Coláiste na Tríonóide, Baile Átha Cliath
Trinity College Dublin
Ollscoil Átha Cliath | The University of Dublin

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Faculty of Engineering, Mathematics and Science

School of Computer Science & Statistics

Integrated Computer Science **Semester 1 2019**
Ba (mod) Computer Science and Business
Year 3 Annual Examination
Integrated Engineering
Year 4 Annual Examinations

Information Management II

Monday 16 December **Goldsmith Hall** **09.30-11.30**

Prof Vincent Wade, Dr Kerstin Ruhland

Instructions to Candidates:
Attempt **three** questions in total. **Question 1 is mandatory**. Answer **any two** questions from **Question 2, Question 3 and Question 4**.

All questions carry equal marks. Each question is scored out of a total of 25 marks.
Answer each question in a separate answer book.

You may not start this examination until you are instructed to do so by the invigilator.

Materials permitted for this examination:
None.

Q1 A newspaper publisher wishes to keep track of the articles to be printed within each edition of the newspaper, the authors of these articles and a set of descriptive key words (topics) which characterise the articles. For each author the newspaper maintains the authors name, the (topical) areas within which he/she has expertise, the address and phone number. The publisher publishes a different edition of the newspaper each day. For each article, the publisher maintains the title of the article, its author(s), the number of words in the story and the topical area(s) which are covered in the article. An article which is not yet published, will not have an edition of the newspaper associated with it. Each article can actually be published in several editions of the newspaper and an edition is published on a single day. Each edition of the newspaper must have a single edition editor who chooses the articles for that edition.

(i) Develop an Entity Relational (ER) Model for the above problem, stating any assumptions you make.

[8 Marks]

(ii) Using the appropriate mapping techniques, map the ER Model to a Relational Model and show the functional dependency between attributes within each table. In your answer identify the Primary and Foreign keys for each relation.

[5 Marks]

(iii) Give the SQL command(s) for the following queries:

a. Insert a new article written by 'John Smith' on the topic 'Boris Johnson loses election again'. You may suggest appropriate attribute values for the article. You may assume that John Smith is already an author of other articles and has an unique identification number (e.g. AuthorID) of 7777.

[3 Marks]

b. Find out the topics of all the articles which were published on 2091-11-11 which were more that 100 words long.

[4 Marks]

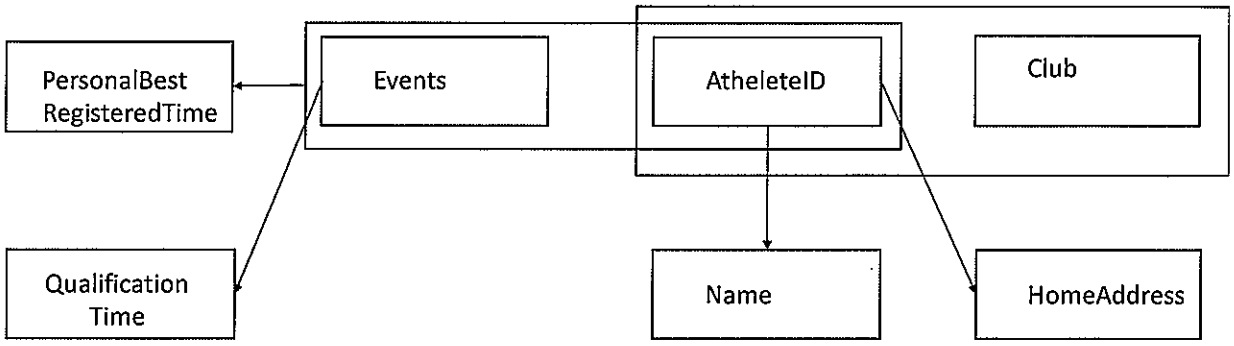
c. Create a view in the database of all the authors who have expertise about crime and the titles of the articles that they have written.

[3 Marks]

d. Change the author name of the author whose AuthorID is 8888 to the name 'Donal Daly'

[2 Marks]

2. Suppose the Olympic Federation of Ireland (OFI) wished to maintain a database of all Irish runners who wish to qualify for the Irish Olympic team in running events. The database contains information about the athletes registration number, address, athletic clubs for which they have membership, the events for which they are registered, their personal best registered time for each event for which they are registered. The OFI also maintains a list of the events and qualification time for each event (which an athlete has to equal or surpass to qualify for that event to get into the Irish team). The diagram below gives the FUNCTIONAL DEPENDENCY DIAGRAM for the database.



(i) Identify the primary keys, foreign keys and other attributes of EACH of the tables in the above diagram.

[12 Marks]

(ii) Using examples from the tables explain 1st, 2nd and 3rd Normal Forms.

[3 Marks]

(iii) Write SQL commands to perform the following:

a. List all the events for which Irish athletes can attempt to qualify.

[2 Marks]

b. Give the SQL to list the athletes names, their clubs and the events for which they have registered best times

[3 Marks]

c. Give the SQL command to define the table which contains information about atheletes and the events they have personal best registered times

[3 Marks]

d. Give the SQL command to make a new column in the appropriate table to indicate whether the current personal best time of each athlete in whatever event they have registered is QUALIFIED (i.e. is below the qualification time) or NOT QUALIFIED (i.e. is greater than the qualification time).

[2 Marks]

3.

(i) What does integrity in the database context mean? Explain how integrity is defined and what types of integrity are part of the relational model?

[5 Marks]

(ii) Describe how entity integrity can be specified in SQL.

[2 Marks]

(iii) Discuss how triggers can be used to monitor integrity. Use an SQL statement for one of the tables in question 1 of this paper to help illustrate your answer.

[5 Marks]

(iv) Suppose a university wishes to manage staff, lecturers and modules taught (in the university). Suppose the university (UNI) is sub-divided into the following responsibilities (roles): departments (DEPARTMENT), subject areas (SUBJECT_AREAS) and university staff (UNIVERSITY_STAFF). The university database contains, among others, the relations: modules taught (MODULE), staff (STAFF) and lecturer (LECTURER).

To improve the university-wide cooperation, departments are awarded further rights to the UNI-database (read, insertion and modification privileges on relations MODULE, STAFF, LECTURER).
GRANT SELECT, INSERT, UPDATE ON MODULE TO DEPARTMENT WITH GRANT OPTION
GRANT SELECT, INSERT, UPDATE ON LECTURER TO DEPARTMENT WITH GRANT OPTION
GRANT SELECT, INSERT, UPDATE ON STAFF TO DEPARTMENT WITH GRANT OPTION

MODULE should now be passed on to individual subject areas (SUBJECT_AREAS). The subject area offices should be able to create new modules and lecturer allocations. Subject areas should get read, insertion and modification privileges on MODULE and LECTURER. University staff (UNIVERSITY_STAFF) of the subject areas should get read privileges to all three relations, as well as modification privileges to MODULE.

a. What SQL command(s) are needed to assign the appropriate privileges?

[3 Marks]

(Question 3 continues on the next page)

(Question 3 continued from previous page)

b. What happens, when the university decides to revoke the insertion and modification privileges to the relations MODULE and LECTURER from the subject areas (SUBJECT_AREAS)? Write down the corresponding SQL command(s).
What are the consequences for the staff privileges?

[3 Marks]

(v) Assume you work as database administrator for a European company which stores information about its customers. Does this data need to be protected? Explain why and what you, as database administrator, must do.

[7 Marks]

Q4.

(i) Explain the problems of traditional processing of large amounts of data using file systems. [5 Marks]

(ii) Describe how databases and DBMS addressed these problems and why further databases such as NoSQL are needed.

[10 Marks]

(iii) Discuss when a NoSQL database should be favoured over a relational database?

[3 Marks]

(iv) Explain what "polyglot persistence" means and how it is implemented into NoSQL.

[7 Marks]