Model-Based Software Design

Date: Monday 25th January 2010
Time: 14.00 – 15.30

Please answer any TWO questions from the FOUR questions provided

The use of electronic calculators is NOT permitted.
1. a) Write an Emfatic model that captures the following specification:

Banks have a name and multiple branches; each branch has an address and a set of customers. Like a branch, a customer also has an address; they also have a customer number. A customer can be responsible for one or more accounts. A bank offers two types of account, general accounts and savings accounts. All accounts have an account number and a balance; overdrafts are only allowed on general accounts. (10 marks)

b) Evaluate the usefulness of including invariants in models and the style of invariant specification used by Emfatic models. (5 marks)

c) In a pure model-based approach, a platform independent model (PIM) should contain no implementation details. During the transformation of the PIM to a platform specific model (PSM) implementation decisions must be made. By using examples of the sort of implementation detail that must be added, critically evaluate alternative approaches for adding this implementation detail. (5 marks)

2. a) A new application that supports the design of network protocols is to be developed. As part of this it will be necessary to describe the structure of the messages that are exchanged by implementations of this protocol; i.e. the fields that messages contain, and the sizes and types of these fields. If an application typically requires the definition of four different types of message, critically evaluate whether a graphical or textual syntax should be developed to support the definition of these messages. Your evaluation should include assess both technical and non-technical (e.g. ease of use) aspects of each approach. (6 marks)

b) Consider the implementation of the support for defining message formats in part a). Describe the pros and cons of basing this implementation on completely new bespoke tooling, an implementation generated from a UML profile, or a specially crafted Domain Specific Language (DSL) syntax produced using a model-driven approach. (8 marks)

c) A complete definition of a network protocol includes not only the messages that are exchanged by the protocol, but also the sequence of allowable messages and the way in which these messages are processed. Evaluate alternative modelling approaches that could be used to capture these aspects of a network protocol. (6 marks)
3. a) A banking application is to be developed using a model-driven approach. This application will use relational database technology for its backend, a web-based client for its customer facing front-end, and Java clients for internal maintenance use. For the development of this application, outline, with reasons, the development flow that would be required, and the models, meta-models and transformations that would be used by this flow. (10 marks)

b) Model-driven workflows, such as the one that you have described in your answer to part a), include model-to-model transformations; describe, with reasons, the features that are required in a model-to-model transformation language. (5 marks)

c) Outline a model-based approach to the development of a model-to-model transformation language. (5 marks)

4. a) A model-based tool is going to be developed that allows end-application developers to define a model of an application that is used to run a business and generate the application from this model. As part of the model-based tool, a meta-model of business operations is required. It can be assumed that these business applications will have to deal with things like the type of staff, customers, accounts and products that business uses, and that these objects will have attributes and relationships between themselves. Given these business application requirements, describe, using Emfatic, a meta-model suitable for use in the model-based tool. (10 marks)

b) In the model-based world, meta-models are just one of the types of model that are defined. List all of the types of model that exist in model-based design and describe the purpose of each. (5 marks)

c) Describe the pros and cons of creating and using generic tool, such as the EMF instance editor. (5 marks)

END OF EXAMINATION