UNIVERSITY OF EDINBURGH

COLLEGE OF SCIENCE AND ENGINEERING

SCHOOL OF INFORMATICS

Computer Literacy 1

Degree Examination

Solutions

Date: 9 December 2006
Time: 9:30 – 11:00 pm (one and a half hours)
Place: Adam House Ground Floor

Board of Examiners
Chair: Michael O'Boyle
External Examiner: Robert Irving

Instructions to Candidates

Attempt **ALL** questions in part 'A' and **ONE** question from part 'B'.

Marks for questions are indicated in brackets after each question. Each question is worth 20 marks and the total for the exam is 100.

Candidates in the third or later year of study for the degrees of MA(General), BA(Relig Stud), BD, BCom, BSc(Social Science), BSc(Science) and BEng should put a cross (×) in the box on the front cover of the script book.

Part "A"

Answer ALL questions from this section

1. (a) What are the principal functions of

i. A mainframe computer [2 marks]

ii. A networked server ? [2 marks]

[bookwork] Mainframe: Central corporate machine; large; probably business-critical; Probably carries out a limited number of complex tasks on large volumes of data (e.g. salaries, trading positions, airline transaction processing).
Server: One of possibly many machines that provides a single function to clients on a network, e.g. print server, web server, mail server

(b) i. Describe two key differences between the GIF and JPEG image formats. [2 marks]

ii. Why would JPEG be a bad choice for storage of diagrams? [1 mark]

[bookwork]
GIF: Lossless, 256 colours, proprietary. Good for graphics and diagrams; can be animated, allows transparent background.
JPEG: Lossy, 24-bit colour. Good for real-world scenes. JPEG doesn't handle sharp edges and lines well (blurs them or creates ghosting effects)

(c) A PC requires a complex interaction between the hardware, firmware and parts of the operating system in order to work. Identify three aspects of the 'behind the scenes' operation of a PC and explain how they work together to help you launch an application such as Office. [3 marks]

[starting point is bookwork. Considering how the functions work together is not] This is an invitation to talk about any three aspects of the operating system or PC fundamentals. The GUI, file system, scheduler, virtual memory, configuration management, BIOS, bootstrapping process etc. were all touched on in lectures.

(d) What is a Distributed Denial of Service attack and how does it work? [3 marks]

[bookwork] It is the process of using large numbers of 'drone' or 'zombie' PCs to flood a victim machine with traffic. The drones are recruited by tricking their owners into acquiring a Trojan horse program which logs on to a central point then lies dormant awaiting instructions. When activated they flood the target bringing it down.

(e) What are the key features of:

i. A Cyclic Redundancy Check (otherwise known as a CRC or checksum) [2 marks]

ii. A datagram [2 marks]

iii. The TCP network protocol layer [2 marks]

iv. A DNS server [1 mark]

[bookwork]

i. A number computed from the contents of a data packet and transmitted with it. Recomputing the checksum and comparing it with the received copy enables error detection.

ii. A packet of data which is sent off into a TCP/IP network such as the Internet. Datagrams are self-contained entities which can arrive at their destination via alternate routes and may arrive out of sequence or not at all.

iii. TCP is responsible for maintaining a reliable data service over a datagram network. Packets are reassembled into the correct order and lost packets are retransmitted.

iv. A DNS server provides a translation between names and IP addresses.

2 **(a)** Describe the critical differences between client-server and peer-to-peer networks. Why are businesses interested in P2P systems for sharing files between large numbers of users? [4 marks]

[starts with bookwork but considering the business aspects isn't really] A true P2P system has no central server and each peer is exactly equivalent to all the others. In practice P2P systems generally have a network of servers that help peers discover each other but once they are in touch, data transfer goes ahead without a central server. In a client-server model all transactions are routed via the server. In this model the server has much greater control but is the central point of failure or bottleneck. P2P networks generally scale better though can be demanding of networks. Business are interested in P2P as it scales well and potentially avoids the need for expensive servers.

(b) Processor performance has followed Moore's Law for many years but there are signs that this will not be the case for much longer. What techniques are computer processor manufacturers using to achieve maximum overall processor performance? [3 marks]

[bookwork] Cacheing – storing of items likely to be reused in fast memory close to the processor; pipelining – anticipating future steps in a computation and prefetching items likely to be needed; multi-processing – building systems with multiple processors or multiple processor cores.

(c) I purchase an item on the Internet using my credit card and the goods that arrive are not what I ordered. What is my protection under the Consumer Credit Card Act 1974? What would have happened had I made this purchase from eBay using PayPal? [3 marks]

[bookwork] Under CCA 1974 the credit card company is jointly responsible with the supplier for execution of the contract of sale. You are entitled not only to your money back but for any attendant costs arising from sorting it all out (e.g. return postage). PayPal is not a credit mechanism so is not covered by CCA 1974 and you need to rely on the protection offered by eBay or PayPal.

(d) Describe two schemes that have been used to defraud Internet users. Why do they succeed and how can they be defended against? [2 marks]

[bookwork] Phishing and spamming of mail relating to scams such as 'must-buy' share offers come to mind but there is no shortage of others. They succeed because of peoples' naivety, carelessness, stupidity or greed and the defence is common sense, education and vigilance. Defence mechanisms such as spam assassins reduce the numbers but are no substitute for common sense and scepticism.

(e) I want to create a home network with the following characteristics:

a) The network will have a broadband connection
b) I want to be able to use a fixed PC from my study and at the same time a laptop from anywhere in the house.
c) My son wants to be able to exchange data between his PC and mine at speeds of at least 100 Mbit/second
d) The whole network needs to be reasonably secure.

My laptop is network-ready but the other PCs are not. What hardware and software components will I need to install and what will be their purpose? [3 marks]

[part bookwork] A cable or DSL modem – interfaces to the broadband network and handles low-level data transmission and reception; A switch/router that routes packets on and off the local network; a wireless access point to talk to the laptop; network cards for the two fixed PCs. You will want to be sure that the network has some firewalling built in and that as much wireless security (e.g. WEP and MAC address filtering) as possible is switched on.

What would I have to do in order to run an externally-visible Web server from this network? [2 marks]

[bookwork] 1. Open up the firewall to allow traffic in on port 80; 2. route port 80 traffic specifically to the IP address hosting the Web server.

(f) My web site content and style are as good as I can make them. How else can I increase the prominence of my Web site on the Internet and increase the number of visitors? [3 marks]

[part bookwork] Create accurate metadata with relevant keywords; update the site regularly with new content; ensure that the lead page contains a good concise overview of what the site is about; arrange link swaps or citations from other sites; Subscribe to free or paid-for link schemes (e.g. those run by local Chambers of Commerce); advertise through conventional channels

3. (a) What are the *peripherals* of a computer? Give examples of three different peripherals and in each case describe the measures you would use to distinguish between different peripherals of the same type. [3 marks]

[bookwork] Peripherals are the input, output and 'external' storage devices. Monitor, keyboard and printer are three types of peripheral. [half point for each]. Measures include resolution, speed, colour depth, size etc.

(b) Give a characterization of analogue values and of digital values, and provide an illustration of each. Give an example of a device that converts between the two types of representation. What are two main advantages of digital over analogue? [4 marks]

[part bookwork part not as examples arise from applying the concept] Analogue values are continuous, and are often represented using gauges or dials, while digital is discrete and can be represented as an exact numerical display [2pts]. A telephone modem converts between the 2 [1pt]. Digital is faster (on/off as opposed to how much), and robust to errors (small errors at each switch in the computer are not propagated)

(c) In the context of file storage, what is *fragmentation*, how does it occur, and why is it undesirable? [3 marks]

[bookwork] Fragmentation is where parts of files are scattered all over a disk [1pt]. It's a result of repeated deletion and then addition of files, because the operating system will utilize non-contiguous free blocks [2pts]. Bad because it forces the disk read head to move around to access the file, which is inefficient and slows things down

(d) In the context of genetic algorithms, name and describe the two basic operators that transform the chromosomes. How does an Elitist genetic algorithm move the generations along? [4 marks]

[bookwork] Crossover allows the characteristics of 2 different chromosomes to mix (as in sexual reproduction) [1pt], while mutation allows the characteristics of a given chromosome to change [1pt]. In and Elitist GA, the children replace the parents only if they are fitter, otherwise child is discarded

(e) Give both a positive and a negative aspect of information technology in the spheres of:

- **i.** commerce
- **ii.** the environment
- **iii.** the workplace
- **iv.** quality of life [6 marks]

[not bookwork] A number of possibilities, including (i) online shopping/depersonalization, (ii) paper saved/hardware disposal, (iii) work from home/RSI, (iv) new forms of experience and entertainment/couch potatoes. There is no shortage of examples.

4. (a) Consider the Turing machine specified by the program <1,1,1,1>, <1,0,0,1>. If it begins its computation in state 1 reading a 1, what 'actions' will it perform next? If in state 1 reading a 0? Describe the overall computational behaviour of the machine. [4 marks]

If it begins its computation in state 1 reading a 1, it will print a 1 and enter state 1 [1pt]. If in state 1 reading a 0 it will print a 0 and enter state 1 [1pt]. So the machine will never move to a new square, alter the contents of the tape, or change state, but the computation will never halt – it will be stuck in an infinite loop in state 1 [2pts].

(b) In relational database terminology give a characterization of the following:

- **i.** record
- **ii.** field
- **iii** primary key
- **iv.** foreign key [4 marks]

[bookwork] A record is the data for a single item in a table, where the record is presented as a row. A field is a piece of data within a record, where each field is a column. Primary key is the field that is the unique identifier in each record – can't enter duplicate info in a primary key field. A foreign key refers to the primary key in another table [1pt each].

(c) What is the general notion of an effective procedure? [3 marks]

[bookwork] An effective or 'mechanical' procedure is a finite set of instructions for manipulating symbols, where the symbols can be manipulated without knowing what they mean or what the manipulations are supposed to accomplish

(d) Describe the Eliza program and the design strategy behind it. [4 marks]

[not really bookwork] The Eliza program was created in 1964 to show that it doesn't take sophisticated linguistic theories to give the appearance of intelligent conversation. Uses strategy of key-phrase matching – stores a set of key phrases and words and looks to match these to the input sentences in order to generate a plausible output. Still the basic strategy used by most contemporary chatbots and Turing test hopefuls.

(e) What does 'multiple realizability' mean in the context of computation? Give a non-computational example as well. Why is multiple realizability important for Artificial Intelligence? [5 marks]

[part bookwork] Multiple realizability: the same abstract computational formalism can be realized in any number of different arrangements of matter and energy: gears and levers, electronic circuitry, pen and paper. Non-computational examples: literature, musical compositions, chess. Important for Artificial Intelligence because it allows us to think of the mind at the abstract computational level but implemented in physical hardware such as the brain, giving a very general theoretical handle on intelligence and mentality

Part "B"

Answer ONE question only from this section

B1. IBM has been exploring the possibilities of using the "Second Life" virtual world to hold business meetings. Discuss and speculate on the benefits and disadvantages of using this as opposed to other computer-mediated and real world mechanisms for holding meetings.

[20 marks]

[two news articles were supplied. Not really bookwork] 2nd life allows a mixture of verbal and non-verbal communication plus a visual context to the meeting (avatars sit in chairs around a table in a meeting room; One could raise a hand as an indication of a desire to speak rather than just cut in as would happen with instant messaging). Possibly the presence of social cues such as a constant reminder that one is in a meeting might reduce flaming and off-topic discussion. There would also be a constant visiual reminder of who was in the chair; expressions could be accommodated, removing the need for smileys. 2nd life works much like being in a game. "Gaming generation" users may feel familiar with this but older people might not and might have difficulty expressing themselves or even mastering basic operations.

Alternatives include real-world meetings (not always easy or cheap to organise in a globally distributed corporation), conference calls (may be issues about communicating reactions, also different cultures react differently to silences or verbal interruptions. Studio video conferences require effort to set up. Current desktop video is slow and at the mercy of lighting or camera position as to whether it conveys more information that a phone call. Instant messaging systems such as MSN lack visual control/status cues which can lead to people making inappropriate comments.

B2. What issues does the chief Web architect of a multinational corporation have to consider in designing and maintaining the corporation's web sites

[20 marks]

[some bookwork but the ideas need to be developed from background reading to secure a good mark] Content and corporate style; ease of maintenance; customisation and content management for a multilingual site; observing guidelines and law in respect of disabled users; signing-off of material to ensure corporate editorial control; performance issues; security; compatibility with legacy systems; testing; target audience; reusability of content in different contexts

B3. Making explicit use of material covered in the course, write an essay discussing the basic phenomenon of linguistic communication, including attempted definitions and models, and the role of computers *both* in understanding *and* facilitating this phenomenon. Be sure to include discussion of the basic strengths and weakness of computers in processing human language.

[20 marks]

[not bookwork] Two entire lectures devoted to the topic of 'Computers, Communication and Language', so plenty of material for students to draw on. To a first level of approximation, communication is the exchange of information between agents, though this can be refined and further analyzed. Obviously linguistic communication is central to human culture, and it has many subtleties, such as non-literal meanings, conversational implicatures, etc. The strengths and weakness of computers applied to this domain help reveal features of the phenomenon itself. Should mention that computers are very good at recursion, composition, and other 'bottom-up' methods of generation. Not very good at top down methods that require a global understanding to fill in crucial gaps. Serious weakness in NLP applications, since humans rely crucially on understanding and world knowledge, i.e. semantics, to interpret and disambiguate various input signals.

B4. There are at least three primary dimensions to being 'computer literate'. One is familiarity with the rapidly changing techniques and technologies made possible by computer applications. Another is an acquaintance with the fundamental concepts and theories of computation underlying the technology. Third is an appreciation of the effects these technologies have on human cultural and ways of life, both for better and for worse.

Write an essay in which you discuss what you found most beneficial and/or interesting about the course along each of these three dimensions.

[20 marks]

*[not bookwork] Quite open-ended, basic marking scheme of allocating one third of the points for each 'dimension'. In this question students are invited to reflect on what they've learned in the course, under the proffered thematic schema. The intention is for them to make a case for, or at least indicate through their own exposition, what they found interesting and/or important in each of the three dimensions. May not be particularly easy unless they *were* genuinely interested in some topics, but in that case it's not necessarily bad to reward them with a chance to express this. Difficult to predict the exact content of a good response, but, e.g. along the fundamental concepts and theory dimension, a good student might talk about the Church-Turing Thesis, the halting problem...*