Department Computer Science	Distributed Systems
VU University	08.01.2008

1a Some distributed systems can simply not scale, no matter which techniques are applied. Give an example of such a system and explain why scalability is (close to) impossible. *5pt*

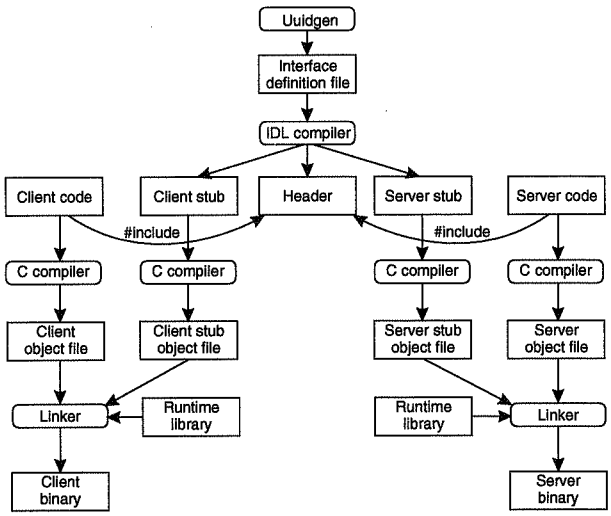
1b Explain how code shipping as is done with Java applets in the case of Web services, can help improve scalability. Which scalability problem is actually being tackled? *5pt*

2a Explain the difference between a process virtual machine and a virtual machine monitor. *5pt*

2b Explain how virtual machine technology is used in the PlanetLab system, and how it helps to support multiple applications. *5pt*

2c Virtual machines help in migrating applications between different servers. Why is this easier than general solutions for strong mobility? *5pt*

3a Explain which functions are implemented in the runtime library of an RPC system. See also the following figure. *5pt*



3b Executing an RPC requires that a client can contact a server. How does it find the contact point for a server, and what does that contact point consist of? *5pt*

3c RPC systems cannot support local references (such as pointers), as these refer to objects only locally accessible. Instead, global object references should be used, if possible. Outline an implementation of such a reference. *5pt*

4a Explain the principle of an epidemic protocol. *5pt*

4b Sketch how the nodes in a distributed system can each compute the size of the system (i.e., the total number of nodes) using an epidemic protocol. *5pt*

4c What is the problem with removing a data item in an epidemic system, and how can this problem be solved? *5pt*

5a Why is the following data store not sequentially consistent? Is it causally consistent? Be sure to explain your answer. *5pt*

P1:	W(x)a			
P2:		W(x)b		
P3:			R(x)b	R(x)a
P4:			R(x)a	R(x)b

5b Consider a system that combines read-your-writes consistency with writes-follow-reads consistency. Is this system also sequentially consistent? Explain your answer. *5pt*

5c Consistency can also be formulated in terms of numerical deviations. Give an example of such a form of consistency, and sketch how that consistency can be enforced. *5pt*

6a What is a k fault-tolerant group, and how does k depend on failure semantics? *5pt*

6b Show that having three processes of which one is faulty, is not enough to guarantee agreement between the two nonfaulty ones in a Byzantine setting. *5pt*

7c Explain what a flash crowd is, and why it is so difficult to develop general-purpose predictors. *5pt*

7b What is the best measure against flash crowds? Explain briefly how it works. *5pt*

Grading: *The final grade is calculated by accumulating the scores per question (maximum: 90 points), and adding 10 bonus points. The maximum total is therefore 100 points.*