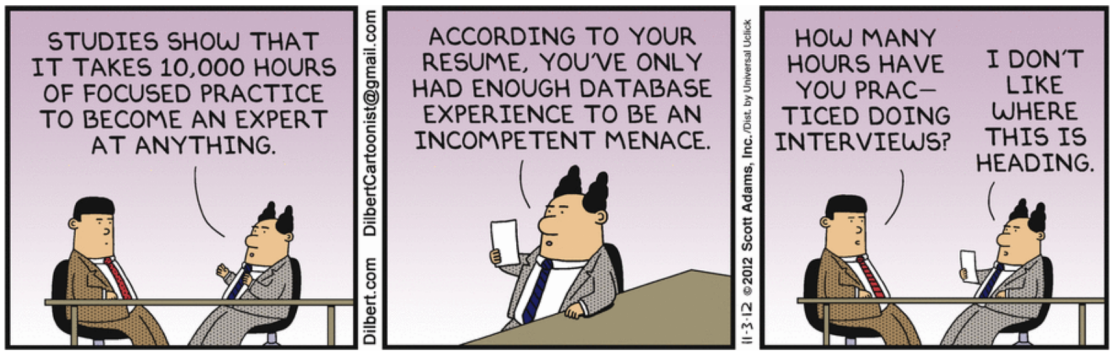
Q1 Preliminaries

1 Point



Instructions (1 point!)

The allowed time for the exam is 60 minutes (50 minutes plus a 10 minute technology buffer). Be sure to pay attention to time and budget your time accordingly!

The exam is open pre-prepared cheat sheet, open book, open notes, open web browser, and even open MySQL. You are just not allowed to communicate with or otherwise interact with other students (or friends) during the course of the exam, and this includes your HW brainstorming buddy. This exam is to be a solo effort!

Read each question carefully, in its entirety, and then answer each part of the question. If you don't understand something, please just make your best educated guess and proceed accordingly.

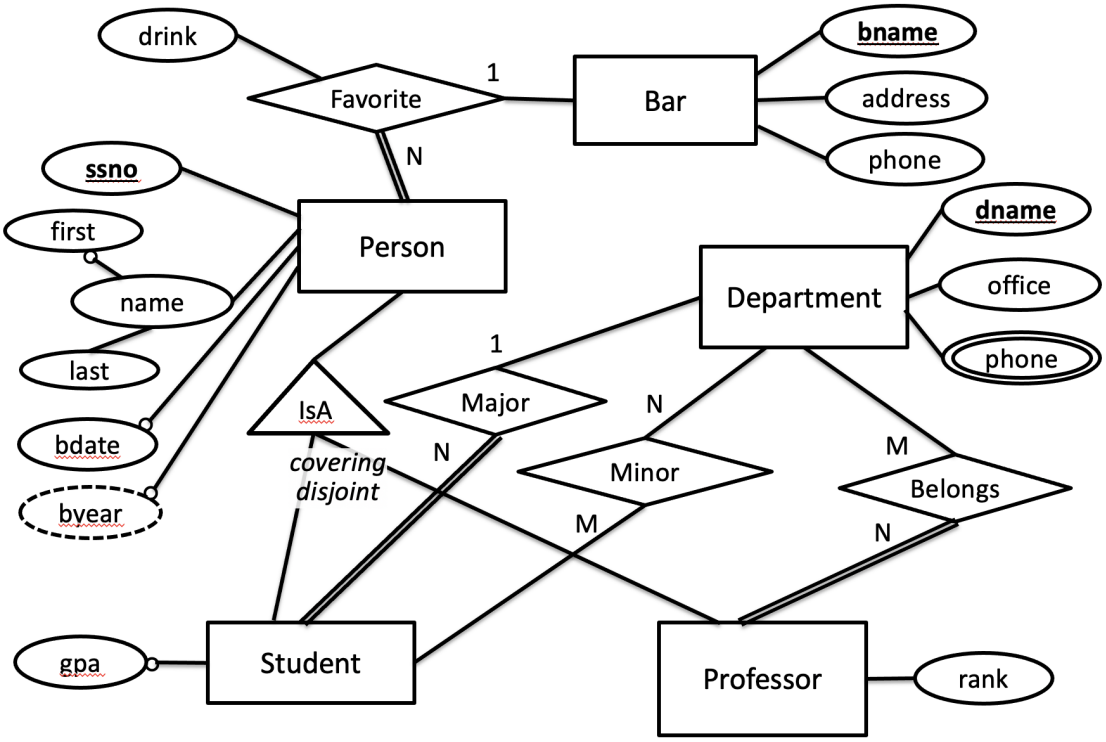
Acknowledgement: I certify that I am taking this exam myself, on my own, with honesty and integrity, without interaction with others during the exam, and without having obtained any information about the exam's content from others prior to taking it.

- (●) True
- ( ) False

Q2 To E-R is Human

33 Points

Based ***only*** on the E-R model pictured below, examine the model carefully and indicate whether each of the following statements are True or False. (Hint: You might want to screen-shot this picture and keep it open in a separate window for fast access without scrolling.)



Q2.1

2 Points

A department may not have two phone numbers.

- ○ True
- ◉ False

Q2.2

2 Points

A person may not have two social security numbers.

- [x] True
- [ ] False

Q2.3
2 Points

Two different persons may have the same social security number.

- [ ] True
- [x] False

Q2.4
2 Points

Birth year is a function of birth date.

- [ ] True
- [x] False

Q2.5
2 Points

Every professor has a favorite drink.

- [x] True
- [ ] False

Q2.6
2 Points

A student must have a major.

- [x] True
- [ ] False

Q2.7
2 Points

A student may have two minors.

- [x] True
- [ ] False

Q2.8
2 Points

A bar must be the favorite of at least one person.

- [ ] True
- [x] False

Q2.9
2 Points

A student can minor in their major department.

- [x] True
- [ ] False

Q2.10
2 Points

A student can minor twice in the same department.

○ True

◉ False

Q2.11
2 Points

A professor may never have a gpa.

◉ True

○ False

Q2.12
2 Points

A person may have a gpa.

◉ True

○ False

Q2.13
2 Points

A professor and a student may have the same social security number.

○ True

◉ False

Q2.14
2 Points

A professor and a student may have the same favorite drink.

- [x] True
- [ ] False

Q2.15
2 Points

For a given bar, everyone's favorite drink must be the same.

- [ ] True
- [x] False

The next few questions indicate an extension that we'd like to make to the given schema. For each one, identify which E-R modeling feature will **best** help to model the desired extension. **Note:** These extensions can add entities and/relationships but they should not involve changing those that are already in the diagram.

Q2.16
1 Point

To help departments keep track of student progress towards graduation, the university wants to assign a professor to monitor each student's major progress in a department. (Note: Different students in a given major may have different professors acting as their monitor, i.e., as their major advisor.)

- [ ] IsA
- [ ] weak entity
- [x] aggregation
- [ ] *n*-ary relationship
- [ ] not E-R-model-able

Q2.17
1 Point

To enable on-street dining in Covid times, each bar is adding set of *n* outdoor tables to have and use street-side during the pandemic. For a given bar, each table will have the following information: table number (in the range 1 .. *n*) and table size.

- ○ IsA
- ◉ weak entity
- ○ aggregation
- ○ *n*-ary relationship
- ○ not E-R-model-able

Q2.18
1 Point

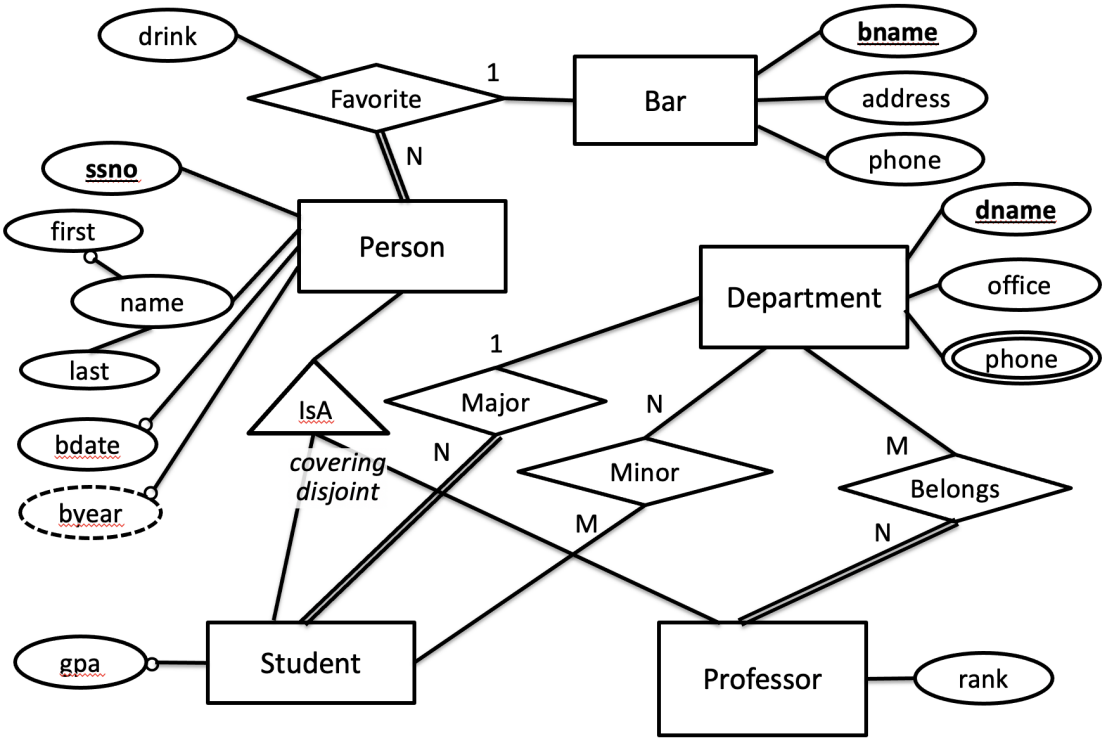
The university wants to make sure that no student is affiliated with more than 5 departments as a major and/or minor.

- ○ IsA
- ○ weak entity
- ○ aggregation
- ○ *n*-ary relationship
- ◉ not E-R-model-able

Q3 To E-R --> R is Divine
33 Points

Consider again the earlier E-R model (repeated below for ease of reference). For this question, your job is to translate this E-R model into an appropriate relational schema that will capture as many of the E-R model's features and constraints as possible. Use the delta-table approach for the Person/Student/Professor aspect of the model. Be sure to include ON DELETE clauses for all of your FOREIGN KEYs. Use table and column names that

correspond to the E-R diagram's artifact names wherever possible, and use good naming conventions otherwise. You may introduce additional tables where needed to fully capture the model. Answer each of the questions that follow about the resulting relational mapping.



Q3.1

17 Points

Write a complete SQL CREATE TABLE DDL statement to model only the Person entity. Use your best judgement when choosing the data type for each column, and treat birth year simply as stored data here. Your answer *must* include any relationship merging needed to avoid having more tables than what's really necessary for this schema overall.

```
CREATE TABLE Person (
 -- Entity information
   ssno VARCHAR(10),
   name_first VARCHAR(50)
   name_last VARCHAR(50) NOT NULL,
   bdate DATE,
   byear INTEGER,
 -- Relationship information
   fav_barname VARCHAR(50) NOT NULL,
```

```
  fav_drink VARCHAR(50) NOT NULL,
 -- Integrity constraints
  PRIMARY KEY(ssno),
  FOREIGN KEY (fav_bname)
     REFERENCES Bar(bname)
     ON DELETE NO ACTION
)
```

Q3.2

9 Points

Now write the complete SQL CREATE TABLE DDL statement to model the Professor entity.

```
CREATE TABLE Professor (
  ssno VARCHAR(10),
 -- Note: No inherited attributes!
  rank VARCHAR(25) NOT NULL,
  PRIMARY KEY(ssno),
  FOREIGN KEY (ssno)
    REFERENCES Person (ssno)
    ON DELETE CASCADE
)
```

Q3.3

5 Points

And now write the complete SQL CREATE TABLE DDL statement(s) to model the Department entity. In addition to what the given schema says, you have just been informed that no two departments can share an office. Your table design should also capture this new constraint.

```
CREATE TABLE Department (
  dname VARCHAR(25),
  office VARCHAR(100) NOT NULL
  PRIMARY KEY (dname),
  UNIQUE (office)
```

```
)

CREATE TABLE Department_phone (
  dname VARCHAR(25),
  phone VARCHAR(25),
  PRIMARY KEY (dname, phone),
  FOREIGN KEY (dname)
    REFERENCES Department (dname)
    ON DELETE CASCADE
)
```

Q3.4
2 Points

How many tables will you need in total for a relationship-optimized, delta-table based relational schema that captures the given E-R model?

- ○ 5
- ○ 6
- ○ 7
- ◉ 8
- ○ 9

Q4 Relational DB Design Theory
33 Points

Suppose that you walk into a haunted house and find the following dataset in the basement:

kind	pic	food	type	home	address
ghost		none	n/a		Spook Town
vampire		blood	liquid		Transylvania
ghost		none	n/a		Transylvania
zombie		brain	solid		Scare City
alien		blood	liquid		Saturn
vampire		blood	liquid		Romania

Q4.1

5 Points

Which of the following are possible FDs, based on what you can tell from the dataset's current contents?

- [ ] home -> pic
- [x] kind -> pic
- [x] type -> food
- [ ] kind -> address
- [x] address -> home

Q4.2

6 Points

Even though it's almost Halloween, let's try to act "normal"! Suppose that on the first floor of the haunted house you find a relation with schema **M (a, h, k, p, f, t)** with the following FDs as its set (**F**) of initially given dependencies:

F: a -> h,a
p -> k
p,k -> f
k -> p
f -> t

What attributes are in the attribute closure of the attribute set {p, k}?

- [x] k
- [x] p
- [x] f
- [ ] h
- [x] t
- [ ] a

Q4.3

8 Points

Which of the following FDs, taken together, form a minimal cover (**F-**) for M?

- [x] a -> h
- [x] p -> k
- [x] k -> p
- [ ] a -> h,a
- [x] p -> f
- [x] f -> t
- [ ] p,k -> f
- [ ] p -> t

Q4.4

6 Points

Which of the following are prime attributes of M?

- [x] k
- [x] p
- [ ] f
- [ ] h
- [ ] t
- [x] a

Q4.5

4 Points

What is the highest normal form that the initial relation M satisfies?

- (•) 1NF
- ( ) 2NF
- ( ) 3NF
- ( ) BCNF

Why?

- ( ) It has trivial dependencies
- (•) It has partial dependencies
- ( ) It has transitive dependencies
- ( ) It has overlapping candidate keys

Q4.6

4 Points

On the bed in the master bedroom, on the second floor, you find (gasp!!!) a decomposing relation **D (p, k, a)**, apparently broken off from M, with the same FDs as M. What is the highest normal form that D satisfies?

- ○ 1NF
- ○ 2NF
- ◉ 3NF
- ○ BCNF

Why?

- ○ It has trivial dependencies
- ○ It has partial dependencies
- ○ It has transitive dependencies
- ◉ It has overlapping candidate keys

Midterm 1

● UNGRADED

7 DAYS, 22 HOURS LATE

STUDENT

Unknown Student (removed from roster?)

TOTAL POINTS

- / 100 pts

QUESTION 1

Preliminaries 1 pt

QUESTION 2

To E-R is Human 33 pts

2.1	(no title)	2 pts
2.2	(no title)	2 pts
2.3	(no title)	2 pts
2.4	(no title)	2 pts
2.5	(no title)	2 pts
2.6	(no title)	2 pts
2.7	(no title)	2 pts
2.8	(no title)	2 pts
2.9	(no title)	2 pts
2.10	(no title)	2 pts
2.11	(no title)	2 pts
2.12	(no title)	2 pts
2.13	(no title)	2 pts
2.14	(no title)	2 pts
2.15	(no title)	2 pts
2.16	(no title)	1 pt
2.17	(no title)	1 pt
2.18	(no title)	1 pt

QUESTION 3

To E-R --> R is Divine 33 pts

3.1	(no title)	17 pts
3.2	(no title)	9 pts
3.3	(no title)	5 pts
3.4	(no title)	2 pts

QUESTION 4

Relational DB Design Theory 33 pts

4.1	(no title)	5 pts
4.2	(no title)	6 pts
4.3	(no title)	8 pts
4.4	(no title)	6 pts

4.5	(no title)	4 pts
4.6	(no title)	4 pts