Xi'an Jiaotong-Liverpool University

西交利物浦大学

PAPER CODE	EXAMINER	DEPARTMENT	TEL
CPT103	Jianjun Chen	Computing	0512 81889137

2nd SEMESTER 2022/23 RESIT EXAMINATION

Undergraduate – Year 2

Introduction to Database Systems

TIME ALLOWED: 2 Hours

INSTRUCTIONS TO CANDIDATES

1、   This is a closed book examination.

2、   Total marks available are 100.

3、   Answer all questions.

4、   Answer should be written in the answer booklet(s) provided.

5、   Only English solutions are accepted.

6、   The university approved calculator - Casio FS82ES/83ES can be used.

7、   All materials must be returned to the exam supervisor upon completion of the exam. Failure to do so will be deemed academic misconduct and will be dealt with accordingly.

Question A: SQL (30 marks)

Consider the following relations used in a gaming platform:

Games

ID (int)	Title (varchar(255))	Developer (varchar(255))	Publish_date (date)
1	Game1	Developer1	2022-02-01
2	Game2	Developer2	2021-01-01
3	Game3	Developer2	2021-12-01

Players

Username (varchar(100))	Join_date (date)
Player1	2022-01-11
Player2	2022-01-01
Player3	2020-12-12

Ownership

Username (varchar(100))	Game_ID (int)
Player1	1
Player1	2
Player2	1
Player2	2
Player2	3

a) You are given the following SELECT queries. What are the results of application of these queries to the tables "Games" "Players" and "Ownership"? Provide the answer in a table format. In case that query is not valid, explain the reason. (3 marks each)

1) **SELECT DISTINCT** ID, Developer **FROM** Games **WHERE** Publish_date > '2021-05-17';

[Handwritten answer:]

ID	Developer
1	Developer 1
3	Developer 2

2) **SELECT** sum(Game_ID), count(Join_date) **FROM** Players **NATURAL JOIN** Ownership;

[Handwritten answer:]

Sum(Game_ID)	Count(Join_date)
9	5

3) **SELECT** Title **AS** GameTitle **FROM** Games **WHERE** Publish_date **LIKE** '2021-%-01';

[Handwritten answer:]

GameTitle
Game2

4) **SELECT * FROM** Games **WHERE** ID <> 1
   UNION
   SELECT * FROM Players **WHERE** Join_date > '2022-01-01';

[Handwritten answer:] The number and datatype of two query are different, so can't use union.

b) Write an SQL statement to find the total number of players registered in the platform.
(4 marks)

[Handwritten answer:] SELECT count(*) from players.

c) Write an SQL statement to list all developers that have developed more than 2 games. In the result, show developers.
(4 marks)

[Handwritten answer:] SELECT Developer from Games Group BY Developer having count(ID) >= 2.

d) Write an SQL statement to list all games that no player owns. The query result should list game IDs.
(5 marks)

[Handwritten answer:] SELECT G.ID as games-IDs from Games G where G.ID Not IN (SELECT O.Game-ID from Ownership O)

e) Write an SQL statement to find all players that own none of the games owned by the player 'player6'. In the result, list usernames of these players.
(5 marks)

[Handwritten answer, crossed out:] ~~SELECT UserName from Ownership where Game_ID Not IN (Select Game_ID from Ownership where username='player6'.~~

[Handwritten answer:] SELECT P.username from players p WHERE NOT Exists (SELECT 1 From Owers O where O.username = p.username and O.Game_ID IN (SELECT Game_ID From Ownership where username = 'player6'));

Question B: Functional Dependencies (20 marks)

The relation t below stores the information about modules, lectures and teachers of lecture sessions. Assume that the module code is unique for a given module. A module has several lectures and each lecture is assigned with a session ID. If two lectures teach the same content, their session IDs will be the same. As a result, if a lecture of a module is delivered in two different academic years, their session ID will be the same. A same lecture will not be delivered again in the same day. Lecture session IDs are always different among different modules.

t

A ModuleCode	B ModuleTitle	C SessionID	D SessionDate	E TeacherID	F TeacherName
UG101	Programming	101_1	2022-09-01	01001	John Lewis
UG101	Programming	101_2	2022-09-08	01001	John Lewis
UG101	Programming	101_1	2021-09-01	01030	Henry Greenhill
UG101	Programming	101_2	2021-09-08	01030	Henry Greenhill
UG102	Operating Systems	102_1	2022-09-02	01002	Anne Sarah
UG102	Operating Systems	102_1	2021-09-02	01002	Anne Sarah

From the given table data:

1. Identify the Primary Key for the relation. (5 marks) *(ModuleCode, SessionDate)*
2. Determine all functional dependencies. From these dependencies, identify which are partial (if any) and which transitive (if any). (5 marks)
3. Normalise t to the third normal form. Write down each normalisation step (2NF then 3NF) in details. (10 marks)

2. (ModuleCode SessionDate) → all other attributes

TeacherID → TeacherName   transitive dependence

ModuleCode → ModuleTitle   partial dependence

3. (A, B, C, D, E, F) | (A, D, C, E)

AD → B, C, E, F | (E, F)

E → F

A → B | (A, B)

Question C: Relation Constraints (20 marks)

Answer the following questions related to relation constraints:

1. Explain the effect of specifying reference options when creating foreign keys using "CASCADE" and "RESTRICT" as examples: How do these two options work under different situations (delete and update)?

    (10 marks)

2. Assume that the underlined columns (A1 and B1) are the primary keys of table A and table B. Explain what will happen if one tries to add the following foreign key to table A and why?

    ```
    ALTER TABLE B ADD
    CONSTRAINT fk_a FOREIGN KEY (A2) REFERENCES B (B1)
    ```

    (5 marks)

It will fail because ALTER TABLE B means we want to add a foreign key on Table B and reference the column in Table A, but CONSTRAINT fk_a FOREIGN KEY (A2) REFERENCES B (B1) means we want to make A2 a foreign key, but A2 is not in Table B.

问题 A2中有3.0值不在 B中，无法构对

A

A1 (INT)	A2 (INT)
1	2
1	3

B1 (INT)	B2 (INT)
3	3
4	4

3. Explain the difference between primary key and unique key.

    (5 marks)

1. CASCADE: when the referenced column in referenced table is updated or deleted, the referencing column in referencing table will be updated or deleted as well.

RESTRICT: when the referenced column in referenced table is updated or deleted, the system will stop users from doing this.

3. ① Primary key cannot contain any nulls, but unique key can.

② There is only one primary key in one table, but unique key can be multiple in one table.

- **ON UPDATE CASCADE**: If the primary key (or unique key) in the parent table is updated, the foreign key in the child table will automatically update to reflect the new value.

- **ON DELETE CASCADE**: If a row in the parent table is deleted, all corresponding rows in the child table that reference that row will also be automatically deleted.

- **ON UPDATE RESTRICT**: If there are foreign key references in the child table, attempting to update the primary key in the parent table will be blocked.

- **ON DELETE RESTRICT**: If there are foreign key references in the child table, attempting to delete a row from the parent table will be blocked.
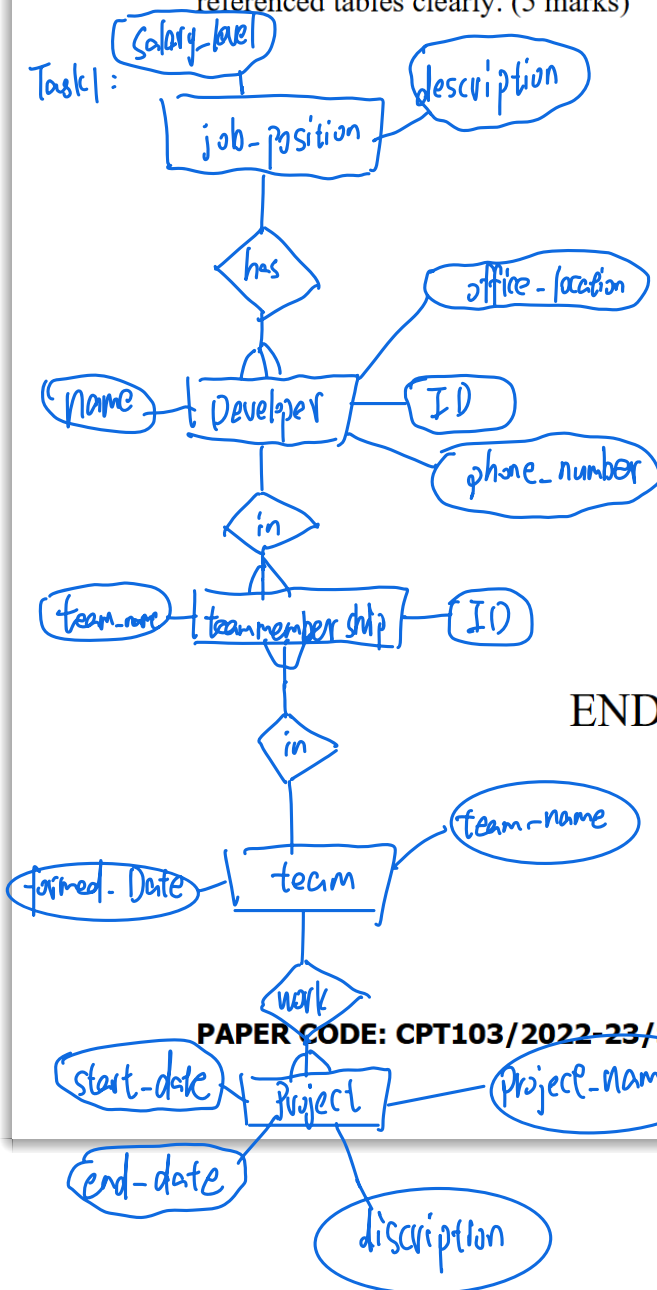
Question D: Entity-relationship Modelling (30 marks)

You are hired by a software company to develop a database for managing developers and projects.

1. Each developer has an ID card with a unique ID number, a job position, a name, a phone number and an office location.
2. A job position is associated with a description and a salary level. Many developers can have a same job position.
3. Developers form teams to develop projects. Each project is handled by a single team and each team can only work on one project at the same time.
4. A team has a team name, the date it was formed and a list of developers.
5. Each project has a project name, project start date, project end date and a description.
6. The database should have a record of historical projects handled by teams.

Task 1: Draw the entity relationship diagram for the port company's database. (25 marks)

Task 2: Write down the foreign keys of these tables. You must indicate referencing tables and referenced tables clearly. (5 marks)

Task1:

END OF RESIT EXAM