DATA BASES 2 – JULY 1ST, 2021 – DURATION: 2H

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A. Active Databases (9 p.)

A sports competition database records the performances of athletes in national running competitions. Primary keys are represented with capital letters.

ATHLETE (ATHL_ID, DISCIPLINE, name, personal_record, country_code, qualified)
COMPETITION (COMP_ID, discipline, number_of_enrolled, winner)
RESULT (COMP_ID, ATHL_ID, time)
COUNTRY (COUNTRY_CODE, DISCIPLINE, national_record)

At the end of a competition, an application inserts all the results of the athletes. Some triggers react to the insertion of the results of a competition, by:

a) Setting the winner of the competition;

b) Updating the personal record if some athlete has improved his best time for the discipline;

c) Updating the national record if some athlete has improved the best time for the discipline of all the athletes of the country;

d) Updating the qualified attribute of an athlete to true if the athlete has set the national record or has won more than 10 competitions.

B Concurrency Control (7 p.)

Classify the following three schedules. Notice that the point where the transactions commit is explicitly reported.

1	r2(x) w2(x) r1(y) C2 r1(x) w1(x)
2	r2(y) w2(y) r1(y) w1(y) C2 C1
3	r1(y) r2(y) w2(y) r2(x) w2(x) C2 r1(x) C1

a) Build a table like the one below that summarizes the results. Fill it in just with Yes/No.

	VSR	CSR	2PL	Strict-2PL	TS Multiversion
1					
2					
3					

b) Then, briefly motivate all the “No” (one or at maximum 2 lines of explanations for each “No”).

C. Physical Databases (9 p.) Consider again tables COMPETITION, ATHLETE and RESULT from Ex. A.

Table COMPETITION stores 1000 tuples in a B+ primary storage built on attribute Discipline, with 3 levels and 100 leaf nodes. Table ATHLETE stores 100K tuples in 5K blocks in a hash primary storage with the hash function defined on ATHL_ID. The average cost for a lookup is 1.2 i/o ops. Table RESULT stores 1M tuples in 100K blocks in a primary entry-sequenced sequential structure.

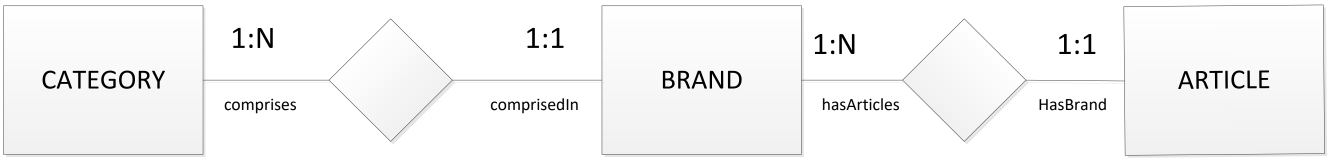
On table RESULT there are a secondary B +-tree index built on attribute COMP_ID, with three levels and 2.5k leaf nodes and a hash-index built on attribute ATHL_ID with (the same function as that of the primary hash on Athlete and) negligible overflow chains.

Consider the query that extracts the athletes who won the 5000m with a time that is less than 13 minutes. Describe a reasonably efficient plan (and estimate its cost) in the above scenario, knowing that val(Discipline)=50.

```
select *
from ATHLETE
where Discipline = "5000m" and
      (ATHL_ID, Discipline) in
        ( select ATHL_ID, Discipline
          from COMPETITION join RESULT on
               ATHL_ID = Winner
          where Time < "13:00.00" )
```

D. JPA (7 p.)

An e-commerce web application manages data that adhere to the following conceptual model.



The user can access a HOME page where he can start to drill down the catalogue. In the HOME page he can select one category (e.g., “sport apparel”) from a list of categories to see its brands, which are shown in a BRANDS page. For the list of brands in the BRANDS page he can select one brand (e.g., “Adidas”) of the chosen category to see its articles, which are listed in an ARTICLES page. By choosing one article from the list in the ARTICLES page finally he can see the details of the chosen article in the ARTICLE page. The details of an article include: code, name, price, picture and the brand it belongs to. Clicking on the bands attribute of an article leads back the ARTICLES page showing all the articles of that brand.

The categories are in the order of tens, the brands in the order of hundreds, and the articles in the order of hundreds of thousands.

Show the JPA entities that map the domain objects of the conceptual model, taking into account the above mentioned access paths of the application. When designing the annotations for the relationships, specify the owner side of the relationship, the mapped-by attribute, and the cascading policies you consider more appropriate to support the access required by the web application.