UNIVERSITY OF EDINBURGH

FACULTY OF SCIENCE AND ENGINEERING

M.Sc./DIPLOMA IN ARTIFICIAL INTELLIGENCE
M.Sc./DIPLOMA IN COGNITIVE SCIENCE
M.Sc./DIPLOMA IN COMPUTER SCIENCE
M.Sc./DIPLOMA IN INFORMATICS

SOFTWARE ENGINEERING WITH OBJECTS AND COMPONENTS 2

Friday 19 April 2002

14:00 to 15:30

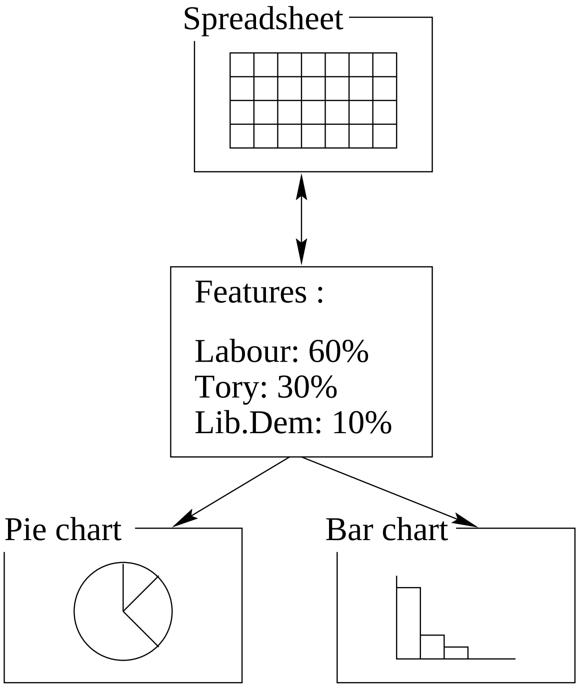
Examiners:
N. Chater (External)
N. Jennings (External)
E. Hancock (External)
K. Hawick (External)
R.N. Ibbett (Convener)
J. Oberlander (Co-Convener)

INSTRUCTIONS TO CANDIDATES

Answer any TWO questions.

All questions carry equal weight.

1. Suppose that you are involved in a project to construct a computer based reporting system for an election, as illustrated in the diagram below. Data on election results is collated on a spreadsheet by electoral return officers. Key features of the data (such as the percentage wins to Labour, Tory and Lib.Dem. political parties) are calculated from the spreadsheet and stored separately. Numerous different views (*e.g* a pie chart or a bar chart) are then presented of these key features.



   (a) Explain how the *Model-View-Controller* architectural pattern could be applied to your project. Summarise the advantages and disadvantages of this architectural pattern for your project. [*10 marks*]

   (b) You are asked to use a COCOMO cost model to estimate the cost of producing software for this project. Your analysis is based on the equation:

$$E = C * P^s * M$$

   where:

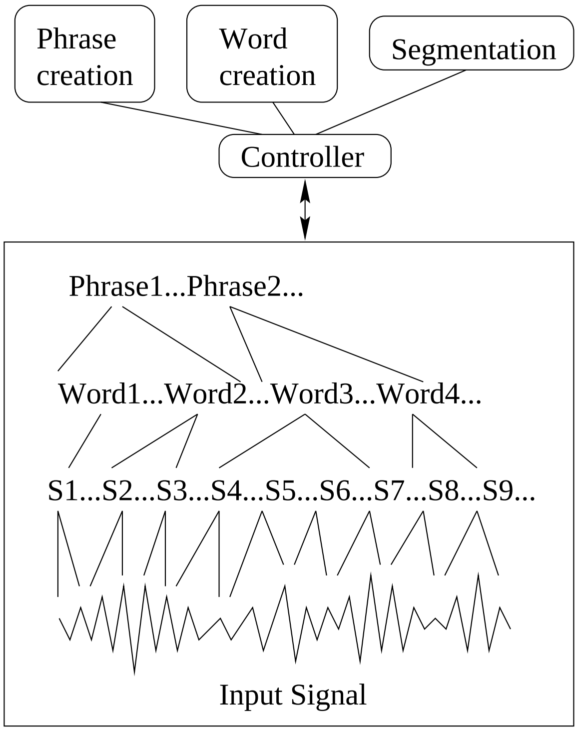
   - P is a measure of product size(*e.g.* number of lines of source code).
   - C is a complexity factor.
   - s is an exponent (usually close to 1).
   - M is a multiplier to account for project stages.
   - E is the estimated effort (*e.g.* in person-months).

Explain how you would obtain the parameters C, s and M (but not P) and use them with this equation for basic COCOMO cost estimation. [*5 marks*]

(c) You now have the task of estimating the size of the code you want to build (parameter P in the previous question). Summarise how you would use either fuzzy estimating, standard component estimating or function point analysis for this. [*5 marks*]

(d) When planning the early stages of your project you decide to deliver an early version of your system as soon as possible, with subsequent regular deliveries of extended versions of it. You also assign ownership of each major component and functionality. What are the advantages of doing this and why should you be careful not to overdo it? [*5 marks*]

2. Suppose that you are involved in a project to construct a speech recognition system, as illustrated in the diagram below. Your system receives as input the waveform of a recorded message uttered by a human speaker. The task of your system is to construct from this corresponding speech-segment, word and phrase structures. There is no single algorithm available to do this but you are able to build more specialised algorithms for segmentation, word creation and phrase creation. These need to be harnessed together, via a controller, to produce a full system.



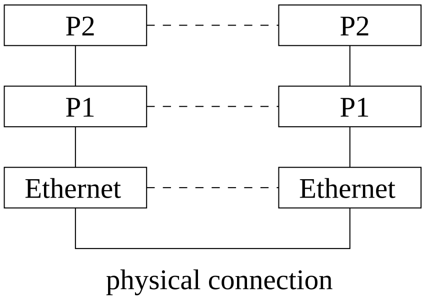
(a) Explain how the *Blackboard* architectural pattern could be applied to your project. Summarise the advantages and disadvantages of this architectural pattern for your project. [*10 marks*]

(b) You are required to develop your blackboard system as an open source system. Describe a way in which you might organise the development effort. Explain the advantages and disadvantages of this for your project. [*5 marks*]

(c) It is suggested that you attempt a program of cumulative quality improvement in which you measure progress in defect removal at each major stage in development of your software as a function of the number of defects removed at that stage and an estimate of the number of defects remaining. Give a simple way of measuring this and explain any problems with the method. [*5 marks*]

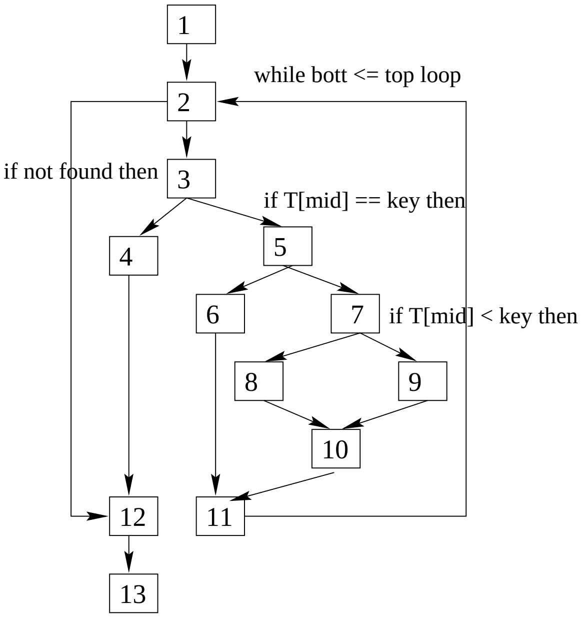
(d) It is suggested that the subsystems used for segmentation, word creation and phrase creation might be obtained through re-use of components from a similar project attempted several years previously, when re-use was not considered an option. Summarise the potential problems with this. [*5 marks*]

3. Suppose that you are involved in a project to construct an information transfer protocol, as illustrated in the diagram below. Movement of information from source to target locations occurs at the level of an Ethernet protocol but higher level protocols above this (P1 and, above it, P2) are used to provide more convenient points of contact for programmers.



(a) Explain how the *Layers* architectural pattern could be applied to your project. Summarise the advantages and disadvantages of this architectural pattern for your project. [*7 marks*]

(b) You use "white box" testing for part of your code. Part of your analysis produces the flow graph shown below.



Explain how information from this flow graph can help decide on tests of your code. [*6 marks*]

(c) You are asked to produce a measurement plan which assists in assessing the size of the project. The key issues to be addressed are: the schedule; the cost; scaling due to the growth of the project; quality of product; ability of the design team; and viability of the technology. Give one appropriate measure which addresses each of these issues and summarise how each measure might contribute to your measurement plan. [*6 marks*]

(d) It is suggested that to save effort in early design you rely on testing to uncover defects in the software for your project. Explain why this may be a bad idea. [*6 marks*]