

CS343 H1 Y Section 5201 Midterm Exam Summer 2003

June 26th 2003

This exam is closed course's book and course's notes. Only one letter page double side is allowed. You have 60 minutes to complete it.

Print your First name: _____

Print your Last name: _____

Print your student number: _____

I acknowledge that this booklet is complete (9 pages, 5 Problems):

Problem	Points	Maximum points
1		20
2		30
3		30
4		60
5		10
Total		150

Problem

The goal of this midterm is to design a database allowing to a shipowner to manage the spatial ship belonging to him. He wants to be able to administrate space ships (s_name, speed, ...) , astroports (a_name, ...) and planets (p_name, solar system, affiliation, ...).

Entity/Relationship Model [20 pts]

Give and justify the entity relationship model of this shipowner. To simplify this model, we assume:

- A starship can stop to several astroports. In each astroport it unloads some freights (quantity, price and date).
- An astroport can receive several starships.
- A planet can manage several astroports.
- An astroport is managed by one and only one planet.

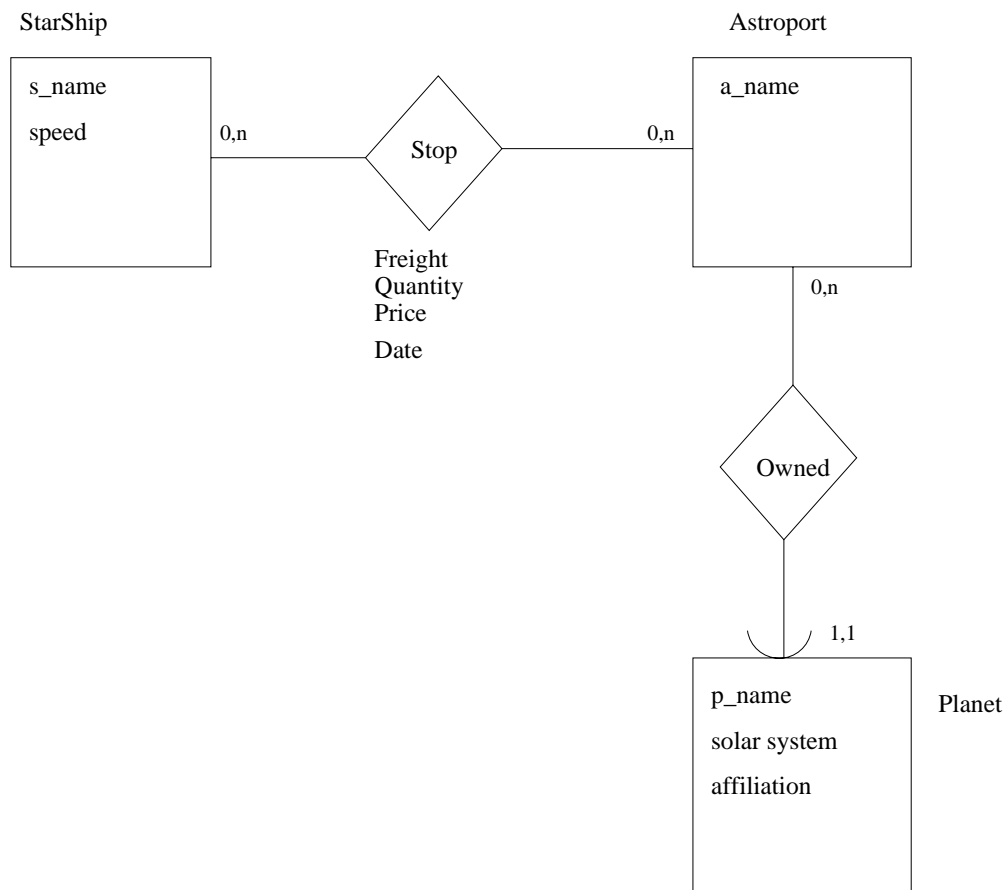


Figure 1: E/R model.

Relational Model [30pts]

Transform the E/R model of the above question in a relational schema using the DDL instructions valid in DB2 and give a small explanation.

```
CREATE TABLE Starship (  
  s_name VARCHAR(256) NOT NULL PRIMARY KEY,  
  speed integer,  
  pilot VARCHAR(256)  
)  
  
CREATE TABLE ASTROPORT (  
  a_name VARCHAR(256) NOT NULL PRIMARY KEY,  
  p_name VARCHAR(256) FOREIGN KEY REFERENCES Planet  
)  
  
CREATE TABLE Planet (  
  p_name VARCHAR(256) NOT NULL PRIMARY KEY,  
  solar_system VARCHAR(256),  
  affiliation VARCHAR(256)  
)  
  
CREATE TABLE Stop (  
  s_name VARCHAR(256) NOT NULL,  
  a_name VARCHAR(256) NOT NULL,  
  freight VARCHAR(256) NOT NULL,  
  quantity integer,  
  price integer,  
  date DATE NOT NULL,  
  PRIMARY KEY (s_name, a_name, freight, date),  
  FOREIGN KEY (s_name) REFERENCES Starship,  
  FOREIGN KEY (a_name) REFERENCES Astroport  
)
```

Relational Algebra [30 pts]

Express the following queries in relational algebra:

1. Name of the starships that never stopped at an astroport affiliated to the empire. [15 pts]

$$\begin{aligned}T &= \pi_{a_name}(Astroport \bowtie \sigma_{affiliation='Empire'}(Planet)) \\TT &= \pi_{s_name}(Stop \bowtie T) \\R &= \pi_{s_name}(Starship) - TT\end{aligned}$$

2. Name of starships that stopped at least once on every astroport of the planet "Tatoine". [15pts]

$$\begin{aligned}T &= \pi_{a_name}(\sigma_{p_name='Tatoine'}(Astroport)) \\TT &= \pi_{s_name}(Stop \bowtie T) \\R &= \pi_{s_name}(Starship) / TT\end{aligned}$$

SQL [60 pts]

Write the following queries in SQL:

1. Name of the astroports, date of the stop and freight that the starship named "Milleniun Falcon" unloaded. [10 pts]

```
SELECT st.a_name, st.date, st.freight
FROM   Stop st, Starship s
WHERE  s.name = 'Milleniun Falcon'
      AND st.s_name = s.name
```

2. Name and speed of the slowest starships. [12 pts]

```
SELECT s.s_name, s.speed
FROM   Starship s
where  s.speed IN (SELECT min(speed)
                  FROM   Starship
                  )
```

3. Total amount of money that the shipowner earned, by planet. [14 pts]

```
SELECT p.p_name, sum(st.price)
FROM   Astroport a, Stop st
WHERE  st.a_name = a.a_name
GROUP BY a.p_name}
```

4. For each starship list the name of the last astroport where it unloaded some freight and the date. [24 pts]

```
SELECT st.s_name, st.a_name, st.date
FROM   Stop st
WHERE  (st.s_name, st.date) IN (SELECT s_name, max(date)
                                FROM Stop
                                GROUP by s_name
                                )
```

Expressibility [10 pts]

Using the previous relational model, answer to the following questions if possible, otherwise explain why you can not.

- Write a SQL query non expressible in relational algebra. [5 pts]

```
SELECT count(*)  
FROM Starship
```

- Write a query in English that you can not express in standard SQL. [5 pts]
The name of the starships for which its seep is a prime number

