Databases and Web Services
Final Exam, Fall 2022

Instructor: Peter Baumann

| Task	1.1	1.2	1,3	2.1	2.2	2.3	3.1	3.2	4.1	5.1	6.1	6.2	7.1	7.2	8.1	9.1	10.1	Total
Pts	7	4	7	6	8	7	4	4	3	6	4	4	3	4	3	8	8	90
Score																		

1. Data modeling

Task 1.1 (7 pts):

Draw the ER diagram for the following "movie" miniworld, based on the following information (plus common sense, where not stated):

- Movies, which can be Cartoons or Murder-Mysteries, are identified by their title and year, and also have a length and a film type

- Studios have a unique name, and an address

- Stars also have a unique name, and an address

- Studios own Movies, and they do not share

- Stars appear in Movies.

- Due to difficult financing, every Movie can have only one star, but never without any.

Task 1.2 (2+2 pts): In ER modeling, IS-A hierarchies have two important constraints: their *overlap* and *complete-coverage* properties. Explain both (if you want with the help of an example).

Task 1.3 (7 pts): Write SQL statements to create the relations corresponding to the ER diagram below. Assume cardinalities are m:n, and assume suitable attribute types. Remember to introduce all constraints properly.
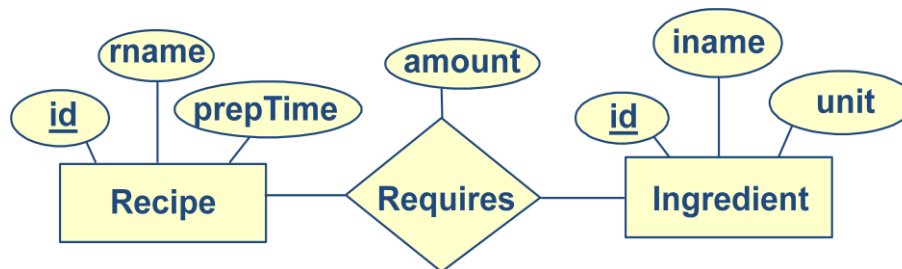

2. SQL

Task 2.1 (2+4 pts): You have a database that contains the following 3 tables:

Movies(id, title, releaseYear, releaseMonth)

Write the following queries in SQL:

  (a) "Titles of all movies released in 2022"
  (b) "For each year, number of movies released"
  (c) "All months where no movie came out"

Task 2.2 (8 pts): In class three different techniques have been explained for mapping entities engaged in an IS-A hierarchy to table schemas. Explain two of them in detail showing the concrete table definitions (be complete wrt constraints, as always!), based on the following schema:
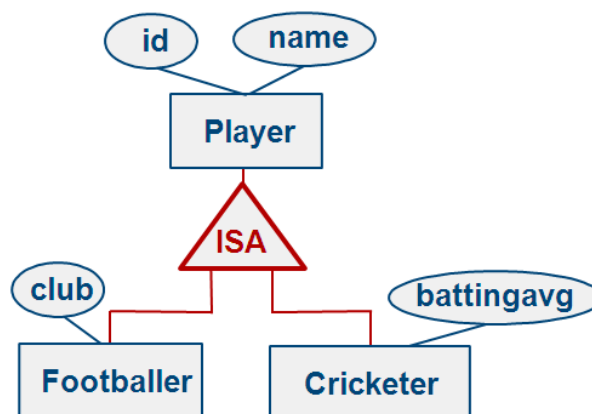
For both schemas, formulate the queries "All Player names" and "All Footballer clubs".

Task 2.3 (7 pts): Draw a logical query plan for the following query:

```
SELECT x.name, z.name
FROM    Product x, Purchase y, Customer z
WHERE x.pid = y.pid AND y.cid = z.cid AND x.price > 100 AND z.city = 'Seattle'
```

3. Indexing

Task 3.1 (4 pts): Explain the B+-Tree database index. (Hint: 4 properties, without "tree")

Task 3.2 (4 pts): In the symbolized B+-Tree below, list the nodes (pages) fetched for answering the range query "value between 68 and 90" in proper sequence.
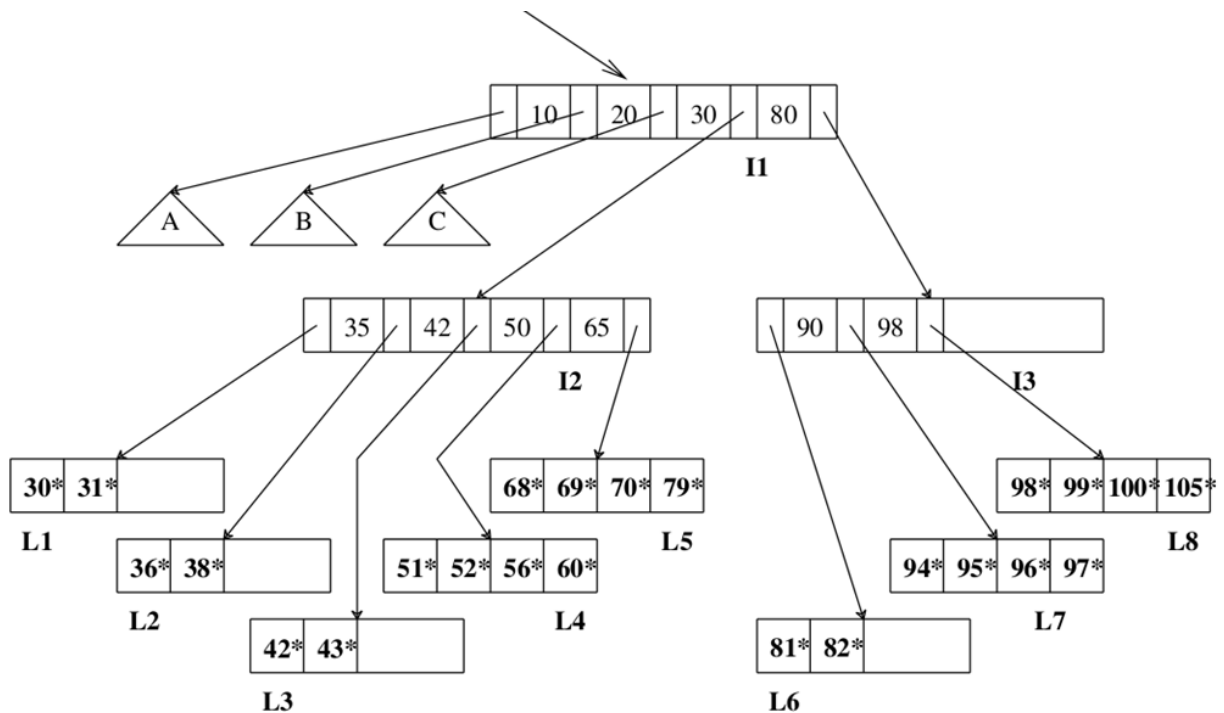
4. Normal Forms

Task 4.1 (3 pts): Assume a relation schema UVWXYZ with Functional Dependencies U→W and X→YZ. Transform this schema into an equivalent one (ie, where all information can be recovered in full) where each table is at least in 3NF. Mark the key(s) of each table!

5. Database Application Programming

Task 5.1 (6 pts): You are hired as a TA for my course and need to provide an example for students showing how, on principle, parameters are passed from the client to search a database and return the result. Write three items, inventing URLs, keys and values, and tables as deemed fit:

- An http request to some imaginary server which contains one search parameter value.
- An SQL query where the incoming parameter of the above request gets used (clearly mark where the input parameter appears in the query)
- An example HTML table which shows how a result consisting of several rows, several columns gets transformed into something the browser understands.

6. Transactions

Task 6.1 (4 pts): You join Bit-On-The-Run Ltd and bring in a fresh view on data management. Your team is curious to learn about transactions in databases. Name the four core properties the (classic) transaction concept offers to database users, and explain each (either by way of what is good with it, or what would go wrong if missing).

Task 6.2 (4 pts): Give an example schedule with actions of transactions T1 and T2 on objects X and Y that results in a read-write conflict through "unrepeatable reads". Show where (=when) exactly the conflict happens. Hint: A diagram (timeline) may help.

7. Security

Task 7.1 (3 pts): You are joining LostSouls Inc. and get instructed to use their standard email disclaimer. Explain to the team why email disclaimers are just wishful thinking and name methods to really achieve <u>secrecy</u> and <u>trust</u>.

Task 7.2 (4 pts): Describe how an SQL injection attack works.
Hint: the attack string has 3 components.

8. NoSQL

Task 8.1 (3 pts): Name and explain two non-relational data models.

9. OLAP

Task 9.1 (8 pts): Explain OLAP datacubes and describe the relational schema used for OLAP datacubes in the ROLAP approach.

10. Big Data

Task 10.1 (8 pts): Define the term Big Data by naming each of the four "V" words and explaining them with the help of examples.

– make me proud! –