

# **Course and Faculty Management System**

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# **Course and Faculty Management System**

#### **Christopher Grime, Jozef Goetz**

Article Info	Abstract
Article History	The purpose of the paper is to show how to expand the low code interactive
Received: 01 January 2023 Accepted: 14 April 2023	framework in order to develop a web app for the broad needs of different fields. The goal of this work is to give a chance to computer science senior project students to work on a broad spectrum of projects using Apache, HTML, CSS, JavaScript, PHP, and MySQL. In this paper the web app is Course and Faculty Management System allowing educational organizations efficiently organize and
<i>Keywords</i> Engineering University Education Management system Software development	manage their courses and faculty. The web application is interactive, responsive, secured, password and database driven app. The website is accessible on all devices. Public users can view the courses the university offers as well as which instructors teach them. Courses can be filtered by term and subject. Users that are logged in and have the correct permissions can edit/add/delete courses, departments, and instructors in the database. Admins can import files containing information about multiple courses as well as export the courses in the database to a csv file. The admin can also edit the other user's permissions. In conclusion, the project has been successfully designed and implemented according to best practices and finally tested on a web hosting server provider.

# Introduction

Keeping track of different entities is an important task and can be very useful for monitoring events. The project [Miranda-Hill, W., Goetz, J. (2019, June 30 – July 4)] aims to prototype the functionality of a user-generated geospatial meteorology map (for keeping track of temperature and pressure) based on low code interactive framework [Butler, T., & Yank, K. (2017)]. This includes the design and implementation of a database driven website with a public and a password protected admin component, in addition to a database, web server and hardware component. Another project Patient Care Reporting App [Guarrera, A., Goetz, J. (2022, *May* 10)] is based on low code interactive framework [Butler, T., & Yank, K. (2017)] as well. The purpose of the app was to provide a platform to simulate an electronic patient care reporting system for the students to interact with. Additional project [Flores Marquez, A., Goetz, J. (2023)] based on low code interactive framework [Butler, T., & Yank, K. (2017)] is Certificate Management Application that the goal was to develop a web application that keeps track of recipients of computer science certificates by managing (viewing, adding, editing, deleting) certificates, recipients, courses, categories and setting the users permissions.

The basic goal of Course and Faculty Management System is to keep track of courses and faculty by managing (viewing, adding, editing, deleting) courses, instructors, subjects, departments, timeslots, and course attributes

with given constrains for each entity. Course and Faculty Management System is a custom data management system designed to meet the needs of universities. Data management systems help companies and organizations organize and manage large data sets. Course management systems, in particular are ways for universities to organize their course schedules. There are various systems available to universities to assist in creation of schedules, though many do not meet the requirements of the organization. These limitations require the scheduler to manually check for conflicts and errors in their schedule.

Smaller organizations often rely on the use of spreadsheets to create their schedules. Spreadsheets introduce additional opportunities for errors to arise. Some of the considerations that a scheduler must take into consideration include:

- Time constraints in the instructors' schedules
- Major courses cannot be offered at overlapping times that do not let students meet their requirements.
- Instructor's schedules cannot be overloaded
- Enough courses must be offered to meet the demand of interested students

Some examples of employee management systems that are popular in the industry today are Kronos, Banner and PeopleSoft. These particular programs expand upon the capabilities of traditional Enterprise Resource Planning systems in order to adapt to the unique nature of university management. The most advantageous outcomes of using such a system are allowing users to work from the same data at the same time, allowing the latest technology to be leveraged by the users, ease of data access, fewer points of security breaches, and improved working efficiency of the users [Kumar, M., Garg, A., & Kumar, A. 2021]. Additional outcomes of the improved efficiency provided by university management systems are better access to information to assist in planning and management, better services provided to the faculty and students, fewer business risks, increased income and decreased expenses [Soliman, Karia 2015]. These outcomes provide huge incentives to move to a university management system from older, outdated methods of resource and schedule management.

Course and Faculty Management System combines tasks that currently require multiple applications and data sources. The application improves the efficiency and accuracy of the university schedulers. These optimizations save the university hours of time and allows the university to make better informed decisions regarding their course offerings. The data stored in the Course and Faculty Management System could also be provided for other purposes. For example, the data could be used to assist in generating contracts of instructors. Storing the university's data in a management system such as this would allow analytics to be used to create reports that provide insights into many aspects of the university.

#### **Problem Statement**

The purpose of the paper is to show how to expand the low code interactive framework [Kevin Yank, Tom Butler 2017] in order to develop a web app for the broad needs of different fields. The low code framework (LCF) is to expand a framework based on PHP and MySQL for creating low cost, customized, and integrated Web based Course and Faculty Management System. Moreover, the framework should host many users which can have

access from different clients the same time. The basic goal of Course and Faculty Management System is to keep track of courses and faculty by managing (viewing, adding, editing, deleting) courses, instructors, subjects, departments, timeslot, course attributes with given constrains for each entity.

The University of La Verne currently uses multiple systems to manage their course offerings and faculty members. These systems are unable to communicate with each other. The university often has the need to resort to using spreadsheets to consolidate the data and create schedules. This process requires manually gathering and cleaning data from multiple sources. This is a time consuming and error prone task. Errors can range from simple mistyping of data to miscalculating the number of courses an instructor has.

The purpose of the project is to build Course and Faculty Management System from scratch and solve those problems as well by allowing mass import of course data. When course data is imported, Course and Faculty Management System automatically checks for errors and conflicts with existing data.

The custom-built Course and Faculty Management System solves these problems by allowing mass import of course data. When course data is imported, Course and Faculty Management System automatically checks for errors and conflicts with existing data. This will ensure that there are no conflicts in an instructor's schedule. Mass importing and exporting eliminates human error when entering data into the Course and Faculty Management System.

Proposed expansions to the Course and Faculty Management System include further automation of schedule generation and analytical report writing. The inclusion of report writing to the Course and Faculty Management System would eliminate a time-consuming process of manually creating reports while being precise and accurate. The reports generated would allow the university to make informed decisions about faculty, courses, and students that benefit the university, faculty and students. An additional future goal of the Course and Faculty Management System is to provide an efficient way for the University to create instructor contracts.

### System Design

### **Design Overview**

The Course and Faculty Management System is a full-stack web based application consisting of three main components. The three components are the user interface, the server, and the database. The technology stack currently used by Course and Faculty Management System is HTML, CSS, JavaScript, PHP, and MySQL.

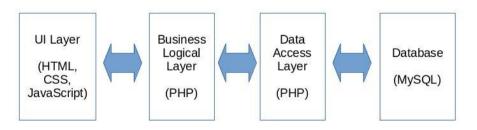


Figure 1. Framework Logical Layers (FLL)

The framework logical layer (FLL) architecture consists of three functional layers (see Figure 1):

- User Interface, Presentation Layer (UI)
- Business Logical Layer (BLL)
- Data Access Layer (DAL)

The front-end, user interface (UI) layer of this application is to present web pages on the client side using HTML, CSS, and JavaScript generated on the server side. The user interface allows users to view, add, update, and delete data relating to courses and instructors. The components of the web application interface are dynamically created using the template engine provided by the PHP framework. The application also includes a permissions-based access system. The permissions system is used to generate and display only the relevant user interface elements required by the active user.

The back-end, server components (BLL and DAL) of the application is coded in PHP. The server application is built on a PHP framework. This framework provides methods to connect to a MySQL database and perform queries on the connected database. The server application performs calculations on data and also adds, deletes or modifies data in the database. The system prevents malicious users from performing SQL injection to run undesired code in the web application. The PHP framework provides a PHP routing system that allows the server to handle GET, POST, and PUT requests. The framework is robust and flexible allowing a large variety of web applications to be built with it.

The last component is a MySQL Server as its Relational Database Management System (RDBMS) but it's considered a third party application and not a logical layer [Azma, H., Goetz, J. 2007]. *RDBMS is used* to store data. The web application's back-end connects to the database and interacts with it using SQL queries. The foundation for this functionality is provided by the framework and expanded in the Course and Faculty Management System.

The functional diagram in Figure 2 shows the admin user interaction with any admin web page.

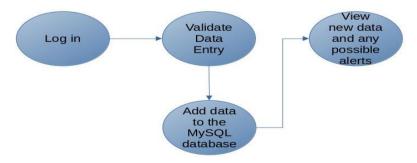


Figure 2. The Functional Diagram shows the Admin User Interaction with the System.

### User Interface Layer

The user interface uses HTML for the structure of the application's pages, CSS for the styling and placement of

elements on the application, and JavaScript for dynamic elements within the application. The website conforms to the [Web Design Best Practices Checklist (2023)].

Course and Faculty Management System has two main components, the public and admin components. The public functionality and the main menu are shown in Figure 3. The user interface of Course and Faculty Management System is designed as a dashboard to function as a menu.

		Course Management System	
Menu	Welcome to the Course Timetabling Managment System.		
Courses			
Instructors			
Departments	View Courses	) for the start of the sec	View Dependence to
	view courses	View Instructors	View Departments
Login/Register			
	See project on Github		
4			

Figure 3. The Public Component of Course and Faculty Management System Menu

All public entities such as courses, instructors and departments are only available to view and don't have interactions buttons such as add, edit or delete (see Figure 4 - 6).

Cou	irses																	
▼ F	ilters																	
Filter	by Term		Show All			~												
Filter	by Attrib	ute:	Show All			~												
Filter	by Subje	ct:	Show All			~												
CRN	Subjec	t Number	Section	Campus	Credits	Title	Days	Time	Actual	Сар	Remaining	XL Actual	XL Cap	XL Rem	Date	Instructor	Location	Term
324	CMPS	372	1	Main	4	Introduction to Python Programming	т	06:00pm - 09:20pm	12	24	12	0	0	0	08/22/22 - 12/18/22	Jozef Goetz (P)	FH 207	Fall 2022
163	CMPS	375	1	Main	4	Systems Analysis and Design	MWF	10:40am - 11:45am	11	24	13	0	0	0	08/22/22 - 12/18/22	Dale Thomas (P)	FH 207	Fall 2022
150	CMPS	320	1	Main	4	Internet Apps Development	w	06:00pm - 09:20pm	16	24	8	0	0	0	08/22/22 - 12/18/22	Jozef Goetz (P)	FH 207	Fall 2022
1119	CMPS	218	2	Online	4	Publishing on the Web I	MWF	08:10am - 09:15am	12	12	0	12	15	3	08/22/22 - 12/18/22	Chris Grime (P)	FH 207	Fall 2022
324	CMPS	218	1	Main	4	Publishing on the Web I	R	12:00pm - 01:00pm	12	12	0	12	12	0	08/22/22 - 12/18/22	Hera Floyd (P) , Jozef Goetz (S) , Chris Grime (T)	FH 207	Fall 2022
245	CMPS	471	4	Main	1	Internship	R	12:00pm - 01:00pm	5	10	5	0	0	0	08/22/22 - 12/18/22	Beniamin Gunski (P)	ТВА	Fall 2022
	CMPS	499	2	Main	4	Senior Seminar/Project	F	06:00pm - 09:20pm	10	10	0	0	0	0	08/22/22 - 12/18/22	Jozef Goetz (P)	FH 207	Fall 2022
245		386	1	Main	4	Introduction to Data Mining	TR	01:50pm - 03:25pm	16	24	8	0	0	0	08/22/22 -	Don Bauman (P)	FH 207	Fall 2022
245 249	CMPS		3	Main	4	Senior Seminar/Project	F	06:00pm - 09:20pm	6	10	4	0	0	0	08/22/22 - 12/18/22	Dale Thomas (P)	FH 206	Fall 2022
		499	5												10/24/22 -			Fall Onlin

Figure 4. The Public View of the Courses Page

5	 Name	Email	Office Phone	Faculty Category
	 Douglas Arthur	grimechristopher1@gmail.com	9095550123	Web Developer
nts	 Julie Abir	jabir@laverne.edu	(909) 123-4567	Web Developer
	 Dale Thomas	dthomas@laverne.edu	(909) 987-6543	Web Developer
	 Christopher Grime	cgrime@laverne.edu	(909) 555-6789	Web Developer
iter	 Beniamin Gunski	bgunski@laverne.edu	(909) 234-5678	Web Developer
ter	 Aleli B. Clark	aclark@laverne.edu	(909) 876-5432	Web Developer
	 Thomas H Newby	tnewby@lv.com	(909) 555-7890	
	 Joseph Manuval	jmanuval@laverne.edu	(909) 321-6547	Web Developer
	 Don Bauman	dbauman@laverne.edu	(909) 456-7890	Web Developer
	 Joe Goetz	joegoetz@laverne.edu	2147483647	Professor (Full)
	 Chris Grime	chris@chrisgrime.com	(909) 555-2468	Web Developer
	 John Boley	johnb@lavene.edu	(909) 876-5432	Web Developer
	 Sarah James	sjames@lavene.edu	(909) 234-5678	Web Developer
	 Mark Gomez	mgomez@lavene.edu	(909) 789-0123	Web Developer
	 Hera Floyd	hfloyd@lavene.edu	(909) 555-7891	
	 Tina Black	tblack@lavene.edu	2147483647	Adjunct Senior Professor
	 Mary Harris	mharris@lavene.edu	(909) 321-9876	Web Developer
	Ginny Loui	gloui@lavene.edu	(909) 555-4321	
	Appa Pimentel	apimentel@lavene.edu	(909) 876-5432	
	 Kylie Teran	kteran@lavene.edu	(909) 234-5678	
	 Bailey Herm	bherm@lavene.edu	(909) 321-6543	Web Developer
	Jozef Goetz	jgoetz@laverne.edu	(909) 555-7892	Web Developer

Figure 5. The Public View of the Instructors Page

Menu Courses Instructors Departments Cogn/Register Login/Register Login/Register Departmental Major Natural Science Computer Science Computer Science Natural Science Natural Science Computer Sc			Course Management System	
Courses       Instructors         Departments       Mathematics         Departments       Chemistry         Login/Register       Computer Science And Engineering         Dispartments       Physics         Physics       Phris - Physics         Biology       Biolol - Biology         Honors       HONR- Honors         Interdepartmental Major       NASC - Natural Science         Computer Science Computer Science       CMPS - Computer Science         Computer Science       NASC - Natural Science         Computer Science/Computer Engineering       CMPN - Computer Engineering         Charter Science       Computer Science         Computer Science/Computer Engineering       CMPN - Computer Engineering	Menu	Departments		
Department Name         Subjects           Departments         Mathematics         MATH-Mathematics           Chemistry         CHEM - Chemistry         CHEM - Chemistry           Computer Science And Engineering         CMPS - computer Science         CMPN - Computer Science           Digit/Register         Biology         Biology         Biology           Natural Science         NASC - Natural Science         CMPS - Computer Science           Computer Science/Computer Science         CMPS - Computer Science         CMPS - Computer Science	Courses	Departments		
Departments         Chemistry         CHEM - Chemistry           Computer Science And Engineering         CMPS - Computer Science         CMPN - Computer Science           Login/Register         Biology         Biol Biology         Biol Biology           Honors         HOR- Honors         HOR- Honors         Interdepartmental Major           Natural Science         NASC - Natural Science         CMPS - Computer Science           Computer Science/Computer Science/Computer Engineering         CMPS - Computer Engineering	Instructors		Department Name	Subjects
LogivRegister Computer Science And Engineering CMPN - Computer Science CMPN - Computer Science CMPN - Computer Science Physics Physics Biology Biology Biology Biology Honors HOR - Honors Interdepartmental Major Natural Science Computer Science/Computer Engineering CMPN - Computer E	Departments			
Biology BIOL - Biology Honors HORR - Honors Interdepartmental Major Natural Science NASC - Natural Science Computer Science/Computer Engineering CMPN - Computer Engineering				CMPS - Computer Science
Honors Honors Honers Honers Honers Honers Honers Interdepartmental Major Natural Science NASC - Natural Science Computer Science/Computer Engineering CMPS - Computer Engineering CMPN - Computer Engineering	Login/Dogistor		Physics	
Interdepartmental Major Natural Science Computer Science/Computer Engineering CMPS - Computer Science CMPN - Computer Engineering	LOBINKERISTEI			
Natural Science NASC - Natural Science Computer Science/Computer Engineering CMPN - Computer Engineering				HONR - Honors
Computer Science/Computer Engineering CMPS - Computer Science CMPN - Computer Engineering				
Computer Science/Computer Engineering			Natural Science	
See project on Github			Computer Science/Computer Engineering	
See project on Github				
See project on Github				
		See project on Github		
	4			

Figure 6. The Public View of the Departments Page

In order to have admin privileges the user needs to be registered (see Figure 7) and then proceed to login (see Figure 8).

	Course Management System
Menu	
Courses	Create Your Account
Instructors	First Name
Departments	Last Name
Login/Register	Email
	Password
	Register
	Already have an account? Log in
4	

Figure 7. The User Registration Page

The main page, after the user is authenticated, has buttons for each of the main entities: courses, instructors, and departments. The user interface of Course and Faculty Management System consists of the following sections: header, navigation side bar menu, main, and footer. The buttons on the main page navigate to a certain entity. The functionality of each of the page changes based on the permissions of the logged in user. The just logged in user, for the first time, doesn't have ability to add, edit or delete any record for any entity (see Figure 4 - 6). The super admin user who has all permissions can change selectively all eight web page combinations of edit permissions (see Edit Permission in Figure 22). Figures 9, 11 - 12, 14 - 16, 18, 20 - 21, 23 show all adding, editing and deleting permissions. All pages are responsive to the display size of a smart phone, tablet and desktop.

	Course Management System
Menu	
Courses	Login To Your Account
Instructors	Email
Departments	Password
Login/Register	Log in
	Don't have an account? Register Account
4	

#### Figure 8. The Login Page

			Co	urse Management System	
Menu Courses Instructors	Departments Add				
Departments		Manage		Department Name	Subjects
		Edit	Delete	Mathematics	MATH - Mathematics
Course Fields		Edit	Delete	Chemistry	CHEM - Chemistry
Time Slots		Edit	Delete	Computer Science And Engineering	CMPS - Computer Science CMPN - Computer Engineering
Terms		Edit	Delete	Physics	PHYS - Physics
Campuses		Edit	Delete	Biology	BIOL - Biology
Subjects		Edit	Delete	Honors	HONR - Honors
Subjects		Edit	Delete	Interdepartmental Major	
Attributes		Edit	Delete	Natural Science	NASC - Natural Science
Instructor Fields		Edit	Delete	Computer Science/Computer Engineering	CMPS - Computer Science CMPN - Computer Engineering
Faculty Categories					
	See project on Github				
Import/Export					
Upload Courses					

Figure 9. The Departments Page as a User with Editing Permissions

The courses page has the ability to mass import and export course data in a specific csv format (see Figure 10).

The courses page also includes filters to allow users to quickly navigate the large dataset of courses. The main portion of the courses page is dedicated to a table displaying courses and the courses' attributes concisely. The table also has pagination at the bottom to improve performance by reducing the amount of data that needs to be loaded at a single point in time (see Figure 11). Under the courses table any errors or warnings (e.g. a time conflict between the first row and the third row in Figure 12) that have been found by the system are displayed.

	Course Management System
Menu Courses	Upload courses with CSV file
Instructors Departments Course Fields	Select a Term         Fail 2022         Choose File         No file chosen         Submit           The uploaded file should be a civ file with the following header.         Select.CRN.Subj.Crs.Sec.Cmp.Cred.Title.Days.Time.Location.Cred.Cap.Act.Rem.XL Cap.XL Act.XL Rem.Primary instructor.Secondary instructor.Tertiary instructor
Time Slots Terms Campuses	Download a template CSV. See project on Github
Subjects Attributes Instructor Fields	
Faculty Categories	
Upload Courses	

Figure 10.	The	Upload	Courses Page	
------------	-----	--------	--------------	--

enu	Course																			
ourses																				
structors	Add	Impo	HE DO	port																
epartments	▼ Filte	rs																		
urse Fields	Filter by Te		s	how All				$\sim$												
ne Slots	Filter by A	ttribute:	s	how All				~												
ms	Filter by St	ubject:	s	how All				~												
mpuses	_																			
ojects	Manage	CRN	Subject	Number	Section	Campus	Credits	Title	Days	Time	Actual	Сар	Remaining	XL Actual	XL Cap	XL Rem	Date	Instructor	Location	Term
ributes	Edit Delete	3246	CMPS	372	1	Main	4	Introduction to Python Programming	т	06:00pm - 09:20pm	12	24	12	0	0	0	08/22/22 - 12/18/22	Jozef Goetz (P)	FH 207	Fall 202
uctor Fields	Edit Delete	1636	CMPS	375	1	Main	4	Systems Analysis and Design	MWF	10:40am - 11:45am	11	24	13	0	o	o	08/22/22 - 12/18/22	Dale Thomas (P)	FH 207	Fall 202
ort/Export	Edit	1509	CMPS	320	1	Main	4	Internet Apps Development	w	06:00pm - 09:20pm	16	24	в	o	0	o	08/22/22 - 12/18/22	jozef Goetz (P)	FH 207	Fall 202
ort Courses	Edit	1115	CMPS	218	2	Online	4	Publishing on the Web I	MWF	08:10am 09:15am	12	12	0	12	15	з	08/22/22 - 12/18/22	Chris Grime (P)	FH 207	Fall 202
out	Edit Delete	3245	CMPS	218	1	Main	4	Publishing on the Web I	R	12:00pm - 01:00pm	12	12	0	12	12	0	08/22/22 - 12/18/22	Hera Floyd (P) , Jozef Goetz (5), Chris Grime (T)	FH 207	Fall 202
	Edit Delete	2451	CMPS	471	4	Main	1	Internship	R	12:00pm - 01:00pm	5	10	5	0	0	o	08/22/22 - 12/18/22	Beniamin Gunski (P)	тва	Fall 202
	Edit Delete	2451	CMPS	499	2	Main	4	Senior Seminar/Project	F	06:00pm - 09:20pm	10	10	0	0	0	0	08/22/22 - 12/18/22	Jozef Goetz (P)	FH 207	Fall 202
	Edit Delete	2494	CMPS	386	1	Main	4	Introduction to Data Mining	TR	01:50pm - 03:25pm	16	24	8	o	0	o	08/22/22 - 12/18/22	Don Bauman (P)	FH 207	Fall 202
	Edit Delete	1664	CMPS	499	з	Main	4	Senior Seminar/Project	e .	06:00pm - 09:20pm	6	10	4	0	0	o	08/22/22 - 12/18/22	Dale Thomas (P)	FH 206	Fall 202
	Edit	3245	CMPS	218	з	Online	4	Publishing on the Web I	weekly	12:00am - 11:59pm	12	12	0	0	0	0	10/24/22 - 12/18/22	Jozef Goetz (P)	Online	Fall Online 2022 (Session 2)

Figure 11. The Courses Page Displaying the Courses Data in a Table Format

									Cou	rse Management Sy	stem									
_	Courses																			
-1	Add Import Eq	port																		
- 11	<ul> <li>Filters</li> </ul>																			
s	Filters										_	_								
- 11	Manag	CRN	Subject	Number	Section	Campus	Credits	Title	Days	Time	Actual	Сар	Remaining	XL Actual	XL Cap	XL Rem	Date	Instructor	Location	Term
	Edit	3246	CMPS	372	1	Main	4	Introduction to Python Programming	w	06:00pm - 09:20pm	12	24	12	0	0	0	08/22/22 - 12/18/22	Jozef Goetz (P)	FH 207	Fall 2022
	Edit		CMPS	375	1	Main	4	Systems Analysis and Design	MWF	10:40am - 11:45am	11	24	13	0	0	0	08/22/22 - 12/18/22	Dale Thomas (P)	FH 207	Fall 2022
	Edit		CMPS	320	1	Main	4	Internet Apps Development	w	06:00pm - 09:20pm	16	24	8	0	o	0	08/22/22 - 12/18/22	Jozef Goetz (P)	FH 207	Fall 2022
	Edit		CMPS	218	2	Online	4	Publishing on the Web I	MWF	08:10am - 09:15am	12	12	0	12	15	3	08/22/22 - 12/18/22	Chris Grime (P)	FH 207	Fall 2022
	Edit	2451	CMPS	471	4	Main	1	Internship	R	12:00pm - 01:00pm	5	10	5	0	0	0	08/22/22 - 12/18/22	Beniamin Gunski (P)	тва	Fall 2022
	Edit	2451	CMPS	499	2	Main	4	Senior Seminar/Project	F	06:00pm - 09:20pm	10	10	0	0	0	0	08/22/22 - 12/18/22	Jozef Goetz (P)	FH 207	Fall 2022
	Edit	2494	CMPS	386	1	Main	4	Introduction to Data Mining	TR	01:50pm - 03:25pm	16	24	8	0	0	0	08/22/22 - 12/18/22	Don Bauman (P)	FH 207	Fall 2022
	Edit	1654	CMPS	499	3	Main	4	Seniar Seminar/Project	F	06:00pm - 09:20pm	6	10	4	o	0	0	08/22/22 - 12/18/22	Dale Thomas (P)	FH 206	Fall 2022
	Edit	3245	CMPS	218	1	Main	4	Publishing on the Web I	м	06:00pm - 09:20pm	12	12	0	12	12	0	08/22/22 - 12/18/22	Jozef Goetz (P)	FH 207	Fall 2022
	Edit		CMPS	218	3	Online	4	Publishing on the Web I	weekly	12:00am - 11:59pm	12	12	0	0	0	0	10/24/22 - 12/18/22	Jozef Goetz (P)	Online	Fall Online
	Select page: [1]234567	8 9 10 11	12 13 14	15 16 17 1	8 19 20	_						_			_					
	The following warnings hav • Jozef Goetz's Introduc • Jozef Goetz's Internet	tion to Py	thon Prop																	

Figure 12. The Courses Page Displaying the Problems found in the Course Schedule List

The edit	hutton	allows	editing	of the	selected	course	( 600	Figure	13)
The cult	button	anows	cultung	or the	selected	course	(300	riguie	15).

	Course M	lanagement Sys	tern										
Menu													
Courses	net Apps Development												
Instructors	se details below.												
Departments	Course Details:												
Course Fields	Course Title:	Internet A	ops Developr	nent									
Time Slots	Course CRN:	1509											
Terms	Subject:	Computer	Science	~									
Campuses	Course Number:	320											
Subjects	Course Section:	1											
	Credit Hours:	4											
Attributes		Select the attributes of this course:											
Instructor Fields		mmunication A (L mmunication B (L											
Faculty Categories	Quantitati	ve Reasoning (LVC											
Import/Export		ellness (LVLW) nunication (LVOC)											
Upload Courses		s – 2 (LVHU)											
Export Courses	<ul> <li>Social Scie</li> <li>Life Science</li> </ul>	nces – 2 (LVSS)											
		ience (LVPS)											
Log out													
		ninar SoLVE (LVUV											
		y Engagement (LV Reflection (LVUR)											
		y Engagement (LV	CS)										
	Student Enrollment (	Optional):											
	Actual Enrollment: 16		Capacity:	24									
	Crosslist Actual: 0		Crosslist Capacity:	0									
	Time and Location:												
	Term:	Fall 2022		~									
	Building - Optional:	FH											
	Room - Optional:	207											
	Timeslot:	W 06:00:0	0 pm - 09:20:	00 pm 🖌									
	Campus:	Main		~									
	Instructor Informatio												
	Primary Instructor	,	z	~									
	Primary Percentag				J								
	Secondary Instruc			~									
	Secondary Percen												
	Tertiary Instructor			~									
	Tertiary Percentag	ge: o											
Save													
4 Þ													

Figure 13. The Edit Courses Page

On the edit courses page (Figure 13), the course subjects, attributes, terms, timeslots, campuses in the drop-downs are editable on the side-bar menu after clicking the corresponding menu items and pressing the edit or delete buttons for the selected entities (see Figures 9, 11 - 12, 14 - 16, 18, 20 - 21, 23). The instructors in the drop-downs of the Instructor Information of Figure 13 are editable on the side-bar menu after clicking the instructor button (see Figure 21 - 23).

		Course M	anageme	nt System	
Menu Courses Instructors	Subjects Add				
Departments		Manage Edit	Delete	Short Code	Subject Name Biology
Course Fields		Edit	Delete	CHEM	Chemistry
Time Slots		Edit	Delete	MATH	Mathematics
Terms		Edit	Delete	CMPS	Computer Science
Campuses		Edit	Delete	CMPN	Computer Engineering
Subjects		Edit	Delete	NASC	Natural Science
Attributes		Edit	Delete	PHYS	Physics
		Edit	Delete	HONR	Honors
Instructor Fields Faculty Categories	See project on Github				
Import/Export					
Upload Courses Export Courses					
Log out					

Figure 14. The Course Subjects Page

	Course Management System
Menu Courses	Edit subject
Instructors Departments	Enter Subject Code: BIOL Enter Subject name: Biology
Course Fields Time Slots Terms	Save
Campuses Subjects	See project on Github
Attributes Instructor Fields Faculty Categories	
Import/Export Upload Courses	
Export Courses	

Figure 15. The Edit Course Subjects Page

		Course Manag	jernent System
Menu Courses Instructors	Attributes Add		
Departments		Manage	Name
Course Fields		Edit Del	
Time Slots		Edit Del Edit Del	
Terms		Edit Del	
		Edit Del	
Campuses		Edit Del	Humanities – 2 (LVHU)
Subjects		Edit Del	social Sciences – 2 (LVSS)
Attributes		Edit Del	Life Science (LVLS)
Instructor Fields		Edit Del	Physical Science (LVPS)
Faculty Categories		Edit Del	Creative Expression – (LVCE)
		Edit Dei	
Import/Export		Edit Dei	
Upload Courses		Edit Del	
Export Courses		Edit Del	
		Earc	Community Engagement (LVCS)
Log out	See project on Github		
•			

### Figure 16. The Course Attributes Page

	Course Management System
Menu Courses	Edit attribute
Instructors Departments Course Fields	Enter attribute name: Verteen Communication A (LVWA) Enter Description: Verteen Communication A
Time Slots Terms Campuses	See project on Giftuio
Subjects Attributes	Set follow on corpora
Instructor Fields Faculty Categories	
Upload Courses Export Courses	
Log out	

Figure 17. The Edit Course Attributes Page

The other entity pages follow the same pattern as courses for timeslots, terms and campuses. Each entity is organized into tables for a clean and organized view (see Figure 18 - 20).

		 	Course Mar	agement	System		
vlenu							
	Timeslots						
Courses	Add						
nstructors	_						
Departments			Manage		Days	Start Time	End Time
tiolde			Edit	Delete	F	01:10 pm	02:45 pm
urse Fields			Edit	Delete	F	08:35 am	11:45 am
ne Slots			Edit	Delete	F	09:25 am	10:15 am
erms			Edit	Delete	F	09:25 am	11:00 am
ampuses			Edit	Delete	м	01:00 pm	03:25 pm
			Edit	Delete	м	09:25 am	11:00 am
Subjects			Edit	Delete	MW	10:20 am	11:55 am
Attributes			Edit	Delete	MW	10:40 am	11:30 am
structor Fields			Edit	Delete	MW	01:10 pm	02:00 pm
			Edit	Delete	MW	01:10 pm	02:45 pm
Faculty Categories			Edit	Delete	MW	02:20 pm	03:10 pm
nport/Export			Edit	Delete	MW	07:15 am	08:05 am
Jpload Courses			Edit	Delete	MW	07:40 am	09:15 am
·			Edit	Delete	MW	08:15 am	09:05 am
Export Courses			Edit	Delete	MW	09:25 am	10:15 am
			Edit	Delete	MW	09:25 am	11:00 am
.og out			Edit	Delete	MWF	10:40 am	11:45 am
			Edit	Delete	MWF	01:10 pm	02:15 pm
			Edit	Delete	MWF	02:20 pm	03:25 pm
			Edit	Delete	MWF	07:00 am	08:05 am
			Edit	Delete	R	10:25 am	11:55 am
			Edit	Delete	R	12:05 pm	02:30 pm
			Edit	Delete	R	01:10 pm	02:45 pm
			Edit	Delete		01:50 pm	03:25 pm
			Edit	Delete		02:05 pm	01:40 pm
			Edit	Delete	R	07:40 am	09:15 am
			Edit	Delete		07:55 am	08:45 am
			Edit	Delete		08:35 am	10:10 am
			Edit	Delete	т	10:20 am	11:35 am
			Edit	Delete	т	12:05 pm	12:55 pm
			Edit	Delete	т	12:05 pm	01:40 pm
			Edit	Delete	т	12:05 pm	02:30 pm
			Edit	Delete	т	01:50 pm	02:50 pm
•			Edit	Delete		01:50 pm	

Figure 18. The Timeslots Page

	Course Management System
Menu Courses	Edit Timeslot
Instructors Departments	Days (Entered as MTWRFSU): F
Course Fields	Start Time (Enter in 24h time): 13:10
Time Slots	End Time (Enter in 24h time): 14:45
Terms	
Campuses	Submit
Subjects Attributes	See project on Github
Instructor Fields	
Faculty Categories	
Import/Export	
Upload Courses Export Courses	
Log out	

Figure 19. The Edit Timeslot Page

		Course Manag	ement System	
Menu	Campuses			
Courses	Add			
Instructors				
Departments		Manage	Name	Code
		Edit Dele	Main	MA
Course Fields		Edit Dele	Online	OL
Time Slots		Edit Dele	CAPA	CA
Terms		Edit Dele	Bakersfield	BA
Campuses		Edit Dele	Burbank	BU
		Edit Dele	Irvine	IR
Subjects		Edit Dele	ontario	ON
Attributes		Edit Dele	Naval Base	NA
Instructor Fields		Edit Dele	Santa Clarita	SA
		Edit Dele	Vandenberg Space Force Base	VA
Faculty Categories		Edit Dele	College of Bus & Public Mgmt	BUS
Import/Export				
Upload Courses	See project on Github			
	See project on on the			
Export Courses				
Log out				

Figure 20. The Campuses Page

Similarly, the instructors are organized in a table with direct email links and phone numbers of the instructor (see Figure 21). Users with the permissions to edit instructors will be able to edit the instructor info by clicking the corresponding edit button.

				Course Man	agement System		
u	Instructors						
urses							
structors	Add						
Pepartments		Manage		Name	Email	Office Phone	Faculty Category
- cpuranents		Edit	Delete	Douglas Arthur	grimechristopher1@gmail.com	Children Phone	Adjunct Instructo
urse Fields		Edit	Delete	Julie Abir	jabir@laverne.edu		Adjunct Instructo
me Slots		Edit	Delete	Dale Thomas	dthomas@laverne.edu		Professor (Full)
rms		Edit	Delete	Christopher Grime	cgrime@laverne.edu		Web Developer
		Edit	Delete	Beniamin Gunski	bgunski@laverne.edu		Lecturer
mpuses		Edit	Delete	Aleli B. Clark	aclark@laverne.edu		Associate Profess
bjects		Edit	Delete	Thomas H Newby	tnewby@lv.com		Assistant Profess
ributes		Edit	Delete	Joseph Manuval	jmanuval@laverne.edu		Assistant Profess
ructor Fields		Edit	Delete	Don Bauman	dbauman@laverne.edu		Web Developer
		Edit	Delete	Joe Goetz	joegoetz@laverne.edu		Professor (Full)
culty Categories		Edit	Delete	Chris Grime	chris@chrisgrime.com		Instructor
ort/Export		Edit	Delete	John Boley	johnb@lavene.edu		Visiting Professor
load Courses		Edit	Delete	Sarah James	sjames@lavene.edu		Adjunct Instructo
		Edit	Delete	Mark Gomez	mgomez@lavene.edu		Senior Adjunct In
port Courses		Edit	Delete	Hera Floyd	hfloyd@lavene.edu		Adjunct Professo
		Edit	Delete	Tina Black	tblack@lavene.edu		Adjunct Senior Pr
out		Edit	Delete	Mary Harris	mharris@lavene.edu		Adjunct Instructo
		Edit	Delete	Ginny Loui	gloui@lavene.edu		Assistant Profess
		Edit	Delete	Appa Pimentel	apimentel@lavene.edu		Adjunct Senior Pr
		Edit	Delete	Kylie Teran	kteran@lavene.edu		Lecturer
		Edit	Delete	Bailey Herm	bherm@lavene.edu		Senior Adjunct In
		Edit	Delete	Jozef Goetz	jgoetz@laverne.edu		Professor (Full)

Figure 21. The Instructors List Page

Clicking the edit button of the instructors page the instructor's information can be displayed and can be edited permissions and other information (see Figure 22).

A unique feature to the instructor page is the ability to view instructor details on a details page. The instructor details page is available by clicking the instructor name on the instructor list page. The page shows information about the instructor and a list of the courses that instructor is assigned to as well (see Figure 23). The courses are

displayed in a table similar to the table on the courses page.

	Course Manag	gement System
lenu Courses	Edit Instructor Jozef Goetz	
nstructors	Instructor Info:	
Departments	Instructor's First Name:	Jozef
ourse Fields	Instructor's Middle Name/Initial (optional)	
ime Slots	Instructor's Last Name:	Goetz
ferms	Email:	jgoetz@laverne.edu
ampuses	Phone Number:	9497483647
ubjects	Degree:	Ph.D.
attributes	Position:	Professor
structor Fields	Contract:	tenured
Faculty Categories	Workload Cap:	16
port/Export	Course Release:	0
Jpload Courses	Office Hours:	MW 2 - 4 pm
xport Courses	Pay info: Pay Rate 3.4.5:	5000
	Pay Rate 2:	0
og out	Pay Rate 1:	0
	Faculty Category:	Professor (Full)
	Academic	tenured
	Appointment: Edit Permissions	tenured
	Modify Courses	
	Modify Department	ients
	Modify Instructor	
	Modify User Acc	
	Modify Course F     Modify Faculty F	
	Access Pay Info	
	Import And Exp	Drt
	Submit	

Figure 22. The Edit Instructor Page with Available Permissions

								Course Manag	ement Syst	tem									
	lozef G	ioetz																	
	Title: Prof		ulb																
1	Office Pho		uny																
	Email: jgo		erne.edu																
	Pay Info																		
	Workload	Capacit	y: 16																
	Pay rate f	or 3 or m	nore units	s: 5000															
l	Pay rate f	or 2 unit	ts: 0																
	Pay rate f	or 1 unit	ts: 0																
	_	_										_		_	_	_			
	The inst	ructor i	is a prim	ary instru	uctor of	the follo	wing cou	rses:											
	Manage	CRN	Subject	Number	Section	Campus	Credits	Title	Days	Time	Actual	Сар	Remaining	XL Actual	XL Cap	XL Rem	Date	Instructor	Locat
	Edit Delete	2451	CMPS	499	2	1	4	Senior Seminar/Project	t F	06:00:00 pm - 09:20:00 pm	10	10	0	0	0	0	08/22/22 - 12/18/22	Jozef Goetz (P)	FH 20
l	Edit Delete	3246	CMPS	372	1	1	4	Introduction to Python Programming	т	06:00:00 pm - 09:20:00 pm	12	24	12	0	0	0	08/22/22 - 12/18/22	Jozef Goetz (P)	FH 20
l	Edit Delete	1509	CMPS	320	1	1	4	Internet Apps Development	w	06:00:00 pm - 09:20:00 pm	16	24	8	0	0	0	08/22/22 - 12/18/22	Jozef Goetz (P)	FH 20
	Edit Delete	3245	CMPS	218	3	2	4	Publishing on the Web	I weekly	12:00:00 am - 11:59:00 pm	12	12	0	0	0	0	10/24/22 - 12/18/22	Jozef Goetz (P)	Onlin
	The inst	ructor i	s a seco	ndary ins	structor	of the fol	llowing c	ourses:											
l	Manage	CRN	Subject	Number	Section	Campus	Credits	Title Days	Time	Actual Ca	p Rema	aining	XL X Actual C	L XL ap Re	m Da	te	Instructor		Locat
	Edit Delete	3245	CMPS	218	1	1	4	Publishing on R the Web I	12:00:00 pm - 01:00:00 pm	12 12	0		12 1	2 0		22/22 - 18/22	Hera Floyd Goetz (S) , (T)	(P) , Jozef Chris Grime	FH 20
			and the te	rtiany instr	uctor of a	inv course	s.												
	This instru	actor is r	for the te																
	This instr	uctor is r	iot the te	cony msu								_		_	_	_			_

Figure 23. The Instructor Details Page, Displaying Info about the Selected Instructor

#### **Business Logical Layer**

The Business Logical Layer (BLL) consists of PHP generic and project specific classes where data are processed. A specific connection PHP class facilitates the communication with the Data Access Layer (DAL). The BLL hides the SQL statements calls from the UI Layer (see Figure 1). The low code framework provides methods in PHP generic classes to get and send SQL commands to the database. The application also uses GET, POST and PUT requests via a PHP routing system for accessing numerous elements.

Any user can have multiple permissions assigned to them. The permissions system allows for the admin of the site to grant only the necessary permissions to the users. The following are permissions that are currently available to be assigned to any user (see Figure 22).

- *Modify Courses* Allows users to change course related data.
- Modify Departments Allows admin to modify departments and
- Modify Instructors Allows admin to change Fields related to instructors
- *Modify User Access* Allows changing the permissions of users
- *Modify Course Fields* Allow access to create update and delete fields related to courses such as: term, timeslot, attribute, and campuses
- Modify Faculty Fields Allows the admin to create delete and edit the faculty categories
- Access Pay Info Allows the admin to modify and view instructors' pay rates
- Import and Export Allows the admin access to the mass import and export features.

### Data Access Layer and Database

The low code framework (LCF) uses MySQL as a relational database management system (RDBMS). The database is normalized to improve performance and disk space utilization. The UI objects use the Business Logical Layer (BLL) to communicate with the Data Access Layer (DAL). The DAL connects to RDBMS and request the content that belongs in the web page. The RDBMS responds by sending the requested content to the DAL. The DAL stores the content into one or more PHP variables of Business Logical Layer (BLL). UI layer outputs the content in the browser as part of the web page using the HTML and CSS code.

The database consists of the database tables with its primary and foreign keys. Primary, foreign keys of the tables and the admin permission determine business logic. Adding, editing and deleting table records are limited by business logic. The database structure is designed around the course and instructor models. The application data table (see Table 1) stores user specific information about courses, instructors, subjects, departments, terms, timeslots, campuses and course attributes. Subjects, terms, timeslots, campuses, and attributes are related to courses. Subjects have a relationship to department. The database table relationships are easily identified when the database structure is represented visually (see Figure 19). Columns in those tables are connected through relationships defined by foreign keys.

Table Name	Table Columns	Description
department	id, name	Stores information about the organization's
		departments
subject_department	subjectid, departmentid	Links subject to department. Many subjects can be part
		of a single department
subject	id, code, name	Stores information about the course subjects
term	id, name, termstart,	Holds term information. The name of the term, start
	timeend, number	datetime and end datetime
timeslot	id, description,	Holds information for the time a course can be held at.
	timestart, timeend, days	Includes the days, start datetime, and end datetime.
campus	id, name, code	Holds information about which campus a course is
		located
course_attribute	courseid, attrributeid	Links course to attribute. Many-to-many
attribute	id, name, description	Holds attributes set by the organization that a course
		may have
course	id, title, subjectid,	Holds information about courses
	coursenumber,	
	credithours, creatorid,	
	crn, <i>termid</i> ,	
	timeslotcode, capacity,	
	actual,	
	crosslistcapacity,	
	crosslistactual, section,	
	dateadded, courselevel,	
	primaryinstructor,	
	secondaryinstructor,	
	tertiaryinstructor,	
	primarypercentage,	
	secondarypercentage,	
	tertiarypercentage,	
	campusid, building,	
	room	
instructor	id, firstname,	Holds information about the faculty
	middlename, lastname,	
	email, password,	
	permissions, phone,	
	degree, position,	
	contract, workloadcap,	

# Table 1. Application Data Table

## (Primary Keys are in bold, Foreign Keys are in italics)

	academicappointment,	
	rate345, rate2, rate1,	
	address, city, state, zip,	
	officephone,	
	facultycategoryid	
facultycategory	id, name payrate, code	Holds category information about faculty

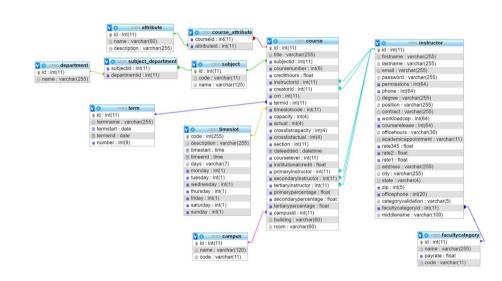


Figure 19. Visual Database Table Relationship

### Implementation

The project files in the relationship to the website map is shown in Figure 20. Course and Faculty Management System project with all files is available at github.com Grime C. (2023).

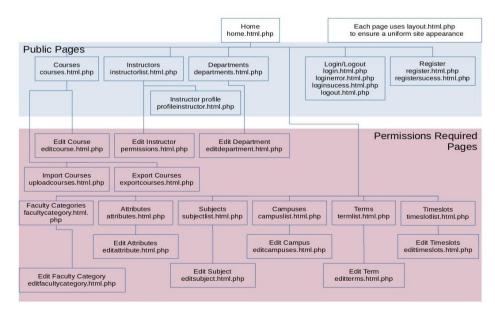


Figure 20. Website map with Corresponding File Names

#### **Test and Results**

Testing for the website is a very important step in the project. An example of a test case would be testing the register system (see Figure 21). The system expects four inputs: a first name, a last name, an email address in the correct format, and password. The software has to check if the email is in the correct format and if all the fields in the form are filled. If one of these checks are not true and the software doesn't allow the user to register and doesn't let the incomplete data be sent to the database. An example of a use case for the register system is that the user is able to visit the register page and fill out the form to register in the system. If the entered data is correct (i.e. satisfied the requirements), then the data is sent to the database and the user is able to log in [Flores Marquez, A., Goetz, J. (2023)].

	Course Management System
Courses Instructors Departments Login/Register	Create Your Account Chris Grime ChrisGrime
	Vour account could not be created, please check the following:

Figure 21. Registration Web Page Showing Error

Testing for the website application is performed on all web pages. Responsive design principles are implemented for smart phones, tablets and desktops (see the last three columns Table 2). The example of verification matrix for the web pages courses, instructors, departments, export, import and courses.css is shown in Table 2. All links are tested and they function as intended. Test cases for all possible inputs are performed for each of the input fields on the site. HTML, CSS [Felke-Morris, T. (2021), Deitel, P. J., Deitel, H. M., & Deitel, A. (2012), PHP Butler, T., & Yank, K. (2017)] errors were tested for using validation websites [W3C Markup Validation Service (2023), W3C CSS Validation Service (2023) and **PHP** Code Checker (2023)]. Testing ensures that no improper data is entered into the database.

Table 2. Test Plan and Results - Verification Matrix for the Web Application

1. Page #/name	2. Test item	3. Validation	4. Outcome	5. Outcome	6. Outcome in
_	- list hyperlinks,	each web page	in Mobile	in	- desktop.
list all pages	fields, buttons,	using	Phone	- tablet.	Resolution
	videos,	http://validator	- android	Resolution	1440*900.
	images,	.w3.org	chrome	1920x1080	Good
	GUI controls,		browser, brave	Outcome	Outcome
	web pages		browser and	in Chrome,	in Chrome and
			Firefox	Firefox,	Firefox

	Schema: click			Brave and	
	action =>			Edge are all	
	reaction			good	
	Legend:				
	=> means				
	land in				
courses.html.ph	Edit Button =>	Nu Hard Charder The below suppopulation with the UKE postigs of 8 below strates objects thep- Bong with in the Chargement of the control philothese graph control	Course Managment System	Constituent (con	Institutional lines
р	Edit page	Under 2011 The Transfer (1996) The Transfer Transfer (1996) The Transfer Transfer (1996) The Transfer Transfer (1996) The Transfer Transfer (1997) The Transfer (1997)	Add Imput Dapart		
	Add Button =>	annaite d'eanna	ON         1279           Statest         IIIG.           Number         201           Section         3333           Campan         Man           Title         FLID Concretificitagy 11,ab           Dip         Wit           Time         1200pn - 1201pm           Actual         22           Capably         24	10         10         20         2         More         More <th></th>	
	Add page		Time 12:05pm - 12:15pm Actual 22 Capacity 24 Pamainting 2 Crossilit Actual 0 Crossilit Cap 0		
	Delete		Orosisti Cop 0 Crossist Renaining 0 Date 01/02/20- 05/08/20 Instructor Doug Furnie (P) , Dave Thomas (3)		
	Button =>				
	Deleting is				
	working, pop up				
	to confirm				
editcourses.html	Save Button =>	Nuclear Dadar To Information of the TRU-backgood backgood	Course Management System	bait ( Gait ) Kai ( Gait )	No.
.php	Working	The first star in the second star in the second star is the second sta	Add Course Erner the course details below: Course Details:	Name Name Name Name Name Name Name Name	No.20         No.20           Bit Mark         Annual
		The free longer free (all to the shares and an energy with set the control of the standard set of the stan	Course Title:	tetarfeit killy one	
	Required text	And the first of the second	Subject: Biology •	latitation latitation latitation	-Errors for
	fields display a		Course Number:	tetter linit title color a	blank required
	message and do		Credit Hours:		fields are
	not allow form		Select the attributes of this course: New Attribute		shown when
	submission.		UVCS - Community Service Student Enrollment (Optional) :		field is left
					blank
	Title, subject,				-Errors for
	crn, section left				number only
	blank will give				field are shown
	display a				if non-numbers
	message to				are entered into
	prompt the user				the field
	to fill the fields				-error handling
	in. => Working				is working
	-				The course could not be added. Data balance for more information.   The course the course balance  The course of t

instructors.html.	Edit Button =>	No Hen Ducker Turbin angegeneers der Mittandig ert blever men start storg	Course Managment System	En Franchington figure	Name
php	Edit page	Terry selecting to a sequence spectra set of the second se	Instructors Add See Core Name Dougla Arthur Enail Disenschnistigher? (grad.com Addr Colego y		
	Add Button =>	is 4 (by a loss of monology of 1 Straction work) Socknow works of value work of 10	Facility Category Solt ESt Device Name Doug Furnie Email dougt Governa edu Office Phone	i diffe jurihanski jurihanski jelova	Hele ( Interpretation
	Add page		Facility Category Edit Exercise Name Dure Trisma Email db(Exercised) Office Hone Rochy Category		
			Final rank Roally Category Edit Edit Seaso Name Oristopher Grine		
	Delete Button =>				
	Deleting is				
	working, pop up				
<u> </u>	to confirm	Sti Umi Physika	Course Management System	insingst las	laningen (ar
permissions.htm	Submit Button	No. 1991 LA LA CALLE This birs as report operative in birs HTL, ducing and is before mean subject to deep Booking wash for they low approximation provided and they applicate to provide the Outbin high State Town Town Towney (State)	Course Management Bystem Add new Instructor Instructor	No.	Note         Material State           State         State         State
l.php	=> Working	Detty sins * The constraints for the second data sins, which are a second as the second data sins are been beings from the best of both the particle memory, and are believed of error an instage lines; it means that by them it	Instruction's First Name: Instruction's Middle Name/Initial powers)	B1H         Handle	A CARENT AND
	Text Inputs =>	Sourcest develop sampling, for which or wandings in down back-MC your freeds which reads a well or a (71) for want to (1) shared	Instruction's Last Name (mail)	Notes	The required
	Working		Phone Number: Dagree		fields: Name
	C		Poston: Contract:		and email
	Checkboxes =>		Workhowd Cape		cannot be left
	Working				blank.
					Validation is
					working
					the one re-crash online stability, these below for neuron information, $= \mbox{ for any constraint by Model } \\ = \mbox{ or any constraint by Model } \\ = \mbox{ bit and constraint by Model } \\ = \mbo$
departments.ht	Edit Button =>	No Hint Checker Toritolise separa spannet i take 1783, decing of its Mean many sejects deeps	Course Managment Bystem	Excertangentiples	
ml.php	Edit page	Design with the first pre-strategies and spatialistic particular.	Add Marcage Edit Dever Department Mathematics Subjects MATH - Mathematics	Image: Section of the sectio	
	Add Button =>	Lacha lanage Fanny blac skore. Molitine getaler menage, with see this carb of errors of serving. Name Princy Concentration, sprease Lanary and serving states mark-finance, and sprease the serving serving transition and serving serving serving transition and serving serving	Marage Edit Dekite Department Diverbitry Solgicts Or6M-Chemistry Marage Edit Dekite	Litingapations	
	Add page	Maritubeit - Instance-Inst 0 ()	Department Computer Science And Engineering Subjects Computer Science CMPN - Computer Science CMPN - Computer Engineering		
	1 0		Department Physics Sobjects Marage <u>Balt</u> Orlinte Department Biology		
	Delete Button =>				
	Deleting is				
	working, pop up				
	to confirm				
editdepartments.	Save Button =>	No Held Checker The late an experiment model THE, the lag and hadron more capital storp Theory with the the check present system can be presented at the check present store that mail the transmission (camital store).	Add Department Enter department name:	tes Reference Anno Ann	Extraction      Extractio
html.php	Working	In the second se	Select subjects that are a part of this department:	AirWith         In With any Part of the Part o	<ul> <li>i and a second se</li></ul>
	Checkboxes =>	ana hanno lan anna 4000 401	Computer Engineering Network Conce Physics	Verlage Anno Terration Ter	Department
	Working		Honors La Viene Experience Sale		name gives
			© 2019 christopher grinne@lawens edu		error is it is left
					blank
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# Discussion

This project has been a great exercise to show how expandable the low code interactive framework is. Many new additions to the various PHP, CSS and HTML files were needed in order to achieve a full functionality of Course and Faculty Management System. One addition was adding management pages for courses, instructors, subjects, departments, campus, timeslots, and course attributes with given constrains for each entity. Software like Notepad++ [Notepad++ (2023)], Visual Studio Code [Visual Studio Code (2023)] and phpMyAdmin, which is bundled with XAMPP, [XAMPP (2023)] were used as the core software when constructing the web application.

The basic goal of Course and Faculty Management System is to keeping track of courses and faculty by managing (viewing, adding, editing, deleting) courses, instructors, subjects, departments, timeslots, course attributes with given constrains for each entity. The project was successfully designed and implemented.

Course and Faculty Management System is an emerging application therefore it is limited in features. The current version allows privileged users to perform create, read, write, and delete operations on the connected MySQL database. Other functionality in the application is more limited. Potential expansions can fit into two categories: data, and data analytics.

Each column for the course page can be expanded by adding ascending and descending ordering features. Another extension is to build a notification system around the administrators, specifically if another administrator permission is changed or its record is modified or deleted. In a data management system that has the potential to hold large amounts of data, such as Course and Faculty Management System, navigating the stored data is an important function. Filters and search functionality for entities such as the courses and instructions should be implemented for any attributes that entity may have. Filtering and search will improve the efficiency of the users of Course and Faculty Management System. Data imported using the mass import feature currently requires data

to be in an exact format. A better solution would be to use application programming interfaces (API) provided by other applications where available. If an API is not available the Course and Faculty Management System should provide a dynamic method of importing data.

Another expansion is to develop a system to allow users the ability to upload and retrieve binary files (images and documents) for instructors and classrooms and have them stored on database server for the user display. Additional development is to introduce a two-factor authentication security subsystem.

Data analytics and report generation are the main future goal of Course and Faculty Management System. Google analytics can be incorporated in the system and pivot table services can be incorporated into the framework as well. The application is excellent at receiving and storing data, the next step is for the application to use the data to create exports. Another extension of the project is to generate instructor contracts and reports to help the university to make informed decisions backed by data.

# Conclusions

The goal of this work is achieved within the computer science senior project by studying, learning and expanding coding of the low code, interactive, secure framework for the purpose of designing, implementing and testing Course and Faculty Management System. The main goal of the Senior Project course (CMPS 499) is to provide a capstone and culminating experience in which the student combines knowledge, skills and topics that the student previously learned with new topics learned during the course. Moreover, students need to have a senior project presentation and write a final project report. All computer science undergraduates are required to take a capstone course senior project at the La Verne University and many other universities [Computer Science Curricula (2013)].

Moreover, the senior project course (CMPS 499) satisfies the following Program Criteria for Computer Science student outcomes [Accreditation Board for Engineering and Technology – ABET (2022-2023)] as follows:

- Ability to analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions.
- Ability to design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.
- Ability to communicate effectively in a variety of professional contexts.
- Ability to apply computer science theory and software development fundamentals to produce computingbased solutions.

Before starting work on a senior project, in another class (CMPS 320 - Internet Apps Development), students learn how to construct dynamic, data-driven web applications, and secure, customized content management systems using PHP and MySQL. Students develop skills in many aspects of the software development and deployment process. Students develop basic and intermediate skills in structured Query Language (SQL), MySQL, development using PHP, form processing, and regular expressions. Therefore, many new additions to the various PHP and HTML framework files were successfully added or modified to achieve the well-structured,

full functionality of Course and Faculty Management System. The design, implementation and testing of Course and Faculty Management System with a wide spectrum of functionality is an excellent proof of a senior project achievement beyond regular CMPS 499 requirements.

The current version of Course and Faculty Management System provides an excellent base for expansion. The web application provides the ability to perform create, read, update, and delete operations on university course and faculty data. Expansion of this data management solution would provide increased efficiency and allow any organization that implements it to make optimizations based on their own data. Course and Faculty Management System has a clear purpose, to manage and assist in creation of course scheduling. Course and Faculty Management System also has the potential to assist in any task that requires course and faculty data as well as generate analytical reports.

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# References

- Accreditation Board for Engineering and Technology ABET (2022-2023). *Program Criteria for Computer Science*. https://www.abet.org/wp-content/uploads/2022/03/2022-23-CAC-Criteria.pdf.
- Azma, H., Goetz, J. (2007). WEBCRM Application Generator, Proceedings of the 2007 International Conference on Internet Computing, World Congress in Computer Science, Computer Engineering, and Applied Computing (WORLDCOMP'07), Las Vegas, USA, ISBN: 1-60132-044-2, pp 29-35.

Butler, T., & Yank, K. (2017). Php & MySQL: Novice to Ninja (6th ed.). SitePoint Pty, Ltd.

- Computer Science Curricula (2013), https://ieeecs-media.computer.org/assets/pdf/CS2013-final-report.pdf, Curriculum Guidelines for Undergraduate Degree Programs in Computer Science December 20, 2013, *The Joint Task Force on Computing Curricula Association for Computing Machinery (ACM) IEEE Computer Society.*
- Grime C. (2023). Course and Faculty Management System, https://github.com/grimechristopher/cms.

Deitel, P. J., Deitel, H. M., & Deitel, A. (2012). Internet & World Wide Web: How to program (5th ed.). Pearson.

Felke-Morris, T. (2021). Web Development & Design Foundations with HTML 5 (10th ed.). Pearson.

- Flores Marquez, A., Goetz, J. (2023). Certificate Management Application. In M. Shelley & V. Akerson (Eds.), Proceedings of ILSET 2023-- International Conference on Life Sciences, Engineering and Technology, Denver, CO, USA. ISTES Organization.
- Guarrera, A., *Goetz, J.* (2022, May 10). *Patient Care Reporting App*, https://libapps.s3.amazonaws.com/customers/897/images/Case\_Day\_2022\_v2.png, La Verne's Research Case Day, May 10, 2022.
- Kumar, M., Garg, A., & Kumar, A. (2021). Critical factors of post implementation of ERP in Higher Education Systems Survey Review. *IOP Conference Series: Materials Science and Engineering*, 1149(1), 012017.

https://doi.org/10.1088/1757-899x/1149/1/012017.

- Miranda-Hill, W., Goetz, J. (2019, June 30 July 4). User-generated Geospatial Meteorology Map Prototype, Proceedings of the Informing Science + Information Technology Education Conference (InSITE), Jerusalem, Israel, pp 257 – 269.
- Soliman, M. &, Noorliza, K. (2015). Higher Education Competitive Advantage: Enterprise Resource Planning Systems. *International Journal of Research in Management & Technology*, *5*, 380-384.

Notepad++ (2023). https://notepad-plus-plus.org/.

Visual Studio Code (2023). https://code.visualstudio.com/.

W3C Markup Validation Service (2023). https://validator.w3.org/ .

W3C CSS Validation Service (2023). https://jigsaw.w3.org/css-validator/.

Web Design Best Practices Checklist (2023). http://terrymorris.net/bestpractices.

PHP Code Checker (2023). https://phpcodechecker.com/.

XAMPP (2023). https://www.apachefriends.org/download.html.

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