COMSW4111_003_2024_03: Midterm Examples

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Introduction

This document provides *examples* of the types of questions that will be on the midterm exam. It is **not** a practice exam. You cannot use answering the questions in this document to estimate how long it will take you to complete the midterm.

The structure of the document, i.e. the sections, represents the structure of the midterm. The document's format also reflects the midterm's format.

Please see the lecture from 11-OCT and slides 6 from the lecture slides for additional information. There is a discussion thread on Ed for questions and clarification.

Note: This is a "living" document and we may make updates, corrections and additions.

Written Questions

Overview

The first section of the exam will be questions requiring short written answers. The questions test your knowledge of the material and ability to apply. The answers will typically be 5 sentences or fewer. If your answer rambles, is too long, or appears to just be slinging ideas hoping for a correct answer, we will deduct points. More specifically, you will receive points for correct or partially correct answers. If you are rambling hoping to get some points, you may get negative points (deductions).

Examples

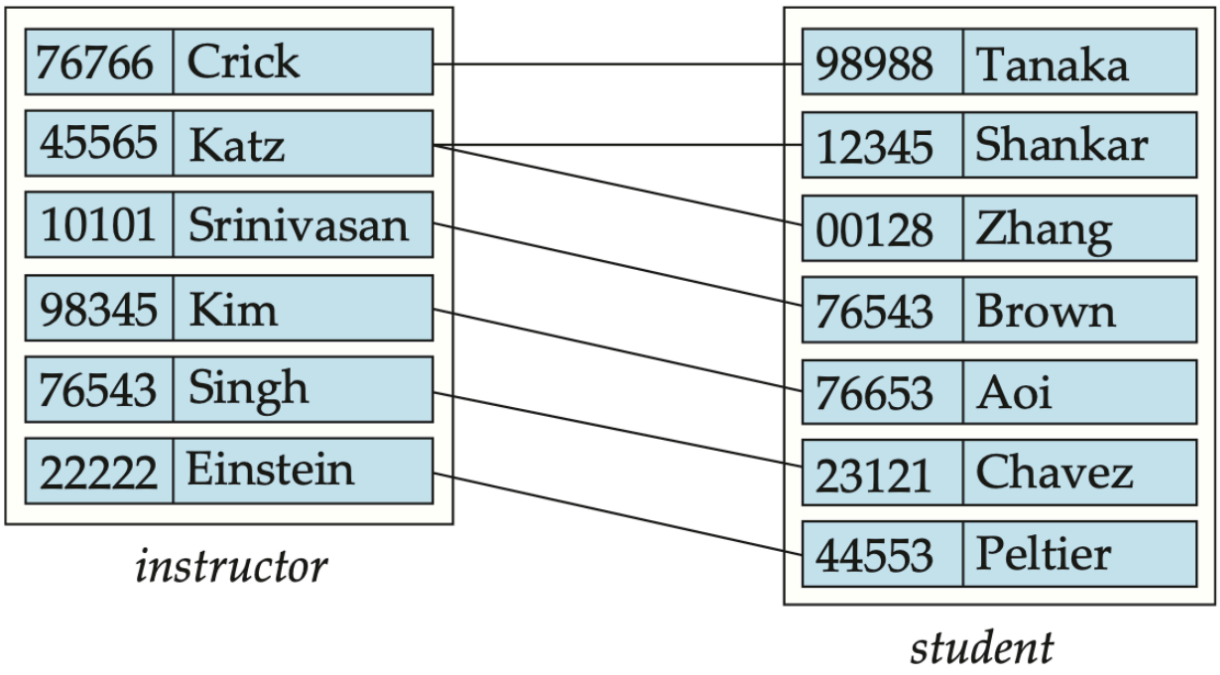
W1 What are the three stages/levels in data modeling? Briefly explain the purpose of each stage/level.

W2 A key concept/feature of database (management) systems is *Data Abstraction.* Briefly explain the concept and its benefits.

W3 List four types of database-system users and briefly explain them.

W4 “The result of a relational-algebra operation is relation …” Please explain this concept and give an example.

W5 The following figure represents instance information for some data in the data model associated with the recommended textbook.



Produce the *relationship set* below.

W6 In SQL, what is the primary difference between a *primary key* and a *unique key?*

W7 Briefly explain the concepts of *degree* and *cardinality* of a relationship set.

W8 Codd's Rule 6: View Updating Rule: All the views of a database, which can theoretically be updated, must also be updatable by the system.

Explain why this rule states the qualification, "... can theoretically be updated, …"

W9 The relational model requires/recommends that the domain for an attribute/property is *atomic.* Briefly explain the concept.

W10 Briefly explain the concept of a *weak entity.*

Relational Algebra

The questions in this section reference the following relations.

R

R.a	R.b	R.c
1	a	d
3	c	c
4	d	f
5	d	b
6	e	f

S

S.b	S.d
a	100
b	300
c	400
d	200
e	150

T

T.b	T.d
a	100
d	200
f	400
g	120

R1 What is the result of executing $R \bowtie (T \cup S)$

R2 Write a relational algebra expression that produces the following relation.

R.a	S.b	S.d	R.c	T.b	T.d
null	*null*	*null*	*null*	a'	100
1	a'	100	d'	d'	200
4	d'	200	f'	f'	400
6	e'	150	f'	f'	400
null	*null*	*null*	*null*	g'	120

R3 The relation below is the full outer join R $\bowtie$ T.

a	b	d
1	'a'	100
3	'c'	*null*
4	'd'	200
5	'd'	200
6	'e'	*null*
null	'f'	400
null	'g'	120

Write an equivalent relational expression that does not use outer join.

R4 The following tables are the course, *section* and *classroom* tables from the dataset associated with the recommended textbook.

course

course.course_id	course.title	course.dept_name	course.credits
BIO-101'	Intro. to Biology'	Biology'	4
BIO-301'	Genetics'	Biology'	4
BIO-399'	Computational Biology'	Biology'	3
CS-101'	Intro. to Computer Science'	Comp. Sci.'	4
CS-190'	Game Design'	Comp. Sci.'	4
CS-315'	Robotics'	Comp. Sci.'	3
CS-319'	Image Processing'	Comp. Sci.'	3
CS-347'	Database System Concepts'	Comp. Sci.'	3
EE-181'	Intro. to Digital Systems'	Elec. Eng.'	3
FIN-201'	Investment Banking'	Finance'	3

section

course_id	sec_id	semester	year	building	room_number	time_slot_id
BIO-101'	1	Summer'	2009	Painter'	514	B'
BIO-301'	1	Summer'	2010	Painter'	514	A'
CS-101'	1	Fall'	2009	Packard'	101	H'
CS-101'	1	Spring'	2010	Packard'	101	F'
CS-190'	1	Spring'	2009	Taylor'	3128	E'
CS-190'	2	Spring'	2009	Taylor'	3128	A'
CS-315'	1	Spring'	2010	Watson'	120	D'
CS-319'	1	Spring'	2010	Watson'	100	B'
CS-319'	2	Spring'	2010	Taylor'	3128	C'
CS-347'	1	Fall'	2009	Taylor'	3128	A'
EE-181'	1	Spring'	2009	Taylor'	3128	C'
FIN-201'	1	Spring'	2010	Packard'	101	B'
HIS-351'	1	Spring'	2010	Painter'	514	C'
MU-199'	1	Spring'	2010	Packard'	101	D'
PHY-101'	1	Fall'	2009	Watson'	100	A'

classroom

building	room_number	capacity
Packard'	101	500
Painter'	514	10
Taylor'	3128	70
Watson'	100	30
Watson'	120	50

Write a relational algebra expression that produces the following relation showing the capacity of sections offered by the Computer Science Dept.

Section Capacity

course.course_id	course.title	section.sec_id	section.semester	section.year	classroom.capacity
CS-101'	Intro. to Computer Science'	1	Fall'	2009	500
CS-101'	Intro. to Computer Science'	1	Spring'	2010	500
CS-190'	Game Design'	1	Spring'	2009	70
CS-190'	Game Design'	2	Spring'	2009	70
CS-315'	Robotics'	1	Spring'	2010	50
CS-319'	Image Processing'	1	Spring'	2010	30
CS-319'	Image Processing'	2	Spring'	2010	70
CS-347'	Database System Concepts'	1	Fall'	2009	70

Entity Relationship Modeling

A university data model has the following entity types:

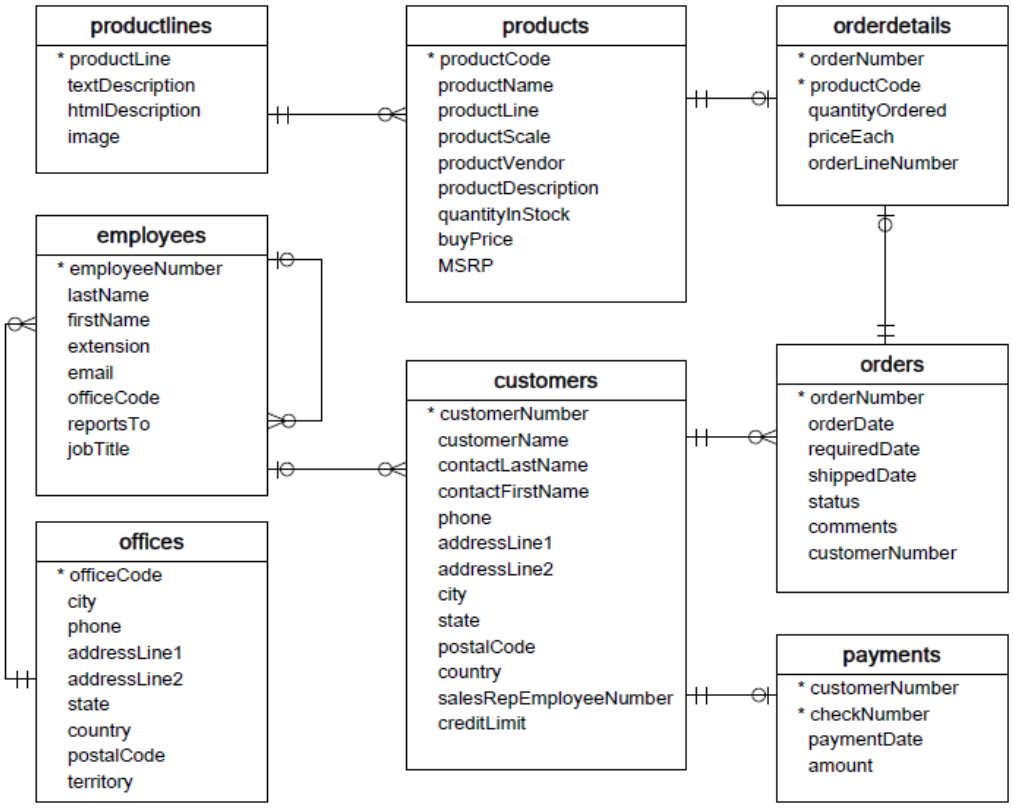
- School with properties
  - school_name
  - school_code
- Department with properties
  - department_code
  - department_name
- Faculty with properties
  - uni
  - first_name
  - last_name
  - title

There are the following relationships:

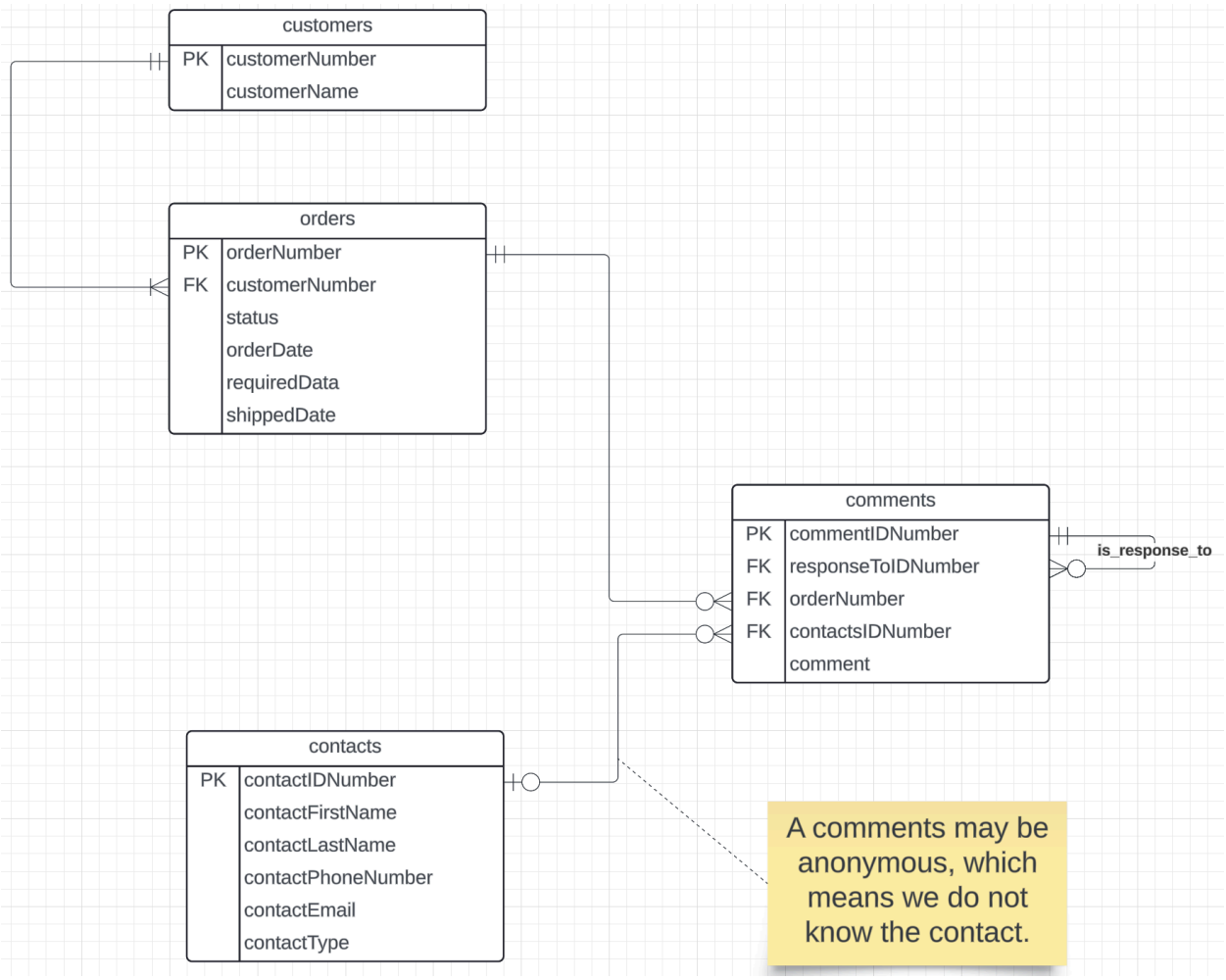
- Department-School:
  - A School may have multiple Departments
  - A Department may be “in” multiple schools, but a Department has one Host school.
- A Department has several Faculty members. A Faculty member is in exactly one Department.

Draw a Crow’s Foot Notation diagram that represents the data model. Add comments/notes to explain any assumptions or explanations for clarity.

Realizing an ER Model in SQL DDL



Consider the Classic Models sample database. I want to make some modifications to improve and generalize the design. My first pass at a subset of the model is:



Notes:

- You can assume that the data type for all columns is *varchar(64).*
- You should assume that all columns are *not null* **unless the relationships in the ER diagram indicate otherwise.**
- There is a mistake in the model which makes one of the relationships unimplementable without using concepts we have not yet covered in the class, i.e. *transactions.*

Please your SQL CREATE TABLE statements below.

SQL

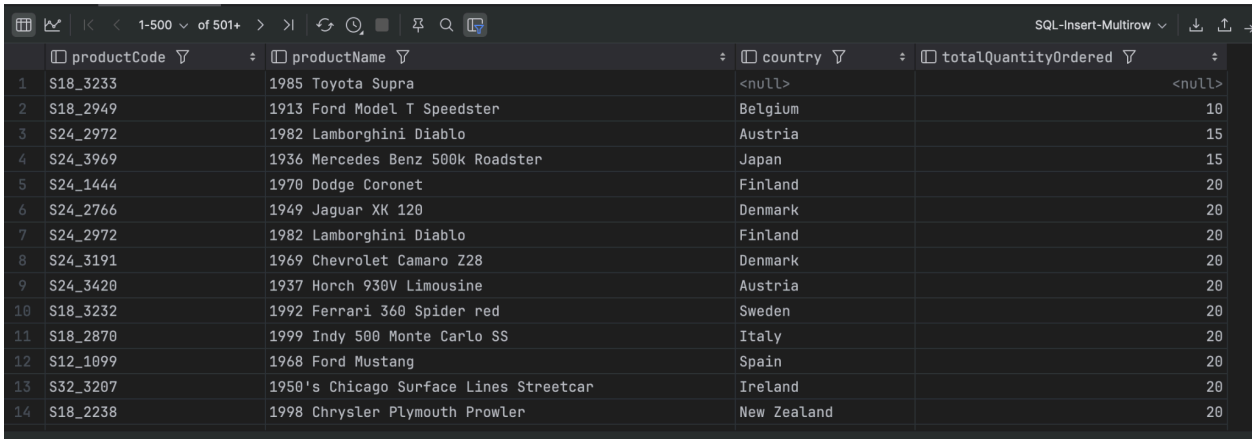
Consider the original Class Models database using the schema above.

SQL1 Produce a query result of the form:

(productCode, productName, country, totalQuantityOrdered)

totalQuantityOrdered is the sum of *quantityOrdered* over all *orderDetails* for the *productCode* in the *country* from the *customers* table. Order the result by *totalQuantityOrdered* ascending.

My answer looks like:



1-500 of 501+ SQL-Insert-Multirow

	productCode	productName	country	totalQuantityOrdered
1	S18_3233	1985 Toyota Supra	<null>	<null>
2	S18_2949	1913 Ford Model T Speedster	Belgium	10
3	S24_2972	1982 Lamborghini Diablo	Austria	15
4	S24_3969	1936 Mercedes Benz 500k Roadster	Japan	15
5	S24_1444	1970 Dodge Coronet	Finland	20
6	S24_2766	1949 Jaguar XK 120	Denmark	20
7	S24_2972	1982 Lamborghini Diablo	Finland	20
8	S24_3191	1969 Chevrolet Camaro Z28	Denmark	20
9	S24_3420	1937 Horch 930V Limousine	Austria	20
10	S18_3232	1992 Ferrari 360 Spider red	Sweden	20
11	S18_2870	1999 Indy 500 Monte Carlo SS	Italy	20
12	S12_1099	1968 Ford Mustang	Spain	20
13	S32_3207	1950's Chicago Surface Lines Streetcar	Ireland	20
14	S18_2238	1998 Chrysler Plymouth Prowler	New Zealand	20

For the remaining questions, use the schema for *department* from the sample database associated with the textbook is:

```
create table if not exists db_book.department
(
   dept_name varchar(20)    not null
       primary key,
   building  varchar(15)    null,
   budget    decimal(12, 2) null,
   check (`budget` > 0)
);
```

SQL2 Write a statement to add a row *('Chem. Eng.', 'Taylor', 150,000)* to the table.

SQL3 Write a statement that changes the building name for building in *Taylor* to *Northwest* except for 'Comp. Sci.'