Conceptual Data Modeling — SS 2023

a.Univ.-Prof. DI Dr. Wolfram Wöß — 1

Group		
Name	**MatNr.**	**SKZ.**

Exercise 1 — 4 Points — Submission: 24.04.2023

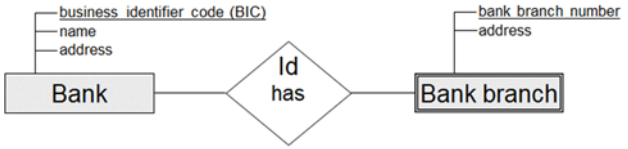
Specify the most important benefits of creating a data model. In which phase of an information system's life-cycle the data modeling process mainly takes place?

Exercise 2 — 4 Points — Submission: 24.04.2023

What are essential reasons for the necessity of assigning an association type to a generalization hierarchy?

Exercise 3 — 3 Points — Submission: 24.04.2023

What constraints are specified by the partial key and by the identifying relationship of the weak entity type in this ER model?



Exercise 4 — 6 Points — Submission: 24.04.2023

Logistics Company

In a logistics company, the warehouse locations, cities, trucks and drivers are stored. Cities are described by the city name and the state in which they are located. For the individual trucks, the truck number, a description and the load capacity are stored. For drivers, the driver number, name and date of birth are stored. Drivers can be responsible for several trucks, for which the period has to be stored. For a warehouse location the name, the number of loading ramps, and the city where the warehouse is located are stored.

For the individual truck routes, a logbook should be kept with information which driver drives which truck to which warehouse location. The logbook has to contain the arrival time, the departure time (planned time and actual time respectively), as well as the number of the loading ramp at which a loading is carried out.

Create an ER model for the requirements specification. Consider the association types, relevant attributes and key attributes of the entity types.

Exercise 5 — 10 Points — Submission: 24.04.2023

Blood Donation Center

The blood donation center designs an information system for managing blood drives. A blood donor has the attributes name, postal address, email address, date of birth and is identifiable by his/her social security number (SSNo.). Blood donors can attend a blood drive, for which an individual blood drive number, the date of this blood drive, the location and the zip code where it takes place, are stored. The blood drive number is necessary to identify a blood drive. Former and potential blood donors, who are already registered, are invited to every upcoming blood drive. A donor, who participates the first time, receives a blood donation pass. A blood donor can attend a blood drive several times, but not the same blood drive. At the beginning of the collection each blood donor has to register. During the blood-letting a blood-preservation (blood unit) is filled. A serial number is the unique identifier for a blood-preservation. A blood donor fills several blood preservations, but an individual preservation is solely attributed to one blood donor. Additionally, for each blood-preservation the donor's blood group and her/his name are stored. A medical doctor carries out the blood collection. After the collection the blood-preservations are sent to a laboratory. The laboratory tests the blood-preservations concerning potential quality limitations (diseases, allergies, etc.). A blood donor can have one or more donation risks.

After the laboratory tests of the blood-preservations, the blood donor receives an email notification of the test results.

Create an ER model for the requirements specification. Consider the association types, relevant attributes and key attributes of the entity types.

Exercise 6 — 15 Points — Submission: 24.04.2023

E-Shop

A distributor plans to simplify the business processes and therefore to establish an online shop for the products. For the customers the online shop should provide information about products and special offers and should enable to use a new medium for purchase ordering. A purchase order is a list of special offers and products. Special offers are a composition of several products, which are available for a defined time period and for a special price. A purchase order is organized as follows: a customer selects the desired products, which are represented in several product- and special offer web pages. Afterwards the customer has to complete the purchase order form with some personal information, the desired method of payment, and finally, the customer can assign some additional notes regarding the delivery. The delivery of these products requires the name of the customer and the postal address. There are two different payment options.

The first option is payment per credit card – for this purpose the customer has to transmit her/his credit card number and the validity date of the credit card. The e-shop provides for a customer a variety of direct debit dates (e.g., on day of delivery, delivery+14 days, 21 days after delivery). Depending on the selected direct debit date, on the purchase itself, as well as on comments in the customer database, a special discount (cash discount) or other sales discounts are granted. Finally, the credit card is checked for its validity.

The second payment option is "pay on delivery". The customer pays on the receipt of her/his purchased products. Additionally, for checking the customer's existence a telephone number has to be filled in the purchase order. Before the internal purchase process starts this telephone number is called. If the customer has some special issues concerning the delivery, she/he has to note them in the purchase order form.

After the customer has completed the purchase order and the purchase process is finished on the customer's side, the system starts a detailed purchase review concerning the terms of delivery, the customer itself and the selected payment option. For terms of delivery the availability of products is checked in order to guarantee the requested delivery date. If the product is currently not available, the system offers a new delivery date. In case of "pay on delivery" an additional review task is necessary in order to avoid the risk of returned products and consequently increasing inventory costs. The review task bases on the amount of unpaid invoices, the amount of the current purchase as well as on the classification of the customer's credit rating. If the "pay on delivery"-check results as too cost-intensive either the first payment option "payment per credit card", or reduction of the customer's purchase amount is proposed.

Those customers paying their invoices always in time are graded with the highest possible credit rating, and dependent on their purchase volume their credit limit is calculated. For new customers, both, credit limit and credit rating base on experienced fixed data.

After the purchase order is approved by the system also the customer is asked to confirm it again. The customer has to respond within a specified time period (e.g., 10 minutes) otherwise the purchase order is refused. Depending on the customer's response an order confirmation is generated. If the customer's email address is available she/he receives an email, otherwise she/he receives postal confirmation. As long as the customer does not confirm the purchase order the customer is allowed to discard it.

After the confirmation process the customer receives a password that authorizes her/him in combination with the purchase order number to modify those purchase order positions (products) which are not yet delivered. After each modification purchase data is checked again according to the process described above.

The database stores information about customers, products, special offers, and purchases etc. Customers can be differentiated in retailer and consumer. The differentiation is necessary because products have a different sale price for a consumer and a retailer. Retailers have to declare their sector of trade in the purchase order form. Additionally, information necessary to evaluate the retailer's purchase acceptance like credit limit or credit rating is stored in the database. Moreover, similar to a consumer, for a retailer a generally granted special discount (cash discount) or other generally granted sales discounts are stored. Invoice number and date of issue allow the identification of an invoice. A final invoice beside the total amount includes the granted sales discount as well as the cash discount, time for payment, and time of payment. Furthermore, the method of payment is stored. Each invoice refers to exactly one purchase order.

Special offers in many cases have special conditions (e.g., delivery time is at least 15 days). For each product three different prices are stored in the database: the purchase price for a distributor, the retail price which is used for the consumer accounting, and finally, the wholesale price for a retailer. Products can be distinguished by their names and product codes. Each product purchase and sale requires inventory management updates which are executed by a responsible employee. Several employees are, depending on their function, responsible to keep the online shop up-to-date. Therefore, additional data of these persons is required: social security number, first name and last name, postal address, their function, password and authorization. Each data manipulation, depending on whether it is initiated by a customer or a responsible employee, is recorded in a log-file with access identification (session), date and time. Manipulations of personal data of responsible employees or customers as well as subsequent modifications of product prices, purchase orders or invoices are recorded as well including the date and a reference to the person executing the modification.

Create an ER model for the requirements specification. Consider the association types, relevant attributes and key attributes of the entity types.

Exercise 7 — 12 Points — Submission: 24.04.2023

Hospital Care

In a hospital the staff is classified in doctors, (male) nurses (caretaker) and cleaning staff. Patients are categorized in public health and private patients. Doctors are classified in senior physicians (Oberarzt), chief physicians (Primar) and surgeons.

Private patients only get care from a chief physician; in contrast to public health patients, who get care from a senior physician. A patient is in care on a specific ward (Station) and gets care from a specific nursing staff team.

The patient gets during her/his stay in hospital several medical treatments and at least one (male caretaker) nurse of the nursing staff must attend. The medical treatments can only be prescribed by a doctor.

There are three different operation rooms (OR) in the hospital. It has to be stored which surgeon operates which patient in which operation room. A medical assistant always assists the operation.

If a patient checks out from hospital a doctor writes a report about the patient's diseases.

Every year the data of patients is stored on an external storage medium. In case of a re-admission the data of a patient can be resumed from the external storage and stored again as current medical record.

Create an ER model for the requirements specification.

Exercise 8 — 15 Points — Submission: 24.04.2023

Tourist Coach Operator

A tourist coach operator employs drivers (driver_ID, name, address, license) and administrates the driver's absenteeism (date, reason for absence). A journey (journeyNo, departure, arrival, weekdays, number of stopovers) must be differentiated into ordinary trips and specific events.

A journey consists of several journey parts (departure, departure time, arrival, arrival time, price, distance). Scheduled journeys are operated on a specific date. For each part of a journey the booking information of the customers is stored. Furthermore, it is stored which customer finally participated in the journey. In general, customers that are booking a seat in a bus are subdivided in passengers and travel agencies. A booking always refers to a seat number in the bus. Seats are categorized in first class and economy ones. A passenger can be a frequent traveler. A certain driver operates a journey by using a certain bus (bus_ID, number of seats, last service date, required license).

Create an ER model for the requirements specification.

Exercise 9 — 15 Points — Submission: 24.04.2023

Sugar Refinery

A sugar refinery processes sugar beets to sugar. The sugar refinery comes with a number of customers (soda producer, candy factories, spirits producer …) who negotiate several contracts ("sugar contract") with the refinery.

A customer has several addresses (delivery address, billing address …). A contract covers the following information: contract number, product, delivery quantity in tons, price per tons, contract date, delivery starting date, delivery end date, delivery address.

The refinery also concludes contracts ("sugar beet contracts") with suppliers (depots, wholesaler, farmers …). In order to temporally store sugar beets until the product delivery starts some supplier use large depots as third-party warehouses. These third-party warehouses have a defined capacity of storage and are distributed over the country. Therefore, the address is used to identify a warehouse. A beets supplier may have several addresses.

For a contract a number of orders (from a supplier) and deliveries (to a customer) are carried out until the contracted quantity is fulfilled.

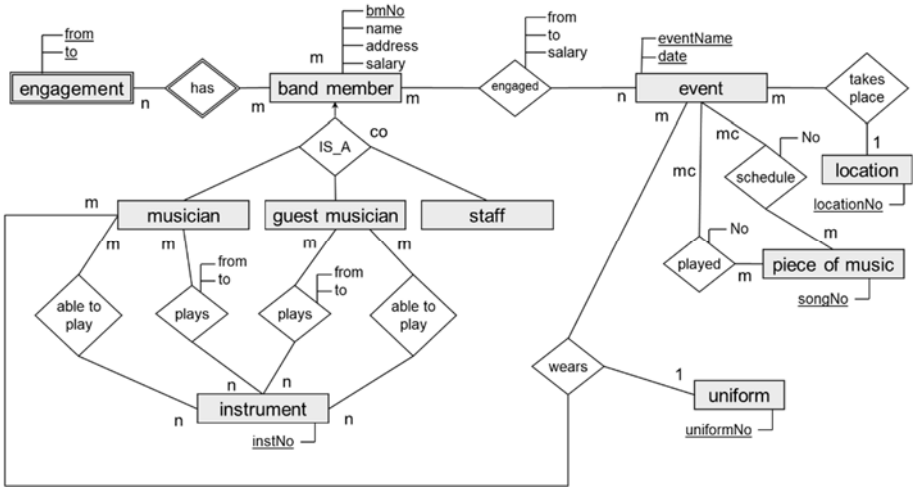
Queries like "What is the delivered/ordered quantity at a specific date?", "What was the sales volume of the sugar refinery?", "Which sales volume reaches a specific product?" have to be implemented in the information system.

Create an ER model for the requirements specification.

Exercise 10 — 12 Points — Submission: 24.04.2023

Databand

Transform the given ER-model into a relational data model.



Exercise 11 — 15 Points — Submission: 24.04.2023

Spa Hotel

A spa hotel processes data about hotel guests, hotel rooms and the spa area in an internal information system. Each hotel room (room category: single, double, suite …) offers a particular furnishing package (television, mini bar, bathtub, king-size bed, balcony …), which depends on the room category. A hotel room is located in one of the three different wings of the spa hotel. Bookings of rooms and booked lodging and meals (bed-and-breakfast, half-board, full board) are stored. For the duration of a hotel guest's stay in the spa she/he can book an additional parking place in the underground car park.

The spa hotel offers several recreation and health programs (massage, spinal exercises, physical condition checks …) as well as beauty programs (manicure, beauty-weekend, 3-days-beauty treatment …). For all offers a registration is necessary, but only beauty services can be charged to the hotel room. Also meals and beverages can be charged to the hotel room.

The payroll accounting distinguishes between cleaning, service and reception staff. For quality assurance the room, the cleaning date and the responsible cleaner are documented.

Hotel guests can participate on several day tours, for example they can book a balloon ride. For balancing the accounts with the provider of the tours these bookings are stored in the database. A hotel guest is allowed to book day tours for more than one person (e.g., for the whole family).

Create an ER model for the requirements specification.

Exercise 12 — 15 Points — Submission: 24.04.2023

University Information System

The following specification describes an extract of a university, in particular of students and their professors, necessary for the implementation of a new information system.

Professors are affiliated with a department and are born in a place of birth. Students are also born in a certain place of birth and are living in a certain location (city). Moreover, students are registered for several courses. A student plans to attend certain courses. A course takes place at a scheduled time in a reserved room. If a student is a master student, a professor supervises her/his master thesis.

Persons of the university are categorized in students and professors. Students are classified in undergraduates and master students. Professors are subdivided in visiting professors and permanent professors. Professors hold several courses.

Create an ER model for the requirements specification. Consider the association types, relevant attributes and key attributes of the entity types.

Finally, create a GSM for the requirements specification.

Exercise 13 — 16 Points — Submission: 24.04.2023

Radio UniAir

Radio UniAir owns a large collection of several recording media (recordings, CD, audio tapes, …). In order to consider further developments of recording techniques available in the future it should be possible to extend the system with new recording media types. Different recording media types have a number of different attributes. But in general, the information system has to be adapted for new recording media types (schema modification).

Each individual recording media contains at least one piece of music. A piece of music is recorded by at least one interpreter. In addition, each recording media has a specific recording method and a certain producer. Radio UniAir purchases each recording media from a supplier or receives the recording media as a promotional gift due to some PR-arrangements. The source (supplier or sponsor) of the recording media has to be stored in the database.

The recording media are stored in several archives. Each archive consists of a number of racks, which are identifiable by a numbering schema within the archive. A rack is subdivided in shelves. The shelf number defines the place where a recording media is stored within the archive.

For a certain radio show a recording media is retrieved from the archive. The information system stores the list of borrowed recording media with the corresponding radio show and person. Every day the system administrator has to print the current list of borrowed recording media.

Create an ER model for the requirements specification.

Create a GSM for the requirements specification.

Exercise 14 — 8 Points — Submission: 24.04.2023

ER-Model: Tourism

Transform the GSM discussed in the course that describes person, tourist and traveling salesman (in the script under heading GSM: Global Aspects 4) into an Entity-Relationship (ER) model.

Based on the tourism example discuss all relevant qualitative aspects and differences between both models.

Exercise 15 — 12 Points — Submission: 24.04.2023

Books

An ISBN identifies a book. Furthermore, a book is written by at least one author and has a title. For each book there is at least one edition. The combination of edition and year the book was published specify a book version. Several keywords are added to an individual book and finally, a publisher publishes the book.

Create a GSM for the requirements specification. Where appropriate, use the modeling concepts aggregation and grouping as often as possible. (8 points)

What is the (defining) consequence of applying aggregation in this example? (2 points)

Create a different alternative GSM for the subpart "book version" and explain the differences between the two alternative solutions. (2 points)

Exercise 16 — 10 Points — Submission: 24.04.2023

Journal Volumes

A library manages several journal volumes. A journal volume includes all issues of a journal published within a year. The volume number identifies a journal volume. An issue number identifies a single issue of a journal. Each issue contains a number of papers, which are indexed by selected keywords. A paper is written by at least one author and has a title. Furthermore, the starting and end page of a paper within an issue are stored.

Create a GSM for this requirements specification.