Two hours

UNIVERSITY OF MANCHESTER
SCHOOL OF COMPUTER SCIENCE

M.Sc. in Advanced Computer Science

Grid Computing and eScience

Tuesday 27th January 2009

Time: 09:45 – 11:45

Please answer Question 1 from Section A and TWO Questions from Section B

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

1. **Compulsory**

   a) What is a Unicore plugin and what is the role of plugins in the development of functionality in a Unicore Grid? Give one example of a plugin and give a brief description of its functionality. (4 marks)

   b) What is meant by the terms: transport level security and message level security? Explain how each of these is implemented in the Unicore architecture and protocols using the example of an Abstract Job Object (AJOs) that contains sub-AJOs. (4 marks)

   c) Expand these acronyms to their full description and briefly explain the relevance of each to the problem of Grid Computing: OGSA, WSRF, SOAP, WSDL. (4 marks)

   d) Explain the difference between a toolkit approach to building a Grid (e.g. as exemplified by Globus) and a modelling approach (e.g. as exemplified by Unicore). Identify one strength and one weakness for each approach. (4 marks)

   e) Describe the three functions of the Web Services “triangle” and for each one briefly describe how it is essential in distributed computing. What is the difference between the interface and the implementation of a Web Service? (4 marks)
2. a) What do the terms Uspace, Xspace and Nspace mean in the Unicore abstraction of the grid? In a client-server model, where do these spaces reside and what are their roles in the management of Unicore job submission? (6 marks)

b) A user prepares a job that involves sending a file of C source code on their desktop machine to an NJS representing Machine A at a Usite called Manchester. The code is compiled at Machine A in temporary filesystem and is executed. The output files are sent by third party file transfer to Machine B which is at a Usite called London where they are then stored in the user’s permanent filestore at Machine B. Draw a diagram showing how the Gateways at Usites Manchester and London and NJses at Machine A and B would implement this task. Show how the files sent and created in this job would be transferred between the abstract spaces Uspace, Nspace and Xspace and show clearly on the diagram where these spaces are in terms of the NJs. (4 marks)

c) What are the functions of Import tasks and Export tasks in the Unicore AJO? Give one example of the use of an Import task in an application and one example of the use of an Export task. What is third party file transfer and how does it differ from Import and Export tasks. (4 marks)

d) In the diagram below, describe in detail what task is being performed by the actions in Group A, Group B and Group C (separate answer for each group). State how these tasks are performed in the context of a Script Task. (6 marks)
3. a) Here are six terms used to describe the essential characteristics of a service oriented architecture. For each term explain in a single sentence only what the term means in the context of a Service Oriented Architecture.

1) Logical view
2) Message orientation
3) Description orientation
4) Granularity
5) Network orientation
6) Platform neutrality (6 marks)

b) Describe two differences between a Web Service as defined in the basic Web Services standard and a Grid Service as defined in the Open Grid Services Infrastructure (OGSI). [Hint: what can the latter do that the former cannot?] (2 marks)

Describe two advantages for Grid Computing that OGSI provided. Give two reasons why OGSI was not adopted and was replaced by the Web Services Resource Framework. (4 marks)

c) Consider the problem of creating and using a service to implement a counter that can be controlled via a client on a machine which is remote from the server on which the service is implemented. Draw two diagrams to explain how this could be implemented

(i) in an OGSI framework,
(ii) in a WSRF framework.

You must annotate and explain your diagrams so that all the messages and operations are clearly shown. (8 marks)
4.  

a) Give a definition of an ontology as used in computer science and very briefly give an example of how ontologies might be useful in solving problems caused by the need to link together heterogeneous resources. 

(2 marks)

b) What is the difference between “implicit” and “explicit” semantics? Explain why the need to make implicit semantics explicit and discoverable arises from the need to make different Grid systems interoperable. By means of a diagram, show how the Unicore interoperable resource broker used an ontological service to solve the problem of resource discovery across Grids implemented in Globus and Unicore. (You should minimise the detail in your diagram to refer only to those components that are necessary for achieving interoperability and should describe clearly what each component is doing and how they are coordinated). 

(8 marks)

c) What do the following terms mean within the context of a Unicore Abstract Job Object; AbstractAction, AbstractTask, ExecuteTask, FileAction. 

(4 marks)

d) What does the term Incarnation mean in the Unicore architecture? Draw a diagram to show how the Unicore Client, Gateway, Network Job Supervisor and Target System Interface interact to Incarnate an Abstract Job Object created in the client and eventually to be run at a Vsite. 

(6 marks)