

SCHOOL OF COMPUTING AND INFORMATION SYSTEMS

## **COMP30023 Computer Systems**

### **Sample exam questions**

You may make rough notes, and prepare draft answers, on the reverse of any page, and then copy them neatly into the boxes provided.

The number of ruled lines in the box under each question provides an indication as to the maximum length of the expected answer.

Dot point answers are acceptable.

- A: 1. What is the supervisor or *kernel* mode? What is the *user* mode. What are the differences? Why are they needed?
2. The code implementing a system call inside the OS always starts by checking whether the user is allowed to perform the requested operation. What prevents the user program from violating security by jumping directly to the code immediately after this check?
3. Multi-programming (or multi-tasking) enables more than a single process to apparently execute simultaneously. How is this achieved on a uniprocessor?
- B: 1. The output listed below was generated using the Unix `stat` command.

```
1. File: 'demo.txt'
2. Size: 58          Blocks: 2          IO Block: 8192   regular file
3. Device: 30c0627h/51119655d Inode: 320966      Links: 2
4. Access: (0760/-rwxrw----)  Uid: (341/ mkirley)   Gid: (10/ staff)
5. Access: 2014-05-14 17:46:46.562688596 +1000
6. Modify: 2014-03-29 13:19:05.582539168 +1100
7. Change: 2014-05-14 17:53:31.271288540 +1000
```

Answer the following questions using the output listed on the previous page:

- on line 3, what does `Links:2` refer to?
  - on line 4, what does `0760` refer to?
  - what do `Modify` and `Change` refer to on lines 6 and 7 respectively?
2. In Unix, what is an *i-node*? How is it used? [2 marks]
3. Describe the actions taken by the Unix kernel when it services the system call `open(filename)`. What data structures are involved and how are they updated?
4. The Unix buffer cache delays writing disk blocks for up to 30 seconds. What are the advantages and disadvantages of this delay?
5. Consider a file named `script` containing the lines:

```
prog1
prog2
```

and the following command submitted to the UNIX shell on the command line

```
holly: script < infile > outfile
```

Explain what happens during the execution of this command. Your explanation should include a description of all the processes involved, the relationships that exist between them and a description of the changes in state of all the file system data structures.

- C: 1. Consider the simple *run/ready/block* state transition scheme for process scheduling. Draw the state transition diagram, showing all the possible transitions. Label each transition with a brief, precise description of an event that might cause a process to make that transition.
2. Most round robin schedulers use a fixed size quantum. Give one argument in favour of using a small quantum. Give one argument in favour of using a large quantum. What kinds of systems and jobs will benefit from using a large quantum? What kinds of systems and jobs will benefit from using a small quantum?
3. Give an example reason why a real-time thread may require different amounts of CPU time at different times.
- D: 1. Discuss the advantages of a system with *page-based virtual memory* compared to a system with *base-limit registers that implements swapping*.
2. A machine has 48 bit virtual addresses and 32 bit physical addresses. Pages are 8 KB. How many entries are needed for the page table?
3. Under what circumstances do *page faults* occur?
4. What is a 2 level page table? Why might it be used?
5. Explain the difference between *internal fragmentation* and *external fragmentation*. For each kind of fragmentation, name a kind of virtual memory system in which that kind of fragmentation is likely to occur.
- E: 1. What are three requirements of any solution to the critical section problem? Why are the requirements needed?
2. i. Give pseudocode for the implementation of the *wait* semaphore operation.  
 ii. The semaphore operations *wait* and *signal* need to be atomic, if they are to be used to provide mutual exclusion. Provide an example to show that if wait was not atomic, then mutual exclusion cannot be guaranteed.
3. What does the term *priority inversion* mean?
- F: 1. Identify 2 ways in which the OSI reference model and the TCP/IP reference model are the same. Identify 2 ways in which these models differ.
2. What is the principle difference between *connectionless* communication and *connection-oriented* communication?
3. Give three distinct types of addresses by which a computer can be known on a network
4. Explain the difference between a *protocol* and a *service* in a layered protocol hierarchy.

- G: 1. What is the difference between *forwarding* and *routing*?
2. A network on the Internet has a subnet mask of 255.255.224.0. What is the maximum number of hosts on this network?
3. What is the purpose of hierarchical IP addresses? Explain how the hierarchical address is used in IP routing.
4. A router has the following entries in its routing table:

Address/mask	Next hop
135.46.56.0/22	Interface 0
135.46.60.0/22	Interface 1
192.53.40.0/23	Router 1
default	Router 2

For each of the following IP addresses, what does the router do if a packet with that address arrives? a) 135.46.63.10, b) 135.46.57.14, c) 135.46.52.2, d) 192.53.40.7, e) 192.53.56.7

- H: 1. What steps are involved in establishment of a TCP connection?
2. Why do live audio and video traffic typically use UDP?
3. Since a datagram socket (i.e., a UDP socket) does not require establishing a connection, why is a port number necessary?
- I: 1. In HTTP version 1.0. a server marked the end of a transfer by closing the connection. Explain why, in terms of the TCP layer, this was a problem for servers.
2. Describe how Web caching can reduce the delay in receiving a requested object. Will Web caching reduce the delay for all objects requested by a user or for only some of the objects? Why?
3. The DNS service in the Internet is distributed by design. Alternatively, DNS could have a centralized design instead. List two disadvantages of a centralized design. Justify your answer.
4. SMTP, POP3 and IMAP are all protocols concerned with the provision of email services. State the main service(s) provided by each protocol. [3 marks]

- J:
1. What is public key cryptography?
  2. What is a digital certificate? How are certificates used?
  3. Explain what a digital signature is supposed to achieve. In particular, what should happen when an attacker tries to attach a (valid) digital signature for one message to a different message?

Extra revision:

- basic **scheduling and memory management** (Project 1)
- basic **socket programming** and key system calls for sockets (Project 2)
- key concepts introduced in Lab tasks

**Finally** ... the theory questions from the workshops provide additional practice questions.