CSC3170 Project: Database for Models and Datasets

0. How to run our code

- **Step 1-3 has to be done ONLY when running it at the first time; if it's not the first time, you can skip 1-3, and also can skip 4 if you don't need to initialize the database.**

1. Install dependencies according to `requirements.txt`
2. Create an `.env` file at the root directory of the project, and add the following lines to it (repalce `$your_api_key` and `$your_base_url` with your own values):

```
# -----database-----
 DB_USERNAME=root
 DB_PASSWORD=123
 DB_HOST=0.0.0.0
 DB_PORT=3306
 TARGET_DB=openmodelhub
# -----agent----
API_KEY=$your_api_key
BASE_URL=$your_base_url
```

3. Test connection by running `database/db_connection_check.py`.
4. Initialize the database with the records stored in `database/records/demo.json`, by running:

```
database/load_data.py
```

- then you'll be asked to choose a .json file stored in `database/records` to intialize it; just choose `demo.json`.

5. Run the GUI:

```
streamlit run frontend/app.py
```

6. Login as common user or admin

- Login to admin with **username: admin, password: admin**.
- After logging in as admin, you can see the list of all users in the page `user management`. Note that some users are admin, too, as indicated on the page.
- Every user's password is admin.
- You can register your own user, too.

1. Introduction and motivation

1.1. Introduction

- Our project is a database for machine learning models and datasets.
  - **Basic database operations:** It allows users to browse the information about the models and datasets, upload and download models and datasets.
  - **Schema:** Apart from the basic schemas such as dataset, model, user, we also included schemas that are especially helpful for machine learning developers, such as tables describing the modular structures of different architecture of models (CNN, RNN, Transformer).
  - **GUI:** A beautifully designed graphic user interface is implemented, where users and administrators can perform multiple types of operations.
  - **LLM:** An LLM agent is implemented, to translate user's natural language query into SQL language. User can also customize their query by selecting different tables and different fields.
  - **Security:** Methods are implemented to protect data security.

1.2. Motivation

- We are motivated by huggingface, one of the most influential platform in the AI community that facilitates the sharing and collaboration of machine learning models and datasets.

2. Design and implementation

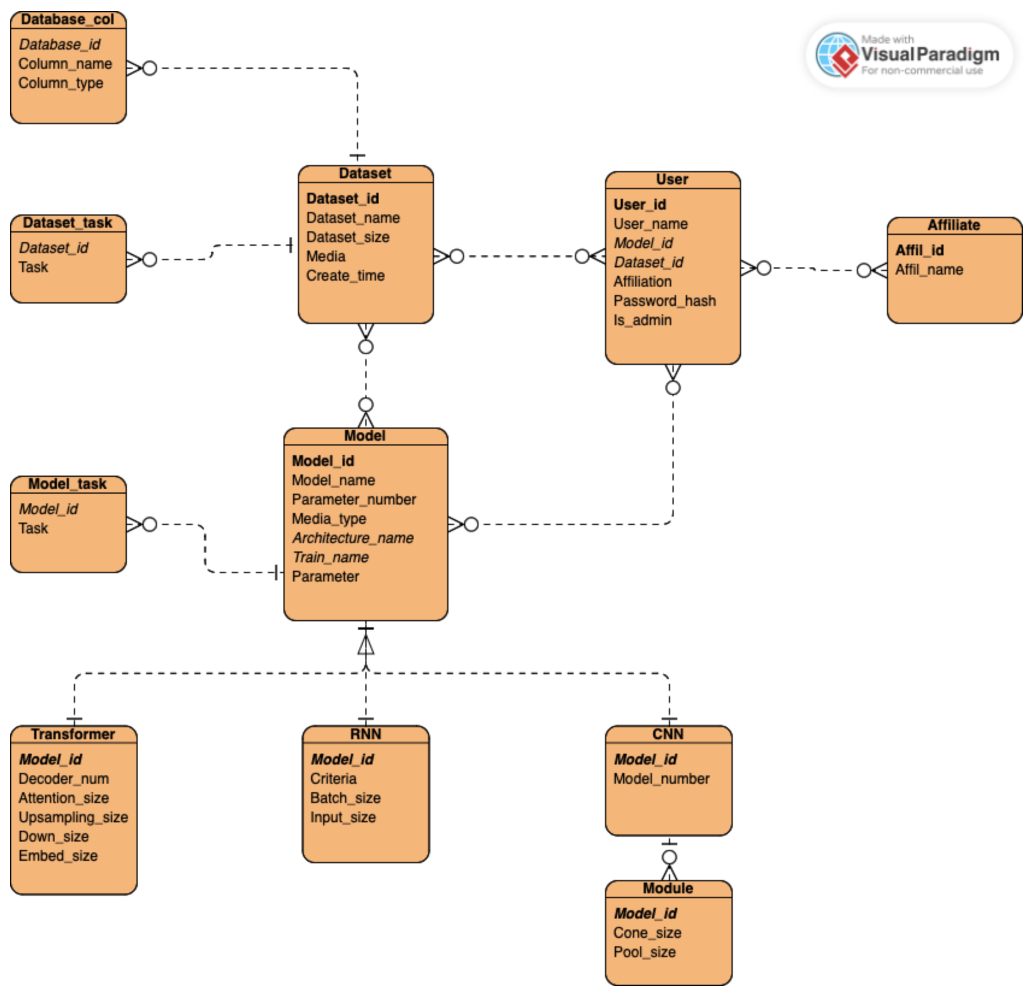
2.0. Project Structure

- our project is composed of the following components:
  1. Database.
  2. Data.

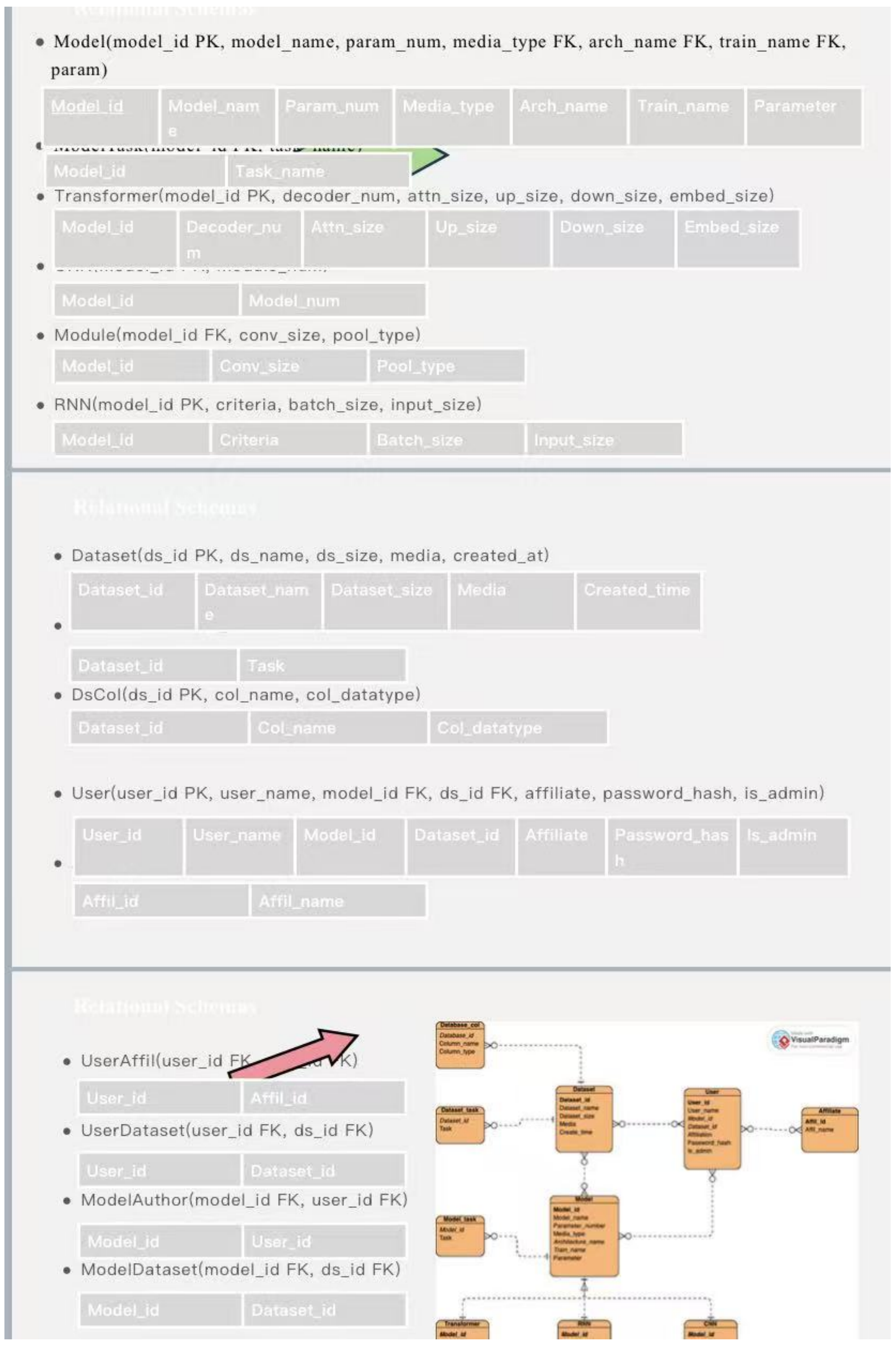
3. Frontend.
4. Agent.
5. Security.
6. Data analysis.

2.1. Database

ER Diagram



Relational Schema



- Model(model_id PK, model_name, param_num, media_type FK, arch_name FK, train_name FK, param)

Model_id	Model_name	Param_num	Media_type	Arch_name	Train_name	Parameter

Model_id	Task_name

- Transformer(model_id PK, decoder_num, attn_size, up_size, down_size, embed_size)

Model_id	Decoder_num	Attn_size	Up_size	Down_size	Embed_size

Model_id	Model_num

- Module(model_id FK, conv_size, pool_type)

Model_id	Conv_size	Pool_type

- RNN(model_id PK, criteria, batch_size, input_size)

Model_id	Criteria	Batch_size	Input_size

- Dataset(ds_id PK, ds_name, ds_size, media, created_at)

Dataset_id	Dataset_name	Dataset_size	Media	Created_time

Dataset_id	Task

- DsCol(ds_id PK, col_name, col_datatype)

Dataset_id	Col_name	Col_datatype

- User(user_id PK, user_name, model_id FK, ds_id FK, affiliate, password_hash, is_admin)

User_id	User_name	Model_id	Dataset_id	Affiliate	Password_hash	Is_admin

Affil_id	Affil_name

- UserAffil(user_id FK, [illegible] FK)

User_id	Affil_id

- UserDataset(user_id FK, ds_id FK)

User_id	Dataset_id

- ModelAuthor(model_id FK, user_id FK)

Model_id	User_id

- ModelDataset(model_id FK, ds_id FK)

Model_id	Dataset_id

Schema Design

- Our database follows the relational model and the 4th normal form.
- Our schema are as follows:

Model(model_id PK, model_name, param_num, media_type FK, arch_name FK, train_name FK, param)

Attribute	Description	Data Type	Example
model_id (PK)	A unique identifier for the model (Primary Key).	int	1001
model_name	Name of the model.	varchar	gpt_4_13b
param_num	The number of parameters in the model.	bigint unsigned	175000000000
media_type	Foreign Key that links to a table that defines the type of media the model deals with.	enum	text
arch_name (FK)	Foreign Key linking to the architecture name.	enum	transformer
train_name (FK)	Foreign Key linking to the training process or dataset used for training.	varchar	pretrained
param	binary parameter of the model		blob

ModelTask(model_id FK, task_name)

Attribute	Description	Data Type	Example
model_id (PK,FK)	Foreign Key referencing **model_id** in the model table.	int	1001
task_name(PK)	The task associated with the model (e.g., classification, translation).	enum	classification

Transformer(model_id PK, decoder_num, attn_size, up_size, down_size, embed_size)

Attribute	Description	Data Type	Example
model_id (PK, FK)	Primary Key, Foreign Key referencing **model_id** in the model table.	int	1001
decoder_num	Number of decoders used in the model.	int	12
attn_size	Size of the attention mechanism used in the model.	int	64
up_size	The upsampling size in the model.	int	256
down_size	The downsampling size in the model.	int	64
embed_size	The size of the embedding layer in the model.	int	128

CNN(model_id PK, module_num)

Attribute	Description	Data Type	Example
model_id (PK, FK)	Primary Key, Foreign Key referencing **model_id** in the model table.	int	1001
module_num	The number of modules (e.g., convolution layers) in the model.	int	3

Module(model_id FK, conv_size, pool_type)

Attribute	Description	Data Type	Example
id (PK)	auto increasement primary key	int	1
model_id (FK)	Foreign Key referencing **model_id** in the cnn table.	int	1001
conv_size	The size of the convolution layers in the model.	int	3
pool_type	The type of pooling used in the model (e.g., max pooling, average pooling).	enum	max

RNN(model_id PK, criteria, batch_size, input_size)

Attribute	Description	Data Type	Example
model_id (PK, FK)	Primary Key, Foreign Key referencing **model_id** in the model table.	int	1001
criteria	The training criteria or loss function used by the RNN model.	varchar	cross_entropy
batch_size	The number of data samples processed together in one pass through the model (used in training).	int	64
input_size	The size of the input data (e.g., number of features for each data point).	int	256

Dataset(ds_id PK, ds_name, ds_size, media, created_at)

Attribute	Description	Data Type	Example
ds_id (PK)	Unique identifier for the dataset.	int	1
ds_name	The name of the dataset (e.g., "Coco", "ImageNet").	varchar	Coco
ds_size	The size of the dataset (e.g., number of images or data points).	int	1000000
media	The type of media in the dataset (e.g., image, text, video).	enum	image
created_at	The date and time when the dataset was created.	datetime	2025-04-01
description	The description of the dataset	varchar	This dataset...

Dataset_TASK(ds_id FK, task)

Attribute	Description	Data Type	Example
ds_id (PK,FK)	Foreign Key referencing **ds_id** in the dataset table.	int	1
task (PK)	The task associated with the dataset (e.g., classification, segmentation).	enum	1

DsCol(ds_id PK, col_name, col_datatype)

Attribute	Description	Data Type	Example
ds_id (PK,FK)	Foreign Key referencing **ds_id** in the dataset table.	int	1
col_name (PK)	Name of the column within the dataset (e.g., "image_id", "label").	varchar	image_id
col_datatype (PK)	The data type of the column (e.g., integer, float, text).	varchar	integer

user(user_id PK, user_name, model_id FK, ds_id FK, affiliate, password_hash, is_admin)

Attribute	Description	Data Type	Example
user_id (PK,FK)	Unique identifier for the user.	int	123090342
user_name	The name of the user (e.g., "JohnDoe").	varchar	JohnDoe
affiliate	A reference to the affiliate company or group the user is associated with.	varchar	AffiliateX
password_hash		The hashed password of the user.	varchar
is_admin		Boolean flag indicating if the user has admin privileges.	boolean

Affil(affil_id PK, affil_name)

Attribute	Description	Data Type	Example
affil_id (PK,FK)	Unique identifier for the affiliate.	int	1
affil_name	Name of the affiliate organization.	varchar	AffiliateX

UserAffil(user_id FK, affil_id FK)

Attribute	Description	Data Type	Example
user_id (PK,FK)	Foreign key referencing `user_id` in the **user** table	int	123090342
affil_id (PK,FK)	Foreign Key referencing `affil_id` in the **affli** table.	int	1

UserDataset(user_id FK, ds_id FK)

Attribute	Description	Data Type	Example
user_id (PK,FK)	Foreign key referencing `user_id` in the **user** table	int	123090342
ds_id (PK,FK)	Foreign key referencing `ds_id` in the **dataset** table	1	

ModelAuthor(model_id FK, user_id FK)

Attribute	Description	Data Type	Example
model_id (PK,FK)	Foreign key referencing `model_id` in the **model** table	int	1001
user_id (PK,FK)	Foreign key referencing `user_id` in the **user** table	int	123090342

ModelDataset(model_id FK, ds_id FK)

Attribute	Description	Data Type	Example
model_id (PK,FK)	Foreign key referencing `model_id` in the **model** table	int	1001
ds_id (PK,FK)	Foreign key referencing `ds_id` in the **dataset** table	int	1

Implmentation

- In `database/database_schema.py`, schemas are represented by python classes.
- In `database/database_interface.py`, we have encapsulated interfaces to perform SQL operations safely. Therefore, in other programs where we have to execute SQL, we can call an encapsulated functions instead of executing the SQL operations directly.

2.2. Data

Data Fetching

Initially, all the data for the models and datasets are obtained from HuggingFace.co. Other data, such as users and relations, are generated randomly. Therefore, we did not look at all the information related to users and relations.

Initialization

- We created a set of records to initialize our database; although more records can be inserted to or deleted from the database during use. It is stored in `database/records/demo.json`, and can be run by `database/load_data.py`, as indicated previously.

- The records consist of:

    1. 12 affiliations;

2. 28 users from these affiliations;
3. 100 datasets;
4. 92 models.

- The models' names, corresponding architecture, media type, train method (fine-tuned or pre-trained) are real; the dataset's names and media types are real, because they are copied from models and datasets that are actually posted to huggingface. However, some other attributes, such as parameter number and authors, are made up.

Upload and Download

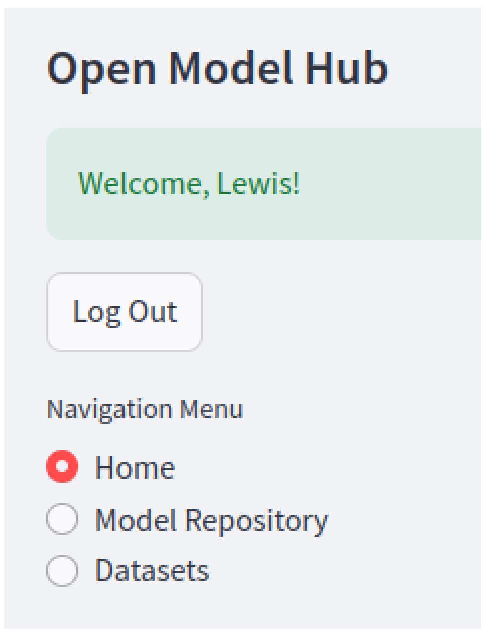
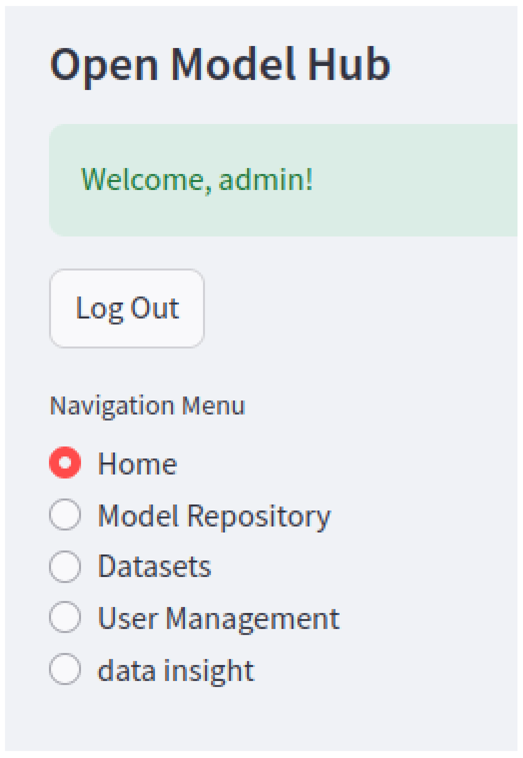
- `database/load_data.py` can initialize the database by inserting records stored in json formats, containing entities among `affiliation`, `user`, `dataset`, `model`.
- For model upload:
  - Users can upload models through the "Upload New Model" form in the Model Repository page
  - Required fields include: model name, architecture type (CNN/RNN/TRANSFORMER), media type (TEXT/IMAGE/AUDIO/VIDEO), training type (PRETRAIN/FINETUNE/RL), and task types
  - Supported file formats: .pt, .pth, .ckpt, .bin, .txt
  - Files are saved in `database/data/models` directory with timestamped filenames
  - Users can specify accessible users for the model
- For dataset upload:
  - Users can upload datasets through the "Upload New Dataset" form in the Dataset Management page
  - Required fields include: dataset name, media type, and task type
  - Supported file formats: .csv, .txt, .zip
  - Files are saved in `database/data/datasets` directory with timestamped filenames
  - Users can specify accessible users for the dataset
- For downloading:
  - Models and datasets can be downloaded from their respective detail pages
  - The system will automatically find the latest version of the file based on the filename
  - Files are served with appropriate MIME types for different file formats
  - The download functionality is implemented using Streamlit's download_button component
- File operations are handled by:
  - `frontend/file_operations.py`: Core file handling functions
  - `frontend/database_api.py`: Database interface for file operations
  - `frontend/components.py`: UI components for upload forms
  - `frontend/config.py`: Configuration for file paths and upload settings

2.3. Frontend

login/regsiter

1. common user login
2. common user register and login
3. admin login: has some pages that common users don't have.
   - username: admin; password: admin.

- The pages visible to a common user / an admin is different.

type	user	admin
sidebar	 Open Model Hub Welcome, Lewis! Log Out Navigation Menu Home Model Repository Datasets	 Open Model Hub Welcome, admin! Log Out Navigation Menu Home Model Repository Datasets User Management data insight

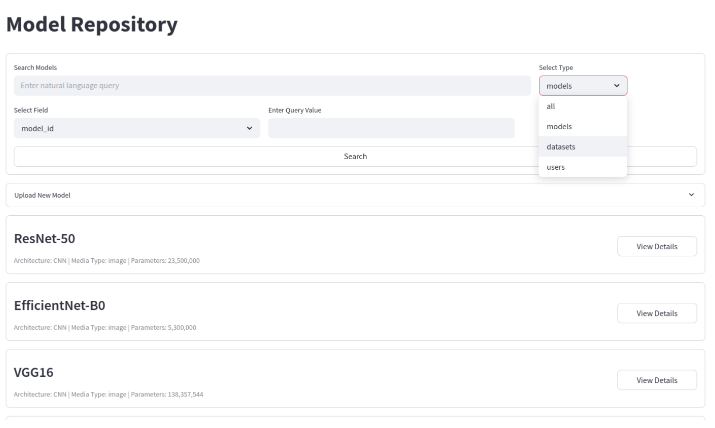
Home page

- export and download data.

Model/Dataset Repository page

- the following screenshots are from the model page; but the dataset page is very similar.

LLM assisted search, with specifying the entity in the drop-down box



Model Repository

Search Models: Enter natural language query — Select Type: models (all / models / datasets / users)

Select Field: model_id — Enter Query Value:

Search

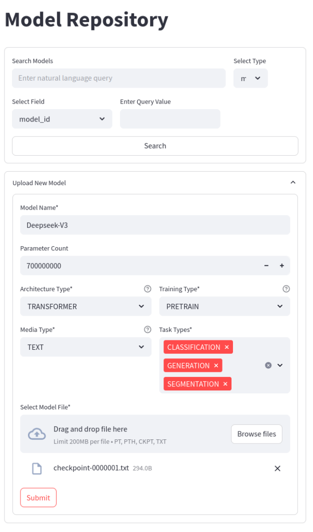
Upload New Model

ResNet-50 — View Details
Architecture: CNN | Media Type: image | Parameters: 23,500,000

EfficientNet-B0 — View Details
Architecture: CNN | Media Type: image | Parameters: 5,300,000

VGG16 — View Details
Architecture: CNN | Media Type: image | Parameters: 138,357,544

upload model



Model Repository

Search Models: Enter natural language query — Select Type: m

Select Field: model_id — Enter Query Value:

Search

Upload New Model

Model Name*: Deepseek-V3

Parameter Count: 700000000

Architecture Type*: TRANSFORMER — Training Type*: PRETRAIN

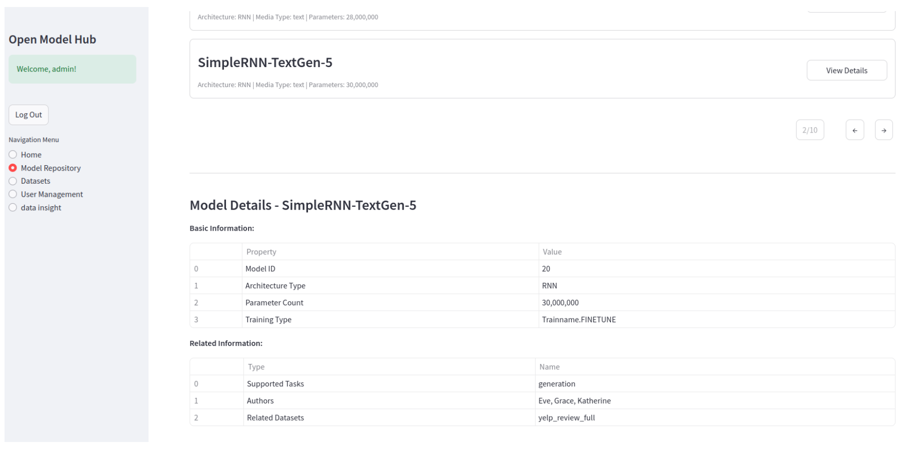
Media Type*: TEXT — Task Types*: CLASSIFICATION ×, GENERATION ×, SEGMENTATION ×

Select Model File*: Drag and drop file here — Limit 200MB per file • PT, PTH, CKPT, TXT — Browse files

checkpoint-0000001.txt 294.0B

Submit

click "view details", and 2 tables representing the detailed information of that model will be displayed. paging are implemented for improved user experiment.



Open Model Hub

Welcome, admin!

Log Out

Navigation Menu: Home / Model Repository / Datasets / User Management / data insight

Architecture: RNN | Media Type: text | Parameters: 28,000,000

SimpleRNN-TextGen-5 — View Details
Architecture: RNN | Media Type: text | Parameters: 30,000,000

2/10

Model Details - SimpleRNN-TextGen-5

Basic Information:

	Property	Value
0	Model ID	20
1	Architecture Type	RNN
2	Parameter Count	30,000,000
3	Training Type	Trainname.FINETUNE

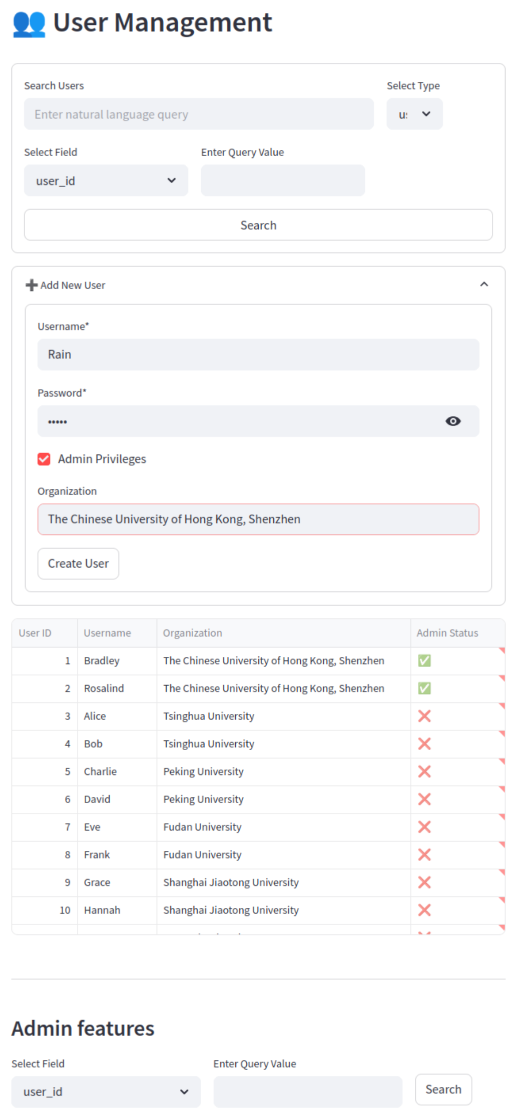
Related Information:

	Type	Name
0	Supported Tasks	generation
1	Authors	Eve, Grace, Katherine
2	Related Datasets	yelp_review_full

(Admin Privilege) User Management / Data Insight

4. (Admin Privilege) User Management

create/edit user



👥 User Management

Search Users: Enter natural language query — Select Type: u

Select Field: user_id — Enter Query Value:

Search

➕ Add New User

Username*: Rain

Password*: •••••

[✓] Admin Privileges

Organization: The Chinese University of Hong Kong, Shenzhen

Create User

User ID	Username	Organization	Admin Status
1	Bradley	The Chinese University of Hong Kong, Shenzhen	✅
2	Rosalind	The Chinese University of Hong Kong, Shenzhen	✅
3	Alice	Tsinghua University	❌
4	Bob	Tsinghua University	❌
5	Charlie	Peking University	❌
6	David	Peking University	❌
7	Eve	Fudan University	❌
8	Frank	Fudan University	❌
9	Grace	Shanghai Jiaotong University	❌
10	Hannah	Shanghai Jiaotong University	❌

Admin features

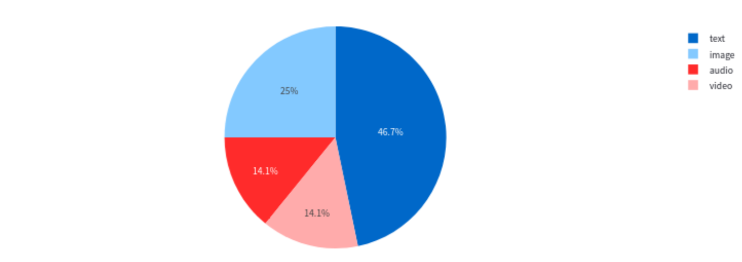
Select Field: user_id — Enter Query Value: — Search

5. (Admin Privilege) Data Insights

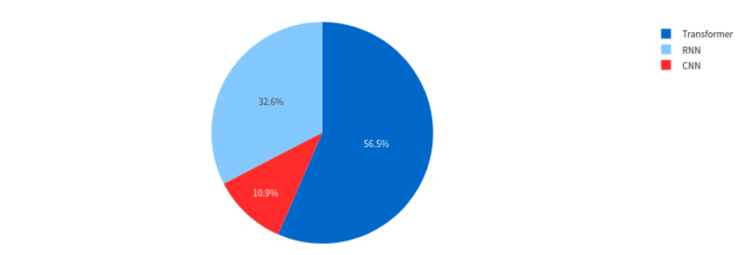
illustration of the analysis on the data in the database.

Model

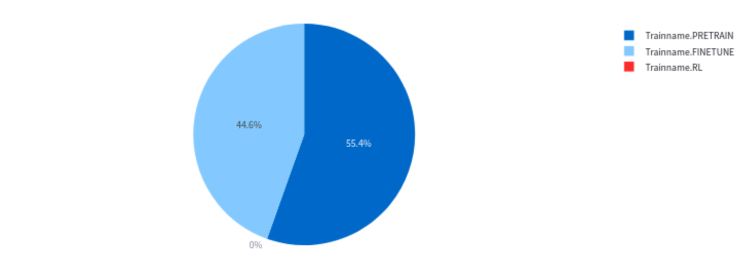
number & percentage of each media_type of model



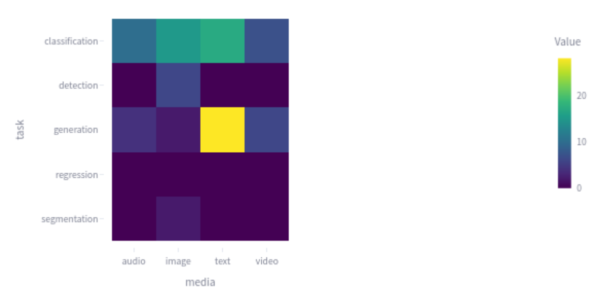
number & percentage of each arch_name of model



number & percentage of each trainname of model



media_task_relation



data insight, page 2

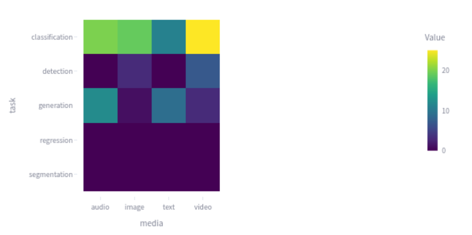
Also illustration.

param_num summary:

	value
max	175000000000
min	3500000
mean	1980706060.2609
std	18236912385.1081

dataset

media_task_relation

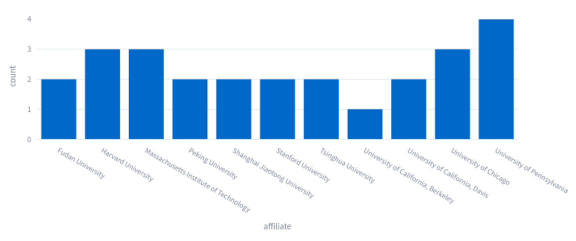


param_num summary:

	value
max	1000000000
min	5
mean	11979168.45
std	100318822.1054

user

user in different affiliations



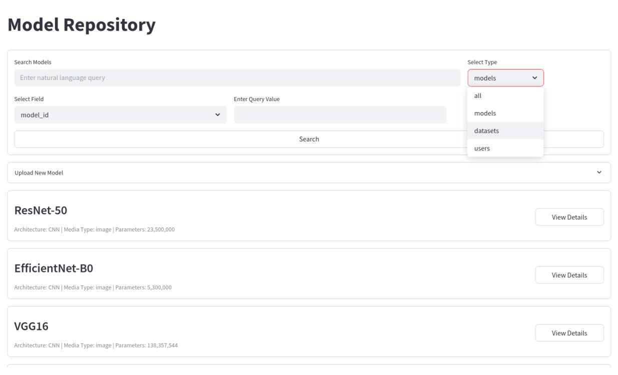
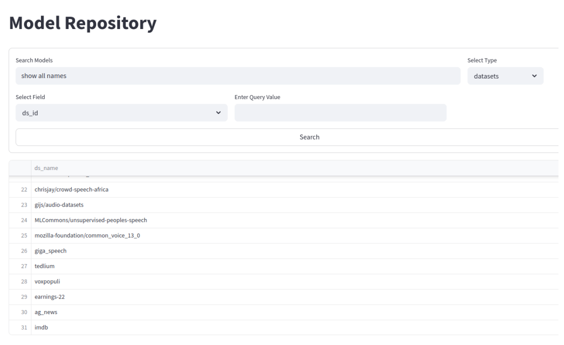
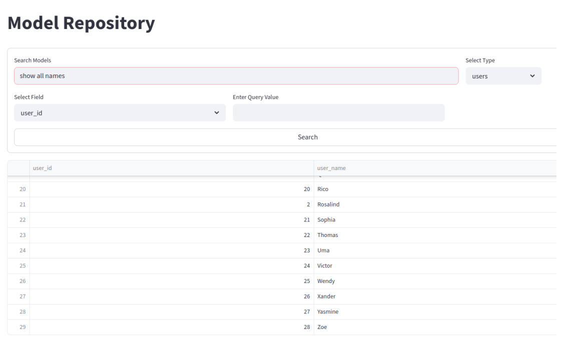
2.4. Agent

Implementation

- We incorporated gpt-4o as an LLM agent that translates user's natural language input into SQL queries.
- **Input/Output**
  - Input includes a natural language query, and a integer specifying the type of entity user is asking for. A corresponding string will be appended to the natural language query. This integer is by default 0, indicating no specific constraints.
  - Output: a dictionary, consisting of:
    - an error code indicating whether a grammatically correct sql is generated;
    - a SQL query generated
    - the result of the SQL query
- **System prompt**
  - **Schema:** In the system prompt, we describe our database, the integrity constraints, and other information required.
  - **Synonyms:** In practice, we find it necessary to add some synonyms to help agent understand user's needs in this context. For example, if user asks for a `langauge model`, user is referring to `models where media_type includes 'text'`
  - **Instance type:** The constraints on the type of entity user's asking for is also indicated in the system prompt.
- **2-stage error-detection leveraging agent's self-correction**:
  - After the SQL is created, it will be executed to check its grammatical correctness, instead of directly returning the SQL.
  - **If incorrect, agent will perform another attempt to generate SQL, based on the previous failure.** However, if it fails again, no more attempts will be made.

Demonstration: using LLM assisted search in the GUI

- Feature: generate query of a specific entity.

entity type	model	dataset	user
query: show all names			

Model Repository

Search Models: Enter natural language query
Select Type: models (all / models / datasets / users)
Select Field: model_id
Enter Query Value:
Search
Upload New Model

ResNet-50
Architecture: CNN | Media Type: image | Parameters: 23,500,000
View Details

EfficientNet-B0
Architecture: CNN | Media Type: image | Parameters: 5,300,000
View Details

VGG16
Architecture: CNN | Media Type: image | Parameters: 138,357,544
View Details

Model Repository

Search Models: show all names
Select Type: datasets
Select Field: ds_id
Enter Query Value:
Search

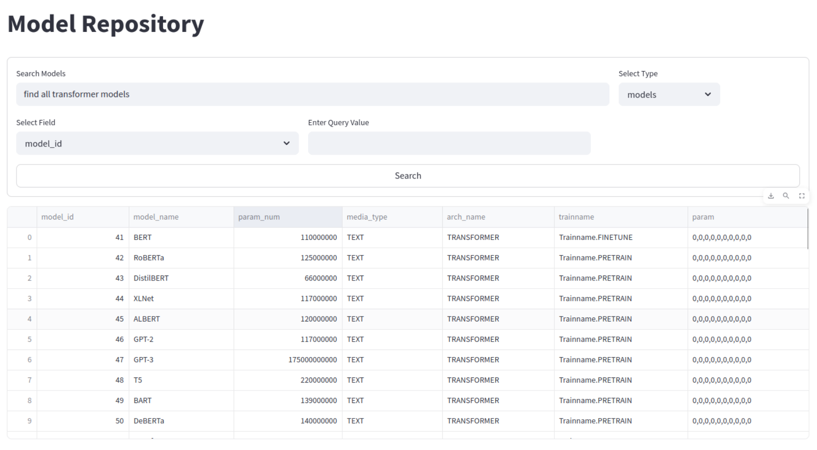
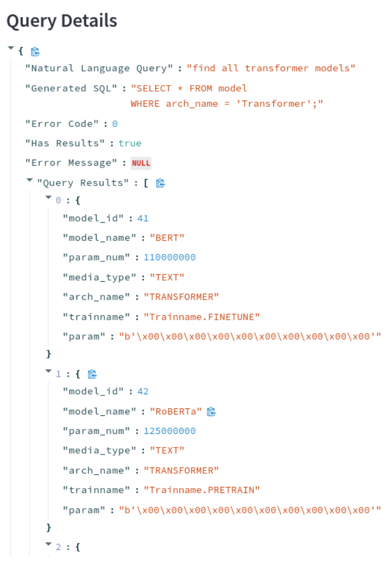
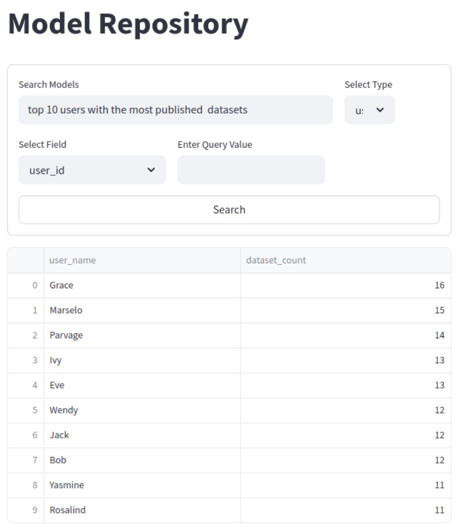
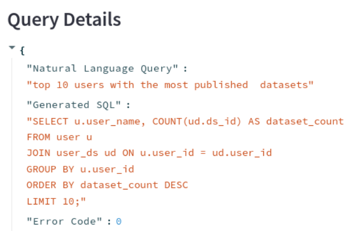
	ds_name
22	chrisjay/crowd-speech-africa
23	gijs/audio-datasets
24	MLCommons/unsupervised-peoples-speech
25	mozilla-foundation/common_voice_13_0
26	giga_speech
27	tedlium
28	voxpopuli
29	earnings-22
30	ag_news
31	imdb

Model Repository

Search Models: show all names
Select Type: users
Select Field: user_id
Enter Query Value:
Search

	user_id	user_name
20	20	Rico
21	2	Rosalind
22	21	Sophia
23	22	Thomas
24	23	Uma
25	24	Victor
26	25	Wendy
27	26	Xander
28	27	Yasmine
29	28	Zoe

- other queries

Query	Find all transformer models	(same as previous)	top 10 users with the most published datasets
Result	Result can be represented in a table. 	Can also view the corresponding SQL query. 	More complicated queries can also be executed.  

Model Repository

Search Models: find all transformer models
Select Type: models
Select Field: model_id
Enter Query Value:
Search

	model_id	model_name	param_num	media_type	arch_name	trainname	param
0	41	BERT	110000000	TEXT	TRANSFORMER	Trainname.FINETUNE	0,0,0,0,0,0,0,0,0,0
1	42	RoBERTa	125000000	TEXT	TRANSFORMER	Trainname.PRETRAIN	0,0,0,0,0,0,0,0,0,0
2	43	DistilBERT	66000000	TEXT	TRANSFORMER	Trainname.PRETRAIN	0,0,0,0,0,0,0,0,0,0
3	44	XLNet	117000000	TEXT	TRANSFORMER	Trainname.PRETRAIN	0,0,0,0,0,0,0,0,0,0
4	45	ALBERT	120000000	TEXT	TRANSFORMER	Trainname.PRETRAIN	0,0,0,0,0,0,0,0,0,0
5	46	GPT-2	117000000	TEXT	TRANSFORMER	Trainname.PRETRAIN	0,0,0,0,0,0,0,0,0,0
6	47	GPT-3	175000000000	TEXT	TRANSFORMER	Trainname.PRETRAIN	0,0,0,0,0,0,0,0,0,0
7	48	T5	220000000	TEXT	TRANSFORMER	Trainname.PRETRAIN	0,0,0,0,0,0,0,0,0,0
8	49	BART	139000000	TEXT	TRANSFORMER	Trainname.PRETRAIN	0,0,0,0,0,0,0,0,0,0
9	50	DeBERTa	140000000	TEXT	TRANSFORMER	Trainname.PRETRAIN	0,0,0,0,0,0,0,0,0,0

Query Details

```
{
  "Natural Language Query" : "find all transformer models"
  "Generated SQL" : "SELECT * FROM model
                     WHERE arch_name = 'Transformer';"
  "Error Code" : 0
  "Has Results" : true
  "Error Message" : NULL
  "Query Results" : [
    0 : {
      "model_id" : 41
      "model_name" : "BERT"
      "param_num" : 110000000
      "media_type" : "TEXT"
      "arch_name" : "TRANSFORMER"
      "trainname" : "Trainname.FINETUNE"
      "param" : "b'\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00'"
    }
    1 : {
      "model_id" : 42
      "model_name" : "RoBERTa"
      "param_num" : 125000000
      "media_type" : "TEXT"
      "arch_name" : "TRANSFORMER"
      "trainname" : "Trainname.PRETRAIN"
      "param" : "b'\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00'"
    }
    2 : {
```

Model Repository

Search Models: top 10 users with the most published datasets
Select Type: u:
Select Field: user_id
Enter Query Value:
Search

	user_name	dataset_count
0	Grace	16
1	Marselo	15
2	Parvage	14
3	Ivy	13
4	Eve	13
5	Wendy	12
6	Jack	12
7	Bob	12
8	Yasmine	11
9	Rosalind	11

Query Details

```
{
  "Natural Language Query" :
  "top 10 users with the most published  datasets"
  "Generated SQL" :
  "SELECT u.user_name, COUNT(ud.ds_id) AS dataset_count
  FROM user u
  JOIN user_ds ud ON u.user_id = ud.user_id
  GROUP BY u.user_id
  ORDER BY dataset_count DESC
  LIMIT 10;"
  "Error Code" : 0
```

2.5. Security

Hybrid Encryption

Utilizes a combination of symmetric (AES-CBC) and asymmetric (RSA) encryption to protect sensitive data such as user credentials and model/dataset metadata. Files and database entries are encrypted at rest.

Authentication & Integrity

Implements Argon2Key for secure password derivation and HMAC and RSA for data integrity verification. User sessions are validated via challenge-response mechanisms.

Access Control

Role-based access (user/admin) with granular permissions.

Secure Data Sharing

Users can share models/datasets via encrypted invitations, revocable by owners.

Audit Trails

All user actions (uploads, downloads, modifications) are logged with timestamps and hashed to prevent tampering.

Realization

- User passwords are hashed with Argon2Key and stored.
- Database fields containing sensitive data (e.g., model parameters) are encrypted using symmetric encryption.
- The frontend integrates with the security module to enforce role-based UI rendering and API access.
- Security schema designed to guarantee data security, retrievability, and timely revocation.

DataStore Name	DataStore Value	KeyStore Name	KeyStore Value
UserID UUID	UserData struct user	Username+"Enc" string	EncPublicKey PKEEncKey
FileID UUID	FileData File	Username+"Ver" string	VerPublicKey DSVerifyKey
FileContentID UUID	EncFileContent FileContent		
FileNode UUID	EncFileNode FileNode		
KeyManagerID UUID	EncFileKeyManager KeyManager		
InvitationID UUID	EncInvitationData Invitation		

This section aligns with the project's focus on usability while ensuring compliance with confidentiality, integrity, and availability principles.

2.6. Data Insight

We dynamically analyze the database when the user renders to the `Data Insight` page. The database will be analyzed in three aspects: models, datasets, and users stored in the database.

For the model part, we summarize the percentage of different media types, architecture names, and training types. We also investigate the relation between media types and tasks using the heat map. Moreover, we summarized the parameter numbers by their maximum, minimum, mean, and standard deviation.

For the dataset part, we summarize the relation between media types and tasks using a heat map. Also, we summarized the parameter numbers by their maximum, minimum, mean, and standard deviation.

For the user part, we count the total number of users for each affiliation.

2.7. Sample SQL Queries

SQL Queries used for practical daily operations and activities

```sql
CREATE TABLE affiliate (
    affil_id INT AUTO_INCREMENT PRIMARY KEY,
    affil_name VARCHAR(50)
);

INSERT INTO user (user_id, user_name, Affiliation, password_hash, is_admin)
VALUES (0, 'Alice', 'The Chinese University of Hong Kong, Shenzhen', 'ILoveCSC3170', FALSE);

UPDATE model
SET Media_type = 'audio'
WHERE Media_type = 'Music';
```

SQL Queries used for data analysis

```sql
SELECT
    Train_name,
    COUNT(*) AS TOT_TRAIN_NAME
FROM
    model
```

```
GROUP BY
    Train_name
HAVING
    COUNT(*) > 15;
```

3. Conclusion and self-evaluation

3.1. Conclusion

- We finished task 1-7 as mentioned in the project guideline.

Req. 1: Analyze the requirments of the organization.

- Data Storage: The system must store models and datasets along with their metadata in a structured database.
- User Interface: A graphical interface should allow users and administrators to upload, download, and manage resources.
- AI-Assisted Querying: An AI agent should help users perform efficient and intelligent queries.
- Security and Privacy: Encryption and access control mechanisms must ensure data confidentiality and security.

Req. 2: Identify the relevant entities, attributes, and relationships together with any constraints and properties

- This has been displayed in our database implementation part.
- For example:
    - entities: model (inherited by transformer, RNN, CNN entities), dataset, user, affiliation ...
    - relationship: model_user, ds_user (in the sense that a user may be an author), user_affil, ...
    - constraints: can only choose from several machine learning tasks; can only choose from several model architectures.

Req. 3: ER Diagram for the database; Req. 4: Convert ER Diagram to Relational Schema

- refer to the database section's beginning

Req. 5: Populate the schemas with a reasonable amount of realistic data

- data are stored in: `database/records/demo.json`, including: 92 models; 100 datasets; 28 users; 12 affiliations; etc.
- Relaionships are generated by the program when loading the data.
- model name and corresponding architecture, media type; dataset name and media type are real data from huggingface.

Req. 6: Produce sample SQL queries on these relations that are used for practical daily operations and activities

- refer to corresponding content: sql for daily operations

Req. 7: Produce sample SQL queries on these relations which are of an analytic or data mining nature

- refer to corresponding content: sql for analysis

Req. 8: Suggest which data fields of the relational schemas should be indexed or hashed, and explain your decision

- refer to the security part

Bonus 1: LLM + Database

LLM generated SQL

- refer to the implementation of LLM agent

LLM refined database architecture

[?]

3.2. Self-Evaluation

- Work division is as follows: (members' names follows alphabetical order)

Linyong Gan

- Implemented the entire `Data Insights` part.
- Generated the demo data for the database obtained from HuggingFace.
- Fix some type constraints of attributes.
- Drafted the answers to seven questions of this project and designed the powerpoint slides of presentation.

Yimeng Teng

- Implemented the entire `agent` part. Generated test cases to evaluate and refine it.
- Collaborated with Linyong Gan to generate `demo.json`, which contains sufficient amounts of records for initializing the database.
- Collaborated with Wentao Lin in implementing a data loader that load json files and insert records to the database. Designed the first version and help completed the final version.
- Participated in the formulation of the database schema (but not the implementation). Provided some knowledge about the real-life scenario (machine learning) that our database is trying to capture.
- Designed the powerpoint for presentation with Linyong Gan; did the presentation. Designed the project demonstration in the presentation. Completed major parts of the report.

Yufeng Lin

- Collaborated with all members in designing database schema.
- Implement the entire database schema part.
- Implement the entire database interface part.
- Collaborated with Wentao Lin, Zirun Zheng, and Yuxuan Liu in fixing bugs in frontend.
- Manage the github repository and handle pull requests.
- Manage the project, communicate with members and assign taks.
- Group leader

Yuxuan Liu

- Collaborated with Wentao Lin, Zirun Zheng, and Yufeng Lin in refining the `frontend` part.
- Participated in the design of database schema and draw the E-R diagram.
- Inplemented the associate search and attribute search functionality in the frontend.

Zirun Zheng

- Collaborated with Wentao Lin, Yuxuan Liu, and Yufeng Lin in refining the `frontend` part.
- Integrate with the agent and datebase part to implement the frontend's search functionality and pagination functionality, and further refine with Wentao Lin.
- Collaborated with Wentao Lin in implementing the data upload and download functionality.
- Translate the frontend's texts into English.

Wentao Lin

- Designed and implemented the core frontend architecture using Streamlit framework.
- Developed the database API middleware layer for secure and efficient data operations.
- Created modular components for user authentication, file upload/download, and search functionality.
- Implemented the pagination system with Zirun Zheng and data visualization components.
- Integrated the LLM agent with the frontend search interface with YuXuan Liu.
- Collaborated with Zirun Zheng in refining the user interface and implementing file operations.

Shuhan Zhang

- Designed the security schema upon database schema.
- Designed the security code architecture.
- Implemented symmetric and asymmetric encryption and signature algorithms.
- Implemented user, invitation, and key operation functions.
- Implemented python-Go socket connector.
- Implemented encryption and decryption logics in frontend.

4. References

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