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Directions:

You may use your textbook, notes, course assignments and internet resources. Submit your file as a word DOCX or PDF file. Check iLearn course page for deadline date and time.

You do not have a time limit for this exam. If you are well prepared it should take about 2 hours. You may use resources such as your computer, textbook and notes from the class. But do not get help from other people or give help to other students. Sign the honor pledge below.

I did not give or receive any unauthorized help in doing this exam. The exam is my own work.

_____ *Christopher Holmes* _____

Sign your name above.

Problem	Possible Points	Your Score
1-14 3 points each	42	
15	4	
16	8	
17	3	
18	3	
19-30 2 points each	24	
31	8	
32	8	
Total	100	

Multiple Choice. Indicate the single best answer.

1. A relational database design for an entity with sub-type entities is done using
 - a. single table, the extra attributes of the sub-type entity have NULL values
 - b. multiple tables, one for the super-type entity, and one table containing the additional attributes of each sub-type
 - c. using a 1:Many relationship between parent – child types.
 - d. **either option a or b will work.**

2. Students enroll in one or more courses each semester. This is an example of
 - a. **One:Many relationship between entities STUDENT and COURSE.**
 - b. One:One relationship between entities STUDENT and COURSE.
 - c. Many:Many relationship between entities STUDENT and COURSE.
 - d. Weak entities.

3. Defining an index on a column will
 - a. provide fast access for the predicate column =
 - b. eliminate the need to sort records when there is an order by column
 - c. provide fast access for column like '%value'
 - d. all of the above
 - e. **a and b only.**

4. A column can be defined with the NULL attribute to indicate
 - a. a data value is missing
 - b. the attribute is not applicable to this entity.
 - c. a default value should be inserted by the DBMS.
 - d. **A and B**
 - e. A, B and C.

5. Dirty read is
 - a. Reading data that was previously changed in the same transaction.
 - b. **Reading data that been committed by another transaction but has not been written to the log yet.**
 - c. Reading data that was modified by another transaction before it was rolled back.

6. Nonrepeatable read is
 - a. **Reading data and then later in the same transaction finds that the record has changed.**
 - b. Two requests read the same record and get different values.
 - c. A request reads a record and then commits. It later reads the record again and finds that it has changed.

7. The names of the ANSI isolation levels, in order from least to most restrictive are
 - a. dirty read, non repeatable read, phantom read
 - b. serializable, repeatable read, read committed
 - c. **read committed, repeatable read, serializable**
 - d. auto commit, read commit, repeatable read, serializable

8. The payroll department accidentally runs the wrong payroll database update program on Friday at 2:00pm. The error is caught a few minutes after the program has terminated normally. The best way to recover from this error is
 - a. restore the database to the last backup
 - b. restore the database to the last backup and apply all log records since the backup
 - c. **restore the database to the last backup and apply all log records between the last backup and Friday 1:59pm just before the erroneous updates.**
 - d. tell the payroll department that it is too bad and nothing can be done.

9. You attempt to recover a database using the latest backup but find the backup file is corrupted. What can you do?
 - a. Nothing. The data is lost.
 - b. **Use the next latest backup and use all logs since that backup.**
 - c. Don't worry. The DBMS will automatically use the logs to repair the corrupted backup.

10. On Friday at 2:46pm there is a power failure and the database server stops. When power is restored what should you do?
 - a. Restore all database to the last backup and apply logs.
 - b. Do nothing. The DBMS will automatically recovery all committed transactions and undo any uncommitted transactions.
 - c. You need to use the logs to undo any uncommitted changes to the data.
 - d. You need to use the log to redo committed changes that were buffered in RAM and not written to the hard drive.
 - e. **You need to do both C and D using the appropriate command.**

11. SQL views can be used to
- create virtual tables that are summaries of data tables.
 - hide columns from a user
 - hide rows from a user
 - provide additional security that a user can only select or update certain columns or rows in a table that contain their user id.
 - B and C and D only.
 - All of A, B, C and D.**
12. If I want to allow user1 to read and update the jrj.customer table I would do the following sql
- grant update on jrj.customer to 'user1'@'%'
 - give read, write on jrj.customer to 'user1'@'%'
 - grant select, update on jrj.customer to 'user1'@'%'**
 - give select, update on jrj.customer to 'user1'@'%'
13. What does the "WITH GRANT" keyword do on an SQL DCL statement
- give all privileges owned by the user to another user
 - give specified privileges to another user and allow that user to give them to other users**
 - give DBA administrator privileges to the user
 - gives administrator privileges to another user but only for the specified table
14. Given the following table and data

Key	LastName	Rank	Room	Shift
1	Smith	Manager	34	AM
2	Johnson	Custodian	33	PM
3	Smith	Custodian	33	Evening
4	Doe	Clerk	222	AM

Which is a candidate key for this data?

- LastName**
- Room
- Shift
- {Rank, Room}
- {Room, Shift}

Short Answer– answer with a few well written sentences.

15. Isolation

A web program does the following operations

```
start transaction
```

```
set isolation level = repeatable read
```

```
select count from inventory where partno = ?
```

```
update inventory set count = ? where partno = ?
```

```
commit
```

The DBMS uses MVCC (multi version concurrency control). The program occasionally receives an SQL error from the update statement when another concurrent request for the same partno is executing. What could be done to avoid this error?

To help avoid this error, you could set the isolation level to read committed. This will ensure that as soon as the data is read, it is written so that there is no lingering lock on it, and this would help to eliminate the error when two users are trying to access the same part number at the same time.

16. Atomic.

- i. What does the term “atomic” mean in database processing?

It means that a transaction is one where either all occur, or nothing occurs.

- ii. Why is it important that program work in an “atomic” manner?

It is important that the program work in an atomic manner to ensure data integrity. If you were working with a customers bank account, if money was lost due to a transaction error, the customer would not be happy, however, with an atomic transaction, the entire transaction completes ensuring no money is lost, or nothing happens.

- iii. What is the php statement that is used to start a transaction in mysql?

`mysqli_begin_transaction`

- iv. What is the php statement that will terminate a successful transaction in mysql?

`mysqli_commit`

17. Give an example of a lost update problem?

A lost update could happen when you have an inventory system for a store, and two sales are being attempted to be made at the same time for the same exact item. The first sale starts its transaction, and a second one begins almost immediately. The first transaction updates the quantity on hand, and before it is able to commit, the second transaction updates the quantity on hand to reflect its sale. The quantity on hand will only reflect the items sold on the second transaction due to the lost update.

18. Specify the SQL CREATE TABLE statements that would be used to implement the following E-R model . Specify primary and foreign keys constraints. Specify appropriate data types and NULL or NOT NULL properties for each attribute.



```

-- MySQL Script generated by MySQL Workbench
-- Sat Feb 17 20:19:38 2018
-- Model: New Model   Version: 1.0
-- MySQL Workbench Forward Engineering

SET @OLD_UNIQUE_CHECKS=@@UNIQUE_CHECKS, UNIQUE_CHECKS=0;
SET @OLD_FOREIGN_KEY_CHECKS=@@FOREIGN_KEY_CHECKS,
FOREIGN_KEY_CHECKS=0;
SET @OLD_SQL_MODE=@@SQL_MODE,
SQL_MODE='TRADITIONAL,ALLOW_INVALID_DATES';

-----

-- Schema mydb
-----

-----

-- Schema mydb
-----

CREATE SCHEMA IF NOT EXISTS `mydb` DEFAULT CHARACTER SET utf8 ;
    
```

```

USE `mydb` ;

-----
-- Table `mydb`.`PROJECT`
-----
CREATE TABLE IF NOT EXISTS `mydb`.`PROJECT` (
  `ProjectID` INT NOT NULL,
  `ProjectName` VARCHAR(45) NULL,
  `Department` VARCHAR(45) NULL,
  `MaxHours` VARCHAR(45) NULL,
  `StartDate` VARCHAR(45) NULL,
  `EndDate` VARCHAR(45) NULL,
  `EMPLOYEE_EmployeeNumber` INT NULL,
  PRIMARY KEY (`ProjectID`, `EMPLOYEE_EmployeeNumber`),
  INDEX `fk_PROJECT_EMPLOYEE_idx` (`EMPLOYEE_EmployeeNumber` ASC),
  CONSTRAINT `fk_PROJECT_EMPLOYEE`
    FOREIGN KEY (`EMPLOYEE_EmployeeNumber`)
      REFERENCES `mydb`.`EMPLOYEE` (`EmployeeNumber`)
    ON DELETE NO ACTION
    ON UPDATE NO ACTION)
ENGINE = InnoDB;

-----
-- Table `mydb`.`EMPLOYEE`
-----
CREATE TABLE IF NOT EXISTS `mydb`.`EMPLOYEE` (
  `EmployeeNumber` INT NOT NULL,
  `FirstName` VARCHAR(45) NULL,
  `LastName` VARCHAR(45) NULL,
  `Department` VARCHAR(45) NULL,
  `Phone` VARCHAR(10) NULL,
  `Email` VARCHAR(45) NULL,
  `PROJECT_ProjectID` INT NULL,
  `PROJECT_EMPLOYEE_EmployeeNumber` INT NULL,
  PRIMARY KEY (`EmployeeNumber`, `PROJECT_ProjectID`,
  `PROJECT_EMPLOYEE_EmployeeNumber`),
  INDEX `fk_EMPLOYEE_PROJECT1_idx` (`PROJECT_ProjectID` ASC,
  `PROJECT_EMPLOYEE_EmployeeNumber` ASC),
  CONSTRAINT `fk_EMPLOYEE_PROJECT1`
    FOREIGN KEY (`PROJECT_ProjectID`, `PROJECT_EMPLOYEE_EmployeeNumber`)
      REFERENCES `mydb`.`PROJECT` (`ProjectID`, `EMPLOYEE_EmployeeNumber`)
    ON DELETE NO ACTION
    ON UPDATE NO ACTION)
ENGINE = InnoDB;

SET SQL_MODE=@OLD_SQL_MODE;

```



```
SET FOREIGN_KEY_CHECKS=@OLD_FOREIGN_KEY_CHECKS;  
SET UNIQUE_CHECKS=@OLD_UNIQUE_CHECKS;
```

19. A hard drive containing database JRJ crashes and all data is lost. Briefly describe what you would do. You do not have to give specific MySQL commands, but you have to indicate the steps.

The first thing I would do is bring back up a database server that is running the same version of the database server. Once I have a the server installed, I would then restore the most recent database backup that was taken of the database that was lost. Since all data was lost, we do not have any transaction logs to restore further than the last backup that was taken. This is why it is important to take consistent backups of your data so that if you do have a hardware failure resulting in data lose, you only loose a small amount of data instead of lots.

If you need to create (or recreate) the Art Course tables for questions 20 - 29, use the file from iLearn

- FinalExam Art Course Tables.sql

20. What are the names of the tables created in the art course database?

The tables in the art database are, course, customer, and enrollment

21. What are the names of the columns in the enrollment table?

CustomerNumber, CourseNumber, and AmountPaid

22. What is the datatype of the course.CourseDate column?

datetime

23. Describe the type and cardinality of the relationships among the Course, Customer and Enrollment tables.

Course to Enrollment is a one and only one mandatory to a one or more mandatory.
Customer to Enrollment is a one and only one mandatory to one or more mandatory.

24. What are the primary and foreign keys in the enrollment table?

CourseNumber is the Primary Key
CustomerNumber is the Foreign Key

25. If Course with CourseNumber 1 was deleted from the Course table, would this delete be successful?

This delete will complete.

26. What changes would occur in the Enrollment table when courseNumber 1 was deleted?

The rows that have a coursenum of 1 will be removed from the enrollment table.

27. If I wanted to prevent the deletion of a course that had active enrollments, what changes would I make to table definitions?

You would use the phrase 'on delete no action' so that when you try and delete a course that has enrollments, it will not allow for the deletion and throw an error as long as there are enrollments.

28. Is it possible to change the value of a primary key with an update statement? What effect does this have on the foreign key values in other tables?

Primary keys should not be changed with an update statement. This will cause data integrity issues in your database down the line if you start making changes to them. While it is possible to change them, you most definitely should not change them. If you change the primary key, you will need to go through and update all the foreign keys.

MySQL supports date-time arithmetic. You can do arithmetic on dates and intervals. Examples are

```
select curdate();  
  
select curdate() + interval 1 week;  
  
select curdate() - interval 3 day;
```

More information can be found at

<https://dev.mysql.com/doc/refman/5.5/en/date-and-time-functions.html>

Study the add_date and date_diff functions. Also see

<http://www.mysqltutorial.org/mysql-interval/>

for examples of interval values.

update the start dates of all courses with the sql statement

```
update course
```

```
set course date = coursedate + interval 3 year - interval 3 week;
```

The completion message should indicate that 5 rows were changed.

29. Write an sql SELECT that return courses that start within the next 6 weeks from now. [The answer should be courseNumber 3].

```
select * from COURSE
where CourseDate < curdate() + interval 6 week;
```

Given a table of biology facts about animals and their habits (the following table shows a portion of data from the table)

Key	CommonName	Class	Eats	LifeExpectancy
1	Cat	Mammal	mice	15
2	Cat	Mammal	milk	15
3	Bear	Mammal	fish	30

30. Discuss whether this table is normalized? Explain your reasoning.

Based on what we know about normalization, I would say that this table would be in first normal form. It is a two dimensional table, each row has data in it, each column has data for a single attribute, each cell only has one item in it, none of the rows are identical, and the order of the columns doesn't make a difference on the data.

31. Given the table of biological facts above, write a select statement for
- Find all animals that eat fish.

```
Select CommonName from BioTable where Eats='fish';
```

- Bears only eat fish. What is the select statement and what would be the expected answer be to show this statement is TRUE?

Select eats from BioTable where CommonName='Bear';
This would return one row indicating that bears eat only fish.

c. What do cats eat?

Select Eats from BioTable where CommonName='Cat'

d. What select statement and result would show that no animal eats sharks is true?

Select * from BioTable where Eats='Shark';
This would return now rows showing that it is true no animal eats sharks.

Essay

32. Describe in a few well written paragraphs recent trends in databases. Include in your answer what the terms Data Warehouse, ETL, Star-Schema, NoSQL, Hadoop, Distributed Databases, and how they are used on real world applications.

A data warehouse is a component of an enterprise database setup that is used for reporting and data analysis. The data warehouse is a central location for all reporting data that can be stored in different databases that the organization will use. To be able to fill a data warehouse with data, ETL is used. The data has to be extracted from the primary database, the data will need to be transformed to meet the requirements of the data warehouse, and finally, the data is loaded into the data warehouse. A common schema that is used when setting up a data warehouse is the star-schema. This schema will use one or more fact tables, that will then contain relations with any of the dimension tables that are in the database.

NoSQL is a trend that has been becoming popular in data storage with the influx of Web 2.0 applications. It provides a way to store and retrieve the data that does not use the same relation model that an SQL database will use. It provides many advantages that are useful to web apps and provide many benefits.

Hadoop is a piece of software that can be used to analyze big data. Big data is a term that has come into usage lately with the exponential creation of data that exists in the world. It is a distributed infrastructure type program that relies on many computers running different parts to allow for failures of one or more.

A distributed database is a database hardware setup that exists where not all of the storage devices that have data are connected to a single database engine machine. These nodes can be distributed across a single data center, or even across different geographic regions. The benefits to having a distributed database in practice is that it allows for more reliability, better performance, and allows for some fault tolerance.

Feedback

You are given many surveys during this course to give feedback. Here is one more. But please do take a few minutes to do this one.

Assignments (indicate the assignment numbers for the following 3 questions)

- Of the 13 assignments and the project in the course, I learned the most from _____.
- The assignment(s) which I feel were least beneficial to me where _____.

Agree or Disagree The feedback I received on assignments, quiz and exams was useful and helped me to learn. **Agree**

Agree or Disagree The grading of assignments, quiz and exams was fair. **Agree**

Agree or Disagree Writing a learning journal entry every week helped in my learning for this course.

Neither agree nor disagree. It forced me to think back on what I had learned, but I didn't think it helped me learn the things in the week.

**Any other comments you want to make: either positive or negative about anything in this course?
Your feedback will help me to improve the course.**