UNIVERSITY OF TORONTO

FACULTY OF APPLIED SCIENCE AND ENGINEERING

FINAL EXAMINATION, APRIL 2001

Third Year Program 4

MIE353S DATA MODELING

Exam Type: A

Examiners: Prof. I.B. Türkşen

1) There are five questions. You are to answer all five.

2) The relative value of each question is 20 pts, but pay attention to their sub parts.

3) Be explicit and provide all necessary explanations

4) If necessary, draw all diagrams clearly

1) **a. (6 marks)**Can you deduce "D" from the premises given below? Use resolution and contradiction principles. Show your work step by step.

Premises:

$A \Rightarrow B,\ C \Rightarrow B,\ D \Rightarrow (A \vee C),\ D$

b. (7 marks) Can you deduce "$\neg A$" from the premises given below? Use resolution and contradiction principles. Show your work step by step.

Premises:

$((A \Rightarrow B) \wedge (C \Rightarrow D)),\ ((B \Rightarrow E) \wedge (D \Rightarrow F)),\ \neg (E \wedge F)$

b. (7 marks) Can you deduce "$((D \vee \neg C) \vee B) \wedge A$" from the premises given below? Show your work step by step.

Premises:

$(A \Rightarrow (D \vee \neg C)),\ ((A \Rightarrow B) \vee (B \Rightarrow D)),\ A,\ \neg(\neg(\neg B \Rightarrow C) \wedge (\neg D \wedge \neg A))$

2) **a. (10 marks)** The rulebase and facts are given as:

Ozge owns a dog. Every dog owner is an animal lover. No animal lover kills an animal. Either Ozge or curiosity killed the cat who is named Minnok.

A set of well-formed formulas (wff) in predicate logic are given below

1) $\exists X(Dog(X)\ AND\ Owns(ozge,X))$
2) $\forall X\ \exists Y\ ((Dog(Y)\ AND\ Owns(X,Y)) \Rightarrow AnimalLover(X))$
3) $\forall X\ (AnimalLover(X) \Rightarrow \forall Y(Animal(Y) \Rightarrow NOT\ Kills(X,Y)))$
4) Kills (ozge, minnok) OR Kills(curiousity,minnok)
5) Cat(minnok)
6) $\forall X\ (Cat(X) \Rightarrow Animal(X))$

a.1) (Convert the wff's in predicate logic into their clausal forms. Show your work step by step.

a.2) In your own words, explain whether you can deduce the statement "curiosity kills the Minnok" or not, i.e., you don't have to use resolution&contradiction principle.

a.3) In your own words, explain whether you can deduce the statement "Ozge kills the cat" or not, i.e., you don't have to use resolution&contradiction principle.

a.4) What can you say about the integrity of rulebase and the facts if the fourth wff is given as "Kills(ozge, minnok)"?

b. (10 marks) The rulebase and facts are given as:

- *If a patient has a very high fever, the patient has a high fever.*
- *If a patient has whooping cough, the patient has a cough.*
- *If a patient has poison ivy, the patient has a rash.*
- *If a patient has a high fever and congestion, the patient has the flu.*
- *If a patient has a rash and no high fever, the patient has poison ivy.*
- *If a patient has a cough and a very high fever, the patient has whooping cough.*
- *If a patient has no fever, no cough, and no rash, the patient is healthy.*
- *If one patient has a particular disease which is contagious and that patient contacts another patient, then the other patient has the disease.*
- *Ed has a very high fever.*
- *Ed has a cough.*
- *Ed contacts Alice*
- *Whooping cough is contagious*

Well-formed formulas in clausal form are given as:

NOT has(X,veryHighFever) OR has (X, fever)

NOT has (X, whoopingCough) OR has (X, cough)

NOT has (X, posionivy) OR has (X, rash)

NOT has (X, fever) OR NOT has (X, congestion) OR has(X,flu)

NOT has (X, rash) OR has (X, fever) OR has (X, poisonivy)

NOT has (X, cough) OR NOT has (X, veryHighFever) OR has (X, whoopingCough)

has(X, fever) OR has (X, cough) OR has (X, rash) OR healthy(X)

NOT has(X,Y) OR NOT contagious(Y) OR NOT contact(X,Z) OR has(Z,Y)

Can you deduce "Alice has whooping cough" by using resolution and contradiction principle. Show your work step by step. This goal can be represented as has(alice, whoopingCough)

3) (20 marks) Given the following relational schema:

EMP(SIN, EName, Title)

PROJECT(PNO, Pname, Budget)

ASSIGNMENT(SIN, PNO, Responsibility, Duration)

FK SIN ref to SIN EMP

FK PNO ref to PNO PROJECT

a) (10 marks) Give the query graph of the following query, expressed in SQL and state whether this SQL statement is semantically correct or not. Explain your answer using query graph.

```
SELECT ENAME,PNAME
FROM EMP, ASSIGNMENT, PROJECT
WHERE Duration>12
AND EMP.SIN=ASG.SIN
```

b) (10 marks) Simplify the following query:

```
SELECT SIN
FROM ASSIGMENT
WHERE Responsibility = "Analyst"
AND NOT(PNO = "P2" OR Duration=12)
AND NOT (PNO= "P2")
AND Duration=12
```

For questions 4 and 5, use the following relational schema.

MOVIES(Title, Year, Director,Country, Rating, Genre, Gross Revenue, Producer)
ACTORS(Title, Year, Character_name, Actor)
FK Title ref to Title Movies
FK Year ref to Year Movies
AWARDS(Title, Year, Award. Result)
FK Title ref to Title Movies

FK Year ref to Year Movies

4) (20 marks) Write the SQL statement for the following questions :

a. (5 marks) List actors who played more than one character in the same movie

b. (5 marks) Find the average gross for movies directed by a director who won an Oscar

c. (5 marks) Find movies made in 90s that won every award they were nominated for.

d. (5 marks) For each award category, find average rating of movies that won that award

5) (20 marks) a) Formulate QBE solutions to the following questions

i. (5 marks) For each award count the number of movies that have gross revenue more than $500M

ii. (5 marks) For each director, select his/her movies rated higher than 8, ordered by their gross.

iii. (5 marks) List producers and the total amount of money their movies made.

b. (5 marks) Discuss the strengths and weaknesses of QBE as a relational language.

Properties of Crisp Set Operations

Involution	$\neg(\neg A)=A$
Commutativity	$A\cup B=B\cup A$ $A\cap B=B\cap A$
Associativity	$(A\cup B)\cup C=A\cup(B\cup C)$ $(A\cap B)\cap C=A\cap(B\cap C)$
Distributivity	$A\cap(B\cup C)=(A\cap B)\cup(A\cap C)$ $A\cup(B\cap C)=(A\cup B)\cap(A\cup C)$
Absorption	$A\cup(A\cap B)=A$ $A\cap(A\cup B)=A$
Absorption of complement	$A\cup(\neg A\cap B)=A\cup B$ $A\cap(\neg A\cup B)=A\cap B$
Absorption by X and $\varnothing$	$A\cup X=X$ $A\cap\varnothing=\varnothing$
Identity	$A\cap X=A$ $A\cup\varnothing=A$
Law of contradiction	$A\cap\neg A=\varnothing$
Law of excluded middle	$A\cup\neg A=X$
DeMorgan's Law	$\neg(A\cap B)=\neg A\cup\neg B$ $\neg(A\cup B)=\neg A\cap\neg B$

Resolution principle

((f OR g) AND (NOT g OR h)) $\Rightarrow$ (f OR h)