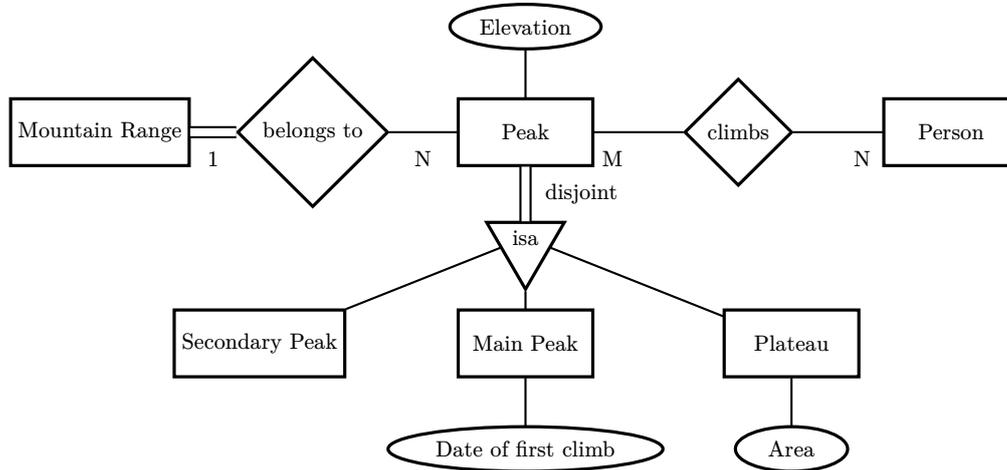


Exercise 1

1 Point

Mark the following statements as true (**T**) or false (**F**) with respect to the given ER-diagram.



(1) There are mountain ranges without peaks.

(2) Every person has to climb a peak.

(3) Each peak is either a main peak, a secondary peak, or a plateau.

(4) Every peak has a date of first climb.

(5) Each secondary peak has an elevation.

Exercise 21 Point

Draw an **ER-diagram** which satisfies the following requirements:

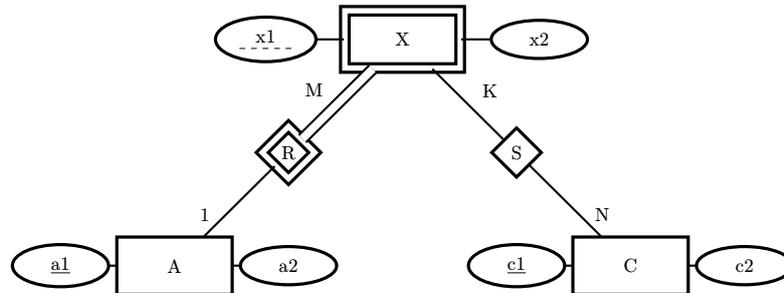
- (1) A driver has a unique name and a number of points.
- (2) A race has a unique name and takes place in a city.
- (3) A driver participates in races and finishes in a specific position.
- (4) At least one driver participates in each race.
- (5) A team has a unique name and a main sponsor.
- (6) Each driver belongs to exactly one team.
- (7) Teams have at least one driver.



Exercise 3

1 Point

Translate the following ER-diagram into a **relational schema** and state all **foreign key constraints** using projection and subset operations.



Relational Schema (0.5 Punkte)

Foreign Key Constraints (0.5 Punkte)

This schema is used for the following exercises

Person(person_name, age, gender)

Consumes(person_name, pizza_type, pizzeria_name, date)

Offer(pizzeria_name, pizza_type, price)

Pizzeria(pizzeria_name, city)

Foreign keys

$$\pi_{\text{person_name}}(\text{Consumes}) \subseteq \pi_{\text{person_name}}(\text{Person})$$

$$\pi_{\text{pizza_type, pizzeria_name}}(\text{Consumes}) \subseteq \pi_{\text{pizza_type, pizzeria_name}}(\text{Offer})$$

$$\pi_{\text{pizzeria_name}}(\text{Offer}) \subseteq \pi_{\text{pizzeria_name}}(\text{Pizzeria})$$

Database instance for the following exercises

(Pe)rson			(Pi)zzeria	
person_name	age	gender	pizzeria_name	city
Thomas	26	m	Piccolo	Salzburg
Gordon	31	m	Verona	Hallein
Emily	23	f	Stella	Salzburg

(C)onsumes			
person_name	pizza_typ	pizzeria_name	date
Emily	Diavola	Piccolo	01.06.2025
Emily	Diavola	Verona	02.06.2025
Emily	Margherita	Stella	03.06.2025
Gordon	Diavola	Piccolo	04.06.2025
Thomas	Marinara	Piccolo	05.06.2025
Thomas	Marinara	Verona	06.06.2025

(O)ffer		
pizzeria_name	pizza_typ	price
Piccolo	Margherita	10
Piccolo	Marinara	12
Piccolo	Diavola	14
Stella	Diavola	15
Stella	Margherita	11
Verona	Capricciosa	14
Verona	Diavola	14
Verona	Margherita	11
Verona	Marinara	13

The space above and below the message intentionally is left blank.

Name:

Student ID:

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Exercise 4

1 Point

Formulate the following query using **relational algebra**. Pay attention to syntactic correctness.

The average price of a pizza per pizza type in Salzburg.

Exercise 51 Point

Formulate the following queries using **SQL**. Pay attention to syntactic correctness.

Specify the number of pizzas per pizza type that were consumed by people under 30 years old. The results should be sorted in descending order.

Exercise 6

1 Point

Consider the following modeling of mathematical sets as relations. The relation $R[id, element]$ stores sets by having all elements ($element$) of a set share the same id . For **example**, the following relation stores the sets $r_1 = \{a, b, e\}$ and $r_2 = \{b, c, d, e\}$:

R	
id	element
1	a
1	b
1	e
2	b
2	c
2	d
2	e

Write an SQL query that finds all sets that contain at least the elements c , d , and e ; the required sets may contain more than just these elements. Mathematically speaking, for a set of sets R , we are looking for the following subset:

$$\{r \in R \mid c \in r \wedge d \in r \wedge e \in r\}$$

It is sufficient if you only output the ids of the sets. For the relation above, the result would therefore be $\{2\}$.

Exercise 7

1 Point

Consider relation $R[A, B, C, D, E]$ with the following functional dependencies:

$$F = \{ABD \rightarrow CE, \\ BCD \rightarrow E, \\ B \rightarrow ACDE, \\ A \rightarrow B, \\ CD \rightarrow AE\}$$

Find and list all candidate keys of R . **Explain your answer.**

Exercise 8

1 Point

Consider relation $R[A, B, C, D, E, I, J]$ with the following functional dependencies:

$$F = \{A \rightarrow C, \\ AB \rightarrow DE, \\ AB \rightarrow CDI, \\ AC \rightarrow J\}$$

Compute the canonical cover F_C of F in the following four steps. Show your work for every step.

1. Left reduction.

2. Right reduction.

3. Remove empty sets.

4. Union.

Exercise 9

1 Point

Consider relation $R[A, B, C, D, E]$ with the following functional dependencies:

$$F = \{CE \rightarrow ABD, \\ BC \rightarrow D, \\ B \rightarrow AD\}$$

Is relation R in 3NF? Explain your answer.