

Wednesday 21 February 2001

1. In the case of a parallel or distributed system, what is meant by each of the following terms:

a. tightly-coupled hardware (5 points)

processors in close physical proximity, sharing a common clock and memory, with a fast interconnection that allows frequent communication and many concurrent memory accesses

b. loosely-coupled hardware (5 points)

processors with individual clocks and memory, communicating infrequently over a less powerful interconnection network

c. tightly-coupled software (5 points)

software that provides the feel of a single OS

d. loosely-coupled software (5 points)

multiple OS's working together, does not appear to the user as a single OS

2. There are many possible organizations of a distributed system.

a. Briefly describe the workstation-server model. (8 points)

Users log onto workstations, where normal computation is done. However, the workstations can also act as clients and connect via the network to obtain services (file service, print service, web service, etc.) from specialized server machines

b. Briefly describe the processor-pool model. (7 points)

Users log onto terminals, which perform essentially no communication, but are connected to the network. A special server, called the "run server", connects each terminal to one or more processors in the pool as necessary, and computation is performed on those processors.

3. In a client / server information system, what capabilities are provided by calendar / scheduling products that are not provided by a paper calendar on the wall of your office? (10 points)

Make calendars accessible and viewable over the networks, allowing users to share calendars, schedule meetings with others, manage shared resources (e.g., conference rooms), etc.

4. Consider the “star” network topology.

a. Briefly describe this topology (draw a diagram if you like). (5 points)

All nodes connect to a single centralized node.

b. What are the advantages and disadvantages of this topology? (5 points)

Advantages: (1) is that it is inexpensive in the sense that only a single wire is required for each node, (2) it is robust in the sense that if any of the outer nodes fails that failure will not affect communication among the other nodes, and (3) each message only takes two hops to reach its destination. Disadvantage: the central node is a single point of failure — if it fails, no node can talk to any other node.

c. Does a star ever make sense as a physical network topology? Explain. (5 points)

Yes, a star topology is used when connecting machines to a hub or switch.

d. Does a star ever make sense as a logical network topology? Explain. (5 points)

Yes, this is the typical client / server organization. Also, some distributed algorithms are based on a central coordinator, with whom all the other nodes communicate.

5. Explain how the TCP network protocol ensures that the packets that make up a message do not get lost or corrupted during transmission. (15 points)

Packets do not get lost: if the receiver does not acknowledge the receipt of a particular packet within a set period of time, the sender retransmits that packet.

Packets do not get corrupted: a checksum is computed and attached to each packet when it is sent. The receiver independently generates the checksum from the received data, and compares that computed checksum to the received checksum; if they do not match the packet was corrupted in transmission.

6. A message passing system often provides some form of “mailboxes”.

a. Explain what is meant by a “mailbox” in a message-passing system. (10 points)

A “mailbox”, owned by the receiver, is used in indirect message-passing communication. The sender sends to a mailbox, rather than a particular receiver. Since a particular receiver may have more than one mailbox, it can use each mailbox for a different purpose, or for different types of messages.

Note that whether or not the mailbox acts as a buffer with a size of more than one is a totally separate issue.

b. Does MPI provide a mailbox, or something that provides similar functionality? Explain. (5 points)

MPI uses “tags”, and a receiver can choose to either receive a message with any tag, or with one particular tag (like reading from only one particular mailbox).

Name: _____

7. What does the MPI_Waitall function do? (5 points)

It blocks until all of a specific set of requests — usually a set of immediate sends or receives — finishes.