

Question 1. A group of five processes (P1-P5) are involved in the execution of a distributed transaction. They all execute on different nodes. They share six resources R1-R6. Each resource is used in a mutually exclusive manner. Whenever a process is holding a resource Rx, it marks Rx as “Hold.” When it is releasing the same resource, it marks it as “Free.” When it is requesting a resource that it does not currently have, it marks it as “Wait” and sends a message “Requesting Rx” to all other processes. If a process Pa has marked Rx as “Free,” then it would respond to the requesting process with a message “Granted Rx” removes Rx’s information.

At time T, the system is in the following situation:

P1: Holding R1; Freed R2; Sent “Requesting R6”;
P2: Holding R3; Sent “Requesting R5”;
P3: Holding R4; Freed R5; Sent “Requesting R2”;
P4: Holding R6; Sent Requesting R1”;
P5: Sent “Requesting R4”

If just after time T, P1 invokes Chandy and Lamport’s global snapshot algorithm,

- (i) Determine *one possible global snapshot* that may be collected by the algorithm.
- (ii) From the collected snapshot, determine whether or not the system is in a deadlock.

Question 2.

(a) In the following scenarios, indicate the type of RPC you suggest between the clients and the servers. JUSTIFY YOUR ANSWER.

- (i) A distributed sales environment where 30 points of sale are distributed but recorded at a central server.
- (ii) A distributed sensor environment with 1000 sensors recorded at one of the 5 repositories. Each sensor records the environmental conditions once in a second and sends it to any of 5 repositories.
- (iii) The “root” process sends “System will be down from 5PM-5:30PM” message to all 1000 users.
- (iv) 10,000 clients send “read-only” requests to one of the two stock-price information servers.

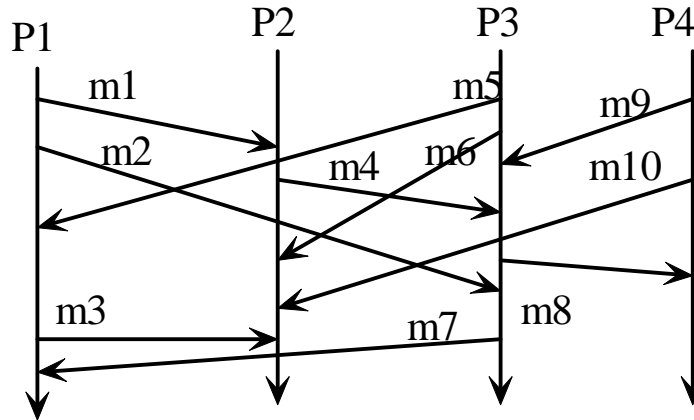
(b) An organization with 1000 employees is contemplating on procuring a file server to hold the data to be shared among several project teams. The employees themselves are spread across several offices within a radius of 15 miles. In response to their request-for-quotations, they received several bids. Describe the criteria they should use in selecting a server. (Hint: Answer should be in the context of what we have been studying in the course. Do not answer as a layman who has no knowledge of our course content.)

Question 3.

(a) Given the following flow of messages in a system of four processes, give a sequence of these messages for each of the following message orders:

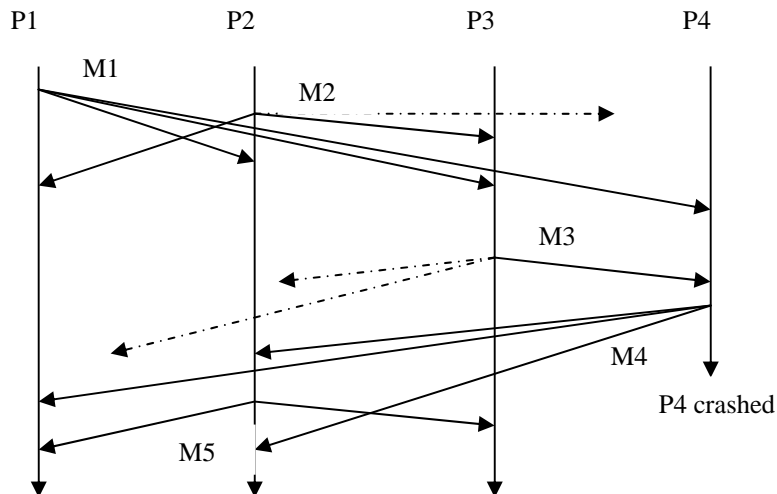
- (i) FIFO order
- (ii) Causal order
- (iii) Total order

With each answer, write a brief justification as to why it satisfies the required ordering and that is self evident.



(b) Given the following scenario, determine what messages would be delivered in which order to which processes under: (Broken lines indicated failed messages;)

- (i) Non-uniform failure-atomic group multicast
- (ii) Dynamically uniform failure-atomic group multicast



Question 4.

- (a) An organization has two legacy applications--Application 1 to handle unclassified employees and Application 2 to handle classified employees. Both are designed to be stand-alone applications each using a single server with no fault tolerance or reliability. The organization now intends to define a new application that combines both. It wants the new application to offer a reliable service so even if one server were to be down, there would be others that handle the users' requests. Obviously, they do not want to tamper with the legacy application code. Suggest a way how this can be achieved using the techniques discussed throughout the course so far.
- (b) A scheduling server for a specific conference center has the following functionality: (i) Make a reservation for a specific date and a time duration (e.g., 9:30-11:30 am on January 15, 2007) (ii) Check the availability (free/booked) for a specific data and time duration (iii) Cancel a reservation made earlier. In the case of reservation/cancellation the user must specify an ID. Write the following to implement this service in a CORBA environment;
- (i) CORBA IDL for the server functionality
 - (ii) An outline code for the server object
 - (iii) An outline code for the client object
 - (iv) Procedure to install the server and for the client to access the server

Question 5.

An organization has requested the services of a consulting firm to suggest an infrastructure for their organization to support the following six application. The consultant suggested the below multi-tier architecture. You are asked to review the architecture and prepare a review of the proposal and suggest any changes. In writing the review/criticism, use the principles discussed in the class, Do not simply make a statement because it sounds good. There should be a basis for it. If you don't like some features, suggest alternates/changes.

- (i) File transfers from servers to users (there are multiple servers and multiple users); file transfers from clients to servers also
- (ii) Audio/Video conferencing among several users within the organization. All may be working on the same project but located in different buildings or rooms.
- (iii) E-mail
- (iv) Secure communication channels for an application that involves exchange of confidential data from the president to vice-presidents.
- (v) Company announcements to all users
- (vi) News forums like bulletin boards where users may exchange ideas (open to all).

Application layer
GMS (Causal group multicast)
Security layer (Data Encryption/ Decryption)
Transport layer (TCP/UDP)
Other OSI layers and OS (including file servers)