Component-based Software Development

Date: Thursday 24th January 2013
Time: 09:45 - 11:45

Please answer THREE Questions:
Answer the Question in Section A and any TWO Questions from Section B

This is a CLOSED book examination

The use of electronic calculators is permitted provided they are not programmable and do not store text.
Section A

1. a) A component is just an arbitrary piece of code. Discuss. Illustrate your answer with suitable examples. (4 marks)

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

c) 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)

d) 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)

e) 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)
Section B

2. a) Explain the phases of the idealised component life cycle. (4 marks)

   b) Explain 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)

   c) 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 support the W model:

      i) component models with objects as components; (4 marks)
      ii) component models with architectural units as components; (4 marks)
      iii) component models with encapsulated components. (4 marks)
3. a) Briefly explain the X-MAN component model in terms of:
   
   i) its components and composition operators; (4 marks)
   ii) its development life cycle. (4 marks)

b) An environment control system is used for maintaining the temperature of a vehicle cabin at a desired level set by the driver. The system contains a heater and a cooler, only one of which is running at any one time, and a fan. The factory pre-set value for temperature is 19 degrees Celsius. The environment control system takes the cabin temperature and desired temperature. The system then regulates the speed of the fan to low or high depending on the difference between the current temperature and the desired temperature. The system also turns the heater or the cooler on or off.

   i) Using the X-MAN component model, identify suitable components required for the system. For each component, list the services it provides. (3 marks)

   ii) Compose the identified components using suitable connectors to implement the system. (3 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 composite component. (2 marks)
4. a) Briefly explain the EJB (Enterprise JavaBeans) component model in terms of:

   i) its components and their composition;  (4 marks)
   ii) its development life cycle.  (2 marks)

b) Compare and contrast EJB with JavaBean component model. Focus on component
definition, composition mechanism, and development life cycle.  (4 marks)

c) Consider the environment control system described in Question 3.

   i) Identify suitable components to implement the above system. For each com-
   ponent, list the services (signatures) and briefly describe what they do.  (4 marks)

   ii) Construct the environment control system using your components.  (2 marks)

   iii) Use a suitable notation to express the control flow in your system.  (4 marks)
5. a) Briefly explain the UML 2.0 component model, in terms of
   i) the components it defines and their composition; (4 marks)
   ii) the associated development life cycle. (2 marks)

b) Contrast UML 2.0 with another architecture description language that differs from UML 2.0 in component definition, composition mechanism, and development life cycle. (4 marks)

c) An environment control system is used for maintaining the temperature of a vehicle cabin at a desired level set by the driver. The system contains a heater and a cooler, only one of which is running at any one time, and a fan. The factory pre-set value for temperature is 19 degrees Celsius. The environment control system takes the cabin temperature and desired temperature. The system then regulates the speed of the fan to low or high based on the difference between the current temperature and the desired temperature. The system also turns the heater or the cooler on or off.

   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. (4 marks)
   ii) Describe in detail how the control logic of the system is realised. You can use a UML sequence diagram or pseudocode. (2 marks)
   iii) Compose the identified components to implement the system and specify the system’s interface. (4 marks)