Two hours

UNIVERSITY OF MANCHESTER
SCHOOL OF COMPUTER SCIENCE

Component-based Software Development

Date:  Tuesday 14th January 2014
Time:  09:45 - 11:45

Please answer THREE Questions:

Answer the Question in Section A and any TWO Questions from Section B

Use a SEPARATE answerbook for each SECTION.

This is a CLOSED book examination

The use of electronic calculators is NOT permitted
1. a) A component is just an arbitrary piece of code. Discuss. (2 marks)

b) What is a component model? Why is it important? Illustrate your answer with an example. (4 marks)

c) Briefly outline the phases of the idealised component life cycle. (2 marks)

d) What is the role of repository in the idealised component life cycle? Why is it important? (2 marks)

e) Briefly outline the W model for the development of component-based systems, and show how the idealised component life cycle fits in with the W model. (4 marks)

f) Consider the lab exercises for this course, in which you constructed an ATM (automated teller machine) system in different ways, using different component models. Based on your results for the lab exercises, discuss how well each of the following categories of component models supports the W model:

i) component models with objects as components; (2 marks)

ii) component models with architectural units as components; (2 marks)

iii) component models with encapsulated components. (2 marks)
2. a) How is an encapsulated component different from objects and architectural units? What are the merits and demerits of encapsulated components as components? Illustrate your answer with suitable examples. (4 marks)

b) Briefly explain the X-MAN component model in terms of:
   i) its components and composition operators; (2 marks)
   ii) its development life cycle. (2 marks)

c) In X-MAN what entities contribute to:
   i) behaviour; (1 mark)
   ii) data passing. (1 mark)

d) Consider a coin-operated vending machine that makes and sells cups of light or strong coffee, with or without milk. To buy a drink, the customer must insert coins and select the drink. The machine contains dispensers for coins, coffee, and milk, and uses them to make the drink the customer has selected. All drinks are the same price, and the machine does give change. The machine validates the amount of coins inserted. When enough coins have been inserted, the selected drink will be made and change will be dispensed if necessary. Assume that the machine serves one size of the drinks and that its stock is infinite.

   i) Using the X-MAN component model, identify suitable components required for the system. For each component, list the services it provides. (2 marks)
   ii) Compose the identified components using suitable connectors to implement the system. (2 marks)
   iii) Identify the interface of the system. (2 marks)
   iv) Specify all data channels between all services in the system. (2 marks)
   v) Find one reasonably reusable composite component in your design. Specify the interface of such a composite component. (2 marks)
3. a) How can objects be used as components? What are the merits and demerits of objects as components? Illustrate your answer with suitable examples.
   (4 marks)

   b) Briefly explain the EJB (Enterprise JavaBeans) component model in terms of:
      i) its components and their composition; (2 marks)
      ii) its development life cycle; (1 mark)
      iii) the steps involved when a remote client calls an EJB component residing in an EJB server. (1 mark)

   c) Compare and contrast the EJB and JavaBean component models. Focus on component definition, composition mechanism, and development life cycle. (4 marks)

   d) Consider the vending machine in Question 2.
      i) Identify suitable components to implement the above system in EJB. For each component, list the services (signatures) and briefly describe what they do. (4 marks)
      ii) Construct the vending machine system in EJB using the components you identified in i). (2 marks)
      iii) Use a suitable notation to express the control flow in your system. (2 marks)
4. a) How are architectural units composed? What are the merits and demerits of this composition mechanism? Illustrate your answer with a suitable architecture description language. (4 marks)

b) Briefly explain the UML 2.0 component model in terms of

   i) the components it defines and their composition; (2 marks)
   ii) the associated development life cycle. (2 marks)

c) Compare and contrast UML 2.0 with any other ADL. (4 marks)

d) Consider the vending machine in Question 2.

   i) Using the UML 2.0 component model, identify suitable components for the system. For each component, list the services it provides and requires, and summarise what it does. (2 marks)
   ii) Compose the identified components to implement the system and specify the system’s interface. (4 marks)
   iii) Describe in detail how the control logic of the system is realised. You can use e.g. a UML sequence diagram or pseudocode. (2 marks)