CS1Q Summer 2010

Answers.

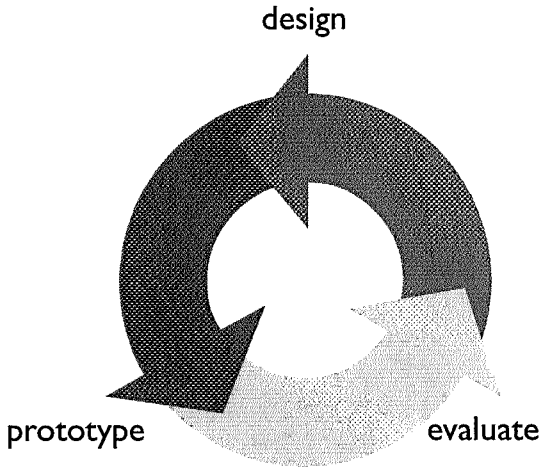
1.

a) What is iterative design? Use a diagram in your answer.

[5]

Lecture material:

- *Iterative design is a process of system design that repeatedly moves from making designs [1], to prototyping [1] and then to evaluation [1] of the prototypes, and then back to making designs again.*



[1] for a diagram showing the three stages in the right order, in a loop

- *Users should be involved all the throughout this process, and needs and requirements for the system should be set out before it starts [1].*

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.

[9]

Lecture material, but involving simple analysis/comparison
Lo-fi prototypes are generally made using simple materials/techniques [1] such as sketching screen layouts on card or paper [1], hand-drawn storyboards of the stages of an interaction [1], and 'Wizard-of-Oz' simulation where an evaluator carries out the actions that an envisioned system should perform [1]. Their main advantage is that are quick to make and easily changed, and cheap to produce. [1]
Hi-fi prototypes are generally made using a programming language such as Macromind Director [1], so the appearance and behaviour of the prototype is much more realistic than in lo-fi [1]. Such a prototype generally takes longer and costs more to make than lo-fi [1]. On the other hand, users may mistakenly think that they have a final product at hand even though performance may be poor/patchy and the graphic design may be rough [1]. Extra [1] for clear explanation/comparison.

c) You have been asked to evaluate the interface to a new TV remote control. The interface will allow users to speak commands, and the remote will use voice-recognition to recognise them and send them to the TV. For example, you might say "Channel 1" and the TV will switch to that channel.

Briefly outline what evaluation by direct observation is. Choose a direct observation technique and describe how you would use it to evaluate the effectiveness of the interface, and what potential problems or dangers you might face in running your evaluation.

[11]

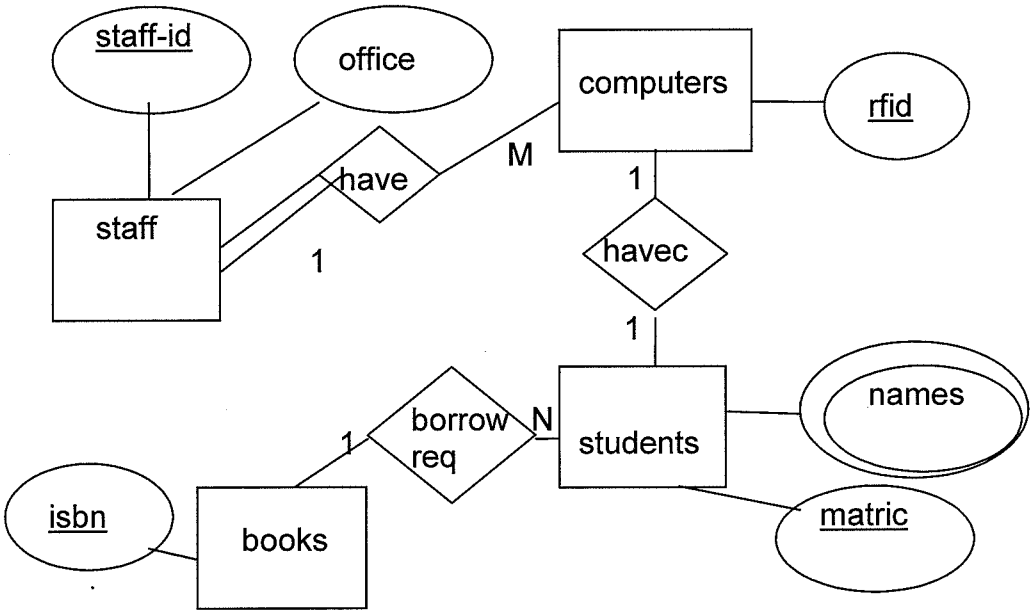
Essay based on unseen design example

- *Direct observation techniques focus on recording or documenting what people do when using a system, either in controlled or uncontrolled environments, rather than (for example) asking them about it afterwards in an interview [2]*
- *Example approach: 'think aloud', where people say out loud what they are doing and why. Gets each user to use the device and show what problems come up [1]. (Other DO approaches would be fine too, if also explained well.)*
- *You would video or audio tape the subjects so that later on you can hear what they are saying and doing [1]*
- *Should test with the particular group of users the product is aimed at. Shouldn't just be tested on you and the design team [1]*
- *You should test the users doing an appropriate set of tasks. They should at least be doing tasks related to the remote and the TV. [1]*
- *Should do this in a relevant environment of use, i.e. the home. This is very important in this case as the home is noisy – makes the speech recognition less effective. You would not find this just from doing a study in a quiet lab [1]*
- *What happens if someone else in the room (or even on TV) says "channel 1"? Wouldn't find this out in a quiet lab [1]*
- *By thinking aloud you might trigger the speech recogniser by saying one if its key words [1]*
- *When you think aloud it changes the way you perform a task. Also can be awkward for the subject, they may feel embarrassed by speaking aloud. Other techniques such as interviews do not suffer from these [1]*
- *Extra [1] for a particularly clear well-structured answer*

2.a) Draw an Entity-Relationship diagram for the following scenario, indicate clearly and primary keys and the cardinality and totality of all relationships.

Academic staff have unique identification numbers and have singly occupied offices. Students have unique matric numbers and first and last names. Staff and students may have computers, which are uniquely identified by RFID tags. All staff have at least one computer each, whereas only some students have at most one computer. A student may request to borrow a book from the library, several students may request the same book. Each books is uniquely identified by an ISBN number.

[11]



1 mark reasonable entitites
1 mark reasonable attributes
1 mark names is multiple
1 mark primary keys

1 mark overall structure sensible

2 marks correct totality, cardinality for each relations (=6)

b) Given a relational database with two tables as follows:

Academic = (Surname:Text, Firstname:Text, Staff-no:Text, Dept:Text)
Course =(Name:Text, Code:Text, Lect-id:Text,)

Assume that underlined attrributes are primary keys and Lect-id is a foreign key referring to the Staff-no attribute of Academic.

i) surnames of academics in the department of "Basket Weaving".

```
Select Surname
 from  Academic
 where Dept="Basket Weaving".
```

[2]

ii) firstnames and surnames of lecturers on the "CS1-Q" course.

```
Select Firstname, Surname
 from  Academic, Course
  where Staff-no=Lect-id and  Name="CS-1Q".
```

[4]

c) Given the following sets: A={1,3,7,9}, B = {2,4,6}, C={7,9}

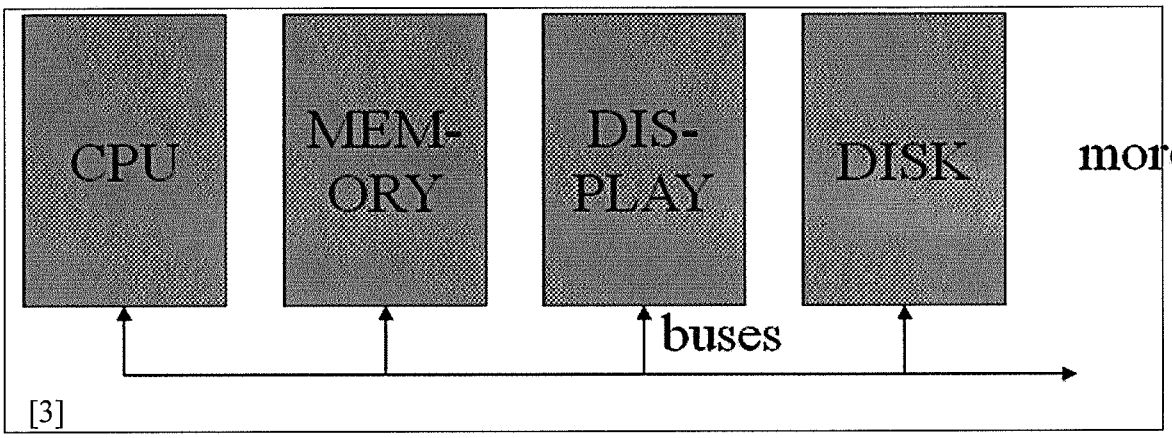
give the following. Assume that $\wp$ is the powerset operator.

i) $|B| = 3$
ii) $\wp(B) = \{\{\},\{2\},\{4\},\{6\},\{2,4\},\{2,6\},\{4,6\},\{2,4,6\}\}$
iii) $|\wp(C)| = 4$
iv) $B \times C = \{<2,7>,<2,9>,<4,7><4,9>,<6,7>,<6,9>\}$
v) $A \cup B = \{1,2,3,4,6,7,9\}$
vi) $A \cap C = \{7,9\}$
vii) Which of the following are true
   a. $C \subseteq A$ =True
   b. $C \subseteq B$ = False
   c. $<1,2> \in A \times B$ =True

[8]

3. **(a)** Draw a labeled diagram of a simple computer architecture showing how the core components connect together.

[3]



[3]

(b) Explain how to represent an image digitally. Why have analogue (film) image representations been generally replaced by digital representations?

[2]

A digital image comprises an array of pixels, where each element represents a sampled light intensity or colour value[1]. Digital image representations are becoming more widespread because they can be captured without film processing delays and it is convenient to use computer methods for the manipulation, storage, display and dissemination of digital images[1].

(c) Outline briefly the four principal functions of an Operating System.

[4]

1. Controlling the loading and execution of application programs: a multi-tasking OS must also share resources among several executing programs.[1]
2. Organising disk storage: information stored on disk is organised into files and directories (or folders), in a structure determined by the OS.[1]
3. Providing services to application programs: The OS provides many common software functions, and insulates applications from hardware details.[1]
4. Providing a uniform user interface: Applications use OS services to interact with the user; this gives a consistent "look and feel". [1]

(d) Operating systems have recently migrated from 32bit to 64bit processing architectures and CPU platforms. Explain what advantages this change has brought, citing an example of a type of application program that might benefit.

[1]

64bit operating systems can access much larger core memory spaces than 32 bit operating systems (limited to 4Gb), making them suitable for manipulating very large data sets used in digital films or certain types of database [1].

(e) You are required to design a circuit which, given an input *xyz* representing a 3 bit binary number *n*, produces an output *abcdef* representing n^2. For example, if the input is 110 ($x = 1$, $y = 1$, $z = 0$), representing $n = 6$, then the output is 100100, representing 36.

(i) Draw a truth table which shows *a, b, c, d, e, f* as functions of *x, y, z*. [3]

N	n^2	x	y	z	a	b	c	d	e	f
0	0	0	0	0	0	0	0	0	0	0
1	1	0	0	1	0	0	0	0	0	1
2	4	0	1	0	0	0	0	1	0	0
3	9	0	1	1	0	0	1	0	0	1
4	16	1	0	0	0	1	0	0	0	0
5	25	1	0	1	0	1	1	0	0	1
6	36	1	1	0	1	0	0	1	0	0
7	49	1	1	1	1	1	0	0	0	1

(1/2 mark for each correct binary output column.)

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

[6]

Karnaugh map for **a**: (1 mark)

	not(y)	y	y	not(y)
not(x)	0	0	0	0
x	0	1	1	0
	not(z)	not(z)	z	z

Karnaugh map for **b**: (1 mark)

	not(y)	y	y	not(y)
not(x)	0	0	0	1
x	1	0	1	0
	not(z)	not(z)	z	z

Karnaugh map for **c**: (1 mark)

	not(y)	y	y	not(y)
not(x)	0	0	1	0
x	0	0	0	1
	not(z)	not(z)	z	z

Karnaugh map for **d**: (1/2 mark)

	not(y)	y	y	not(y)
not(x)	0	1	0	0
x	0	1	0	0
	not(z)	not(z)	z	z

Karnaugh map for **e**: (1/2 mark)

	not(y)	y	y	not(y)
not(x)	0	0	0	0
x	0	0	0	0
	not(z)	not(z)	z	z

Karnaugh map for **f**: (1/2 mark)

	not(y)	y	y	not(y)
not(x)	0	0	1	1
x	0	0	1	1
	not(z)	not(z)	z	z

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

[3]

$$a = xy$$

$$b = x\bar{y}\bar{z} + xyz + \bar{x}\bar{y}z$$

$$c = \bar{x}yz + x\bar{y}z$$

$$d = y\bar{z}$$

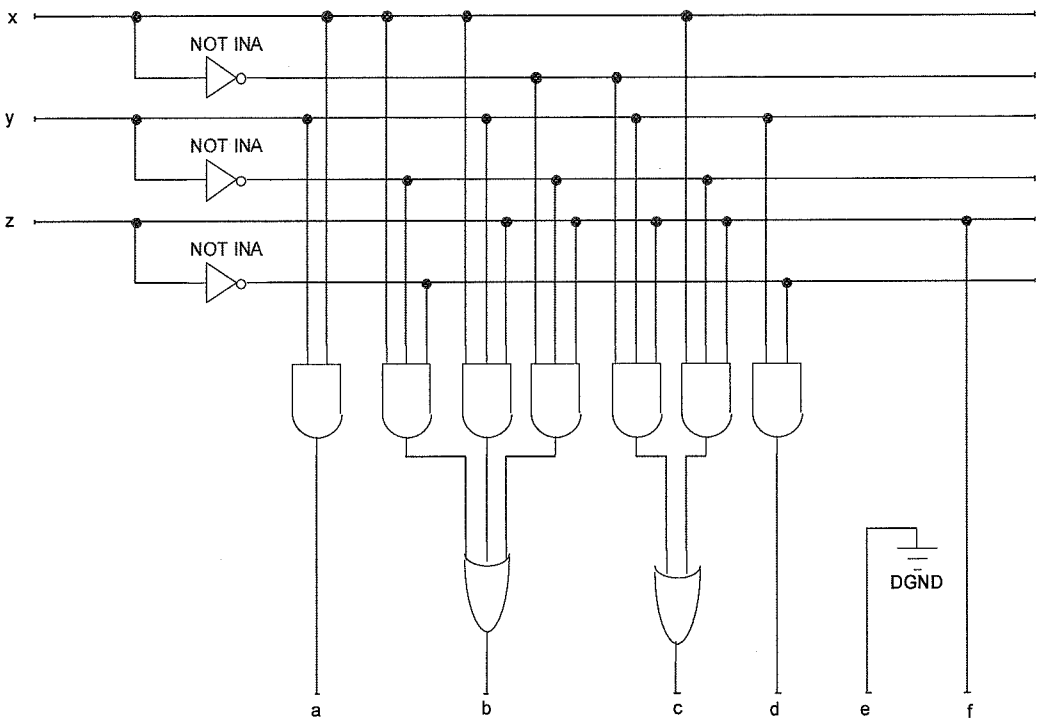
$$e = 0$$

$$f = z$$

(1/2 mark for each formula.)

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

[3]



1/2 mark for each correct part, i.e. calculation of a, b, c, d, e, f

4. **(a)** Explain the term *topology* in the context of computer networks. What is the difference between *circuit switching* and *packet switching* and explain their relative merits?

[5]

The term topology in a computer network refers to the configuration of the nodes in the network [1]. Circuit switching establishes a complete set of links from source to destination in a network that is maintained for the duration of the message transmission [1]. Packet breaks the message into smaller units of data, i.e. packets, switching and routes these individually. [1]. Circuit switching has the potential for high speed connections [1]. Packet switching is flexible and potentially fault tolerant [1].

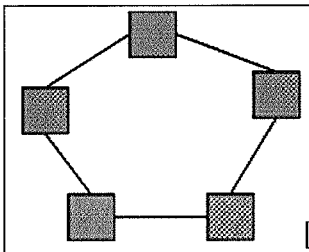
(b) Explain the difference between a *domain name* and an *IP address*, giving an example of each.

[4]

An IP address is a 32-bit number identifying a host on the internet [1], for example (in dotted decimal form) 130.209.48.1 [1]. A domain name is a human-readable name for an IP address or group of IP addresses [1], for example marion.dcs.gla.ac.uk [1].

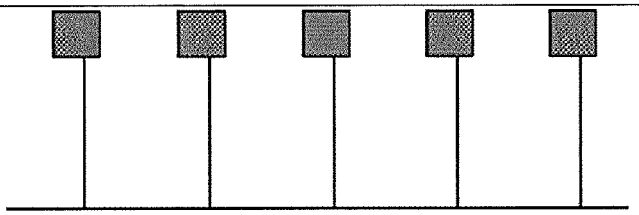
(c) Explain in detail the difference between a token ring topology network and a bus topology network, illustrating your answer with diagrams of each of their configurations. Give a detailed account of how they communicate messages between their respective nodes and your view of the relative advantages of each approach.

[10]



[1]

In a token ring each computer passes a message to the next [1]. In order to transmit a new message, a computer must wait for permission. Permission is obtained by receiving a special message, the *token*, which circulates around the ring [1]. After receiving the token, a computer is allowed to transmit one packet, then it passes the token on. Any computer not holding the token just passes messages on [1].



[1]

Only one computer can transmit data at a time (otherwise there would be electrical conflicts) [1]. Each computer is able to detect *collisions* when transmitting. If a collision occurs, each sender waits for a random time (up to 10ms, say) before trying again [1]. If there is a second collision, the upper bound for the random delay is doubled (and so on, for subsequent collisions). This is called *binary exponential backoff* [1]. The token ring avoids the need for collision detection, but has the disadvantage over a bus topology that if any one computer fails, then the network for entire ring is potentially disabled[1]. The bus topology is potentially more fault tolerant, since any individual computer failing will not halt the entire network, but requires a more complex message passing protocol that is indeterminate in operation [1].

(d) In a typical home computer system, all of the user's standard applications programs, such as office suites (including word processing and spreadsheet editors), image manipulation, games and multimedia applications, are usually purchased once and stored on the hard drive. In a new model of computing, users' programs are stored on a central file server and accessed through the internet for a monthly, or annual, fee.

What do you think are the advantages and disadvantages of "owned" applications on local storage compared with "hired" applications on central storage?

[6]

Many issues to discuss, including: reliability of access (consequence of not getting access to applications or networks not being available ubiquitously); speed (depending on the speed of the network;); the need for a permanent network connection; potential to access the server from other locations; decreased storage requirement of the netbook. Pros and cons of hiring the software (always latest software revision, temporary access at low cost to expensive packages, access to more packages than able to purchase etc., but no control of application release revisions or perhaps the particular applications themselves) Marks for considering as many issues as possible in an intelligent way, especially with reference to other sections of the course; also for quality of writing and argument.

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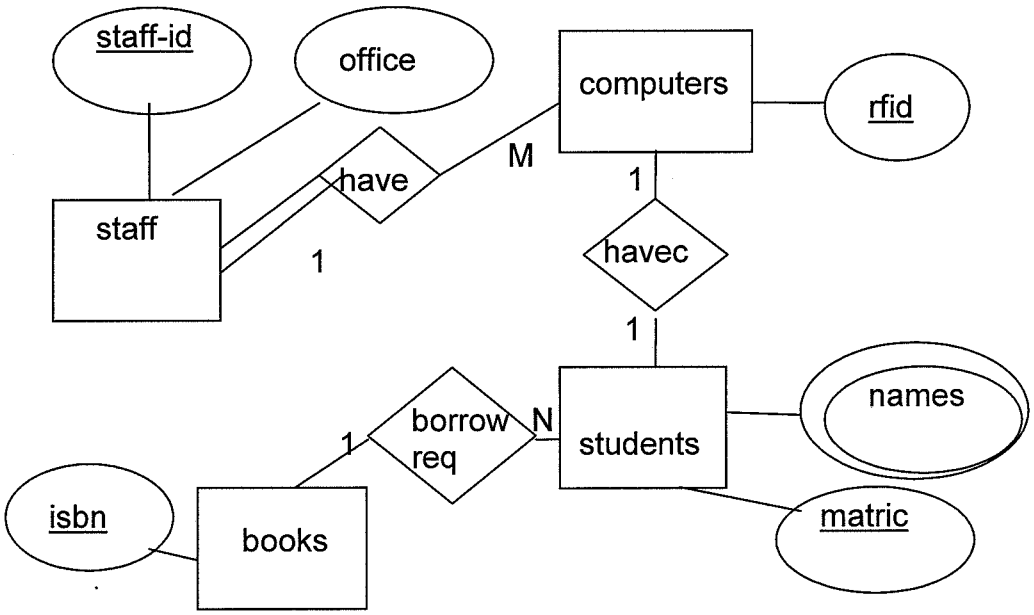

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