CSC3170 FINAL PROJECT -- OPTION 3

TEAM 21

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PRESENTATION OUTLINE

INTRODUCTION

OVERVIEW

- We choose option 3 as our final project.
- In this project, we will write a miniature relational database management system (DBMS) that stores data *tables*, where a table consists of some number of labeled *columns* of information. Our system will include a database *query language* similar to SQL to extract information from these tables. Extra features and robustness support are provided in our database system.
- We will mainly use C++ to implement our code. Therefore, we do not adopt the original backbone.

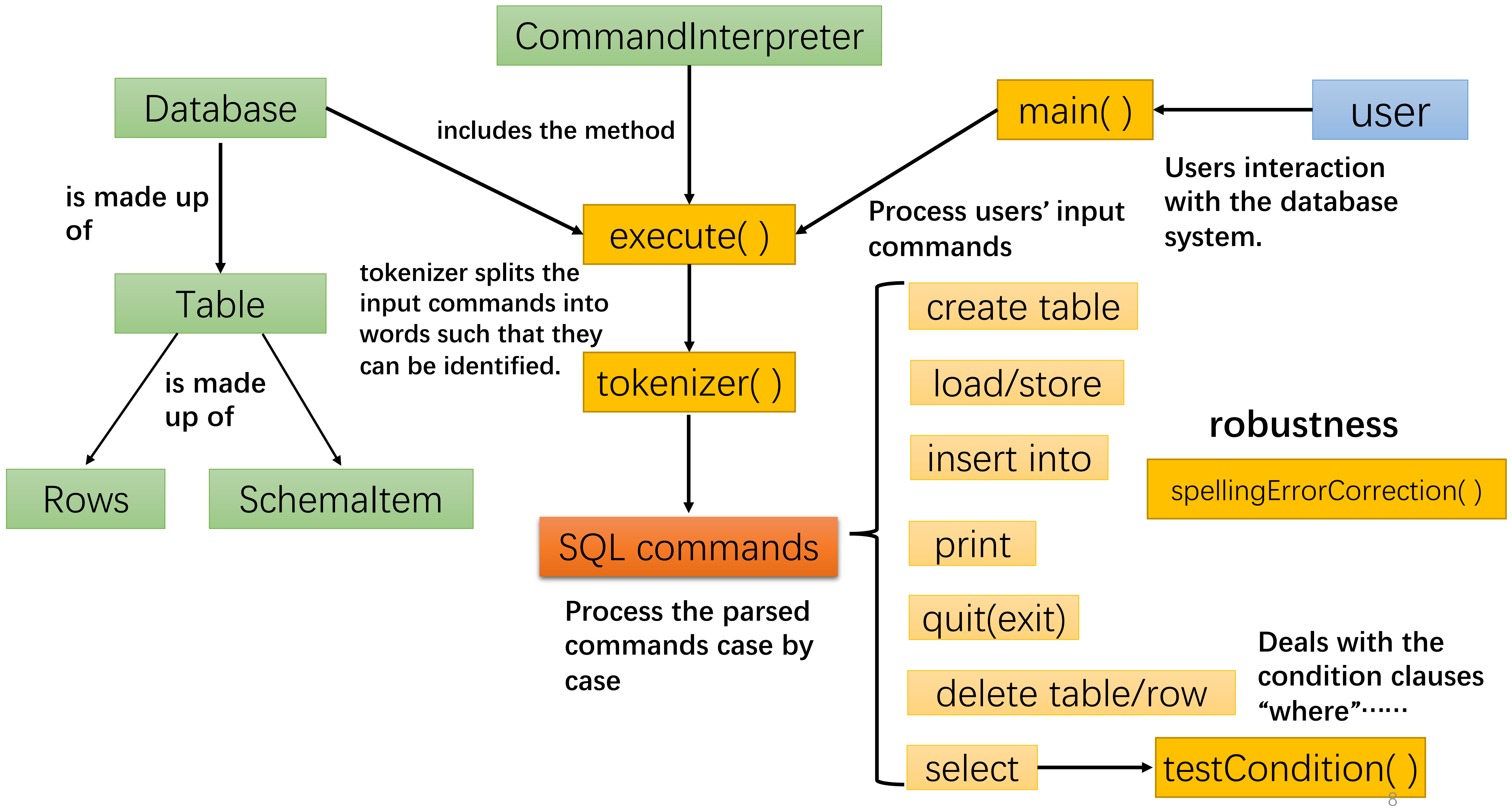
FUNCTIONS WE ACHIEVED

- Support a database *query language* similar to SQL
  - create table (as…) : create an empty table with the given name
  - load : load data from the file *name*.db to create a table name *table*
  - store : store data from the table *name* to the file *table*.db
  - insert into : add a new row to the given table
  - print : print all rows of the table with the given name
  - quit (exit) : quit the database program
  - help : print help messages
  - select <column(s)> from <table(s)> where <condition(s)> : extract a new (unnamed) table consisting of the <column(s)> from the given <table(s)> with all rows that satisfy the <condition(s)>

FUNCTIONS WE ACHIEVED

- Additional functions apart from those required in the project
  - delete table <table name> : delete the table with given name
  - delete from table (where <condition(s)>) : delete specific rows from a given table
  - Robustness support:
    - spellingErrorCorrection( ) : predict the command that the user may want to input if he/she gives a wrong syntax
    - Beautify the output and improve user experience
    - Handling error cases
  - GUI interface

PROJECT DESIGN LOGIC


CommandInterpreter
Database
includes the method
main( )
user
is made up of
execute( )
Process users' input commands
Users interaction with the database system.
Table
tokenizer splits the input commands into words such that they can be identified.
tokenizer( )
create table
load/store
is made up of
robustness
insert into
spellingErrorCorrection( )
Rows
SchemaItem
SQL commands
print
quit(exit)
Process the parsed commands case by case
Deals with the condition clauses "where"……
delete table/row
select
testCondition( )

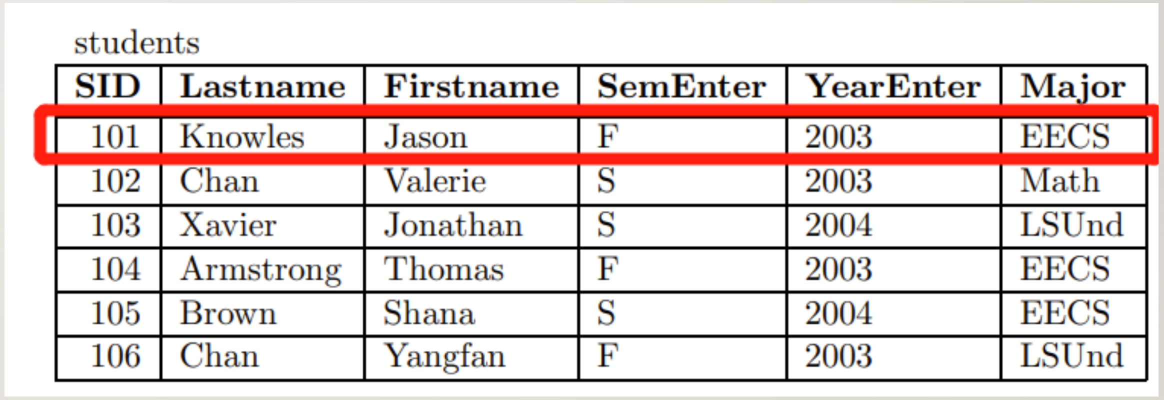
MAJOR DATA STRUCTURES

DATA STRUCTURES

- To implement the specific database and related methods, we divide it into a number of classes. The specific architecture we will adopt is as follows:
- Row class
- SchemaItem class
- Table class
- CommandInterpreter class
- Database class

Row CLASS

- Serves as the underlying storage unit for information about tables in the database, recording row information. (A row corresponds to a vector variable)
- Methods:
    - getValues, setValues

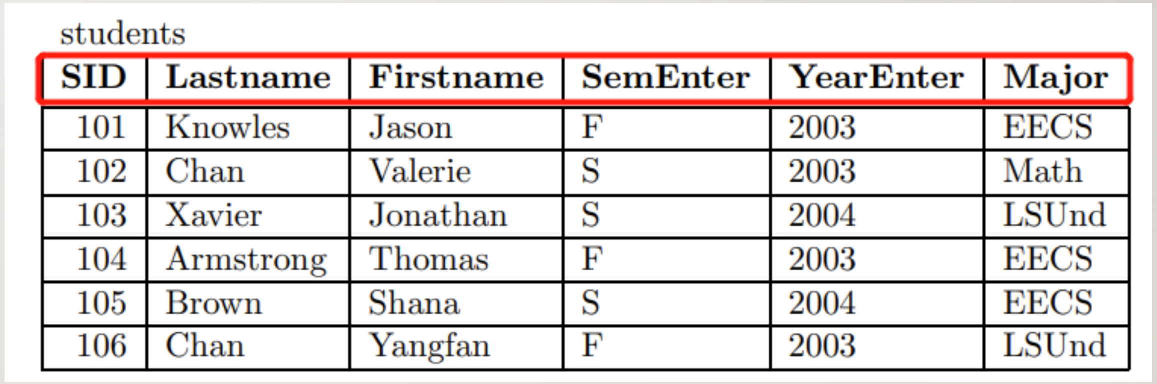


students

SID	Lastname	Firstname	SemEnter	YearEnter	Major
101	Knowles	Jason	F	2003	EECS
102	Chan	Valerie	S	2003	Math
103	Xavier	Jonathan	S	2004	LSUnd
104	Armstrong	Thomas	F	2003	EECS
105	Brown	Shana	S	2004	EECS
106	Chan	Yangfan	F	2003	LSUnd

SchemaItem CLASS

- Records tables' schemas. (Similar to row class)
- Methods:
  - getName, getType, getTypeFromString



students

SID	Lastname	Firstname	SemEnter	YearEnter	Major
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102	Chan	Valerie	S	2003	Math
103	Xavier	Jonathan	S	2004	LSUnd
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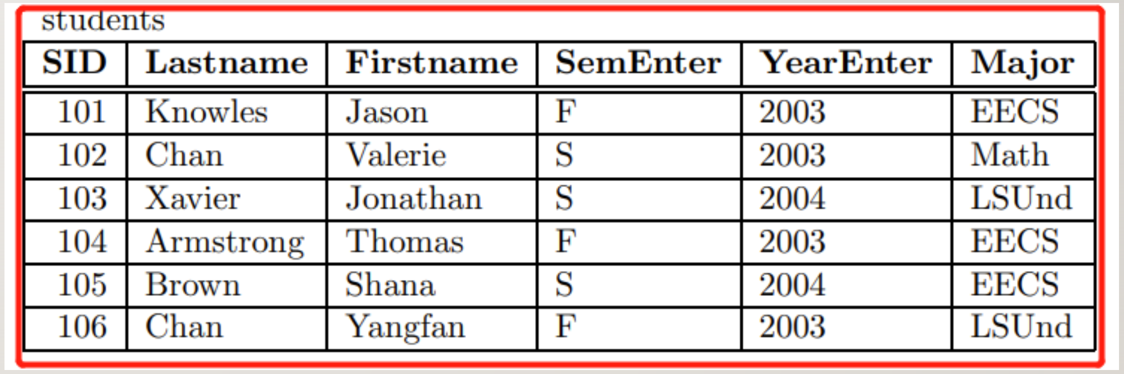
105	Brown	Shana	S	2004	EECS
106	Chan	Yangfan	F	2003	LSUnd

Table CLASS

- A data structure that stores tables in a database. It contains three attributes, the rows (Row class) to record the row information, the schema (SchemaItem class) to record the schema, and the database (Database class) to record the database which the table belongs.
- Methods:
  - printOut, saveToFile, loadFromFile, getSchema, insertAt


students

SID	Lastname	Firstname	SemEnter	YearEnter	Major
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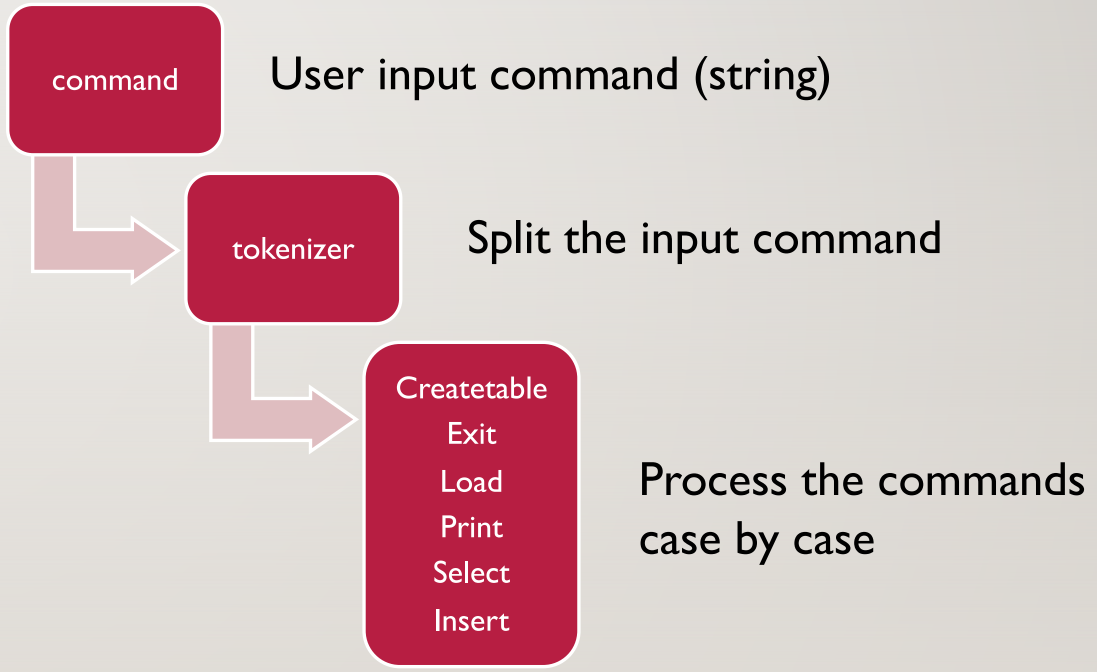
CommandInterpreter CLASS

- Used to accept and execute commands. Contains the specific implementation method of the command. (exit, select, help…)
- It first decomposes the command using the takon variable, and then implements the operations corresponding to the command.



Database CLASS

- As a whole database, which contains instances of the Table and CommandInterpreter classes as attributes.

Tables

- Students table
- Enrolled table
- Schedule table

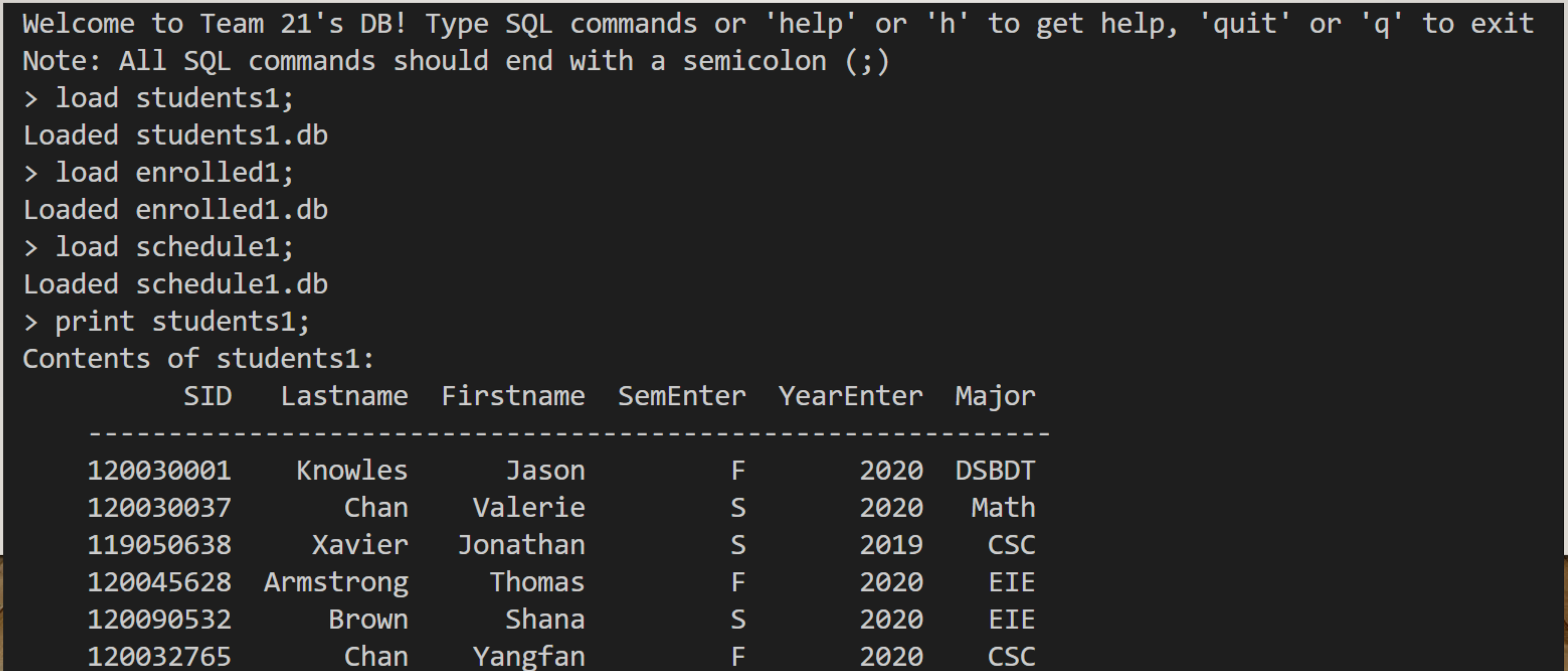
Methods

- removeTable, execute, switchTable, addTable, setTable, getDatabase

IMPLEMENTATION DEMO

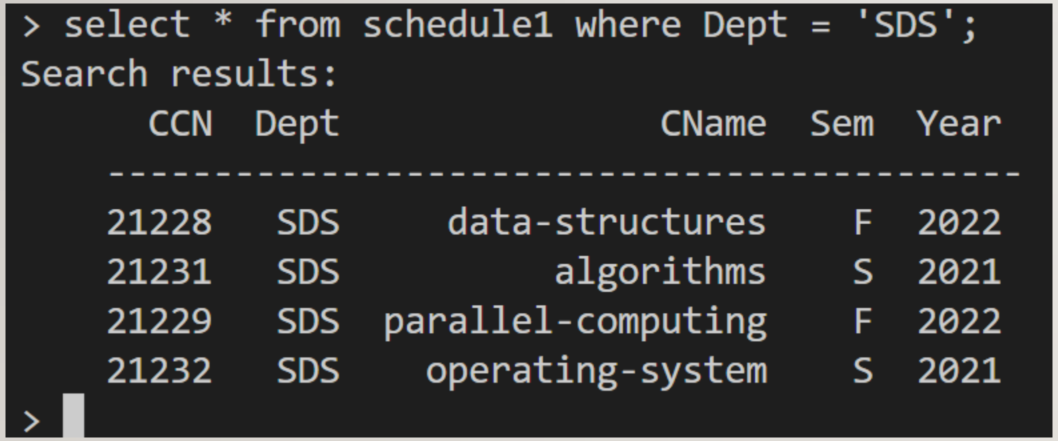
IMPLEMENTATION DEMO: "LOAD" AND "PRINT"

Scenario: A database for CUHK(SZ) to record the data of students and courses
We have provided pre-stored sample tables: students, enrolled, and schedule, that can be directly loaded.

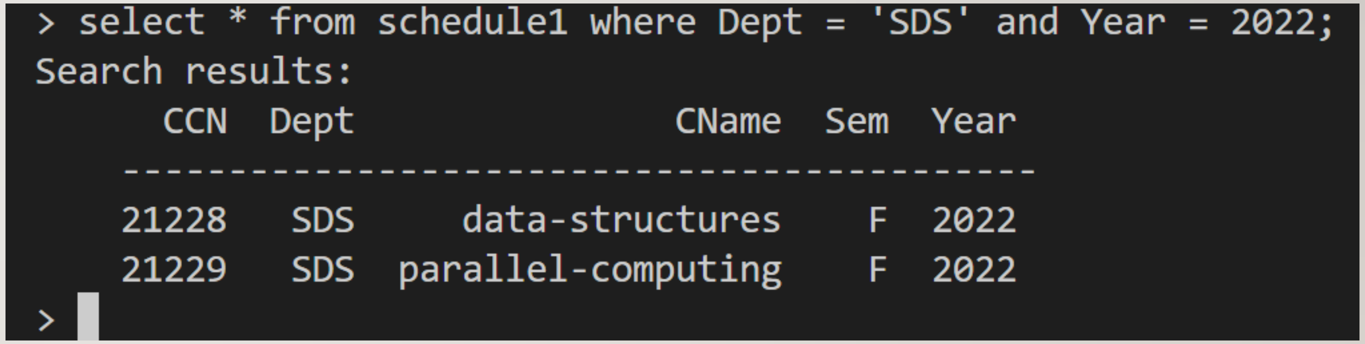


```
Welcome to Team 21's DB! Type SQL commands or 'help' or 'h' to get help, 'quit' or 'q' to exit
Note: All SQL commands should end with a semicolon (;)
> load students1;
Loaded students1.db
> load enrolled1;
Loaded enrolled1.db
> load schedule1;
Loaded schedule1.db
> print students1;
Contents of students1:
          SID   Lastname  Firstname  SemEnter  YearEnter  Major
    ------------------------------------------------------------
    120030001    Knowles      Jason         F       2020  DSBDT
    120030037       Chan    Valerie         S       2020   Math
    119050638     Xavier   Jonathan         S       2019    CSC
    120045628  Armstrong     Thomas         F       2020    EIE
    120090532      Brown      Shana         S       2020    EIE
    120032765       Chan    Yangfan         F       2020    CSC
```

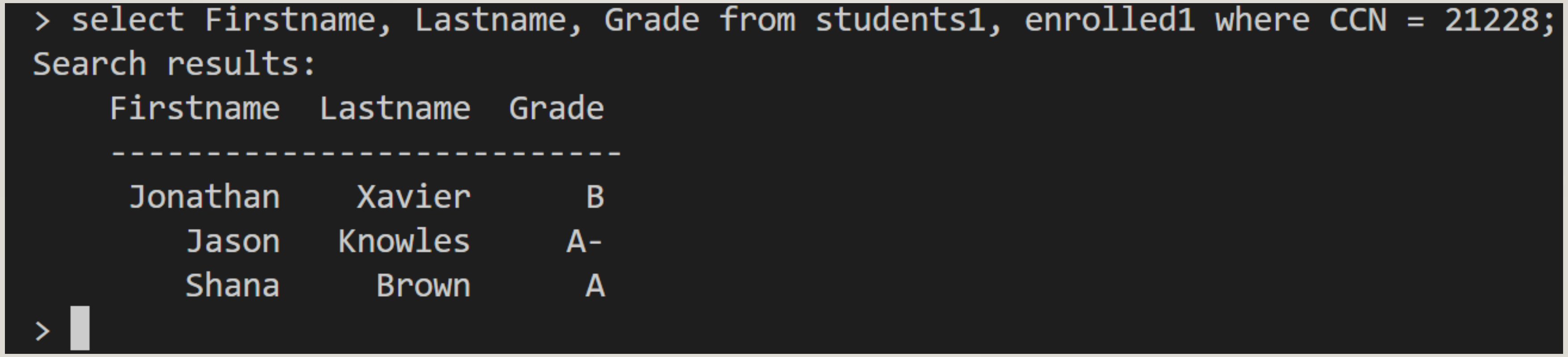
IMPLEMENTATION DEMO: QUERYING



```
> select * from schedule1 where Dept = 'SDS';
Search results:
      CCN  Dept                CName  Sem  Year
    -------------------------------------------
    21228   SDS      data-structures    F  2022
    21231   SDS           algorithms    S  2021
    21229   SDS   parallel-computing    F  2022
    21232   SDS     operating-system    S  2021
> 
```

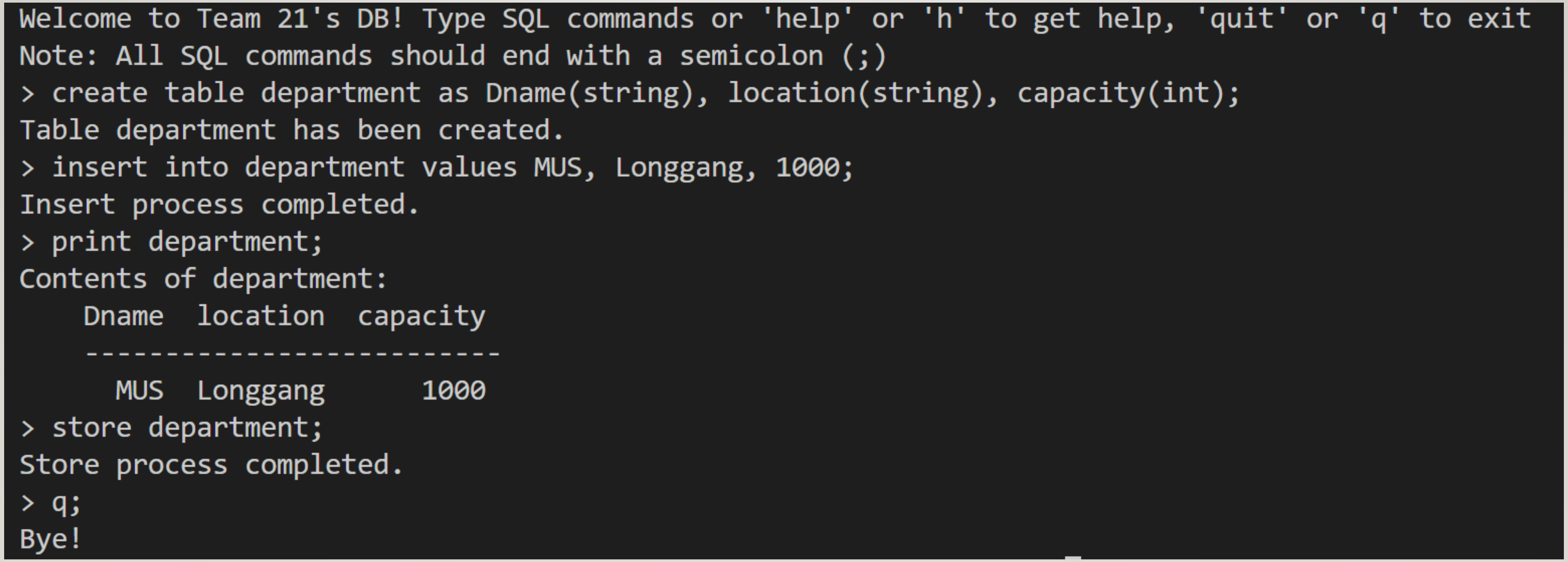


```
> select * from schedule1 where Dept = 'SDS' and Year = 2022;
Search results:
      CCN  Dept                CName  Sem  Year
    -------------------------------------------
    21228   SDS      data-structures    F  2022
    21229   SDS   parallel-computing    F  2022
> 
```



```
> select Firstname, Lastname, Grade from students1, enrolled1 where CCN = 21228;
Search results:
    Firstname  Lastname  Grade
    ---------------------------
     Jonathan    Xavier      B
        Jason   Knowles     A-
        Shana     Brown      A
> 
```

IMPLEMENTATION DEMO: CREATE TABLE, INSERT



```
Welcome to Team 21's DB! Type SQL commands or 'help' or 'h' to get help, 'quit' or 'q' to exit
Note: All SQL commands should end with a semicolon (;)
> create table department as Dname(string), location(string), capacity(int);
Table department has been created.
> insert into department values MUS, Longgang, 1000;
Insert process completed.
> print department;
Contents of department:
    Dname  location  capacity
    --------------------------
      MUS  Longgang      1000
> store department;
Store process completed.
> q;
Bye!
```

We can verify this by starting another instance of the DB and load it into memory.

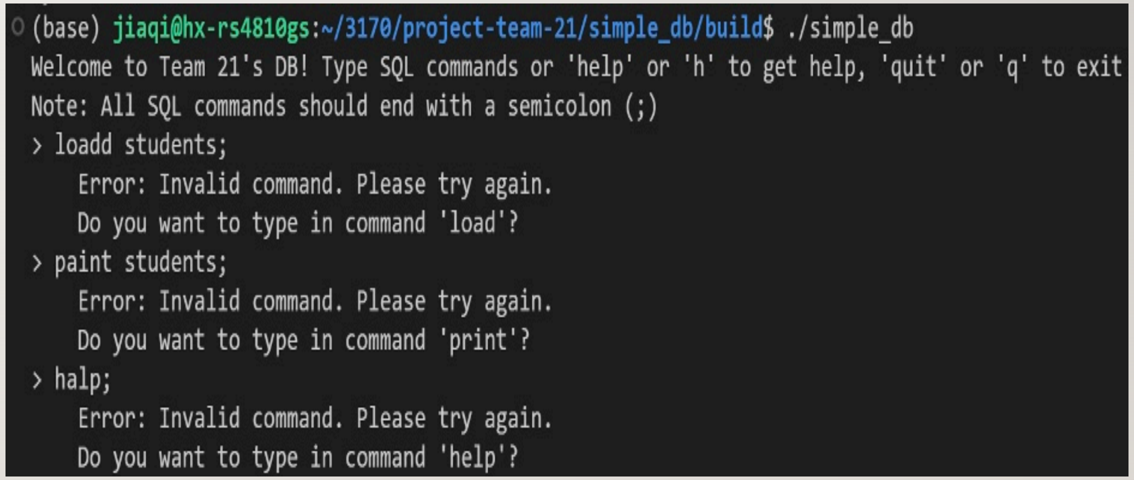
ADDITIONAL FEATURES & GUI

ADDITIONAL FEATURES – ENRICH QUERY LANGUAGE

- Support "delete" a table from the database
- Support "delete" specific rows from a given table
- Support *comments* inputs (/* … */)
- Support "*select*", "delete" command with conditional clause (*where*…)
- Support "*select*" multiple columns from multiple tables

ADDITIONAL FEATURES – Syntax Error Correction

- Function *CommandInterpreter:: spellingErrorCorrection ()*
- "Guess" the query command that user may want to type in if he/she gives a wrong one
- Implementation detail:
  - compare the user input with each of the standard SQL commands (select, create, print…)
  - Function *CommandInterpreter::lcs(string a, string b) obtains the length of longest common substring between 2 strings*
  - the SQL command with *lcs()* value larger than threshold will be the possible input, and give user a hint

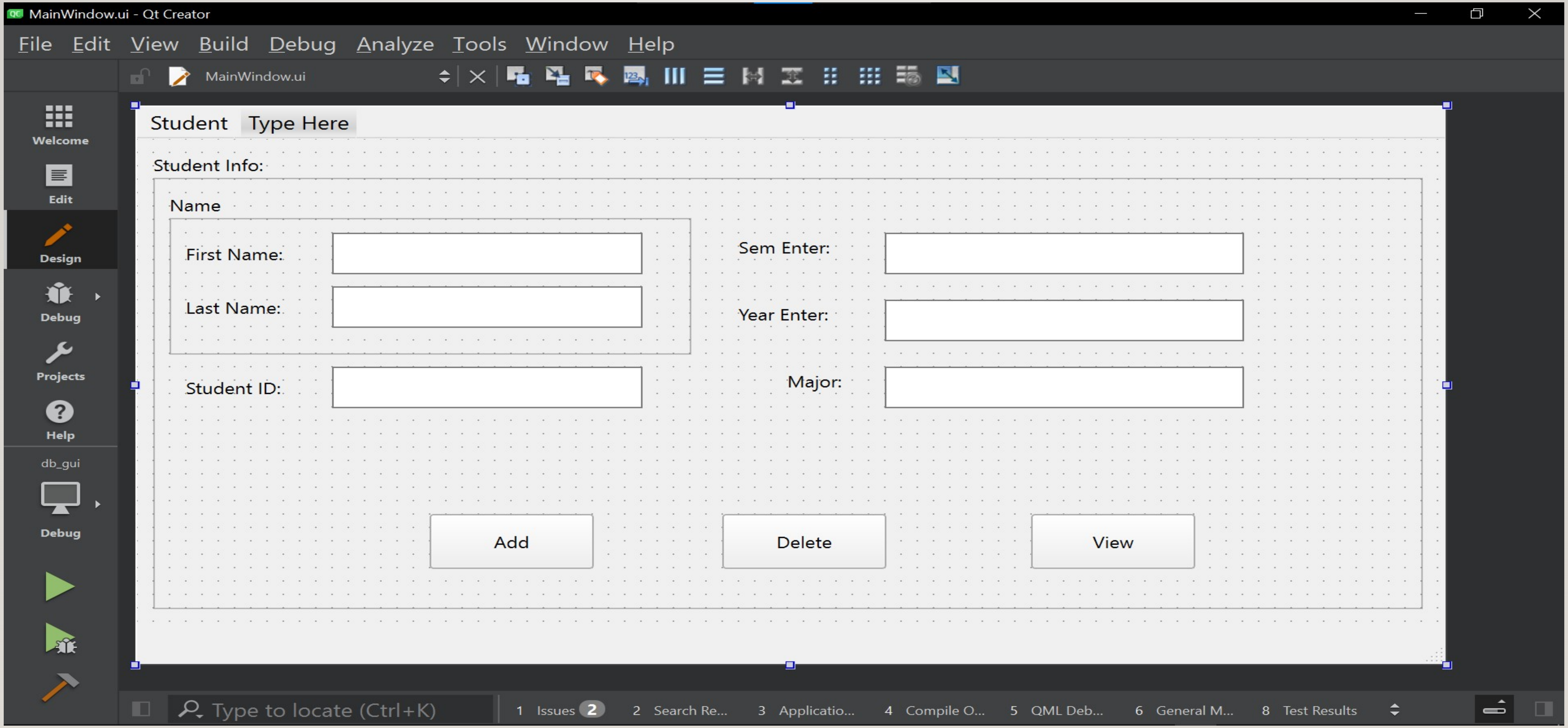


```
(base) jiaqi@hx-rs4810gs:~/3170/project-team-21/simple_db/build$ ./simple_db
Welcome to Team 21's DB! Type SQL commands or 'help' or 'h' to get help, 'quit' or 'q' to exit
Note: All SQL commands should end with a semicolon (;)
> loadd students;
    Error: Invalid command. Please try again.
    Do you want to type in command 'load'?
> paint students;
    Error: Invalid command. Please try again.
    Do you want to type in command 'print'?
> halp;
    Error: Invalid command. Please try again.
    Do you want to type in command 'help'?
```

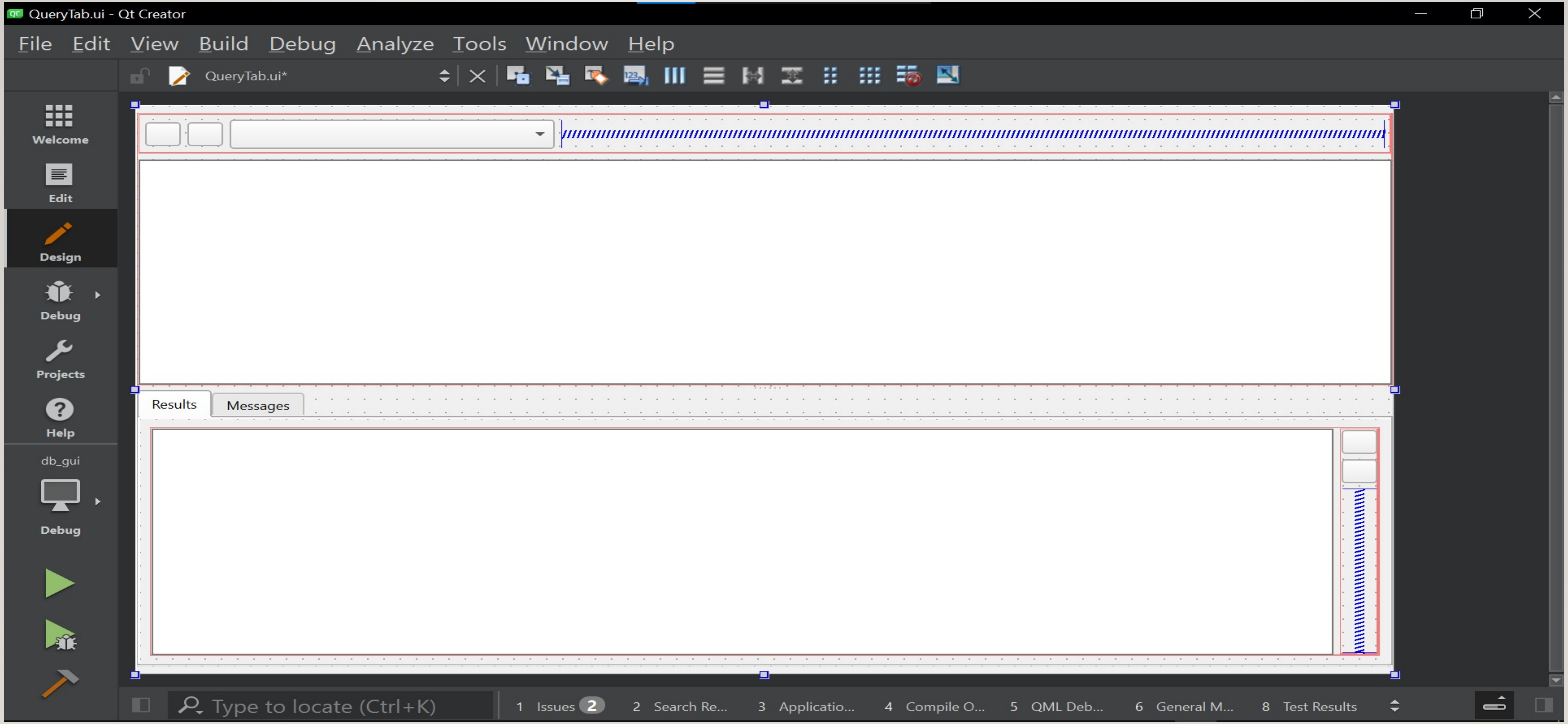
ADDITIONAL FEATURES - ROBUSTNESS SUPPORT

- Identify error cases and post error messages when
  - user operates(load, print, store…) a table that did not exist
  - user “*insert*” values with numbers that does not match the number of columns
- Beautify the “*print*” outputs to make the tables tidy and aligned
- Support input that spans multiple lines

GUI – LOAD STUDENTS



GUI – QUERY TAB



SUMMARY & FUTURE IMPROVEMENT

SUMMARY & FUTURE IMPROVEMENT

- Have a deeper understanding of a database system by implementing one ourselves
  - Knowledge of natural inner join, database components are utilized
- Future improvements
  - Search efficiency improvements
  - GUI / user interaction improvement
  - Support larger-scale databases

THANK YOU

For more details, please refer to our codes and report.