

Computer science
Higher level
Paper 1

Friday 8 November 2019 (afternoon)

2 hours 10 minutes

Instructions to candidates

- Do not open this examination paper until instructed to do so.
- Section A: answer all questions.
- Section B: answer all questions.
- The maximum mark for this examination paper is **[100 marks]**.

Attempt 1: $\frac{85}{100} = 85\%$



4 PAGES / PÁGINAS

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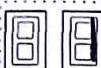
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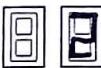
1 2 3 4 5 6 7 8 9 10



offsite storage is frequently used to prevent data loss through backing up data: i.e. store frequently and systematically making duplicates of the hard drives to ensure the most up-to-date data is backed up.

②

③



Cache memory works to speed up computer CPU processing by acting as a "buffer" between RAM and the CPU. Cache will often use the faster "SRAM" type storage which makes it the ideal solution, however, is considerably expensive, meaning it can only practically be used in small quantities, such as acting as the aforementioned buffer.

④

⑤

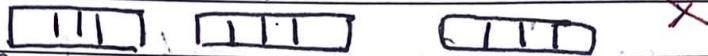
~~3~~

3/



a) hexadecimals are a good way to represent binary in a more human-readable format. It is better suited to do so than base 10 as it can store 16, a power of 2, "digits" per field.

b) bit: one character



for yellow: will need to use 12 bits.

c) 2^{12} ~~x~~

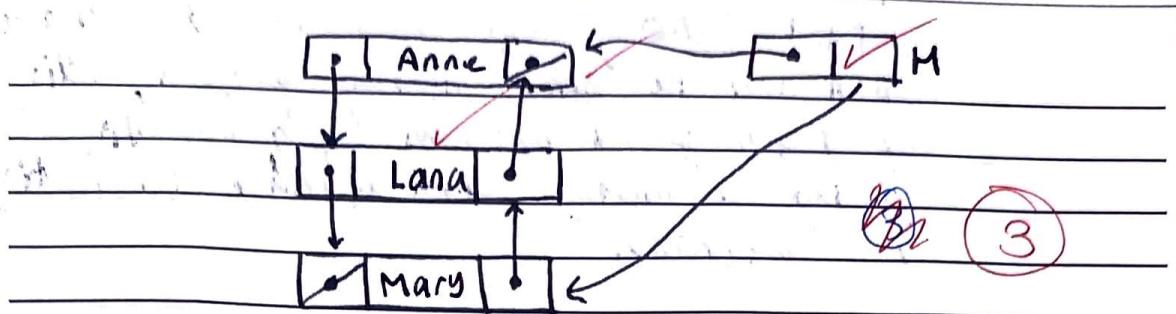
(1)

A	B	C	X	Y	Z	
0	0	0	0	1	0	
0	0	1	0	0	0	
0	1	0	1	0	1	
0	1	1	1	0	1	
1	0	0	1	0	1	
1	0	1	1	0	1	
1	1	0	0	0	0	
1	1	1	0	0	0	

$$A = X = A \text{ XOR } B$$

$$Y = A \text{ NOR } C$$

$$Z = X \text{ OR NOT } Y$$



abstraction is required when designing algorithms because all computer science programs are inherently complex. When designing algorithms, it is useful to modularise the program as to clearly design specific functionality. Furthermore, during development stage, abstraction allows programmers to work on separate modules, and test them, which speeds up the development phase.

(2)

(1)

Virtual memory is that created as to abstract the complexities of RAM memory management.

Behind the OS's & memory management unit (MMU):

- while each program's physical memory may be spread across varying addresses, virtual memory gives the program a clean and continual block of memory, where it need not worry about the physical reality.

6 /

- virtual memory also gives the OS ultimate control over the memory process, letting it keep track of all programs open preventing overlap on memory and leakage (resulting in deadlock).

(4)

$K \leq 5$	K	N	M	$K+1$	$N+1$	$M+2$	Output
T	1	1	1	2	2	2	1, 1
T	2	2	2	3	3	4	2, 2
T	3	3	4	4	4	8	3, 4
T	4	4	8	5	5	16	4, 8
F	+	-	-	-	-	-	-

(5)

K	N	M	$K \leq 5$	OUTPUT
1	1	2	T	1, 2
2	3	4	T	3, 4
3	5	8	T	5, 8
4	7	16	T	7, 16
5	9	32	F	-

(5)



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1 2 3 4 5 6 7 8, 9 10

- (a) - resistance to change ^{compatibility} ✓ (2)
- lack of knowledge / competence / training

(b) When implementing a new system, phased convergence with implementation will involve systematically converging implementing the system in ~~all~~ parts of the organization different modules. This way, ~~it~~ stakeholders have sufficient time to train and adjust to the new system. However, this also presents issues in the compatibility between the new and old modules, as well as additional complexity for employees.

Instead of phased implementation, ~~an~~ direct changeover may be used which involves an immediate ~~smooth~~ switch to the new systems. If done well, this can be highly efficient as no data incompatibilities will exist in the organization's operations. However, if adequate skill does not exist within the organization's management, a failed implementation may impede operations through

2/ ~~2~~



requiring a roll-back, with the monetary costs also posing an issue. (5)

(c) (i) Beta testing (small group of end users)

(i)

1) bugs / errors

2) unfit / unsuitable for purpose

3) unintuitive for targeted end-user. (3)

1

3

(d) Implementing a new system will often involve a range of ethical considerations needing to be made:

- data security: confidential data will often need to be transferred to a new system. During this process, confidentiality and security must be maintained, as well as preventing ~~careless~~ carelessness data loss.

- the impacts on various stakeholders should be considered. Namely, a system should be made such that as few stakeholders as possible are negatively impacted. A certain margin should be accepted as it is very difficult to always please all stakeholders.

VAGUE

(2)

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(a) 7) communication with other devices on the network ensures information can be shared between stakeholders within the school (students and teachers). This can be very beneficial to the learning process as it speeds up learning through new efficiencies.

2) Access. Access to the internet enables students and teachers to access an amalgamation of information through their network, which can magnificently benefit all users. Without the school network, information could not be as easily accessed for learning purposes. 4

(b) (i) A router handles the sending and receiving of all data packets on the information network. It will forward packets to routers their destination, ensuring all data route packets being transferred on the network to interfaces reaches its intended destination. 1

(ii) A network interface card (NIC) is a piece of hardware on all computers that facilitates communication ~~to~~ into NIC to and from the network. It is used for wired so that computers can access wired networks, as special technology is required to be able to understand wireless radio signals. X 1

(c) Protocols are a common set of rules that all nodes on a network must follow. They ensure that, despite the highly diverse types of hardware on each network, each can communicate well with each other with a "common language." 2

(d) Data encryption is a process whereby data packets are transformed using a key (symmetric or asymmetric), so that they cannot be understood by any entity other than the desired recipient. 1

NIC OR WIRELESS NETWORK ADAPTER

(e) Mac addresses are unique identifiers of all network interface cards. Usually, they will ~~be~~ not be able to be changed, hence can be used to identify all the devices on a network. This way, administrators may:

- whitelist: allow only certain MAC addresses onto the network
- blacklist: block certain ~~MAC~~ MAC addresses from accessing the network.

However, MAC address white/blacklists are often very high maintenance and must be frequently updated. Malicious entities may also simply use a different NIC to access the wireless network if blacklisting is used. 4

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1 2 3 4 5 6 7 8 9 10

(a) (i) The level of fidelity of the pixels on a screen. Measured as:

Width \times Height not multiplication (1)

(ii) Software may be incompatible with the screens used on different devices, as not all types of hardware can all be accounted for within all websites. The biggest issue usually is portrait vs. landscape which has become more prominent with the ~~increases~~ increased use of smartphones.

Gestures on different devices also differ. This means that logic between different devices such as smartphones vs. desktops must differ. For example, keyboard shortcuts are commonly used on desktop applications, while touchscreen gestures are more prominent on mobile devices.

4

5

→ check up on explain and discuss requirements
w/ markschere

- (b) · Peripherals: the OS controls access to peripherals through a driver layer, as well as managing when and how peripherals may interact with the computer and access its resources.
- CPU time: Processor resources are managed through scheduling policies, ensuring the CPU is being utilised efficiently and fairly by all processes on the computer. (3)

- (c) → Sensors used:
1) buttons for user input
2) weight sensor for wash load
3) temperature sensor for water

- The user first configures the microprocessor using buttons to set duration, cycle type, temperature and more. This is a control system in its self, however can be abstracted into the configuration process.
- The weight sensor sends an analogue signal through an ADC to inform further configuration by the processor.
- When the system is started, the microprocessor informs water dispensers (output transducers) to begin dispensing water. Continual feedback with the temperature sensor ensures water is the user-defined temperature.
- The microprocessor also sends an electronic through GTO a DAC to a motor which follows the preselected wash cycle program. There will generally not be a feedback loop here.

3

→ lastly, interrupts are used in the case of the door opening, in which case the door sensor will immediately inform the microprocessor through an ADC, which will use a DAC to inform the water dispenser and machine motor actuators to halt operations.

(6)

- (a) - undo button in a word processor.
- back button in a browser.

(2)

(b) A one dimensional array is a static implementation of a stack, which ~~functions~~ can have the various required methods:

→ describe initialisation more

the COUNTER is incremented.

→ Push: Using a COUNTER, a pointer to the top of the array can be used to append a new item. The stack is limited in this implementation in that the array has a fixed length. Hence, when COUNTER reaches the array length, no more items may be appended.

→ Pop: like the push operation, the item at the COUNTER can be used. In this case, it is used to return the top item of the stack, and then is decreased by 1.

→ isEmpty: will check if the COUNTER is at 0, hence meaning the array is empty. This should prevent any more pop() function.

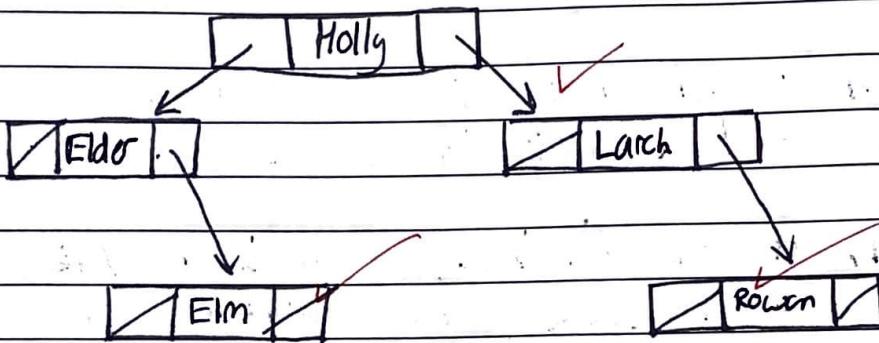
(c) (i)

(c) (i) Postorder: LRV

7

Elm, Elder, Holly, Rowan, Larch, Hazel

(ii) Using a minimum search on the right subtree:



3

(d) static:

- use random access (very quick retrieval)
- require adjacent blocks of memory, hence the length cannot change from initialisation

Dynamiz:

- uses pointers as to allow elements to exist anywhere within memory.
- this allows for a dynamic length of size of the data structure.
- uses more storage memory as each element needs one (or more) pointer.

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(a) $\text{MAT}[3][4] = 4$ ✓ (1)

(b) BEGIN isValidMatrix(N, A)

VALID = TRUE

loop J from 0 to N-1 ✓

loop I from 0 to N-1 ✓

if $I < J-1$

if $I \geq J-1$ AND $I \leq J+1$, then

if $A[J][I] \neq 0$, then

VALID = FALSE ✓

end if

else :

if $A[J][I] \neq 0$, then

VALID = FALSE ✓

end if

end if

end loop

end loop

output VALID

Efficiency:

flag

8/



(c)	R	R > 0	A[R][R-1]	R-1	Return	Output
	5	T		4		
	4	T		3		
	3	T		2		
	2	T		1		
	1	T		0		
	0	F			O	
	1	-	1			1
	2	-	9			10
	3	-	-5			5
	4	-	7			12
	5	-	5			17
						17

∴ Output = 17

41

2

(d) Add up all the numbers on the lower
sub-diagonal (below the main
diagonal).

61