

**DEVELOPMENT OF THE WEB-BASED DATA-DRIVEN UNIVERSITY  
INFORMATION MANAGEMENT SYSTEM (UIMS) FOR INTER-  
UNIVERSITY COUNCIL FOR EAST AFRICA (IUCEA)**

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**A Project Report Submitted in Partial Fulfillment of the Requirements of the Award  
the Degree of Master of Science in Embedded and Mobile Systems of the Nelson  
Mandela African Institution of Science and Technology**

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## **ABSTRACT**

A significant challenge faced by the Inter-University Council for East Africa (IUCEA) is the lack of a common Higher Education Information System (HEIS) for the East African Community (EAC) to harmonize the region's education and training system. The system has to manage data about the academic program, universities, research, and human capital respectively developed in different modules. Both EAC's citizens and IUCEA need statistics regarding this information and complex questions these data may answer. Traditional high education management is not only costly but also ineffective. In this work, a web-based data-driven University Information Management system (UIMS) for IUCEA is designed to effectively manage university information concerning the academic life cycle, assets, finance, and human resource. In addition, a university application portal to help high education institutions is provided to apply for being among all degrees awarding high education. This system is the second module of the East Africa Community High Education Information System (EAC HEIS); it has been developed using agile software development and web technology such as RESTful API, React, Django, and MySQL. UIMS for IUCEA will significantly impact the IUCEA's day-to-day operation and receive recognition from the surfer. It will improve the efficiency of many processes.

## DECLARATION

I, Abel Nshimiye, do hereby declare to the Senate of the Nelson Mandela African Institution of Science and Technology that this project report is my original work and that it has neither been submitted nor being concurrently submitted for a degree award in any other institution.

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14.07.2022

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## CERTIFICATION

The undersigned certify that they have read and hereby recommend for acceptance by The Nelson Mandela African Institution of Science and Technology, a project report titled **"Development of the Web-Based Data-Driven University Information Management System (UIMS) For Inter-University Council for East Africa (IUCEA)"** in partial fulfillment of the requirements for the degree of Master of Science in Embedded and Mobile Systems, Mobile Systems specialty of the Nelson Mandela African Institution of Science and Technology.

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## **DEDICATION**

This work is dedicated to God, my creator, and my source of inspiration, knowledge, comprehension, and wisdom. This work is also dedicated to my father, siblings, and other friends. I will always appreciate all they have done.

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## **LIST OF ABBREVIATIONS AND SYMBOLS**

API	Application Programming Interface
ARIS	Academic Records Information System
ASIS	Assets Information System
AUC	African Union Commission
CRUD	Create Read Update Delete
CSS	Cascading style sheet
CUE	Commission for University Education
DOM	Document Object Model
EACAPIMS	East Africa Community academic program Information Management System
EACHCIMS	East Africa Community Human Capital Information Management System
EACHEIS	East Africa Community high education information system
EACRIMS	East Africa Community Research Information Management System
EACUIMS	East Africa Community-University Information Management System
EAQFHE	East African Qualifications Framework for Higher Education
FINIS	Financial Information System
GCC	Gulf Cooperation Council
gRPC	Google Remote Procedure Call
HEC	Higher Education Council
HTML	HyperText Markup Language
HTTP	Hypertext Transfer Protocol
HURIS	Human Resource Information System
ICT	Information and Communications Technology
IM	Instant Message

IRC	Internet Relay Chat
IUCEA	Inter-University Council for East Africa
MVC	Model Control View
NCHE	National Council for Higher Education
NIS	National Innovation Systems
NPM	Node Package Manager
ORM	Object-Relational mapper
P2P	Peer-to-Peer
RDBMS	Relational Database Management System
RDBMS	Relational Database Management System
RDI	Research Development and Innovation
REST	Representational State Transfer
RPC	Remote Procedure Call
SIMS	Student Information Management System
SMTP	Simple Mail Transfer Protocol
SOAP	Simple Object Access Protocol
SQL	Structured Query Language
TCU	Tanzania Commission for Universities
UIMS	University Information Management System
UML	Unified Modeling Language
URL	Uniform Resource Locator
WWW	World Wide Web

## CHAPTER ONE

### INTRODUCTION

#### 1.1 Background of the Problem

The EAC is an African region that brings Burundi, Kenya, Rwanda, South Sudan, Tanzania, and Uganda into variant modes of economic partnership. The eventual dream is to achieve a political alliance (Baariu *et al.*, 2019). The EAC as a union of Uganda, Kenya, and Tanzania was established in 1967. The partnership did not take long since it collapsed in 1977, but after a few years, in 1999, it was re-established. Burundi and Rwanda joined the community in 2007, and South Sudan followed in 2016 (Murage *et al.*, 2019).

However, since 1981, when the Arusha Convention treaty was signed, attempts have been made to establish a typical higher education space in East Africa; unfortunately, the collapse of the EAC in 1977 hampered his progress (Ogachi, 2018). Therefore, upon the re-establishment of the EAC, East Africa's political leaders decided to resurrect the IUCEA, which would be entrusted with investigating methods for greater higher education convergence in the region. In addition, the EAC works in concordance with other provincial monetary networks in Africa to advance the plan of the African Union Commission (AUC) advanced education methodology.

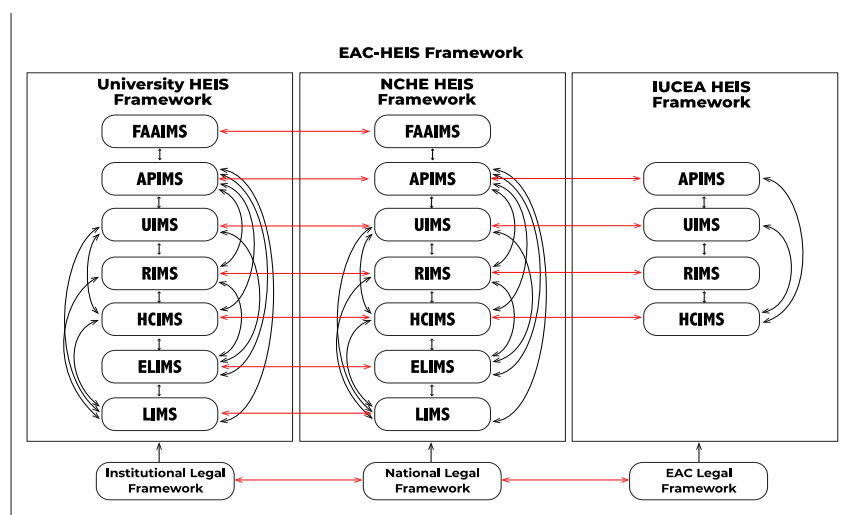
In addition, EAC aims to provide elite education to United Nations Member States. The contribution to the development of higher education, professional and affordable training, elimination of equitable gender and wealth gaps, and the achievement of universal access to high-quality higher education is provided by EAC through the IUCEA in the region. The EAC member states signed the treaty to expressly pursue deliberate steps to encourage collaboration in education and training in the community in a cooperative effort to foster the development of higher education. The specific agreement concerns harmonizing education and training systems for comparability and compatibility among partner nations (O'leary, 2017). Through the IUCEA, the EAC developed the East African Qualifications Framework for Higher Education (EAQFHE) in response to the above development. A qualification framework was defined by (O'leary, 2017) as a tool for bringing the training and education systems closer together. The IUCEA, a leading EAC institution for an exemplary common higher education space for a prosperous and sustainable EAC, has been chosen to implement the system.

Furthermore, the IUCEA must develop a tool to harmonize the education and training system in the EAC region. According to (Ng'ingo, 2019), the tool will be a framework that will stipulate the easy mobility of learners and labour in the community. According to the final report on the EACHEIS submitted to the IUCEA by individual consultant Prof. Venansius BARYAMUREEBA in July 2020, The EACHEIS shall integrate four modules:

- (i) EAC Academic Programs Information Management System (EACAPIMS); will be used by universities and university colleges to submit curricula for review or approval before being operational and publishing approved curricula.
- (ii) EAC Universities Information Management System (EACUIMS) manages information for accredited or licensed Universities and University Colleges.
- (iii) The EAC Human Capital Information Management System (EACHCIMS) should derive its information from the National Human Capital Information Management Systems.
- (iv) EAC Research Information Management System (EACRIMS) should derive its information from the National Research Information Management Systems.

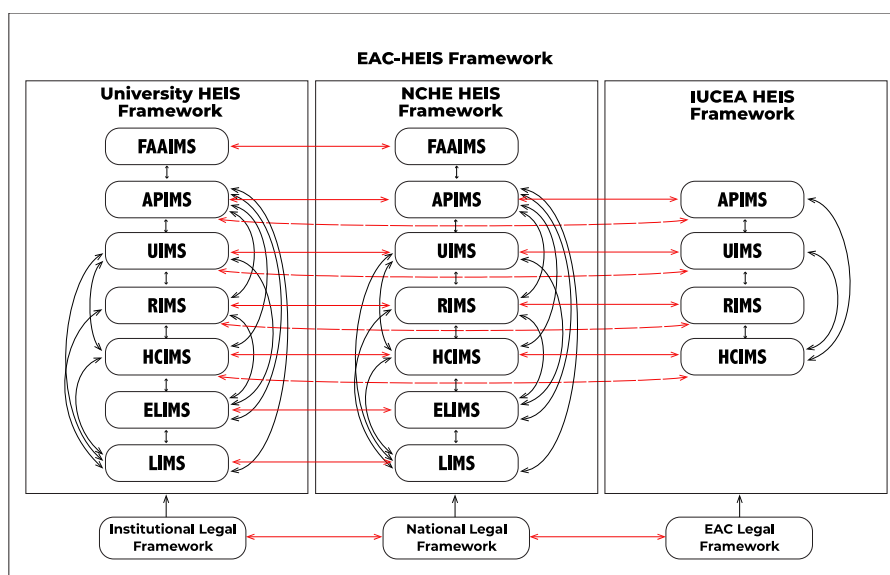
The EACHEIS uses data from six countries to involve legal analysis on data sharing in the region. It was established that the Institutional or University legal framework should conform to the National legal framework, which should work with the EAC legal framework. The EAC legal framework shall ensure that Partner States have a shared enabling environment to operate. Likewise, the national legal framework shall ensure that the Universities or Institutions in each Partner State have a shared enabling environment to work. The institutional, legal framework shall address the specific needs of each institution without contradicting neither the national legal framework nor the EAC legal framework.

Given the above legal analysis, the final report on the Status of the EAC HEIS provides two Frameworks about EAC HEIS, respectively, presented in the following figures.



**Figure 1: East Africa community high education information system framework – where EAC-HEIS derives data or information from NCHE HEIS**

The framework (Fig. 1) ensures data is validated at the national level by the national council or commission for higher education before sharing it with IUCEA for the EAC-HEIS.



**Figure 2: East Africa community high education information system framework – Where EAC-HEIS derives data/information from NCHE HEIS or/and University HEIS**

The framework (Fig. 2) provides flexibility to IUCEA to either collect data from national councils or commissions for higher education or from universities and university colleges, or both.

The model technology has been adopted to manage the universities' education and the national council or commission for higher education within the EAC partner states. According to the final report on the Status of the EAC HEIS, as described in Table 1, four commissions or councils for higher education had a University Information Management system (UIMS) that manages information for accredited and licensed Universities operating among six in a Partner States.

**Table 1: National council or commission for higher education available in the EAC region**

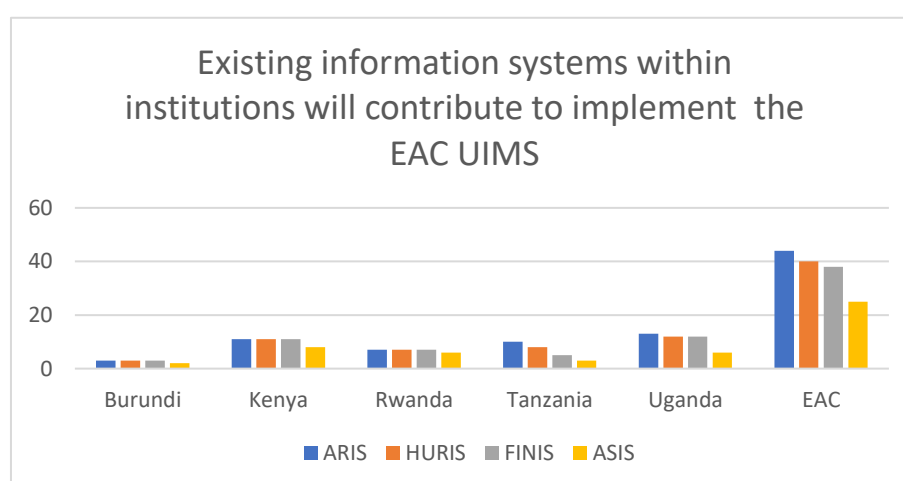
	<b>NCHE</b>	<b>UIMS</b>
Burundi	National Commission for Higher Education (NCHE)	0
Kenya	Commission for University Education (CUE)	1
Rwanda	Higher Education Council (HEC)	1
South Sudan	Directorate of higher and tertiary education, Ministry of Higher Education, Science and Technology	0
Tanzania	Tanzania Commission for Universities (TCU)	1
Uganda	National Council for Higher Education (NCHE)	1
EAC	(Total)	4

The same report recommends that EACHEIS have the UIMS that manages the academic life cycle, human resources, assets, and finances. The academic life cycle shall include admission data, student enrolment, graduates, and drop-outs. Human resources shall consist of academic, administrative, and support staff. Assets shall contain information about facilities and infrastructure. Finances shall collect information about revenue and expenditure data. The system should also include University governance organs (structure, membership, powers, and functions), University policies, statutes, rules, and procedures. Also, UIMS should have a module that captures all information required to assess an application for license or accreditation or charter for proposed or new universities. That information needed for the UIMS comes from the four subsystems the HEIS institution should have, which are the Human

Resource Information System (HURIS), Academic Records Information System (ARIS), Assets Information System (ASIS), and Financial Information System (FINIS) (Tatnall *et al.*, 2011). The table below shows the Status of existing information systems within 49 institutions among 133 degrees awarding higher education in the survey done within five countries over six countries of the East African Community.

**Table 2: Existing information systems within institutions will contribute to implementing the EAC UIMS**

S/N	Country	ARIS	HURIS	FINIS	ASIS	N° Institutions Surveyed
1	Burundi	3	3	3	2	8
2	Kenya	11	11	11	8	11
3	Rwanda	7	7	7	6	7
4	Tanzania	10	8	5	3	10
5	Uganda	13	12	12	6	13
6	EAC	44	40	38	25	49



**Figure 3: Existing information systems within institutions will contribute to implementing the EAC UIMS**

The analysis has allowed us to design and implement the web-based data-driven university information management system for IUCEA, adopting the second framework that collects data from national councils or commissions for higher education and all degrees-awarding high education. In the final report about EACHEIS, this system has been called the East Africa Community University Information Management System (EACUIMS).

## **1.2 Statement of the Problem**

The world's most valuable resource is no longer oil but data (Economist, 2017). Moreover, the advances in technology create new demands. As a result, Universities are constantly searching for new insights from data to generate strategies to meet these new demands (Daniel, 2017).

However, in higher education in the East African Region, there is a need for data-driven information systems to accommodate new economic, regional, national and international demands. Moreover, since the higher education system in East Africa has been undergoing revolution from the colonial to when African countries signed the Arusha convention to facilitate staff and student mobility through the continent, and the emergence of the European Higher Education Area (EHEA) through the Bologna process.

The East Africa Community needs a straightforward way to gather information about the academic life cycle, human resources, assets, and finance from all degree-awarding higher education within the EAC region. Then the EAC through the IUCEA will use that information to make decisions concerning the evolution of high education in the EAC region. That will be possible by developing a web-based data-driven University Information Management System (UIMS) for IUCEA, the second module of EACHEIMS.

## **1.3 Rationale of the Study**

The conviction that education is one of the most powerful and proven engines for sustainable development is reaffirmed by achieving inclusive and high-quality education for all. The purpose of education is to achieve the success of a society which we can define as measuring how successfully the community meets the needs of its members (Bass, 1997).

However, there is a lack of a Common Higher Education Area (HEA) for the East African Community (EAC) in awareness of the need to harmonize the region's education and training



systems. A tool needed by the Inter-University Council for East Africa (IUCEA) as the leading EAC institution for an exemplary common higher education space.

This project aims to develop the web-based data-driven University Information Management System (UIMS) for the IUCEA, the second module of the East African community High Education Information System (EAC HEIS).

## **1.4 Objectives**

### **1.4.1 Main Objective**

To develop the web-based data-driven University Information Management System (UIMS) for IUCEA.

### **1.4.2 Specific Objectives**

- (i) To collect requirements for developing the proposed system.
- (ii) To develop the proposed web application and integrate it with the first module's database.
- (iii) To test and validate the performance of the developed system.

## **1.5 Research Questions**

This project aims to respond to the questions below:

- (i) What is required to develop the web-based data-driven University Information Management System (UIMS) for IUCEA and integrate it with the first module of EAC HEIS?
- (ii) What are the features for developing the proposed web application system to manage a massive volume of data?
- (iii) Is the developed system working as anticipated?

## **1.6 Significance of the Study**

This project will contribute to the development of the EACHEIS, which will be all about electronic resource planning, integrated education management information system, and

knowledge management in the EAC region. Furthermore, it will help address suitable solutions to the high education questions in the EAC region.

## **1.7 Delineation of the Study**

Developing the UIMS for the East African Community involves writing code and a lot of work and deep research about its implementation. Even if the report concerns that the proposed system has already specified types of data the system needs to handle, the project's scope has remained huge. First, to decide the framework to collect data among the two proposed by the report. To determine if the data collected will be stored in aggregated or disaggregated format. All decisions should be upon a study done in the region since the report did not decide; instead, the possible ways have been proposed.

Resource limitations such as lack of time, small budget, delay of the budget, and lack of experience have been the leading cause of not putting live the developed system. The period of six months and the Corona-Virus disease 2019 (COVID-19) situation in Kampala, Uganda, has been the leading cause of not realizing all required on the system analysis stage. Furthermore, the project's budget was small and has delayed for two months which caused the delay of many activities. Finally, a lack of experience working on big projects has been time-consuming since much time has been spent learning instead of working on the project.

The project's background has been explained in Chapter One. The project objectives and questions have been identified, and the value of such a project argued. The limitations of the project have also been discussed. Chapter Two reviews the existing literature to determine the current system and the critical value our system will have. Chapter three discusses the materials and methods needed to foster the proposed system. Finally, the results and discussion are reported and discussed in Chapter four.

## CHAPTER TWO

### LITERATURE REVIEW

#### 2.1 Overview of High Education in Africa

Education is vital for the economic development of any country. No country will guarantee endogenous and property development while not adequate education and analysis establishments provide an important mass of mean and educated individuals (Astakhova *et al.*, 2016). Therefore, every economy needs vital education, research, and development.

Education changes depend on time and the environment; it is a socialization process that integrates individuals within a social context. Africa has started the model education and has created universities that date back to the colonial era. The recent ones have been started under the patronage of former colonial powers (Portugal, France, Belgium, and the United Kingdom) (Pellaud *et al.*, 2019). The University of London, for example, has branches in Sierra Leone's Fourah Bay College, the Nigeria's University of Ibadan, the United Kingdom's University of Salisbury, Ghana (the contemporary University of Harare), and Rhodesia's College of Rhodesia (now College of Zimbabwe). University of Yaoundé, Dakar, Brazzaville, and Abidjan are among the French institutions with "African campuses (Alemu, 2011).

With technology advancement, the current trend of university education is characterized by internationalization and globalization of higher education, leading to increased student and staff flows across borders. Domination of English as popular research and instruction, setting up offshore campuses and leveraging advanced technologies to provide education (Ogachi, 2009). The marketplace for university education is highly complex and calls for innovativeness and proper strategic direction.

With this complexity, East African Partner states have come together and identified the need for harmonizing education and training systems in East Africa to promote the free movement of labour within the region. To achieve this, IUCEA was identified as the institution to develop mechanisms and frameworks for ensuring the harmonization agenda. Information at the regional level is required for IUCEA to promote the harmonization of education and training institutions.

### 2.1.1 Status of High Education in EAC

#### (i) Burundi

Burundi's population is about 11 million people (Yaya *et al.*, 2020). It has a gross enrolment rate of approximately 4% (World Bank, 2021). The oldest University in Burundi is the University of Burundi (and presently, Burundi has two public Universities and nine private universities) (Wikipedia, 2021).

#### (ii) Kenya

Kenya's population is about 52 million people (National Council for Population and Development [NCPD], 2020). It has a tertiary, gross enrolment rate of approximately 11% (World Bank, 2021). The oldest University in Kenya is the University of Nairobi which was earlier the University of East Africa (Oketch *et al.*, 2008). Presently, Kenya has 74 institutions, as shown in Table 1 as extracted from Commission for Universities-Kenya.

**Table 3: Growth trend in the number of universities licensed in Kenya**

University Category	2016	2017	2018
Public Chartered Universities	23	30	31
Public Universities Constituent Colleges	8	4	6
Private Chartered Universities	17	18	18
Private Universities Constituent Colleges	5	5	5
Private Universities with LIA	12	12	14
Registered Private University	1	0	0
<b>Total</b>	<b>66</b>	<b>68</b>	<b>74</b>

#### (iii) Rwanda

Rwanda's population is about 12 million people, with a tertiary enrolment of about 6.2 % (World Bank, 2021). The University of Rwanda is the oldest in Rwanda. Rwanda has 26 private

universities and two public universities, i.e., the University of Rwanda and the Institute of Legal practice and development (Higher Education Council [HEC], 2021)

**(iv) South Sudan**

South Sudan's population stands at about 11 million people (World Bank, 2021), with no data publicly available for tertiary enrolment. Presently South Sudan has five public universities and 13 private universities, but only four are recognized (Kuyok, 2017).

**(v) Tanzania**

Tanzania's population is approximately 58 million people, with a tertiary enrolment rate of approximately 3% (World Bank, 2021). The oldest university in Tanzania is the University of Dar es Salaam, an East African college. Currently, there are 34 fully-fledged universities, 15 university colleges, and 11 university campuses, centers, and institutes (Tanzania Commission for Universities [TCU], 2021).

**(vi) Uganda**

Uganda's population is approximately 44 million people (World Bank, 2019), with a tertiary enrolment of about 4% (World Bank, 2014). Makerere University in Uganda is the oldest university in Uganda. Currently, Uganda has about 39 private universities and 11 public Universities (Ochwa-Echel, 2016).

### **2.1.2 Status of Internet Development in EAC**

Internet use in the East African Community (EAC) region is without challenges, such as the high cost of broadband (Ayoo, 2009). As a result, East Africa is cut off from global economic and information possibilities provided by the Internet. Simultaneously, the majority of the earth is linked to many underwater fiber optic cables, giving the most cost-effective way to connect. Unfortunately, East Africa is one of the only places in the world without a fiber optic link, forcing it to rely on satellite communication at high costs (Goldstein, 2008)

There have been efforts to bridge this gap. One of them is SEACOM, a Mauritius-based business that has committed \$ 650 million to link Djibouti, Kenya, Tanzania, and Mozambique to Madagascar, South Africa, across a distance of 15 000 km. Furthermore, the East African undersea cable system will extend 9900 km with a capacity of 20 gigabits per second, while

the East African maritime system will cover 4887 km from the United Arab Emirates. Mombasa, Kenya is a place where people come together (Ayoo, 2009). Also, internet usage (percentage of the population) among East African Community countries has increased steadily for the past ten years, as shown in Table 4.

**Table 4: Internet usage for the past 10 years in EAC**

Country	Internet Usage in 2009 (%)	Internet Usage in 2019 (%)
Burundi	0.9	2.661
Kenya	6.1	22.565
Rwanda	7.7	21.768
South Sudan	3.83 (2013 data)	7.977
Tanzania	2.4	25
Uganda	9.78	23.707

## **2.2 Information and Communication Technology for High Education**

Clarkson (2002) categorizes Information and Communications Technology (ICT) as the impact on what is learned, how, when and where students learn. In terms of what is learned, the World Bank recognizes the widespread belief that ICT can empower teachers and students, transforming teaching and learning methods from strong teacher dominance to student-centered. Students will benefit from this transition because it will allow them to enhance their creativity, problem-solving abilities, informational reasoning skills, communication skills, and other thinking skills (World Bank, 2008).

### **2.2.1 Benefits of using ICT in High Education**

Technology has drastically changed higher education; there is now the existence of virtual classrooms and the possibility for eLearning systems in terms of Massive Open Online Courses. In terms of education management, Information Communication and Technology enables people to lay out their educational and professional achievements to provide transparency on qualifications, rewards, and regulated experiences to members of the public

and employers (Qualification Register [QR], 2021).

Information Communication and Technology also promotes students' mobility; someone can email a prospectus university abroad and receive instant communication. In addition, massive Online courses and degree programs are now delivered online without physically needing to be at the university.

### **2.2.2 Challenges of using ICT in High Education**

Barriers to using ICT in University education are extrinsic or intrinsic barriers (Ertmer & Hruskocy, 1999). Access, time, support, resources, and training are examples of extrinsic hurdles, while attitudes, beliefs, behaviors, and resistance are examples of intrinsic barriers (Al-Alwani, 2005). Extrinsic obstacles, on the other hand, are those that are tied to organizations rather than people, whereas intrinsic barriers are those that are related to instructors, administrators, and individuals.

In the work of other scholars, they divided the obstacles into two general categories: Barriers at the school and the level of the teacher. For example, Salehi-Isfahani (2012) categorized the obstacles into two categories: those affecting the person (teacher-level obstacles) and those affecting the establishment (school-level barriers). A teacher's lack of self-confidence is a teacher-level barrier, whereas a school's lack of practical training in tackling technical difficulties is a school-level obstacle.

### **2.3 Existing System**

The study made by Richardson *et al.* (1998), examines the influence of policy environments, system design, and leadership on the performance of state higher education systems, using case studies of seven large and diverse state higher education systems: California, Florida, Georgia, Illinois, Michigan, New York, and Texas. Starting with an overview of the evolution of state higher education governance structures. This study presents and illustrates the differences in system design and policy environments among states. The study presents the state context; characteristics and history of higher education; the design of the higher education-state government interface; and work processes which include the information management, the budget process, program planning and review, and system articulation. This study has reported that the difference between the performance observed across the seven systems is related to system design and policy environments. The lack of direct communication between the system

and universities is the main problem with the functionality of the system. The system got different information that was supposed to do the same thing.

The study made by Cranfield and Taylor (2008) at seven UK higher education institutions focus on knowledge management. Even with the complexity of Higher Education Institutions within the United Kingdom, the institution has insisted the universities in today's knowledge economy with the dichotomy of priorities that aims to provide quality teaching and research activity. This study does not involve the use of ICT in the process of knowledge management which involve the waste of time. The lack of ICT in the process causes hard work in the evaluation of the process since the record is not well-tracked.

Gulf Cooperation Council (GCC) nations have integrated the use of ICT into their education systems, according to the research made by Wiseman and Anderson (2012). Internationally, ICT-based education has been a driver for the development of national innovation systems (NIS) and RDI capacities. The study shows that the GCC countries have the institutional capacity in ICT which is not used for knowledge development because of limitations imposed by the cultural contexts for education in the Gulf. Finally, this study recommends ways that GCC teachers can use ICT to create national innovation systems and research capacity.

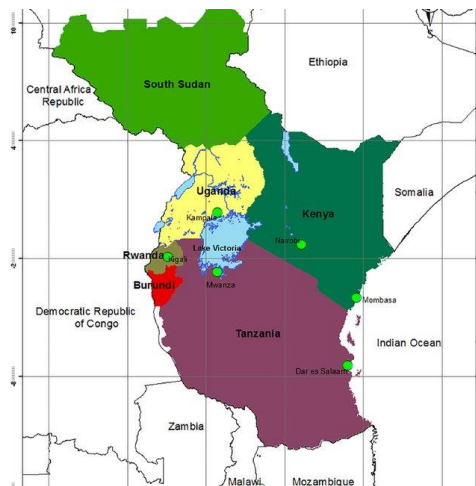


## CHAPTER THREE

### MATERIALS AND METHODS

#### 3.1 Scope of the Project

The project's scope is to create a web-based platform for IUCEA called “*East African Community University Information Management System (EAC UIMS)*” to manage the information from all degree-awarding higher education in the EAC region. The project will collect and manage the academic life cycle, human resources, finance, and assets of all degree-awarding high education in the EAC region. In addition, the project will allow the application of new universities to work with IUCEA. On top of that, the project will allow EAC Citizens to access public information from universities. Last but not least, the project will work as a tool for harmonization and decision support in the EAC region.



**Figure 4: Map of the East African community region**

#### 3.2 Data Collection Methods

Methods to collect data may be quantitatively dealing with count data or qualitative methods that consider factors other than numerical values. Both data collection methods, qualitative and quantitative, have been conceded (Allen-Meares & Lane, 1990). During the industrial outreach and internship, data were collected within five weeks, from June to July 2021. Data were available in the final report on the Status of the EAC HEIS submitted by individual consultant Prof. Venansius BARYAMUREEBA in July 2020 to the IUCEA used for the quantitative data collection method. Other techniques used in this study were document analysis, interviews, Joint Application Design (JAD), Brainstorming, and Prototyping as described:

### **3.2.1 Document Analysis**

According to the International Classification of Qualitative Data (ICQD), document analysis is one of the qualitative data gathering methodologies (Bowen, 2009). The three primary types of documents analysis, as defined by Zina (2021) have been used to support decision-making when choosing the type of data EAC UIMS will handle:

- (i) Like an open report about the education of deferent national commissions in Africa and worldwide, public records have been used to categorize the data those institutions request from high education institutions.
- (ii) Personal documents like newspapers, journals, blogs, and emails have saved costs and time during the development stage.
- (iii) Physical evidence about EAC HEIS within the IUCEA, including the final report on the Status of the EAC HEIS submitted by individual consultant Prof. Venansius BARYAMUREEBA in July 2020 to the IUCEA, has been analyzed and used to support the data capturing decision-making stage.

### **3.2.2 Interviews**

An interview defined as a face-to-face conversation between two individuals can be semi-structured, structured, and unstructured (Gill *et al.*, 2008). Interview technic has been used to support the need for new ideas about EAC UIMS; unstructured interviews have been organized, involving different IUCEA employees from different departments. The main objective was to understand how IUCEA works and add value to the developed system.

### **3.2.3 Joint Application Design (JAD)**

Chuck Morris and Tony Crawford from IBM came up with the Joint Application Design (JAD). Collaborative workshops, known as JAD sessions, are used to design and create applications with input from the client or end-user (Davidson, 1999).

Joint application design sessions have been organized involving several employees within IUCEA and other experts in education from outside of the institution. In addition, the opening session has been organized between the ICT department and other facilitator departments of the IUCEA. Furthermore, the opening session has organized several meetings between the

IUCEA's ICT department and each National or Commission for High Education within EAC. However, unfortunately, all the meetings did not happen because of the COVID-19 pandemic.

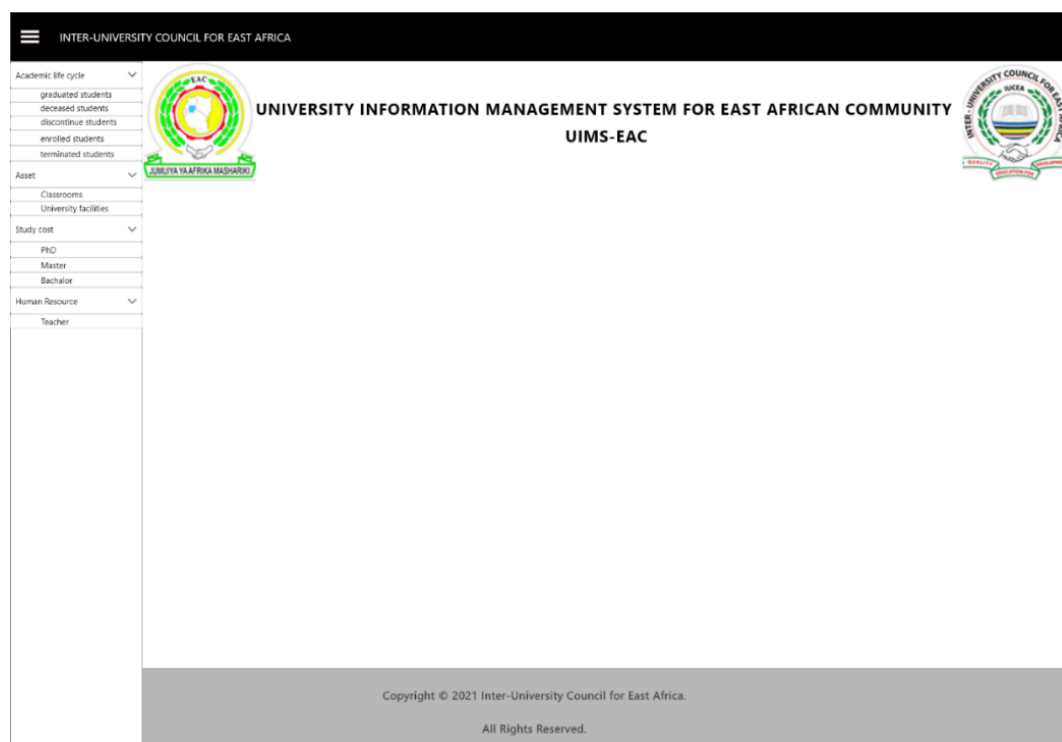
Weekly online JAD session has been organized between the ICT department and other education experts. During those JAD sessions, the ICT department presented the progress of the EAC UIMS to the Executive secretary of IUCEA, who also contribute to the analysis stage of the system.

### 3.2.4 Brainstorming

Brainstorming is defined as generating ideas and sharing knowledge (Rawlinson, 2017). This method has been involved in all JAD sessions organized to develop the specific designs and requirements for the system.

### 3.2.5 Prototyping

Prototyping defines as an experimental method wherein design teams put into effect thoughts into tangible bureaucracy from paper to digital (Budde *et al.*, 1992). During the prototyping stage, Adobe XD has been used for the startup design. Figure 5 shows the startup design of the public dashboard.



**Figure 5: Prototype view of the public dashboard (Adobe XD product)**

### 3.3 Requirements Analysis

The requirement engineering process describes that the next stage is requirement analysis after requirements elicitation or gathering. Both functional and non-functional requirements have been analyzed to understand the requirement of the proposed system.

#### 3.3.1 Functional Requirements

Functional requirements describe the developed system's performance task, operation, and service behaviors from the user's perspective (Glinz, 2007). Graphic User Interface (GUI), log in and logout functionalities, and right to Create Read Update Delete (CRUD) functionalities on the database of different sub-modules of the system by different types of users have been used to categorize the functional requirements for the proposed system.

**Table 5: Functional requirements of the proposed system**

S/N	Requirements	Description
1	Login and logout	All degree-awarding or NCHE and system admin have a different portal to access the database. Therefore, the system should authenticate them to access the data.
2	Create Read Update Delete (CRUD) information about the academic program, academic life cycle, asset, human resource, and finance submodules.	All degree-awarding or HCHE in each EAC's national will apply CRUD functions to the academic program, academic life cycle, asset, human resource, and finance information submitted by them.
3	View information about the academic life cycle, human resource, and finance submodules	In comparison and statistic view, anyone will view public information about universities concerning academic life cycle, human resources, and finance.
4	View information about the assets and other private information from different system submodules.	IUCEA can view a deep analysis of all information submitted, including assets information.
5	Apply to be among all degree-awarding	New universities or existing high education students will be among all degree-awarding working with IUCEA.

### 3.3.2 Non-Functional Requirements

Non-functional requirements set the criteria and define the performance attribute to the system according to how the system has to function; it defines how the system is supposed to be (Chung *et al.*, 2012). Finally, the table describes all quality attributes the developed system will have.

**Table 6: Non-functional requirements of the proposed system**

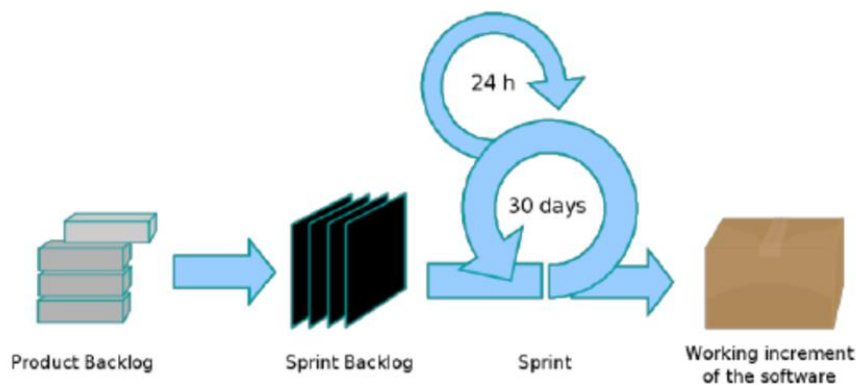
No	Requirements	Description
1	Security	The system should permit only authenticated universities to access and modifier information submitted by these universities. Each university should view and modify the information concerning their universities.
2	Robustness	The system has been developed to reduce the impact of operational mistakes, hardware errors, and erroneous input data.
3	Testability	The system has been developed upon different frameworks which accept the modularity and Structuredness approach. Therefore, the testability of the developed system depends on it.
4	Usability	The proposed system should be usable to IUCEA and let the institution automate many actions in high education. In addition, IUCEA should enjoy the easy way to operate the system should bring.
5	Learnability	The system should be easy to use and follow all rules of user experience design. In addition, the system should be designed to understand it and know what it has been built for without reading many things.
6	Reusability	The proposed system should fulfill all functions defined in the final report about the high education information system.
7	Performance	The system will support numerous statuses concurrently and handle different users without disappointment.
8	Maintainability	The system shall be suitable for debugging, the extension of functionality, and modification. In addition, the proposed system should allow the integration of new technology and easily update the functionality.
9	Extensibility	The system shall allow required modifications at the appropriate locations to be made without undesirable side effects.

### 3.4 Agile Software Development

During the development of this project, we will use the agile development methodology for a continuous iteration of the development and testing of the variable prototype. There will be a continuous improvement at each system stage (Abrahamsson *et al.*, 2017). Among the different approaches to agile software development such as scrum, crystal methods, adaptive software development, extreme programming, and learning development.

#### 3.4.1 Scrum Agile Methodology

During the development of this project, we will use the Scrum agile methodology approach to have good management of time since this methodology evaluates the progress of the project day by day.



**Figure 6: Diagram of Scrum agile method (Way *et al.*, 2009)**

### 3.5 Architectural Design

This section explores the detailed design of the proposed system. It will present the conceptual design, use case diagram, data flow diagrams, and Entity Relationship diagram of the system.

#### 3.5.1 Conceptual Design

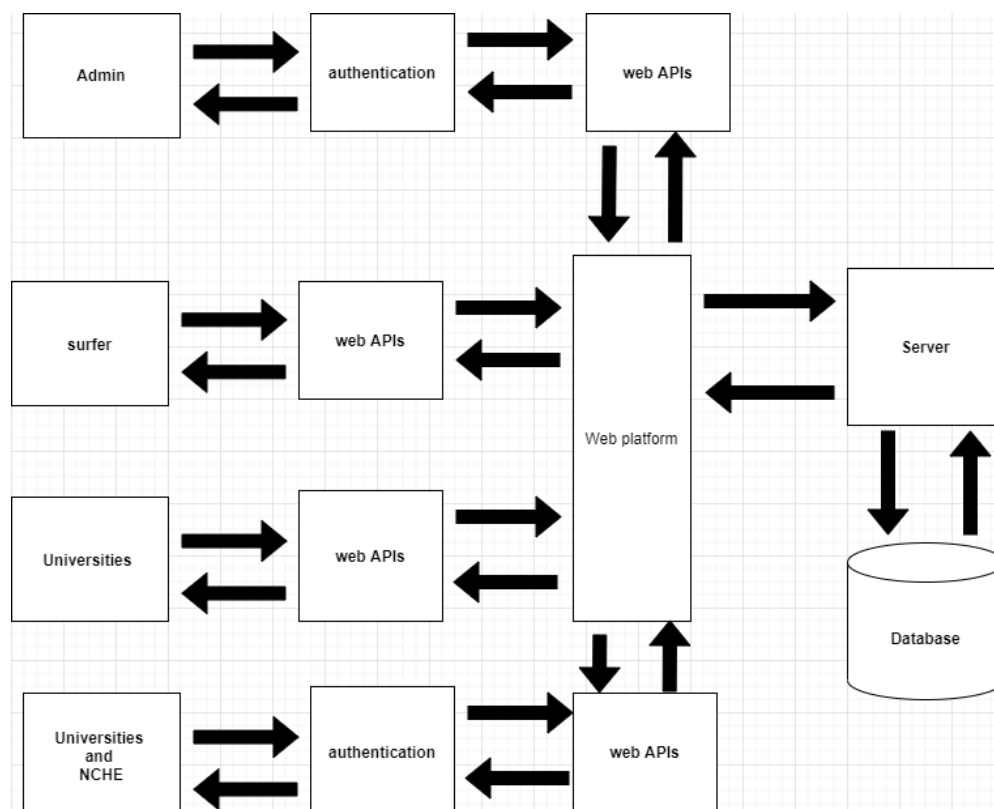
The assessment and analysis of functional and non-functional requirements have brought to the next step, the conceptual design. The conceptual design is defined by Andreasen *et al.* (2015) as an umbrella term given to all forms of non-aesthetic design management displaces. The main lines of software function and form are established at this step of the design process. The design of encounters, experiences, processes, and tactics follows. Finally, it entails comprehending

people's wants and figuring out how to answer them via goods, services, and business processes: design artifacts, conceptual drawings, and models.

The proposed web-based university information management system will manage four types of users; the overall admin, Universities, National or Commission for High Education (NCHE), and Surfer. All those users will be able to access the information of universities concerning academic life cycle, human resources, assets, and finance with different rights on it.

The authentication is required for the overall admin to manage all information concerning universities. The Overall admin will manage all modules EAC HEIS contain. Universities will be able to apply for being among all degree-awarding higher education within EAC. The authentication will be required for all Degree Awarding High Education and each national commission or council for high education within the East African community to feed data needed by the system.

Surfer will be able to access the public information of universities within the East African community concerned academic life cycle, finance, and staff. Figure 7 presents the conceptual diagram developed to give the visual shape to a proposed system.



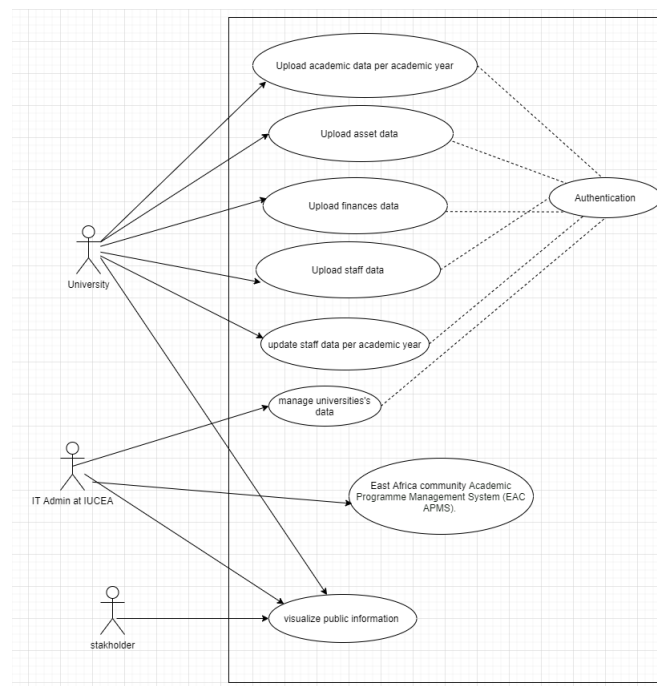
**Figure 7: Conceptual diagram of the proposed system**

### 3.5.2 Use case Diagram

After analyzing the system features and requirements, a case diagram was designed through a function and non-functional requirement. The use case diagram is among the tools used in software requirement specification (SRS) documentation to gather the system's requirements.

However, the use case diagram is one diagram among the behavioral diagrams of Unified Modeling Language (UML). UML has more than 14 diagrams to model application structures, software solutions, business processes, and system behavior. Use cases help structure the user's needs and the corresponding goals of a system and focus on expressing the system's requirements. The use cases identify the system's users, also called actors, and their interactions. They make it possible to classify the actors and structure the system's objectives. An actor represents a role played by a person who interacts with the system. When an external person, process, or item interacts with a system, they perform the role of an actor (Gomaa, 2011).

During the proposed system development, a use case diagram has been used to support the Scrum methodology for requirement definition. In addition, a brief study of the system to be put in place allowed us to identify the players and the corresponding use cases. Figure 8 shows the use cases designed for the proposed system.

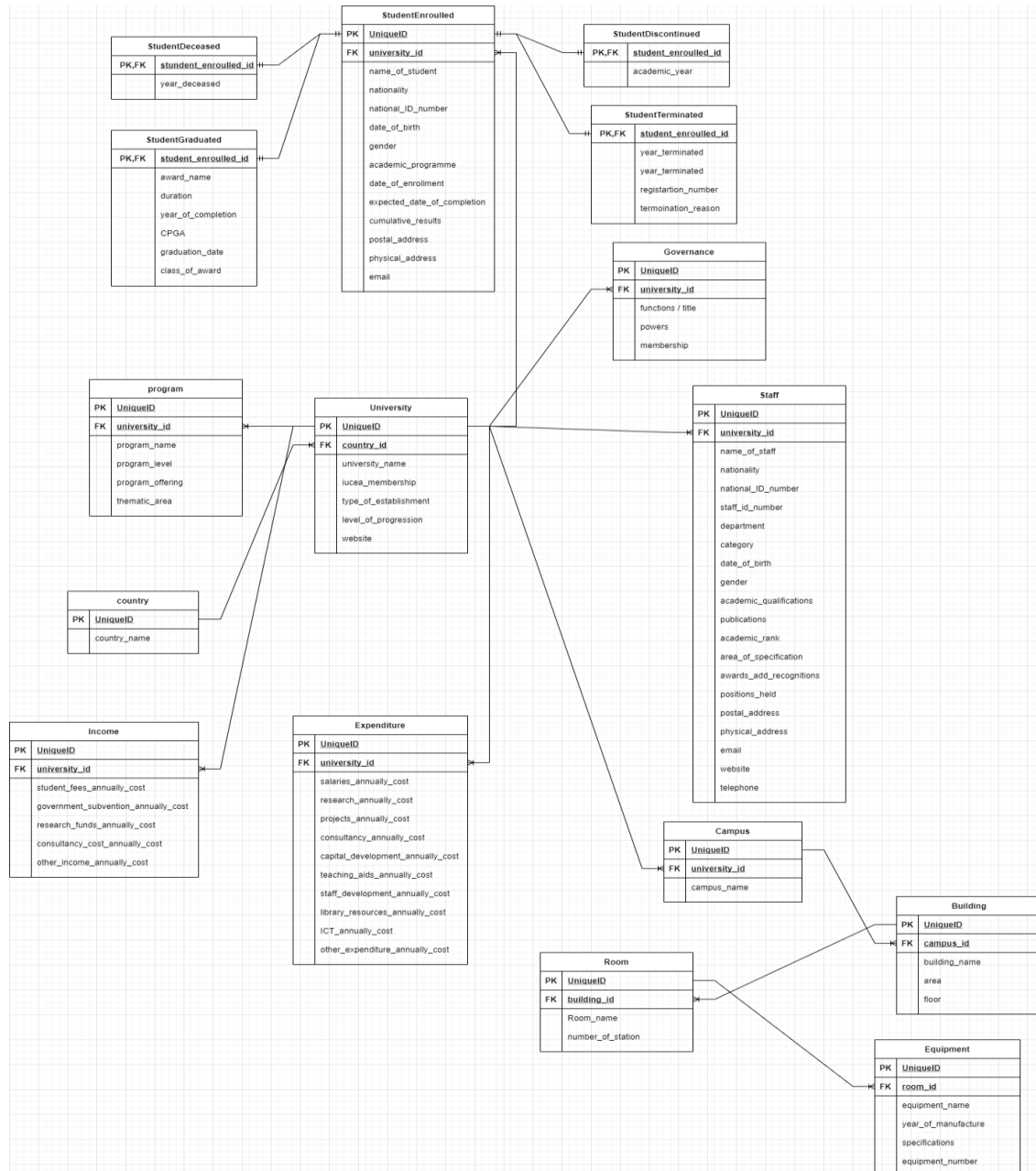


**Figure 8: Use case diagram of the proposed system**



### 3.5.3 Entity-Relationship (ER) Diagram

During system design ER diagram as a structure, diagram has been used to display the relationship between entities. In addition, ER diagram has been used to support the Scrum methodology to explain the logical structure of databases. Figure 9 shows the entity-relationship diagram of the proposed system, which displays the entail system's entities, attributes, and relationships.



**Figure 9: Entity-Relationship (ER) Diagram of the proposed system**

### **3.6 Tools and Technologies in System Design and Implementation**

This section explores the tools and technologies used to develop the proposed system. It starts by describing different technologies from their history and the current state of those technologies, and finally, this section will describe the tools used to develop the proposed system.

#### **3.6.1 Web Technology**

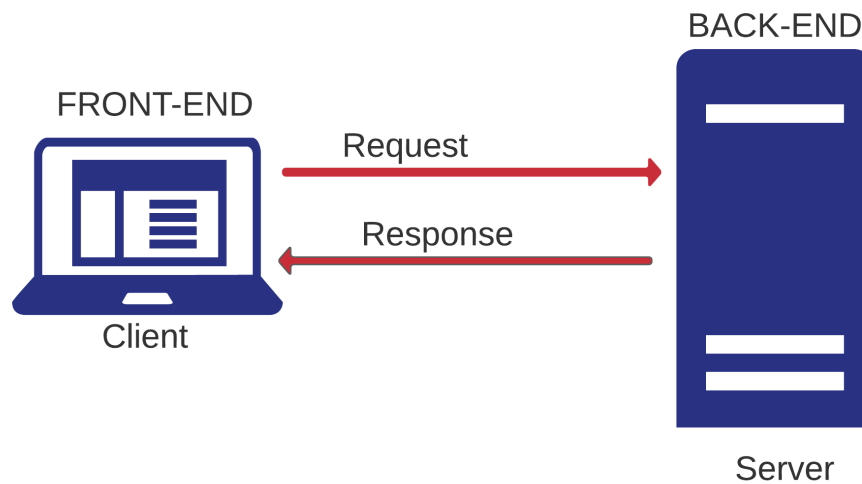
In a nutshell, web technologies are related to the markup languages that computers and other devices use to interact with one another via the internet. A hypertext markup language (HTML) is used to communicate over the web and to create, transport, or manage online content (HTML) (Berners-Lee *et al.*, 1994).

There is a big difference between the world wide web (WWW) and the Internet. The Internet is a global network that connects computers all over the world. Many protocols enable computers connected to the Internet to communicate with one another, including Hypertext Transfer Protocol (HTTP), Simple Mail Transfer Protocol (SMTP), File Transfer Protocol (FTP), Internet Relay Chat (IRC), Instant Message (IM), Telnet, and Peer-to-Peer (P2P). Interconnected hypertext pages and applications may be found on the WWW, which can be accessed over the Internet, usually using HTTP (Hitzler *et al.*, 2009; Gralla, 1998).

The web has a long history behind it. In 1969 the ancestor of the Internet called Arpanet was created. It was a military network that wanted to be decentralized (with no central command Center). The network then evolved into a place of academic exchange before gradually becoming mainstream under the name of the Internet. In 1972 emails to exchange messages appeared. Moreover, the web was created in 1991 to display information on pages (Meier-Brügger, 2010).

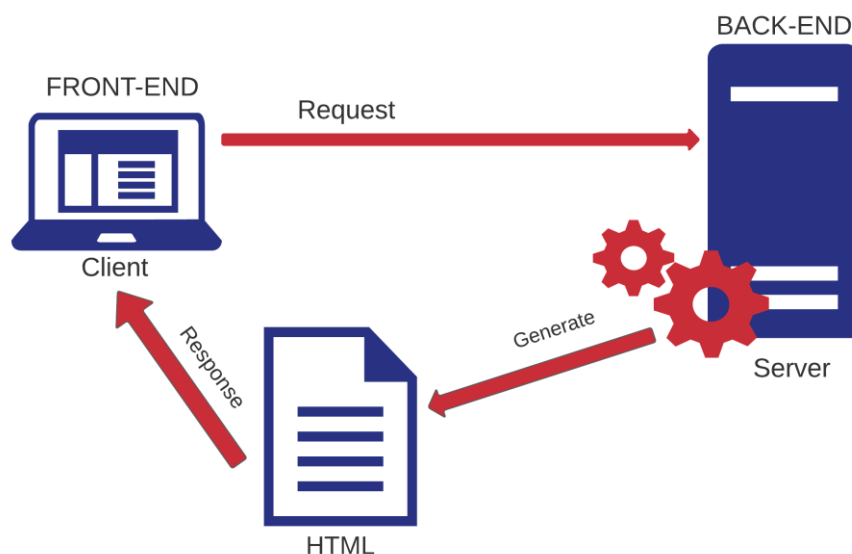
When we talk about web technology, we have two types of computers called Server or Backend and Client or Frontend, which must communicate through the Internet. The backend is the part that runs on a web server and is responsible for data processing and validating business rules. The frontend is the part that is loaded inside a web browser on a client machine; it is the part that the user sees and interacts with. Hypertext Transfer Protocol (HTTP) governs this flow of information. Servers and clients may interact with each other using it. The client makes an

HTTP request to the server and gets a response in the form of an HTTP message (Luck *et al.*, 2004).



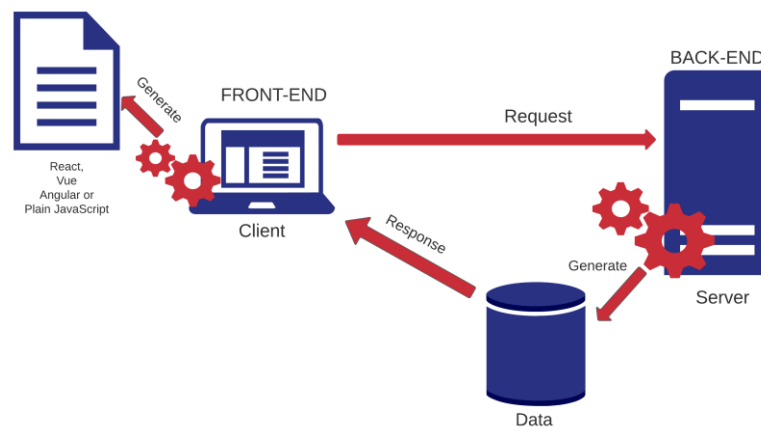
**Figure 10: General concept of web technology**

To build the backend for the website, we need to decide how we will respond to clients. The server might produce the requested page and send it back to the client. To do this, our team uses HyperText Markup Language (HTML). In HTML, web pages and their content are expressed using a basic markup language. Technically, the server generates the page and returns an HTML document to the client.



**Figure 11: First approach of responding to the client by generating an HTML file**

Returning just the information required to create the requested page and letting the client do the rest is the second option you have. Instead of putting a complete page or a complete HTML document in an HTTP response, we only return the data. This approach frees up the server, enables it to serve more clients, and makes it more scalable. The server becomes a gateway to the data. On the server, we can provide endpoints that the client can talk to get or save various pieces of data. Together, these endpoints represent the clients' interface to talk to the server. The server provides an API or an application programming interface to the client in technical terms.



**Figure 12: The server generates data, and the client generates a file to present data**

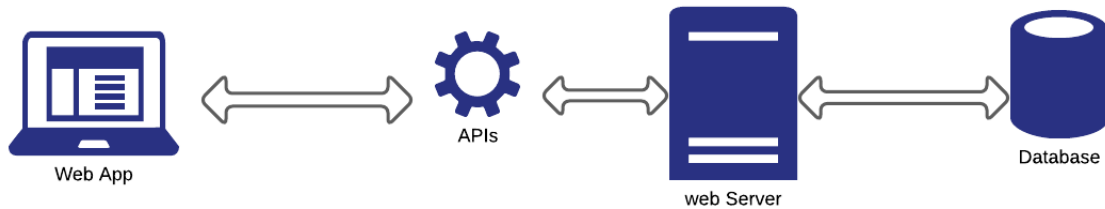
To develop the client-side (Frontend) of the proposed system, react has been used for generating web pages on the client, and the server-side (Backend) has been developed using Django.

### 3.6.2 Web APIs

Application Programming Interface (API) is an interface for software, a point where two programs may meet and interact. The term API is often used to name the whole software product, including the API and its implementation (Robillard, 2009).

We have two main API types: hardware and software APIs. The software APIs are also divided into remote APIs and local APIs. Web APIs are remote APIs that may be used with the HTTP protocol. The web APIs can be public APIs or personal APIs. Public APIs are designed as the product or service by others; they do not construct, run, or install them; however, they use them. Public APIs are provided to anyone who needs them and is willing to accept the terms and conditions of the third-party supplier. Depending on the business model of the API providers,

such APIs can be free or paid for, just like any other software product. On the other hand, a private API is built for a company or institution; only applications developed by the company or teams inside the company use it. In this case, they are API providers and API consumers (Henning, 2007).



**Figure 13: Illustration of the web APIs programming**

The whole point of using an API is to make it easy for people to achieve their goals, regardless of the programming part. There have been, and there will be, many different ways of exposing data and capabilities through software; also, as different ways of enabling software to communicate over a network. For example, RPC (Remote Procedure Call), SOAP (Simple Object Access Protocol), REST (Representational State Transfer), gRPC (Google Remote Procedure Call), or GraphQL are different technologies used to create web APIs. Some are architectural styles, and others are protocols or query languages (Paternò & Santoro, 2019).

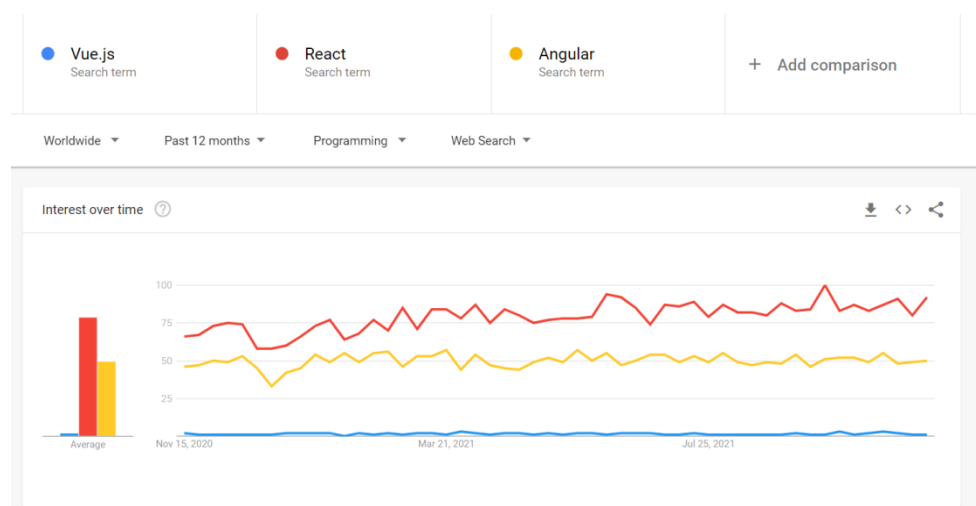
The REST style has been used to develop the private web APIs for the proposed system. REST is an architecture first proposed in 2000 by Roy Fielding in his PhD dissertation thesis. It is an approach to building APIs that relies on HTTP protocol. Software architecture must comply with the following six constraints in others to become RESTful as described by Patni (2017):

- (i) Client and Server separation: client and server must be separated and allow communication between them. Once a web application and its API server are integrated, it should be possible to clearly distinguish between the two.
- (ii) Statelessness: The request itself contains all of the information needed to carry out a task. During consultation between requests, no consumer context is kept on the server.
- (iii) Cache ability: Requested information must describe what can be saved and how long it will be saved, so the client doesn't have to repeat the process.

- (iv) Layered system: When a user interacts with a sensor, the server is the only thing they can see. There is only one layer of the system that is visible to the end user.
- (v) Code on demand: Servers may deliver executable code to clients (such as JavaScript); this constraint is optional.
- (vi) Uniform interface: All interactions must be driven by the idea of resources that have been recognized and may be managed via representations of resources in various stages of use. Information on the resources and their uses must be provided as part of standard method interactions.

### 3.6.3 React

JavaScript's React library allows developers to quickly and interactively create user interfaces. The most widely used JavaScript library for developing user interfaces was created by Facebook in 2011. React is the most used library and framework for creating user interfaces, according to Google trends. Angular and vue.js are the other two contenders (Gackenheimer & Paul, 2015).

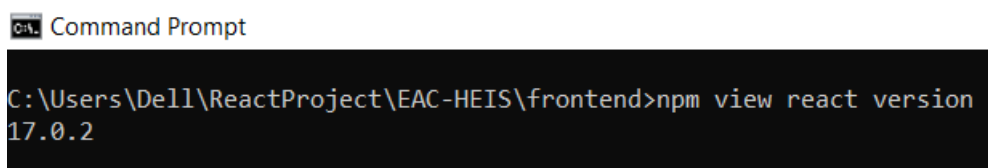


**Figure 14: Trend between Angular, vue.js and React**

As a user interface component, a component is at the center of all react activities. When using React to develop applications, we generate a large number of small, independent apps and then combine them to make larger, more complicated apps. The root component is a need for any React project. This component serves as a container for all of the other components that make up the application as a whole (Gackenheimer & Paul, 2015).

A JavaScript class including a render function and some state is used to design and build a component. When a component is drawn, the render function describes how the User Interface should appear based on the data in the component's state. As a result of the rendering technique, a JavaScript object that responds to a document object model item is generated (DOM). It's only a JavaScript object that represents it in memory, not an essential part of the DOM. The virtual DOM is React's lightweight version of the DOM in memory. When it comes to creating a virtual DOM, it's a lot easier than creating an actual one. For each component that we alter, we receive a React element, which is compared to the previous one to determine what has changed; subsequently, React updates a portion of the real-world DOM to match the virtual one. For this reason, we don't require the DOM API in browsers when building apps with react, unlike vanilla JavaScript and Query. That is to say, no code in Query or DOM manipulation is required, nor are DOM elements or event handlers required to be attached. As a substitute, we can just make changes to the state of our components, and React will take care of updating the DOM accordingly. In addition, this library is named React because react responds to the state change and changes the DOM (Jensen *et al.*, 2009).

React and angular are similar in component-based architecture; however, angular is a framework or a complete solution, while React is a library. React renders the view and makes sure the view is in sync with the state. For this very reason, react has a minimal API to learn. When building applications with React, we need to use other libraries or things like routing or calling HTTP services, and many more. Nevertheless, these are not necessarily bad because we get to choose the libraries we prefer instead of being fixed with what Angular gives us, which often breaks from one version to another (Saks, 2019). React library has been used to develop and implement the frontend side of the proposed system.

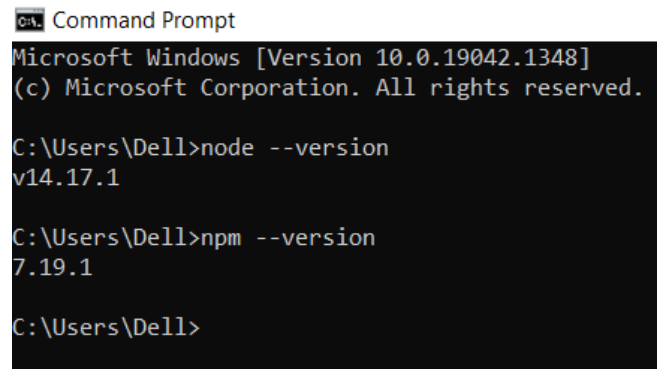


```
Command Prompt
C:\Users\Dell\ReactProject\EAC-HEIS\frontend>npm view react version
17.0.2
```

**Figure 15: React version used to develop the proposed system**

### 3.6.4 Node JS

Node.js is one of the prerequisites to work with React. It is used to manage the project. Figure 16 shows the node JavaScript version V14.17.1 downloaded on NodeJS.org and installed to manage the proposed system.



```
Command Prompt
Microsoft Windows [Version 10.0.19042.1348]
(c) Microsoft Corporation. All rights reserved.

C:\Users\Dell>node --version
v14.17.1

C:\Users\Dell>npm --version
7.19.1

C:\Users\Dell>
```

**Figure 16: Windows, Node JavaScript runtime, and Node Package Manager (NPM) versions used to develop the proposed system**

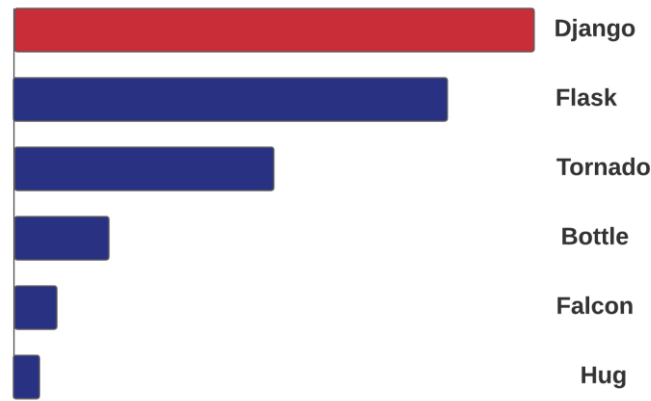
Node JS installation allows us to run the node JavaScript runtime and the Node Package Manager (NPM), an invaluable tool for installing the packages for the project.

### 3.6.5 Django Framework

Django is among the open-source frameworks for building web apps with python. It is maintained by the Django software foundation and was initially released on 21 July 2005 (Forcier *et al.*, 2008). A web framework may be defined as a collection of modular tools that abstract the difficulty and repetition inherent in web development. For example, most websites need the same basic functionality. These include setting Uniform Resource Locator (URL) routes, connecting to a database, handling security properly, displaying content on a page, and many more features. Rather than recreate all of this from scratch, programmers have created web frameworks in all the major programming languages (Curie *et al.*, 2019).

Django is not only the web framework for python; there are many and many more; in comparison, Django is the most popular one and old, which helps build a website in less time with few lines of code (Chouhan *et al.*, 2020). Figure 17 compares Django and other web frameworks such as Flask, Tornado, Bottle, Falcon, and Hug.



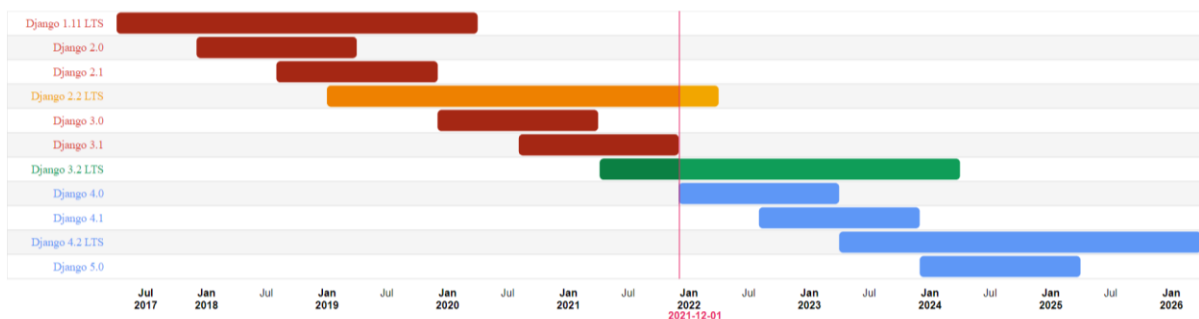


**Figure 17: Comparison of Web framework built with python by popularity**

Django is what we called batteries included, which means it comes with many features:

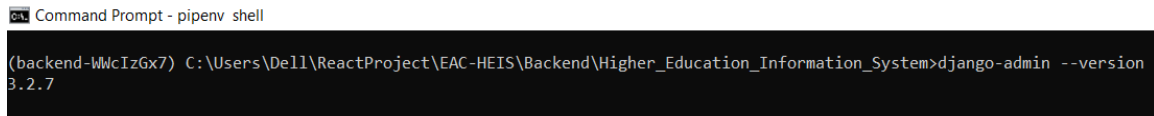
- (i) Admin site gives us an admin interface for managing data which is a huge time saver.
- (ii) Object-Relational mapper (ORM) allows the machine generates database tables based on the application's classes and abstract database. We can query or process data without writing a lot of Structured Query Language (SQL) code.
- (iii) Authentication package for identifying users.
- (iv) It also has a package for caching data.

The current Django version is 3.2.7, released on 1 September 2021. Figure 17 represents the Django released cycle from 2017 to 2026 as reported by the (<https://jefftriplett.com/django-release-cycle/>) website visited on 2 December 2021.



**Figure 18: Django release cycle on <https://jefftriplett.com/django-release-cycle/>**

The proposed system has used the current Django framework to develop the system's backend. Django combined with Django REST Framework library has been used to develop all web APIs the system will need to interact with the frontend side.

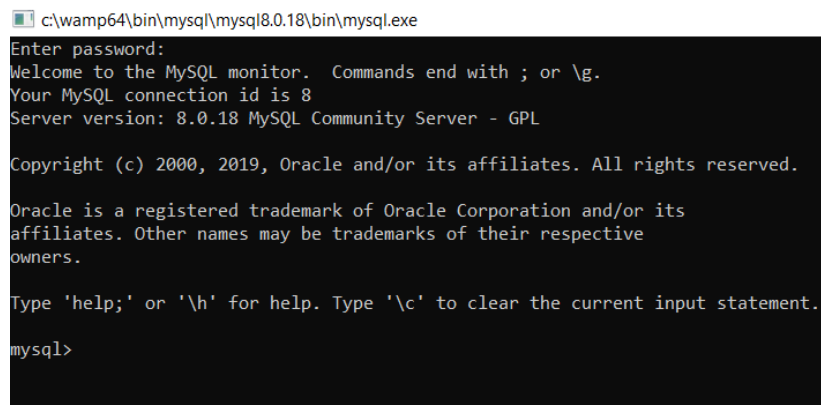


```
Command Prompt - pipenv shell
(backend-WwCIZGx7) C:\Users\Dell\ReactProject\EAC-HEIS\Backend\Higher_Education_Information_System>django-admin --version
3.2.7
```

**Figure 19: Django framework used to develop the proposed system**

### 3.6.6 MySQL

MySQL is an open-source relational database management system (RDBMS) that is developed, distributed, and supported by oracle corporations (Christudas, 2019) (Malecha *et al.*, 2010). MySQL's name is a combination of "My," one of the names of the co-founder Michael Widenius's daughter, and "SQL," the abbreviation for the Structured Query Language (SQL). MySQL has been chosen for the proposed system among many relational database management systems because it is free and popular, and many companies use it to store information.



```
c:\wamp64\bin\mysql\mysql8.0.18\bin\mysql.exe
Enter password:
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 8
Server version: 8.0.18 MySQL Community Server - GPL

Copyright (c) 2000, 2019, Oracle and/or its affiliates. All rights reserved.

Oracle is a registered trademark of Oracle Corporation and/or its
affiliates. Other names may be trademarks of their respective
owners.

Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.

mysql>
```

**Figure 20: The version of MySQL server installed for the development of the proposed system**

### 3.6.7 Visual Studio code

The visual Studio code editor has been used to develop the proposed system. It is an extensible code editor free and developed by Microsoft for Windows, Linux, and Mac OS. It offers various features, including debugging assistance, integrated Git, intelligent code completion, syntax highlighting, snippets, and refactoring of existing code.

## CHAPTER FOUR

### RESULTS AND DISCUSSION

#### 4.1 Results from Data Collection

Different IUCEA members deal with direct questions about high education responded that: *“There is a need of East African Community University Information Management System able to manage academic life cycle, human resource, asset, and finance data to help IUCEA in knowledge Management (KM) and electronic resource planning (ERP) within EAC region. Moreover, the system should be able to manage information and advice or help IUCEA in decision making.”*

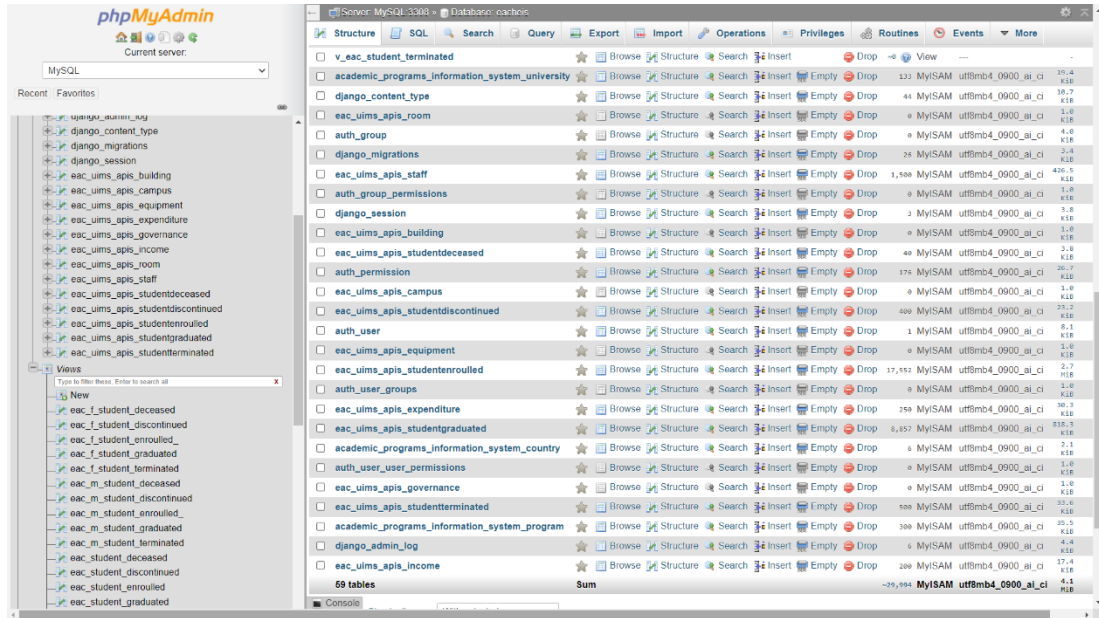
The IUCEA was tasked with operationalizing the EAC Common Higher Education Area. For IUCEA to effectively implement the EAC Common Higher Education Area, there is a need to establish a one-stop live repository for information and data on higher education status and dynamics in the region. IUCEA can generate regional reports for the Partner States and also member universities.

#### 4.2 Result of the Backend Design and Implementation

The backend consisted of database models, URLs, and views that interacted with the frontend templates of HTML, Cascading style sheet (CSS), and JavaScript that controlled the presentational layout of each web page if using the MVC (Model Control View) approach. In addition, the frontend will interact with the backend via URLs called endpoint or web APIs. This section will present database and web APIs designed to build the backend of the proposed system.

##### 4.2.1 Database Design Section

The database has been developed based on the existing database for the first module of EACHEIS. In addition, different tables to store aggregated data from all degree-awarding about the academic life cycle, assets, governance, finance, and human resource have been added to the existing database. Further, the database has been implemented on a MySQL server to store and retrieve relational data using the MyISAM database engine. Figure 21 presents some of the 59 tables and views of the whole database of the developed system.



**Figure 21: Database of the proposed system viewed through phpMyAdmin**

#### 4.2.2 Web APIs Design Section

Different web APIs to communicate with the developed database have been designed for the proposed system. Further, all Web RESTful APIs for the proposed system have been developed using Django and Django RESTful framework libraries. Django RESTful framework provides the visualization by default. Figure 22 shows the endpoint which GET and POST the student information.

**Figure 22: Web API to manage students enrolled**

Fig. 23 shows the endpoint to manage some hypertext transfer protocol (HTTP) verbs which GET, POST and DELETE the student deceased information. This endpoint helps the specific high education to upload, update and retrieve information about student deceased in a specific academic year.

Django REST framework

Student Deceased Capture

OPTIONS GET

GET /api/v1/students\_deceased

HTTP 200 OK  
Allow: GET, POST, HEAD, OPTIONS  
Content-Type: application/json  
Vary: Accept

[ ]

Raw data HTML form

Student enrolled id

Year deceased

POST

**Figure 23: Web API to manage students' deceased**

Fig. 24 shows the endpoint which will retrieve, update and register information about graduation. It corresponds to GET, POST and UPDATE in HTTP verbs. Students graduated should be registered by providing their registration number, award name, duration, completion year, their GPA, their award's class and their graduation date.

Django REST framework

Student Graduated Capture

OPTIONS GET

GET /api/v1/students\_graduated

HTTP 200 OK  
Allow: GET, POST, HEAD, OPTIONS  
Content-Type: application/json  
Vary: Accept

[ ]

Raw data HTML form

Student enrolled id

Award name

Duration

Year of completion

CPGA

Graduation date dd/mm/yyyy

Class of award

POST

**Figure 24: Web API to manage students who graduated**

Fig. 25 shows the endpoint to capture the information about discontinued student. it helps to register, delete and update student discontinued in a specific institution. The endpoint will manage HTTP verbs like POST, GET and PATCH.

The screenshot shows the Django REST framework interface for the 'Student Discontinued Capture' endpoint. The title 'Student Discontinued Capture' is displayed at the top. Below it, the endpoint URL is shown as 'GET /api/v1/students\_discontinued'. The response details are listed: 'HTTP 200 OK', 'Allow: GET, POST, HEAD, OPTIONS', 'Content-Type: application/json', and 'Vary: Accept'. The response body is an empty array '[]'. At the bottom, there is a form with two input fields: 'Student enroulled id' (a dropdown menu) and 'Academic year' (a text input). A 'POST' button is located at the bottom right of the form. There are also tabs for 'Raw data' and 'HTML form'.

**Figure 25: Web API to manage students discontinued by academic year**

Fig. 26 shows the endpoint which manage the student terminated in a specific high education. It all the registration, retrieve and modification functions on student terminated. The HTTP verbs like GET, POST and DELETE are used to manage that information.

The screenshot shows the Django REST framework interface for the 'Student Terminated Capture' endpoint. The title 'Student Terminated Capture' is displayed at the top. Below it, the endpoint URL is shown as 'GET /api/v1/students\_terminated'. The response details are listed: 'HTTP 200 OK', 'Allow: GET, POST, HEAD, OPTIONS', 'Content-Type: application/json', and 'Vary: Accept'. The response body is an empty array '[]'. At the bottom, there is a form with four input fields: 'Student enroulled id' (a dropdown menu), 'Year terminated' (a text input), 'Registration number' (a text input), and 'Termination reason' (a text input). A 'POST' button is located at the bottom right of the form. There are also tabs for 'Raw data' and 'HTML form'.

**Figure 26: Web API to manage students terminated by academic year**

Figures 27 to 31 present different Web APIs developed for assets. Figure 30 and Fig. 31 for human resources and governance.

The screenshot shows the Django REST framework interface for the 'University Capture' API. The top bar is dark grey with the text 'Django REST framework'. Below it, the title 'University Capture' is displayed in a large font. To the right of the title are two buttons: 'OPTIONS' and 'GET'. Below the title, the URL 'GET /api/v1/university\_application' is shown. The main content area displays the HTTP response details: 'HTTP 200 OK', 'Allow: GET, POST, HEAD, OPTIONS', 'Content-Type: application/json', and 'Vary: Accept'. Below this, the response body is shown as an empty array '[]'. At the bottom, there is a form with the following fields: 'University name' (text input), 'lucea membership' (dropdown menu with 'full member' selected), 'Type of establishment' (dropdown menu with 'private' selected), 'Level of progression' (dropdown menu with 'chartered' selected), and 'Website' (text input). A 'POST' button is located at the bottom right of the form. There are also tabs for 'Raw data' and 'HTML form'.

**Figure 27: Web API to register universities among the APIs used to build the application portal**

The screenshot shows the Django REST framework interface for the 'Campus Capture' API. The top bar is dark grey with the text 'Django REST framework'. Below it, the title 'Campus Capture' is displayed in a large font. To the right of the title are two buttons: 'OPTIONS' and 'GET'. Below the title, the URL 'GET /api/v1/asset\_campus' is shown. The main content area displays the HTTP response details: 'HTTP 200 OK', 'Allow: GET, POST, HEAD, OPTIONS', 'Content-Type: application/json', and 'Vary: Accept'. Below this, the response body is shown as an empty array '[]'. At the bottom, there is a form with the following fields: 'Campus name' (text input) and 'University id' (dropdown menu). A 'POST' button is located at the bottom right of the form. There are also tabs for 'Raw data' and 'HTML form'.

**Figure 28: Web API build to capture campus within one university**

Django REST framework

Building Capture

Building Capture

OPTIONS GET

GET /api/v1/asset\_building

HTTP 200 OK  
Allow: GET, POST, HEAD, OPTIONS  
Content-Type: application/json  
Vary: Accept  
[]

Raw data HTML form

Building name

Area

Floor

Campus id

POST

**Figure 29: Web API to manage building within one Campus**

Django REST framework

Room Capture

Room Capture

OPTIONS GET

GET /api/v1/asset\_room

HTTP 200 OK  
Allow: GET, POST, HEAD, OPTIONS  
Content-Type: application/json  
Vary: Accept  
[]

Raw data HTML form

Room name

Room type

Number of station

Building id

POST

**Figure 30: Web API to manage rooms within the building**



Django REST framework

Equipment Capture

Equipment Capture

OPTIONS GET

GET /api/v1/asset\_equipment

HTTP 200 OK  
 Allow: GET, POST, HEAD, OPTIONS  
 Content-Type: application/json  
 Vary: Accept  
 []

Raw data HTML form

Name of manufacture  
 Specifications  
 Equipment index number  
 Location id

POST

**Figure 31: Web APIs to manage equipment within one room within a building**

Django REST framework

Staff Capture

Staff Capture

OPTIONS GET

GET /api/v1/staff\_info

HTTP 200 OK  
 Allow: GET, POST, HEAD, OPTIONS  
 Content-Type: application/json  
 Vary: Accept  
 []

Raw data HTML form

Name of staff  
 Nationality  
 National ID number  
 Staff id number  
 Department  
 Category  
 Date of birth  
 Gender  
 Academic qualifications  
 Publications  
 Academic rank  
 Research grants  
 Awards add recognitions  
 Positions held  
 Postal address  
 Physical address  
 Email  
 Website  
 Telephone  
 University id

POST

**Figure 32: Web API to manage staff information**

Django REST framework

Governance Capture

Governance Capture

OPTIONS GET

GET /api/v1/staff\_governance

HTTP 200 OK  
 Allow: GET, POST, HEAD, OPTIONS  
 Content-Type: application/json  
 Vary: Accept  
 []

Raw data HTML form

Functions or title  
 Powers  
 Staff id

POST

**Figure 33: Web API to manage university’s governance information**

Figure 26 and Fig. 27 show how to manage the finance within universities.

Django REST framework

Income Capture

Income Capture

OPTIONS GET

GET /api/v1/finance\_income

HTTP 200 OK  
 Allow: GET, POST, HEAD, OPTIONS  
 Content-Type: application/json  
 Vary: Accept  
 []

Raw data HTML form

Student fees  
 Government subvention  
 Research funds  
 Consultancy fees  
 Other income  
 University id

POST

**Figure 34: Web API to manage income within the university**

Django REST framework

Expenditure Capture

Expenditure Capture

OPTIONS GET

GET /api/v1/finance\_expenditure

HTTP 200 OK  
 Allow: GET, POST, HEAD, OPTIONS  
 Content-Type: application/json  
 Vary: Accept  
 []

Raw data HTML form

Salaries

Research

Projects

Consultancy

Capital development

Teaching aids

Staff development

Library resources

ICT

Other expenditure

University id

POST

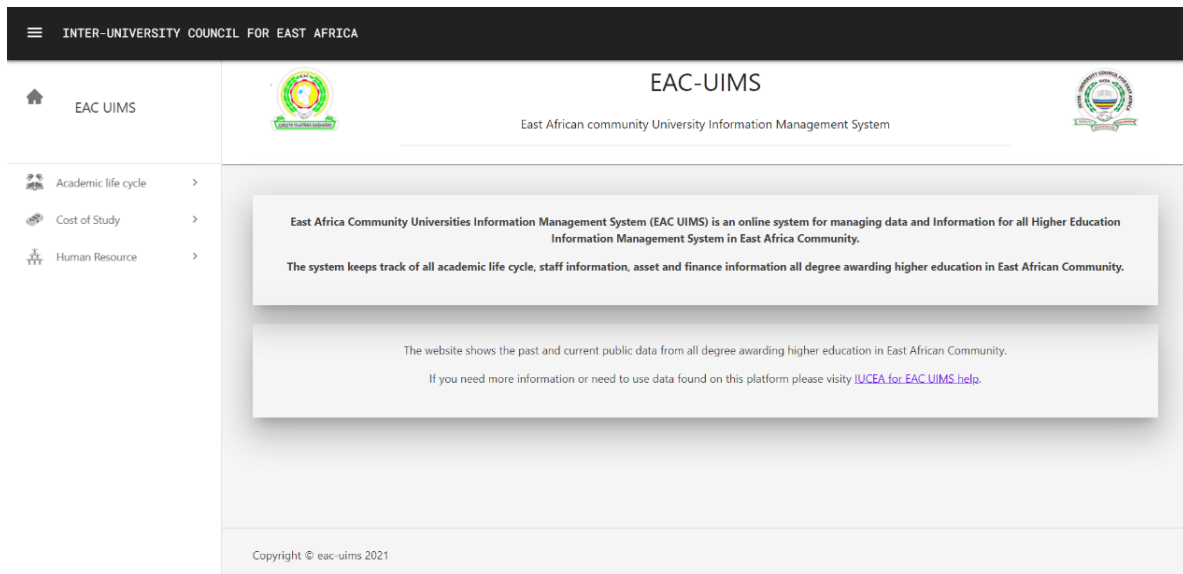
**Figure 35: Web API to manage expenditure within the university**

### 4.3 Result of the Frontend Design and Implementation

This section will present different portals of different system users developed for the proposed system. Those portals will contain labels and buttons, more of them equal to APIs.

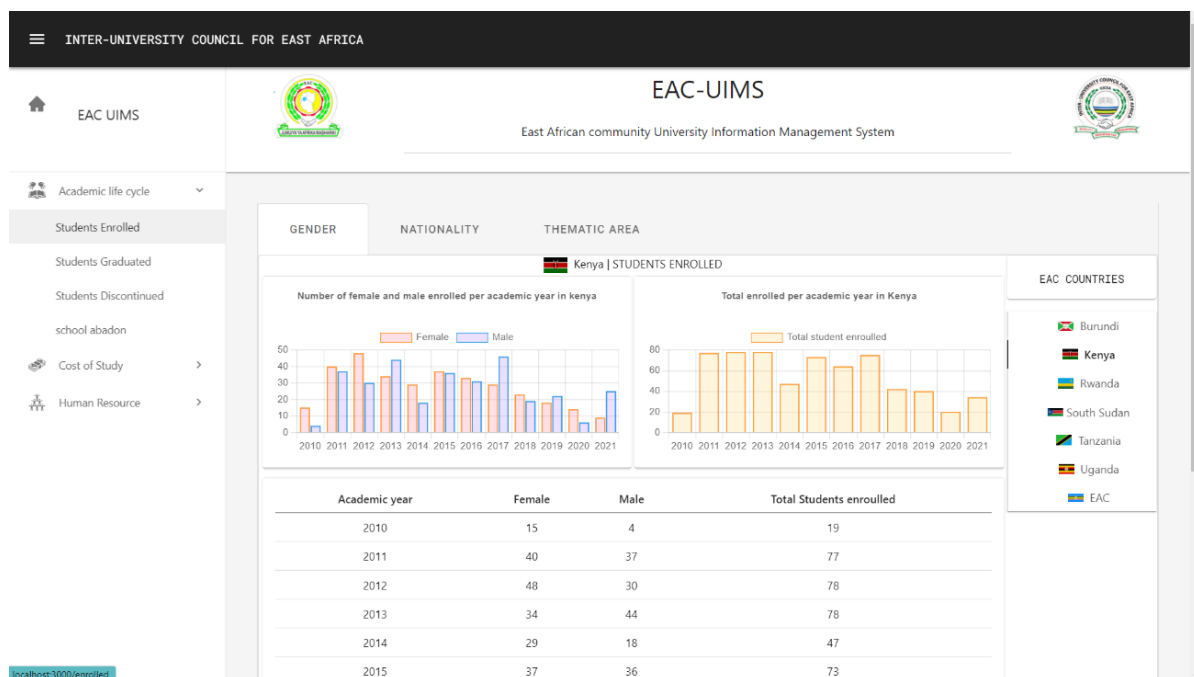
#### 4.3.1 Public Dashboard Design Section

The public dashboard displays public information about universities within the East African Community region to anyone who wants to know. That information is subdivided into three submodules: academic life cycle, cost of study, and human resources. This section summarizes the public dashboard design with some interface and explains the public information the universities within the EAC region will display. The following figure displays the home page of the public dashboard.

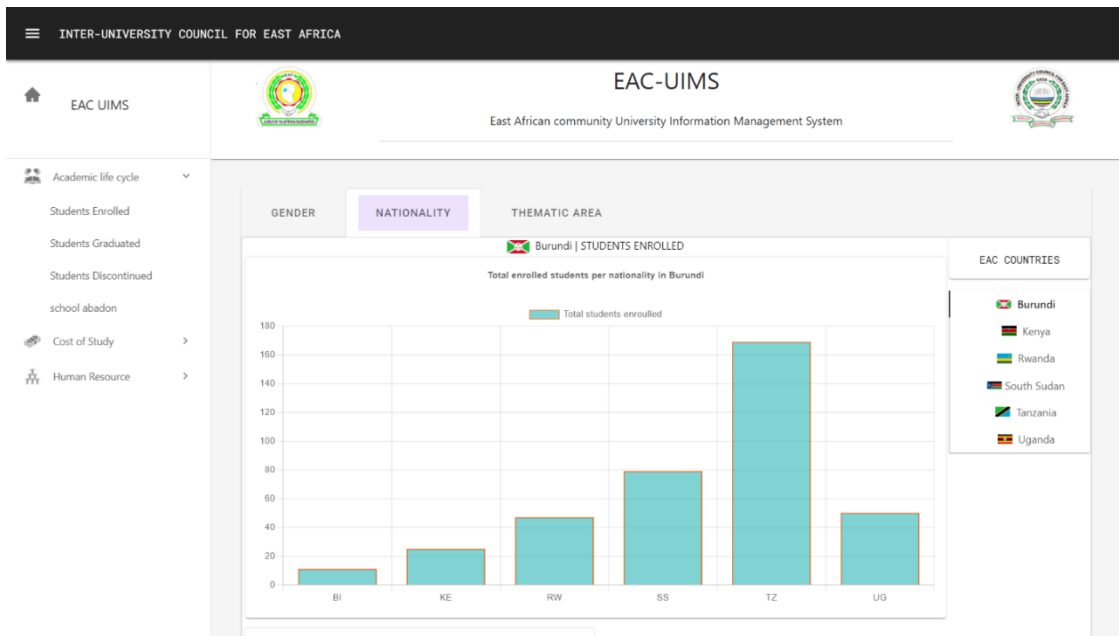


**Figure 36: Homepage of the public dashboard**

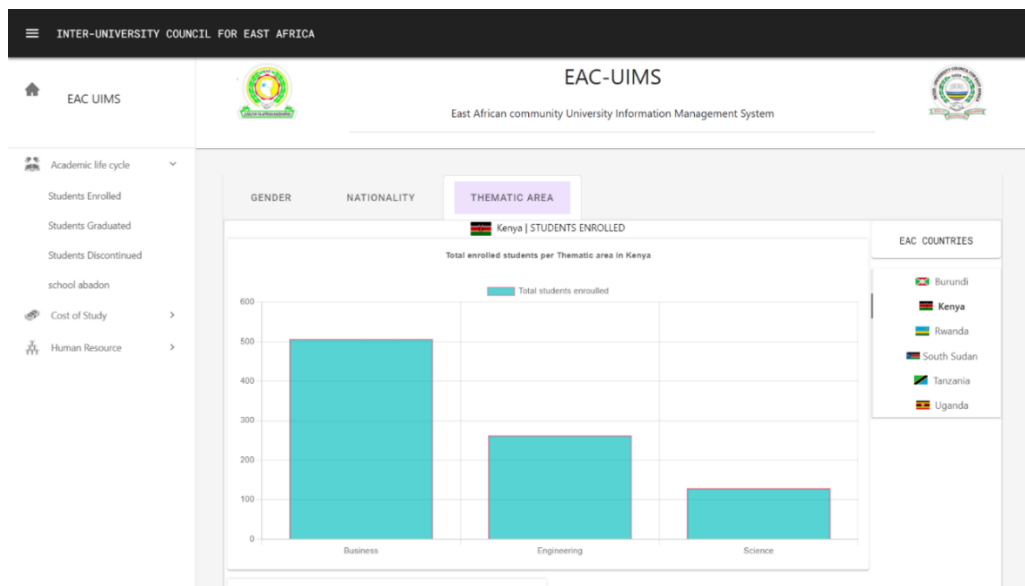
The academic life cycle section displays information about students Enrolled, students who graduated, students who discontinued, and schools abandoned per academic year for each country of the East African community by gender, nationality, and thematic area. For example, the following figures display students enrolled in Kenya by academic year from 2010 to 2021 by gender, nationality, and thematic area.



**Figure 37: Students enrolled in Kenya from 2010 to 2021 academic year by gender**

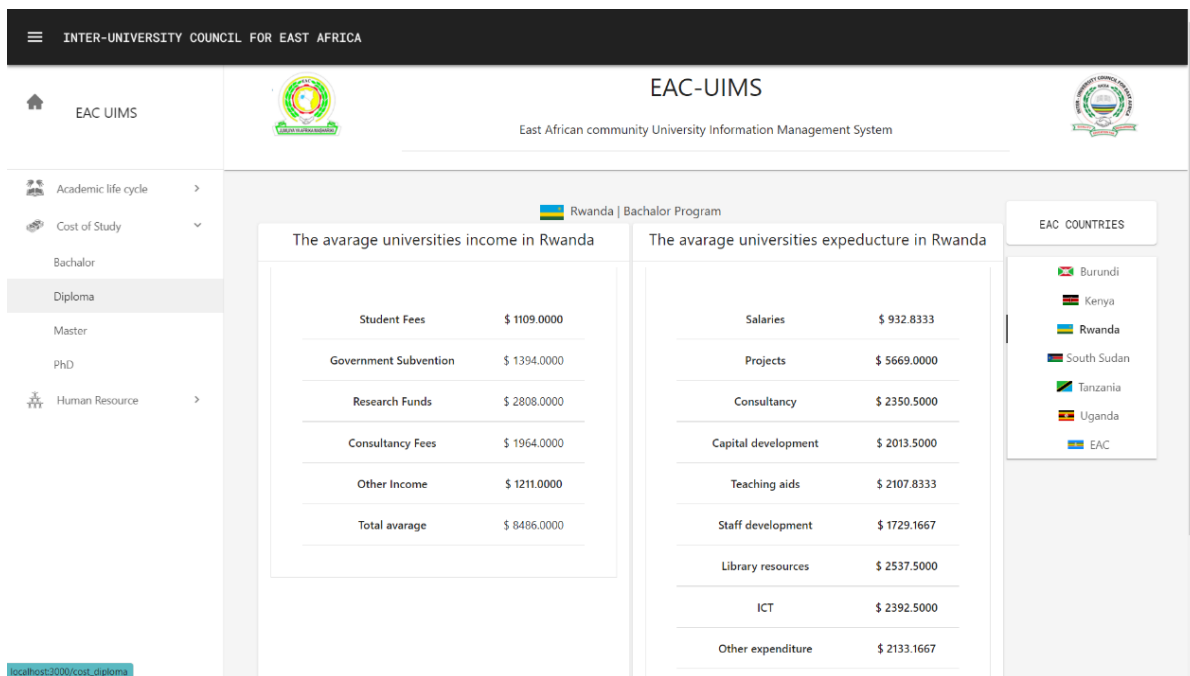


**Figure 38: Students enrolled in Kenya from 2010 to 2021 academic year by nationality**

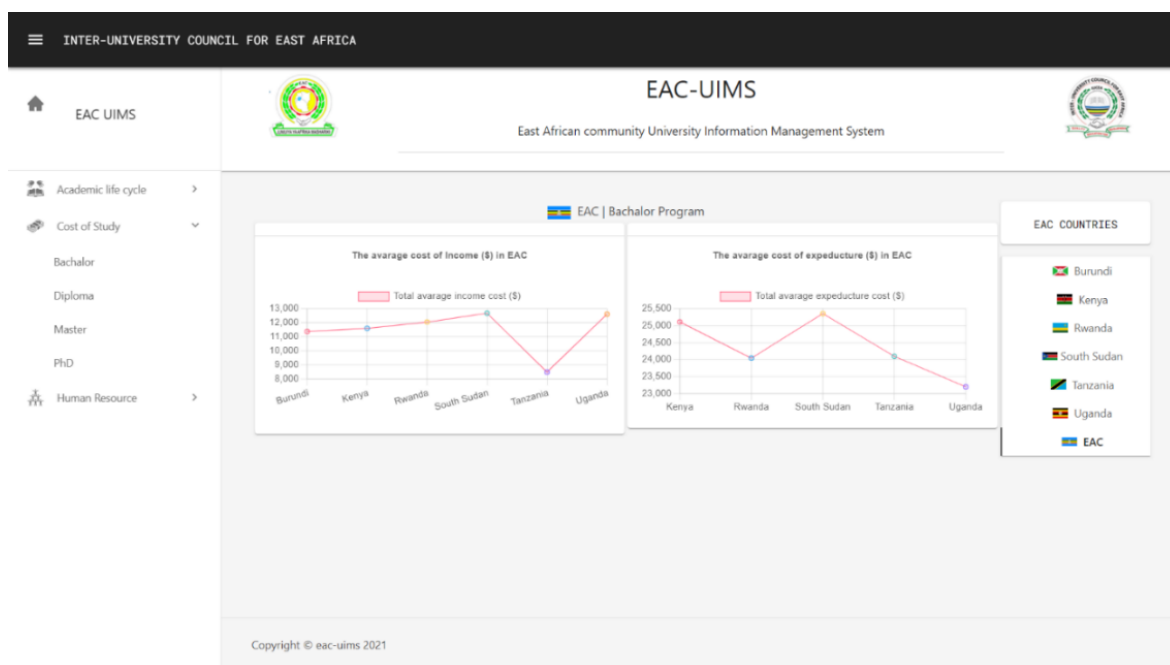


**Figure 39: Students enrolled in Kenya from 2010 to 2021 academic year by thematic area**

The cost of study section displays information about finance in different high education program levels such as bachelor's, diploma, Master's, and PhD. This information gives a picture of the cost of the study within the East African Community region since it displays the average cost of income and expenditure by each country by program level. For example, the following pictures show the average university income and expenditure of diploma level in Rwanda and EAC.

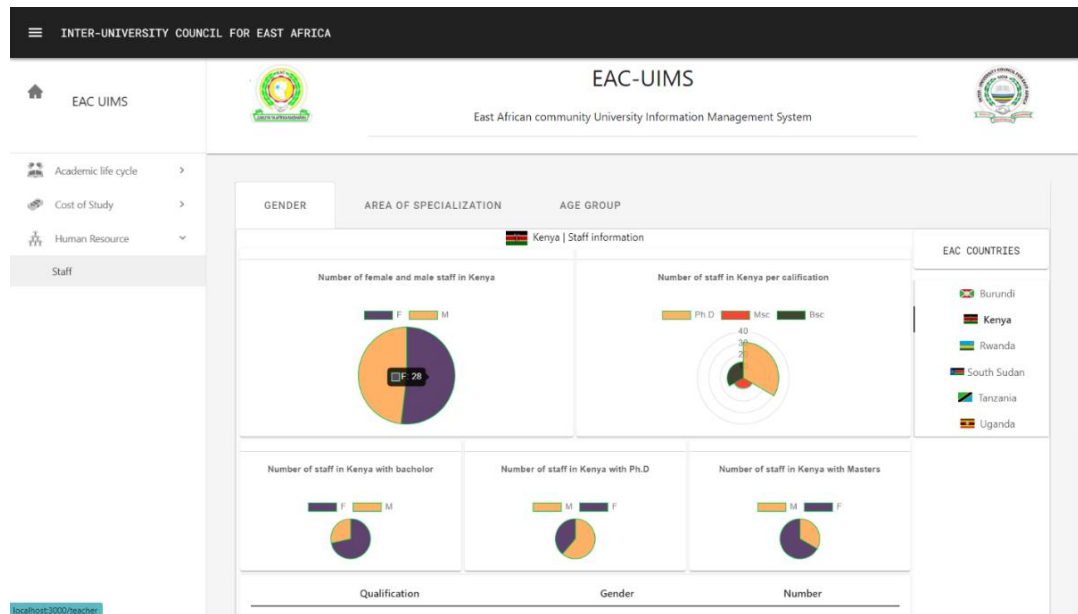


**Figure 40: Cost study of diploma level in Rwanda**

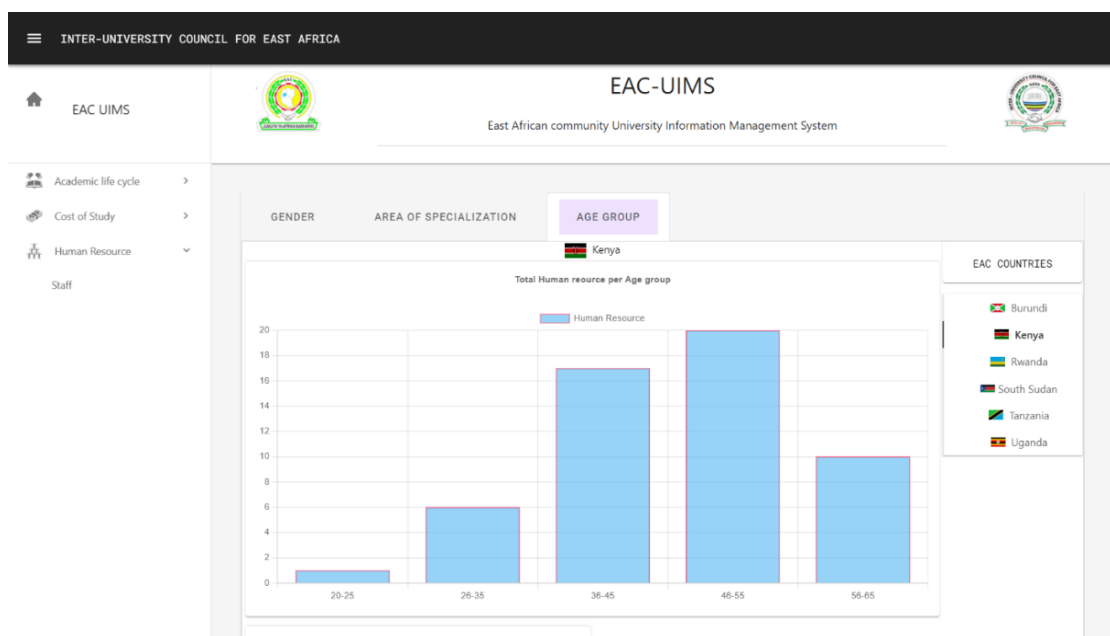


**Figure 41: Comparison of the cost of the diploma level within EAC**

The human resource section displays staff information on high education for each country of the EAC region by gender, area of specialization, and age group. The following figures display staff information in high education by gender, area of specialization, and age group.



**Figure 42: Staff information in high education in Kenya by gender**

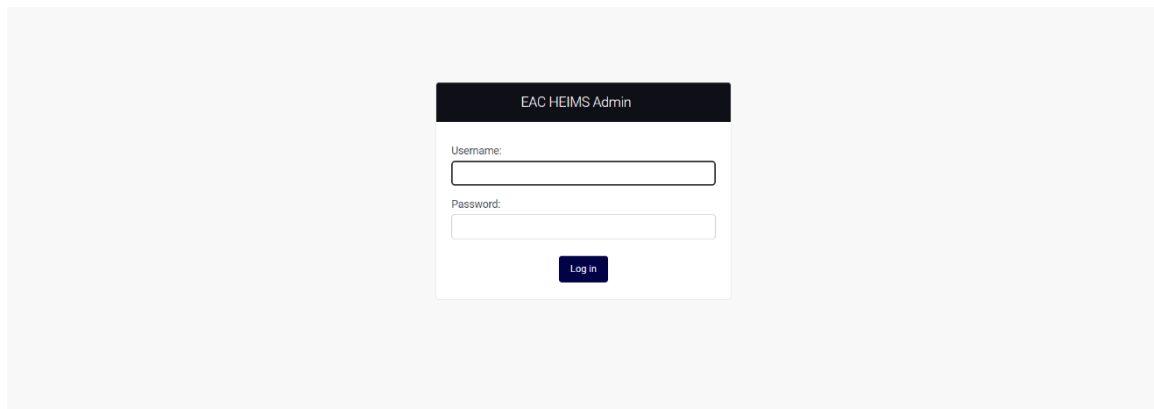


**Figure 43: Staff information in high education in Kenya by age group**

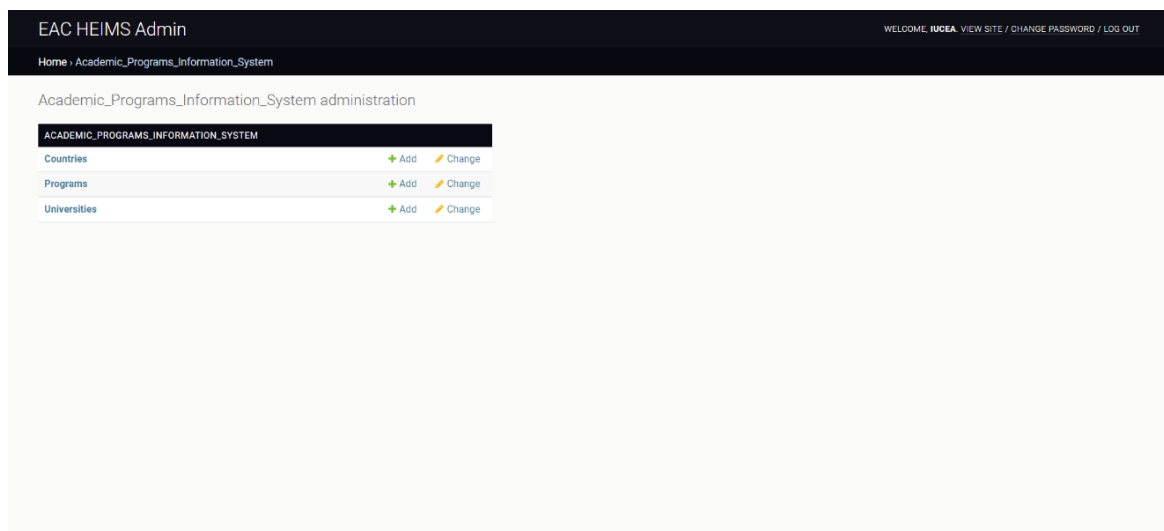
### 4.3.2 Overall Admin Design Section

The overall admin has all rights to the whole system and can do many things. Since EAC UIMS is the second module, the overall admin will be able to access even the first module, EAC PIMS, and other modules will come in the future to complete EAC HEIS. Moreover, an overall admin must be known as a superuser and have limited rights to different information. For example, the overall admin should have the right to create, read, delete, update and generate a

report about high education in East African Community region. Figure 43 to Fig. 46 present different interfaces and functionality of the overall admin portal.

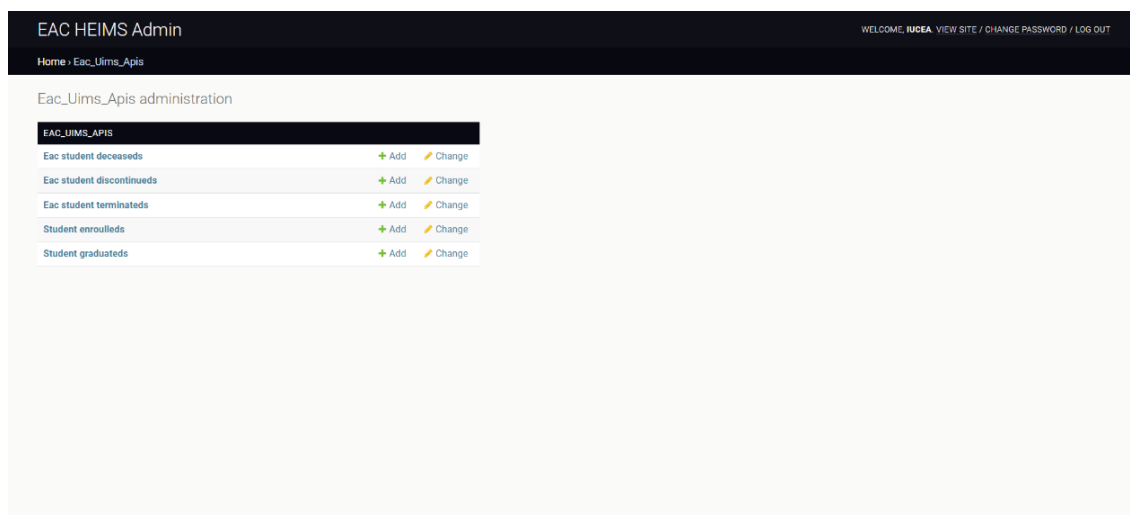


**Figure 44: Authentication page**



**Figure 45: East Africa community APIS view page**





**Figure 46: East Africa community UIMS view page**

Select student enroulled to change

ADD STUDENT ENROULLED +

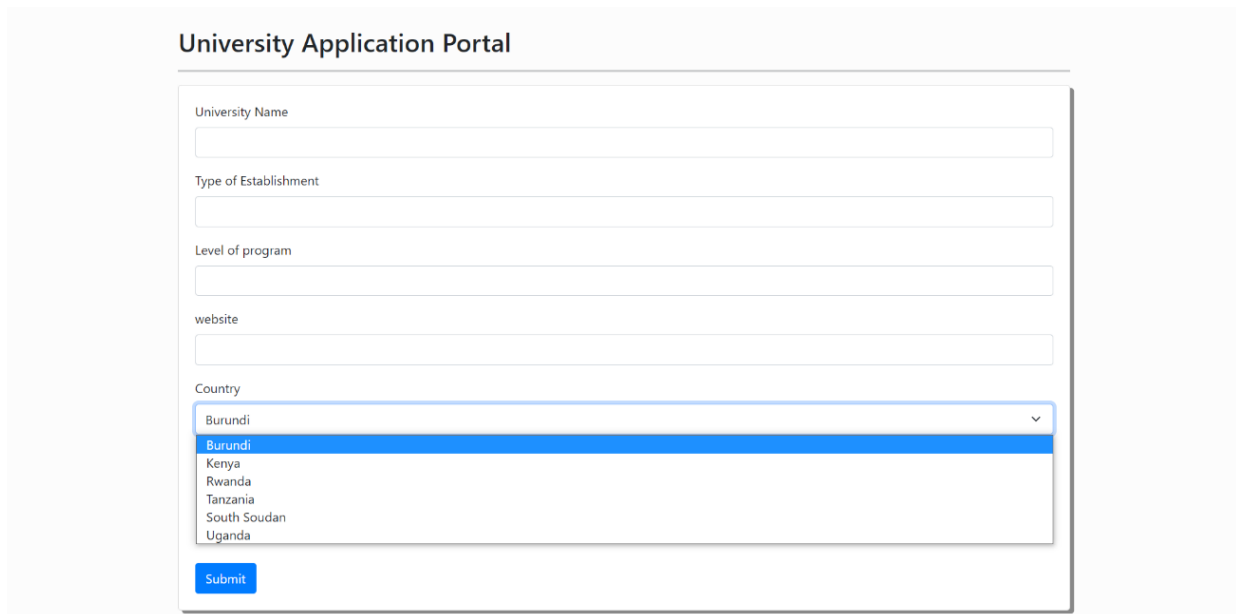
Action:  Go 0 of 100 selected

ID	NAME OF STUDENT	NATIONALITY	NATIONAL ID NUMBER	STUDENT ID NUMBER	DATE OF BIRTH	SEX	ACADEMIC PROGRAMME	DATE OF ENROLLMENT	EXP
<input type="checkbox"/> 11768	Zuzana	Tanzania	61-873-1773	67-887-6831	March 3, 2066	Female	Stronghold	May 9, 2014	Apri
<input type="checkbox"/> 7413	Zulema	Tanzania	69-817-6230	19-520-1546	June 26, 2005	Male	It	April 28, 2013	Jan
<input type="checkbox"/> 8481	Zulema	Tanzania	00-650-6559	34-219-5945	May 6, 2007	Female	Stronghold	Aug. 2, 2014	Aug
<input type="checkbox"/> 10566	Zulema	Tanzania	23-567-4536	86-158-4364	May 14, 2057	Male	Transcof	Dec. 18, 2011	Dec
<input type="checkbox"/> 13685	Zulema	Tanzania	51-573-7633	31-353-0412	July 21, 2026	Male	Andalax	Aug. 20, 2015	Aug
<input type="checkbox"/> 11501	Zea zsa	Rwanda	07-367-2067	88-060-5785	March 28, 2006	Male	Duobam	Dec. 28, 2011	May
<input type="checkbox"/> 8935	Zorine	Tanzania	14-094-6932	68-394-9286	Jan. 23, 2063	Female	Bamity	Dec. 31, 2013	Sep
<input type="checkbox"/> 12197	Zorine	Tanzania	38-438-2933	77-516-2521	Sept. 24, 2055	Male	Candify	Sept. 25, 2011	Apri
<input type="checkbox"/> 8235	Zorina	Rwanda	64-187-3549	24-989-9278	Nov. 30, 2041	Female	Job	May 31, 2011	Jan
<input type="checkbox"/> 13010	Zorina	Tanzania	88-840-1438	32-281-2263	Oct. 13, 2005	Male	Cookley	March 24, 2015	Apri
<input type="checkbox"/> 9730	Zorana	Uganda	60-546-8865	90-640-6210	Jan. 13, 2045	Male	Voltsilam	Jan. 7, 2015	Aug
<input type="checkbox"/> 10611	Zorana	Tanzania	80-295-6385	96-656-5789	Nov. 21, 2034	Male	Vigram	Sept. 30, 2010	Mar
<input type="checkbox"/> 6811	Zorah	Burundi	96-671-3693	54-469-5622	March 30, 2062	Male	Duobam	Jan. 14, 2015	Feb
<input type="checkbox"/> 15017	Zora	Rwanda	32-133-7481	84-837-8193	Nov. 12, 2053	Female	Konklux	Sept. 2, 2012	Nov

**Figure 47: Students enrolled view page**

### 4.3.3 University Application Portal Design Section

The Status of high education report reported that IUCEA works with 133 institutions. However, more than 133 institutions are in the EAC region. Since all data matter in the management of high education in the region, the EACUIMS provides a portal for the universities to apply for being among all degree-awarding higher education. This portal will receive all information about universities. Figure 40 presents the application portal.

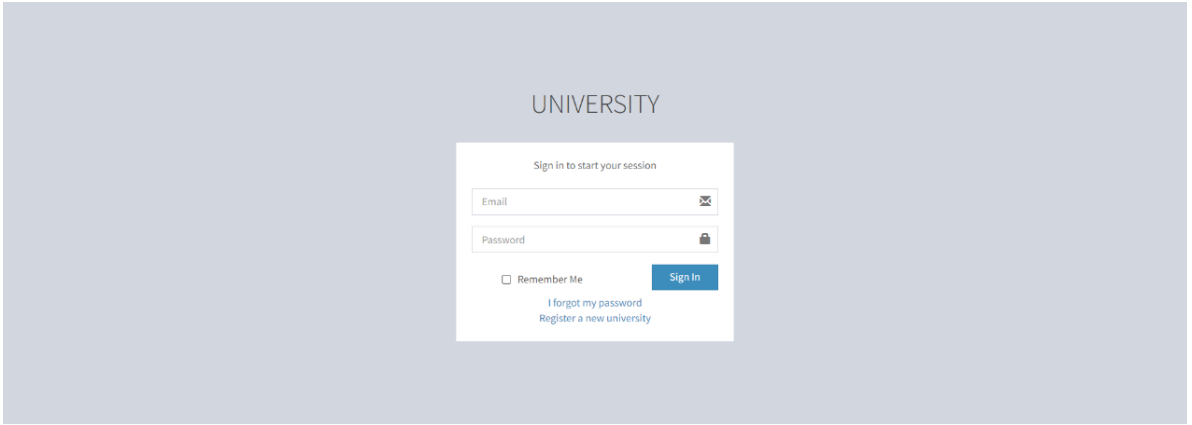
The image shows a web form titled "University Application Portal". It contains several input fields: "University Name", "Type of Establishment", "Level of program", and "website", each with a corresponding text box. Below these is a "Country" dropdown menu. The dropdown is open, showing a list of countries: Burundi (highlighted in blue), Kenya, Rwanda, Tanzania, South Soudan, and Uganda. At the bottom of the form is a blue "Submit" button.

**Figure 48: University application portal**

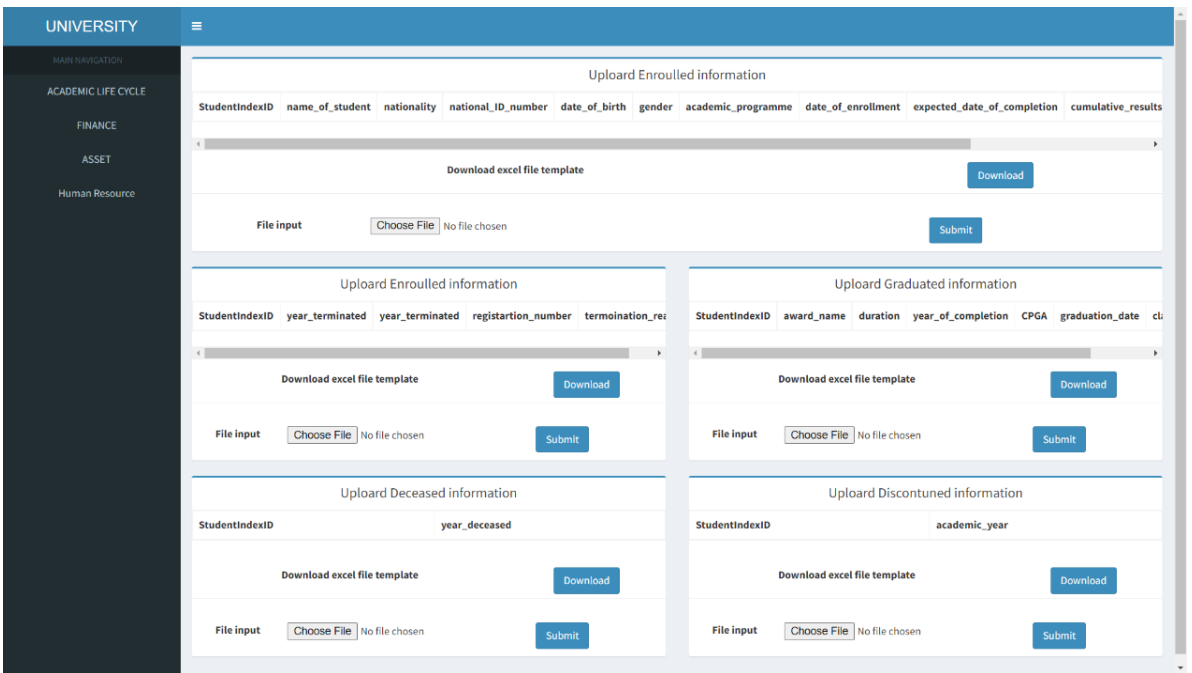
#### **4.3.4 University Portal Design Section**

All degree-awarding high education should feed the system by submitting information about assets, academic life cycle, finance, and human resource. Of course, that information can also come from NCHE within each country. However, suppose that all that information will come directly from the universities; this section will present the university portal to submit all that information, one of the solutions proposed to resolve data sources issues for the proposed system. Otherwise, many propositions have been given of how the system will get valid information.

Start by university login page; all universities must be known before submitting the information to EAC UIMS. The proposed portal will allow all degree-awarding institutions to submit information about assets, academic life cycle, finance, and human resource. Figure 48 to Fig. 51 present different interfaces of the proposed system.



**Figure 49: University login portal**



**Figure 50: University's academic life cycle portal**

The screenshot displays the 'UNIVERSITY' finance portal. On the left is a dark sidebar with navigation links: 'ACADEMIC LIFE CYCLE', 'FINANCE' (highlighted), 'ASSET', and 'Human Resource'. The main content area is titled 'Upload Expenditure information' and contains a table with columns: 'salaries\_annually\_cost', 'research\_annually\_cost', 'projects\_annually\_cost', 'consultancy\_annually\_cost', 'capital\_development\_annually\_cost', 'teaching\_aids\_annually\_cost', and 'staff\_development\_annua'. Below the table is a 'Download excel file template' button and a 'File Input' section with a 'Choose File' button and 'No file chosen' text. A 'Submit' button is at the bottom. The second section, 'Upload Income information', has a table with columns: 'student\_fees\_annually\_cost', 'government\_subvention\_annually\_cost', 'research\_funds\_annually\_cost', 'consultancy\_cost\_annually\_cost', and 'other\_income\_annually\_cost'. It also includes a 'Download excel file template' button, a 'File Input' section, and a 'Submit' button. A browser address bar at the bottom left shows 'localhost:3000/finance'.

**Figure 51: University’s finance portal**

The screenshot shows the 'UNIVERSITY' human resource management interface. A modal window titled 'ADD NEW STAFF MEMBER' is open, featuring a form with two columns of input fields. The left column includes: 'Name' (text), 'Nationality' (text), 'national ID' (text), 'staff ID' (text with 'staff\_id\_number' label), 'Department' (text), 'Category' (text), 'Date of birth' (calendar icon), 'Gender' (text), 'academic qualifications' (text), and 'Publications' (text). The right column includes: 'academic rank' (text), 'Area of specification' (text), 'Awards add recognitions' (text), 'Positions held' (text), 'Postal address' (text), 'Physical address' (text), 'email' (text), 'Website' (text), and 'Telephone' (text). A 'Save' button is at the bottom right of the form, and a 'Close' button is at the bottom left. The background shows the same sidebar as Figure 51.

**Figure 52: University's human resource (staff) management**

## 4.4 System Requirement Evaluation

Table 7 describes, in brief, the accomplishment of the functional requirements in the developed system.

**Table 7: System requirements verification**

S/N	Requirements	System verification
1	The developed system should gather the university's academic life cycle, assets, finance, and human resource information.	MySQL database has been developed and connected to the RESTful API to communicate with the different clients.
2	The developed system must manipulate the received data and produce the analyzed report format.	The overall admin should generate a report about the East African Community region universities. A surfer should visualize data in graphic format.
3	The developed system must protect data successfully.	The database developed will store or retrieve data using web APIs. This approach will secure the system since the information will be accessed on different endpoints.
4	The developed system should be flexible and user-friendly.	The developed system has adopted the APIs development approach. In addition, the user experience design principle has been used to develop user-friendly interfaces.

## **4.5 Testing**

Software verification processes include activities such as reviews, walkthroughs, and inspections. For example, the system verification exercise was performed by performing a walkthrough often performed by the ICT team at IUCEA to verify whether the developed software met the standards. Then, a validation involving several test phases was carried out to verify if the software requirements were met.

### **4.5.1 Unit Testing**

Unit testing involves checking individual units or small components to check if they perform as expected (Runeson, 2006). Unit testing has been done on different components in this study, including the public dashboard, admin, and university application portal. Some examples are

the home page, filter, login to the admin dashboard, university application, university portal login, and other components.

#### 4.5.2 Integration Testing

Integration testing as the ability to check the system's compatibility as a whole has been done on the developed system.

#### 4.5.3 System Testing

System testing validates the fully integrated product against the requirements established for the system (Agarwal *et al.*, 2010). According to the specified requirements, the developed system was validated. The results of the validation process are summarized in Table 8.

**Table 8: Table showing the results for system testing**

Requirement	Description	Test Score
Management of the System	The Administrator shall manage the overall system, including the first module (EACAPIMS).	Passed
Filter	The public dashboard will allow the users to filter information about the academic life cycle, finance, and staff by East African Community's country and EAC.	Passed
View information about the academic life cycle, finance, and staff	The system shall display information about the academic life cycle, finance, and all degree-awarding high education staff.	Passed
University application	The system shall provide a portal for universities to apply for being among all degree-awarding high education worked with IUCEA.	Passed

#### 4.5.4 User Acceptance Testing Results

User acceptance testing involves testing the developed system with dummy data to inspect that the system meets the requirements defined by the final report about EACHEIS. Under this, different levels of management had to test the developed system to determine whether or not the developed system is ready to be accepted for use and deployed in the client's environment. The respondents found the system impressive and could yield positive results. In addition, the system offered outstanding contributions such as a better management information system and better decision-making support.

The higher education experts of the IUCEA were clustered into 3 (three) clusters i.e. All Staff, ICT staff, and Quality assurance staff, the purpose of this clustering was to collect domain-specific data. For this study, we got 15 responses who are the staff of IUCEA and are fully involved in the harmonization of education and training systems in East Africa. At the time of data collection, the Quality Assurance Unit had one staff who was female, the ICT unit had two staff, and the questionnaire for all staff was filled by 12 respondents were by 41.7% were male, and 58.3 % were female.

Table 9 contains user acceptance testing results done by different users on the public dashboard interface, which helps the surfer know different information about universities in the EAC region.

**Table 9: User acceptance testing results for the public dashboard**

	Respondents			
	Strong agree (%)	Agree (%)	Disagree (%)	Not sure (%)
Web application is easy to use	75	25	0	0
The appearance of the web application is user friendly	100	0	0	0
The interfaces are well organized	75	25	0	0
The purpose of the system is well implemented	70	30	0	0
The system is comfortable to use	65	30	0	5

## **4.6 Discussion**

The developed UIMS has fulfilled all requirements needed as reported by Prof. Venansis BARYAMUREEBA within the final report on the Status of the EACHEIS. The system is suitable to support higher education within the EAC region. Its suitability is the required goal for higher education, where IUCEA will use information about higher education from the EAC region. The developed system is the continuous development of EAC HEIS, which will help the IUCEA support higher education activities in the EAC region. The EAC HEIS as one stops live repository for information and data will allow IUCEA to generate regional reports for partner states and member universities of higher education status and dynamics. Moreover, EAC UIMS as a second module has successfully been developed to produce public and private data visualization reports.

However, the developed system is limited by the legal and policy since before implementation of the system, EAC and IUCEA should develop a legal framework. As reported, EAC should implement the EAC access to information and data law, and IUCEA should implement the IUCEA policy framework and EAC regional policy for higher education information and data management.



## CHAPTER FIVE

### CONCLUSION AND RECOMMENDATIONS

#### 5.1 Conclusion

The project aimed to improve higher education in the EAC region by designing the second module of EACHEIS called EAC UIMS. Since EAC PIMS has been designed as the first module to deal with higher education programs in the EAC region, the EAC UIMS has been designed to manage the academic life cycle, finance, assets, and human resource within the universities in EAC region.

However, data needed by the developed system will come from NCHE and universities. The NCHE will help validate data from national universities, and all degrees awarding high education will share data needed by the system that are not in the NCHE databases. During the development, we did not contact a survey to know more about the different data-managed systems of different NCHE. Therefore, we assumed that all data needed by the system would come directly from all degree-awarding high education.

The developed system will help IUCEA manage higher education in the EAC region and all users to know the universities' public information. Considering the system's data where the universities upload the information about academics, finance, and human resource, the system allowed the public to visualize the academic life cycle, the cost of the study, and staff information statistically.

#### 5.2 Recommendations

Web technology has been developed from web 0.0, known as the developing Internet, up to the current web 5.0, known as the Emotional web (Chakraborty *et al.*, 2014). IUCEA should put more effort into embracing technology and its IT-related supporting tools. By supporting the EACHEIS, there will be a more remarkable improvement in information management within the institution. The institution should also offer their employees training about the new ICT technology and related tools and software.

More features can be added to implement the functionality of the developed system. Therefore, the following can be conceded to improve the system design and quality:

- (i) communication module between all degree-awarding high education and IUCEA may be integrated to support direct messages, group messages, or calls.
- (ii) Machine learning algorithms can be implemented to allow the system to answer complex questions (Portugal *et al.*, 2018).
- (iii) Since more users use mobile devices for different consumer services online (Schnauber-Stockmann & Karnowski, 2020), a mobile application version should be developed.

Due to the limitation of time, the developed system is still not yet implemented to the public's view, and dummy data still populate the database. IUCEA and other institutions in which the subject matter should push the implementation of all needed to start using the developed system.

As reported by the final report on the Status of the EAC HEIS the implementation of the EAC HEIS should follow rules and regulations regarding data sharing in the East African community region. The future work should consider deep analysis between two modules already developed deploy them and test the performance, design architecture, and scalability of the system.

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## **APPENDICES**

### **Appendix 1: Sample interview questions**

1. Does the system go to exchange data with the existing HEIS of institutions?
2. Does the data format managed by the system aggregated or disaggregated?
3. Did the existing HEC go to exchange data with the system?
4. Does the system go to manage structured data or unstructured data?
5. Which data collection method was used by the consultant to collect data used to write the report about the system?
6. Does the developed module (first module of EACHEIS, EAC APIMS developed by Alban MANISHIMWE) online or live for the use of IUCEA? If not, why?

## Appendix 2: Sample questions for user acceptance validation

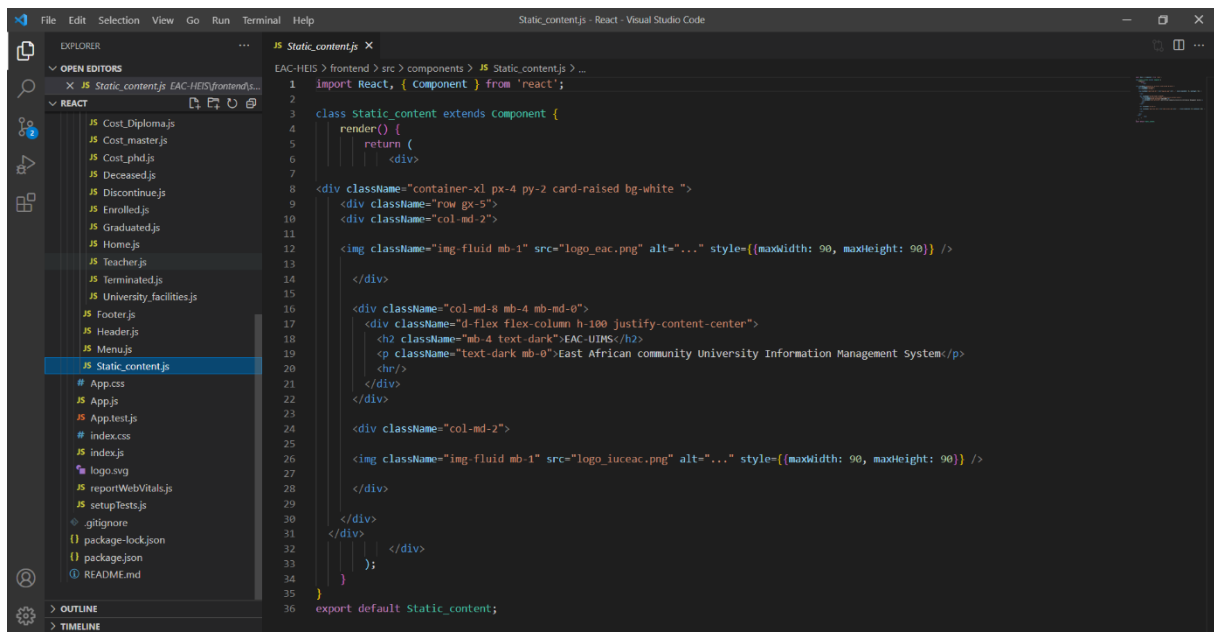
	Respondents			
	Strong agree (%)	Agree (%)	Disagree (%)	Not sure (%)
The web application is easy to use				
The appearance of the web application is user friendly				
The interfaces are well organized				
The purpose of the system is well implemented.				
The system is comfortable to use.				

### Appendix 3: Sample questions for system testing results

Requirement	Description	Test Score
Management of the System	The Administrator shall manage the overall system, including the first module (EACAPIMS).	
Filter	The public dashboard will allow the users to filter information about the academic life cycle, finance, and staff by East African Community's country and EAC.	
View information about the academic life cycle, finance, and staff	The system shall display information about the academic life cycle, finance, and all degree-awarding high education staff.	
University application	The system shall provide a portal for universities to apply for being among all degree-awarding high education worked with IUCEA.	

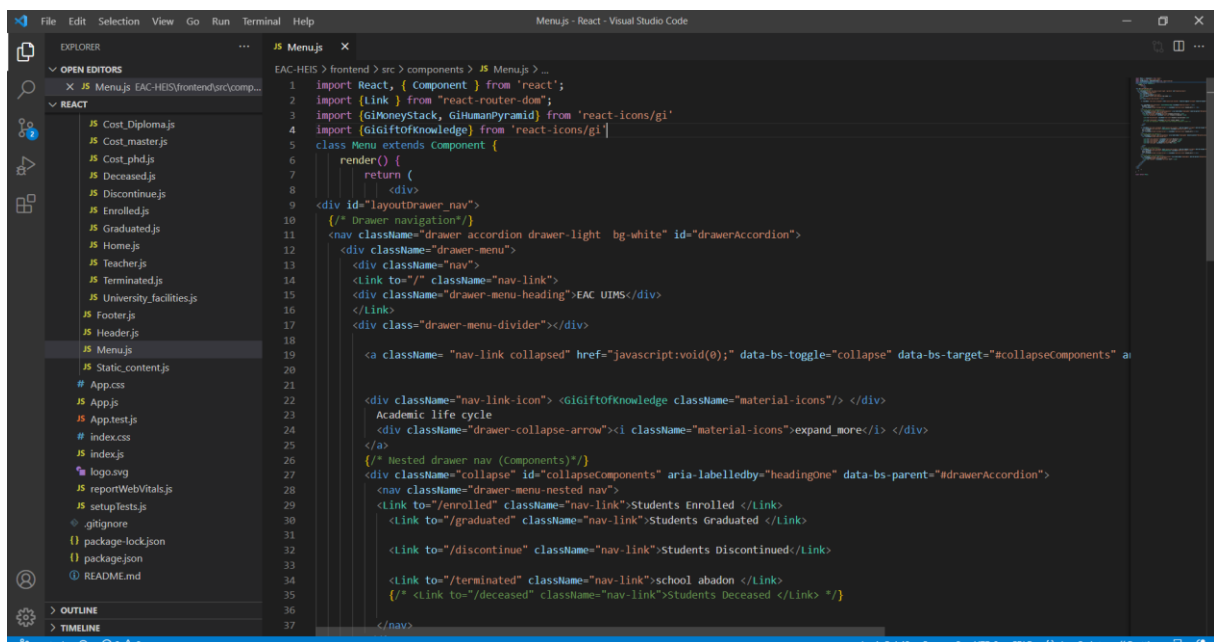
## Appendix 4: Code of different components of the homepage of the public dashboard

### a. Static Content



```
1 import React, { Component } from 'react';
2
3 class Static_content extends Component {
4   render() {
5     return (
6       <div>
7
8         <div className="container-xl px-4 py-2 card-raised bg-white">
9           <div className="row gx-5">
10            <div className="col-md-2">
11              
12            </div>
13
14            <div className="col-md-8 mb-4 mb-md-0">
15              <div className="d-flex flex-column h-100 justify-content-center">
16                <h2 className="mb-4 text-dark">EAC-UIMS</h2>
17                <p className="text-dark mb-0">East African community University Information Management System</p>
18              </div>
19            </div>
20          </div>
21
22          <div className="col-md-2">
23            
24          </div>
25        </div>
26      </div>
27    );
28  }
29}
30
31 export default Static_content;
```

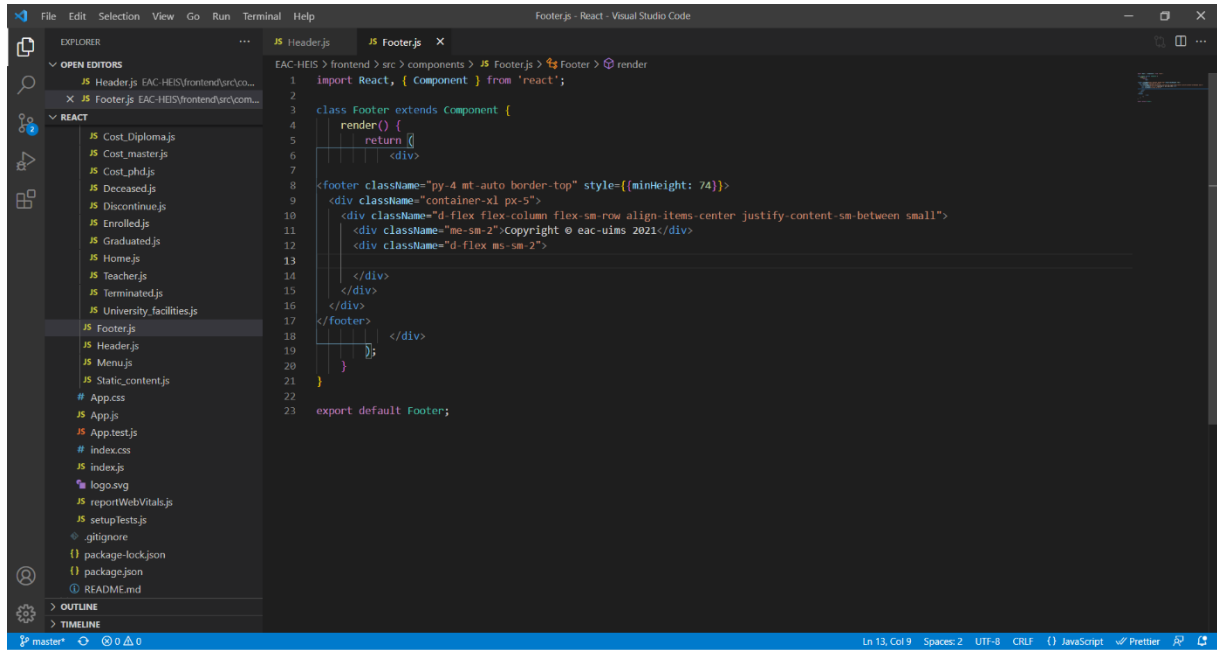
### b. Menu



```
1 import React, { Component } from 'react';
2 import { Link } from 'react-router-dom';
3 import { GiMoneyStack, GiHumanPyramid } from 'react-icons/gi';
4 import { GiGiftOfKnowledge } from 'react-icons/gi';
5 class Menu extends Component {
6   render() {
7     return (
8       <div id="layoutDrawer_nav">
9         <div className="drawer navigation">
10           <div className="drawer accordion drawer-light bg-white id="drawerAccordion">
11             <div className="drawer-menu">
12               <div className="nav">
13                 <Link to="/" className="nav-link">
14                   <div className="drawer-menu-heading">EAC UIMS</div>
15                 </Link>
16               </div>
17               <div class="drawer-menu-divder"></div>
18
19               <a className="nav-link collapsed" href="javascript:void(0);" data-bs-toggle="collapse" data-bs-target="#collapseComponents" a
20
21                 <div className="nav-link-icon"> <GiGiftOfKnowledge className="material-icons"/> </div>
22                 Academic life cycle
23                 <div className="drawer-collapse-arrow"><i className="material-icons">expand_more</i> </div>
24               </a>
25
26               <div className="collapse">
27                 <div className="drawer-menu-nested nav">
28                   <div className="collapse">
29                     <Link to="/enrolled" className="nav-link">Students Enrolled </Link>
30                     <Link to="/graduated" className="nav-link">Students Graduated </Link>
31                     <Link to="/discontinue" className="nav-link">Students Discontinued</Link>
32                     <Link to="/terminated" className="nav-link">school abadon </Link>
33                     <Link to="/deceased" className="nav-link">Students Deceased </Link>
34                   </div>
35                 </div>
36               </div>
37             </div>
38           </div>
39         </div>
40       </div>
41     );
42   }
43 }
44
45 export default Menu;
```



## d. Footer component

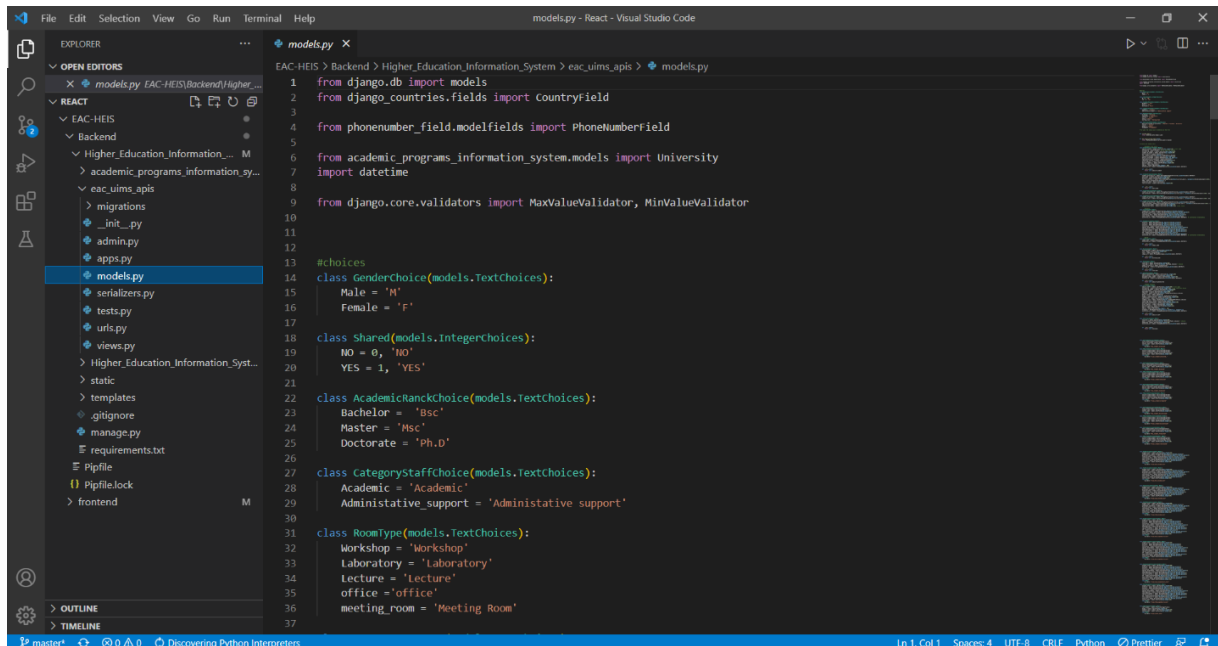


The screenshot shows a Visual Studio Code editor window with the following components:

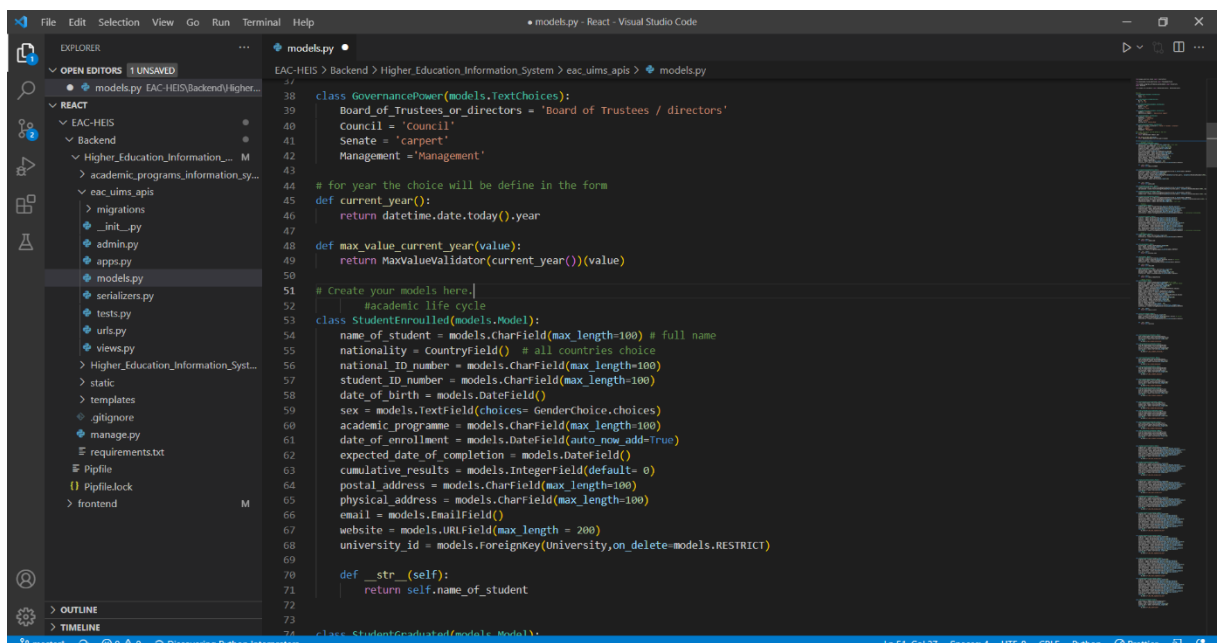
- EXPLORER:** A file tree on the left showing the project structure. The file `Footer.js` is selected under the `components` directory.
- EDITOR:** The main workspace showing the code for `Footer.js`. The code is as follows:

```
1 import React, { Component } from 'react';
2
3
4
5 class Footer extends Component {
6   render() {
7     return (
8       <footer className="py-4 mt-auto border-top" style={{minHeight: 74}}>
9         <div className="container-xl px-5">
10           <div className="d-flex flex-column flex-sm-row align-items-center justify-content-sm-between small">
11             <div className="me-sm-2">Copyright © eac-uims 2021</div>
12             <div className="d-flex ms-sm-2">
13
14             </div>
15           </div>
16         </div>
17       </footer>
18     );
19   }
20 }
21
22 export default Footer;
```
- STATUS BAR:** At the bottom, it shows the current file is `Footer.js`, line 13, column 9. It also indicates the encoding is UTF-8 and the language is JavaScript.

## Appendix 5: Code of Models which generates a database using ORM technology



```
1 from django.db import models
2 from django_countries.fields import CountryField
3
4 from phonenumber_field.modelfields import PhoneNumberField
5
6 from academic_programs_information_system.models import University
7 import datetime
8
9 from django.core.validators import MaxValueValidator, MinValueValidator
10
11
12
13 #choices
14 class GenderChoice(models.TextChoices):
15     Male = 'M'
16     Female = 'F'
17
18 class Shared(models.IntegerChoices):
19     NO = 0, 'NO'
20     YES = 1, 'YES'
21
22 class AcademicRankChoice(models.TextChoices):
23     Bachelor = 'Bsc'
24     Master = 'Msc'
25     Doctorate = 'Ph.D'
26
27 class CategoryStaffChoice(models.TextChoices):
28     Academic = 'Academic'
29     Administrative_support = 'Administrative support'
30
31 class RoomType(models.TextChoices):
32     Workshop = 'Workshop'
33     Laboratory = 'Laboratory'
34     Lecture = 'Lecture'
35     office = 'office'
36     meeting_room = 'Meeting Room'
37
```



```
38 class GovernancePower(models.TextChoices):
39     Board_of_Trustees_or_directors = 'Board of Trustees / directors'
40     Council = 'Council'
41     Senate = 'carpet'
42     Management = 'Management'
43
44 # for year the choice will be define in the form
45 def current_year():
46     return datetime.date.today().year
47
48 def max_value_current_year(value):
49     return MaxValueValidator(current_year())(value)
50
51 # Create your models here.
52 # academic life cycle
53 class StudentEnrolled(models.Model):
54     name_of_student = models.CharField(max_length=100) # full name
55     nationality = CountryField() # all countries choice
56     national_ID_number = models.CharField(max_length=100)
57     student_ID_number = models.CharField(max_length=100)
58     date_of_birth = models.DateField()
59     sex = models.TextField(choices= GenderChoice.choices)
60     academic_programme = models.CharField(max_length=100)
61     date_of_enrollment = models.DateField(auto_now_add=True)
62     expected_date_of_completion = models.DateField()
63     cumulative_results = models.IntegerField(default= 0)
64     postal_address = models.CharField(max_length=100)
65     physical_address = models.CharField(max_length=100)
66     email = models.EmailField()
67     website = models.URLField(max_length= 200)
68     university_id = models.ForeignKey(University,on_delete=models.RESTRICT)
69
70     def __str__(self):
71         return self.name_of_student
72
73 class StudentGraduated(models.Model):
74
```

```

models.py 4
EAC-HEIS > Backend > Higher_Education_Information_System > eac_uims_api > models.py > StudentGraduated
73
74 class StudentGraduated(models.Model):
75     student_enrolled_id = models.ForeignKey(StudentEnrolled,on_delete=models.RESTRICT)
76     award_name = models.CharField(max_length=100)
77     duration = models.CharField(max_length=100)
78     year_of_completion = models.PositiveIntegerField(default=current_year(), validators=[MinValueValidator(1984), max_value_current_year]) # year of completion
79     CPA = models.IntegerField(default= 3)
80     graduation_date = models.DateField()
81     class_of_award = models.CharField(max_length=100)
82
83     def __str__(self):
84         return self.award_name
85
86 class StudentDeceased(models.Model):
87     student_enrolled_id = models.ForeignKey(StudentEnrolled,on_delete=models.RESTRICT)
88     year_deceased = models.PositiveIntegerField(default=current_year(), validators=[MinValueValidator(1984), max_value_current_year]) # year of completion
89
90 class StudentDiscontinued(models.Model):
91     student_enrolled_id = models.ForeignKey(StudentEnrolled,on_delete=models.RESTRICT)
92     academic_year = models.PositiveIntegerField(default=current_year(), validators=[MinValueValidator(1984), max_value_current_year]) # year the student has been discontinued
93
94 class StudentTerminated(models.Model):
95     student_enrolled_id = models.ForeignKey(StudentEnrolled,on_delete=models.RESTRICT)
96     year_terminated = models.PositiveIntegerField(default=current_year(), validators=[MinValueValidator(1984), max_value_current_year]) # year of completion
97     registration_number = models.CharField(max_length=30)
98     termination_reason = models.CharField(max_length=100) # text field
99
100     #finance
101 class Income(models.Model):
102     student_fees = models.DecimalField(max_digits=14,decimal_places=4)
103     government_subvention = models.DecimalField(max_digits=14,decimal_places=4)
104     research_funds = models.DecimalField(max_digits=14,decimal_places=4)
105     consultancy_fees = models.DecimalField(max_digits=14,decimal_places=4)
106     other_income = models.DecimalField(max_digits=14,decimal_places=4)
107     university_id = models.ForeignKey(University,on_delete=models.RESTRICT) # institution relationship
108
109

```

```

models.py 4
EAC-HEIS > Backend > Higher_Education_Information_System > eac_uims_api > models.py > Campus > __str__
109
110 class Expenditure(models.Model):
111     salaries = models.DecimalField(max_digits=14,decimal_places=4)
112     research = models.DecimalField(max_digits=14,decimal_places=4)
113     projects = models.DecimalField(max_digits=14,decimal_places=4)
114     consultancy = models.DecimalField(max_digits=14,decimal_places=4)
115     capital_development = models.DecimalField(max_digits=14,decimal_places=4)
116     teaching_aids = models.DecimalField(max_digits=14,decimal_places=4)
117     staff_development = models.DecimalField(max_digits=14,decimal_places=4)
118     library_resources = models.DecimalField(max_digits=14,decimal_places=4)
119     ICT = models.DecimalField(max_digits=14,decimal_places=4)
120     other_expenditure = models.DecimalField(max_digits=14,decimal_places=4)
121     university_id = models.ForeignKey(University,on_delete=models.RESTRICT) # institution relationship
122
123     #asset
124 class Campus(models.Model):
125     campus_name = models.CharField(max_length=100)
126     university_id = models.ForeignKey(University,on_delete=models.RESTRICT)
127
128     def __str__(self):
129         return self.campus_name
130
131 class Building(models.Model):
132     building_name = models.CharField(max_length=100)
133     area = models.CharField(max_length=100)
134     floor = models.IntegerField()
135     campus_id = models.ForeignKey(Campus,on_delete=models.RESTRICT)
136
137     def __str__(self):
138         return self.building_name
139
140
141 class Room(models.Model):
142     room_name = models.CharField(max_length=100)
143     room_type = models.TextField(choices= RoomType.choices) # choices
144     number_of_station = models.IntegerField()
145     building_id = models.ForeignKey(Building,on_delete=models.RESTRICT)

```



```
File Edit Selection View Go Run Terminal Help
models.py - React - Visual Studio Code

models.py 4
EAC-HEIS > Backend > Higher_Education_Information_System > eac_uims_api > models.py > Room

140
141 class Room(models.Model):
142     room_name = models.CharField(max_length=100)
143     room_type = models.TextField(choices= RoomType.choices) # choices
144     number_of_station = models.IntegerField()
145     building_id = models.ForeignKey(Building, on_delete=models.RESTRICT)
146     def __str__(self):
147         return self.room_name
148 class Equipment(models.Model):
149     name_of_manufacture = models.CharField(max_length=100)
150     specifications = models.CharField(max_length=100)
151     equipment_index_number = models.CharField(max_length=100)
152     location_id = models.ForeignKey(Room, on_delete=models.RESTRICT)
153
154     def __str__(self):
155         return self.name_of_manufacture
156         # Human resource
157 class Staff(models.Model):
158     name_of_staff = models.CharField(max_length=100) # full name
159     nationality = models.CharField(max_length=100) # all countries choice
160     national_id_number = models.CharField(max_length=100)
161     staff_id number = models.CharField(max_length=100)
162     department = models.CharField(max_length=100)
163     category = models.TextField(choices= CategoryStaffChoice.choices)
164     date_of_birth = models.DateField()
165     gender = models.TextField(choices= GenderChoice.choices)
166     academic_qualifications = models.CharField(max_length=100)
167     publications = models.CharField(max_length=100)
168     academic_rank = models.TextField(choices= AcademicRankChoice.choices)
169     research_grants = models.CharField(max_length=100)
170     awards_and_recognitions = models.CharField(max_length=100)
171     positions_held = models.CharField(max_length=100)
172     postal_address = models.CharField(max_length=100)
173     physical_address = models.CharField(max_length=100)
174     email = models.EmailField()
175     website = models.URLField(max_length = 200)
176     telephone = PhoneNumberField(null=False, blank=False, unique=True)
177
178
Python 3.8.2 64-bit
```

```
File Edit Selection View Go Run Terminal Help
models.py - React - Visual Studio Code

models.py 4
EAC-HEIS > Backend > Higher_Education_Information_System > eac_uims_api > models.py > ...

180
181     return self.name_of_staff
182
183 class Governance(models.Model):
184     functions = models.CharField(max_length=100)
185     powers = models.TextField(choices= GovernancePower.choices) # choices
186     membership = models.CharField(max_length=100)
187     university_id = models.ForeignKey(University, on_delete=models.RESTRICT)
188     def __str__(self):
189         return self.functions
190
191 class EacStudentEnroulled(models.Model):
192     total_student=models.PositiveIntegerField()
193     year_of_enrollment =models.PositiveIntegerField()
194     country_name = models.CharField(max_length=100)
195     class Meta:
196         db_table = "Eac_student_enroulled"
197
198 class VEacstudentenroulled(models.Model):
199     total_M_student=models.PositiveIntegerField()
200     total_F_student=models.PositiveIntegerField()
201     year_of_enrollment =models.PositiveIntegerField()
202     country_name = models.CharField(max_length=100)
203     class Meta:
204         db_table = "v_eac_student_enroulled_"
205
206 class EacStudentDeceased(models.Model):
207     total_student=models.PositiveIntegerField()
208     year_of_deceased =models.PositiveIntegerField()
209     country_name = models.CharField(max_length=100)
210     class Meta:
211         db_table = "Eac_student_Deceased"
212
213 class VEacstudentDeceased(models.Model):
214     total_M_student=models.PositiveIntegerField()
215     total_F_student=models.PositiveIntegerField()
216     year_deceased =models.PositiveIntegerField()
217
218
Python 3.8.2 64-bit
```

```
models.py 4
EAC-HIEIS > Backend > Higher_Education_Information_System > eac_uims_api > models.py > ...
212
213 class VEacstudentDeceased(models.Model):
214     total_M_student=models.PositiveIntegerField()
215     total_F_student=models.PositiveIntegerField()
216     year_deceased =models.PositiveIntegerField()
217     country_name = models.CharField(max_length=100)
218     class Meta:
219         db_table = "V_Eac_student_Deceased"
220
221 class EacStudentGraduated(models.Model):
222     total_student=models.PositiveIntegerField()
223     year_of_comletion =models.PositiveIntegerField()
224     country_name = models.CharField(max_length=100)
225     class Meta:
226         db_table = "Eac_student_Graduated"
227
228 class VEacstudentGraduated(models.Model):
229     total_M_student=models.PositiveIntegerField()
230     total_F_student=models.PositiveIntegerField()
231     year_of_comletion =models.PositiveIntegerField()
232     country_name = models.CharField(max_length=100)
233     class Meta:
234         db_table = "V_Eac_student_Graduated"
235
236 class EacStudentDiscontinued(models.Model):
237     total_student=models.PositiveIntegerField()
238     academic_year =models.PositiveIntegerField()
239     country_name = models.CharField(max_length=100)
240     class Meta:
241         db_table = "Eac_student_Discontinued"
242
243 class VEacstudentDiscontinued(models.Model):
244     total_M_student=models.PositiveIntegerField()
245     total_F_student=models.PositiveIntegerField()
246     academic_year =models.PositiveIntegerField()
247     country_name = models.CharField(max_length=100)
248     class Meta:
```

```
models.py 4
EAC-HIEIS > Backend > Higher_Education_Information_System > eac_uims_api > models.py > ...
251
252 class EacStudentTerminated(models.Model):
253     total_student=models.PositiveIntegerField()
254     year_terminated =models.PositiveIntegerField()
255     country_name = models.CharField(max_length=100)
256     class Meta:
257         db_table = "Eac_student_Terminated"
258
259 class VEacstudentTerminated(models.Model):
260     total_M_student=models.PositiveIntegerField()
261     total_F_student=models.PositiveIntegerField()
262     year_terminated =models.PositiveIntegerField()
263     country_name = models.CharField(max_length=100)
264     class Meta:
265         db_table = "V_Eac_student_Terminated"
266
267 class EacBacIncomeCost(models.Model):
268     program_level = models.CharField(max_length=200)
269     student_fees = models.DecimalField(max_digits=14,decimal_places=4)
270     government_subvention = models.DecimalField(max_digits=14,decimal_places=4)
271     research_funds = models.DecimalField(max_digits=14,decimal_places=4)
272     consultancy_fees = models.DecimalField(max_digits=14,decimal_places=4)
273     other_income = models.DecimalField(max_digits=14,decimal_places=4)
274     total_avg = models.DecimalField(max_digits=14,decimal_places=4)
275     country_name = models.CharField(max_length=200)
276     class Meta:
277         db_table = "V_Eac_Bac_Income_Cost"
278
279 class EacMscIncomeCost(models.Model):
280     program_level = models.CharField(max_length=200)
281     student_fees = models.DecimalField(max_digits=14,decimal_places=4)
282     government_subvention = models.DecimalField(max_digits=14,decimal_places=4)
283     research_funds = models.DecimalField(max_digits=14,decimal_places=4)
284     consultancy_fees = models.DecimalField(max_digits=14,decimal_places=4)
285     other_income = models.DecimalField(max_digits=14,decimal_places=4)
286     total_avg = models.DecimalField(max_digits=14,decimal_places=4)
287
```

```
models.py 4
EAC-HEIS > Backend > Higher_Education_Information_System > eac_uims_api > models.py > EacMscIncomeCost > Meta

280 class EacMscIncomeCost(models.Model):
281     program_level = models.CharField(max_length=200)
282     student_fees = models.DecimalField(max_digits=14,decimal_places=4)
283     government_subvention = models.DecimalField(max_digits=14,decimal_places=4)
284     research_funds = models.DecimalField(max_digits=14,decimal_places=4)
285     consultancy_fees = models.DecimalField(max_digits=14,decimal_places=4)
286     other_income = models.DecimalField(max_digits=14,decimal_places=4)
287     total_avg = models.DecimalField(max_digits=14,decimal_places=4)
288     country_name = models.CharField(max_length=200)
289     class Meta:
290         db_table = "V_Eac_Msc_Income_Cost"
291
292 class EacDiplIncomeCost(models.Model):
293     program_level = models.CharField(max_length=200)
294     student_fees = models.DecimalField(max_digits=14,decimal_places=4)
295     government_subvention = models.DecimalField(max_digits=14,decimal_places=4)
296     research_funds = models.DecimalField(max_digits=14,decimal_places=4)
297     consultancy_fees = models.DecimalField(max_digits=14,decimal_places=4)
298     other_income = models.DecimalField(max_digits=14,decimal_places=4)
299     total_avg = models.DecimalField(max_digits=14,decimal_places=4)
300     country_name = models.CharField(max_length=200)
301     class Meta:
302         db_table = "V_Eac_Dipl_Income_Cost"
303
304
305 class EacPhdIncomeCost(models.Model):
306     program_level = models.CharField(max_length=200)
307     student_fees = models.DecimalField(max_digits=14,decimal_places=4)
308     government_subvention = models.DecimalField(max_digits=14,decimal_places=4)
309     research_funds = models.DecimalField(max_digits=14,decimal_places=4)
310     consultancy_fees = models.DecimalField(max_digits=14,decimal_places=4)
311     other_income = models.DecimalField(max_digits=14,decimal_places=4)
312     total_avg = models.DecimalField(max_digits=14,decimal_places=4)
313     country_name = models.CharField(max_length=200)
314     class Meta:
315         db_table = "V_Eac_PhD_Income_Cost"
316
master Python 3.8.2 64-bit 0.0.4 Ln 290, Col 42 Spaces: 4 UTF-8 CRLF Python Prettier
```

```
models.py 4
EAC-HEIS > Backend > Higher_Education_Information_System > eac_uims_api > models.py > ...

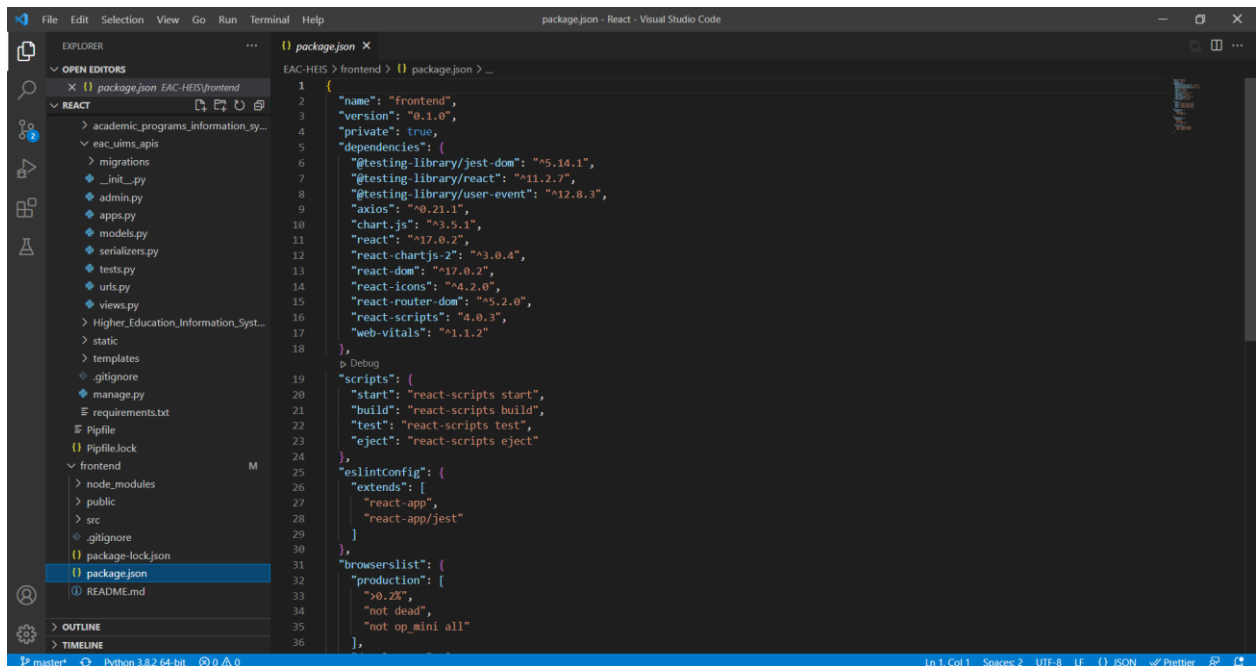
317 class EacBacexpenditureCost(models.Model):
318     program_level = models.CharField(max_length=200)
319     salaries = models.DecimalField(max_digits=14,decimal_places=4)
320     projects = models.DecimalField(max_digits=14,decimal_places=4)
321     consultancy = models.DecimalField(max_digits=14,decimal_places=4)
322     capital_development = models.DecimalField(max_digits=14,decimal_places=4)
323     teaching_aids = models.DecimalField(max_digits=14,decimal_places=4)
324     staff_development = models.DecimalField(max_digits=14,decimal_places=4)
325     library_resources = models.DecimalField(max_digits=14,decimal_places=4)
326     ICT = models.DecimalField(max_digits=14,decimal_places=4)
327     other_expenditure = models.DecimalField(max_digits=14,decimal_places=4)
328     total_avg = models.DecimalField(max_digits=14,decimal_places=4)
329     country_name = models.CharField(max_length=200)
330     class Meta:
331         db_table = "V_Eac_Bac_expenditure_Cost"
332
333
334 class EacMscexpenditureCost(models.Model):
335     program_level = models.CharField(max_length=200)
336     salaries = models.DecimalField(max_digits=14,decimal_places=4)
337     projects = models.DecimalField(max_digits=14,decimal_places=4)
338     consultancy = models.DecimalField(max_digits=14,decimal_places=4)
339     capital_development = models.DecimalField(max_digits=14,decimal_places=4)
340     teaching_aids = models.DecimalField(max_digits=14,decimal_places=4)
341     staff_development = models.DecimalField(max_digits=14,decimal_places=4)
342     library_resources = models.DecimalField(max_digits=14,decimal_places=4)
343     ICT = models.DecimalField(max_digits=14,decimal_places=4)
344     other_expenditure = models.DecimalField(max_digits=14,decimal_places=4)
345     total_avg = models.DecimalField(max_digits=14,decimal_places=4)
346     country_name = models.CharField(max_length=200)
347     class Meta:
348         db_table = "V_Eac_Msc_expenditure_Cost"
349
350
351
352 class EacDiplxpenditureCost(models.Model):
353     program_level = models.CharField(max_length=200)
354
master Python 3.8.2 64-bit 0.0.4 Ln 333, Col 1 Spaces: 4 UTF-8 CRLF Python Prettier
```

```
File Edit Selection View Go Run Terminal Help • models.py - React - Visual Studio Code
models.py 4
EAC-HEIS > Backend > Higher_Education_Information_System > eac.ums.apis > models.py > ...

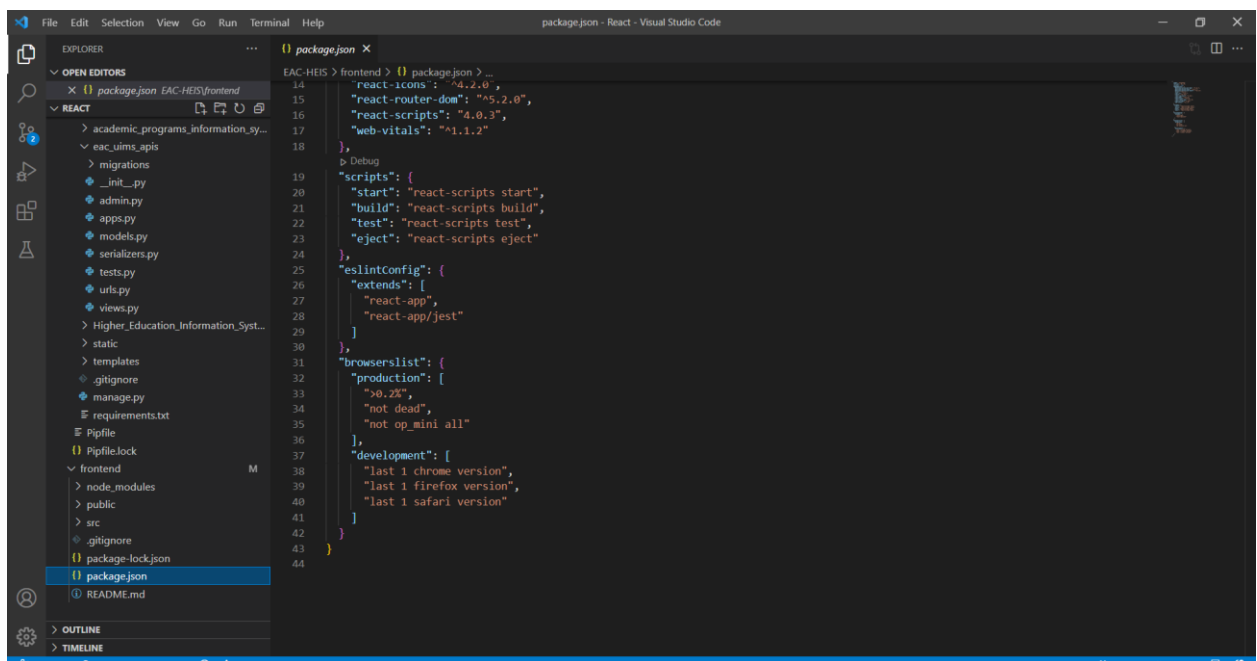
352 class EacDiplExpenditureCost(models.Model):
353     program_level = models.CharField(max_length=200)
354     salaries = models.DecimalField(max_digits=14,decimal_places=4)
355     projects = models.DecimalField(max_digits=14,decimal_places=4)
356     consultancy = models.DecimalField(max_digits=14,decimal_places=4)
357     capital_development = models.DecimalField(max_digits=14,decimal_places=4)
358     teaching_aids = models.DecimalField(max_digits=14,decimal_places=4)
359     staff_development = models.DecimalField(max_digits=14,decimal_places=4)
360     library_resources = models.DecimalField(max_digits=14,decimal_places=4)
361     ICT = models.DecimalField(max_digits=14,decimal_places=4)
362     other_expenditure = models.DecimalField(max_digits=14,decimal_places=4)
363     total_avg = models.DecimalField(max_digits=14,decimal_places=4)
364     country_name = models.CharField(max_length=200)
365     class Meta:
366         db_table = "V_Eac_Dipl_expenditure_cost"
367
368 class EacPhdExpenditureCost(models.Model):
369     program_level = models.CharField(max_length=200)
370     salaries = models.DecimalField(max_digits=14,decimal_places=4)
371     projects = models.DecimalField(max_digits=14,decimal_places=4)
372     consultancy = models.DecimalField(max_digits=14,decimal_places=4)
373     capital_development = models.DecimalField(max_digits=14,decimal_places=4)
374     teaching_aids = models.DecimalField(max_digits=14,decimal_places=4)
375     staff_development = models.DecimalField(max_digits=14,decimal_places=4)
376     library_resources = models.DecimalField(max_digits=14,decimal_places=4)
377     ICT = models.DecimalField(max_digits=14,decimal_places=4)
378     other_expenditure = models.DecimalField(max_digits=14,decimal_places=4)
379     total_avg = models.DecimalField(max_digits=14,decimal_places=4)
380     country_name = models.CharField(max_length=200)
381     class Meta:
382         db_table = "V_Eac_PhD_expenditure_Cost"
383
384
385 class VtacStaffinfo(models.Model):
386     staff_number = models.PositiveIntegerField()
387     gender = models.CharField(max_length=10)
388     academic_rank = models.CharField(max_length=100)
```

## Appendix 6: Packages and libraries used to develop the system

### a. React additional packages

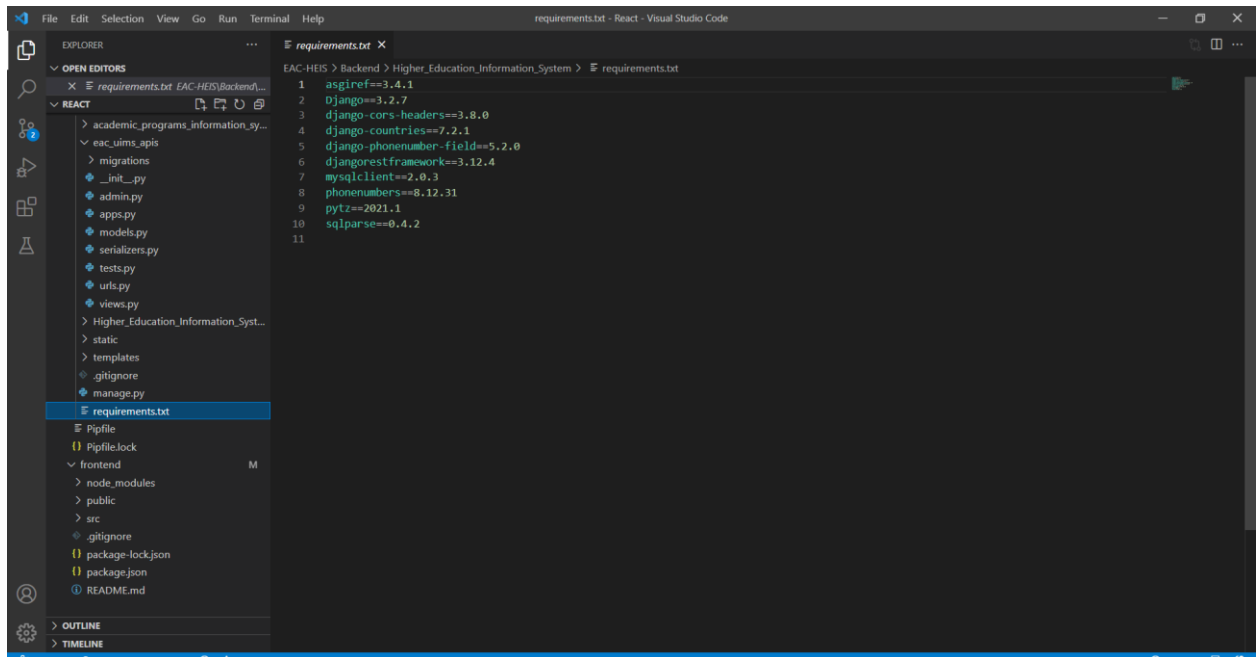


```
1 {
2   "name": "frontend",
3   "version": "0.1.0",
4   "private": true,
5   "dependencies": {
6     "@testing-library/jest-dom": "^5.14.1",
7     "@testing-library/react": "^11.2.7",
8     "@testing-library/user-event": "^12.8.3",
9     "axios": "^0.21.1",
10    "chart.js": "^3.5.1",
11    "react": "^17.0.2",
12    "react-chartjs-2": "^3.0.4",
13    "react-dom": "^17.0.2",
14    "react-icons": "^4.2.0",
15    "react-router-dom": "^5.2.0",
16    "react-scripts": "4.0.3",
17    "web-vitals": "^1.1.2"
18  },
19  "scripts": {
20    "start": "react-scripts start",
21    "build": "react-scripts build",
22    "test": "react-scripts test",
23    "eject": "react-scripts eject"
24  },
25  "eslintConfig": {
26    "extends": [
27      "react-app",
28      "react-app/jest"
29    ]
30  },
31  "browserslist": {
32    "production": [
33      ">0.2%",
34      "not dead",
35      "not op_mini all"
36    ],
```



```
14   "react-icons": "^4.2.0",
15   "react-router-dom": "^5.2.0",
16   "react-scripts": "4.0.3",
17   "web-vitals": "^1.1.2"
18 },
19 "scripts": {
20   "start": "react-scripts start",
21   "build": "react-scripts build",
22   "test": "react-scripts test",
23   "eject": "react-scripts eject"
24 },
25 "eslintConfig": {
26   "extends": [
27     "react-app",
28     "react-app/jest"
29   ]
30 },
31 "browserslist": {
32   "production": [
33     ">0.2%",
34     "not dead",
35     "not op_mini all"
36   ],
37   "development": [
38     "last 1 chrome version",
39     "last 1 firefox version",
40     "last 1 safari version"
41   ]
42 }
43 }
44 }
```

## b. Django libraries



The screenshot shows the Visual Studio Code interface with a Django project. The Explorer sidebar on the left displays the project structure, including a 'react' folder and a 'requirements.txt' file. The main editor window shows the contents of 'requirements.txt'.

```
1 asgiref==3.4.1
2 Django==3.2.7
3 django-cors-headers==3.8.0
4 django-countries==7.2.1
5 django-phonenumbers-field==5.2.0
6 django-rest-framework==3.12.4
7 mysqlclient==2.0.3
8 phonenumbers==8.12.31
9 pytz==2021.1
10 sqlparse==0.4.2
11
```



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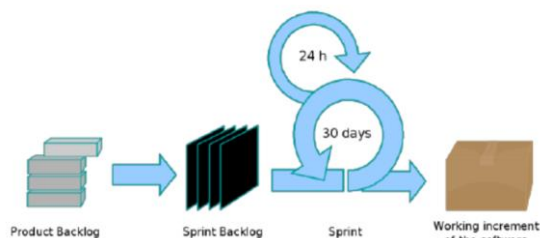
The conviction that education is one of the most powerful and proven engines for sustainable development is reaffirmed by achieving inclusive and high-quality education for all. The purpose of education is to achieve the success of a society which we can define as measuring how successfully the community meets the needs of its members (Bass, 1997).

However, there is a lack of a Common Higher Education Area (HEA) for the East African Community (EAC) in awareness of the need to harmonize the region's education and training systems. A tool needed by the Inter-University Council for East Africa (IUCEA) as the leading EAC institution for an exemplary common higher education space.

This project aims to develop the web-based data-driven University Information Management System (UIMS) for the IUCEA, the second module of the East African community High Education Information System (EAC HEIS).

What are required to develop the web-based data-driven University Information Management System (UIMS) for IUCEA and integrate it with the first module of EAC HEIS? What are the features for developing the proposed web application system to manage a massive volume of data? Is the developed system working as anticipated?

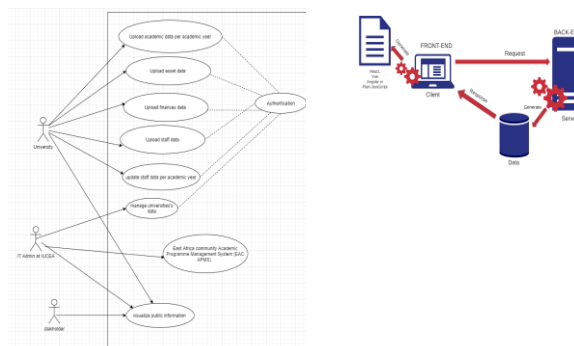
During the development of this project, we will use the SCRUM agile methodology approach to have good management of time since this methodology evaluates the progress of the project day by day.





```

graph LR
    Admin[Admin] <--> AdminAuth[authentication]
    AdminAuth <--> AdminWeb[web APIs]
    AdminWeb <--> Map[Map pattern]
    AdminWeb <--> Server[Server]
    
    surfer[surfer] <--> surferWeb[web APIs]
    surferWeb <--> Map
    surferWeb <--> Server
    
    Universities[Universities] <--> UniversitiesWeb[web APIs]
    UniversitiesWeb <--> Map
    UniversitiesWeb <--> Server
    
    UniversitiesNCHE[Universities and NCHE] <--> UniversitiesNCHEAuth[authentication]
    UniversitiesNCHEAuth <--> UniversitiesNCHEWeb[web APIs]
    UniversitiesNCHEWeb <--> Map
    UniversitiesNCHEWeb <--> Server
    
    Map <--> Server
    Server <--> Database[(Database)]
  
```

The developed system will help IUCEA manage higher education in the EAC region and all users to know the universities' public information. Considering the system's data where the universities upload the information about academic, finance, and human resource, the system allowed the public to visualize the academic life cycle, the cost of the study, and staff information statistically






**ENTER-UNIVERSITY COUNCIL, FOR EAST AFRICA**





## EAC-UIMS


East African community University Information Management Systems



 **EAC UIMS**

 Academic life icon >

 List of study >

 Library resources >

**East Africa Community Information Management System (EAC-UIMS)** is an online system for managing data and information for all Higher Education Information Management System in East Africa Community.

The system helps track all of academic life cycle, staff information, asset and financial information of **Academy** providing higher education in East African Community.

The website shows the past and current public data from all degree awarding higher education in East African Community.

If you need more information or need to use data based on the platform please visit [EACU to EAC UIMS info](#)

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Level of Agreement	Respondents Strong agree (%)	Respondents Agree (%)	Respondents Disagree (%)	Respondents Not sure (%)
1	75	25	0	0
2	100	0	0	0
3	75	25	0	0
4	70	30	0	0
5	65	30	0	5

This project contribute to the development of the EACHEIS, which will be all about electronic resource planning, integrated education management information system, and knowledge management in the EAC region. Furthermore, it will help address suitable solutions to the high education questions in the EAC region.