M358
Assignment Booklet II

TMA 02 Cut-off date : 23 March 2004

Please send all your answers to each tutor-marked assignment (TMA), together with an appropriately completed assignment form (TMA form), to reach your tutor on or before the appropriate cut-off date shown above.

If you wish your tutor to acknowledge receipt of your TMA, complete an assignment acknowledgement card, affix the appropriate postage and send it to your tutor together with your TMA.

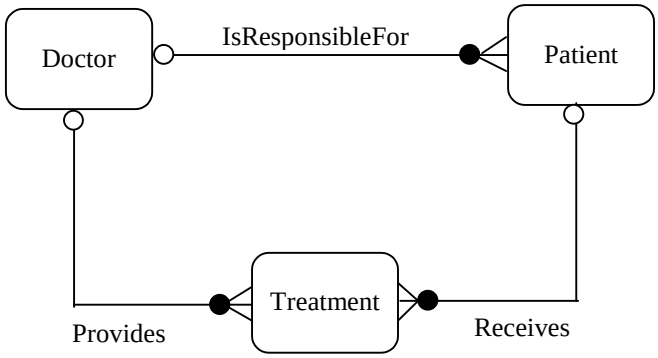
You will find instructions on how to fill in the TMA form in the current Student Handbook. Remember to fill in the correct Assignment Number as listed above and allow sufficient time in the post for each assignment to reach its destination on or before the cut-off date.

The marks allocated to each part of each question are indicated in the margin.

Please also note it is to your benefit to monitor the acknowledgement from your tutor on the receipt of your TMA within two weeks after submission; otherwise any claim for TMA Lost in Postage ***will not be accepted.***

Question 1-2

Figure 1 gives a fragment of the E-R model for the Hospital example, which records details of doctors and patients, the treatment of patients by doctors, and that each consultant may be responsible for a number of patients.



Entity types

Doctor (StaffNo, DoctorName, Position, Specialism)

Patient (PatientId, PatientName)

Treatment (StaffNo, PatientId, StartDate, Reason)

Constraints

A doctor has the position of consultant, registrar or house officer.

Only a consultant has a medical specialism.

The doctor who is responsible for a patient is always a consultant.

Assumptions

Only the current situation is modelled.

Figure 1 *Hospital example E-R model*

Figure 2 gives the corresponding relational representation for the model given in Figure 1.

```
domains
     IdentifiersOfPatients = p01..p99
     PersonNames = string
     StaffNumbers = 100..999
     PositionsOfDoctors = (Consultant, Registrar, House Officer)
     SpecialismsOfConsultants = string
     Dates = calendardates
     Reasons = string

relation Doctor
     StaffNo: StaffNumbers
```

```
        DoctorName: PersonNames
        Position: PositionsOfDoctors
        Specialism: SpecialismsOfConsultants
        primary key StaffNo
        constraint ((Position = 'Consultant' and Specialism is not
        null) or (Position <> 'Consultant' and Specialism is null))

    relation Patient
        PatientId: IdnetifiersOfPatients
        PatientName: PersonNames
        ConsultantNo: StaffNumbers
        primary key PatientId
        foreign key ConsultantNo references Doctor not allowed
        null
        constraint (join (select Doctor where Position <>
        'Consultant')
          and Patient where StaffNo = ConsultantNo) is empty

    relation Treatment
        StaffNo: StaffNumbers
        PatientId: IdnetifiersOfPatients
        StartDate: Dates
        Reason: Reasons
        primary key (StaffNo, PatientId)
        foreign key StaffNo references Doctor
        foreign key PatientId references Patient
```

Figure 2 *Hospital example relational model*

Figures 3, 4 and 5 give some representative tuples of the Doctor, Patient *and* Treatment *relations respectively which are to be used with this question but which are different from those provided with the RAS software.*

Doctor

StaffNo	DoctorName	Position	Specialism
112	*Buckley*	*Consultant*	*Orthopaedic*
113	*Chen*	*Registrar*	*null*
114	*Gersting*	*Consultant*	*Paediatric*
115	*Molluzo*	*Consultant*	*Obstetrics*
116	*Potter*	*House Officer*	*null*
117	*Fleming*	*Consultant*	*Obstetrics*

Figure 3 *Representative tuples of the* Doctor *relation depicted as a table*

Patient

PatientId	PatientName	ConsultantNo
p41	*Collins*	*112*
p42	*Monod*	*112*
p43	*Ravetz*	*112*
p45	*Shriver*	*114*
p56	*Weber*	*115*
p57	*Wegner*	*115*

Figure 4 *Representative tuples of the* Patient *relation depicted as a table*

Treatment

StaffNo	PatientId	StartDate	Reason
112	*p41*	*2001-01-05*	*Tendonitis*
112	*p42*	*2001-01-08*	*Fracture*
113	*p43*	*2001-01-09*	*Tendonitis*
114	*p45*	*2001-01-11*	*Bunion*
115	*p56*	*2001-01-03*	*High blood pressure*
116	*p56*	*2001-01-13*	*Anaemia*
116	*p57*	*2001-01-11*	*Chest infection*

Figure 5 *Representative tuples of the* Treatment *relation depicted as a table*

Question 1

For each of the following relational algebra expressions give both *a sentence expressing the request that the query answers* and *the relation that results from its execution using the relations given in Figure 3, 4 and 5.*

(i) `project Doctor over Specialism`

(ii)
```
project (join (join (select Doctor where DoctorName =
'Buckley')
and Treatment where StaffNo = StaffNo) and Patient where
PatientId = PatientId) over PatientName
```

(iii) `(project Patient over ConsultantNo) difference (project Treatment over StaffNo)`

(iv)
```
project ((project Patient over ConsultantNo, PatientId)
difference (project Treatment over StaffNo, PatientId))
over ConsultantNo
```

(v)
```
a alias Treatment
b alias Treatment
project (select (join a and b where PatientId = PatientId)
where StaffNo <> StaffNo) over PatientId
```

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Question 2

A relational assignment may fail to update a relation because a particular kind of relational constraint would be violated (See Block 2). For example, consider the following assignment:

```
Doctor:= Doctor union <117, Warnock, Consultant, Obstetrics>
```

This assignment would fail to update the Doctor *relation because the kind of relational constraint that would be violated is the primary key constraint since there already exists a tuple in the* Doctor *relation whose* StaffNo *value is '117' (see Block 2, Section 5, page 83). In the E-R model (Figure 1), this constraint is represented by making StaffNo the identifier of the Doctor entity type. In the corresponding relational model (Figure 2), this constraint is represented by the following primary key declaration in the* Doctor *relation.*

```
primary key StaffNo
```

For the following relational assignments applied to the relations given in Figures 3, 4 and 5, each one would fail to update the referenced relation because a relational constraint would be violated. For each assignment, you should identify, as in the above example:

1 the kind of relational constraint that would be violated;

2 how the constraint is represented in the E-R model (Figure 1); and

3 how the constraint is represented in the corresponding relational model (Figure 2).

(i) `Doctor:= Doctor union <null, Fleming, Consultant, Paediatric>`

(ii) `Treatment:= Treatment union <112, p58, 2001-01-13, Fracture>`

(iii) `Patient:= Patient union <p59, Connor, null>`

(iv) `Doctor:= Doctor union <118, Copleston, Registrar, Paediatric>`

(v) `Doctor:= Doctor union <119, Sesonske, Pathologist, null>`

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Question 3

The proprietor of a shop that rents videos of films requires a database system to facilitate the day-to-day running of her business. The proprietor needs to maintain data about films that are available on video when they are released and about copies of those films when they arrive in the shop. The cost of renting a video depends on the price band assigned to the film. For some films, the musical sound track may be available on compact disk (CD) for purchase. The proprietor needs to distinguish between two separate classes of registered customer who rent videos: individual customers and group customers (residential homes and hotels, for example). In each case she wishes to record the customer number, name and address. In addition, individual customers should have their date of birth and telephone number recorded, and group customers should have a discount level. Only individual customers are allowed to make reservations for a film.

Figure 6 shows the E-R diagram, entity types and assumptions of an E-R data model representing the data requirements of a video rental shop.

(a) The E-R data model given as Figure 6 does not represent all the data requirements of the video rental system; if more than one individual customer reserves the same film then, when a copy of that film becomes available, the individual who reserved it first will be offered it for rent. Give the changes to the E-R data model needed to accommodate this requirement. You may assume that the reservation date is enough to determine this ordering.

[10]

(b) Provide a list of relation headings that represent the entity types of the complete E-R data model, as revised by the change you gave in part (a). Make sure that each relationship described by the E-R diagram can be represented by your relations.

[10]

(c) Write down, in a style similar to that used in *Block 2 of the Relational Database Systems*, the relational model that represents the E-R data model as revised by the change you gave in part (a) for relations: Rental Class, Film, CD and Copy.

You must provide all appropriate domain definitions. You may assume that the attribute *PriceBand* takes the values *a*, *b* or *c*, that the attribute *Certificate* takes the values *U*, *PG*, *12*, *15*

or *18*, that the attribute *DiscountLevel* takes the values *low* or *high*, and that the attributes *CDNumber*, *CustomerNumber* and *VideoNumber* all take the values in the range *000000* to *999999*. The attributes *Address*, *FilmTitle*, *Name* and *PhoneNumber* all take string values, the attributes *Price* and *QuantityInStock* all take numeric values, and the attributes *DateAcquired*, *DateOfBirth*, and *ReleaseDate* all take values that are calendar dates.

Make sure that Rents, Includes, Mayhave and Hasmany relationships, including their participation conditions described by the E-R diagram, are declared in your relational model.

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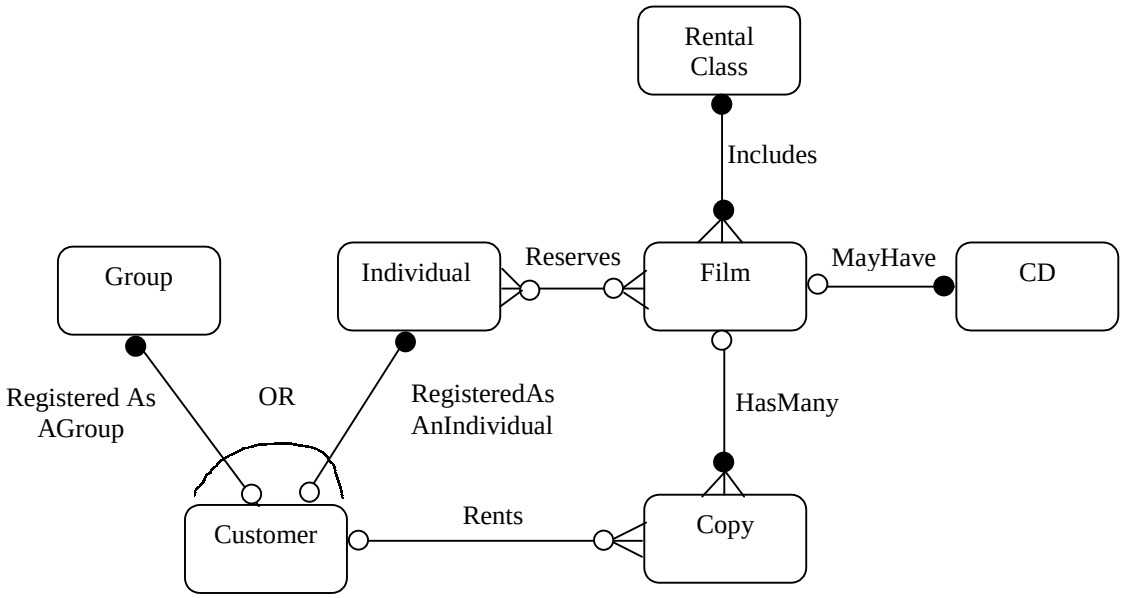

Entity types

RentalClass (PriceBand, Price)

Film (FilmTitle, Certificate, ReleaseDate)

Copy (VideoNumber, DateAcquired)

CD (CDNumber, Price, QuantityInStock)

Customer (CustomerNumber, Name, Address)

Group (CustomerNumber, DiscountLevel)

Individual (CustomerNumber, DateOfBirth, PhoneNumber)

Assumptions

Details of films are recorded as soon as the release date is announced.

Details of copies of films are recorded only when they arrive in the shop.

A video number identifies a video cassette and is not dependent on the film which the video cassette contains.

Only current rentals are recorded.

Figure 6 An E-R data model for the video rental system

End