University of Glasgow

Tuesday, 06 May 2014
9:30 a.m. – 11:30 a.m.
(Duration: 2 hours)

DEGREES OF MSci, MEng, BEng, BSc, MA and MA (Social Sciences)

COMPUTING SCIENCE: CS1Q

(Answer all 4 questions.)

This examination paper is worth a total of 100 marks

(Use SEPARATE ANSWER BOOKS for sections A and B and C)

The use of calculators is not permitted in this examination.

For examinations of at least 2 hours duration, no candidate shall be allowed to leave the examination room within the first hour or the last half-hour of the examination.

INSTRUCTIONS TO INVIGILATORS

Please collect all exam question papers and exam answer scripts and retain for school to collect. Candidates must not remove exam question papers.

Section A – Human Computer Interaction

1.

(a) Briefly describe what is meant by the iterative design lifecycle in relation to developing interactive systems in human computer interaction.

[4]

(b) You have been asked by a client to determine the user requirements for a new large interactive display on the history of dinosaurs for a local museum. Describe 2 aspects of human psychology that you would have to consider when designing the size, position and content for the display.

[6]

(c)

(i) What are usability heuristics?

[2]

(ii) What is the Hawthorne Effect and why is it important to consider when conducting user evaluations in HCI?

[3]

(d)

(i) Evaluation can be both ***formative*** and ***summative***. Briefly describe what the main differences are between formative and summative evaluation and what stage in the software lifecycle they would be carried out.

[4]

(ii) Today usability evaluations are often carried out 'in the field'. Discuss the advantages and disadvantages of evaluating the usability of a new smartphone app in the field.

[6]

Section B – Information Management

2. (a)

(i) What is an ER diagram and what is it used for in Information Management?

[2]

(ii) What is composite attribute in ER modeling and why is it useful when it comes to implementing a database?

[2]

(b)

(i) One of the key functions of a database management system (DBMS) is to control concurrent access to the same data. Explain what this is and why it is important that it is 'controlled'.

[2]

(ii) What are each of the following: candidate key, primary key, and foreign key?

[3]

(c) A magazine publisher keeps data on its publications. A publication has a reference code, a title, and a type (editorial, report, poem). A member of staff has a unique employee code, a name, and a job title. Each publication has staff working on it. All staff are assigned to at least one publication, but may work on more than one.

Draw an ER diagram that could be used in the development of a database to support the publisher.

[6]

(d)

(i) If U = Football Players, B stands for 'play in British clubs' and W stands for 'play for their home country', give a description in English of the following set:

$S = \{ x \mid B(x) \wedge W(x) \}$

[1]

(ii) If S = {5,8} and T = {1,2,9}, list the elements of the Cartesian product of the two sets S and T.

[1]

(iii) Let S = { 7, 8, 9 }. Let V = { 7, 8, 8, 9, 9 }.

Is it true that S = V? Why or why not?

[1]

(iv) Express as a Venn diagram the intersection of sets S and V from (iii).

[1]

(v) List the elements in the relation R from A = { 7, 8, 9 } to B = {2,3, 9} where:

$\langle x,y \rangle \in R$ if and only if $x < y$.

[1]

(e)

(i) Other than querying a database – what else can SQL (structured query language) be used for in information management?

[2]

(ii) Employee and Department are two tables in a relational database.

Employee (Name, <u>NI-Number</u>, Email, Phone-No, Works_In)

Department (Name, <u>Code</u>, Building)

The attribute **Works_In** is a foreign key in Employee relating to the primary key **Code** in Department.

Express the SQL required to extract the names of all the employees of the "Accounts" department.

[3]

Section C – Computer Systems

3. **(a)** Convert 1001 0011 to a decimal number, assuming binary representation.

[2]

(b) Convert 1001 0011 to a decimal number, assuming two's complement representation.

[4]

(c) Translate the statement x = a – b*c into assembly language for Sigma16. You may assume that the variables have been declared with data statements; just write the instructions needed to execute the statement.

[7]

(d) Suppose `index` is a variable in memory that contains an integer, and `x` and `y` are both arrays of integers. Translate the statement `y[index] = x[index]` into assembly language. You may assume that the variables and arrays have been declared; just write the instructions needed to execute the statement.

[5]

(e) Define the term *type* in a programming language. Give two reasons why machine language does not have types. Explain how a compiler uses types to make the machine language object code it generates more reliable.

[7]

4. **(a)** Write the truth table for a half adder circuit, which takes two input bits x and y, and produces two output bits c and s. The pair (c,s) gives the carry output and sum resulting from adding x and y. Draw a diagram of the circuit using logic gates.

[4]

(b) State what the behavior of a delay flip flop (dff) is. Explain what would happen in a synchronous circuit containing delay flip flops if the clock runs too fast.

[5]

(c) State what happens when an interrupt occurs. Explain how the operating system uses interrupts to implement concurrent processes, and how all processes can make progress even if one of them goes into an infinite loop.

[8]

(d) Define the terms circuit switching and packet switching. Give one reason that circuit switching was used in the old analogue telephone network. Give two reasons for using packet switching in the Internet.

[8]