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# Assessment Information/Brief Semester 2

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| Module title | Database Systems | |
| CRN | 32741 | |
| Level | 4 | |
| Assessment title | Database Systems Semester 2 Coursework | |
| Weighting within module | This assessment is worth 50% of the overall module mark. | |
| Submission deadline date and time | 4pm, Wednesday 19th April 2023, Week 31 (T2.11). | |
| Assessment Set by Dr Bryant   * Dr Bryant’s surgeries take place during the teaching part of the semester. The time of his next surgery is shown on Blackboard’s calendar. Please note that this is a drop-in service. In other words, there is no need to make an appointment. * If you just want to send him a written message, then do not use MS Teams or Blackboard to do this. Instead, please send it to his usual e-mail address, which is C.H.Bryant@salford.ac.uk. | | |
| How to Submit   * You must submit a **single document, in PDF format**. Zero (0) marks will be awarded for supplementary files or files in other formats. Do not submit a zip file. * The name of your PDF file must include your student roll number and your User ID. Please do not include your name because the University will mark assessments anonymously where this is possible. Student roll numbers usually comprise the @ symbol followed by eight digits. User IDs usually comprise three characters followed by three digits. * You must submit using the Blackboard Assessment tool. It is your responsibility to ensure that your work is submitted successfully to the correct folder and that the correct version has been submitted. If you find that you have submitted the wrong version, you can contact the Digital IT Service Desk before the submission deadline. They will be able to withdraw an incorrect submission, enabling you to make a new submission. Once the submission deadline has passed, no further action can be taken and work that has been submitted cannot be withdrawn. You can find the contact details of the Digital IT Service Desk in Chapter 2 of the module’s exercise booklet. | | |
| Assessment Task Details and Instructions   * This is an individual assessment. You must **not** work in a team. The whole of your submission must be your own work. * You are reminded that penalties will be applied to late submissions, in accordance with the regulations and policies. * At the start of your document, you must include your student roll number, your User ID, the assessment’s title, and the module’s title and the CRN. Please do not include your name because the University will mark assessments anonymously where this is possible. * You must answer **all** the questions. * Do **not** include the questions in your submission. * The order of your answers must correspond to the order of the questions in this briefing. * Your submission must be typed (rather than hand-written) in, at least, font size 12pt. Do not use the colours red or green anywhere in your submission. * Do not include diagrams in your submission that are illegible, blurred or require the reader to use a magnifying glass. This briefing does not place any constraints on how you prepare your diagrams, but you are encouraged to learn how to use a digital drawing tool because it is a useful skill that may be useful during the remainder of your studies and career. There is a wide range of drawing software available. The university provides you with a wide range of support for developing your digital skills, see: https://www.salford.ac.uk/skills/ * Citations and references must conform to the APA 7th (Harvard) style. | | |
| Assessment Criteria  Each part of each question is followed by the number of marks it is worth.   |  |  | | --- | --- | | Percentage Mark | Level of Performance | | 90-100 | Outstanding | | 80-89 | Excellent | | 70-79 | Very Good | | 60-69 | Good | | 50-59 | Fair | | 40-49 | Adequate | | 30-39 | Unsatisfactory | | 20-29 | Poor | | 10-19 | Very Poor | | 0-9 | Extremely Poor | | | |
| Assessed Intended Learning Outcomes  On successful completion of this assessment, you will be able to:  1. describe the basic concepts of relational database design;  2. describe the process of database query processing and evaluation;  3. explain the concepts of transaction management and concurrency control;  4. discuss database security and recovery. | | |
| Employability Skills Developed / Demonstrated   * Communication? Yes * Critical Thinking and Problem Solving? Yes * Data Literacy? Yes * Digital Literacy? Yes * Industry Awareness? No * Innovation and Creativity? No * Proactive Leadership? No * Reflection and Life-Long Learning? Yes * Self-management and Organisation? Yes * Team Working? No | | |
| Word Count  There are four questions. Your answer for each question must not exceed seven hundred and fifty (750) words. Zero marks will be awarded for parts of your submission beyond the word limits. | |  | |
| Feedback Arrangements  The university expects that you will receive marks within 15 working days of the submission deadline. Your mark will be made available via Blackboard. A message will be posted on Blackboard (and emailed to you) when the mark has been released. | | |
| **Academic integrity & Referencing**  Students are expected to learn and demonstrate skills associated with good academic conduct (academic integrity). Good academic conduct includes the use of clear and correct referencing of source materials. Here is a link to where you can find out more about the skills which students need: [Academic integrity & referencing](https://www.salford.ac.uk/skills/academic-integrity-referencing)  Academic Misconduct is an action which may give you an unfair advantage in your academic work. This includes plagiarism, asking someone else to write your assessment for you or taking notes into an exam. The University takes all forms of academic misconduct seriously. | | |
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| Assessment Information and Support  **Support for this Assessment**  There will be a verbal briefing on the contents of this document and some question-and-answer sessions during scheduled class times. You can obtain further support for this assessment by attending Dr Bryant’s surgery. If you send Dr Bryant a query about this assessment via e-mail then he may respond by making an announcement via Blackboard so that all students can benefit from his answer.  You can find more information about understanding your assessment brief and assessment tips for success [here](https://www.salford.ac.uk/skills/university-assessments).  **Assessment Rules and Processes**  You can find information about assessment rules and processes in Blackboard in the [Assessment Support](https://blackboard.salford.ac.uk/ultra/courses/_129709_1/cl/outline) module.  **Develop your Academic and Digital Skills**  Find resources to help you develop your skills [here](https://testlivesalfordac.sharepoint.com/sites/Uos_Students/SitePages/Skills-Support.aspx).  **Concerns about Studies or Progress**  If you have any concerns about your studies, contact your Academic Progress Review Tutor/Personal Tutor or your Student Progression Administrator (SPA).  **askUS Services**  The University offers a range of support services for students through [askUS](http://www.askus.salford.ac.uk/) including Disability and Learner Support, Wellbeing and Counselling Services.  **Personal Mitigating Circumstances (PMCs)**  If personal mitigating circumstances (e.g. illness or other personal circumstances) may have affected your ability to complete this assessment, you can find more information about the Personal Mitigating Circumstances Procedure [here](https://www.salford.ac.uk/askus/admin-essentials/personal-mitigating-circumstances). Independent advice about this process is available from the [Students’ Union Advice Centre](https://www.salfordstudents.com/advice/centre). |
| In Year Retrieval Scheme  Your assessment is **not** eligible for in year retrieval. | |
| Reassessment   * If you fail this assessment, and are eligible for reassessment, you will be required to do the same assessment again. The provisional resit submission deadline is 28th July 2023. For students with accepted personal mitigating circumstances for absence/non submission, this will be your replacement assessment attempt. * Having to undergo a reassessment can be challenging. However, support is available. See all the sources of support outlined earlier in this brief and refer to the [Personal Effectiveness](https://www.salford.ac.uk/skills/personal-effectiveness) resources. | |

**Questions**

1) *(a)* Suppose that a relation bicycle(frameNo, name, manufacturerID, gears) contains 750 tuples. Each tuple is comprised of a header (24 bytes) and four attributes: frameNo (15 bytes), name (10 bytes), manufacturerID (20 bytes) and gears (2 bytes). The size of each disc block is 1024 bytes and the size of the header of each disc block is 24 bytes.

*(i)* How many blocks would be required to store the whole of this relation?

***(3 marks)***

*(ii)* How many blocks would be required to store a projection that does not include the attribute manufacturerID?

***(3 marks)***

*(iii)* Explain why such a projection could be used to optimise a query whose results do not include data for the attribute manufacturerID.

***(2 marks)***

*(b)* Consider the SQL query shown in Table 1.

*(i)* Draw a near-optimal query tree for the SQL query.

***(8 marks)***

*(ii)* Identify the root and leaf nodes in the tree that you drew for part (i).

***(1 mark)***

*(iii)* Write down a justification for the position of the root node and each of the internal nodes in the tree that you drew for part (i) in terms of the heuristic steps that optimisers apply to reduce the cost of optimisation. Explain why the position of the nodes should make the query efficient.

***(8 marks)***

SELECT manufacturer.name

FROM manufacturer, bicycle

WHERE bicycle.manufacturerID=manufacturer.ID

AND manufacturer.origin=’France’

AND manufacturer.factories>5;

***Table 1: An SQL query about bicycles.***

2) Suppose that a stock exchange (market) uses a relational database to store data on stocks and the brokers who own them. Assume that numerous sales of stocks may take place concurrently between different pairs of brokers.

*(a)* Describe the properties that transactions must have.

***(8 marks)***

*(b)* Discuss the extent to which a database management system alone can ensure that the stock market’s database remains in a consistent state. Illustrate your answer using the sale of some stock.

***(3 marks)***

*(c)* What are the benefits to the stock market of using a database management system to support concurrent transactions?

***(3 marks)***

*(d)* Consider the schedule of two transactions involving three brokers shown in Table 2.

*(i)* How do the two transactions interfere with each other? State what the resulting error is and explain why it occurs.

***(3 marks)***

*(ii)* What phrase is usually used to describe this type of interference?

***(1 mark)***

*(e)* Consider the schedule of three transactions shown in Table 3.

*(i)* Draw the precedence graph for this schedule.

***(5 marks)***

*(ii)* Isthe schedule conflict-serializable? Use your graph to justify your answer.

***(2 marks)***

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Time | Transaction 1 | Transaction 2 | Trader | | | total |
| B1 | B2 | B3 |
| t1 |  | begin\_transaction | 50 | 75 | 25 |  |
| t2 | begin\_transaction | total=0 | 50 | 75 | 25 | 0 |
| t3 | read(quantityB1) | read(quantityB1) | 50 | 75 | 25 | 0 |
| t4 | quantityB1=quantityB1+ 5 | total=total+quantityB1 | 50 | 75 | 25 | 50 |
| t5 | write(quantityB1) | read(quantityB2) | 55 | 75 | 25 | 50 |
| t6 | read(quantityB3) | total=total+quantityB2 | 55 | 75 | 25 | 125 |
| t7 | quantityB3=quantityB3- 5 |  | 55 | 75 | 25 | 125 |
| t8 | write(quantityB3) |  | 55 | 75 | 20 | 125 |
| t9 | commit | read(quantityB3) | 55 | 75 | 20 | 125 |
| t10 |  | total=total+quantityB3 | 55 | 75 | 20 | 145 |
| t11 |  | commit | 55 | 75 | 20 | 145 |

***Table 2: Schedule involving two transactions and three brokers (B1, B2 and B3). The columns B1,B2, and B3 show the quantity of units of stock owned by the brokers as recorded on secondary storage. The total column shows the value of a variable that is local to Transaction 2.***

|  |  |  |
| --- | --- | --- |
| Transaction 1 | Transaction 2 | Transaction 3 |
| Read(bondPrice) |  |  |
|  | Read(bondPrice) |  |
|  |  | Write(assetPrice) |
|  | Write(bondPrice) |  |
| Read(assetPrice) |  |  |
|  |  | Read(bondPrice) |
|  | Write(bondPrice) |  |

***Table 3: Schedule*** ***involving three transactions.***

3)Suppose that a railway company has a computer system for reserving seats on its trains, which stores data in a relational database. The seat reservation system must ensure that a seat on a train journey is not reserved by more than one passenger.

*(a)*Explain why concurrent access to the database is relatively easy during periods when all Users are only checking whether seats are available.

***(2 marks)***

*(b)* Describe a protocol that the company could use to ensure that schedules are conflict serializable.

***(3 marks)***

*(c)* The locking information for five transactions of the seat reservation system is shown in Table 4.

*(i)* Produce a wait-for-graph for the transactions.

***(7 marks)***

*(ii)* Does deadlock occur? Justify your answer.

***(1 mark)***

*(d)* Table 5 shows the company’s transaction log file. Suppose that part of the seat reservation system fails at 20:06. Assume that the DBMS is using the Immediate Update protocol.

*(i)* Describe the actions that the recovery manager would take to recover from the failure. Explain why each action is taken.

***(8 marks)***

*(ii)* Describe how the recovery manager would use the recovery log during the recovery from the failure. State the order in which it would do things.

***(4 marks)***

|  |  |  |
| --- | --- | --- |
| Transaction | Data items locked by transaction | Data items transaction  is waiting to lock |
| T1 | B | E |
| T2 | D, E |  |
| T3 |  | A, C, E |
| T4 | C | D |
| T5 | A | B |

***Table 4: Information on locks.***

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Transaction ID | Time | Operation | Seat | Before Image | After Image |
| T4 | 19:40 | Start |  |  |  |
| T4 | 19:41 | Insert | S11 | Kelly |  |
| T2 | 19:43 | Start |  |  |  |
| T2 | 19:44 | Delete | S60 |  |  |
| T2 | 19:46 | Update | S33 | Green | Wu |
| T3 | 19:48 | Start |  |  |  |
| T4 | 19:49 | Update | S57 | Smith | Patel |
| T4 | 19:51 | Commit |  |  |  |
| T2 | 19:52 | Insert | S44 |  | Adams |
| T3 | 19:55 | Delete | S89 | Hussain |  |
| T2 | 19:57 | Commit |  |  |  |
|  | 19:58 | Checkpoint |  | | |
| T1 | 19:59 | Start |  |  |  |
| T3 | 20:01 | Commit |  |  |  |
| T1 | 20:05 | Update | S44 | Quinn | Ali |

***Table 5: Recovery Log File***

4**)** *(a)*Suppose a database includes a relation called Clothes and a relation called Shops. Tables 6 and 7 list a sample of the data in Clothes and Shops. Express the query “List the brand of clothes which do not have the same name as a shop.” as follows.

*(i)* Write a single statement of **relational algebra**.

***(3 Marks)***

*(ii)* Write a single **SQL** query.

***(5 Marks)***

*(b)* Consider the authorisation grant graph shown in Figure 1. What would be the effect on each of the other Users if the Database Administrator (DBA) revoked authorisation from User U2? Justify your answer.

***(3 marks)***

*(c)* Suppose that the database of an army includes the following relations.

* + soldier(soldierID, soldierName, rank, dateOfBirth, **regimentNo\***)
  + barracks(barracksID, name, address, capacity)
  + regiment(regimentNo, regName, location, **barracksID\***)

*(i)* The Users of the database are:

* + Taylor who has read-only access to regiment and cannot access the other relations;
  + Robertson who has the same authorisation as Taylor.
  + Khan who is authorised to do anything with the relation barracks;

Write SQL statements that give these Users the access described above.

***(6 marks)***

*(ii)* Suppose that there is another User, Ahmed, who can only remove soldiers whose rank is captain; she is not authorised to do anything else. Write SQL statements that implement this.

***(5 marks)***

*(iii)* Write an SQL statement that will prevent Kham deleting tuples from barracks.

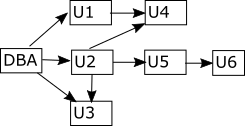
***(3 marks)***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| item\_ID | brand\_name | type | colour | size |
| g010 | M&S | shoes | red | small |
| g020 | BHS | coat | blue | medium |
| g030 | Jefferies | jumper | red | medium |
| g040 | BHS | jumper | black | large |
| g050 | Trecker | shoes | black | medium |
| g060 | M&S | dress | orange | small |

***Table 6:*** ***Sample of data in a relation called Clothes.***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| shop\_ID | shop\_name | Street | city | postcode |
| SH00005 | BHS | Balloon St | Manchester | M1 9DD |
| SH00007 | BHS | Green Lane | Manchester | M2 5DP |
| SH00003 | Greens | Main St | Liverpool | L1 3XY |
| SH00004 | M&S | Old Rd | Chester | CH1 3AB |
| SH00002 | M&S | Mersey Sq | Salford | M5 5NX |

***Table 7: A relation called Shops.***

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***Figure 1: Authorisation grant graph.***