DB 1 - english
Prof. Saake

Exam Datenbanken I

18.02.2014

NAME: .....

FORNAME: .....

MATRNO: .....

STUDY COURSE: .....

SIGNATURE: .....

GRADED/UN-GRADED (UNDERLINE APPROPRIATE)

PAGES: 12 PAGES

1	2	3	4	5	6	Σ
12	10	9	15	15	8	69

- Time: 12:00 - 14:00 h (120 Minutes)
- Usage of lecture slides, pre-filled pages, or books is prohibited.
  Except: Dictionaries.
- You should exclusively use the notations introduced in the lecture.
- Please, do only use the space left between the tasks for your answers.
  (Backsides of pages can be used for preliminary sketches.)
- Please, do write clearly. Do not use lead pencils. Shut down your mobile phone.
- Please, sign each pages with your name at the upper right corner.

1. Introduction [overall 12 Points]

   (a) Which properties does a database have to fulfill (9 rules of Codd)? [3 Points]

   (1) ..... (2) .....
   (3) ..... (4) .....
   (5) ..... (6) .....
   (7) ..... (8) .....
   (9) .....

   (b) Explain the `natural join` ($\bowtie$) and the `cross product` ($\times$) with respect to their functionality. [2 Points]

   (c) Name the aspects of *data independence* and explain them. Sketch the *3-level schema architecture* and state where the aspects of data independence can be found in this architecture. [7 Points]

2. Entity-Relationship modeling and relational implementation [overall 10 Points]

   (a) ER modeling [8 Points]

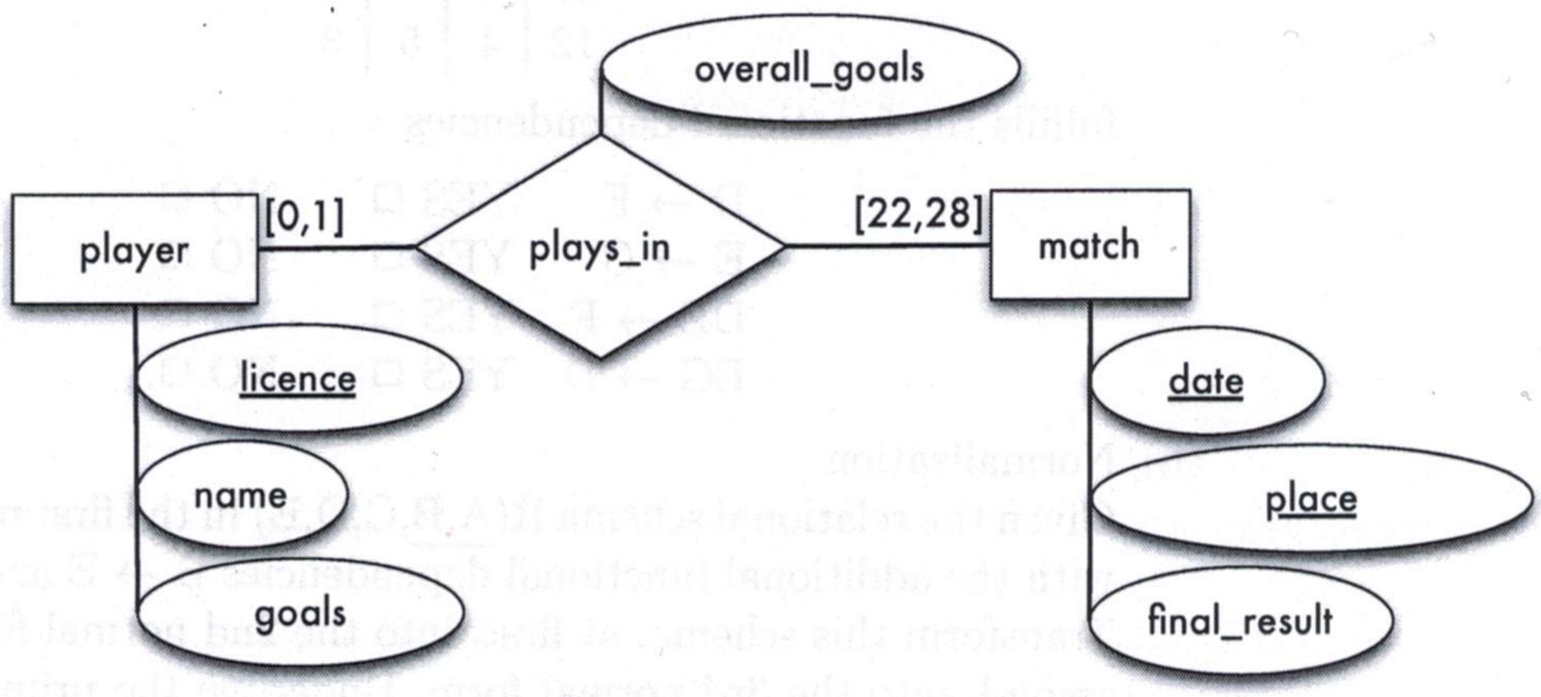
   Draw an ER diagram for the following scenarios. Avoid redundancies and inconsistencies in your model. Exploit all adequate ER concepts (Keys, Cardinalities, ...) to reach a diagram as comprehensive as possible.

   i. *In the database to be modeled, data of the FIFA World Cup 2014™ have to be stored. In the database, participating teams of the world cup should be stored. A team is identified by its name and nationality. Furthermore, each team has a trainer and group for their group matches. At the world cup, the teams are playing against each other, but not against themselves. Additional information to be stored for a match is the date and the final score of the match. Each team consists of 11 to 23 players. In a specific team, the player is identified by its shirt number. Furthermore, each player has a name and a number of cards.* [4 Points]

ii. *Another ER model captures data of fans and security staff at the FIFA World Cup 2014™. For this, information about a person is stored. A person has an ID that is only valid in conjunction with the nationality that is also stored for a person. Additionally, the accommodation during the world cup is stored. At the world cup, different stadiums are used. Stadiums have a specific place and a name. Both together make a stadium unique. Furthermore, the amount of allowed fans and the amount of needed security is stored. A stadium is visited by fans. Here, at maximum 50,000 fans fit into one stadium. A fan is a person and has, additionally, a favored team. Furthermore, a stadium has a minimal number of 10 security officers. A security officer is also a person and, in addition, has a tax ID. Since several matches can be hosted in a stadium, fans and security officers may be several times in the same stadium.* [4 Points]

(b) Transformation into relational model [2 Points]
The following ER diagram has be transformed into the relational model as precise as possible. For this, use the following notation: e.g., R1(a,b → R2,c) denoting a as primary key and b as foreign key to R2

to define the resulting relational schema.



3. Database theory [overall 9 Points]
Remark: No minus points for wrong answers!

(a) Functional dependencies [2 Points]
Mark the correct statements with an X: The table

D	E	F	G
1	2	2	1
11	3	3	2
12	4	4	25
12	4	5	3

fulfills the functional dependencies

$D \rightarrow F$	YES ☐	NO ☐
$E \rightarrow G$	YES ☐	NO ☐
$DE \rightarrow F$	YES ☐	NO ☐
$EG \rightarrow D$	YES ☐	NO ☐.

(b) Normalization [3 Points]
Given the relational schema R(A,B,C,D,E) in the first normal form with the additional functional dependencies $B \rightarrow E$ and $E \rightarrow CD$. Transform this schema, at first, into the 2nd normal form and, at second, into the 3rd normal form. Underline the primary keys in the resulting relational schemas. Keep the amount of relations in the third normal form minimal.

(c) Decomposition properties [4 Points]
Given the relation R(V,W,X,Y,Z) with the functional dependencies $VW \rightarrow XY$ and $W \rightarrow Z$. Check whether the following decompositions are *loss less* and/or *dependency preserving*!

		Loss less		Dependency preserving	
R_1(V,W,Z)	$R_2(X, Y, Z)$	YES ☐	NO ☐	YES ☐	NO ☐
R_1(W,Z)	$R_2(V, W, X, Y)$	YES ☐	NO ☐	YES ☐	NO ☐
R_1(V,W,X,Y)	$R_2(Y, W, Z)$	YES ☐	NO ☐	YES ☐	NO ☐
R_1(V,W,Y)	$R_2(Y, X, Z)$	YES ☐	NO ☐	YES ☐	NO ☐

4. SQL [overall 15 Points]

Write the following queries in SQL! *Remark: All tasks concerning query languages are based on the relational schema and the exemplary database on the last page (12)!*

(a) Delete the table `Recommendation`! [1 Point]

(b) Create the table `Recommendation` with suitable data types and primary/foreign keys. [2 Points]

(c) Insert the following `Recommendation` into the database. Critic `Bruch` recommends the wine `Riesling Reserve` for the dish `Erdbeersorbet`. [1 Point]

(d) Update the `side dish` served with the `Erdbeersorbet` to `heiße Schokolade mit Sahne`! [1 Point]

(e) Create an SQL statement to show the name of each `Productionarea` and the corresponding `Countries`, that are located in the region `Bordeaux`. [1 Point]

(f) Which `Vineyard` produces `Wine` out of the grape `Weißer Riesling` and comes from `Deutschland`? [2 Points]

(g) In which `Countries` are the `Wines` produced that the critic `Bruch` recommends? [2 Points]

(h) Output the `Grapes` and the `Color` of the grapes that are used for more than `one Wine`. [2 Points]

(i) Output the `Wines` (only their name), having a `smaller Residual Sugar than 18`, but they must not be recommended by the Organization `Quarin e.V.`. [3 Points]

5. Further query languages [overall 15 Points]
   Remark: All tasks concerning query languages are based on the relational schema and the exemplary database on the last page (12)!

   (a) Relational algebra [overall 9 Points]
   Translate the following queries into relational algebra!

   i. Find the `Name` of all wines that are produced in the `Vineyard Creek`. [1 Point]

   ii. What are the `Names` of wines, that are recommended for `Dishes`. In addition, the `Description` and the `Side dish` of the recommended `Dishes` have to be shown. [1 Point]

   iii. In which `Region` is the wine `Pinot` produced? [2 Points]

   iv. What are the `Years` of the `Wines`, that are recommended by `Critic Meier`? [2 Points]

   v. Which `Grape` is used for more than `one Wine`? Additionally, output the Color of the grape! [3 Points]

(b) Query calculus [insgesamt 6 Points]
Translate the following queries into the tuple calculus (Tupelkalkül)!

i. Which `Critic` (name of the critic) recommends `Dishes` in combination to the `Chardonnay`? [1 Point]

ii. Which `Address` has the `Vineyard` from `Napa Valley` with the `LicenceNo 5439871`. [2 Points]

Translate the following queries into the range calculus (Bereichskalkül) or in Query by Example (QBE)!

i. Which `Vineyards` sell `red wine`? [1 Point]

ii. Which `Wines` of the `Vineyard Creek` have the `Color red` and were produced before the `year 1980`? [2 Points]

6. Weitere Konzepte [insgesamt 8 Points]

(a) Name and explain the ACID-Prinzip! [4 Points]

(b) Which statements (min. 4) does the DDL offer, to preserve referential integrity when `updating` a tuple in a referenced table? Explain their effect. [4 Points]

Relational Schema

1. WINE (WName,Color,Year,ResidualSugar,Vineyard→PRODUCER)
2. PRODUCER (Vineyard,Address,PName→PRODUCTIONAREA,LicenceNo,Amount)
3. PRODUCTIONAREA (PName;Country,Region)
4. GRAPE (GName,Color)
5. MADE_OF (WName→WINE,GName→GRAPE,Proportion)
6. CRITIC (CName,Organization)
7. DISH (Description,SideDish)
8. RECOMMENDATION (CName→CRITIC,WName→WINE,Description→DISH)

Exemplary Database

WINE

WName	Color	Year	ResidualSugar	Vineyard
La Ros Grand Cru	Rot	1998	12	Château La Rose
Creek Shiraz	Rot	2003	35	Creek
Zinfandel	Rot	2004	47	Helena
Pinot Noir	Rot	2001	15	Creek
Pinot	Rot	1999	16	Helena
Riesling Reserve	Weiß	1999	27	Müller
Chardonnay	Weiß	2002	14	Bighorn

PRODUCER

Vineyard	Address	PName	LicenceNo	Amount
Bighorn	Akropolis 109	Napa Valley	5439871	25000
Château La Rose	Rue Château 41	Saint-Emilion	9967412	5000
Creek	Route 41 Apsonville 5	Barossa Valley	1579276	8000
Helena	Akropolis 31	Napa Valley	2273348	15000
Müller	Kiedricherstraße 1	Rheingau	1234567	6500

MADE_OF

WName	GName	Proportion
Creek Shiraz	Shiraz	92.5
Chardonnay	Sauvignon Blanc	96.5
La Rose Grand Cru	Cabernet Sauvignon	4.5
La Rose Grand Cru	Grand Cru	92.0
Pinot Noir	Pinot Noir	97.0
Riesling Reserve	Weißer Riesling	91.5
Zinfandel	Merlot	95.5

RECOMMENDATION

CName	WName	Description
Bruch	Creek Shiraz	Rotwildkeule
Friedrich	Creek Shiraz	Wildschweinkeule
Kaiser	Chardonnay	Lammschnitzel
Kaiser	Riesling Reserve	Falafel
Meier	Riesling Reserve	Erdbeersorbet
Müller	La Rose Grand Cru	Schweinegulasch
Müller	Pinot Noir	Wildschweinkeule
Schneider	Zinfandel	Schweinegulasch

PRODUCTIONAREA

PName	Country	Region
Barossa Valley	Australien	South Australia
Napa Valley	USA	Kalifornien
Pomerol	Frankreich	Bordeaux
Rheingau	Deutschland	Hessen
Saint-Emilion	Frankreich	Bordeaux

CRITIC

CName	Organization
Bruch	Parker Inc.
Friedrich	Johnson e.V.
Kaiser	Quarin e.V.
Meier	Parker Inc.
Müller	Quarin e.V.
Schneider	Gábor Inc.

GRAPE

GName	Color
Cabernet Sauvignon	Rot
Grand Cru	Rot
Merlot	Rot
Pinot Noir	Rot
Sauvignon Blanc	Weiß
Shiraz	Rot
Weißer Riesling	Weiß

DISH

Description	SideDish
Erdbeersorbet	heiße Schokolade
Falafel	Kaffee
Lammschnitzel	Kroketten
Rotwildkeule	Klöße
Schweinegulasch	Klöße
Wildschweinkeule	Kartoffeln