University of Cape Town ~~ Department of Computer Science

Computer Science 3002F/3023F ~~ 2017

Class Test 2

** *Solutions* **

Enter the following details AND shade in the corresponding blocks to the right with your Student Number.

Student Number :

_____

Name (optional) :

_____

Marks : 40 for CSC3002F
24 for CSC3023F

Time : 45 minutes for CSC3002F
27 minutes for CSC3023F

Instructions:

a) CSC3002F: Answer both questions.

b) CSC3023F: Answer question 2 **ONLY**.

c) Write your answers in PEN in the spaces provided.

d) Show all calculations where applicable.

A	☐	☐	☐	☐	☐	☐	☐	☐	☐	0
B	☐	☐	☐	☐	☐	☐	☐	☐	☐	1
C	☐	☐	☐	☐	☐	☐	☐	☐	☐	2
D	☐	☐	☐	☐	☐	☐	☐	☐	☐	3
E	☐	☐	☐	☐	☐	☐	☐	☐	☐	4
F	☐	☐	☐	☐	☐	☐	☐	☐	☐	5
G	☐	☐	☐	☐	☐	☐	☐	☐	☐	6
H	☐	☐	☐	☐	☐	☐	☐	☐	☐	7
I	☐	☐	☐	☐	☐	☐	☐	☐	☐	8
J	☐	☐	☐	☐	☐	☐	☐	☐	☐	9
K	☐	☐	☐	☐	☐	☐				
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Y	☐	☐	☐	☐	☐	☐				
Z	☐	☐	☐	☐	☐	☐				

FOR OFFICIAL USE ONLY:

Question	1	2	3	4	5	6	7	8
Max	16	24						
Marks								
Marker								

0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
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4	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
5	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
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Question 1 [16] This question is for CSC3002F students only.

(i) Most communication media is shared by multiple devices, rather than exclusive point-to-point communication. This gave rise to three categories of multiple access protocols. Which ones?[1]

channel partitioning, random access, and 'taking turns'

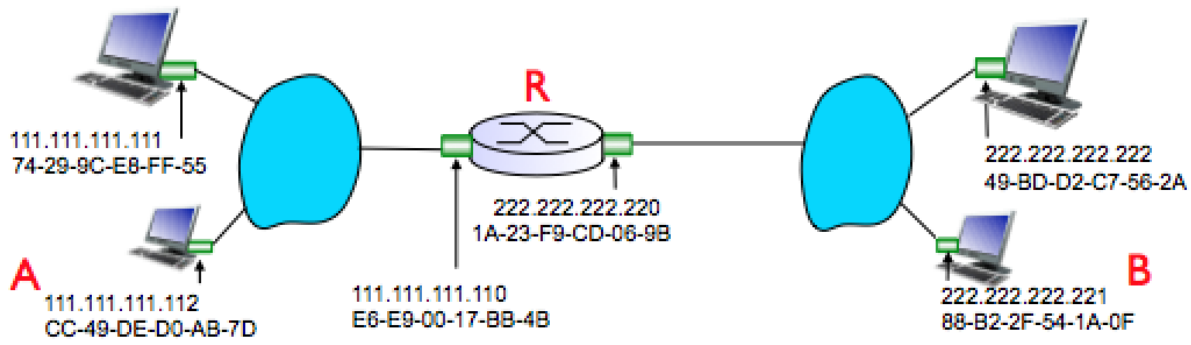
(ii) What is CSMA/CD and how does it work? [4]

carrier sense, multiple access, with collision detection. Device checks if cable is idle; if not, starts transmitting else waits till idle. If NIC transmits entire frame without detecting another, it's done; else, it aborts, sends a jam signal, and does a binary (exponential) back-off and tries again.

(iii) Why do we need MAC addresses even though there already are IP addresses for hosts? [2]

MAC addy is for link layer to identify device, and remains the same throughout (like one's ID number)whereas IP address depends on the network your device is joining (like, say, a home address that will change when you move between cities). Link layer needs its own addressing cf. IP that's at the network layer.

(iv) Consider the following configuration and answer the two questions about it.



A. A is going to send a packet to B. What is the destination IP address and destination MAC address of the packet that A will transmit? [1]

Destination IP: 222.222.222.221. Destination MAC: E6-E9-00-17-BB-4B (i.e., that of the router, not the MAC addy of B)

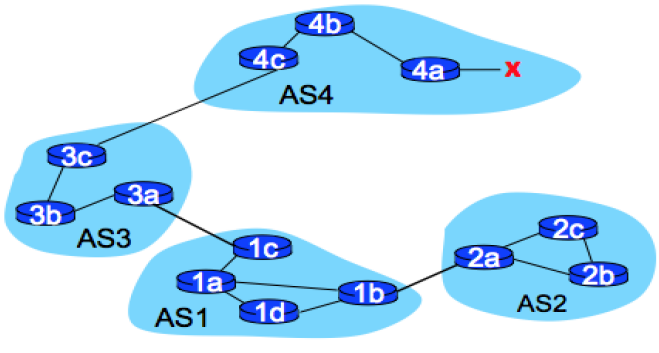
B. In the grand process of A sending something to B, is it ever possible in any ARP scenario that the device with IP address 111.111.111.111 will receive a packet from A? [2]

yes. If A doesn't know the MAC address of the router, it will have to use ARP to figure that out. In so doing, A will send a broadcast message on its subnet first. This message will arrive at 111.111.111.111, for it is on the same subnet.

(v) Switches and routers are both based on store-and-forward of packets, but there are also differences. Compare where a forwarding table in a router comes from with where a forwarding table from a switch comes from. Include in your comparison an explanation of table content creation for a *switch* table. [4]

Router's forwarding table is normally computed with a routing algorithm, whereas that of a switch is self-learning (1). The self-learning means no admin intervention. When some device A sends, it goes through the switch, which then stores in its table that port x is for device A for some TTL amount of time (2). If the switch doesn't know where the destination is, it will flood all ports except x, arriving also at B. when B sends a message back to A, it is then also stored in the table (port y for B). And so on. (1)

(vi) Consider the network in the figure below. Suppose AS2 and AS3 are running OSPF for the intra-AS routing protocol, and AS1 and AS4 are running enhanced-RIP for their intra-AS routing protocol. BGP is used for the inter-AS routing protocol. Router 3c learns about prefix **x** from which routing protocol, *and why that one*? [2]



eBGP (1). x is in another AS than where 3C is, and 3c is a area border router, so between AS, 'exterior' (1). [Marking note: just BGP is not enough, because there's iBGP and eBGP.]

Question 2 [24] This question is for both CSC3002F and CSC3023F.

(i) Explain what an operating system does from a system perspective. [1]

It's a resource allocator. (1)

(ii) Describe the responsibilities of the operating system when it comes to process management. [5]

1) Scheduling processes on the CPU. 2) Creating and deleting processes. 3) Suspending and resuming processes. 4) Provide mechanisms for synchronisation. 5) Provide mechanisms for communication.

(iii) Why do operating systems make use of an interrupt vector for handling interrupts? [2]

To be able to handle interrupts very quickly. (1) There is a predefined number of interrupts so a table of pointers (an interrupt vector) is used to transfer control to the appropriate interrupt service routine. (1)

(iv) Explain what the microkernel approach to operating system structure is, and why it is preferable to using a simple structure such as that employed by MS-DOS. [4]

Remove all non-essential components from the kernel (1) – implement them as system and user-level programs. (1) Interfaces and levels of functionality are well separated, compared to a simple structure such as MS-DOS. (1) Easier to extend an OS, and easier to port to other hardware. (1)

(v) What is a bootstrap loader and what is its function? [2]

Small piece of code in ROM (1) that locates the kernel, loads it into main memory, and starts execution. (1)

(vi) What is the difference between the stack and the heap of a process? [2]

The stack stores temporary data used as part of the process (function parameters, return addresses, local variables). (1) The heap is memory that is dynamically allocated during process runtime. (1)

(vii) What does a medium-term scheduler do, and what is its main purpose? [2]

Removes a process from memory (and therefore from active contention for the CPU). (1) Purpose is to modify the degree of multiprogramming. (1)

(viii) Explain what is a zombie process and how do deal with it. [2]

A process that has terminated (called exit()), but whose parent has not yet called wait(). (1) All processes exist as zombie processes at some point, but generally only briefly. Nothing to be done. Once the parent calls wait(), it ceases to be a zombie.(1)

(ix) In message-passing systems, describe the information contained in the communication primitives, and the properties of the communication link, for direct message passing. [4]

send(P,msg) contains the message and the details of the process to which the message is sent. receive(Q,msg) contains the message and the process which is to receive the message. (1) The link is established automatically. (1) A link is associated with exactly two processes (1). There is exactly one link between each pair of processes.(1)