Analysis and Design of an Accounting Information System

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***Abstract*—This paper discusses an Accounting Information System (AIS) that is developed in-house by the German Jordanian University (GJU). The AIS is a web-based distributed application that is comprised of three separate tiers: the client, web (application), and business (data) tiers. The three tiers are designed and developed such that the system is easy to use, effective, fast, accurate, reliable, and scalable. The AIS mainly enables accountants to manage (i.e., record, view, edit, and delete) the daily financial transactions such as payments, refunds, and adjustments. Furthermore, it allows managing fees (e.g., services and tuition fees) and student data (e.g., academic information, schedules, transcripts, holds, registration invoices, and statement of account). Moreover, it allows specifying sponsors and supports the definition of complex scholarship tuition fees coverage combinations related to the GJU as well as most of the Jordanian universities. Besides that, it enables the quick generation of financial statements and accounting reports (e.g., daily summary, daily journal, and student balances) at the click of a button. The generated reports can be used by the staff and management of the financial department for auditing, financial accounting, and decision making purposes. The system was successfully deployed in the first 2015/2016 academic semester and since then it accurately recorded and processed thousands of accounting transactions.**

***Index Terms:* software engineering, student information system, web applications, accounting,scholarships, tuition fees.**

I. INTRODUCTION

An accounting information system at any institution, and in this case at the German Jordanian University, is very important as it allows accountants to track income (e.g., tuition and services income) and expenses (e.g., utilities and salaries expenses), as well as generate and verify accounting reports. Moreover, the produced accounting data enables management to assess the short and long term financial situation of the institution in order to make strategic financial decisions.

In this paper, the features and design of a computerized AIS that was recently deployed at the GJU are discussed. The AIS is part of an enterprise resource planning (ERP) software solution suite that is currently being developed in-house by the university. All the ERP applications are accessible online from the MyGJU portal [1, 2]. The new accounting system is more user friendly, feature-rich, efficient, accurate, and reliable when compared with the proprietary accounting system that it replaced. As a consequence, it also led to the elimination of the error-prone and cumbersome manual accounting process that was adopted by the accountants due to the inadequacy of the previous system.

As far as related work, several papers such as those in [3-10] discussed the modelling and design of accounting and financial systems. Unlike the aforementioned work, the introduced AIS is designed to manage and report tuition and services income in the case of a public educational institution like the GJU. Moreover, it deals with complex customization scenarios pertaining to defining tuition fees and student scholarships.

The rest of the paper is organized as follows. In section II, the basic features of the AIS are presented. In section III, the design of the various parts of the AIS are discussed. In section IV, the deployment results of the system are shown. In section V, the future enhancements to the system are mentioned.

II. AIS FEATURES

The AIS is very flexible and supports the features shown in the use case diagram in Fig. 1. The activities in that diagram can be grouped into four main categories as discussed next.

A. Fees and Scholarships Management

The AIS allows an accountant to manage (i.e., add, edit, view, and delete) the following information:

- Tuition fees: Those are the fees that the student needs to pay when enrolling in an academic semester. There are two types of tuition fees: credit hours fees and semester fees. The credit hours fees are related to the total credit hours of the courses that the student takes in a certain academic semester. On the other hand, there are several types of semester fees such as the acceptance fee, language test fee, refundable collateral fee, registration fee, computer fee, and health insurance fee. The first three semester fees are charged only once on the student's acceptance semester (i.e., enrolment semester). While the latter three fees are charged on every semester that the student registers in. The price of a credit hour or a semester fee depends on its effective date and on the student's enrolment year, program (e.g., regular, international and visiting), faculty, department, and major. Whereas, the price of the credit hour fee also depends on the type of its course (i.e., language course or major course).
- Services fees: The services fees are the non-tuition related fees such as the official transcript fee, student

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proof fee, student card fee, major transfer fee, late payment fee, transportation fee, parking fee, etc.

- Sponsors and Scholarships: The sponsors are the foundations that provide financial aid to students to help them meet their study expenses. The financial aid at the GJU can be in the form of scholarships or costs. A scholarship differs from a cost in that its provider is an external foundation, whereas the provider of a cost is the GJU. A scholarship and a cost can be defined in a similar way and they may fully or partially cover the student's tuition fees with or without any limit.

B. Student Data Management

The accounting system also enables an accountant to either view or manage different student data, as needed to make financial decisions, such as:

- Academic and financial information: The accountant can view the student's personal (e.g., full name, email, and nationality) and academic (e.g., program, faculty, department, and major) information, study plans, schedules, grades, transcript, major transfers, statement of account, and financial transactions.
- Scholarships: The system also allows accountants to associate students to, or disassociate students from, their respective scholarships. Accordingly, the system automatically debits or credits the student's and sponsor's accounts, based on the definition of the associated scholarship and the price of the course, upon every add/drop course section (i.e., registration) operation.
- Financial exemptions and holds: An accountant may also manage the student's financial exemptions and holds. A student may get a financial exemption because of his/her particular circumstances such as the delay of an anticipated scholarship payment, or obtaining an approval to defer payments. Consequently, the student may add course sections to his/her schedule without paying any tuition fees. Whereas when a student's account is put on hold (e.g., for failure to pay the tuition fees), several operations on the account will be blocked such as: registration, viewing transcripts, and graduation.

C. Bookkeeping

This feature involves managing (recording, editing, viewing, and deleting) the day-to-day financial transactions such as payments, refunds, and adjustments. In addition, to generating statement of accounts, registration invoices, and receipts. Note that the students may pay their tuition or services fees either at the finance department (in this case the payments are recorded in the system by the cashier) or at the bank (such payments are uploaded to the system once a day by the accountants upon receiving them in an Excel text file from the bank).

D. Accounting Data Reporting

The system supports the generation of various types of accounting reports (e.g., students' and sponsors' balances reports, daily journal and summary reports, and financial claims report) at the click of a button. The generated reports are used by the staff and management of the financial department for auditing, financial accounting, and decision making purposes.

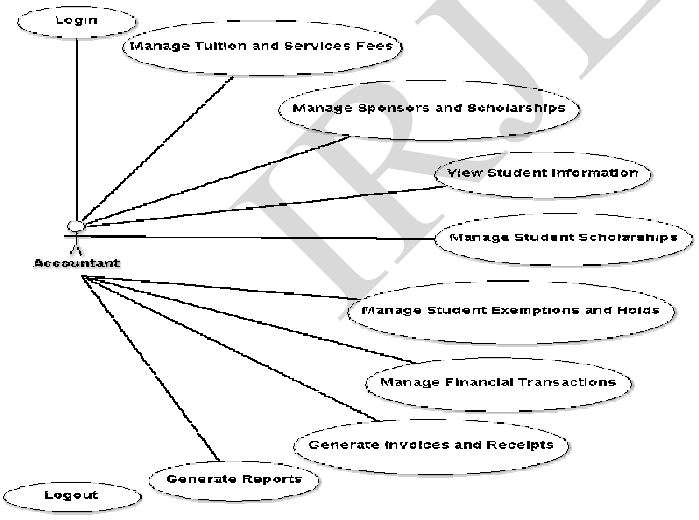

Fig 1. The use Case Diagram of the AIS

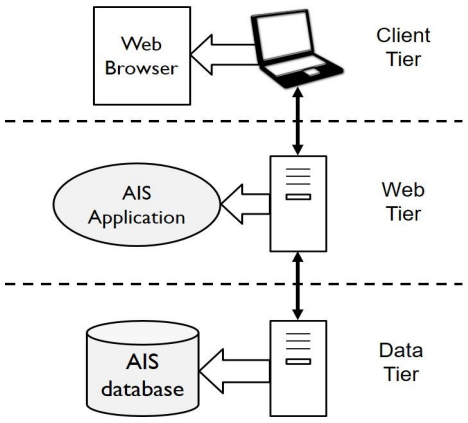

Fig 2. The AIS Three-Tier Application Architecture

III. AIS DESIGN

The AIS is a Java EE [11] three-tier web application (as shown in Fig. 2), therefore its design requires specifying the client tier, web (application) tier, and data (business) tier. The design of the client tier deals with the UI screens that the user interacts with to accomplish the tasks supported by the system.

The UI screens are displayed in the web browser that is running on the client's device (e.g., desktop, laptop or phone). While, the design of the web tier addresses the logic of the AIS application that is hosted on a remote server. Whereas, the design of the data tier involves specifying the database tables in which the system's data is stored. The data tables are managed

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by a database management system (DBMS) that is running on a dedicated server.

Some design aspects of the AIS tiers are discussed in the following subsections, for example, based on the steps that an accountant and a student need to perform ahead of generating the registration invoice for the student (see Fig. 3). Note that the registration step in Fig. 3 (i.e., step 7) is done by the student outside the AIS using the MyGJU registration tool [2], which is integrated with the AIS as they share the same database, but they have different front ends.

A. Client Tier Design

Each HTML page (i.e., application page) in the AIS that is displayed on the client's screen is associated with a JavaServer Faces (JSF) page [12] that is stored on the application server in the web tier. A JSF page may contain HTML, JSF, and PrimeFaces [13] elements. When a certain page is requested by the user's web browser, the web server in response to that request renders eachelement in the corresponding JSF page to an HTML element. Then, it sends the generated HTML page back to the browser at the client side for display. Therefore, the client tier design maps to the development of the JSF pages that are associated with every screen in the application. The UI pages are designed to be effective, efficient, and easy to use as demonstrated in the following examples.

For example, the snapshot of the "Add Credit Hour Fee" page in Fig. 4 demonstrates how easy it is to define a credit hour fee using the AIS (i.e., step 1 in Fig. 3). In this case, the accountant specified the price of the credit hour fee for a language or major course to 100 JDs. This price is effective starting from the First 2015/2016 semester for all the "Bachelor" degree students who were accepted on the 2015/2016 academic year in the "Regular" program, the "School of Computer Engineering and Information Technology" faculty, the "Computer Engineering" department, and the "Computer Engineering" major. Note that the semester fees for those students can be specified in a similar manner to finish step 2 in Fig. 3.

In the second example, we illustrate how flexible it is to define a scholarship using the AIS. Note that this step (i.e., step 4 in Fig. 3) comes after the accountant completes adding the sponsors and their scholarships in the system (i.e., step 3 in Fig. 3) as assumed in this example. Defining a scholarship involves specifying its tuition and semester fees coverage as well as its duration. The scholarships coverages and durations for the main sponsors and scholarships at the GJU (note that most of those sponsors offer similar scholarships in the rest of the Jordanian universities) are shown in Table I. It is obvious from the table that handling scholarships is a complex process due to the many possible coverage and duration combinations.

For example, the scholarship in case 1 covers 100% of the credit hours fees up to 45 credit hours or three consecutive semesters whichever comes first. The scholarship in case 2 fully covers the credit hours fees as long as the student's registered credit hours do not exceed his/her study plan's total credit hours. While, the scholarship in case 3 covers 50% of the tuition and semester fees without any limit. Whereas, in case 4 all the fees are fully covered except the health insurance fee. In case 5, all the fees are covered without any limit, but in case 6 all the fees are covered for only one semester. Finally in case 7, the GJU covers 50% of the credit hours costs for its academic staff's off spring.

Unlike the AIS, the proprietary accounting tool that was previously used at the GJU was not easy to use and not efficient as it contained about 6 UI screens to define the various types of scholarships and it was not effective as it was not able to handle all the needed cases. Whereas, the AIS allows an accountant to define any type of scholarship using the screen shown in Fig. 5. Hence, it is effective as it allows defining all kinds of scholarships and it is efficient and easy to use as it enables the user to specify a scholarship in one place in a clear and concise manner. For example, the scholarship defined in Fig. 5 corresponds to case 3 (in Table I) and is defined by selecting the "Fees" option in the "Scholarship Coverage" field set, entering 100% credit hours coverage, entering 0% coverage for all other fees, and selecting the "Study Plan (without failed courses)" option in the "Scholarship Duration" field set. While case 1 can be specified by selecting the "Credit Hours" option in the "Scholarship Coverage" field set, entering 45 in its adjacent text field, and selecting the "Academic Semesters Cycle (Second, Summer, and First)" option in the "Scholarship Duration" field set. Whereas, as a last example, the scholarship for case 5 (in Table I) can also be defined by selecting the "Fees" option in the "Scholarship Coverage" field set, entering 0% coverage for the "Health Insurance Fee", entering 100% coverage for all other fees, and selecting the "No Limit" option in the "Scholarship Duration" part.

After defining a scholarship, a student can be linked to it (in step 5 in Fig. 3,) using the form shown in Fig. 6. In this instance, the student is linked to the Military scholarship that is defined in Fig. 5. When the system setup is completed, the student needs to deposit enough money in his/her account to cover the costs of the anticipated tuition fees ahead of registration. The accountant, in turn, can record that payment (in step 6 in Fig. 3) using the screen shown in Fig. 7.

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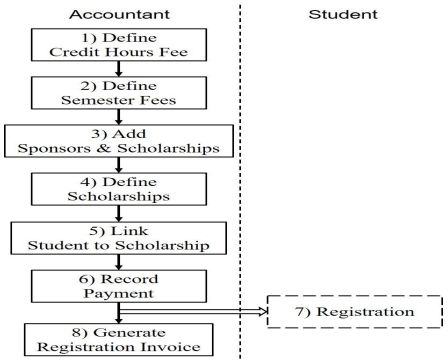

Fig 3. The Steps Needed to Generate a Registration Invoice

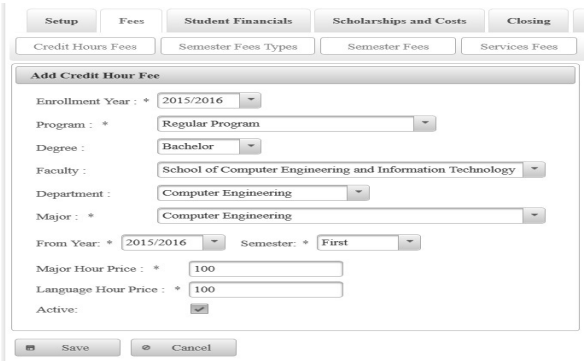

Fig 4. A Snapshot of the add Credit Hour Fee Screen

Table I. The Main Sponsors at the GJU and The Definitions of their Offered Scholarships

#	Sponsor	Scholarship or Cost	Credit Hours Fees	0 Credit Hours Fees	Semester Fees	Duration
1	Ministry of Higher Education	Students Loans	YES (100%)	NO	NO	45 Cr. Hrs. OR 3 consecutive semesters
2	Jordan Armed Forces	Military	YES (100%)	NO	NO	Study plan total Cr. Hrs.
3	DAAD	Half Scholarship	YES (50%)	YES (50%)	ALL (50%)	No limit
4	Saudi Arabian Embassy	Saudi Arabian Embassy	YES (100%)	YES (100%)	Health Ins. Fee 0% Other (100%)	No limit
5	UAE Cultural Attaché	UAE Cultural Attaché	YES (100%)	YES (100%)	ALL (100%)	No limit
6	Yemeni Cultural Attaché	Yemeni Cultural Attaché	YES (100%)	YES (100%)	ALL (100%)	First 2015/2016
7	GJU	Academic Staff Off Spring	YES (50%)	NO	NO	No limit

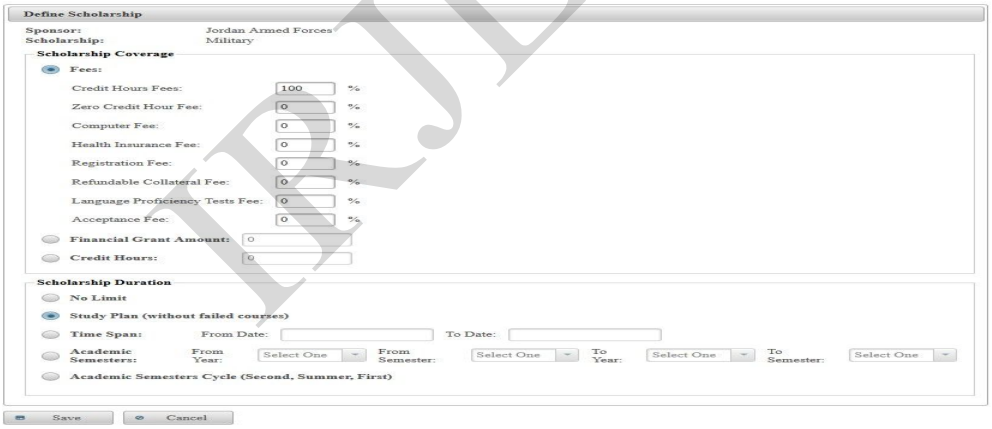

Fig 5. A Snapshot of the Define Scholarship Screen

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Fig 6. A Snapshot of the Form to Link a Student to a Scholarship

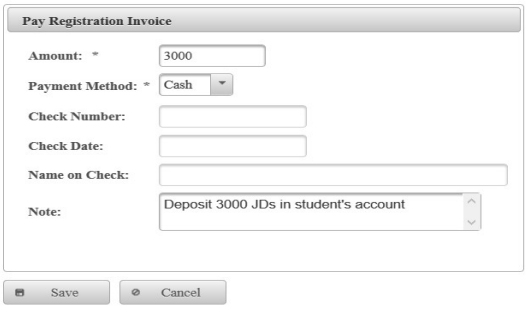

Fig 7. A Snapshot of the Add Payment Screen

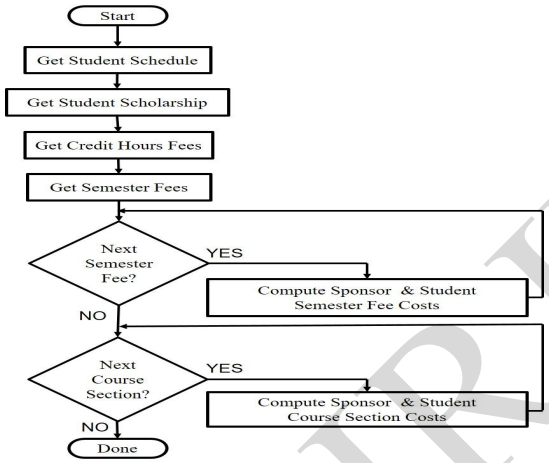

Fig 8. The Registration Invoice Generation Flowchart

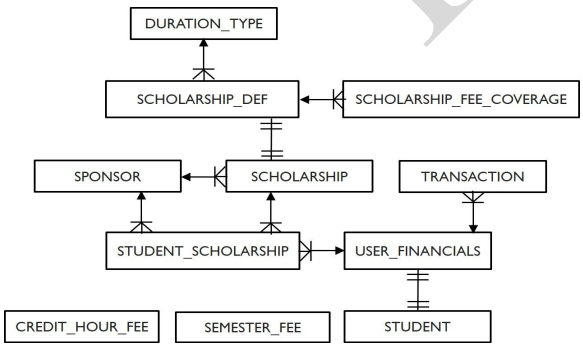

Fig 9. The ER Diagram for some of the AIS Database Tables

B. Web Tier Design

Each application screen is associated with a managed bean object in the web tier. The managed bean is a special Java class instance that is managed (i.e., instantiated, activated, and destroyed) by the web container. It is used to store the state of its associated screen, handle the events fired by the UI elements in its JSF page, and communicate with the database (via data access objects DAOs) to manage (query, insert, update, and delete) the data of its page. Therefore, describing the structure and logic of the managed beans is considered as the main concern of the web tier design phase.

For example, when the generate registration invoice (i.e., an invoice that shows the due amounts of each registered course and every semester fee on the student and the sponsor) button is clicked (i.e., in step 8 in Fig. 3), the event handler (i.e., the method that is invoked on the managed bean of that button) is fired to accomplish the desired task. The flowchart that models the application code logic for that event handler is shown in Fig. 8. Accordingly, the method starts by getting the schedule of the selected student from the database.

Then, it retrieves the credit hours and semester fees as well as the scholarship definition (if any) for that student from the corresponding tables in the database. Subsequently, it iterates over the semester fees to compute the cost of each fee on the student and sponsor based on the fee price and its scholarship coverage. For example, if the price of the registration fee is 100 JDs and its scholarship coverage is 50%, then the cost of that fee on the student and sponsor is 50 JDs each. Afterwards, the code processes each course section in the student's schedule to compute the credit hours costs on the student and sponsor based on the type of the course (i.e., language or major course), the price of the credit hour, the number of credit hours of the course, and the scholarship's credit hours fee coverage. For example, when a major course has 3 credit hours, the price of the major credit hour is 120 JDs, and the scholarship's credit hours fee coverage is 100%, then the cost of the course is 0 JDs on the student and 360 JDs on the sponsor.

C. Data Tier Design

The data tier design process is used to identify the database tables, in which the AIS data is stored, and to determine the relationships amongst them. The identified tables and the relationships amongst them can be modelled using an Entity-Relationship (ER) diagram. For example, the tables that are used to manage the data in the various steps in Fig. 3 are captured in the ER diagram shown in Fig. 9. Accordingly, the defined credit hours and semester fees (in steps 1 and 2 in Fig. 3) are saved in the *Credit_Hour_Fee* and *Semester_Fee* tables respectively. Each sponsor is stored in the SPONSOR table (in step 3) and may be linked to several scholarships in the *Scholarship* table, but a scholarship is associated with only one sponsor.

Moreover, a scholarship definition is saved in the *Scholarship_Def* table (in step 4) and is related to one scholarship. Furthermore, the scholarship definition is connected with one duration type in the *Duration_Type* table and may have several fee coverage records in the *Scholarship_Fee_Coverage* table. In addition, a student in the *Student* table has one financial account in the *User_Financials*

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table. Besides, the association between a student and a scholarship is found in the *Student_Scholarship* table (in step 5). Also, a payment is saved in the *Transaction* table (in step 6) and it can be associated with one financial account, but the account may have several payments credited into it. Similarly, the generated registration invoice (in step 8) is also recorded in the *Transaction* table.

IV. DEPLOYMENT RESULTS

The AIS was officially launched at the beginning of the first 2015/2016 semester. It has been up and running since then with no down times, which asserts its high availability and reliability. For example, the accountants were able to record about 28000 financial transactions from September 2015 to May 2016 with high accuracy and efficiency. The monthly distribution of those transactions is shown in Fig. 10.

Accordingly, the highest number of transactions was recorded in September 2015, which coincided with the launch of the system and hence entering the opening balance transactions as well as the tuition payments for all students ahead of registration. The numbers jumped again in January and February upon generating the registration invoices for the first semester and ahead of the registration period for the second 2015/2016 semester respectively. Whereas, the final jump was in May 2016 upon generating the registration invoices for the second 2015/2016 semester.

Furthermore, the the accountants were able to easily define all the needed fees, sponsors, and scholarships. Besides that, they linked the corresponding students to their respective scholarships. Consequently, the system was capable to automatically and accurately compute the tuition costs on the students and sponsors while generating the registration invoices. Based on that, the top offered scholarships, the number of students linked to each of them, and the calculated total due amounts on their sponsors as of March 2017 are shown in Table II.

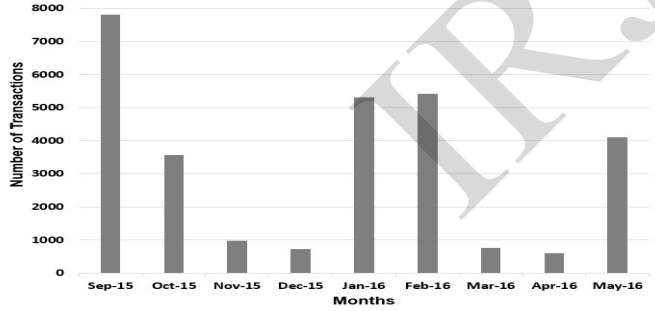

Fig 10. The number of accounting transactions per month from September, 2015 to May, 2016

Table II. he Top Offered Scholarships as of March 2017

Scholarship	Number of Students	Amount in JDs
Military	603	1674500.000
GJU	440	1239998.000
Ministry of Education	208	545180.000
DAAD	95	182530.000
Ministry of Higher Education	126	170850.000
Bahrain Embassy	6	24840.000

V. FUTURE WORK

The following features are planned in the coming release of the AIS: integrating it with the financial information management system in order to instantly update the corresponding income accounts (e.g., tuition income account) in the GJU budget tree upon every transaction, completing the flow to track expenses, and implementing the students' clearance process.

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