

Multimedia Database

Final Report

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CS 4264 Multimedia, Hypertext, and Information Access
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Executive Summary

Throughout this report, our team illustrates the entire process for the creation of a website to interact with a multimedia database. Our team intended to create a centralized system where both undergraduate and graduate Computer Science students at Virginia Tech can upload their personal projects for all instructors who are affiliated with the university to view. The overall goal of this project was to create a system to allow a user a way to view other user's profiles in order to facilitate the ability to find research candidates and opportunities. Our team hopes that this proof-of-concept project can have a greater impact in the future by being expanded upon to include all university students. However, since our goal was to create a prototype, we have limited the number of students who have access to the system to merely Computer Science students. In order to create a successful prototype for our client, we had to first, through careful discussion, create the requirements for both the database and website. Next, came the design phase which outlines the prototype's technologies and overall structure. In the implementation and prototype sections, we go into detail about every aspect of the prototype's capabilities. Finally, in the testing section our team discusses the various metrics deployed to determine the successfulness of the prototype. Furthermore, we discuss the future plans for the project once we have graduated and the valuable lessons our team learned from this experience.

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User Manual

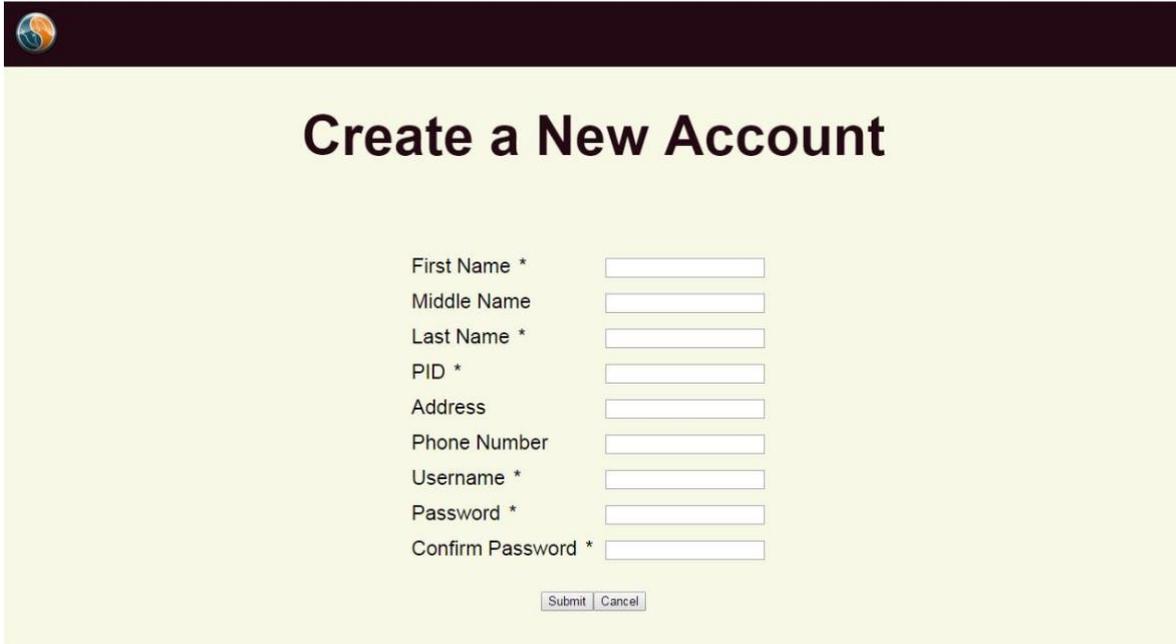
This user manual will illustrate how any user can properly use the multimedia database.

1. When a user first visits the website, the user will be greeted with the following website homepage.



Figure 1: Website Home Screen

2. If the user is an existing user in the system, the user can simply click on the *Login* button located at the top right and enter their credentials to be directed to his profile page. If the user is a new user, they should click on the *Create* button located at the top right to create a new account.
3. Once the user clicks the *Create* button, they will be directed to the following screen in Figure 2.



The image shows a web form titled "Create a New Account" on a light green background. At the top left is a small globe icon. The form contains the following fields, each with a text input box: "First Name *", "Middle Name", "Last Name *", "PID *", "Address", "Phone Number", "Username *", "Password *", and "Confirm Password *". The asterisk indicates required fields. At the bottom of the form are two buttons: "Submit" and "Cancel".

Figure 2: Account Creation Page

4. Once on the 'Create a New Account' page, the user will have to fill out all the necessary information to create their new account. All fields marked with a * are required and account creation cannot be completed if they are left blank. In addition, the user's password should contain at least eight characters and at least one of the following: a capital letter, number, or special character.
5. Once a new account has been created or if the user logs into the application after they have created their account, the user will be directed to their profile page. Figure 3 is a wireframe of what the profile page will look like.



The image shows a wireframe of a user profile page. At the top right, there are links for "Upload" and "Logout". On the left side, there is a profile picture of a person in a green shirt standing by a river with an American flag. Below the picture, the user's information is listed: "Justin Johnson", "Computer Science Student", "Justin@vt.edu", "123-456-7890", "123 Some Street", and "Interests: Machine Learning, computer security". At the bottom of this section is an "Edit Account" button. The rest of the page is a large, empty light green area.

Figure 3: Profile Page

- Once on the profile page, the user can select upload to choose which files they want to upload. Once the user has finished uploading all their files, they will be directed to the search page. Figure 4 below is a wireframe of what the search page will look like.

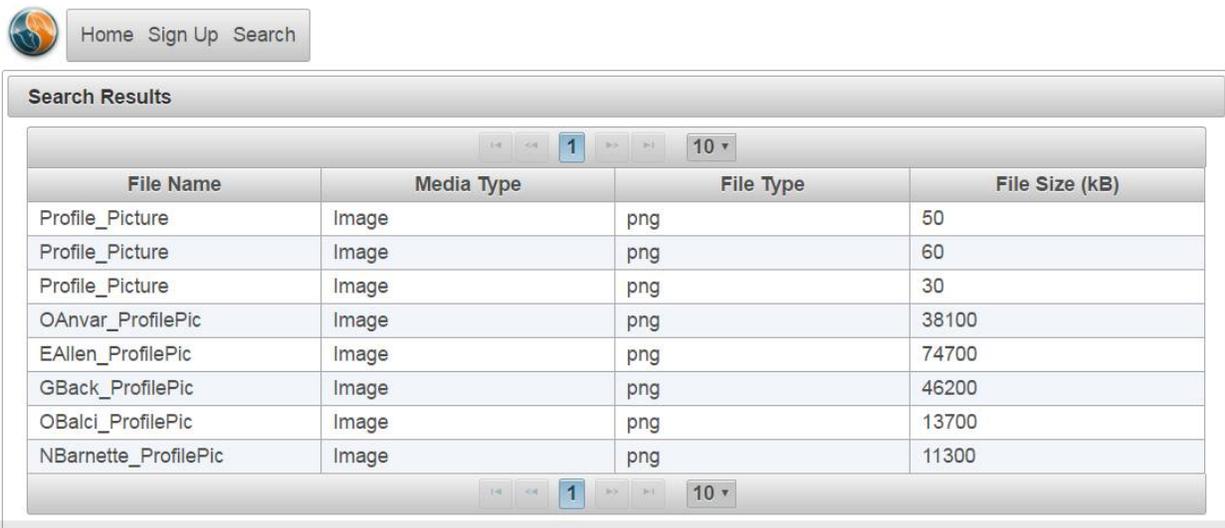


Figure 4: Search page

- Once on the search page, the user can choose what to search by. For example, in Figure 4, the user is looking for all videos uploaded by faculty members. The search will then query the database and return the appropriate results.

Developer Manual

1 - Requirements

1.1 - Client Information

The client for this multimedia database project is Dr. Christopher Zobel, a professor from the Business Information Technology department at Virginia Tech. Dr. Zobel's research focuses on database design and functionality. More information about Dr. Zobel can be found on his website: <http://www.czobel.bit.vt.edu/>.

1.2 - Objectives

The client wanted our team to create a MySQL database for multimedia content and a website prototype to interact with the database. Our team implemented a backend database and a frontend website. The ultimate goal was to implement a website which facilitates searching for research opportunities for students and professors. For example, if a professor is looking for research candidates to help out for a particular project, he can search for students interested in a similar topic. The professor can then view the student's resume and past projects to see if the student will be a good fit for the professor's team. Similarly, if a student is interested in a research opportunity, he can search through the database for a professor who is working on a certain topic and view what the professor has accomplished so far.

1.3 - Justification

There are many multimedia relational database systems. Our team discussed this concern with our client and together decided to use MySQL. We were aware that MySQL is not the ideal choice for storing large multimedia files. However we choose to utilize MySQL rather than another relational database management system to analyze the practicality of such a system that stores multimedia content.

Although this system was designed to serve students in the Department of Computer Science, this team's goal was to develop a prototype to see if such a system could be scaled up for students in other departments as well. Our client was aware that this system will not serve students from BIT as it is a proof-of-concept.

1.4 - Statement of Functionality

The purpose and function of any database is to give centralized location where information can be organized effectively and accessed easily. Thus, our multimedia database supports insertions, deletions, updates, and queries for users. In addition to the database, our team designed a frontend website to provide a UI through which students and faculty members can create a

profile to store all their personal information and projects. The backend will link the website and the database.

1.5 - Performance

It is essential that the UI respond to user input and requests in a timely manner. With that in mind, the following performance goals have been set by our client. The home page for the website must load and display within two seconds of the initial query for any user regardless of connection speed. The system must also authenticate a user and display their profile page in less than two seconds. In addition, any database query should complete in less than two seconds. The database should also be able to delete tables in less than two seconds as well. Since phpMyAdmin does not display the time for insertions and updates, there is no way to measure their respective performances. The UI will display multimedia content in less than three seconds.

1.6 - Reporting

All databases keep transaction logs for whenever a change is made to the database. However, due to fact that this is a proof-of-concept, this database will not keep a transaction log. In addition, it is industry standard and general good practice for databases create backups periodically. Again, since our team is creating a proof-of-concept our database will not create backups. However, below in the future work section there is description about plans to incorporate transaction logs and backups.

2 - Design and Implementation

In this section, we will describe how the frontend website, the backend, and the database will be designed. The system diagram below (Figure 5) describes our software architecture (Balci).

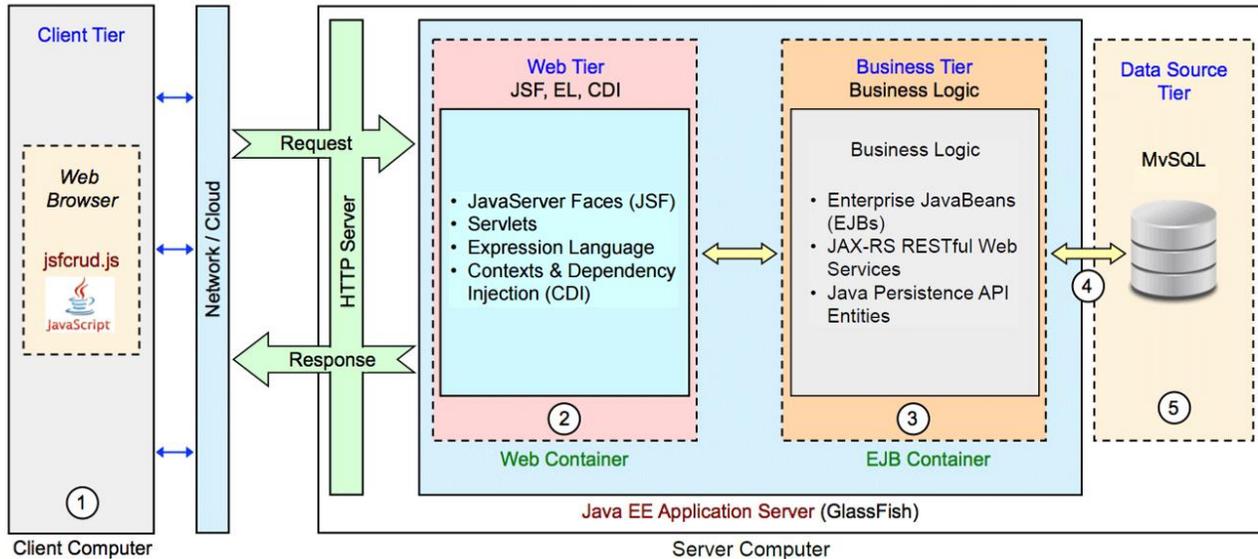


Figure 5: Java Web Architecture

The Client Tier represents a typical user's computer and process that will take place client-side. The Web Tier describes how we will generate and serve web pages to the client (XHTML, JSF, PrimeFaces). The Business Tier will include Java classes to represent entities in our database and provide a means of communicating with the database through JDBC (Heffelfinger; Oracle). JDBC will be utilized to connect to the database, generate and execute queries, and handle result sets. The Data Source Tier is the MySQL database which will store user data and multimedia metadata. Multimedia content will be stored in the file system of the server computer.

2.1 - Database

In order to understand how the database functions it is necessary to understand how the database was designed. The database consists of the following tables: person, student, faculty, department, and media file. Each of these tables has a list of respective attributes. In order for these attributes to be stored in MySQL, we must specify the data types of each attribute. Refer to Figure 16 in the appendix for the extended entity relationship diagram (EER) and Tables 1-5 in the appendix for each table's attributes and respective data type. Each table must have a unique primary key (PK). The PK can be included in another table to reference that entity; this is called a foreign key (FK) reference.

The person table contains personal data about a user. Furthermore, the student table contains academic data about a student, while the faculty table contains data specific to faculty members.

The department table corresponds to each person's department. The student and faculty tables are both subtypes of the person super-type. In relational database design, much like object-oriented programming, a subtype contains all the attributes of its super-type as well as extra properties.

Each individual upload is limited to a maximum size of one gigabyte, and each user may have a maximum of five gigabytes of total data stored in the database. We predict severe performance issues for uploads of a larger size.

Since multimedia information can take up a large amount of space, it is impractical to store all of the media in the database itself. Instead, the media file table will store a file path to the multimedia data on the server computer. There will be a relative file path linked to the actual server computer's file system where the data will be stored and retrieved from.

2.2 - Website

The website follows an approach that is being used by companies such as Microsoft, Google, and Apple - flat. With simple colors and grid layouts of the information, the user will not be distracted by unneeded graphics. There are four pages associated with the website: homepage, profile page, account creation page, and a search page. The first page that the user will access will be the homepage. From the homepage, the user can either log into an existing account or create a new account. After the user creates a new account or logs into an existing account, they will be directed to their profile page. On their profile page, users can upload any past projects they desire for others to view. Once a user has uploaded any projects they please, the user can visit the search page.

2.3 - Backend

When a user executes a search, the website will pass the search parameters to the backend. The backend will generate a MySQL query based on the search parameters and submit the query to the database using JDBC. The database will generate a result set with any matching data from the query. After retrieval, the database will then send the result set to the website for display to the user.

2.4 - Timeline (Scope)

Throughout this section, our team details how the project was broken up into subsections and the work completed in each section. The project scope consisted of four development phases. Each development phase consisted of several project deliverables to be completed. The timeframe dedicated for each phase varied depending on the amount of work necessary.

Phase I: Database and UI Design Specifications

In this phase, the design documents used to create the database and front end were produced. The phase was primarily tasked to Omid Anvar, while Justin Johnson and Michael Harvey served as support specialist.

For the database, we created an enhanced entity-relationship (EER) diagram. This allowed us to conceptualize the entities that needed to be represented in the tables and their relationships with each other. Additionally, a table design document was produced and the database tables were normalized up to at least Boyce-Codd Normal Form.

For the Website UI we produced final mockups and sketches to visualize the layout and flow of the UI. Finally, we produced a system diagram (see figure 5) which describes how each piece of the system (e.g. database, server, user, UI, etc.) will communicate with each other. This diagram helped guide us in choosing the specific technologies we deployed in the system.

Phase II: DB Implementation

This phase was completed solely by Omid Anvar. Since Omid has the most experience with working with creating databases, our team decided Omid would be the most logical option for actually creating the database. In this phase, we deployed the MySQL database using the table design documents generated in Phase I. Meaning we actually created the tables in the database and populated them with data. However, the media file table was populated with mock data during this phase. The reason behind this was that the media file table contains pointers to the multimedia data which are stored elsewhere. Our team anticipated that figuring out how to properly store and access the pointers will take some research and testing thus it was included in future phases.

Phase III: UI Implementation

This phase focused on implementing the front end UI, storing legitimate data in the media file table of the database, and connecting the database to the website. Michael Harvey and Justin Johnson were responsible for creating the website that interacts with the database. Since Michael and Justin have experience with website creation and management, our team decided that they should be the leaders.

For the front end UI, we implemented the website and search functionality. This will require integration of the front end UI with the back end database. This phase still is still in progress, the plan to finish up UI is described in the future work section.

Phase IV: QA and Additional Features

This phase was dedicated to quality assurance testing to touch up the front end UI. Please see section four of the report below for more details on testing metrics.

2.5 - Hardware, Software and Technology

The major tasks for this project can be broken down into two major components, the front end website and the backend database. Our programming environment was NetBeans because it integrated nicely with the technologies we decided to use.

Currently, the MySQL database is deployed on the local GlassFish server, which does not require a dedicated server to keep the information stored for users to interact. The end goal is to have a dedicated GlassFish server, but as of right now, the server is not required. Please see the future work section below for more information on the server.

The user interface that was created will be use Java Server Faces. JSF allows for easy customization, utilizing CSS and HTML type tags, and graphical design. We will deploy Java Database Connectivity (JDBC) to connect the user interface with the database (Oracle). This connectivity allows for searching, creating, viewing, updating, and deleting of files to be done through the JDBC API rather than the command prompt.

2.6 - Security and Privacy

Users must be signed in to upload content and modify their profile. Therefore, users will use the combination of their username and a password to sign in. If a user wishes to create an account, they must create their username and password. The password must be at least eight characters and should contain at least one of the following: capital letter, number, special character. Generally, it is common to store a hashed password in the database instead of the password in plaintext. Since our project is a proof-of-concept we will not be incorporating these security measures during this phase. However, in future iterations of the project better security practices will be enforced.

2.7 - Domain Name

As of now the website name has not been determined, since we are running the website locally. In the future work section below, we will talk about the final website domain name.

3 - Prototype and Refinement

3.1 - Database

In regards to the database, our team first created an extended entity relationship diagram. This ER diagram was the first step in determining the different tables our team wanted the database to contain. The ER diagram loosely contained the different tables and what information those tables would display. However, an ER diagram is only the first step in creating a database due to data redundancies between tables. This means that the same data is stored in multiple tables across the database. Thus, after creating the original ER diagram, our team had to analyze the diagram to get rid of any interdependencies and data redundancies, this process is also known as

normalization. After normalization our team had created an enhanced entity relationship (EER) diagram (Figure 2 in appendix tables). This diagram illustrates the relationships between all the tables in the database and what information the tables contain.

After completing the EER diagram, our team was ready to actually create the database in MySQL. In order to create the database, all team members first had to install MySQL and the Wamp Server on their machines. Once MySQL and Wamp Server were installed and configured correctly, our team was ready to implement our database in MySQL. The database tables created in MySQL mimicked the design that was established in the EER diagrams.

As mentioned before, the database contains five tables: person, department, student, faculty, and media file. All five of these tables have been fully implemented in the database. The first four tables mentioned have their information stored directly in the database. However, the media file table will store a pointer to a file system where all the media content will be stored. The justification for this is that users are allowed to store a maximum of five gigabytes in the media file table. Thus, the size of the table could potentially grow rapidly. If the content was stored directly in the database, a performance issue could arise when the database is queried.

3.2 - Website

The website was developed in NetBeans using Java EE. Using Java EE allowed for the utilization of PrimeFaces, which is the UI framework specific to this platform. The color scheme keeps in line with the “flat” approach. The UI enables the user to access all of the information with minimal mouse clicks (less than three).

The website contains four pages: homepage, account creation page, profile page, and search page. When a user visits the website, they are greeted by the homepage. From the homepage, the user can either log into their account, if they already have one, or create a new account. If they choose to login, then a modal will appear allowing them to sign in and verify their information. If they choose to create an account, they will be directed to the account creation page.

Everything mentioned in the next paragraph has yet to be completed; it simply outlines the plan of what is to come. After a user creates their account or signs into their account, they will automatically be directed to their profile page screen. On the profile page, users can upload projects, papers, pictures, music files, videos, and pdfs. Everything they upload on their profile page will be eventually directly uploaded to the database. Once a user has updated their profile page, they can then navigate to the search page. On the search page, the user can use the search functionality to query the database to return any results the user wants to see. Please note that in order to access the database, one must simply create an account. It is not required to upload information to be able to access the multimedia database.

3.3 - Backend

The backend is a Java application which runs on the GlassFish locally. The specific technologies we utilize can be seen in Figure 5 in the Business Tier. Setting up the JDBC connection in NetBeans is simple and only requires installing the Java DB driver. Once installed in NetBeans, we simply created a connection to the multimedia database (Heffelfinger). Now we have established a direct connection between the MySQL database and our Java application. NetBeans provides functionality to create entity classes directly from the multimedia database. In other words, NetBeans generates the Java code for creating a student, faculty member, or media files in the database. It also creates basic search queries based on attributes of a table.

Currently, the website has still yet to be linked to the database. Thus, when a user uploads a file it will not be stored in the database. In addition, the search page does not currently support user searches. In the future work section more is described about the plan to finish up the website.

4 - Testing

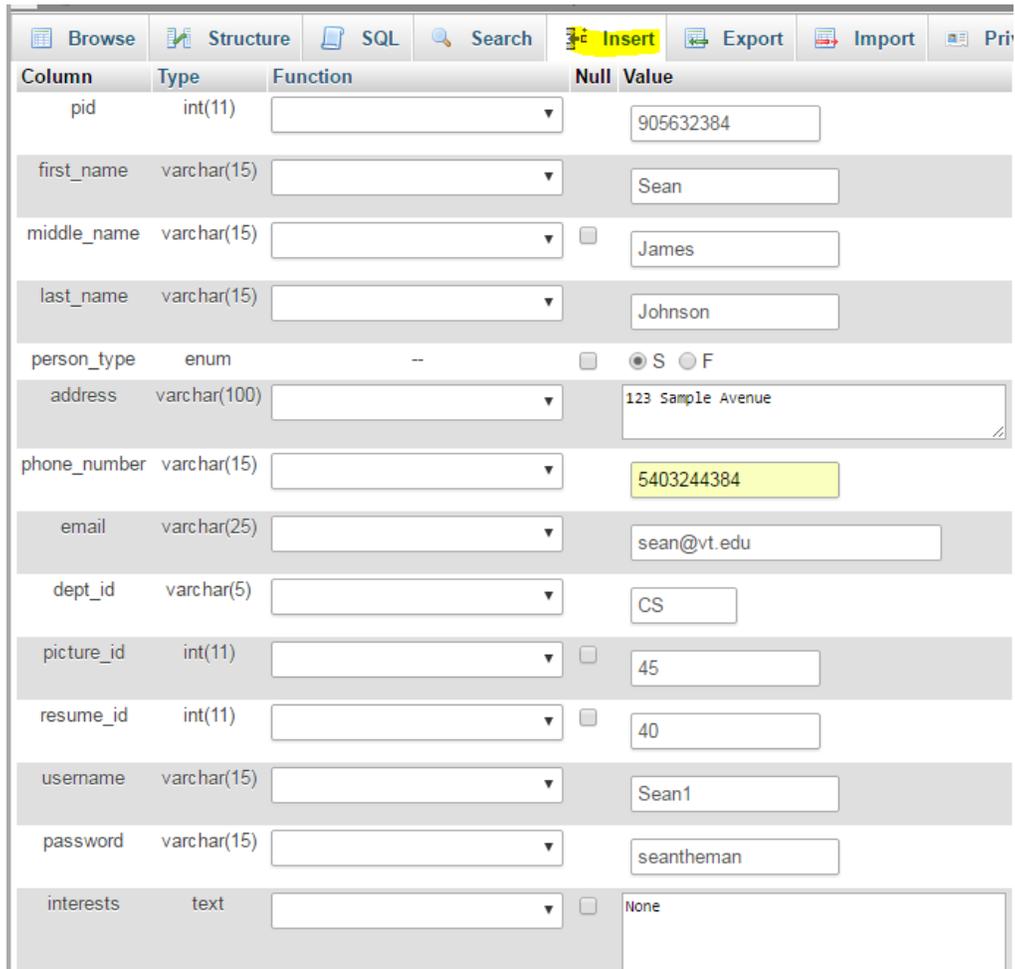
Throughout this section, our team will outline the various testing metrics used to test the database, website, and backend. We will justify the testing metrics deployed as well as talk about whether or not our testing mechanics were successful. The application was purely tested by our team. Although it is good practice to have outside users test an application, our team did not have enough to have outside black box testing.

4.1 - Database

There are a few different measures our team took in order to be able to test the database. As stated previously in the report, the database must be able to insert, delete, as well as update any information in the tables. As stated in the performance section (1.4), deletions must take place in less than two seconds; however, there is no way to measure the performance of insertions and updates due to phpMyAdmin restrictions. Thus, to test insertions and updates we simply check to see if the insertion or update worked as intended. In order to test if the database was performing within the given standards, our team simply performed multiple series of insertions, deletions, and updates (Screen dump from tests shown below).

Inserting into database

In this particular test, we insert a row into our person table.



Column	Type	Function	Null	Value
pid	int(11)			905632384
first_name	varchar(15)			Sean
middle_name	varchar(15)		<input type="checkbox"/>	James
last_name	varchar(15)			Johnson
person_type	enum	--	<input type="checkbox"/>	<input checked="" type="radio"/> S <input type="radio"/> F
address	varchar(100)			123 Sample Avenue
phone_number	varchar(15)			5403244384
email	varchar(25)			sean@vt.edu
dept_id	varchar(5)			CS
picture_id	int(11)		<input type="checkbox"/>	45
resume_id	int(11)		<input type="checkbox"/>	40
username	varchar(15)			Sean1
password	varchar(15)			seantheman
interests	text		<input type="checkbox"/>	None

Figure 6: Insertion data displayed

As you can see below, the insertion was completed successfully. Unfortunately, phyMyAdmin does not display the time it takes to complete an insertion. Thus, we were unable to measure whether or not the insertions took place within our given standard.

✔ 1 row inserted.

```
INSERT INTO `multimedia`.`person` (`pid`, `first_name`, `middle_name`, `last_name`, `person_type`, `address`, `phone_number`, `email`, `dept_id`, `picture_id`, `resume_id`, `username`, `password`, `interests`) VALUES ('905632384', 'Sean', 'James', 'Johnson', 'S', '123 Sample Avenue', '5403244384', 'sean@vt.edu', 'CS', '45', '40', 'Sean1', 'seantheman', 'None');
```

[\[Inline \]](#) [\[Edit \]](#) [\[Create PHP Code \]](#)

Figure 7: Successful insertion

Deleting from database

In this particular test, we delete an entire row from our person table.



A screenshot of a database table row. The row contains the following data: ID 905632384, first name Sean, last name James Johnson, middle name S, address 123 Sample Avenue, phone number 5403244384, email sean@vt.edu, department CS, and age 45. A red 'Delete' button is visible next to the ID.

905632384	Sean	James Johnson	S	123 Sample Avenue	5403244384	sean@vt.edu	CS	45
-----------	------	---------------	---	-------------------	------------	-------------	----	----

Figure 8: Depicts a row about to be deleted

As you can see below, the deletion was successful and took place in .0010 seconds which well under the two second performance standard.

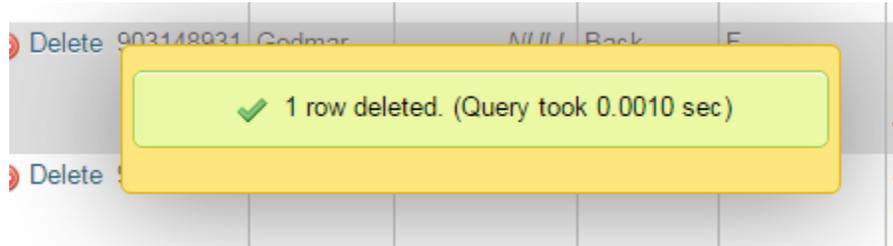
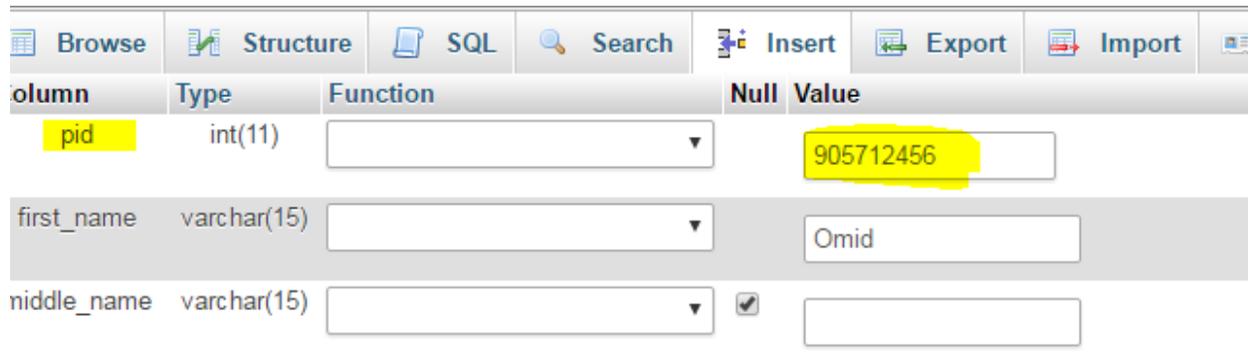


Figure 9: Successful deletion

Updating database table

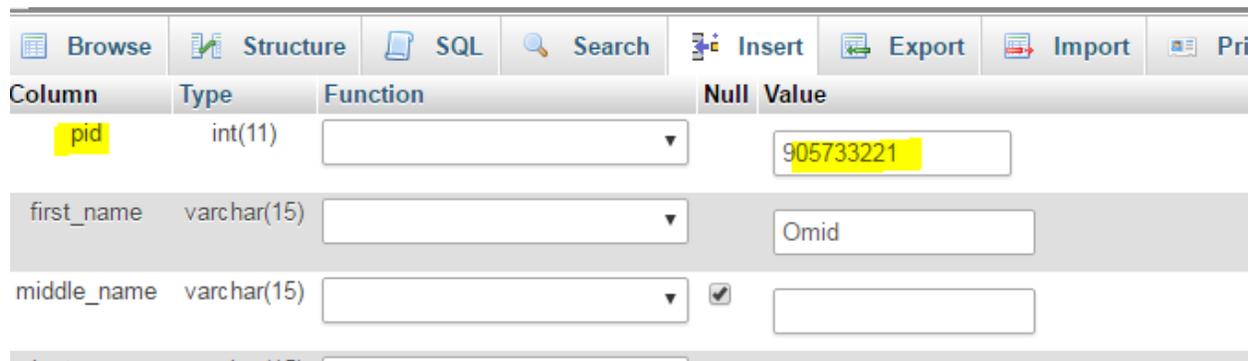
In this particular test, we are updating the PID field in the person table. We changed the PID for Omid from 905712456 to 905733221.



A screenshot of a database table row. The row contains the following data: pid 905712456, first_name Omid, middle_name (empty), and last_name (empty). The pid field is highlighted in yellow.

column	Type	Function	Null	Value
pid	int(11)			905712456
first_name	varchar(15)			Omid
middle_name	varchar(15)		<input checked="" type="checkbox"/>	

Figure 10: Depicts original pid



A screenshot of a database table row. The row contains the following data: pid 905733221, first_name Omid, middle_name (empty), and last_name (empty). The pid field is highlighted in yellow.

Column	Type	Function	Null	Value
pid	int(11)			905733221
first_name	varchar(15)			Omid
middle_name	varchar(15)		<input checked="" type="checkbox"/>	

Figure 11: Depicts new pid

✓ 1 row affected.

```
UPDATE `multimedia`.`person` SET `pid` = '905733221' WHERE `person`.`pid` = 905712456;
```

[Inline] [Edit] [Create PHP Code]

Figure 12: Illustrates that change took place

	pid	first_name	middle_name	last_name	person_type	address	phone_number	email	dept_id	picture_id	re
	905733221	Omid	NULL	Anvar	S	1200 Toms Creek Road (Apt 101H) Blacksburg, VA 240...	703-944-4977	omid8@vt.edu	CS		1

Figure 13: Depicts that PID change was successful

In addition to inserting, deleting, and updating information, the database must obviously be able to handle queries. Again, as stated in the performance section (1.4), the database must be able to handle all queries within two seconds. In order to test this standard, our team ran many queries with different parameters (screen dumps from tests shown below).

Simple query displaying first name and last name of people from person table. This query returned results in 0.0000 seconds.

✓ Showing rows 0 - 12 (13 total, Query took 0.0000 sec)

```
select first_name, last_name FROM person
```

Number of rows: 25

Sort by key: None

+ Options

first_name	last_name
Omid	Anvar
Shane	Henry
Seth	Allen
Filip	Gouglev
Harvey	Michael
Justin	Johnson
Edward	Fox
Godmar	Back
Osman	Balci
Noah	Barnette
Ali	Butt
Chrisopher	Zobel
Preston	Durrill

Figure 14: Simple query from person table

Below is a more complex query. We are displaying the first name, last name, student id, and academic year of students who seniors. This information is stored in multiple tables, thus our query requires a join. Again, this query executed in 0.0000 seconds.

Showing rows 0 - 1 (2 total, Query took 0.0000 sec)

```
1 SELECT first_name, last_name, s_id, academic_year, grad_year FROM person, student
2 WHERE academic_year = 'Senior'
3 AND s_id = pid
```

Go Cancel

Number of rows: 25 ▼

+ Options

first_name	last_name	s_id	academic_year	grad_year
Justin	Johnson	905754345	Senior	2016
Harvey	Michael	905723422	Senior	2016

Figure 15: Query from multiple tables

The screen dumps shown above are merely just an example of all the tests that were run on the database. After careful testing of the database, our team confirmed that the database was performing much better than the standards that were set.

4.2 - Website and Backend

Currently, only the website pages have been created. The website does not interact with the database, thus it is difficult to determine testing metrics for the website. Once the website has been fully integrated with the database, proper testing of the website and backend can take place.

5 - Conclusion

5.1 - Future Work

Since our project was merely a proof-of-concept, there are still some features that need to be implemented to make this a fully functioning multimedia database. Most importantly, the profile page and search page still need to be built. In addition, the website needs to be fully integrated with the database. Our team hopes to have this done before the end of the semester.

After speaking to a few potential students about continuing work on the project after we graduate, our team decided on Kasra Eslami, a sophomore Virginia Tech Computer Science student. Our team is confident that Kasra's strong technical ability and passion will allow our project to continue in the right direction. Kasra can be contacted at kasrae9@vt.edu.

In regards to the database, future projects should include a database backup system. This system will periodically take backups of the data and store it in an external location. Through this practice, if the database was to unexpectedly crash losing all its data, the backup can be deployed to roll back the database to a previous state.

In addition to keeping backups, the database should also keep a transaction log. The transaction log will keep records of any modifications (i.e. insertions, deletion, and updates) made to the database. A transaction log can prove to be useful if the database administrator wants to see who made a certain change. Furthermore, the transaction log must also take backups periodically.

In our project, a user's password was stored as plaintext in the database; however, this is poor practice. A proper method of storing a password is to hash and salt a user's password before storing it in the database. The password must be hashed using Java's PBKDF2 library and a randomly generated 64-bit salt (Gupta). Then the hashed password is stored in the database. On sign-in the stored hashed password will be checked against the entered password to authenticate the user. We hope that in future iterations of the project that this security measure will be invoked.

The application is currently being run locally on our machines. In the mere future, we hope that the application will be deployed on a server. Our team has made attempts to contact university officials about the possibility of finding a server to run the application; however, all our attempts proved futile. Whoever takes over the project from here must be responsible for finding a stable server.

Lastly, the application must be tested by outside users to prove that it can handle large amounts of traffic. Since the goal is allow hundreds of students to be able to upload to the database, we want to ensure that application will not crash.

5.2 - Lessons Learned

The biggest lesson our team learned is that if a team is going to propose their own project to work on (as we did), then the team members need to be technically strong to be able to complete the project without constant struggling. In addition, if a team wants to propose a project, they must have a detailed understanding of what they are proposing and a concrete plan on how to complete the project. Other useful lessons we learned is that it is incredibly important to have a timeline of when certain phases are expected to be completed. This will allow for the project to be completed in a timely matter without constant headaches.

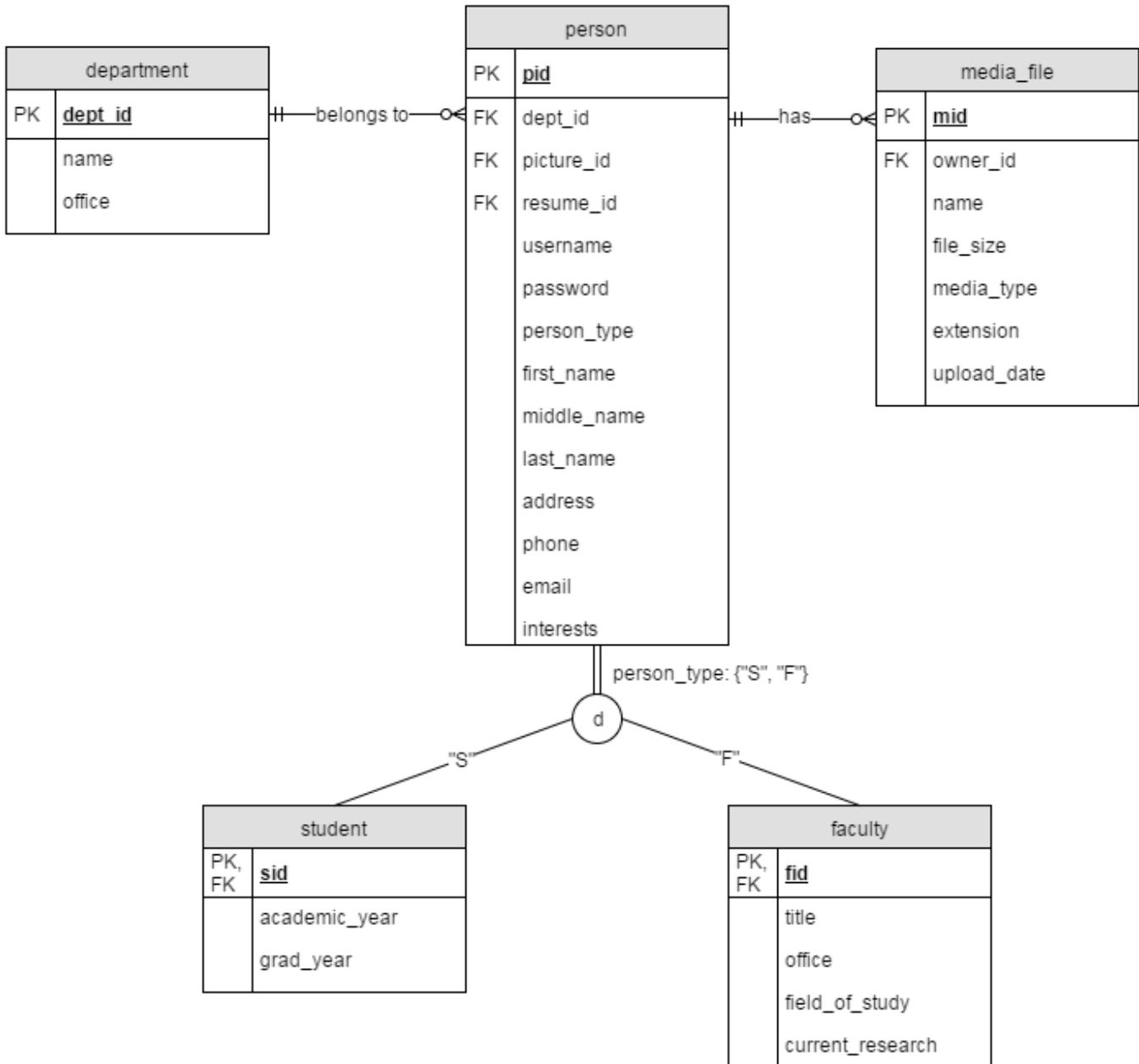
5.3 - Acknowledgements

Our team would like to take the time to thank all the people who helped make this project possible. First, we would like to thank Dr. Christopher Zobel for agreeing to be our project's client and for taking the time to meet with us whenever necessary to help guide the project's direction. In addition, we would like to acknowledge the help of Dr. Edward Fox and graduate teaching assistant Yilong Jin for meeting with us on a weekly basis to help with the process of writing a proper technical report.

Appendix

Figure 16

This figure illustrates our enhanced entity relationship model (EER). The figure depicts the different tables in our database and more importantly the relationships between the tables.



Database Tables

These tables illustrate what our database will contain and the data types of each attributes. Please note that PK means primary key and FK means foreign key. Definitions of these terms are available in the Terminology section of the Appendix.

Table 1
person table

PK	pid	INT
FK	dept_id	VARCHAR(5) NOT NULL (department table)
FK	picture_id	INT (media_file table)
FK	resume_id	INT (media_file table)
	username	VARCHAR(20) NOT NULL (VT PID name)
	password	VARCHAR(15) NOT NULL (plain text)
	person_type	ENUM NOT NULL {"S", "F"} (stu/fac)
	first_name	VARCHAR(15) NOT NULL
	middle_name	VARCHAR(15)
	last_name	VARCHAR(15) NOT NULL
	address	VARCHAR(100) NOT NULL
	phone	VARCHAR(15)
	email	VARCHAR(25) NOT NULL
	interests	TEXT (just an about-me field)

Table 2
student table

PK, FK	sid	(references <u>pid</u> from person table)
	academic_year	ENUM NOT NULL {'freshman', 'sophomore', 'junior', 'senior', 'masters', 'phd'}
	grad_year	YEAR (expected grad year)

Table 3
faculty table

PK, FK	fid	(references <u>pid</u> from person table)
	tittle	VARCHAR(30) NOT NULL
	office	VARCHAR(30) NOT NULL
	field_of_study	VARCHAR(50) NOT NULL
	current_research	VARCHAR(50) NOT NULL

Table 4
media_file table

PK	mid	INT NOT NULL
FK	owner_id	INT NOT NULL (person who owns/uploaded the file)
	name_of_file	VARCHAR(30)
	file_size	INT NOT NULL (size of file in bytes)
	media_type	ENUM {'image', 'audio', 'document', 'video', '3d', 'unkown'} NOT NULL
	extension	VARCHAR(30) NOT NULL
	upload_date	DATE

Table 5
department table

PK	dept_id	VARCHAR(5) NOT NULL
	name	VARCHAR (e.g. College of Computer Science)
	office	VARCHAR (main office location)

Terminology

Please Note: Unless otherwise noted, all of these definitions come from the Database Systems: Design, Implementation, and Management 11th edition textbook by Carlos Coronel and Steven Morris.

Database: A shared, integrated computer structure that houses a collection of related data. A database contains two types of data: end-user data (raw facts) and metadata. The metadata consist of data about data- that is, the data characteristics and relationships.

Multimedia Database: A database that is capable of holding multimedia data in addition to its normal capabilities. Multimedia data includes pictures, videos, music files, PDFs, etc.

BLOB (Binary Large Object): Different multimedia data, can be anything from images, videos, sound, etc. stored as binary data in a database

Database Object: Any object in a database, such as a table, view, index, stored procedure, or trigger.

Database Management System (DBMS): The collection of programs that manages the database structure and controls access to the data stored in the database.

Database Trigger: When one column of a table is updated, then the same column in other tables will automatically be updated by using a database trigger.

Enhanced Entity Relationship Diagram (EER): The entity relationship diagram resulting from the application of extended entity relationship concepts that provide additional semantic content in the ER model.

Foreign Key (FK): An attribute or attributes in one table whose values must match the primary key in another table or whose values must be null.

Java Database Connectivity JDBC: “The Java Database Connectivity (JDBC) API is the industry standard for database-independent connectivity between the Java programming language and a wide range of databases – SQL databases and other tabular data sources, such as spreadsheets or flat files. The JDBC API provides a call-level API for SQL-based database access.” (Oracle)

Primary Key (PK): In the relational model, an identifier composed of one or more attributes that uniquely identifies a row. Also, a candidate key selected as a unique entity identifier..

Normalization: A process that assigns attributes to entities so that data redundancies are reduced or eliminated.

Key Attributes: The attributes that form a primary key.

One-to-One Relationship: Associations among two or more entities that are used by data models. In a 1:1 relationship, one entity instance is associated with only one instance of the related entity.

One-to-Many Relationship: Associations among two or more entities that are used by data models. In a 1:M relationship, one entity instance is associated with many instances of the related entity.

Structured Query Language (SQL): A powerful and flexible relational database language composed of commands that enable users to create database and table structures, perform various types of data manipulation and data administration, and query the database to extract useful information.

Superkey: An attribute or attributes that uniquely identify each entity in a table.

Table: A matrix composed of intersecting rows (entities) and columns (attributes) that represent an entity set in the relational model. Also called a relation.

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