2010 Computing

Advanced Higher

Finalised Marking Instructions

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SECTION I – Software Development

					Marks
1.	**(a)**			Project proposal.	**1 KU**
	(b)	**(i)**		Feasibility study.	**1 KU**
		(ii)		Relatively small initial outlay without the need to continue to full scale development. Range of options/strategies for development. Recommended strategy.	**2 PS**
		(iii)		Use Gantt/Pert to graphically display tasks and their schedule/ duration (by beginning and end indicated by bar position) (1) allowing overall project time to be controlled (1). Identify sub-tasks (1) which could take place independently reducing overall project time (1). Identify sub-tasks (1) allowing responsibility for different tasks to be allocated to different teams/individuals. Must explain why identifying sub-tasks improves time management − identify independent and dependent tasks, assign responsibility. Set deadlines (1) which increases accountability/productivity as they approach (1). 1 mark method, 1 mark explanation.	**2 KU**
	(c)	**(i)**		Inputs/processes/outputs. Scope/boundaries. Data requirements. Physical specification. System prospectus − Preliminary timings/details of proposed user documentation/details of training needed. Any other acceptable.	**3 KU**
		(ii)		Description of validation ie comparing design, implementation etc with ORD to identify if all functional requirements are present. Dispute resolution to protect client/developer from demands not present in the ORD or features not present in the software that were stated in the ORD.	**1 KU**
	(d)			(Source) code automatically created from design/models/UML etc. Automatic documentation generation. Generate models (UML) from source code.	**1 KU**

(e)	**(i)**	Set breakpoints (1) to identify the section of code by stopping the execution of code at defined points to identify the area of code causing the problem. Inspect/watch variables (1) to track changes when stepping through the code. Any other acceptable.	**2 PS**
	(ii)	• User questionnaires. • Summary of test results.	**2 KU**
	(iii)	• End users involved in the running of the software. • On site in a depot/shop. • With users proving feedback to programmers. 1 mark each, maximum of two.	**2 PS**

Marks

2. **(a)** Inefficient use of processor time resulting in slowing of system performance. **1 PS**

(b) **2 PS**

Index	0	1	2	3	4	5	6	7	8	9
Array	C	A	L	E	D	O	N	…	…	…

Front = 5 (1)
Rear = 6 (1)

Award 1 for Front=O and Rear=N

(c) **(i)** Rear will reach 9 but the queue is not full as there are spaces at the front of the array. **1 PS**

(ii) The solution would be to wraparound where items are added at the start of the array. **1 PS**

(d) **(i)** Stack − items added and removed at the same end or last item added is first one removed.
Queue − items removed at one end and join at the other or first item in is first one out/processed. **2 KU**

Accept **expansions** of LIFO and FIFO or similar.

(ii) Characters would be processed in the wrong order (accept reverse) causing characters to be jumbled (1) as more recent input would be removed before earlier typed characters (1). **2 PS**

3. **(a)** Sorted list. **1 KU**

(b)
- 42.
- Upper would be set to 6, (lower is 0).
- middle is calculated to 3.

3 PS

1 mark each.

(c) 26 takes three linear (1).
Binary would go on to check values 12 then 26 giving four comparisons (1) making linear more efficient (1). **3 PS**

4. **(a)**

- Classes are units of code that define the operations that can be performed on the data fields that they contain (1). Any number of instances can be created from a class (1). **2 KU**

- Objects encapsulate (1) their internal workings in terms of data items as variables and methods as procedures or objects data is hidden from other objects or allows different levels of access to data.

- A subclass (new module) can be defined that inherits the data, methods/properties of the superclass (1) stating only the additional data and methods that require to be defined (1).

(b) Changes in a class are inherited by all subclasses (1) resulting in fewer amendments to code (1). **2 KU** **2 PS**

Additional features could be implemented through creation of a subclass (1) meaning fewer new lines of code are needed (because of inheritance) (1).

Tracing errors is easier by checking the behaviour of classes and their subclasses (1). An error in all subclasses means the error is present in the superclass code **or** an error present in a subclass but not detectable in the superclass means the error is present in the subclass code (1).

Accept a suitable encapsulation answer.

Answers must relate to the context of maintainability.

Marks

5. **(a)** **(i)** celebs(0 to 7, 0 to 2) as string. (1 mark data type, 1 mark each correct order.) **3 PS**
Allow indexing from 0 or 1.

(ii) Can choose a suitable data type for each 1-d array. **2 PS**
More efficient to store data in a suitable data type eg race number as byte/integer compared to string.
Operations are defined for each data type.
More efficient to sort data stored as numeric than string.
1 mark each, maximum of two.

(b) **(i)** **3 PS**

48	48	48
42	45	45
45	42	42
27	27	27
18	18	18

1 mark each column.

If there are only two columns the third mark may be awarded if the candidate states that that the sort will terminate as no more swaps take place.

(ii) Checks the first value against the second then third and so on and swaps every time the numbers are out of order. **2 KU**
Then repeats this process with the second value and so on.

(iii) Since only one item will be out of place/partially sorted. **2 PS**
Can detect when the list is sorted and so stop looping.

(iv) Temp=value(counter) **3 PS**
Value(counter)=value(counter+1)
Value(counter+1)=temp

(c) Open (with the close) (1) **4 PS**
Loop while points >40 (1)
Write/print name(), points() (1 write, 1 use of correct variables)
End loop
Close
Allow for use of the if points>40 statements

(d) File read back into the array (1) and competitor deleted from array then written back to file (1). **2 PS**
Or
File read back into the array (1) and use IF statement to exclude disqualified couple when writing array back to file (1).

SECTION II – Part A – Artificial Intelligence

Marks

6. **(a)** **(i)** Slide 5 to the left (1) **2 PS**

1	5	
3	6	8
7	4	2

(ii) [1, 6, 5, 3, 0, 8, 7, 4, 2] **1 PS**

(iii) Easier to program moves referring to two array indices. **1 PS**

(b) **(i)** Hill-climbing (1). **4 KU**
Evaluating function to give node a value (1).
Choose highest value successor (1).
Repeat until no higher successor (1).

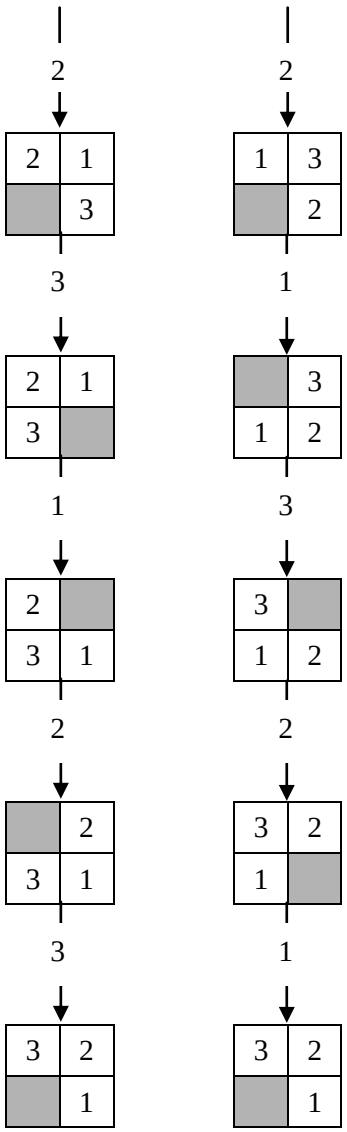
or
Best-first (1).
Evaluation function to give node a value (1).
Keep agenda of visited nodes (1).
Choose highest node from agenda (1).

(ii) Chess suffers from combinatorial explosion (1), but this tree diverges slowly, so no need to prune the search space (1). **2 PS**

(iii) Minimax only used for 2 player games. **1 PS**

(c) **(i)** 2 of these moves simply reverse the previous moves (1), so do not lead to new states of the puzzle (1). **2 PS**

(ii) **2 PS**



1 mark for completing each branch of the tree correctly.

Award 1 mark for both branches completed for the next two descendants.

(iii) The two final states are the same, and the only possible next moves simply reverse the previous moves (1), so there are no other possible states for the puzzle, so the goal cannot be reached (1). **2PS**

Marks

7. **(a)** **(i)** **4 PS**

vehicle	
purpose	transport

car	
subclass	vehicle
powered_by	engine
has_wheels	4

bicycle	
subclass	vehicle
powered_by	human
has_wheels	2

Reliant Robin	
instance	car
has_wheels	3

1 mark for each frame

Award two marks for suitably constructed frames with subclass, instance missing or similar.

(ii) A default value applies to all instances of a class, unless overwritten by the instance's own value (1). For example, has_wheels has the default value 4 for cars, but is overwritten by the value 3 for the Reliant Robin (1). **2 PS**

(b) **(i)** This single rule allows all cars to inherit the property "powered by engine" (1). Without the rule, each new instance of car would need a fact such as powered_by(ford_focus, engine) (1). **2 PS**

(ii) purpose(X, transport) :- instance(X, Y), subclass(Y, vehicle) **2 PS**
award 1 mark for two of three parts correct.

(iii) instance(X, Y) :- instance(X, Z), instance(Z, Y). **2 PS**
award 1 mark for two of three parts correct.

8. **(a)** **(i)** steele. **1 PS**

(ii) [mcbain, fleming, khan, matheson, thom] **1 PS**
(must show answer as a list).

(b) **(i)** X = steele **1 PS**

(ii) The rhs of the rule specifies that the list must contain 6 members. **1 PS**

(c) **(i)** The underscore represents the tail of the list (1), which can be a list of any length (1). **2 PS**

(ii) silver(X) :- sprint100m([_,[X|_]]). **2 PS**
Award 1 mark for a partially correct ([_,[X|_]]) eg only having one set of square brackets or similar.

				Marks
9.	**(a)**	**(i)**	Conflict set: all those rules which could fire at any given time (1). Conflict resolution: the method of choosing which rule to fire (1).	**2 KU**
		(ii)	Maintains working memory of known facts or establishes facts from questions to user (1). "Fires" rules to produce new facts (1). Continues until a conclusion is reached (1).	**3 KU**
	(b)		Prevents input errors due to mis-spelling (1). User could select from a drop-down menu of images (1) (or other valid).	**2 PS**
	(c)		A coin does not have straight edges/not trihedral.	**1 PS**
10.	**(a)**	**(i)**	Speech recognition: converting sound into words (1). Syntactic analysis: structuring words into sentences or checks grammar is correct or identifies components of sentence (1). Semantic analysis: extracting meaning (1). Pragmatic analysis: using context to remove ambiguity (1).	**4 KU**
		(ii)	Syntactic analysis.	**1 KU**
		(iii)	Syntax is correct (1). Command makes sense (1).	**2 PS**
		(iv)	Needs reference to context to remove ambiguity (which mess?) (1).	**1 PS**
	(b)	**(i)**	Rote learning is storing facts without any understanding (1).	**1 KU**
		(ii)	Cannot generalise/apply to new situations (1); domestic context is unpredictable (1).	**2 KU/ PS**
		(iii)	Any of inductive learning, learning by example, learning by analogy etc. (1) for name, (1) for description.	**2 KU**
	(c)	**(i)**	Any reasonable example, which is ethical (or social) rather than legal (eg should robotic carers be used for disabled people).	**1 PS**
		(ii)	Massive increase in processing power/memory, allows programs of the required complexity to be run in real time/stored.	**1 PS**

[END OF SECTION II – Part A]

SECTION II – Part B – Computer Architecture

					Marks
11.	**(a)**		• The contents of the program counter, which indicates the location of the instruction to be loaded from memory is loaded in the Memory address register. • The contents of the memory location whose address is held in the MAR is loaded into the MDR. • The program counter is then incremented.		**3 KU**
	(b)	**(i)**	Both paths of a branch in instructions are processed in advance and the results from the branch that is not taken are discarded.		**2 KU**
		(ii)	The large number of predication registers enables the processor to store the results of multiple branches in a program.		**1 PS**
	(c)	**(i)**	The processor scans the code and detects load instructions. It then executes these instructions, loads the data and stores it in registers before it is required by the program.		**2 KU**
		(ii)	Since the data is already in registers before it is required by the program it avoids memory latency delays.		**1 PS**
12.	**(a)**	**(i)**	Memory is split into several independent RAM chips. Data is written/read to/from these chips concurrently.		**2 KU**
		(ii)	Any situation involving reading large banks of data eg video data.		**1 PS**
		(iii)	Some instructions may need further processing before the next item of data can be read thus leading to delays.		**1 PS**
	(b)	**(i)**	PCI-X has a clock speed of 133MHz. Based on clock speed alone this would bring a 4 fold increase in data transfer rate: 532 Megabytes ps.		**1 PS**
		(ii)	The difference between them can be explained by the width of the bus. The width of a PCI-X bus is 64 bits and in the initial bus it is 32 bits.		**1 PS**
		(iii)	PCI-X: is a multipoint bus enabling connection to several peripherals simultaneously.		**1 PS**

					Marks
13.	**(a)**			Without a pipeline each stage would take 1 clock cycle = 6 in total Once the pipeline is filled an instruction is completed each clock cycle.	**2 PS**
	(b)	**(i)**		• Could cause the program to branch. • Leading to the pipeline being flushed and re-loaded.	**2 PS**
		(ii)		1	**1 PS**
		(iii)		Branch prediction. Keeping a branch history table. Enabling the processor to select whether or not to pre-fetch instructions/data for the branch.	**3 PS**
	(c)			Data flow analysis: Analyses instructions Detects dependencies Rearranges the order of instructions to avoid dependencies.	**4 PS**
14.	**(a)**			• Large instruction set. • Multiple address modes. • Variable length instructions.	**3 KU**
	(b)			More registers and an increased use of register to register instructions.	**2 PS**
	(c)			Instructions of varying length slow down a pipeline. Since superscalar design involves using multiple pipelines, having all instructions the same length multiplies the performance gain this feature brings to the processor's design.	**2 KU**
	(d)	**(i)**		The program counter contents need to be stored on the stack because it contains the address of the next instruction, which the processor will need in order to resume processing after the interrupt has been serviced. The contents of the general purpose register contains the data, loaded speculatively, which is required by following instructions.	**4 PS**
		(ii)		Using a stack will enable the processor to resume processing from the point at which it was interrupted since the stack enables it to retrieve the data in the reverse order from the way in which it was stored.	**2 PS**

				Marks
15.	**(a)**	**(i)**	DEX	**1 PS**
		(ii)	BNE 8	**1 PS**
		(iii)	STA(58) or LDX(42)	**1 PS**
	(b)		The **object** on which the operation is to be performed is the operand in an instruction eg the object of instruction LDX(42) is the data held in memory location 42. The **operation** is defined by the op-code eg the operation in instruction LDX(42) is to load data into the X register.	**2 PS**
	(c)		10001000 (136)	**1 PS**
	(d)	**(i)**	ROL	**1 PS**
		(ii)	Bits may be shifted into the carry or overflow flag bit or may even be lost meaning that the original values cannot be returned.	**2 PS**
16.	**(a)**		In a multitasking system several processes may be contending for access to the processor and so there is a need for a system to allocate the processor's time.	**2 KU**
	(b)		Pre-emptive scheduling enables the operating system to control the amount of time each active process can engage the processor. It enables the operating system to suspend one process, at any point, and give another process a turn.	**2 KU**
	(c)		Round robin maintains one queue whereas multi-level feedback queue maintains a hierarchy of several queues. Round robin: processes in the queue are given identical slices of the processor time. Multi-level: processes are given varied lengths of time as they progress down the levels of queues.	**2 KU**
	(d)		• Multi-level because I/O based processes from the peripherals such as the scanner, the digital camera and the hard drives which only require a short amount of processor time are dealt with rapidly in the top level queue • longer processes such as processing graphic files are catered for efficiently by being given a short time slice in the top level queue and • then moved down to succeeding lower level queues, where the time slice is doubled on each level, until the process is complete.	**4 PS**

[END OF SECTION II − Part B]

SECTION II – Part C – Computer Networking

				Marks
17.	**(a)**	**(i)**	Allows authentication of server and supplies its public key.	**2 KU**
		(ii)	A public key can be made available to anyone (1 mark) but only the owner of the public key can decrypt it by using the private key (1 mark) therefore the symmetrical key can only be known by the server and client (1 mark).	**3 PS**
		(iii)	• HTTPS has been crucial in the popularity and acceptance of e-commerce and on-line banking (1 mark for identifying one or more services which use HTTPS). • Both of which have been important services in relation to the growth of the WWW. (1 mark for mention of the security offered by HTTPS that has allowed the named services to become popular).	**1 PS**
	(b)		Individual ports blocked to all users. Only allow specific IP addresses to access from external side.	**2 PS**
	(c)	**(i)**	• A client machine spoofs a return address in a TCP initial SYN packet. • The server sends the SYN/ACK packet to the spoofed address, which is therefore never acknowledged. • If enough of these SYN packets are sent, they fill up the buffer in the target host so that further legitimate packets cannot be received. 1 mark for each main point.	**3 KU**
		(ii)	• The two most effective adjustments which can be made are to shorten the time before unacknowledged SYN/ACK packets are dropped. • Increase the length of the backlog queue for those TCP ports which might be bombarded. 1 mark for each main point.	**2 KU**
		(iii)	Any suggestion in the context of data held by the government could be accepted. Other governments or political opponents may be attempting to gain access to national secrets. Some government agencies hold a lot of personal data which may be useful to other people.	**2 PS**

Marks

18. **(a)** **(i)** CIDR allows the break up of a single Class network into multiple networks of varying sizes (1 mark) by adding a suffix that states the number of bits allocated to the network section of an IP address (1 mark). **2 KU**

(ii)
- Under the class based IP system a lot of IP addresses were wasted when larger than required networks were allocated to companies thus wasting IP addresses (1 mark).
- In this case the parent company that requires 1022 addresses would have to have been given a class B address thus wasting approximately 64, 512 addresses (1 mark).
- A second problem caused by the class network was that the routing tables on the internet routers were becoming increasingly complex, these are simplified by allowing a hierarchical structure where one network address can point to a lower level router that then has the routes for each of the subnetworks (1 mark).
- In this case only the one router may be required to list the details of the subdivision of the 178.128 network and all requests beginning with those numbers are referred to it.

4 PS

(iii) 11111111.11111111.11111111.10000000 or 255.255.255.128 (1 mark for first 3 octets and 1 for last octet). **2 PS**

(b) **(i)** QuickTime, RealPlayer, Windows Media Player. **1 PS**

(ii) Head. **1 KU**

(iii) **3 PS**

```
<link rel="stylesheet" type= "text/
css"
href="mystyle.css">
```

link tag 1 mark
rel value 1 mark
type 1 mark
href 1 mark
3 marks max, errors in syntax allowed

```
< style type= "text/css">
body {background-colour:
red}
p {font-family: courier}
</style>
```

style tag (open and close) 1 mark
type value 1 mark
a colour setting 1 mark
a font setting 1 mark
3 marks max, errors in syntax allowed

(iv) The words “web hosting” is an object and there are two operations being carried out on it: one to change the font size and style and one to make it the anchor for a hyperlink. The tags define the operations that are to be carried out on the text object. **2 PS**

			Marks
(c)	**(i)**	Application.	**1 KU**
	(ii)	Application, presentation and session. 1 mark for 2, all 3 for 2 marks.	**2 KU**
	(iii)	Proxy: a network may use a proxy server which means that all the clients on that network will ask the proxy server for any URL, the proxy server then requests the website and relays it back to the client. This allows the sharing of one connection with many machines and gives a single entrance point to the network where filtering and packet checking can be carried out. Gateway: the information on some computers are only accessible through a separate computer, the computer that actually holds the information would normally be part of a network that does not use TCP/IP and there may exist security issues about allowing direct access to it therefore this gateway computer prevents access to the local network and performs protocol conversion as appropriate. Tunnel with purpose. 1 mark for name and 2 for good description of use.	**3 KU**
(d)	**(i)**	Full.	**1 PS**
	(ii)	C cannot be a full backup as then neither A or B would have been required. (1 mark). A must be the last full backup and as B is required then C cannot be differential. (1 mark).	**2 PS**

				Marks
19.	**(a)**	**(i)**	• Many bluetooth devices will not give sufficient range. • Bluetooth data transfer rates are not that high (and decrease with distance). • The wireless router will almost certainly use wi-fi (802.11) and not bluetooth. 1 mark each, max 2 marks.	**2 PS**
		(ii)	• 802.11g established standard with support on all operating systems. • Good range (50m indoor, 250 outdoor). • Fast data transfer of 54 mbps although this may decrease with distance. • Equipment readily available in shops/online and relatively cheap. 802.11n may well be the most widely used by 2010.	**4 PS**
	(b)	**(i)**	The (SSID) network name (1 mark) and the encryption key (1 mark).	**2 PS**
		(ii)	Slow Internet access for normal users due to sharing of line. Flashing activity light on router when all computers in Alice's house are off.	**2 PS**
	(c)		SMTP used to send the e-mail to server (1 mark). MIME used to encode and decode attachments (1 mark).	**2 KU**
	(d)	**(i)**	The upload speed of the wireless network should be greater than that of the ADSL connection. The download speed of the wireless network should be greater than that of the ADSL connection. The impact on the bandwidth of the ADSL connection that the group are using will be reduced. They will be less open to strangers asking to join their group. 1 mark each.	**3 PS**
		(ii)	The captured video is compressed using hardware or software codec's (1 mark), synchronisation data for sound and video is added (1 mark), the data transferred and on receipt the data is decompressed (1 mark).	**3 KU**
	(e)	**(i)**	A queue (1 mark) so that the instructions are processed in the same order they are received. (FIFO) 1 mark for reason.	**2 PS**
		(ii)	To try and send video between the stations would result in too slow a game. The central host computer would have to generate different video images for each participant, again resulting in slow performance. (1 mark for any technical difficulty identified).	**1 PS**

[END OF SECTION II – Part C]

[END OF MARKING INSTRUCTIONS]