web application with AI Assistant catering specifically to computer science courses.

Having achieved our main goals, it's great to improve the functionality of our website. One of these paths is the integration of a coding space, allowing users to execute and script their code.

Through the culmination of this project, we've leveraged the knowledge and skills acquired during our tenure at Saad Dahleb University in Blida. This capstone endeavour has not only bolstered our proficiencies but has also provided a platform for professional growth, enabling us to navigate complex working environments with confidence while honing existing competencies and acquiring new ones.

Looking forward, our trajectory is brimming with possibilities for improvement and expansion. By capitalizing on our experiences and the lessons learned, we are poised to further refine ODROSS, ensuring its continued relevance and efficacy in the ever-evolving landscape of e-learning.

Bibliography

[1]   https://www.digiforma.com/definition/e-learning/

[2] Progress and new directions for teaching and learning in MOOCs: Pierre Benckendorff, Ruiqi Deng, Deanne Gannaway, https://doi.org/10.1016/j.compedu.2018.10.019

[3] Lye, S. Y., & Koh, J. H. L. (2014). Review on Teaching and Learning of Computational Thinking through Programming: What Is Next for K-12? Computers in Human Behaviour, 41, 51-61. https://doi.org/10.1016/j.chb.2014.09.012

[4] The Gamification of Learning: a Meta-analysis Michael Sailer & Lisa Homner https://www.researchgate.net/publication/335189630_The_Gamification_of_Learning_a_Meta-analysis

[5] https://www.iu.org/blog/studying-online/advantages-and-disadvantages-of-online-classes/#area-733955

[6] Chickhi, N. (2022). *Introduction à la Génie Logiciel*. Université de Blida 1.

[7] https://www.geeksforgeeks.org/sdlc-models-types-phase

[8] https://www.lucidchart.com/pages/fr/langage-uml

[9] Chikhi N. (2022). *Introduction à la Génie Logiciel*. Université de Blida 1

[10]   https://www.ibm.com/docs/fr/rational-soft-arch/9.5?topic=diagrams-use-case

[11]   https://lipn.univ-paris13.fr/~gerard/uml-s2/uml-cours05.html

[12]   https://laurent-audibert.developpez.com/Cours-UML/?page=diagramme-classes

[13]   https://www.oracle.com/what-is-a-ralational-database

[14]   https://www.postgresql.org/docs/

[15]   https: :// framalibre.org/content/visual-studio-code

[16]   https: :// www.linkedin.com/advice/0/what-benefits-drawbacks using-uml-diagrams-domain

[17]   https: :// www.jetbrains.com/pycharm

[18]   https: :// en.wikipedia.org/wiki/Adobe Illustrator

[19]   https://www.postman.com/

[20]   https://kinsta.com/fr/base-de-connaissances/base-de-connaissances-github/

[21]   https: :// www.chi chiny.me/html-c-est-quoi-3-1.php

[22]   https ::// www.atinternet.com/glossaire/css/

[23]   https://fr.react.dev/

[24]   https://www.w3schools.com/whatis/whatis_js.asp

[25]   Two Scoops of Django: Building Django Web Applications" by Daniel Greenfeld and Audrey Roy

Greenfeld(2007)

[26] https://www.django-rest-framework.org/

[27] https://fr.legacy.reactjs.org/docs/introducing-jsx.html

[28] https://www.json.org/json-en.html

[29] Wei, D. (2024, January 27). AI on Google Cloud: Building a Chatbot with Gemini API. *Google Cloud - Community*. Retrieved from https://medium.com/google-cloud/ai-on-google-cloud-building-a-chatbot-with-gemini-api-250970ab3c33

[30] https://www.pluralsight.com/resources/blog/cloud/what-is-google-cloud-platform-gcp

[31] https://sql.sh/