B23 Programming Methods
1999 Exam
2.5 Hours

Lecturer: Dr. Graham Roberts, Dept. of Computer Science

Answer THREE Questions

1. a) Compare and contrast C++ pointers with object references in Java. Which approach do you believe leads to more reliable programs?

   [15 marks]

   b) Outline the implementation of a C++ smart pointer template class, showing all the key features needed for instance objects to work properly. Show how instances of the class might be used.
   (Exact C++ syntax is not required.)

   [18 marks]
   [Total 33 marks]

2. Consider how an initial design for a file manager application might be put together by making use of Design Patterns. A file manager is a tool used to manage files and directories for a filestore, such as the Unix filestore.
   a) Given that a filestore can be represented as a tree, or hierarchy, of directory and file objects, outline the pattern or patterns needed to represent a filestore, and perform operations such as adding, moving and removing files and directories, and generating directory listings (such as those given by the Unix ls command).

   [18 marks]

   b) Outline how a graphical display window, menus, command handling and scrollbars might be provided for the file manager, showing which patterns can be used.

   [15 marks]
   [Total 33 marks]

3. a) The following C++ mechanisms allow commonality in behaviour or implementation to be captured: inheritance, class template, function template, overloading. For each mechanism, describe what kind of commonality can be expressed and how it allows for *variations* of the commonality to be expressed.

   [5 marks each]

   b) Java lacks the C++ template mechanism. Outline, with example code, how the equivalent of a C++ template Set class could be implemented in Java and used by clients. Assume that at least the operations of inserting and removing set elements are provided, along with an operation to test whether a specific element is already contained in the set.

   [13 marks]
   [Total 33 marks]

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4. a) Describe the role of design patterns in the design and programming process. What benefits do you hope to gain from exploiting patterns?

[10 marks]

b) What is software architecture? How does architecture relate to patterns?

[10 marks]

c) Consider the design of a spreadsheet program. Outline an architecture for the program.

[13 marks]

[Total 33 marks]

5. a) Describe the C++ exception handling mechanism.

[8 marks]

b) In what ways does Java improve on C++ exception handling?

[5 marks]

c) Consider a CharacterBuffer class whose instance objects read data one character at a time from a file, storing the characters in an internal buffer. Clients of the class can then read either single characters or an array of characters. Exceptions should be thrown whenever an invalid buffer operation is performed (such as attempting to read an from an empty buffer).
Describe the implementation in C++ of the class (exact C++ code is not required), with emphasis on the exception handling. Include an exception class to represent exceptions that are thrown by the CharacterBuffer class.

[15 marks]

d) Show how a client would use an instance of the CharacterBuffer class.

[5 marks]

[Total 33 marks]

END OF PAPER