Exercise 01: Introduction

Task 1: Problems with data redundancy

You live in a shared apartment with two other students, Julia and Christian. Each person has their own room, and in addition you have a shared living room and kitchen. Because you get on well with each other, you do a lot of things together, cook together, celebrate together and also cook for each other. So there's a lot going on in your shared apartment!

a. List three very specific problems that this scheduling process can cause for the three of you.

   Julia wants to celebrate her birthday on 1 December, and she has told you and Christian. You and Julia have entered it in your smartphones, but Christian forgot to enter it in his calendar and invites 10 friends to watch football on 1 December. The apartment gets quite full, and Julia is cross. (Problem: forgetting changes).

   Julia is tired of her Android smartphone and buys an iPhone. Unfortunately, the iPhone calendar cannot access the data in the Android calendar. Christian helps her to transfer the data, but the two of them take 5 hours to do so and in the end they are both fed up. (Problem: data is more valuable and durable than applications).

   Michael, one of Christian's friends who is studying political science, comes to visit and wants to look up something quickly on the living room PC. While doing so, he gets a virus that reformats the PC. All of Christian's calendar data is lost. (Problem: data protection and data security are hard to ensure)

b. Which solution would you suggest?

   Use of a shared calendar (=database), which all three can access.

Task 2: Term definitions DB, DBS, DBMS

Define each of the following terms in your own words. Try not to read the script beforehand. One sentence per term is enough.

a) Database Management System (DBMS)
   software used to manage a database.
b) Database (DB)
   actual data that is stored.
c) Database System (DBS)
   DBMS and DB together are the DBS.
d) External schema
   view that an application has of the database (one per application).
e) Conceptual schema
   application-independent data description.
f) Internal schema
   internal organisation of the data, not visible to the outside.

Task 3: Schema architecture

You are tasked with developing a management system for the examination grades at the TH Rosenheim. There are only two types of users of this system: students, who are of course only allowed to see their own grades, and professors, who enter the grades for the lectures they give.

a) What could the two external schemas look like for these two user groups? Draw possible tables as a solution.

Table 1.1: Schema für Studierende

Vorlesung	Semester	Note
Programmieren 3	WS2017	1.7
Datenbanken	WS2017	1.3

Table 1.2: Schema für Professoren

Vorlesung	Semester	Matrikelnummer	Note
Programmieren 3	WS2017	1234565	1.7
Datenbanken	WS2017	3456654	1.3

b) What could a conceptual schema look like? Draw possible tables as a solution.

Table 1.3: Alternative 1

Dozent	Vorlesung	Semester	Matrikelnummer	Note
Höfig	Datenbanken	WS2017	123456	1.2
Hüttl	Programmieren 3	WS2017	1234565	1.7
Breunig	Datenbanken	WS2017	3456654	1.3

Table 1.4: Alternative 2: Schema Vorlesungen

Dozent	Vorlesung	Semester
Höfig	Datenbanken	WS2017
Hüttl	Programmieren 3	WS2017
Breunig	Datenbanken	WS2017

Table 1.5: Alternative 2: Schema Studenten

Vorlesung	Semester	Matrikelnummer	Note
Datenbanken	WS2017	123456	1.2
Programmieren 3	WS2017	1234565	1.7
Datenbanken	WS2017	3456654	1.3

c) What could an internal schema look like? Answer the question in one sentence. You could choose a tree structure in which to store the data.

Task 4: Data independence

Your management system from Task 3 is very successful, so the Examinations Office contacts you and would also like to be able to access your database as a third user group. The Examinations Office needs access to all data, so you create a third suitable external schema for this purpose.

a) Explain what *logical data independence* means here.
It means that you do not have to change the two external schemas for the access by students and professors, even if a new external schema (for the Examinations Office) must definitely be added here, which will probably also lead to changes in the conceptual schema (e.g. it may be that the Examinations Office also requires the rooms and the invigilators of each examination, and these must naturally then be stored somewhere in the conceptual schema).

b) Due to the numerous large accesses by the Examinations Office, your database becomes very slow. So you decide to optimise the internal representation. Explain what *physical data independence* means here. What significant advantage does this have?
It means that you optimise the database by making changes to the internal schema without changing the conceptual schema (and thus the external schemas). The advantage is that you do not have to change the applications for students, professors and the Examinations Office.

Task 5: Application architectures

What might a 3-tier architecture look like for your university management system from Task 3?

The bottom tier is a database, e.g. an SQL server.

The middle tier could be an application server running a web server, which provides http access to the respective data after authentication of the users. Ideally by means of single sign-on (SSO) and integration into the Community at the TH Rosenheim. Here in Rosenheim, this is currently called the “Online Service Center” (OSC).

The top tier could then be any web browser running on the client (PC, smartphone, etc.) of the student or professor.