A36901

Calculators may be used in this examination provided they are not capable of being used to store alphabetical information other than hexadecimal numbers

UNIVERSITY OF BIRMINGHAM

School of Computer Science

Fourth Year Undergraduate/Postgraduate

06-32245

LM Storing and Managing Data

Main Summer Examinations 2025

Time allowed: 2 hours

[Answer all questions]

Turn Over

Note

Answer ALL questions.

Question 1

A Fitness Centre runs many courses that members can enrol in. Each member can view the sessions they have signed on and amend them, including the date, time, duration, leader details, cost, payment status, and a feedback score of 1–5. In addition, each course is identified by an Activity code and has an Activity name. Members sign up to the club by providing a title, given name, family name, full address (including postcode), and a phone number. The membership is either 7-day or weekday only, and is either daytime only (before 5pm) or includes evenings (all-day). The club generates a unique membership record and records the joining date.
Members complete booking forms when registering for each activity. The unprocessed data from these booking forms may be represented as follows in a single un-normalised dataset:

Member No. F912356

Report Printed 5th March 2024 @ 16:32

Activity		Date	Time	Name of Leader	Leader Contact Number	Duration (mins)	Cost	Paid	Feedback Score
Code	Activity Name								
32469	Pilates - Intermediate	18/12/2024	14:00	Patil, Aisha	0583-411-0985	20	£45	Y	4
32586	Aquarobics	29/12/2024	16:30	Jarvis, Max	0266-542-9876	45	£35	Y	4
47820	Pilates - Intermediate	09/01/2025	08:30	Simion, Lea	0523-876-1117	15	£40	Y	4
87309	Zumba Step	15/01/2025	14:00	Michaels, Valerie	0499-923-4719	60	£30	Y	5
35629	Yoga - Intermediate	17/01/2025	18:00	Marco, Pierre	0502-020-2652	90	£55	N	3
44288	Pilates - Intermediate	29/01/2025	08:30	Patil, Aisha	0583-411-0985	15	£35	Y	5
98072	Aquarobics	16/02/2025	20:30	Jarvis, Max	0266-542-9876	45	£40	Y	3
23231	Circuit training	22/02/2025	15:45	Stanis, Otto	0386-533-7285	30	£60	Y	4
76243	Yoga - Intermediate	03/03/2025	17:00	Marco, Pierre	0502-020-2652	60	£40	N	-

Figure 1: Sample unprocessed data from the Fitness Centre

(a) Using all of the attributes shown in Figure 1 and the attributes in the description above, write out the relation in un-normalised form, listing every attribute that needs

to appear in the schema. *Note: Not all fields mentioned in the description are shown in Figure 1. You should include all attributes from both the description and the figure when writing the un-normalised relation.*

[9 marks]

(b) Explain, step by step, how to transform an un-normalised relation into First Normal Form (1NF), then progress it to Second Normal Form (2NF), and finally ensure it complies with Third Normal Form (3NF). Clearly outline the changes and considerations required at each stage of the normalization process. **[10 marks]**

(c) Produce the final set of relations in 3NF. Show how the tables should be arranged, identify any primary and foreign keys, and give a brief justification for how your design meets the requirements of 3NF. **[15 marks]**

Question 2

Daniel uses an online streaming service that suggests movies and TV shows based on his previous viewing history and ratings. Over time, Daniel notices that the service primarily recommends action and thriller genres, even though he frequently watches and rates comedy and drama content highly.

(a) Daniel believes the algorithm is not accurately reflecting his preferences and contacts customer support to inquire about how recommendations are made. Could Daniel rely on his right not to be subjected to automated decision-making and profiling in this scenario? Why or why not? Answer using the IRAC format. IRAC stands for Issue, Rule, Application, Conclusion. **[20 marks]**

(b) Imagine the streaming service uses Daniel's viewing data to automatically adjust his subscription terms, such as changing his subscription price and modifying the types of content and features he has access to, without prior notice. In this case, could Daniel invoke his rights regarding automated decision-making and profiling under the GDPR? Answer using the IRAC format. **[10 marks]**

Question 3

(a) Variable type is important for data analytics tasks.

(i) Name the five common variable types.

[10 marks]

(ii) Suppose that we have a set of *magnitude data*. List the possible variable types that we can use to quantify it.

[8 marks]

(b) Let T be a hash-table with the hash function $h(x) = x \bmod 10$, where x is the key ($a \bmod b$ is the remainder of the integer division $\frac{a}{b}$). Suppose that we want to use the hash table to calculate and store some passwords, and we convert strings into numbers by calculating the sum of the ASCII code of each character. For example, we know that the ASCII code for *"d"*, *"n"*, *"p"*, and *"s"* are 100, 110, 112, and 115, respectively; *"ds"* will be converted as $100 + 115 = 215$.

(i) Write down the hashed values for passwords *"dn"*, *"dp"*, and *"np"*. **[3 marks]**

(ii) Now, we want to add a salt *"s"* to each of the above passwords. If we use the salted versions of *"dn"*, *"dp"*, and *"np"* as the keys, write down the entries of the hash table T after the keys have been inserted in that order using the following format; resolve collision (if any) by linear probing:

[15 marks]

$h(x)$	0	1	2	3	4	5	6	7	8	9	10
T											

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Do not complete the attendance slip, fill in the front of the answer book or turn over the question paper until you are told to do so

Important Reminders

- Coats/outwear should be placed in the designated area.
- Unauthorised materials (e.g. notes or Tippex) must be placed in the designated area.
- Check that you do not have any unauthorised materials with you (e.g. in your pockets, pencil case).
- Mobile phones and smart watches **must** be switched off and placed in the designated area or under your desk. They must not be left on your person or in your pockets.
- You are not permitted to use a mobile phone as a clock. If you have difficulty seeing a clock, please alert an Invigilator.
- You are not permitted to have writing on your hand, arm or other body part.
- Check that you do not have writing on your hand, arm or other body part – if you do, you must inform an Invigilator immediately
- Alert an Invigilator immediately if you find any unauthorised item upon you during the examination.

Any students found with non-permitted items upon their person during the examination, or who fail to comply with Examination rules may be subject to Student Conduct procedures.