STIJ3063

COURSE CODE / NAME : STIJ3063 / DISTRIBUTED COMPUTING
DATE : 14 JANUARY 2012 (SATURDAY)
TIME : 2.30 – 5.00 P.M (2 ½ HOURS)
VENUE : DSB K. T/WD

INSTRUCTION :

1. This exam paper consists of FIVE (5) printed pages.
2. You are allowed to use calculator.
3. For Section B, answer FIVE (5) of SIX (6) questions.
4. For Section C, answer THREE (3) of FOUR (4) questions.

MATRIC NO : ________________________

(IDENTIFICATION CARD NO. :)

LECTURER : ________________________

GROUP : []

TABLE NO. : []

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SECTION A: STRUCTURED QUESTIONS (13 MARKS)

1. List the types of local resource that are vulnerable to an attack by an untrusted program that is downloaded from a remote site and run in a local computer. (2 marks)

2. What are the characteristics of the network that are hidden by the stream abstraction? (2 marks)

3. Define the integrity property of reliable communication and list all the possible threats to integrity from users and from system components. What measures can be taken to ensure the integrity property in the face of each of these sources of threats? (3 marks)

4. Compare and contrast cloud computing with more traditional client-server computing? What is novel about cloud computing as a concept? (3 marks)

5. For each of the factors that contribute to the time taken to transmit a message between two processes over a communication channel, state what measures would be needed to set a bound on its contribution to the total time. Why are these measures not provided in current general-purpose distributed systems? (3 marks)
SECTION B: DISCUSSION QUESTIONS (20 MARKS)
Answer FIVE (5) of the following questions:

1. A search engine is a web server that responds to client requests to search in its stored indexes and (concurrently) runs several web crawler tasks to build and update the indexes. What are the requirements for synchronization between these concurrent activities?
   (4 marks)

2. Consider a simple server that carries out client requests without accessing other servers. Explain why it is generally not possible to set a limit on the time taken by such a server to respond to a client request. What would need to be done to make the server able to execute requests within a bounded time? Is this a practical option?
   (4 marks)

3. A user arrives at a railway station that she has never visited before, carrying a PDA that is capable of wireless networking. Suggest how the user could be provided with information about the local services and amenities at that station, without entering the station's name or attributes. What technical challenges must be overcome?
   (4 marks)

4. A service is implemented by several servers. Explain why resources might be transferred between them. Would it be satisfactory for clients to multicast all requests to the group of servers as a way of achieving mobility transparency for clients?
   (4 marks)

5. Describe the ways in which the request-reply protocol masks the heterogeneity of operating systems and of computer networks.
   (4 marks)

6. Discuss the invocation semantics that can be achieved when the request-reply protocol is implemented over a TCP/IP connection, which guarantees that data is delivered in the order sent, without loss or duplication. Take into account all of the conditions causing a connection to be broken.
   (4 marks)
SECTION B: PROBLEM SOLVING (27 MARKS)
Answer THREE (3) of the following questions:

1. A client sends a 200-byte request message to a service, which produces a response containing 5000 bytes. Estimate the total time to complete the request in each of the following cases, with the performance assumptions listed below:
   a) Using connectionless (datagram) communication (for example, UDP); (3 marks)
   b) Using connection-oriented communication (for example, TCP); (3 marks)
   c) The server process is in the same machine as the client. (3 marks)

   [Latency per packet (local or remote, incurred on both send and receive): 5 milliseconds
   Connection setup time (TCP only): 5 milliseconds
   Data transfer rate: 10 megabits per second
   MTU: 1000 bytes
   Server request processing time: 2 milliseconds
   Assume that the network is lightly loaded.]

2. Consider a message that is 8.106 bits long that is to be sent from source to destination in the figure below. Suppose each link in the below figure is 2 Mbps. Ignore propagation, queuing, and processing delays.
   a) Consider sending the message from source to destination without message segmentation.
      i) How long does it take to move the message from the source host to the first packet switch?
      ii) Keeping in mind that each router uses store-and-forward packet switching, what is the total time to move the message from source host to destination host? (3 marks)

   b) Suppose that the message is segmented into 4,000 packets, with each packet being 2,000 bits long.
      i) How long does it take to move the first packet from source host to the first switch?
      ii) When the first packet is being sent from the first switch to the second
switch. At what time will the second packet be fully received at the first switch?

(3 marks)

c) How long does it take to move the file from source host to destination host when segmentation is used?

a.

End-to-end message transport: (a) without message segmentation; (b) with message segmentation.

(3 marks)

3. A client makes remote procedure calls to a server. The client takes 5 milliseconds to compute the arguments for each request, and the server takes 10 milliseconds to process each request. The local operating system processing time for each send or receive operation is 0.5 milliseconds, and the network time to transmit each request or reply message is 3 milliseconds. Marshalling or unmarshalling takes 0.5 milliseconds per message.

a) Calculate the time taken by the client to generate and return from two requests:
   i) if it is single-threaded, and
   iii) if it has two threads that can make requests concurrently on a single processor.

(6 marks)

b) You can ignore context-switching times. Is there a need for asynchronous RPC if client and server processes are threaded?

(3 marks)

4. A file server uses caching, and achieves a hit rate of 80%. File operations in the server
cost 5 ms of CPU time when the server finds the requested block in the cache, and take an additional 15 ms of disk I/O time otherwise. Explaining any assumptions you make, estimate the server’s throughput capacity (average requests/sec) if it is:

a) single-threaded; (3 marks)

b) two-threaded, running on a single processor; (3 marks)

c) two-threaded, running on a two-processor computer. (3 marks)

END OF QUESTION