

Fall 2005: Mid-Term Exam

IEOR 115: Industrial and Commercial Data Systems

Prof. Ken Goldberg, UC Berkeley

Please put your full name and Student ID number on this page. Don't open the exam until instructed to do so.

You have 50 minutes to work. First check that your copy includes all pages. Please read all questions first and budget your time accordingly (credit for each part is shown in parentheses). If you need to write on the back of a page, indicate the continuation with an arrow from the front of another page.

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Points: (Please do not write below this line)

Part 1 (10):

Part 2 (40):

Part 3 (40):

Part 4 (10):

1. (10) Logic

(a) Does $\{r \vee \neg a, s\} \models r$? Prove or Disprove.

[Faint handwritten notes and a partially visible truth table for part (a)]

(b) Does $\{r \rightarrow \neg a\} \models \neg r \vee \neg a$? Prove or Disprove.

[Faint handwritten notes and a partially visible truth table for part (b)]

r	s	$\neg s$	$r \vee \neg s$	$r \wedge s$	$\beta \rightarrow r$
1	1	0	1	1	1
1	0	1	1	0	1
0	1	0	1	0	1
0	0	1	1	0	1

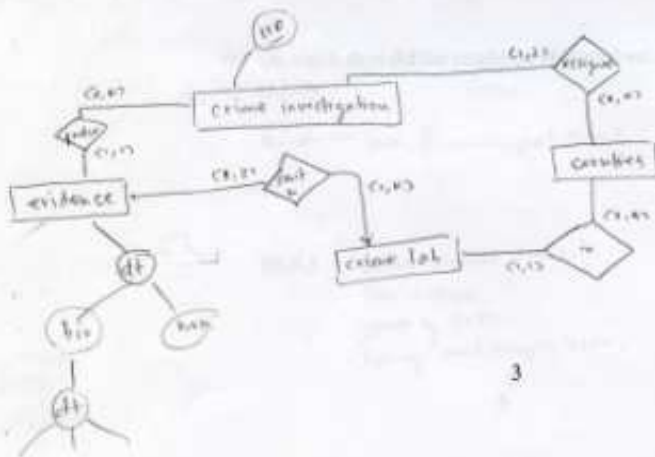
r	s	$\neg s$	$\neg r$	$\neg r \vee \neg s$	$r \rightarrow \neg a$
1	1	0	0	0	1
1	0	1	0	1	1
0	1	0	1	1	1
0	0	1	1	1	1

2. (40) EER Diagrams

Crime Lab Database. You are asked to design a database to track the following data.

- each crime investigation has a unique IID and is assigned to at most two counties. Each investigation can produce many pieces of evidence, each is classified as either biological or non-biological.
- biological evidence can be blood, hair, or other. If blood, we need to store the blood type, if hair, we record one or more hair colors.
- Each crime lab is located in one county, and each county maintains two or more crime labs.
- Each piece of evidence is sent for processing to no more than 3 crime labs.

Design an EER Diagram with exactly 7 Regular Entity Types (these may include subclasses and superclasses), 2 Weak Entity Types, and 4 Relationship Types. Clearly label primary and partial keys, (max,min) constraints, and subclass constraints. List any additional assumptions you need. Please use the following page...



3. (40) Queries in Relational Algebra and SQL.

Consider the following database schema:

- (a) CUSTOMER (CID, cname, city, discount)
- (b) AGENT (AID, aname, city, commission)
- (c) PRODUCT (PID, pname, city)
- (d) ORDER (OID, date, CID¹, AID², PID³, quantity, charge)

For each query below, write a query in relational algebra. If it is impossible to formulate a query in relational algebra explain why. Clearly list all assumptions you make.

- (a) On which dates did we get a single order with charge over 1000?

(ALG)

$$R \leftarrow \pi_{date} \left[\sigma_{charge > 1000} (order) \right]$$

(SQL)

```
select date
from order
where charge > 1000;
```

- (b) On which days did the combined charges from all orders exceed 1000?

(ALG)

$$R \leftarrow \pi_{date} \left[\sigma_{sum(charge) > 1000} (order) \right]$$

(SQL)

```
select distinct date
from orders
group by date
having sum(charge) > 1000;
```

- i. CUSTOMER (CID, cname, city, discount)
- ii. AGENT (AID, aname, city, commission)
- iii. PRODUCT (PID, pname, city)
- iv. ORDER (OID, date, CID¹, AID², PID³, quantity, charge)

(c) Which products (by name) have been ordered by Cleveland customers?

(ALG)

A ← $\pi_{CID}(\sigma_{city=Cleveland}(customer))$
 B ← $\pi_{PID}(order \bowtie A)$
 C ← $\pi_{pname}(R \bowtie B)$

(SQL)

```
select pname
from product p, order o, customer c
where customer c.city = 'Cleveland'
      o.cid = c.cid
      p.pid = o.pid
```

(d) Which customers have ordered all products?

(ALG)

A ← $\pi_{CID}(product)$
 B ← $\pi_{CID, PID}(order)$
 R ← $B - A$

(SQL)

```
select distinct cid
from customer c
where not exist (select *
                from product p
                where not exist (select *
                                from order
                                where o.cid = c.cid and
                                       o.pid = p.pid
```

customers where there not exist
a product that was not ordered

4. (10) MS ACCESS.

(a) Which MS Access form creates an interface that allows users to navigate through the important tables/queries/reports/forms of a database?

(b) If you want to automate the task of printing a report by clicking a command button, which one out of the seven database objects can help you finish this task? Just list its name.