98-Comp-B10, Distributed Systems

3 hours duration

NOTES:

1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper a clear statement of any assumptions made.

2. This is a CLOSED BOOK examination.
   A Casio or Sharp approved calculator is permitted.

3. Answer any **five of the seven** questions.
   Only the first five questions as they appear in the answer book will be marked.

4. All questions carry equal weight.

5. Most questions require an answer in essay format. Clarity and organization of the answer are important.

Question # 1. *Characteristics of distributed systems*
    a. Explain what is meant by a client program and a server program. Explain and illustrate (in graphical form) the client-server architecture of one major Internet applications (for example the Web, email or ftp).
    b. Name two types of software resource and two types of hardware resource that can be shared efficiently in distributed systems. Provide examples of their sharing.

Question # 2. *Fundamental concepts and mechanisms*
Answer <u>only three</u> of the following questions
    a. Name and define two performance characteristics of a communication channel.
    b. What are the differences between buffering and caching?
    c. Identify the integrity property of reliable communication and list all the threats to integrity from users and from system components.
    d. What are the factors that contribute to message transmission delay among two processes over a communication channel? Is it possible to set a bound on each factor's contribution to the overall time?

Question # 3. *Client-server systems & inter-process communications*
    a. Give explanation to the design choices that are relevant to decreasing the amount of reply data held at a server. Suppose the RRA protocol is in use. What is the length of time needed for servers to retain unacknowledged reply data? Do the servers have to continually send the reply in an attempt to obtain an acknowledgement?
    b. Devise a scheme that utilizes message retransmissions with IP multicast to overcome the issue of dropped messages.

Question # 4. *Operating systems for distributed architectures*
    a. Propose a scheme for balancing the load on a set of computers. You should discuss:
        i)   Which user or system requirements are met by such a scheme;
        ii) This is suited for what categories of applications?
        iii) How can load be measured and by what precision; and
        iv) Decide the location for a new process and how it can be monitored. Assume that processes may not be migrated.

        How would your above scheme be affected if processes are capable of migrating between computers? Would you presume process migration to have a considerable cost?

Question # 5. *Security*
    a. Primary exchanges of public keys are vulnerable to the man-in-the-middle attack. Illustrate <u>two</u> defences against it.
    b. Pretty Good Privacy (PGP) is broadly used to secure email communication. Explain the steps needed prior to exchanging email messages with privacy and authenticity guarantees for a pair of users using PGP.

Question # 6. *Distributed file systems*

   a) Name and discuss three key design issues for distributed file systems.

   b) What information should the NFS client module hold on behalf of each user-level process?

Question # 7. *Principles of fault tolerance continual*

   a. What are the benefits of replication?

   b. Write pseudocode for dependency checks and combine measures (as used in Bayou) appropriate for simple room-booking application.