

## Databases Tutorial 2: Modelling and Design

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**Table 1.** We start with a table listing some flights. It is an example of a relation that links together flight codes, airlines, airports, and aircraft. The airlines and airports are real ones, whereas the codes are fake.

flight code	airline	prime flight	operating airline	departure city	departure airport	destination city	destination airport	aircraft type	seats
SK111	SAS	SK111	SAS	Gothenburg	GOT	Frankfurt	FRA	B737	140
LH555	Lufthansa	SK111	SAS	Gothenburg	GOT	Frankfurt	FRA	B737	140
AF111	Air France	AF111	Air France	Gothenburg	GOT	Paris	CDG	A320	170
LH111	Lufthansa	LH111	Lufthansa	Frankfurt	FRA	Paris	CDG	A321	200
LH222	Lufthansa	LH222	Lufthansa	Frankfurt	FRA	Malta	MLA	A320	170
AF222	Air France	AF222	Air France	Paris	ORY	Malta	MLA	A320	170
AB222	Air Berlin	AB222	Air Berlin	Frankfurt	FRA	Munich	MUC	A320	170
KM111	Air Malta	KM111	Air Malta	Munich	MUC	Malta	MLA	A319	140
LH333	Lufthansa	KM111	Air Malta	Munich	MUC	Malta	MLA	A319	140
SK222	SAS	KM111	Air Malta	Munich	MUC	Malta	MLA	A319	140
AF333	Air France	AF333	Air France	Paris	CDG	Frankfurt	FRA	A320	170

We assume the following (slightly simplified) conventions for this domain:

- the “flight code” attribute determines all other attributes on a row
- the “prime flight” is the flight code used by the airline operating the flight; the “flight code” in the first column can thus belong to another airline that has a code sharing agreement with the operating airline
- the “prime flight” appears in the table as a “flight code” as well, having itself as prime flight
- each airport has a unique code
- every aircraft of the same type has the same number of seats

(It is a common practice that one and the same flight can be booked using different airlines. Each airline uses a different “flight code”, but the passengers end up in the same plane. The code used by the actual operating airline is called the “prime flight” code. For example, whether you book flight LH333 with Lufthansa or flight SK222 with SAS, you end up in the plane of Air Malta flight KM111.)

## **Question 1. Modelling and Design, basic (11p)**

### **Question 1a (2p)**

Find at least four redundancies in Table 1.

### **Question 1b (5p)**

Draw an Entity-Relationship diagram that models the data in Table 1 in a meaningful way. The diagram must have some separate entities and relationships. Mark the keys by underlining them.

### **Question 1c (4p)**

Convert your Entity-Relationship (E-R) diagram to a database schema. Mark all keys and references.

**Question 1.** Consider the following domain description.

12 p

A local authority manages several nurseries which provide daycare for children. They want to use a database to record information about their nurseries. Each nursery is identified by its name. Each nursery is organised into several sections, each with around 15 children. The sections within each nursery have unique names, but there might be sections with the same name in different nurseries. The local authority employs several teachers and each teacher is assigned to one of the sections. Each teacher's name and person number should be stored in the database. The name and person number of each child should also be stored. Initially, an application is made for a nursery place for a child. The application contains information about the child, the child's starting date at nursery, and a list of nursery choices (e.g. choice 1 is nursery "A", choice 2 is nursery "B", etc.). After an application is processed, the child is allocated an available place in one of the sections of one of the nurseries. Information about the application and the child's placement should be stored in the database. For each child, the person number, name and telephone number of each parent should be stored in the database.

- a) Draw an E-R diagram that correctly models this domain.  
(6p)
- b) Translate this E-R diagram into a set of relations, clearly marking all references and keys. If any attributes can contain null values, state which ones.  
(6p)

**Question 1.** Consider the following domain description.

12 p

A university wants to use a database to store information about its departments, divisions and employees. Each department at the university has a unique name. Each department contains several divisions. Divisions in different departments can have the same name, but the division names within each department are unique. There can be many employees in each division, but each employee is employed at only one division. For each employee, their name and their unique personNumber should be stored. There are two kinds of employee at the university: faculty members and PhD students. For each PhD student, one faculty member is appointed to be their examiner. Each PhD student also has one main supervisor, but they can have zero or more co-supervisors. One faculty member at each department is appointed to be the head of that department. Similarly, one faculty member at each division is appointed to be the head of that division.

- a) Draw an E-R diagram that correctly models this domain.  
(6p)
- b) Translate this E-R diagram into a set of relations, clearly marking all references and keys.  
(6p)