

UNIVERSITY OF EDINBURGH
COLLEGE OF SCIENCE AND ENGINEERING
SCHOOL OF INFORMATICS

Computer Literacy 1

Resit Examination

SOLUTIONS

Date: 15 August 2007
Time: 9:30 – 11:00 pm (one and a half hours)
Place: [xxx]

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 FOUR questions from this section

1. (a) What factors limit the development of faster and faster Windows PCs and how are manufacturers getting around these? [4 marks]

Principally heat and quantum effects in processors and the mismatch between the fast processor core and the much slower devices that surround it. I would accept any mention of techniques such as multiple processing cores or CPUs, optimising of power consumption, cacheing and pipelining, faster disks and memory, delegating tasks to devices such as graphics chips etc. etc. I would also accept comments such as 'more efficient operating systems'. Mentioning Moore's law with an understanding of what it means and that the question is referring to its limits is worth a mark.

- (b) Alan needs to dictate a table of numbers to Barbara over a very noisy phone line. Alan tends to speak very quickly. The table has several columns and the last number in each column is the total for that column. Using what you know of communications protocols describe how Alan and Barbara might arrange the conversation so that the numbers are received completely and correctly. [6 marks]

First they have to agree on how to go about this (protocol). B needs a way to ensure that she can hold off A if he speaks too quickly (flow control) and to detect and recover from errors. It would also help B if A tells her when he moves on to the next line of the table (packet delimiter!). B can only detect an error when the entire column has dictated at which point she can add up the numbers, compare them to the total (checksum) and ask for a repeat of the entire column. As this is very inefficient B might be better to ask A to either repeat the numbers or dictate a total after each row.

- (c) Imagine you are the parent of children aged 10 and 12. What guidelines would you give them to ensure their safety when using the Internet? [3 marks]

Don't give out personal details to someone you don't know; Do report anything you see that upsets you or you are not sure of; never, ever agree to meet someone you only know on the Internet unless your parent is with you (and preferably is involved in the conversation); Remember not everyone is who they claim to be; etc. etc.

- (d) Describe three ways of making payment from Internet-based suppliers. What are the benefits and drawbacks of each? [3 marks]

*Credit card: Protected by Consumer Credit Act; some vulnerability to having details taken down and abused.
Paypal: No CCA protection but your exposure is limited to the amount of cash in your Paypal account*

Don't pay over the Internet at all – use contact details on the web site to phone up and order that way. No real advantages except that details are not going over the Internet.

- (e) Graphical User Interfaces (GUIs) are the most common way in which users interact with operating systems or computer applications. What would you look for in a well-designed and well-constructed GUI? [4 marks]

Reliable, convenient, fast, intuitive, forgiving of errors / allows experimentation, helpful, unobtrusive ...

2. (a) Dismantling and re-assembling the brakes on a car is a tricky operation and could cause an accident if done incorrectly. Explain how you might use computer graphics and other techniques you have encountered in CL1 to reduce the chance that an engineer will make a mistake when replacing the brakes on an Aston Martin. What problems do you envisage in this approach compared to, say a printed manual with photographs? [6 marks]

One use of graphics is to explain operations in 3-D, of which this is an example. A rendered animation would demonstrate the procedure and help, especially if it could be made available in the workshop (problem #1). The animation would be clear of the clutter but a photograph would give a better idea of what the area actually looked like. The course touched on the problem of data life - instructions will be as relevant in 20 years time as they are now; a manual would survive but a PDF document on a CD-ROM might not be readable then.

- (b) State some forms of malicious computer-related behaviour that a firewall will not protect you from [3 marks]

Viruses, Phishing, Distributed Denial of Service (DDoS)

- (c) I am about to replace Windows XP on my 3 year old desktop machine with the much larger and more demanding Windows Vista and am concerned that I might have problems. What are the most likely signs that my machine is having problems with Vista and what can I do about it? [3 marks]

Probably thrashing – evidence that the disk is being accessed repeatedly every time a program is kicked off; result is very poor performance. Solution is to install more RAM, not go for a faster processor.

- (e) Why might I want to use the following in construction of a Web site?
- i. Cascading Style Sheets
 - ii. Java
 - iii. XML

[3 marks]

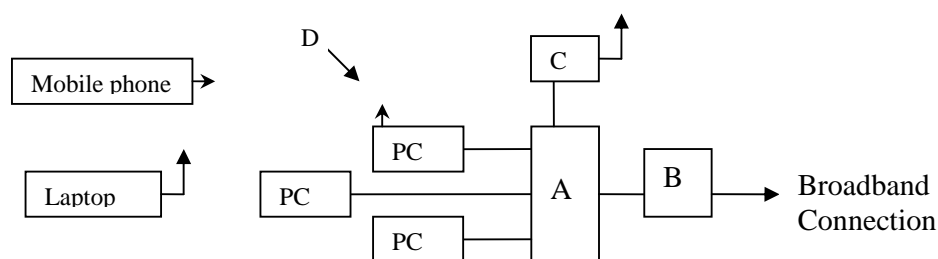
- i. *To maintain consistency of style*

- ii. To provide client-side processing power – everything from animations to local consistency checking of supplied information
- iii. To exchange information with meaning

- (f) What is the main problem with *symmetric key* encryption systems and how do public key systems avoid this? [2 marks]

The key has to be sent between parties in some clear form and can be intercepted. Public key systems avoid this by having a one-way public key which can encrypt only, paired with a secret private key that can decrypt the result. This way the private key never has to be transmitted.

- (g) My home network is laid out as per the diagram below, connecting three fixed PCs and a wireless-enabled laptop. Periodically I synchronise the contents of my mobile phone with one of my PCs. 'A' – 'C' are small boxes that sit on my desk. 'C' has a short aerial. 'D' is a small attachment plugged in to the USB port of one of the PCs. What are the items 'A' – 'D' likely to be and what are their functions? [5 marks]



A: Switch/Router/(probably) firewall; manages, switches and filters traffic between PCs on the network and routes traffic between PCs on the local network and the Internet

B: Cable modem; interface between local Ethernet and broadband signal

C: WiFi Wireless Access Point; Allows multiple wireless devices to connect to network

D: USB Bluetooth (or Infra-Red) dongle; allows wireless connection to phone

3. (a) Describe the notion of an embedded computer and give an example. What is the relevance of 'firmware' in this context? [3 marks]

Embedded computers are built-in special purpose machines that perform specific tasks [1 mark], e.g. climate control inside a modern office building [1 mark]. Embedded computers generally have their programs etched in silicon so they can't be altered i.e. 'firmware' [1 mark].

- (b) Describe or illustrate the key functions of
- i Data mining

ii Geographical Information Systems (GIS) [4 marks]

Data mining: applied to large volumes of data to discover previously unknown trends and patterns, often utilizing AI techniques.

GIS: a specialized database that represents information in a spatial/geographical context, can display data as maps.

- (c) 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? [5 marks]

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 [2 marks]. A telephone modem converts between the 2 [1 mark]. 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) [2 marks].

- (d) What is syntax, and what is semantics? Provide an example of each type. Which is processed by a computer, and why? [4 marks]

They are the 2 primary levels of language. Syntax is the level of sign, symbol or notation. Semantics is the level of meaning or reference – what the symbols are about. So the English word ‘tree’ is an example of syntax, whereas the botanical organisms themselves are the semantics. Computers can only process syntax or symbols, e.g. can manipulate the string ‘tree’ (or ‘baum’), but a tree itself isn’t stored in any register.

- (e) Consider the Turing machine specified by the program $\langle 1, 1, R, 1 \rangle$, $\langle 1, 0, R, 1 \rangle$. 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 move right one square and enter state 1 [1 mark]. If in state 1 reading a 0 it will move right one square and enter state 1 [1 mark]. So the machine will never halt – it will just keep moving right one square at a time [2 marks].

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

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.

- (b) What is a bit? What is a byte? How many different possibilities can a byte express? [4 marks]

A bit is one unit of 'information' in some binary scheme, e.g. 0 or 1, so each bit has one of two values. A byte is eight bits and can therefore express $2^8 = 256$ different possibilities.

- (c) What is the computational paradigm in AI? What is the mind/program analogy and why is it important? [4 marks]

Computational paradigm explains human mental states and thinking as complex information processing states that mediate the inputs and outputs of behaviour – just like in a computer [1 mark]. Hence the allied mind/program analogy holds that the mind is to the physical brain as the program is to the hardware of a computer [1 mark]. It's important because it provides a model for how the mind and brain are related (the mind/body problem) and thus how 'abstract' mental processes can lead to physical effects [2 marks].

- (d) In the context of genetic algorithms, name and describe the two basic operators that transform the chromosomes. How do genetic algorithms utilize the biological notion of 'survival of the fittest'? [4 marks]

Crossover allows the characteristics of 2 different chromosomes to mix (as in sexual reproduction) [1 mark], while mutation allows the characteristics of a given chromosome to change randomly [1 mark]. GA's utilize a 'fitness function' to measure varying degree of fitness of potential solutions, where less fit solutions are eliminated from the population. [2 marks].

- (e) What is the biological inspiration for connectionist networks? Describe three fundamental differences between connectionist networks and classical computation. Name an area in which connectionist style computation is particularly successful. [5 marks]

The brain [1 mark]. Massively parallel processing, highly distributed - representations aren't localized in traditional registers, no explicit rules or symbols [3pts]. Pattern recognition, extracting regularities from data, potential foundation for perception, navigation, motor control [1 mark].

Part "B"

Answer ONE question only from this section

- B1.** We now live in an 'Information Age' and many aspects of human culture are undergoing radical change. As with most changes, there are both benefits and drawbacks. Write an essay discussing what you take to be the most important spheres of impact of information technology, and the primary positive and negative effects. What factors and considerations are required to reduce the negative aspects of change, and for us to make an informed choice about the way we live and the direction in which society is going? [20 marks]

A number of spheres of impact might be discussed, including communication and human interaction, work and business, environment, lifestyle and entertainment, health, education, crime, etc. Some benefits: access to information, people (communication), flexibility in work patterns, location independence, new forms of experience/entertainment, new media for artistic creativity, new products and markets, business efficiency (reduced costs, more choice), breakdown of borders. Some problems: use of info to control people, pace of life, info overload, passive consumerism where people inhabit other peoples' created digital words rather than real life, computer crime, invasion of privacy. Balance: laws on hacking, stalking, etc., data protection. Norms: people usually conform to acceptable behavior (but internet anonymity can erode this). A potential point for discussion is that real choice guides the future direction of society, rather than just profit motives and/or laziness.

- B2.** "To err is human; to really mess things up requires a computer". There are many ways in which errors can arise in computer programs or in which computer-based projects can go wrong. Use what you have learned in the course plus your own reading and experience to explain how one ensures that a large piece of new software performs as intended and is delivered on time and within budget. [20 marks]

One entire lecture was given over to ways in which programs can go wrong and a second covered aspects of how one goes about setting up an IT project. This is really two questions joined together. There should be a proper definition of the requirements and a specification to match it. Other acceptable topics include project management, iterative design, checking and defensive programming, quality of documentation and training. Top marks will go to those who have read a little and have picked up points such as (lightly touched on) that changes to the specification are expensive and have to be managed.

- 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 weaknesses of computers in processing human language.
- [20 marks]

Two entire lectures devoted to the topic of 'Computers, Communication and Language', so plenty of material for students to draw on. 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.** TradCast is an old-fashioned family firm that makes high quality metal castings. It hardly uses IT at all and its accounts and records are on paper. TradCast has just been bought by Newform, a rather more modern company based 120 miles away which uses IT more than TradCast but still only for its accounts and for issuing invoices – sales are handled over the phone. A condition of the takeover was that TradCast's workforce be kept on for three years. You are a senior manager at Newform and you think that a) TradCast and Newform will have to combine their sales and administration procedures or TradCast will drag Newform down, and that b) Newform could be doing much more with IT than it is. Your Board has asked you to report on the possibilities and the likely problems and to give an outline on how you would proceed. Describe what would be in your report – you may invent additional detail if this helps illustrate your points.
- [20 marks]

This is an opportunity to talk about pretty much any aspect of how IT affects business. In this instance the main problem is use IT to allow one business to run in partnership with a second minor partner 120 miles away without huge overheads or alienating the workforce. No-one would want change for its own sake but Newform could use the takeover to introduce full on-line sales and accounting, possibly with a web presence. They could use a whole range of collaborative techniques from email through an intranet sharing documents and, even desktop conferencing to bring the two businesses closer. TradCast employees will be feeling very vulnerable and might feel more comfortable if they are in at the beginning of a change that affected both companies. Any sensible contributions on the problem will be accepted. I would expect some mention of training and an awareness that the first stage is to define the problem properly.

