January 1999 SEM222

Introduction to Databases

2 Hours

Answer ALL questions

1.

(a). Does relational theory allow relations with no attributes? If it does, explain why such relations are compatible with the relational theory definitions and describe the result that joining such relations with other relations would have. If it does not, explain how the relational theory definitions forbids such relations. [5%]

(b). Find a counterexample that demonstrates that the following functional dependency implication is NOT true

$$X \rightarrow Z, Y \subseteq X \Rightarrow Y \rightarrow Z$$ [10%]

(c). Answer **EITHER** (i) or (ii) below [10%]

(i) State the first 3 Armstrong Inference Rules (Subsetting, Augmentation and Transitivity) and, indicating at each step which rule you are using, use these three rules to prove that

$$V \rightarrow W, WX \rightarrow YZ \Rightarrow VX \rightarrow Z$$

(ii) Using the formal definitions of relational select and project, prove that

$$\sigma_{A=a}(\pi_{A,B}(r)) = \pi_{A,B}(\sigma_{A=a}(r))$$

where A and B are attribute names in the schema of r and a is a value in the domain of A.

2. The following (pseudo-)relational schema represents information about a company which provides maintainence support for computer networks to their customers. The particular information involved here is to record information about visits by engineers to the customers. When an engineer visits a client, he/she uses a car from the car pool for the day and may visit several clients, each only once, on that day. For each cisit comments about the state of the client's network at that time is recorded.

Normalise the schema to BCNF, explaining briefly each step as you do so, choosing appropriate primary keys as necessary. Curly braces denote repeating groups. You may use the (bracketed) short names instead of the full attribute names in your answer. [25%]

```
VISIT   (
            CLIENT#,                        (C#)
            ADDRESS,                        (AD)
            {   DATE,                       (DA)
                TIME,                       (TI)
                COMMENTS,                   (CO)
                ENGINEER#,                  (E#)
                ENGINEER_NAME,              (EN)
                CAR_REG                 (CR)
            }
        )
```

where

C#, DATE	→	TIME, COMMENTS, ENGINEER#, ENGINEER_NAME, CAR_REG
CLIENT#	→	ADDRESS
ENGINEER#	→	ENGINEER_NAME
ENGINEER#, DATE	→	CAR_REGISTRATION
ENGINEER#, DATE, TIME	→	CLIENT#, ADDRESS, COMMENTS

3. Develop an Entity Relationship Attribute diagram for the following application:
An estate agent requires a database to manage the properties that it lets on behalf of owner clients. For each property that the agent lets, the address must be kept as well as the owners name and address. An owner may have more than one property which the estate agent manages. A full history of the renting of each property is required to include the name and bank account number of each rentee that each property has had, the rent charge, start date and period of the rent contract (which can change at the owners request between different lettings of the property) and the date at which the contract was actually terminated (if it is not still ongoing). For each change in the amount of rent charged, a new contract is required. Also each property is subject to regular inspections. The results of each inspection, to include the date and a comment, should be kept so that a summary report can be printed which collects together inspection information for each rentee across all contracts that that rentee has had.

[25%]

4. Consider the following relations:

EMPLOYEE	ENO	ENAME	MGR	STATUS	DEPT	SALARY
	2351	J. NORDBY	2452	SINGLE	LANGUAGES	39000
	2452	S.JONES	4016	MARRIED	LANGUAGES	49000
	5004	S.AGARWAL	2011	SINGLE	DBSYSTEMS	35000
	3040	G.CANDOR	2011	SINGLE	DBSYSTEMS	40000
	2011	D.SCHRADER	4016	MARRIED	STORAGESYS	65000
	4016	K.SMITH	4016	MARRIED	DBSYSTEMS	75000
	2210	J.JOHNSON	4016	SINGLE	STORAGESYS	55000

DEPT	DEPT	FLOOR
	LANGUAGES	1
	DBSYSTEMS	2
	STORAGESYS	2

SUPPLIER	SNO	SNAME
	S1	ADAMS
	S2	CLARKE
	S3	SCHWARTZ

ITEM	ITEM	TYPE	COLOUR
	PEN	A	BLACK
	MARKER	B	BEIGE
	PAD	A	RED
	CABINET	C	YELLOW
	STAPLER	A	RED

SUPPLY	SUPPLIER	DEPT	ITEM	VOL
	S1	DBSYSTEMS	PEN	100
	S2	STORAGESYS	MARKER	2
	S2	STORAGESYS	CABINET	3
	S3	DBSYSTEMS	STAPLER	19
	S1	LANGUAGES	PAD	8

(a) Evaluate the following relational algebraic expression and explain in English what the query means:

$$Q = \pi_{\text{ENAME,SALARY}}(\text{EMPLOYEE} \bowtie \rho_{MGR \leftarrow ENO}(\pi_{\text{MGR}}(\sigma_{\text{FLOOR}=1}(\text{EMPLOYEE} \bowtie \text{DEPT}))))$$

[7%]

(b) Write out the relational algebraic expressions that would derive the following result:

Which red items are supplied to a department which has items supplied by ADAMS (result should contain the name of the department and the name of the item only)? [8%]

(c) Using the above tables, write out the result that the following SQL statement would produce, explaining how you obtained your answer. [10%]

```
SELECT      SNAME, SUM(VOL)
FROM        SUPPLY, ITEM, SUPPLIER
WHERE       ITEM.ITEM = SUPPLY.ITEM AND SUPPLIER.SNO = SUPPLY.SUPPLIER
            AND COLOUR <> 'YELLOW'
GROUP BY    SNAME
HAVING      COUNT(SNAME) > 1 ;
```