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Developing an academic institution system based on the Google cloud platform

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Abstract

The Libyan Academy (LA) Administration always aims to develop an integrated system that provides and manages various services for the Libyan Academy, such as student management, educational materials management, human resource management, and other systems.
Suggested approach Student Information System (SIS) aims to digitise student system processes by developing a Student Information System (SIS) based on Google Cloud Platform (GCP).
A set of components are integrated such as Google Cloud SQL (GCS) and G-suite to orchestrate the SIS processes to handle requests firmly. That will leverage the system performance efficiently, downgrade the cost expenses and reduce the development to market time, through owning a usable system with greater scalability.

Keywords: GCP, SIS, GCS, Google Cloud Platform , Google App Engine.

1. Introduction

Nowadays, it is a necessity for educational institutions to develop their entire work processes to ensure higher speed and efficiency. Preferably, with lower costs and better quality to achieve that the institutions must continuously implement best practices when it comes to management principles, strategies, and technologies [1]. A Student Information System (SIS) manages a wide range of information from enrolment to graduation including program of study, participation record, instalment of charges, and assessment results to name a few. All of this process needs to be available and accessible through a safe, online interface installed through the institution's portal of services. The Libyan Academy (LA) Administration is continuously aiming to develop an integrated system that would largely contribute in terms of providing and managing various services for the Academy, including but not limited to: students' files management, educational material management, human resources management, and other services. SIS in LA handles most aspects of students' academic life, right from admission and all the way through course registration and final examination results. While, these aspects facilitate the flow of students' data and information more than ever, yet, parts of these processes, such as admission and enrolment in courses are still deficient in terms of performance, techniques, development, cost, and time consumption. However, such deficiencies can be mitigated by using an advanced technical solution to improve the management efficiency of LA by developing all of its operations. This study focuses specifically on students' processes, for better use and exchange of available resources, by developing SIS that works on the Google Cloud Platform (GCP), allowing students to log into their profiles on the system and enrol in courses with ease and flexibility, and integrating Google Cloud SQL (GCS) as a database management system, and G-suite applications for use by the student and the Teaching-Staff.

2. Cloud Computing Services

Cloud Computing (CC) is a term that has been utilised for quite a while to the idea of re-evaluating information stockpiling or computational requirements without the requirement for the client to try and know about who is offering the services or where the services are performed [2]. CC has acquired significance as far as the significant parts in CC which are service users, infrastructure platform and service providers. Specialist organisations make services available to support clients through Internet-based interfaces. Services are running on platforms provided by platform providers. Most CC services fall into four broad categories: Infrastructure as a Service (IaaS), Platform as a service (PaaS), Software as a service (SaaS) and Database as a service (DaaS).

In the IaaS delivery model, an infrastructure provider delivers virtualized computing resources, such as data storage and computing power. Customers of these resources deploy software stacks that run their services on these resources. Amazon is an example of an IaaS provider. Instead of providing infrastructure resources, in the PaaS delivery model, software platforms, which introduce an additional level of abstraction, are offered. Management tasks such as the scaling of physical hardware resources for the platform are often transparent to customers and the applications they run on the platform. Additionally, service developers building for the platform have access to platform-specific APIs offered by the PaaS provider. Google App Engine is an example of PaaS products.
As an alternative to locally installed applications, in SaaS, applications are made available as a service that runs in the Cloud and may be accessed on the Internet. The infrastructure resources, the software platform, the service implementation, and the related software and hardware management are invisible to the service user. Google web-based applications are an example of SaaS that is offered on Internet. In addition, DaaS is a special form of Cloud based offering where storage with a defined set of operations that customers can perform is offered as a service. Google Cloud SQL and Microsoft SQL Azure Database are examples of DaaS products [3].

3. Google Cloud Platform

Google Cloud Platform (GCP) offered by Google, is a group of cloud computing services that run on the same infrastructure that Google uses internally for end-user products, such as Google Search, Gmail, Google Drive, and YouTube. In addition to its suite of management tools, it provides a series of modular cloud services including IT, data warehousing, data analysis, and machine learning. Registration requires a credit card or bank details.
It provides IaaS, PaaS, and server-less computing environments. In April 2008, Google announced App Engine, a platform for developing and hosting web applications in data centres operated by Google, which was the company's first cloud computing service. The service became generally available in November 2011. Since the announcement of App Engine, Google has added several cloud services to the platform [4]. The GCP built on the best-in-class foundation that Google planned, assembled, and used for business elements like Google Search, which moves billions of search results in milliseconds [5].

3.1. Google Apps

Google Apps is a set of messaging and collaboration web applications that Google hosts on its own

servers. Google provides these applications as a "service" rather than downloading and installing software. To access these applications, All users need is a computer with an Internet connection and a web browser. [6]. More specifically, Google Apps provides a highly scalable environment, ability to enhance messaging platforms, lower costs of assistance and infrastructure, access services anywhere anytime, and Security and Sustainability.

3.2. Google App Engine

Google App Engine (GAE) is a web application hosting service. It is appropriate to serve as an illustration of CC as PaaS, which web application engineers can use to build their applications using a suite of Google tools. Instead of other cloud services, for example, Amazon Elastic Compute Cloud (EC2), GAE requires application architects to use only a small arrangement of proven programming languages along with a small arrangement of APIs (Application Programming Interfaces) and systems mostly dedicated to the web. Applications implemented in a secure work environment that operates based on processing provided and supervised by Google. The infrastructure provides load balancing and automatic balancing capabilities, i.e. it therefore changes the amount of use cases (virtual machines) to the demand rate [7]. In this contribution the student system deployed it on Google App engine.

3.3. Google Cloud SQL

Google Cloud SQL is a MySQL database service hosted on the GCP and entirely operated by Google Inc. MySQL can be accessed by applications hosted on Google Compute Engine databases, Google App Engine applications, and third-party non-Google applications. Cloud SQL provides the best assets that large corporations, private companies, and start-ups need [8]. It Supports encrypted communications from internal and external sources, it automatically perform synchronous / asynchronous copying of data to multiple Cloud Platform regions, providing greater data robustness, it provides easy restore from one-time capacity backups, supports databases up to 500 GB, and provides innovative, on-demand availability of database instances, resulting in lower costs. In this study, Google Cloud SQL is used as a database system.

3.4. GCP Projects

Projects are high-level containers in the Cloud Platform. With projects, you can consolidate all of your resources, IT and non-IT related, project by project. This allows you to work on multiple projects at the same time while ensuring that resources are in separate control areas. Each project has identified by a group consist the following three components:

a. Project name: a text field that allows you to store a handy descriptive string about the purpose of the project. This is just for reference, which can be changed several times during the life of the project.

b. Project ID: The Project ID is a globally unique string for all cloud platform products. A random project ID, consisting of three words separated by hyphens, will be automatically generated when the project is created. You can change the suggested identifier as long as it is unique across all cloud platform projects for all Cloud platform users. The Project ID can include lowercase letters, numbers, or hyphens, and must begin with a lowercase letter. Once the selection is made, the identifier cannot change during the life of the project.

c. Project Number: Cloud Platform automatically assigns a project number at creation time for the

life of the project. You have no control over this number [9].

Cloud Platform almost exclusively uses project numbers to identify projects. The Cloud Platform project also stores information about billing and authorised users. In the Cloud Platform, the billing account is separate from the project account. Where, the invoice linked to multiple project accounts.

To view and manage projects, users can use the Developers Console which is a web interface that you can use to create and manage Cloud Platform resources, team members, traffic data, authentication, and billing through it. Figure 1 shows the Google Developers Console overview screen [9].

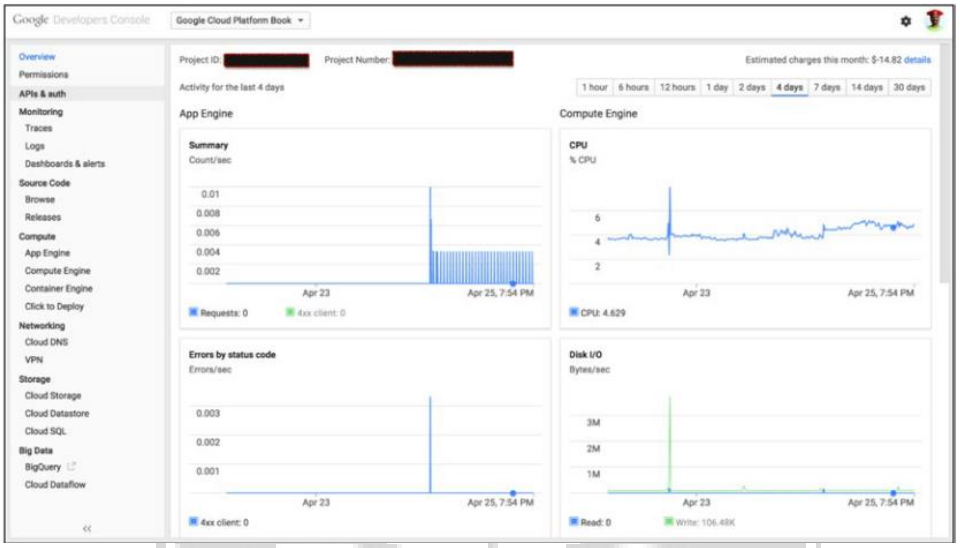

Figure 1. Google Developers Console [9]

4. Legacy SIS

The Legacy SIS for LA was created using standard development methods. Where that system is hosted in an on-premise environment, consequently, these collections have certain limitations on different levels across a wide spectrum of technology. In 2017, the LA subscribed to Google for education, which entitles the LA to a wide range of benefits from Google applications and services in the GCP environment. This allows all academy staff and students to acquire an account in the Google environment, which facilitates for them many services such as e-mail, meet, GoogleDrive, and many other services. Because of that, the author of [10] has formed a Mini_System for the LA that is deployed on GCP to present test students' results as well as each final semester transcript. The Mini_System was designed by using Google Script, JavaScript, and using Google Sheets as a database to mitigate the cost of a database licence. After the success of the use of the Mini_System, which was used as a pilot system in the department of computer and electrical engineering, the academy decided to expand its use to the entire academy. That system faced technical obstacles to expanding, as any system designed on a typical.

5. Proposed SIS

In this research, the proposed SIS is developed using typical programming technique (PHP language) which is deployed on GCP with a Google SQL database and integrated with Google apps that provides a secure environment to run SIS with reliability. Figure 2 is shown SIS components framework.

5.1. SIS Implementation

Programming languages, Cloud SQL, GCP, App.yaml and Google Cloud SDK Shell are important requirements to implement a proposed SIS. PHP, JavaScript, HTML, and CSS are requested programming languages for SIS implementation. Cloud SQL reduces maintenance cost with fully managed relational databases service for MySQL in the cloud with a secure environment. App.yaml is a configuration file in the App Engine app's settings. This file specifies how URL paths correspond to request handlers and static files. The file also contains information about app's code, such as the runtime and the latest version identifier [11]. Cloud Shell is an online development and operations environment accessible anywhere with a browser. It can create, build, test, and deploy cloud-based applications. It can also manage resources with its online terminal preloaded with utilities such as G-cloud command-line tool which requires a project identifier to identify and access various computing resources [12].

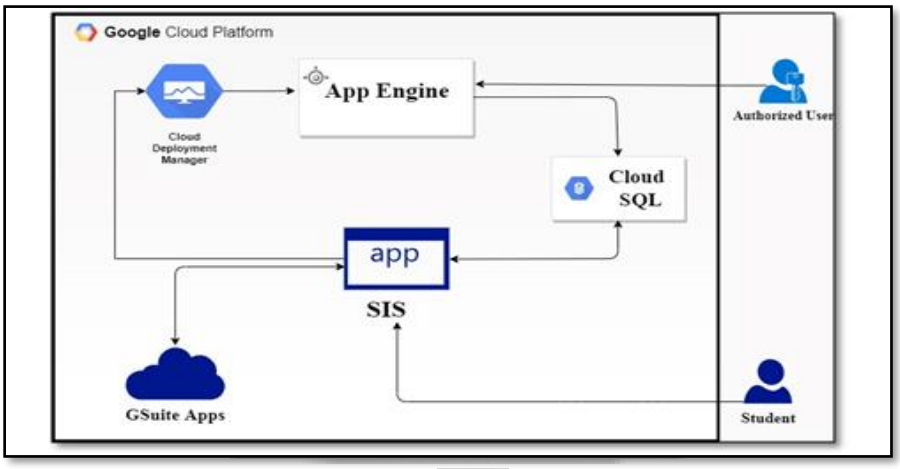

Figure 2. SIS framework

5.2. SIS Deployment

There are two stages for SIS deployment to occur, which are pre- deployment stage and the deployment stage. Three actions have to be created in the first stage, programming SIS using PHP languages with all includes files and save the configuration file (app.yaml) inside the system folder, create a new project from the app engine that contains a project ID as shown in Figure 3, create SQL instance name and create bucket form Storage to upload SIS database on it and link it with created SQL instance as shown in Figure 4.

Figure 3. Create New Project

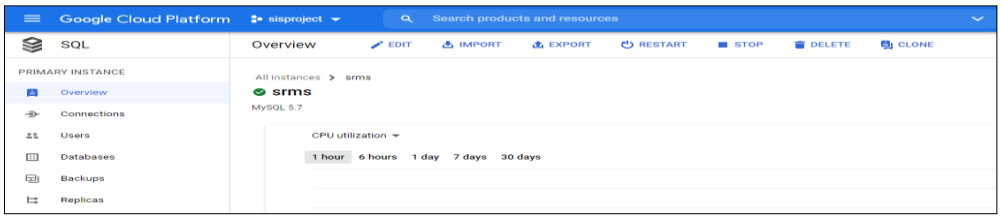

Figure 4. SQL instance

In the second stage, a set of commands is run from within the Cloud SDK Shell Including Selecting the path of the SIS app, where selecting G-cloud account that is available for SIS project, selecting sis project to deploy app on it as shown in Figure 5, deploying app will be done with project menu, and G-cloud app browsing to display the application on the ordinary browser.

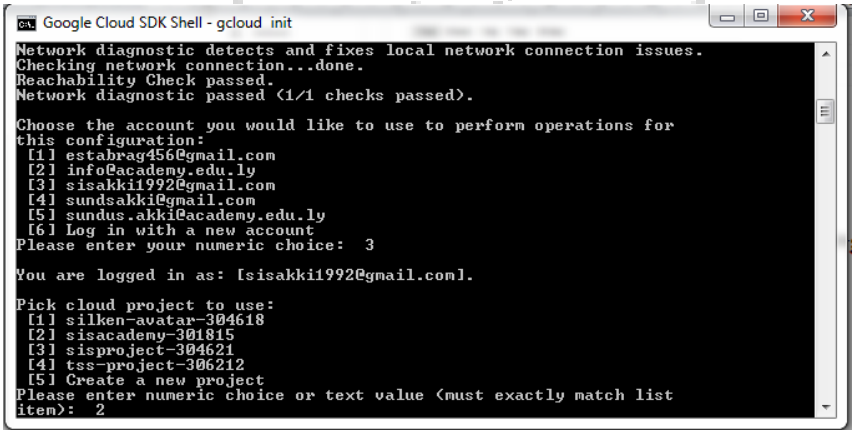

Figure 5. SDK Shell Commands

5.3. SIS User Interfaces

In this section, the interfaces of the proposed SIS will be shown below. The admission option allows the new student to register in the LA so that he agrees to the admission conditions and policies, fills out the registration form by entering his correct data, and then presses the Add button to complete his registration, as shown in Figure 6 and then a message is sent via his registered email informing him of the completion. His registration, the date of the differentiation test, and the registration number to be present on the day of the exam.

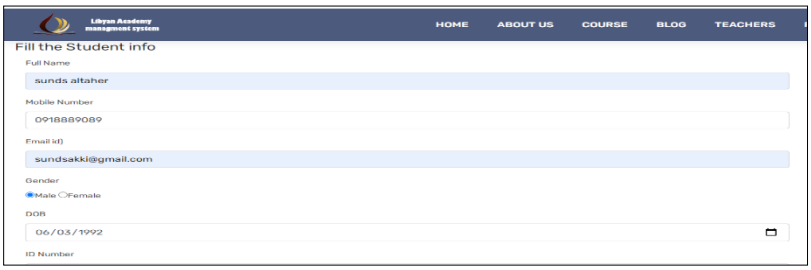

Figure 6. Admission Form

After the student is accepted and registered in the system, an email will be sent with the registration number, the academic email and the temporary password, so that the student can access his control panel by student login to register for the semester courses as shown in Figure 7.

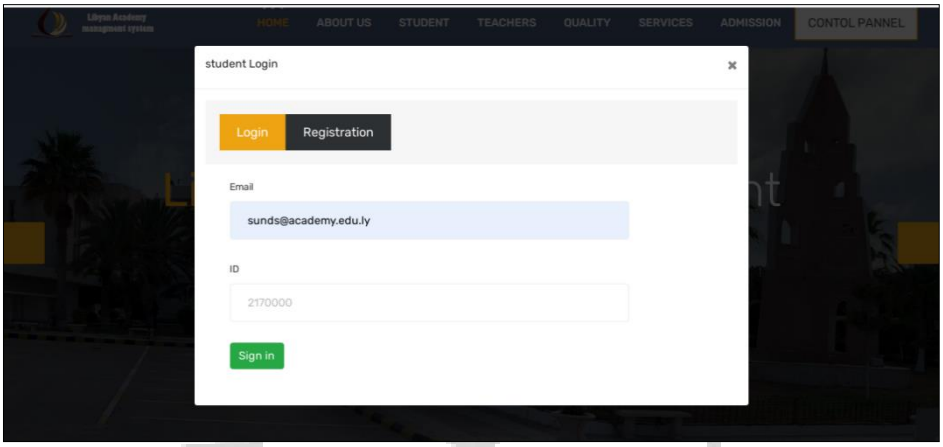

Figure 7. Student Login

After entering the student's control panel, he will be shown all the means to aid in education and procedures, including the Google applications that he will use in the study, and the procedures that the student can take in terms of registering in courses, results, and others as shown in Figure 8.

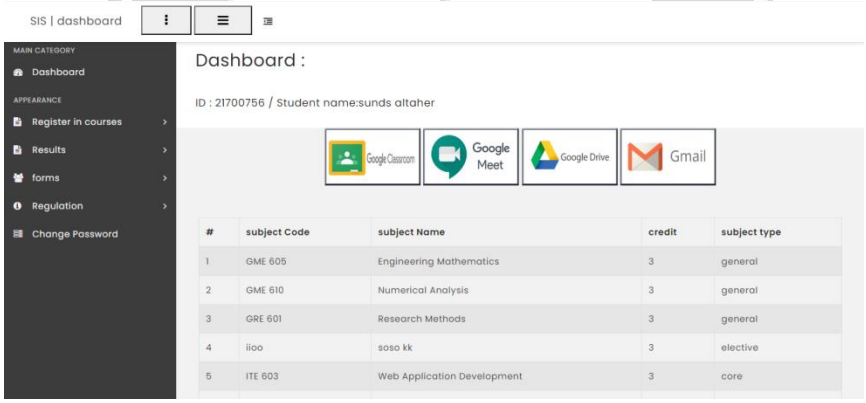

Figure 8. Student Control Panel

The student selects the subjects he wants to study in the current semester according to certain conditions that were mentioned previously, as shown in Figure 9. After registering, he receives a letter via his academic mail to complete the registration successfully after being confirmed by the department.

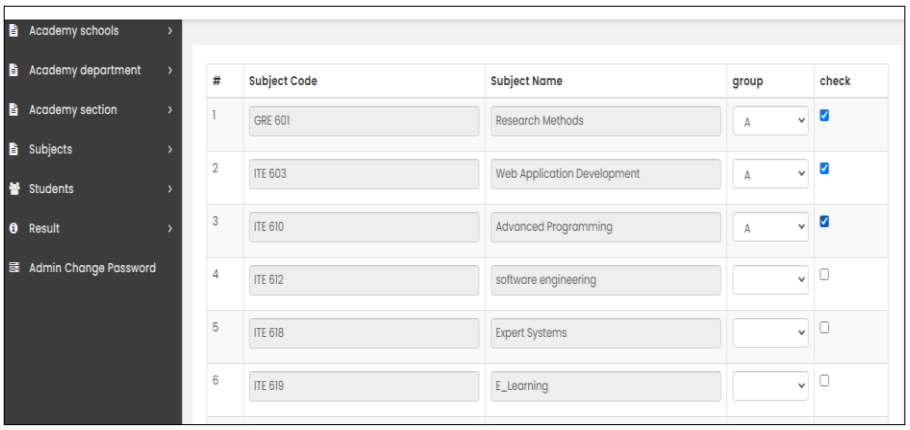

Figure 9. Course Registration

A faculty member can view the lists of students registered in the subjects that teaches, add students' results, modify them, and communicate with students through Google apps. The system administrator is one of the people authorized to enter the system according to the authority given to him. Each person who is granted certain powers can be used in the student system, so that the user who has all the powers can add a school, department, class and modify them as well as adding student data, subjects, and semester results and adjusting them.

6. Discussion

Based on what the student system development methodology represents on the GCP and its central role in raising the efficiency of systems deployment. After the development and comparison between the developed and the Legacy system, legacy SIS is low in storage and security compared to the developed SIS because it has taken advantage of Google tools on the GCP, which provides large storage capacity and a high degree of security. As well as hosting, data centre and tools cost of the developed SIS is better and almost free, and this is within the Google services for educational institutions.

7. Conclusion and Future work

Google cloud applications development has brought many benefits to education, especially for higher education institutions. Hence, SIS was built that aims to improve the efficiency of the academy information management system, based on the GCP, integrate the system with various Google applications. These technologies improved user interface, better storage, security ,better usability, improved performance, greater scalability.

In the future, it will be possible to design and build other systems that can provide LA with the same technology and integrate them with this proposed system. The objective is to get the academy's various systems to communicate with each other in the background to avoid the time and effort spent manually sharing information with other components of the Academy. Through system integration, the Academy will experience an increase in information flow speeds as well as reduced operational costs.

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