CS 377: Database Systems

Project #3: Course Suggestion Website Part I

Due: April 24th 2017 at 11:59 PM on Canvas

Overview

The Mathematics and Computer Science Department wants to hire you to create a web application to help students plan their coursework. A student will provide their planned degree(s) (e.g., Bachelor of Arts in Computer Science, Bachelor of Science in Computer Science, etc.), the number of semesters they have left, and a list of courses they have taken to date. The web application will then determine if the student can graduate in time and suggest one or more course schedules for the remaining time.

1 Database Design (20 points)

Design an ER diagram for the website based on the following requirements:

- Each course has a unique course number, course title, course description, number of credits, and whether it is offered every semester (e.g., CS 171), only every fall or spring (CS 378), or rarely (CS 455).

- Each course may have zero or more class prerequisites (other courses).

- Students must be pursuing at least one major (e.g., BA in Computer Science, BS in Computer Science, etc.).

- A student can pursue either 2 majors, 1 major and 1 minor, or 1 major.

- Each major/minor has a set of required courses that must be taken.

- Each major/ minor has a list of "elective" courses that must satisfy certain buckets. For example, a BA in computer science has the requirement that a student must take "one of CS 356, 377, 452, 455, and 456".

2 Relational Model Creation (20 points)

Design the relational model from your ER diagram. Make sure the key attributes are underlined and the foreign keys are referenced correctly.

3 SQL Database Creation (15 points)

Create a file called `create-tables.sql` that will create the tables (implement the relational schema from the previous part) using MySQL. You can use this file to build / re-build your database if you find that it needs to change. Note that you most likely want your database to be at least be 1NF.

4 Database Population (25 points)

You will use the bulk load option to populate your database. Your first task is to take the data that we've provided and convert it into a format that is consistent with your relational schema. We have provided the data file `courses.csv`, where each line contains all the course information with commas separating the

different values. Multi-valued attributes values will be denoted with an & sign (e.g., CS 224's prerequisites are CS 170 & Math 112, courses offered both fall and spring are F & S). The requirements for the different majors and minors is shown in the Appendix A. Each relation will have its own data file (`<relation-name>.csv`). Inside the data file, each line will represent a tuple with commas separating the different attribute values. For example, the department.csv file will have 3 rows:

```
'Research', 5, '333445555', '1988-05-22'
'Administration', 4, '987654321', '1995-01-01'
'Headquarters', 1, '888665555', '1981-06-19'
```

Create another SQL file called `populate-tables.sql` that will populate all your relational tables using the bulk import capability. Here is an example of the bulk load command in MySQL (note that you will need to make sure your MySQL server allows local infile, which means you might need to restart it with this option available):

```
LOAD DATA LOCAL INFILE 'department.csv' INTO TABLE department FIELDS TERMINATED BY ',';
```

5 Common SQL Queries (20 points)

Your next task is to write the SQL queries that your web application will use. In particular, you will want to make sure you can do the following:

1. Check to see if a course number is valid (e.g., Does CS 170 exist in your database? What about CS 001?). This will be useful for error checking.

2. Given a course number, what are the prerequisites and co-requisites for that course?

3. Given a list of course numbers, degree, and list of concentrations, what courses are left that need to be taken?

4. How many courses does the student need to take to satisfy the credit requirements for a degree if they specify the expected graduation date?

5. Will a student be able to graduate on time assuming that the maximum number of courses they can handle in a semester is at most 4 (from the MathCS department)?

Put each of the queries above in its own command file: `query1.sql`, `query2.sql`, ...

Submission Instructions

Although project 3 and 4 will be submitted together, what you will end up submitting for this portion of the project is the following:

- ER design (pdf file)
- Relational schema (pdf file)
- `create-tables.sql`
- Relation data files: `<relation-name>.csv`
- `populate-tables.sql`
- `query1.sql`
- `query2.sql`
- `query3.sql`
- `query4.sql`
- `query5.sql`

A   Major / Minor Requirements

Requirements for declarations on or after Wednesday, August 28, 2013

Class Number	Class Name
Math 111	Calculus I
Math 112	Calculus II
Math 211	Multivariable Calculus
Math 221	Linear Algebra
Math 250	Foundations of Mathematics
Any 6 Math courses (3 credits or more)	*At the 200-level or above
CS 170	Introduction to Computer Science I

Figure 1: BA in Mathematics

Requirements for declarations on or after Wednesday, August 28, 2013

Class Number	Class Name
Math 111	Calculus I
Math 112	Calculus II
Math 211	Multivariable Calculus
**Math 250	Foundations of Mathematics
Math 318	Complex Variables
Math 321	Vector Spaces
The sequence: Math 411/412	Real Analysis I and II
The sequence: Math 421/422	Abstract Algebra I and II
CS 170	Introduction to Computer Science I
1 additional Math classroom course	*At the 200-level or above
2 additional Math courses	*At the 300-level or above
The sequence: Physics 151/152	General Physics I and II

Figure 2: BS in Mathematics

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Requirements for declarations on or after Wednesday, August 28, 2013

Class Number	Class Name
Math 111	Calculus I
Math 112	Calculus II
Math 211	Multivariable Calculus
Math 212	Differential Equations
Math 221 **or** Math 321	Linear Algebra **or** Vector Spaces
Math 250	Foundations of Mathematics
Math 315	Numerical Analysis
Math 351	Partial Differential Equations
CS 170	Introduction to Computer Science I
Any combination of 3 courses chosen from the following list:	Math 318: Complex Variables Math 344: Differential Geometry Math 345: Math Modeling Math 346: Optimization Theory Math 352: PDEs in Action Math 361: Probability & Stats I Math 362: Probability & Stats II Math 411: Real Analysis I Math 412: Real Analysis II
Any combination of 2 courses chosen from the following:	CS 171: Introduction to Computer Science II *Any Math or CS classroom-course numbered 200 or above
The sequence: Physics 151/152	General Physics I and II
1 course chosen from the following list:	Physics 253: Modern Physics with Lab Physics 361: Analytical Mechanics Physics 365: Electromagnetic Fields Chem/Bio 330: Molecular Modeling Chem 331: Physical Chemistry I Econ 420: Econometrics Math/Econ 425: Mathematical Economics

Figure 3: BS in Applied Mathematics

Requirements for declarations on or after Wednesday, August 28, 2013

Class Number	Class Name
Math 111	Calculus I
Math 112	Calculus II
5 additional Math courses (3 credits or more)	At the 200-level or above

Figure 4: Minor in Mathematics

Requirements for declarations on or after Wednesday, August 28, 2013

Class Number	Class Name
Math 111	Calculus I
Math 112	Calculus II
Math 211	Multivariable Calculus
Math 221	Linear Algebra
Math 212	Differential Equations
2 courses chosen from the following:	Math 315: Numerical Analysis Math 344: Differential Geometry Math 345: Math Modeling Math 346: Optimization Theory Math 351: Partial Differential Equations

Figure 5: Minor in Applied Mathematics

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Class Number	Class Name
Math 111	Calculus I
Math 112	Calculus II
Math 221	Linear Algebra
CS 170	Introduction to Computer Science I
CS 171	Introduction to Computer Science II
CS 224	Discrete Structures
CS 255	Computer Organization/Assembly Programing
CS 323	Data Structures and Algorithms
Any combination of 4 courses chosen from the following list:	*Any CS classroom course at the 300-level or above Math 315: Numerical Analysis Math 346: Optimization Theory Math 361: Probability & Stats I

Figure 6: BA in Computer Science

Class Number	Class Name
Math 111	Calculus I
Math 112	Calculus II
Math 221	Linear Algebra
CS 170	Introduction to Computer Science I
CS 171	Introduction to Computer Science II
CS 224	Discrete Structures
CS 255	Computer Organization/Assembly Programing
CS 323	Data Structures and Algorithms
CS 424	Theory of Computing
CS 450	Systems Programming
1 chosen from the following:	The sequence: Physics 141/142 The sequence: Physics 151/152
Physics 234	Digital Electronics
Any combination of 4 courses chosen from the following list:	*Any CS classroom course at the 300-level or above Math 315: Numerical Analysis Math 346: Optimization Theory Math 361: Probability & Stats I

Figure 7: BS in Computer Science

Class Number	Class Name
Math 111	Calculus I
Math 112	Calculus II
Math 221	Linear Algebra
Math 250	Foundations of Mathematics
Math 315	Numerical Analysis
CS 170	Introduction to Computer Science I
CS 171	Introduction to Computer Science II
CS 224	Discrete Structures
CS 255	Computer Organization/Assembly Programing
CS 323	Data Structures and Algorithms
CS 424	Theory of Computing
CS 450	Systems Programming
1 chosen from the following:	The sequence: Physics 141/142 The sequence: Physics 151/152
Physics 234	Digital Electronics
Any combination of 3 courses chosen from the following list:	*Any CS classroom course at the 300-level or above Math 346: Optimization Theory Math 361: Probability & Stats I

Figure 8: BS in Computer Science / Mathematics

Class Number	Class Name
1 course chosen from the following:	CS 153: Computing for Bioinformatics CS 155: Introduction to Business Computing
CS 170	Introduction to Computer Science I
CS 171	Introduction to Computer Science II
Any combination of 3 courses chosen from the following:	CS 323: Data Structures and Algorithms CS 325: Artificial Intelligence CS 370: Computer Science Practicum CS 377: Database Systems CS 378: Data Mining

Figure 9: Minor in Computer Science Informatics

Class Number	Class Name
CS 170	Introduction to Computer Science I
CS 171	Introduction to Computer Science II
CS 255	Computer Organization/Assembly Programing
3 additional CS courses (3 credits or more)	At the 200-level or above

Figure 10: Minor in Computer Science