北京邮电大学 2021——2022 学年第一学期

《数据库系统原理》期中测验

<table>
<tr><td rowspan="2">考试注意事项</td><td colspan="10">一、学生参加考试须带学生证或学院证明，未带者不准进入考场。学生必须按照监考教师指定座位就坐。
二、书本、参考资料、书包等物品一律放到考场指定位置。
三、学生不得另行携带、使用稿纸，要遵守《北京邮电大学考场规则》，有考场违纪或作弊行为者，按相应规定严肃处理。
四、学生必须将答题内容做在试题答卷上，做在试题及草稿纸上一律无效。
五、填空题用英文答，中文答对得一半分。</td></tr>
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<tr><td>考试课程</td><td colspan="4">数据库系统原理</td><td colspan="2">考试时间</td><td colspan="4"></td></tr>
<tr><td>题号</td><td>一</td><td>二</td><td>三</td><td>四</td><td>五</td><td>六</td><td>七</td><td>八</td><td>九</td><td>总分</td></tr>
<tr><td>满分</td><td>16</td><td>14</td><td>30</td><td>20</td><td>20</td><td></td><td></td><td></td><td></td><td>100</td></tr>
<tr><td>得分</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>阅卷教师</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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1. (16 points) Choices

(1) In the following statements, the correct ones are ___C___

  I. The data model defines the specification of managing data items in database. It is a collection of conceptual tools for describing data structure, data relationships, data semantics, data operations and consistency constraints.

  II. In relational model, as human-machine interfaces, the pure database language consists of two parts, i.e. the data manipulation language and the data definition language that is for specifying the database schema and as well as other properties of the data.

  III. A foreign key is a set of one or more attributes that, taken collectively, can be used to identify uniquely a tuple in the relation.

IV. A C++ application program can access database via embedded SQL.

A. I, II, III, IV   B. I, II, III
C. I, II, IV   D. II, III, VI

(2) In the relational model, there are pure query languages defining operating on relational data, that is___A___

  A. relational algebra, tuple relational calculus, and domain relational calculus

  B. relational algebra and tuple relational calculus

  C. relational algebra and domain relational calculus

  D. relational algebra, tuple relational calculus, and SQL

(3) Among the following groups of database products, which one is completely developed and distributed by domestic companies and manufactures?___C___

  A. Oracle, OceanBase, OpenGauss, TiDB

  B. SQL Server, MySQL, PostgreSQL, DB2

  C. TiDB, 达梦, openGauss, OceanBase, PolarDB, 人大金仓,

  D. Oracle, DB2, Sybase, SQL Server

(4) Among the following statements, the correct one/ones is/are __C___.

  I. OpenGauss database, derived from PostgreSQL, is developed and distributed by Huawei

  II. MySQL and PostgreSQL are two typical open-source database systems.

  III. A on-line shopping site has a three-tier Browser-Server(B/S) architecture. Its application programs are programmed in Java, and these programs access MySQL database server via the ODBC interface.

  IV. The relational model is applicable to managing structured data such as the table data, while XML provides a way to represent semi-structured data, e.g. the data with nested structures.

  A. I, II, III, IV   B. I, II, III   C. I, II, IV   D. II, III, IV

(5) In the relational data model, __B__ is a language for specifying the database

schema as well as other properties of the data.

      A DML   B DDL   C relational algbra   D DSL

(6) With respect to DBS design, a relational table's primary key is defined at the
      C   Phase.

    A. requirement analysis   B. conceptual design

    C. logical design   D. physical design

(7) Data independence means that   B   and   are independent and unaffected.

    A. view level, logical level   B. data, applications

    C. data, DBMS   D. conceptual model, physical model

(8) With respect to DBS design, the index is defined on the table and the database file is determined at the   D   phase.

    A. requirement analysis   B. conceptual design

    C. logical design   D. physical design

(9) The   A   describes the global logical structure of the database's total data, that is, how the data items are stored in DBS, and what relationships exist among those data.

    A. logical schema   B. internal schema

    C. external schema   D. user schema

(10) In relational databases, referential integrity can be ensured by defining   C on tables.

    A. primary key   B. candidate key

    C. foreign key   D. not null constraint

(11) At the conceptual design stage for the database design,   D   is used to describe the data objects in the world and the associations among the objects.

    A. Relational model   B. Hierarchical model

    C. Network model   D. Entity-Relationship data model

(12) Considering the **University** Database given in the textbook. For the following SQL queries, which one will use the relational algebra operator *Cartesian product*? A

   A. select name, course_id   B. insert into student
     from instructor, teaches   values('3003', 'Green', 'Finance', 'null')
     where name='Crick'
   C. update course   D. select name, building
     set   credits=3   from instructor natural join department
     where title=Database

(13) In SQL language, the statement that can be used for security control is D

      A. insert   B. update   C. commit   D. grant

(14) Consider the relation schema **Department-schem**a(*department-name, building, budget*) and relation **department**, which one is not the metadata stored in data dictionary?   D

      A. the name of the relation **department**
      B. the domain and length of attribute **building**
      C. the number of tuples in **department**
      D. a tuple <*Computer, Building_3, 30000*>

(15) Given the cardinalities of the entity sets **A** and **B** with respect to the relationship set **R**, the participation constraints of **A** can be decided by   A ;

    A. l_A B. h_A C. l_B D. h_B
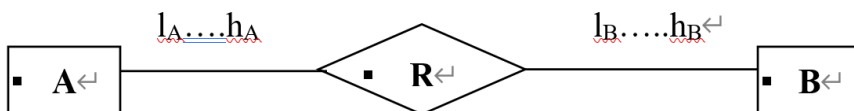
   The mapping cardinality from **A** to **B** can be decided by C .

  A. $[l_A, l_B]$ B. $[h_A , h_B]$ C. $[h_B , h_A]$ D. $[l_A, h_B]$

2. (14 points) Suppose there are the following relations:

Book(<u>BookNum</u>, BookName, Author, PublishingHouse)

Reader(<u>BorrowCardNum</u>, ReaderName, ReaderAddress)

Borrowing(<u>BorrowCardNum</u>, <u>BookNum</u>, BorrowDate, ReturnDueDate)

Returning(<u>BorrowCardNum</u>, <u>BookNum</u>, ReturnDate)

 Please use relational algebra to write the following queries.

(1) Find the book names that Andy borrowed, published by the "POSTS & TELECOMM PRESS" and already returned. (4 points)

(2) Find the reader names and book names that have not returned the books before 31, Dec, 2020. (5 points)

(3) Find the reader names that have not borrowed any books before. (5 points)

Answers：

(1) $\Pi_T(\sigma_{N=\text{'Andy'}}(\sigma_{P=\text{'人民邮电'}}(L \bowtie R \bowtie B \bowtie LA)))$ (4 points)

(2) $\Pi_{N,T}((\Pi_{C\#, B\#}(\sigma_{LD<2020/12/31}(L)) - \Pi_{C\#,B\#}(LA)) \bowtie R \bowtie B)$ (5 points)

(3) $\Pi_N((\Pi_{C\#}(R) - \Pi_{C\#}(L)) \bowtie R)$ (5 points)

Book B(BookNum B#, BookName T，Author A，PublishingHouse P);

Reader R(BorrowCa rdNum C#，ReaderName N，ReaderAddress D);

Borrowing L(BorrowCardNumber C#, BookNumber B#, BorrowDate LD,

   lReturnDueDate DD);

Ruturning LA(BorrowCardNumber C#, BookNum B#, ReturnDate RD).

3. (30 points). In the database of a school sport-meeting management system, there are five relational tables as follows.

competition_category(*category_id, cname, manager*)
competition_event(*event_id, ename, time, level, category_id*)
player(*player_id, pname, age, sex, phone_number, team_number*)
event_player(*event_id, player_id, grade*)
team(*team_number, tname, leader*)

The four data objects competition category, competition events, department teams, players are modelled as the relational table *competition_category, competition_event, team,* and *player*, respectively. Every competition category has several competition events. Each event belongs to a unique category. Every team has several players. Each player belongs to a unique team. Each player could attend different competition events. And each event can be attended by more than one player. Players have their grades in different events.

Give SQL statements for the following queries.

(1) Create the table *player*, in which {*player_id*}is the primary key; there exists a referential integrity constraint from *player* to *team*. It is also required that the player's *phone_number* is not null. (10 points)

create table *player* (*player_id* varchar(5),

                                 pname varchar(10),
                                 age int,
                                 sex char(5),
                                 phone_number varchar(20) not null,
                                 team_number varchar(10),
                                 primary key (*player_id*),
                                 foreign key (*team_number*) references
team(*team_number*)

);

主键、外键、not null 约束，每个 1 分。其它 6 个属性定义 7 分。

(2) Find the *player_id* and average competition grade of each player in the "computer science department team", whose average grade of the competition is more than 85. (10 points)

select *event_player.player_id*, avg(*grade*)

from *player, event_player, team*
where *player.team_number=team.team_number* and
    player.player_id=event_player.player_id and
    tname="*computer science department team*"
group by *event_player.player_id*
having avg(*grade*)>85

关联查询涉及到的每个表 1 分，聚集操作 1 分，每个连接条件和查询条件 1 分，group by 子句 1 分，having 子句 1 分。

(3) Use one or more SQL statements to verify whether or not *cname* is the candidate key in the table *competition_category*(<u>*category_id*</u>, *cname, manager*), i.e. the functional dependency *cname* → <u>*category_id, manager*</u> is satisfied by the table, according to the query results of one or more SQL statements.   (10 points)

答案：
方案 1：
   select   max(count(*)
   from   *customer*

group by *customerID*
或者：
　　select max(*numTuple*)
　　from {
　　select　*customerID*, count(*) as *numTuple*
　　from　*customer*
　　group by *customerID*
　　}
　如果查询结果大于1，则*customerID***不是主键。**

<mark>主键*customerID*进行group by运算，4分；利用count统计相同*customerID*的元组总数2分；用max取最大值，根据结果判断主键是否成立，2分；</mark>

方案2：
　　　　利用下述语句
　　　　select　*
　　　　from　*customer* as A, *customer* as B
　　　　where A.*customerID* =B.*customerID*
　　　　　and (A.*name*<>B.*name* OR A.*address*<>B.*address*)

　　如果该语句查询结果为空，则 *customerID* 是主键。

　<mark>正确写出 where 中的判断条件，4 分；</mark>
<mark>说明根据查询结果是否为空，判断主键是否成立，2 分。</mark>

4.(20 points) A naval base (海军基地) is preparing to set up a fleet (舰队) management information system, which gives the following information.

(1) A *fleet* is uniquely identified by a *FleetName* and described by *FleetLocation* and *FleetState*.

(2) Every *warship* (舰艇) is identified by a *ShipID* and described by *ShipName* and *ShipType*.

(3) Each *weapon* (武器) is identified by *WeaponID*. It also has descriptive attributes *ProductionTime* and *StorageAddress*.

(4) A *soldier* (士兵) is distinguished by its *SoldierID*. For each soldier, the *SoldierName, Age, Sex* and *Rank* should be recorded.

(5) A *camp* (军营) is recognized by its *CampName* and has attributes *CampLocation* and *Capacity*.

(6) Each fleet *contains* more than one warship, and every warship belongs to a unique fleet. The *number* of warships contained by each fleet must be recorded.

(7) Each warship is *equipped* with several weapons, and a weapon can be used on different warships.

(8) A soldier *belongs* to a unique warship, but a warship has more than one soldier.

(9) A camp can *accommodate* many soldiers, but a soldier can only belong to a unique camp.

Construct an E-R diagram to depict the above mentioned data items and the associations among them.
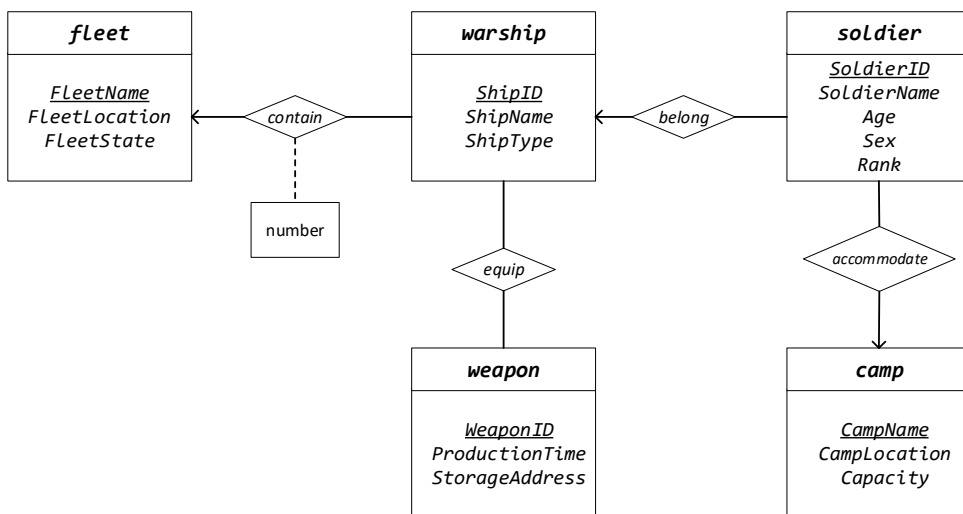
5 个实体各 2 分；3 个联系（belong、accommodate、equip）各 2 分；*contain* 联系正确标注 number 属性得 2 分，没有标注 number 属性得 1 分；联系的映射基数有误，酌情扣分。

5. (20 points) Convert the following E-R diagram about the hospital management information system to the relation schemas, and identify the primary key of each relation by underlining the primary attributes.
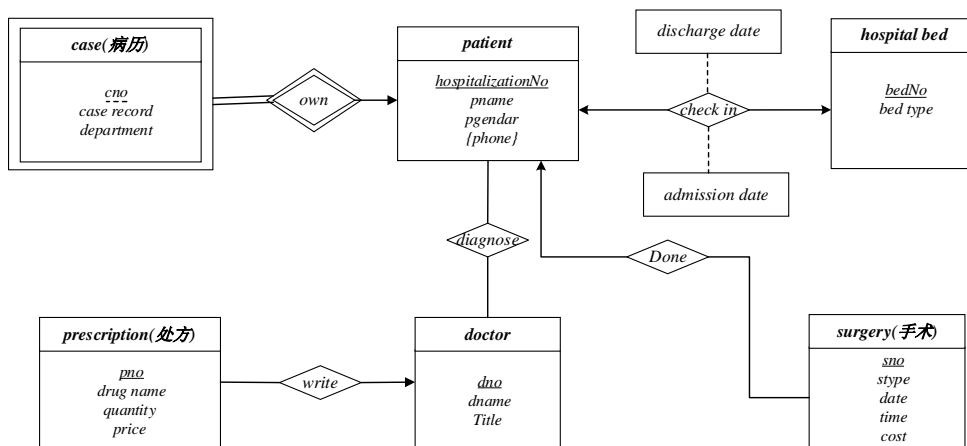
答案：

弱实体集 case：case(<u>hospitalizationNo</u>, <u>cno</u>, case record, department)　（3 分）

方案 1：实体 patient、一对一联系 check-in、hospital bed，check-in 归并到一端 patient

patient (<u>hospitalizationNo</u>, pname, pgendar, bedNo, discharge date, admission date)
(3 分)

hospital bed (<u>bedNo</u>, bed type)　（2 分）

方案 2：实体 patient、一对一联系 check-in、hospital bed，check-in 归并到一端 hospital bed

patient (<u>hospitalizationNo</u>, pname, pgendar) (2 分)

hospital bed (<u>bedNo</u>, bed type, hospitalizationNo, discharge date, admission date)　（3 分）

patient 的多值属性 patientphone:

patientphone (<u>hospitalizationNo</u>, <u style="color:red">phone</u>)　（2 分）

实体 doctor：doctor(<u>dno</u>, dname, title)　（2 分）
多对多联系 diagnose：diagnose(<u>dno</u>, <u>hospitalizationNo</u>)　（2 分）

处方 prescription：prescription(<u>pno</u>, drug name, quantity, price, dno)　（3 分）
手术 surgery：surgery(<u>sno</u>, stype, date, time, cost, hospitalizationNo)　（3 分）

注：没有正确标注主键，扣 1 分。没有正确归并联系 Patient、Case、Prescription、Surgery，分别扣 1 分。

此外，多对一联系 Done、write 由于多端非完全参与，这 2 个联系也可以单独转换为关系表。