University of Glasgow

Thursday 3 May 2012
9.30 am – 11.30 am
(Duration: 2 hours)

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

COMPUTING SCIENCE 1Q

Answer all four questions

This examination paper is worth a total of 100 marks

You must not 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 return to School together with exam answer scripts

1. **(a)** Good HCI design is based on values summarised by these five words: people, prototype, compare, iterate and principles. Briefly explain what each of these words refers to. In your answer, give a brief example of the practical application of each in HCI design.

[10]

(b) Prototyping can be split into low fidelity and high fidelity approaches. Explain and compare these approaches. In your answer, give at least one example of each approach.

[6]

(c) Imagine that you are a programmer for a bank. A financial analyst has several different programs for visualising and interacting with a spreadsheet, but would like to combine the analysis techniques used each of his programs so as to make one program with 'linked views', i.e. data selection in any one view is reflected in all the others.

Outline a user interface management system (UIMS) that would satisfy this design requirement. In your answer, explain what a UIMS is and also explain the main advantages of your choice.

[9]

2. (a)

(i) What is an entity?

Describe the difference between a strong entity and a weak entity.

[2]

(ii) According to the Relational Data Model, explain with examples what is meant by *attributes* and *tuples*.

[4]

(iii) Explain why controlled concurrent access is an important feature of database management systems.

[3]

(b) A TV show company keeps data on all of its TV shows. A show has a reference code, a title, and a type (drama, comedy, news). A member of staff has a unique employee code, a name, and a job title. Each show has staff working on it. All staff are assigned to at least one show, but may work on more than one.

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

[6]

(c)

(i) What is the Power Set of {5,8}?

[1]

(ii) For any set, S, is it true that $\varnothing \subseteq S$? Why or why not?

[1]

(iii) How many elements are in the Cartesian product of A and B, if the cardinality of A is 3 and the cardinality of B is 7?

[1]

(iv) List the elements in the relation R from A = {1,2,7} to B = {2,3,9} where :

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

[1]

(d)

(i) What is SQL and what is it used for in databases?

[2]

(ii) Assume a relational database for a city restaurant booking facility has two tables as follows:

Customer = {id, name, contact_number}

Booking = {customer, restaurant_number}

Where the customer attribute in Booking is a foreign key referring to the id in Customer.

The following SQL query will return the name of all customers booked into restaurant number “Glasgow53”.

```
SELECT Name

    FROM Customer, Booking

        WHERE (id-customer) AND restaurant-number =  “Glasgow53”)
```

Explain what happens when this query is executed in the database, describing the action of each SQL clause in the order in which it is handled.

[4]

3. **(a)** State two advantages that the digital representations used in modern computers confer over the analog representations previously used.

[2]

(b) What does the abbreviation *ALU* stand for? Explain the purpose of the ALU within the CPU.

[2]

(c) Computer architectures have migrated from 32 bits to 64 bits, explain potential reasons for this change.

[2]

(d) Draw the circuit schematic for an **and** gate based on CMOS transistors and explain the operation of this circuit.

[4]

(e) You are required to design a circuit which, given an input *xyz* representing a 3 bit binary number *n*, produces an output *abc* representing *n*-1. For example, if the input is 110 ($x = 1$, $y = 1$, $z = 0$), representing $n = 6$, then the output is 101, representing 5. If the input is 000 then the output is 111.

(i) Draw a truth table which shows *a*, *b*, *c* as functions of *x*, *y*, *z*.

[3]

(ii) Draw a Karnaugh map for each of *a*, *b*, *c*.

[3]

(iii) Use the Karnaugh maps to work out formulae for *a*, *b* and *c* in terms of *x*, *y* and *z*.

[3]

(iv) Draw a diagram of the circuit which calculates *a*, *b* and *c* from *x*, *y* and *z*.

[3]

(v) How could the inputs to this circuit be configured to subtract 2 from a 4 bit binary number?

[3]

4. **(a)** Explain, the difference between multi-tasking and parallel processing and how these concepts relate to each other.

[5]

(b) Explain the concept of *interrupts* and how these are used within operating systems, for example to implement multi-tasking.

[4]

(c) Explain why there isn't a central database which stores the IP address for each domain name in the internet, and briefly describe how this information is actually stored and accessed.

[6]

(d) Do you think that a consistent user interface based on a web browser would be useful for all internet applications? Justify your answer, using email as a specific example.

[10]