CSC 436 Assignment

Database Application Design

Overview

In this initial phase of your group project, you will focus on the intricate process of crafting a resilient database application using the entity-relationship (E-R) model. Your tasks include listing essential entity sets with underlined primary keys and delineating associated attributes, clarifying relationships between different entity sets, and constructing a comprehensive E-R diagram. You will also offer detailed rationale behind your design choices, highlighting how each element enhances the overall functionality of the envisioned database application.

Part I: Setting Up Your Group's GitHub Repository

Now that you've formed your groups for the semester, you will create a shared GitHub repository for your group project. This repository will serve as a central workspace for all project materials including design documents, E-R diagrams, presentation slides, database scripts and application code.

Setting up your repository supports collaboration, version control, and transparency in individual contributions—and mirrors how real-world development teams work. All group members are expected to make regular, meaningful contributions to the shared repository. Commit history may be considered alongside peer evaluations when assessing individual participation in the group project.

ALL Group Members Must Complete Following:

- ☑ ~~Complete the Install Your IDE section to install an IDE on your local device that supports web development (e.g., VS Code).~~
- ☑ ~~Complete the Create A GitHub Account section if you do not already have one.~~
- ☑ ~~Choose ONE of the following options:~~
  - ☑ ~~Complete the Installation & Authentication section to install and authenticate GitHub Desktop (GUI) on your device.~~
  - ☐ Complete the Installation & Authentication section to install and authenticate **Git (CLI)** on your device.

ONE Group Member Must Complete Following:

- ☑ ~~Complete the Create a GitHub Repository for Your Course Projects section to create your group's repository.~~
- ☑ ~~Clone the repository to your local device using GitHub Desktop or Git CLI.~~
- ☑ ~~Navigate to and open the repo folder you cloned to your local device (not the one on GitHub.com).~~
- ☑ ~~Inside your repo folder, create a new folder named **documentation**.~~
- ☑ ~~In your group's repository on GitHub, go to the **Settings** tab → **Collaborators**.~~
- ☑ ~~Click **Add people**, then enter your group members' GitHub usernames and send invitations. This step ensures all group members have access to the shared repository.~~

ALL Group Members (After Receiving the Invitation) Complete Following:

- ☑ ~~In your GitHub dashboard, click the **Notifications** icon (). Open the invitation message and click **Accept Invitation** to join the repo as a collaborator.~~
- ☑ ~~Clone the repository to your local device using GitHub Desktop or Git CLI.~~
- ☑ ~~Open the repository in VS Code and confirm that it contains the expected structure (e.g., the **documentation** folder).~~

Part II: Database Application Design

Design your group's database application using the E-R model by providing thoughtful responses to the following questions. :

1. List the entity sets and their attributes with primary keys underlined in your design.
    - **Lab**: lab_id, lab_name, department_id, building_name, room_num
    - **User**: user_id, first_name, last_name, email, role, lab_id
    - **Chemical**: chemical_id, chemical_name, cas_number, hazard_class, default_unit
    - **Supplier**: supplier_id, supplier_name, contact_email, phone
    - **Batch**: batch_id, supplier_id, lot_number, received_date, expiration_date, concentration, unit_cost
    - **Storage_location**: location_id, lab_id, location_name, location_type
    - **Inventory_Item**: item_id, batch_id, location_id, quantity, unit, status
    - **Experiment**: experiment_id, lab_id, created_by_user_id, title, description, created_at, status
    - **Usage_Log**: usage_id, experiment_id, inventory_item_id, used_by_user_id, used_at, amount_used, unit, notes
    - **Document**: document_id, lab_id, uploaded_by_user_id, doc_type, file_name, file_url, uploaded_at, notes, chemical_id, experiment_id

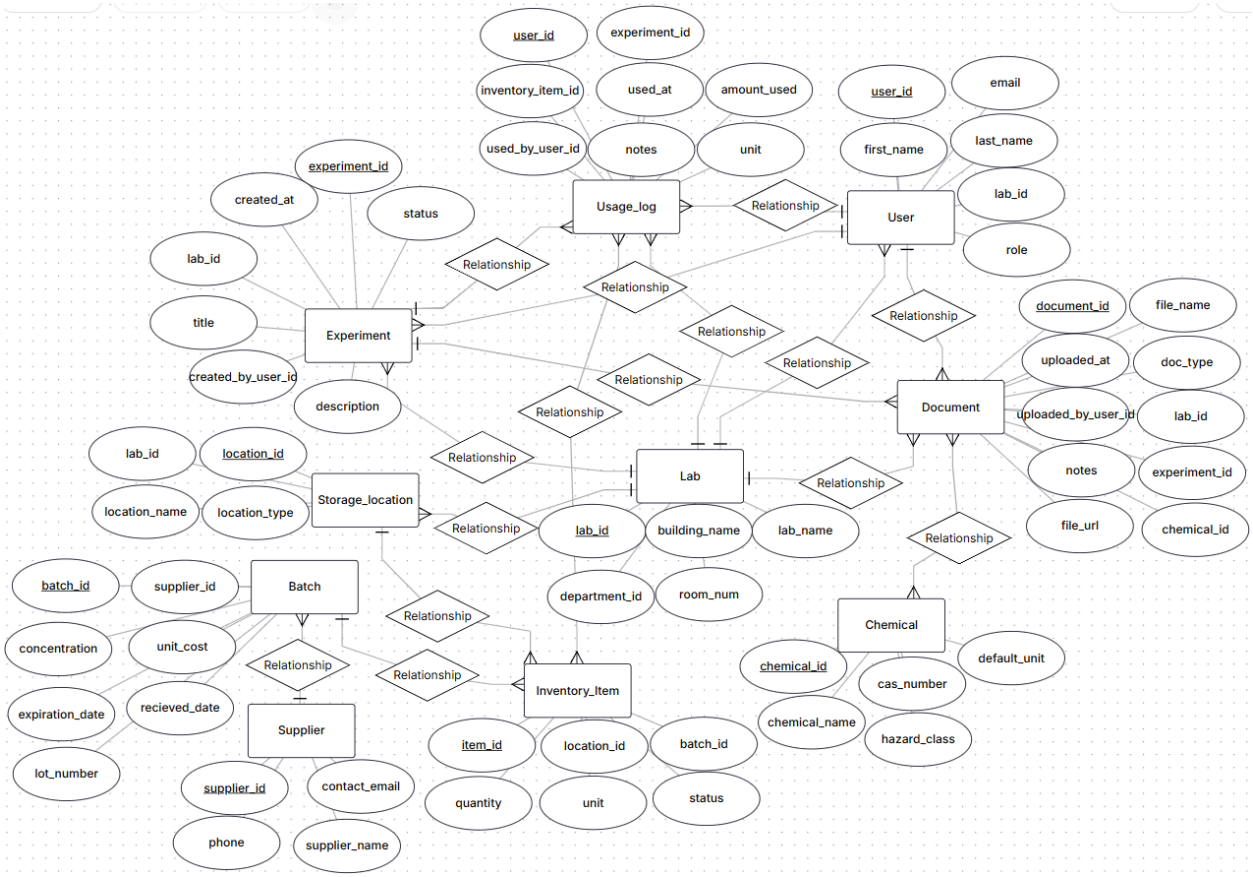
2. List the relationships between different entity sets in your design.
    - **User** – **(N)** – <member_of> – **(1)** – **Lab**: A user can only be a member of one lab and a lab can contain multiple users.
    - **Supplier** – **(1)** – <supplies> – **(N)** – **Batch**: A supplier can supply multiple batches but each batch will be associated with only one supplier.
    - **Lab** – **(1)** – <contains> – **(N)** – **Storage_location** : Each lab can have multiple storage locations while each storage location needs to be associated with one lab only.
    - **Inventory_Item** – **(N)** – <belongs_to> – **(1)** – **Batch**: A batch can contain multiple inventory items while each inventory item is associated with only one batch.
    - **Inventory_Item** – **(N)** – <is_located_at> – **(1)** – **Storage_location**: Each storage location is associated with possibly multiple inventory items but each inventory item is associated with at most one storage location.
    - **Experiment** – **(N)** – <conducted_in> – **(1)** – **Lab**: An experiment is associated with at most one lab but each lab can conduct multiple experiments.

- **Experiment** – **(M)** – <conducted_by> – **(N) – User**: A user can be associated with multiple experiments (participates in multiple experiments) and each experiment can be associated with multiple users (for collaboration experiment).
- **Experiment** – **(1)** – <create> – **(N) – Usage_Log**: An experiment can create multiple usage logs but each usage log has to be associated with at most one experiment.
- **Usage_Log** – **(M)** – <record_item_used> – **(N) – Inventory_Item**: A usage log can record multiple inventory items used and each of the inventory items can be associated with multiple usage logs.
- **Usage_Log** – **(M)** – <record_user> – **(N) – User**: A usage log can record multiple users that conducted the experiment and each user can be associated with multiple usage logs.
- **Usage_Log** – **(N)** – <record_experiment_location**> – (1) – Lab**: A usage log is associated with at max one lab and each lab can be associated with multiple usage log.
- **Document** – **(N)** – <upload_by_lab> – **(1) – Lab**: A document is associated with one lab but each lab can upload multiple documents.
- **Document** – **(N)** – <uploaded_by_user> – **(1) – User**: A document is associated with one user that uploaded the document, and each user can upload multiple documents.
- **Document** – **(M)** – <record_chemical> – **(N) – Chemical**: A document can record multiple chemicals used in the experiment. And each chemical can be associated with multiple documents (The same chemical can appear in multiple documents).
- **Document** – **(N)** – <record_experiment> – **(1) – Experiment**: A document can record at most one experiment but each experiment can have multiple documents (because the same experiment can be conducted at different times).

3. Construct an E-R diagram for your database application. Use the following steps to design your database using the E-R model:

    - Start by identifying essential entity sets to be included in your database.
    - Choose relevant attributes representing the values to be captured in the database for each entity set.
    - Formulate relationship sets among entities, addressing potential redundancy in attributes.

- Incorporate any necessary constraints (ie, relationship cardinalities, total/partial participation, descriptive attributes, weak entity sets).



You can use draw.io to create your E-R diagram. To collaborate with your group, click **File** → **Share** and grant edit access to your group members so everyone can work on the diagram in real time.

4. Provide a detailed explanation of the rationale behind your design choice. Highlight how each element contributes to the overall functionality of your database application.

   There are 10 entities: Supplier, Batch, Storage_location, Experiment, Usage_log, User, Document, Lab, Inventory_Item, and Chemical. They are structured to represent how a chemistry lab functions in real life while also keeping the data organized and easy to manage. Each part is separated into its own table so information is not duplicated and can be updated without interfering with other elements. **User** represents the people working in the lab and is linked to experiments, documents, and usage logs so that the system knows who did what. **Lab** defines physical spaces and connects users,

experiments, documents, and storage locations, which helps keep data organized across multiple rooms. **Experiment** stores information about lab work and links to users, chemicals, documents, and usage log which allows results and materials to be associated with a specific experiment/test. **Chemical** defines what substances exist, while **Batch** tracks shipments with expiration dates and suppliers. **Inventory_item** represents the usable items and connects chemicals, bathes, and locations, which allows us to track quantities. **Storage_location** shows where items are physically which helps prevent losing things. **Usage_log** records when chemicals are used, who used them, in what experiment they were used, and the amount used. **Document** stores files and links them to experiments, chemicals, labs and users. Finally **Supplier** keeps information about suppliers separate from **Batch** so there is no repeated information/records. With everything combined, these entities represent a system that has inventory tracking, experiment documentation, and accountability, which is very similar to how a lab in real life would operate.

Submission

When you're finished, complete the following steps to submit your work:

- ☐ Export your document with responses as a **PDF file AND save** it **inside** your **documentation** folder. Refer to the following for documentation on how to do this:
  - Google Docs (*File → Download → PDF Document*)
  - Microsoft Word (*File → Save As / Export → PDF*)
  - Pages (*File → Export To → PDF*)
- ☐ Export your **E-R diagram** as an **image file** and save it **inside** your **documentation** folder. Be sure your file is clearly named (i.e., **er_diagram.png**).
- ☐ Upload all your changes to GitHub.
  - ☐ **If you're using GitHub Desktop (GUI)**, complete the Uploading Changes (GitHub Desktop) section to upload your changes from your local device to GitHub.
  - ☐ **If you're using Git (CLI)**, complete the Uploading Changes (GitHub CLI) section to upload your changes from your local device to GitHub.

ONE group member must paste the URL of your GitHub repository in the provided textbox in Brightspace. Click the blue *Submit* button to successfully submit your work for this assignment.

Grading Rubric

You can refer to the **Database Application Design grading rubric** given in Brightspace for this assignment to find details on how your submission will be graded.