The University of Nottingham Ningbo China

SCHOOL OF COMPUTER SCIENCE

A LEVEL 1 MODULE, Spring SEMESTER 2021-2022

Database and Interfaces

Time allowed: **TWO Hours**

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Candidates may complete the front cover of their answer book and sign their desk card but must NOT write anything else until the start of the examination period is announced

Answer ALL THREE Questions

No calculators are permitted in this examination.

Dictionaries are not allowed with one exception. Those whose first language is not English may use a standard translation dictionary to translate between that language and English provided that neither language is the subject of this examination. Subject specific translation dictionaries are not permitted.

No electronic devices capable of storing and retrieving text, including electronic dictionaries, may be used.

DO NOT turn your examination paper over until instructed to do so

ADDITIONAL MATERIAL: None.

INFORMATION FOR INVIGILATORS: Exam papers must be collected at the end of the exam.

Question ONE – Web Programming [15 marks]

a) What is CSS and how does it work with HTML?

[2 marks]

b) What is the difference between client-side and server-side scripting? Provide ONE example of a functionality for which client-side scripting **should not** be used?

[2 marks]

c) Identify and describe one accessibility feature included in the following code example:

```
<img src = 'imgs/cat.png' alt='A photo of a black and white cat'>
```

[2 marks]

d) Given the following HTML fragment, write a CSS rule which changes the font colour to be `red` and the font size to `24pt` for all elements with the class `rImportant`.

```
<p id='reminder'>
 You <span class='rImportant'>must</span>
 remember to brush your teeth.
</p>
```

[3 marks]

e) Consider the following HTML fragment which contains a simple form:

```
<form action="sayhi" method="get">
  <label for="name"> Please enter your name: </label>
  <input type="text" name="name" id="username">
  <input type="submit" value="Submit">
</form>
```

Using the Flask Web Application Framework in Python, write a function, with the correct routing, which returns the user's input preceded by the word 'Hello ', as shown in Figure 1. If the user submits the form without a value, your solution should return "Hello Stranger.".
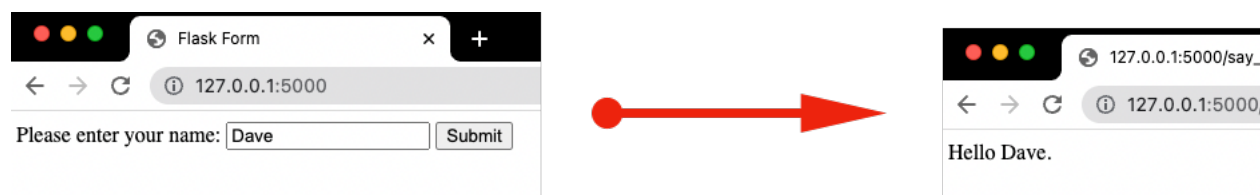

Figure 1. An example Input and Output pairing.

[6 marks]

Turn over

Question TWO – Relational DB Design Theory and DBMS [15 marks]

Consider the following relations:

Student

sId	sName
1	Anne
2	Bob
3	Carl

Book

bId	bName	bAuthor
1	Algorithms	Knuth
2	Biology	Darwin
3	Calculus	Newton
4	Design	Chanel
5	Electronics	Tesla

Borrow

bId	sId	brDue
1	3	06 Nov 2022
2	2	19 Aug 2022
3	3	12 Dec 2022

a) Write down the results of the following relational algebra expressions. If an expression is not valid, please explain the reason.

   i. $\sigma_{bAuthor = \text{‘Newton’}} (\text{Book})$

   [1 mark]

   ii. $\pi_{bName, bAuthor} (\sigma_{bName = \text{‘Algorithms’}} (\text{Book}))$

   [2 marks]

   iii. $\pi_{sName, bName, brDue}(\sigma_{sName = \text{‘Bob’}} ((\text{Student} \bowtie \text{Borrow}) \bowtie \text{Book}))$

   [3 marks]

b) List the output of the following SQL query:

   ```
   SELECT * FROM Student LEFT JOIN Borrow on Student.sId > Borrow.bId;
   ```

   [2 marks]

c) Write a query which returns the names of all Students who have not borrowed a book in both Relational Algebra **and** SQL.

   [4 marks]

d) As an application developer, what are the advantages of utilising a DBMS over writing your own storage solution?

   [3 marks]

Turn over

Question THREE – SQL and ER Design [20 marks]

A university would like to develop an online store which allows customers to purchase products. You have been hired to design and implement the database to support the university's data storage needs. The university requires the following:

- The database must store products that are for sale. Each product has a name, price, description, and quantity in stock.

- Customers must register before they can place an order. During the registration process, the customer's name, email and contact telephone number must be provided for them to register successfully.

- Customers place orders. An order may consist of one or more product. An order may contain more than one of the same product(s). An order is placed on a particular date. An order may be in one of four states: 1) Pending Payment; 2) In-Progress; 3) Shipped; 4) Failed.

- Each order has an associated delivery address. Each customer may have multiple delivery addresses. A delivery address is not unique to a customer. A delivery address is provided by the customer when placing their order.

Using the above description, answer the following questions.

Note, it is expected that you make reasonable assumptions, based on your real-life experiences, in the design and implementation of this database. Assumptions should be written down.

a) Draw the Entity Relationship Diagram (ERD) for the University Online Store. Please draw all entities (associative entities are not necessary), attributes in entities, and the cardinalities between entities.

[8 marks]

b) Write the necessary SQL code to represent your database design in a modern DBMS system. Be certain to indicate primary keys and referential integrity constraints. Sensible referential integrity constraints should be assumed if they are not clearly described in the problem description.

[8 marks]

c) Why do we use Entity Relationship Modelling during the design stage of developing a database solution? What other tools/methods have you been taught that can also aid developers during this design stage? How do the two methods differ from one another?

[4 marks]