UNIVERSITY OF LONDON

IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY AND MEDICINE

EXAMINATIONS 1999

MEng Honours Degrees in Computing Part IV
MEng Honours Degree in Information Systems Engineering Part IV
MSci Honours Degree in Mathematics and Computer Science Part IV
MSc Degree in Advanced Computing
for Internal Students of the Imperial College of Science, Technology and Medicine

This paper is also taken for the relevant examinations for the
Diploma of Membership of Imperial College
Associateship of the City and Guilds of London Institute
Associateship of the Royal College of Science

PAPER 4.75 / I 4.16

SOFTWARE ENGINEERING – ENVIRONMENTS

Friday, May 14th 1999, 10.00 – 12.00

Answer THREE questions

For admin. only:
paper contains 4 questions

Section A *(Use a separate answer book for this Section)*

1a Define *tool, toolkit, workbench* and *environment* in relation to automated software engineering.

b List and define the four component aspects of tool integration. What are the issues that need to be addressed by a designer of an integrated tool environment related to each of these four aspects?

c Any respectable engineering organisation will want to ascertain fully the characteristics of any tools/environments that they wish to purchase to support and improve their software development processes. You are the person in charge of such procurement for WISHFUL THINKING INC and you have been asked to evaluate some products offered by various vendors. What criteria will be used in your evaluation and how will you determine the (quantitative or qualitative) values associated with each criterion for each product?

The three parts carry, respectively, 20%, 30%, 50% of the marks.

2 KIDS and PLANWARE are domain specific environments for transformation based software development. Describe in detail:

a the rationale for these environments,

b the characteristics of the design approach used,

c the kinds of tools integrated into the respective environments and

d the relationship of the two environments to each other.

The four parts carry, respectively, 30%, 30%, 25%, 15% of the marks

Section B *(Use a separate answer book for this Section.)*

3 Your client is a communications company CHEAPCALL and you are designing a system to increase the profitability of connecting phone calls. The nature of the domain in which the application will be put is that of constant change. The requirements have been agreed on and the design phase is ready to begin.

The characteristics of the problem domain are as follows:

- Two switches are connected by a line. Lines belong to different companies and they may vary their charges, both on a regular basis (weekends cost less) and on an adhoc basis (e.g. all charges are cut by 2%). CHEAPCALL own the lines between their switches. The cost of using their own lines is negligible.
- Swithces are replaced regularly with higher capacity than those they replace.
- Switches and lines fail.
- How busy a line is varies. There may be several alternative routes to connect two phones and CHEAPCALL wants to use the least expensive.

The system is being built from scratch but the firm foresees that this system will be used as a platform that will be continuously expanded and upgraded, in some cases to co-operate with third party software and older versions of software.

a Although there are many types of switches, they have some things in common so you have decided that you need a superclass Switch (with methods adjacentSwitch, giveSpeed, maxCapacity, currentUsage and other default behaviour). The concrete subclasses will inherit from this class overriding the necessary methods. Draw a diagram to indicate this class structure.

b In today's market the rate of innovation is very high. If you used a non-design pattern approach you might use `final static int types` that vary the computations according to the type in a massive `switch` statement. What is the problem with this? What happens when you try to add a new type of switch? What pattern should be used to overcome this problem? Draw a diagram of the general structure of this pattern. One of the types of switches is the packet switch. There are atm packet switches, X25 packet switches and other types of packet switches that may be added later. Draw a diagram using the design pattern you have chosen and packet switches as the example.

c Some of the switch manufacturers provide their own software. What pattern will enable the system to deal with this heterogeneous software base? Draw a diagram of the general structure this pattern. Two of the types of X25 switches are FastCo's X25 switch with full software and SlowCo's X25 switch with limited software support. Draw a diagram showing how the design pattern you have chosen using FastCo and SlowCo as the example.

d The engineers using the system want to see the communications traffic in different formats. They might want to see a snapshot in time of the network as a graph or in a spreadsheet. What design pattern would cater for this and why?

The four parts carry equal marks. *Turn over...*

4 Translated from Latin scroll dated 2BC

Dear Cassius:

Are you still working on the Y zero K problem? This change from BC to AD is giving us a lot of headaches and we haven't much time left. I don't know how people will cope with working the wrong way around. Having been working happily downwards forever, now we have to start thinking upwards. However, in two years time Government forecasts predict that there will be simply no year numbers left. You would think that someone would have thought of it earlier and not left it to us to sort it all out at this last minute.

Present abacus programs handle dates on the so-called "Backward Counting" (BC) system. Meanwhile, abacus programmers will have to use a combination of the current BC system with a new "Advancing Dates" (AD) system. The work needed to modify all the abacus procedures will require an extra 3500 highly qualified slaves working full time, and that Rome will have to conquer five extra countries to supply them.

I spoke to Caesar the other evening. We called in Consultus, but he simply said that continuing downwards using minus BC won't work and as usual charged a fortune for doing nothing useful. Some mathematicians have suggested the existence of some new "negative" numbers that could be used, but these have not been observed experimentally and it is expected to take around 1500 years to work out the details of the difficult mathematics involved. Will we have to throw out all our hardware and start again? Macrohard will make yet another fortune out of this, I suppose.

It is stressed that companies cannot afford to do nothing and hope the problem goes away. Without the necessary modifications abaci will just not handle dates correctly. As a simple example, "sell-by" dates will be mistaken for "sell-since" dates, with perishable food being thrown away before even being delivered to the shop

I have heard that there are plans to stable all horses at midnight at the turn of the year as there are fears that they will stop and try to run backwards, causing immense damage to chariots and possible loss of life.

Some say the world will cease to exist at the moment of transition. Anyway, we are still continuing to work on this blasted Y zero K problem. I will send a parchment to you if anything further develops. If you have any ideas please let me know,

Plutonius

a This letter satirises the current Y2K problem. Starting at the beginning of the letter go through the letter stating what the equivalent current problem is.

b What advice should Plutonius give to Cassius to start solving the problem?

The two parts carry, respectively 60% and 40% of the marks.

[End of paper]