Department of Computer Science

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PARIS LODRON UNIVERSITÄT SALZBURG

Databases I — Exam
Summer Semester 2026 — 30.06.2026

Name: _____ **Student ID:** _____

Hints

- Check whether you received all pages of the exam (12 pages).
- Write your name or your student ID on each sheet of the exam and hand in all pages.
- All answers are expected to be written on the exam sheets.
- Clearly highlight and enumerate additional pages that are used for longer answers. Match your text with the according exercise.
- Only use pencils that are permanent and non-red colored.
- Use the notation and techniques discussed in the lecture.
- Exercises with more than one solution are not graded.
- **Multiple-Choice**: Wrong answers result in point deductions!
- You are allowed to use one A4 sheet with your personal notes (both sides, hand written or printed).
- Exam duration: 90 minutes

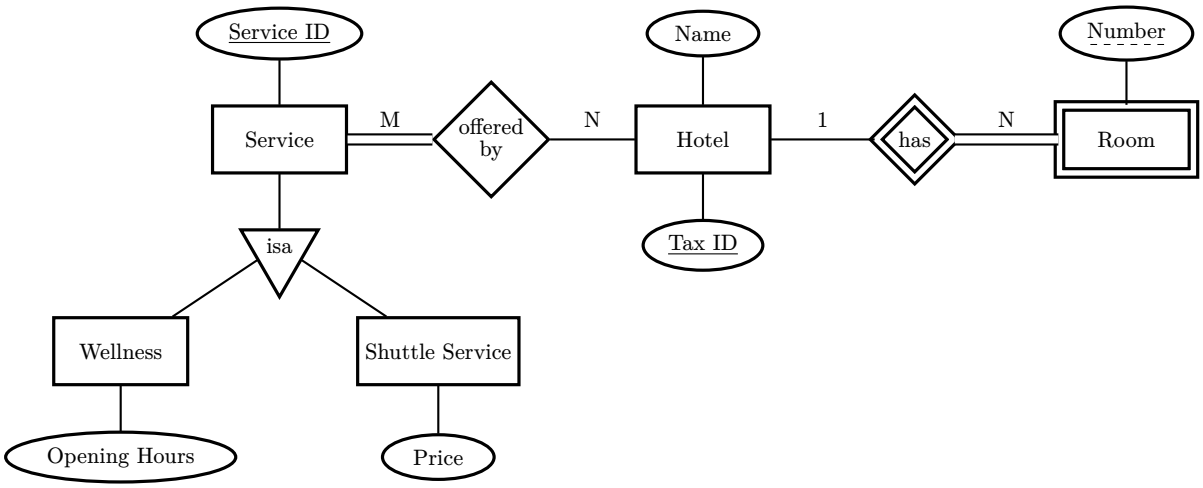
Signature _____

Grading — Filled by the examiner

Exercise	1	2	3	4	5	6	7	8	9	Sum
Total points	1	1	1	1	1	1	1	1	1	9
Points reached										

Exercise 1 — 1 Point

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



(1) There can be hotels which offer no services. ☐

(2) There can be more than one hotel with the same name. ☐

(3) Every service has a price. ☐

(4) There can be services which are neither wellness nor a shuttle service ☐

(5) A service can be wellness and shuttle at once. ☐

(6) There may be rooms with the same number in different hotels. ☐

(7) There can be a room without a hotel. ☐

(8) A hotel must have at least one room. ☐

Exercise 2 — 1 Point

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

(1) An animal has a unique ID and a name.

(2) An animal can either be a cat, a mouse, or a dog.

(3) A cat has a breed.

(4) A dog has a color.

(5) A cat must eat one or more mice.

(6) A mouse can be eaten by exactly one cat.

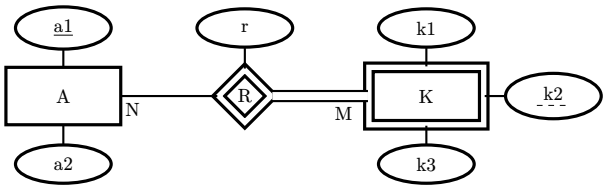
(7) A person has a unique SSN, a name, and a date of birth.

(8) A dog can play with one or more people.

(9) A person can play with one or more dogs.

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 (0.6 Punkte)

Foreign Key Constraints (0.4 Punkte)

Schema for the following exercises

Relational schema

Listener(<u>user_name</u>, country, plan)

Album(<u>album_name</u>, artist_name, release_year)

Title(<u>album_name</u>, <u>title_name</u>, duration_sec)

Playlist(<u>playlist_id</u>, creator_name, playlist_name, visibility)

PlaylistTitle(<u>playlist_id</u>, <u>album_name</u>, <u>title_name</u>, position)

CountryStats(<u>album_name</u>, <u>title_name</u>, <u>country</u>, streams, skip_count)

Foreign key constraints

$\pi_{\text{creator_name}}(\text{Playlist}) \subseteq \pi_{\text{user_name}}(\text{Listener})$

$\pi_{\text{album_name}}(\text{Title}) \subseteq \pi_{\text{album_name}}(\text{Album})$

$\pi_{\text{playlist_id}}(\text{PlaylistTitle}) \subseteq \pi_{\text{playlist_id}}(\text{Playlist})$

$\pi_{\text{album_name,title_name}}(\text{PlaylistTitle}) \subseteq \pi_{\text{album_name,title_name}}(\text{Title})$

$\pi_{\text{album_name,title_name}}(\text{CountryStats}) \subseteq \pi_{\text{album_name,title_name}}(\text{Title})$

Instance for the following exercises

Listener (L)

user_name	country	plan
anna	AT	premium
bernd	DE	free
caesar	US	premium
david	DE	free
eva	SE	free

Album (A)

album_name	artist_name	release_year
Ambition	DiaoYeZong	2014
Turaida	Shikata Akiko	2013
Under the Crossroads	Yellow Squadron	2016

Title (T)

album_name	title_name	duration_sec
Ambition	Unprivileged Access	340
Ambition	Hokus Pokus	330
Ambition	Sundering of the Mortal Veil	340
Turaida	Buonanotte	210
Turaida	Ec Tisia	530
Turaida	Alvorna	300
Under the Crossroads	Into the Zuiun	220
Under the Crossroads	Blaze Heart	290

Playlist (P)

playlist_id	creator_name	playlist_name	visibility
1	anna	Road Mix	public
2	anna	Study Mode	private
3	bernd	Party Queue	public
4	caesar	Soft Hours	public
5	david	Local Picks	private

PlaylistTitle (PT)

playlist_id	album_name	title_name	position
1	Ambition	Unprivileged Access	1
1	Ambition	Hokus Pokus	2
1	Under the Crossroads	Into the Zuiun	3
2	Turaida	Ec Tisia	1
2	Turaida	Buonanotte	2
3	Ambition	Sundering of the Mortal Veil	1
3	Turaida	Alvorna	2
3	Under the Crossroads	Blaze Heart	3
4	Turaida	Buonanotte	1
4	Turaida	Ec Tisia	2
5	Under the Crossroads	Into the Zuiun	1

CountryStats (CS)

album_name	title_name	country	streams	skip_count
Ambition	Unprivileged Access	AT	6200	450
Ambition	Unprivileged Access	US	7600	NULL
Ambition	Hokus Pokus	AT	10200	810
Ambition	Hokus Pokus	DE	8900	NULL
Ambition	Sundering of the Mortal Veil	DE	4100	380
Turaida	Buonanotte	US	2300	95
Turaida	Ec Tisia	AT	1900	NULL
Turaida	Ec Tisia	JP	3300	210
Turaida	Alvorna	SE	3000	NULL
Under the Crossroads	Into the Zuiun	AT	5400	410
Under the Crossroads	Into the Zuiun	DE	5100	390

Exercise 4 — 1 Point

Given the following queries in **relational algebra**:

Query 1

$$\pi_{\text{title_name}}\left(\sigma_{\text{creator_name=anna}\wedge\text{visibility='public'}}\left(\text{Playlist}\times\text{PlaylistTitle}\right)\right)$$

1. Describe the result of the query in natural language (in 1-2 sentences). (**0.2P**)

2. Provide the output of the result with respect to the example instance. (**0.3P**)

Query 2

$$\gamma_{\text{sum(duration_sec)}}\left(\sigma_{\text{album_name}='Turaida'}\left(\text{Title}\right)\right)$$

3. Describe the result of the query in natural language (in 1-2 sentences). (**0.2P**)

4. Provide the output of the result with respect to the example instance. (**0.3P**)

Exercise 5 — 1 Point

Formulate the following queries using **SQL** for the schema on page 5.

1. Find the name of all public playlists that contain at least one title from the album *Ambition*. Each playlist should occur only once. (**0.5P**)

2. For each artist (`artist_name`) and each country, find the total number of streams of that artist in that country. (You may ignore countries without any streams.) (**0.5P**)

Exercise 6 — 1 Point

Create a view `PublicPlaylistTracks` for all titles in public playlists. The view should contain `playlist_id`, `playlist_name`, `creator_name`, `album_name`, and `title_name`.

```
CREATE VIEW PublicPlaylistTracks AS
```

Is the view updatable? Briefly justify your answer.

Exercise 7 — 1 Point

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

$$\begin{aligned} F = \{&DF \to EG, \\ &ABG \to DE, \\ &BE \to G, \\ &BCE \to AFG\} \end{aligned}$$

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

Exercise 8 — 1 Point

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

$$\begin{aligned} F = \{&CE \to BD, \\ &BCE \to A, \\ &E \to AC\} \end{aligned}$$

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:

$$\begin{aligned} F = \{CDE &\rightarrow A, \\ E &\rightarrow ACD, \\ B &\rightarrow ACE, \\ BC &\rightarrow AE, \\ A &\rightarrow D\} \end{aligned}$$

What is the highest normal form satisfied by R?