Problem 1

1.1 The physical and the logical storage units may be different for particular implementation of the storage abstraction. Give a concrete example illustrating how this difference affects: (i) the read-write coherence; (ii) the atomicity.

1.2 During the past few decades the microprocessors, the communication hardware, and the optical storage have experienced a tremendous improvement in performance coupled with a drastic reduction in cost. Illustrate the phenomena of (i) incommensurate scaling; (ii) the propagation of effects for each of the three types of systems.

1.3 The physical realization of each one of the three basic abstractions, (1) interpreter, (2) storage, and (3) communication channels, can be either a “pure system,” in other words consists of just an interpreter, a storage system, or a communication channel, respectively, or a “composite system” involving multiple embodiments of all three abstractions or combinations of them. Give one specific example illustrating “pure” and “composite” physical realization for each of the three basic abstractions. Discuss the role of each component of a “composite” system.

*Hint:* an optical fiber is a “pure” implementation of a communication channel while the IP protocol is a “composite.” The IP protocol implementation includes interpreters (the protocol demons at each site), communication channels (the wires, optical fiber, satellite channel, or wireless channels), and storage (routing tables).

Problem 2

The Harvard architecture is a computer architecture with physically separate storage and signal pathways for instructions and data. The term originated from the Harvard Mark I computer built at Harvard University. Soft modularity of systems based on von Neumann architecture has several weaknesses. Does the Harvard architecture reduce the possibility of errors due to soft modularity? If yes discuss the specific errors that can be prevented by the Harvard architecture.

Problem 3

3.1 The World Wide Web is based upon a client service model. The HTTP servers are stateless; list three advantages of this solution.

3.2 Explain how the system deals with errors e.g., lost data packets, failure of the server, during the transfer of an object consisting of a large number of blocks.

3.3 Can the servers maintain any information about the clients? If the answer is yes explain how.
Problem 4
You have 4 processes $P_1, P_2, P_3$ and $P_4$ reading and writing to a shared memory; only one process can write at a time but all processes may read at the same time. The priorities of $P_1, P_2, P_3$ and $P_4$ are respectively $p_1 > p_2 > p_3 > p_4$. Construct a Petri net model of the system.

Problem 5
Discuss the name mapping algorithms (note the plural) involved in delivering messages sent from another Internet host to an application assuming that the transport protocol can be either TCP or UDP. Draw a diagram illustrating the processing of IP packets on the receiving host.

Problem 6
Consider the stack algorithm for multiple access. This is a non-blocking algorithm; new arrivals are allowed to compete in the first slot they have segments to transmit. Assume that in the first slot 4 senders collide. Then new frames arrive to the MAC layer in slots 3, 6, and 7. Draw the stack for the first 12 time slots.

Problem 7
Consider the FCFS algorithm. Assume that in the first slot 5 senders collide. Then you have a success in slot 2; how should be the arrival times be distributed to solve all collisions and what is the number of slots to achieve this result. Assume that the algorithm is blocking, only the stations which transmitted in the first slot are allowed to compete.