# Unit 1 – System Fundamentals

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| Question [Marks] | Answer |
| Outline one problem of maintaining legacy systems [2] | * Maintaining outdated computer systems which use old technology and old application programs * Hard to understand, expensive to change because programs might be disorganized, and documentation might be missing/incomplete * Compatibility issues due to old programming languages or old database technology; * Difficult to recruit staff or programmers familiar with the old languages or operating systems |
| Outline the use of a failover system [2] | * A failover system is a standby system   + Used to eliminate or reduce the impact on users   + Automatically taking over if the primary system suddenly becomes unavailable. |
| Identify 2 aspects of the data that need to be taken into account during the planning of the new system [2] | * The type of access needed; For example read only/read write/online or offline; * Quantity/size of the data; For example should not exceed storage capacity of the new system; * Type/nature/format; For example incompatibility issues; |
| Describe how direct observations on the current system may provide information to help propose a suitable new system [3] | * Quick/first-hand/realistic information on data/software/hardware/users/procedures in the current system;   + Help better understand positive and negative features of the current system (for example problems in accessing or validating data/user errors/security issues, etc.);   + Which can be used when specifying requirements of the new system (keep/improve positive and change negative features); |
| Describe the purpose of a prototype [3] | * Prototype is used to ensure all essential functions/operations of the system are present/meets the needs of the users; * Prototype is used to speed up development process; * Positive user's feedback helps in refining the acceptable prototype in order to develop the complete system/product; * Or else a further prototype should be created in order to develop the satisfactory system/product; |
| Discuss two possible problem that may occur during data migration [4] | * Data loss/data corruption; * When moving data, from one storage device to another (via network/ cables or transferred by people), data could be corrupted/lost and not useful anymore; * Incompatibility of data formats; * Necessary to translate from one format to another, to be able to use the data in the new system which causes delays/performance issues in business/office operation; |
| State 1 method of providing user documentation [1] | * Help files * Online Support |
| Outline one economic aspect that needs to be taken into account to support parallel running [3] | Example answer 1   * Two systems are running simultaneously so that operations are not disrupted; This is a costly operation; * Because both systems and all their resources should be maintained / More staff should be hired;   Example answer 2   * Safe way of validating the new system; * Running two systems could be cheaper; * Than losing all data in case of failure; |
| Describe one disadvantage of the use of feedback from social networking in relation to business [2] | * Feedback/reviews might not correspond to trustworthy judgement; * And call something cheap that is not cheap / something good that is not so good; * The same person might use more than one identity to add weight to opinions; * There is a market for fake reviews, and people may even be paid to author them; It is hard to counterbalance negative and not trustworthy feedback for the business because of the complexity of the review system; |
| State 3 potential usability issues with cell phones [3] | * Has a small (touch-sensitive) screen; * Uses batteries for power; * No hard disk drive / small memory; * Reliability / Network coverage issues; * Too many steps to access a particular feature |
| Identify one advantage of direct observation [1] | * Direct observation is systematic/structured process * Allows the current computer system to be studied in its natural setting * Provides a better understanding of the way computer system is used |
| Identify one disadvantage of direct observation [1] | * Direct observation is susceptible to observer bias * Also can affect the behavior of users/process being observed * Time consuming |
| Identify two possible compatibility issues as a part of data migration [2] | * Language differences/different character set * Different conventions of representing various data/currencies, dates * Incompatible software/incompatible hardware |
| Outline one social issue associated with data migration [2] | * Employees who are not willing to move * Lost jobs/finding new job/income decrease * Personal or family issue during the period of moving or in a new environment/finances and cost of living/services such as schools =, hospitals, transport/ language problems |
| Describe 1 method by which system requirements can be obtained from the stakeholders [2] | * Interviews could be held (with the librarian/stakeholders); * To establish the functions required by the system; * Direct observation could be made of the users/students using the present system; * To gain an insight on how the library is being used; |
| Outline 1 reason for providing a prototype for this new system [2] | * Allows stakeholders to gain an idea of how the system would be/work/look; * so they can provide feedback / suggest improvements; |
| Describe 2 different methods that the medical center could use that would allow data to be restored should it be lost for any reason [4] | [1] for method [1] for description   * Backup; * Data files on a regular basis; * Printed copies; * Printouts can be kept of transactions; * Transaction Log file; * Written for each transaction can be used to restore; |
| Outline 1 method of collecting information from stakeholders concerning the requirements for a new system [2] | * Surveys; * (General) questions distributed to many stakeholders as a written or online document; * Interviews; * (Specific) questions asked of nominated stakeholders in an individual setting; * Direct observations; * Observer watches stakeholders performing their current tasks; |

# Unit 2 – Computer Organization

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| Question (Marks) | Answer |
| Describe the function of the control unit (CU) in the central processing unit (CPU) [2] | * Obtains the data/instructions from the memory. * Interprets/decodes them into commands. * Controls transfer of data and instructions among other units of a CPU. * Manages and coordinates all the units of the computer |
| State the purpose of cache memory [1] | * Is used to save time in accessing RAM |
| Draw a diagram to show the relationship between RAM, the processor and cache memory [1] |  |
| Distinguish between RAM and ROM [3] | * RAM acts as temporary storage of data, instructions and programs currently running (for the operating system and for the running applications) whilst ROM is permanent memory (stores the instructions and data that won't change/stores the instructions that the computer needs in order to boot up; * Memory access, both read and write operations are performed on RAM whilst ROM works with read only operation; * If power failures happened during access to RAM then all data will be permanently lost/RAM is volatile memory/whilst if power failure happened during the ROM access no data will be lost ROM is non-volatile memory; |
| Explain the roles of the data bus and the address bus in the machine instruction cycle [4] | * Bus is defined as a system that transfers data between hardware components/data bus and address bus enable a processor to communicate with the primary memory; * When the computer processor needs to fetch an instruction from the memory it uses the address bus to specify the (physical) address (of the memory block it needs to access); * It will get the data from (the specific) memory (block) (after checking the address bus to get the read address); * And then it will place this data on to the data bus/data bus carries the data; When the processor wants to store results of execution to the memory it will set the write address on the address bus; * And put the data/results/to be written to memory on to the data bus (to carry this data); |
| Outline the role of the memory data register in the machine execution cycle [2] | * Holds (a copy of) the contents of the memory; * Which are to be transferred from/to memory to/from other CPU components; * Allowing the processor and memory to act independently/processor not affected by differences in the speed of operation; |
| How many different colors can be represented using 2 hexadecimal characters | * 256 |
| Outline the function of an interrupt [2] | * An interrupt is a signal to the CPU sent by hardware or software; * The function of an interrupt is to alert the CPU to suspend execution of the current program; * And to transfer the control to the interrupt handler (which saves the state of the current program to the interrupt stack, services the interrupt and resumes the normal CPU activity); |
| Outline the purpose of the memory address register (MAR) in the central processing unit (CPU) [2] | * The MAR holds the memory location of data/instructions; * that need to be accessed (read/write) (fetch/store); |
| Outline why single processor computers may not be able to render 3D graphics effectively [2] | * Single processor is mainly occupied with the OS jobs / might not be able to handle multiple jobs/; * Rendering 3D graphics requires a great deal of processing (which a single processor may not be able to give); * If attempting rendering on a single processor, a (very) high clock speed is required; * which may not be available, * 3D graphics processing is (inherently) parallel; * A single processor is not able to handle parallel processing; |
| Outline 1 advantage of using virtual memory [2] | * Allows more applications to run than there is available physical memory; By the use of page/swap files/part of hard disk as primary memory; * Larger application can run * With less real RAM; |
| Outline 1 disadvantage of using virtual memory [2] | * Applications run more slowly; * Uses hard drive memory as primary memory / takes more time to switch between applications; * When a computer's virtual memory resources are overused /Reduced amount of hard drive space available for your use; programs lock-up/do not run/disk thrashing; |
| Identify 2 characteristics of RAM [2] | * RAM is volatile/contents erased when power is switched off; * Access speed is fast/faster than hard drive; * Data/instructions can be read from and written to it/RAM can be overwritten; |
| State the purpose of persistent storage on the computers [1] | * To store programs / files / data in a non-volatile device so it isn't lost; * Stores more data as it has a larger capacity; |

# Unit 3 – Networking

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| Question (Marks) | Answer |
| Explain, in terms of resources, how Voice over IP provides a collaborative working environment for a company with multiple locations nationwide [3] | * Explain VoIP and explain 1 resource * VoIP transmits audio (and video) over the internet * Requires a broadband internet connection * Bandwidth * Low bandwidth makes streaming disrupted and impacts the quality of a collaborative environment |
| Distinguish between Ethernet and wireless in terms of reliability of transmission [4] | WIRELESS   * The reliability of wireless depends on the strength of the wireless signal/distance from router; * on the topology/shape of the surroundings; * on interference/number of simultaneous connections; * on an access point;   ETHERNET   * Ethernet is more reliable as the strength of the signal is independent from the distance from the router (within the college); * There is no issue with the topology/shape of the surrounding, as long as the user has a connection; * Connection depends on condition of cables — no loose or broken cable connections; |
| Describe 2 features of a VPN that make it secure [4] | * Authentication; * Nobody outside the VPN should be able to affect the security property of the VPN (it must be impossible for the attacker to weaken/change encryption); * Encryption; * Data intercepted will not be readable; * Tunneling software; * Security properties of each tunnel should be agreed by the administrators of the two endpoints of the tunnel; * Multiple exit nodes; * Makes it hard to distinguish where the data was generated thus more secure (less prone to phishing); |
| State one technology that is necessary for VPN [1] | * SSL 3.0 (Secure socket layer 3); * TLS (with encryption) (Transport Layer Security); * IPsec with encryption; Not accepted: “internet connection”. |
| In relation to the specific activities that may be carried out by students, discuss 2 advantages and disadvantages of the use of external services [6] | Advantages:   * May offer more recent technology than the college itself; * The college cannot replicate the social aspects of diffused discussion/social networking; * each advantage, up to [2 max], [1] for each disadvantage, up to [2 max], and [2] for a discussion in relation to an example. * Registration/creation/access of account is usually easy/cheap/free; * Allows interaction with others/collaborative studies/exchange of materials/opinions; * It means students can access and coordinate data and assignments on any device and from any location;   Note: Do not accept “can reach work when not at college” on its own, as there is a VPN for this purpose.  Disadvantages:   * One might post things they would regret later on; * The content is potentially available across the world; * The content is available for a long time; * The content submitted to external services might not be fully in line with the internal policy, even if posting it is allowed (offensive content); Photos/documents may be hacked by third parties;   For example:   * Posting offensive comments; * Ownership / confidentiality / security of data; * Takedown policy from external providers (if the posted content is offensive, the service provider may take a while to take it down); |
| Outline 1 advantage and 1 disadvantage of wireless networks [4] | Advantage:   * Ease of use for mobile users; * As they can work in many different locations;   Disadvantage:   * Security issues; * As wireless transmissions are easily intercepted; |
| Outline 2 ethical issues concerning this use of internet (student using data from the internet for a science project) [4] | * The data/information is deliberately incorrect; * The data/information has not been validated; * Intellectual property issues; * Plagiarism; |
| Outline the purpose of protocols in transferring this data [2] | * Protocols are sets of rules for transmitting data correctly; * They ensure that data is sent from a customer’s computer and received by the shop’s computer; * To create a secure transmission of data from the client to the server through the use of the Hypertext Transfer Protocol (HTTPS) ie the customer can pay for the books securely (using TLS or SSL). |
| Identify 2 sources of risk to personal data in this online system [2] | * Data can be at risk whilst stored on the shop’s disk; * Data can be at risk during transmissions; |
| State 2 measures that the books shop can take to address the risks identified [2] | * All private information must be encrypted; * Transmission channel must be protected by encryption; * Logging on to the system must be secured (to prevent intruders); |
| Outline the consequences to the customer if their data is not adequately protected [2] | * Details stolen; * Used for fraudulent purposes; * Contact details could be shared; * Used for junk mail/fraud; * Personal details stolen; * For identity theft; |
| Outline what is meant by a computer network [2] | * A group of computers and other computing hardware devices that are linked together through communication channels/cables/wirelessly * To enable communication (share files, sharing information) between systems/among a wide range of users |
| Describe one problem resulting from low bandwidth in a computer network [2] | * Bandwidth indicates the maximum amount of data that can be transferred from one point to another in a unit of time * Low bandwidth means slow network performance/extended duration when transferring large amounts of data/loss of users’ time/ the whole area of users is not covered |
| Outline how a virtual private network will allow employees who are in Europe to communicate with the Head Office in Asia [2] | * VPN allows secure communicate with the Head Office in Asia * VPN is the company’s private network that uses a public network to connect to remote sites/employees/together * Privacy is protected using VPN tunneling * VPN uses encrypted connections routed through the Internet from the company’s private network to the remote site or employee * Hiding IP addresses to prevented unwanted exposure and data leaks * Data security is ensured by encryption – anyone intercepting the encrypted data cannot read it |
| Describe how data is transmitted by packet switching [4] | * Packet switching entails data being separated into specially formatted units (packets) * Each packet contains data and information such as packet number, address that identifies that sending computer and intended recipients * Packets are routed from source to destination using different network switches and routers * Using these addresses, network switches and routers determine how best to transfer the packet on the path to its destination * Packets are reassembled at the destination * If any packets are missing it should be retransmitted |
| Identify 1 hardware security measure that will ensure that confidential data from the Head office cannot be accessed [1] | * Retina scans * Locked doors * Alarms * Protection of equipment within the building |
| Identify 1 software security measure that will ensure that confidential data form the Head office cannot be accessed [1] | * Use of passwords * Different access rights * Encryption |
| Identify 1 network security measure [1] (context of using the internet for remote communications with employees) | * Encryption * UserID * Trusted MAC Addresses |
| Outline 2 advantages, to this company, of installing a WLAN [4] | * Use on the move; * More versatile staff encouraged to collaborate etc.; * Allows Bring Your Own Device: * Which could lead to greater productivity (as familiarity with device); * No extra equipment is needed for expansion after initial set-up; * Which will save the company time and money; * Reduces wiring; * Therefore improved safety for employees; |
| Discuss any 2 of these issues and ways in which the company might resolve them [4] (Context: WLAN introduce additional security issues) | * The data can be intercepted as it goes through "the air"; * Can be resolved by strong encryption/protocols; * WPA-2 / a description of WPA-2; * Use of trusted MAC addresses; * Regular changes of router password; * BYOD issues leading to insecure devices; * Clear company policy regarding use; * Use of sand-box; * Only approved devices allowed; * MAC addresses — only adding clean and tested devices brought in by staff; * Installation of MDM services; * Authentication (user ID + password on all devices including BYOD); |
| Explain how setting up a virtual private network (VPN) would provide a suitable solution [4] (Context: WLAN security issues) | * A VPN/ tunneling allows the employee's device to appear to be part of / a node of the internal company network; * Thus affording him/her full access to the network resources; * Data that passes through a VPN can be encrypted; * So any unauthorized access will not be able to understand the data; |
| Identify 2 characteristics of a Personal Area Network [2] | * Smallest type of network; * Consists of connected devices in close proximity to the individual using them; * Connected via Bluetooth/wireless; * Suitable example: smartphone to car connection; |
| Outline 1 reason why protocols are used in communications between computers [2] | * To provide a set of rules/procedures; * To enable two or more different electronic devices/computers/entities to understand each other during data transfer / enable successful communication; |
| Outline 1 advantage to the company by allowing employees to use their own device by adding wireless networking [2] | * May save money; * Due to not having to supply all the training computers; * May be able to increase the size of the training group; * Which may generate more income; * Trainees / teachers likely to be more familiar with software on own machine (and how new training software interacts with OS / user interface); * Making training sessions more efficient / allowing trainer to concentrate on the training rather than using generic applications; |
| Outline 1 disadvantage to the company by allowing employees to use their own device by adding wireless networking [2] | * May cause security issues; * Due to multiple users having network access from their "unsecured" devices; * May interfere with running of training sessions; * As some machines may not be compatible; |
| Describe 1 method of security that may be used on this wireless network [2] | * Encryption; * Scrambles the contents of the network transmissions so that if they are intercepted they can't be understood (without the decryption key); * User ID (and password); * Only allows authorized users to access the network; * Media Access Control (MAC) addresses; * Unique identification codes embedded in networkable equipment so that only authorized equipment may access the network; * Firewall; * Checks traffic coming into the network and leaving the network, and can block suspicious data; |
| Explain why speed of data transmission on the wireless network in the training room may vary [4] | * The speed of data transmission (on a wireless network) slows down; * The further the receiver is from the transmitter; * Passing through obstructions such as solid walls; * Can slow down transmissions (on a wireless network); * The bandwidth available for transmission on a wireless network is finite; * So, transmission speeds can be affected if the number of users on the network Increases; |

# Unit 4 – Computational thinking

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| Question (Marks) | Answer |
| Outline why a virtual machine is an example of abstraction that is particularly useful when testing software on different platforms [3] | * Virtual machines provide a software emulation/virtualization of other operating systems while hiding the execution environment/OS of the host machine. * Virtual machines are portable since they do not directly correspond to any real platform so software may be tested and executed on any platform * This is more practical than having to test software on several computers with different OS * The software to be tested in compiled into the language of the virtual machine and this is interpreted into the language of the host machine. |
| Identify 2 reasons why consistent grammar and syntax should be essential features of a higher-level programming language [2] | * Easy to learn/use; * Otherwise time may be wasted learning the new language/writing programs in this HLL; * There will be no/less compilation errors; * There will be no/less logical errors; * Future maintenance/development is possible by other programmers; |
| Identify 2 features of a user interface that will allow application programmers to interact more easily with the programming language [2] | * GUI * Toolbars * Menus * Built in commands for inputting from touch screens; * Predicted text so that typing a class name followed by a full stop will bring up a list of methods/attributes |
| Outline the need for an interpreter or a compiler [2] | * Must be translated from a higher-level language understandable by humans/not understood by machines; * Must be translated into machine code; * For the CPU to execute it |
| Describe 1 advantage to application programmers of having both an interpreter and a compiler available [2] | * Interpreter is faster/immediately warns about syntax errors/executes commands and they could use it instead of the compiler while coding and debugging their programs; * Compiler is required when there is a need to produce an executable version of a program; |
| Outline the need for predefined sub-programs and collections [2] | * Reusability; * And this reduces the cost/time needed to develop a large program; * Modularity; * Reliability / All predefined sub-programs are tested and reliable; |
| Construct in pseudocode, an algorithm to fill an N\*N 2-dimensional array, in a circular (spiral pattern), with numbers from 1 to N2 [9] | Basically keep 4 pointers left right top bottom, which indicate the outermost layer of the grid. |
| Outline the need for higher level programming languages [2] | [1] for improved productivity, [1] for machine independence   * High-level language provides statements (for example, high level if(.. .), while(...) etc) which are not dependent on the specific machine / and ability to create various data structures; Which saves the programmer's time; * Higher level languages are closer to human language; * Programmers find them easier to understand/work with than lower level languages; * HLL saves programmer from knowing details of computer architecture (and using all the specific (machine) instructions); * More time to creating/developing the best way of coding a problem/process of coding is simpler and more understandable; |
| Explain 2 benefits of using sub-procedures within a computer program [4] | [1] for identification [1] for expansion   * Problem could be divided into smaller/easier parts; * Which means solving easier/smaller parts of the problem for one programmer; * Or for a team of programmers, each programmer could work on different smaller parts; * Simpler testing; * Each part of the program could be separately tested; * By the programmer who created the code or someone else in the team of programmers; * Reusable code; * Sub-procedures already written/tested could be used in various programs; * Simpler maintenance and changes; * Could be done only on required sub-programs; |
| Identify 3 characteristics of a collection [3] | [1] for description of datastructure/implementation/object  [1] for description of algorithm/methods/functions  [1] for explanation that collections reduces programming effort/increases programming efficiency   * Collection is a container of discrete values; * Usually of the same type (primitive data values and also some other data structures); * Collection objects can be of different types (pointers afford a flexibility and thus collection objects permit references to any data structure as well as to primitive values); * Collections have a set of methods that define operations performed on the elements/objects of that collection; * Such as adding/removing elements to/from collection, comparing elements of collection, search; * Which reduces programming effort (because implementations of data structures and algorithms are provided); * Which increases performance of the program (because efficient implementations are provided); |
| Define the term recursion [1] | * Process/method/ procedure/ subroutine/ function/ algorithm that calls itself; |
| Define the term concurrent processing [1] | * Processes/task are carried out simultaneously/at the same time; |
| Without writing code, describe this recursive procedure [4] (Context: popping items off a stack into a binary tree) | * The (next) stack item is (placed into a new node and) compared (alphabetically) to the root; * If the root is empty it would be placed here (and this recursive procedure terminates); * Else, depending upon the comparison, it would look to the node to the left or right and the (recursive) procedure calls itself again (with the new root); * If it is lower than the root, then the left child of the root becomes the new root; * If it is higher than the root, then the right child of the root becomes the new root; |

# Unit 5 – Abstract Data Structures

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| Question (Marks) | Answer |
| Describe how a linked list is a suitable data structure for the given scenario [2] | * Size of a linked list is not fixed/predetermined (efficient use of memory); * Suitable because the number of objects/cars in the car park may vary greatly; * Efficient addition of elements to the linked list; * Suitable because cars arrive at the car park in any order; |
| By making use of binary trees and the collection LIKES, explain how a list could be produced that shows the restaurants in order of zone and then, within each zone, in order of popularity [3] | * Create three binary trees (one for each zone), by taking 4 elements at a time from LIKES; * The element "zone" identifies the tree and the other three elements make a new node in that tree; * Nodes are added depending on "likes" so that left child (accept the (subtree) root, less than right child; * Do an inorder traversal on the three trees to get three lists, then join them together; |
| Describe how a stack is usually employed in the running of a recursive algorithm [2] | * The current environment (eg values/local variables/current address/registers) PUSHED onto the stack when a new recursive call is met; * To be POPPED OFF the stack when the recursive subprogram is completed |
| Describe how the number of elements held in a circular list can be determined [4] | * Use a variable (counter) to keep track of/increment the number of nodes; * Use a temporary pointer; * Follow the pointers from the beginning of the list/from the node pointed to by pointer x. next; * Until the pointer to the end of the list (pointer X) is encountered; |
| Explain how a stack could be used to output in reverse order, all names held in the linked list [4] | * Initialize an empty stack; * Traverse the list from beginning to end; * Pushing each data value from the list onto the stack; * While stack is not empty; * Popping an element from the stack and output the stack element; |
| Compare the use of static and dynamic data structures [3] | * Static data structure has a predetermined number of elements but number of elements in dynamic data structure does not have to be defined in advance; * Static data structure has limited size, the amount of memory available is the only limit in size of dynamic data structure, size varies; * In static data structure elements can be directly accessed, in a dynamic data structure access is sequential (which is slower); |
| Explain the importance of the method isEmpty() when constructing an algorithm which performs operations on a stack data structure [3] | * Method is return True if there are no elements on the stack, False otherwise * It is important to call this method in logical expression/condition in algorithm constructs such as branches and loops * Before popping an element from the stack * To prevent errors/stack underflow/programs crash |
| Compare the use of a dynamically linked list for holding these names of vegetables with a static one-dimensional array [3] (Context: names of vegetables stored in alphabetical order. List too allow insertion/deletion) | * The size of the dynamic list does not have to be predetermined as in an array; * The size of the dynamic list is not fixed whilst the size of an array is always fixed; * If names are sorted they can be added/deleted (more easily) by changing the pointers without having to shuffle the names; * As records can be dynamically added/deleted the memory is better used because there are no wasted / missing spaces as in an array; |
| Sketch a single linked list holding these vegetables [2] | [1] for node containing data and pointer [1] for showing external pointer first, and null at last |
| List the steps required to insert an element into the linked list [4] | * Create a new node; * Traverse the list (from the beginning) to find the place to insert a new node; * The pointer in new node should be set to point to the node that is before the insertion point; * The pointer in node before insertion point should now point to the new node; |
| Explain why deleting the first node in this list is different to deleting other nodes [2] (Context: linked list) | [1] for identifying a reason why deleting the first node is different to deleting other nodes  [1] for an expansion up   * External pointer (First) must be changed/only in situation when deleting the beginning node, the external pointer must be changed; * And set to the pointer in the link field of the first node which points to the second node; |
| State the dynamic data structure suitable for maintaining this list of vegetables which will allow faster searching for a given vegetable name [1] (Context: vegetables stored in linked list sorted alphabetically) | * Binary tree |
| Sketch the data structure containing the vegetables names sorted in alphabetical order [3] (Context: binary tree) |  |
| Describe the characteristics of a queue [2] | * FIFO data structure; * Items can be added only to one end (rear/tail) and removed from the other end |
| Compare the use of a linked list with an array to store and process the family sales in a business [3] | [1] for size [1] for access [1] for relation to the given scenario (contextualise)   * Size/length of a static array is predetermined/fixed / size of a linked list can be changed / size of a linked list depends only on memory available; * Linked list can be expanded to suit the daily sales; * Each item in a static array can be directly accessed whilst access to the items in a linked list is sequential; * And searching for the given item in the linked list is slower Ian item in the linked list cannot be searched for using binary search; |
| Explain the benefits of using a binary search tree, compared to a stack, when searching for a specific item [3] | * The data in the binary search tree(BST) is ordered; * Such that as each node is checked for the item, half of the remaining nodes are ignored; * But each element in the stack has to be checked; * Which, for large data sets, may be inefficient compared to the BST; * Each element on the stack has to be popped off/removed from the stack to be checked for the searched item; * When the item is found the stack will be empty/stack contents will be changed; * When an element in the BST is checked for the item it is not removed from the BST; * So there is no need to create an additional copy of the BST (but a real copy of the stack must be created which for large data sets may be inefficient); |
| Outline why a binary tree would be a good choice of data structure for maintaining an address book [2] | * Time efficient searching / traversing for a contact in an address book; * Each iteration / comparison allows the size of the search to be reduced (by skipping about half of the remaining contacts); * Fast/easy addition / removal of contacts in an address book; * Quick search for the leaf node / empty node where a new contact can be placed / for the node containing the contact to be deleted; * Contacts can be listed / output in alphabetical order/ fast sorting; using inorder traversal; |
| Explain the difference between a dynamic and static data structure [3] | * Memory is allocated to the static data structure in compile time (a pre-set amount of memory/fixed size); * Memory is allocated to the dynamic data structure at run-time; * The size of a static data structure can never change during run-time whilst the size of dynamic data structure can be randomly updated during run time which makes efficient use of RAM; * Memory allocated to the static data structure is always available in order to be used by the data structure and elements can be accessed either directly or sequentially; * Whilst direct access to elements in the dynamic data structure is not allowed and elements should be accessed sequentially; * So in some/most cases algorithms which use dynamic data structures are slower (during execution) than algorithms with static data structures; |
| Identify 1 alternative data structure for storing class marks [1] | * Linked list * Collection (for example, ArrayList); * Binary tree; |
| Explain the steps to insert a name into a singly linked list. You may draw a labelled diagram in your answer [5] | * Create a new node with data field Jones and pointer field; * Start searching from the beginning of the list; * Find the location/position where the new node is to be inserted (Jones to be inserted after Davies); * Set the pointer in the new node (containing Jones) to the pointer in the node containing Davies (to point to the node containing Pugh); * Set the pointer in the node containing Davies to point to the new node (Jones); |

# Unit 6 – Resource Management

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| Question (Marks) | Answer |
| Explain two functions that an operating system needs to perform in relation to multitasking [4] | Memory management   * OS allows more than one program or process to share the memory * By allocating separate memory to each program   Processor management   * Allow the appearance of more than one program running at the same time * Through the allocation of time slices * It decides which process runs at a certain point in time * Arrange the execution of application so that the user believes that there are several things happening at once |
| Outline the role of the operating system specific to this scenario (greenhouse control system) [4] | * Operating system is a set of programs for this (dedicated) system; * Responsible for input devices (reading sensor data); * Responsible for sending to the output; * And reacting to inputted data in (predetermined) periods of time (to ensure the correct climate in the greenhouses); |
| Distinguish between the use of time slicing and priorities in scheduling of processes by an operating system [3] | * Prioritizing enables execution of the highest priority process until a higher priority task enters * The scheduler put processes in the right place in queue in order of priority (accept examples) * Time slicing allows processes to execute for a fixed time/each process is given a fixed period of time (time slice) for which the process is allowed to run * The scheduler is run once every time slice to choose the next process to run |
| Outline the function of an operating system in managing primary memory [2] | [1] for function of OS allocating memory blocks to individual program and [1] for reallocation   * A part of the OS (memory manager) assigns that block of memory to the program when a running program requests a block of memory; * When the program no longer needs the data in previously allocated memory blocks, they become available for reassignment; * OS ensures the availability of adequate memory for data structures/objects of each running program at all times; * By allocating the memory portions to programs after freeing the space (of the computer memory); * OS (memory management unit) uses virtual memory which provides secondary memory (external storage) for program that does not have enough space in RAM for execution; * After execution of the program this memory is reallocated (used by other programs)/freed; |
| Explain the importance of the memory management function of an operating system [2] | [1] for function of memory management [1] for example of use [1] for importance   * Allocates and de-allocates memory/ assigns blocks of memory to programs; * Ensures a program has sufficient memory to run/manages virtual memory if needed; * To avoid overwriting /clashing of programs/optimise system performance/maximise memory usage |
| Outline the purpose of 1 other peripheral device in this scenario [2] | * Keyboard; * To type in some additional data; * Or to type in barcode data when it is not possible to scan; * Magnetic card reader; * Used when a credit card is used; * Microphone; * To call the next customer; To call manager; * Monitor; * So the salesman can see the information/data on the screen; * Visual display; * So the customer can read the information/data on the display; * Speakers; * For customers to hear information; |
| Define the term peripheral [1] | * A peripheral is an external (computer) device that is connected to a computer such as a keyboard; * A piece of / a hardware device that is externally connected or attached / remotely connected or attached (to the computer system); |
| Identify 2 features of a graphical user interface (GUI) [2] | * Menus; * Dialogue boxes; * Windows; * Icons; Pointers; * Buttons; |
| Identify 2 types of general application software that would be installed on the training computers [2] | * Word processor; * Spreadsheet; * Database management system; * Email; * Web browser; |
| Identify 2 functions of an operating system [2] | * Managing memory; * Managing peripherals; * Processor management; * Scheduling; |
| Explain 1 benefit of using a dedicated operating system on the mobile phone instead of a generic operating system [3] | * dedicated operating system for a mobile phone will take up less storage space than a full-sized operating system; * This will allow the device to function more quickly; Because it doesn't contain features that aren't needed; * A dedicated operating system for a mobile phone can be customized; Benefits the end users; * As they deal with a familiar interface; * The dedicated OS is designed specifically for the mobile phone (hardware equipment); * This avoids compatibility issues; * While a generic operating system is designed for multiple types of hardware (which can lead to compatibility / various issues); |

# Unit 7 – Control Systems

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| Question (Marks) | Answer |
| Discuss one ethical consideration of using CCTV in a workplace [3] | 1 for rationale; 1 for misuse; 1 for prevention   * Right of the company to protect their premises/assets shall not invade the privacy rights of the employee * Precise guidelines must be set to prevent misuse of technology from the employer and ensure rights to the employee   Eg misuse   * CCTV might not be used for surveillance only but also to monitor employees * Threat to personal privacy through intimidation with consequences on quality of life * Prevention: * Problem of where the footage is stored, for how long, who has access, for what use should be addressed * Surveillance staff should not be employees or there could be internal conflicts of interest, ie. Employee backkkstabbbbb/ employee controlling another employee |
| Suggest how zones are calculated and displayed on the map using GPS based technology [4] | * The GPS receiver in the Smartphone picks up the signals from 3 satellites (at least 3); * The signals transmitted are: time of transmission, coordinates of the satellite; * The receiver knows when the signal was received; * Calculate positioning though equation resolution on a sphere; * Zones are displayed relative to the user's current position; * And the current scale of the map; * For each distance required, a circle is drawn (on the map) to define the zone, centered on the current GPS position; |
| Define the term analog data [1] | * Data represented by a continuous variable;   Not accepted: “not in digital format” or just examples |
| With reference to sensors, transducers, and the processor, explain the control process that takes place in the greenhouse [5] | 1 mark outlining the purpose of each device  2 for explaining the importance of feedback in this relationship   * Sensor: converts an inputted physical quantity (temperature, light, etc) into an electrical signal; * Processor: executes a set of instructions (programs) which control the whole process; * Transducer: converts electrical signals into other forms of energy (heat, light, etc); * Feedback: input signals (information about what is happening to a particular process in the greenhouses) is monitored; * And fed back to the processor where they can be used to make decisions whether to change/modify the climate in the greenhouses or not; |
| Describe the difference between polling and interrupt in the event that some of the sensors malfunction [3] | * Polling: * The CPU visits/checks each sensor in turn to see if there is some input data; * It will know that the sensor has malfunctioned; * Interrupt * Each sensor sends data as required; * It will not know that the sensor has malfunctioned (unless a timer is set with a limit on the time between expected interrupts by a given sensor); |
| Compare a centrally controlled system with a distributed system [2] | * One computer/processor controls all the greenhouses; * Whilst in distributed system each of the greenhouses is monitored and controlled by its own computer; |
| Explain the environment benefit of using a computer control system to monitor the pipeline [3] (Context: few thousand kilometer of sub-sea oil and gas pipeline monitored by control system to detect leaks) [3] | * In case of leaks (depending on severity of problem) which could cause pollution (any environmental problem); * Computer control system can react quickly/turn on and off appropriate devices immediately/many times in a short interval of time/(increased efficiency); * Computer control systems are very reliable (will not be tired / will not lose concentration); * Can continue to operate reliably 24 hours a day, 7 days a week, increased level of safety; * Control systems are reasonably cheap to run comparing to the cost involved in situations which can harm environment (and human health) (reduction of costs); |
| Explain the relationship between sensors, output transducers and processor in this situation [4] (Context: flow and pressure sensors for leak detection in pipes to send alarm and email message) | * Input from flow/pressure sensors is analog; * AD convertors are used to convert this analog data into digital form; * Processor performs / logical and arithmetical / operations; * The result of processing is in digital form so it should be converted (by AD convertors) into analog form; * This signal is sent to output transducers (a device that converts energy from one form to another) (for example, alarm sounds in the office); |
| Construct a system flowchart to represent the process described [5] Context: flow and pressure sensors for leak detection in pipes to send alarm and email message. Staff member can configure system) | [1] for sensor input  [1] for manual and configuration  [1] for data storage  [1] for monitoring process  [1] for error routines  or |
| Describe 2 hardware components that would be essential for part of the control system [4] (Context: automatic lights in a water fountain that would turn off/on at sunset/sunrise) | * Sensor; * To detect the presence/absence of the light; * Microprocessor; * To carry out any processing; * Output transducer / Actuator / Activator; * To turn the lights on or off; |
| Explain the concept of feedback, with respect to computer control systems in general [3] | * The output value is (continuously) compared to the desired value; * To produce an error value/difference between observed and measured; * The controller uses the error value/difference between observed and measured; * To determine the new input to the system; |
| Explain how sensors and microprocessors are used to ensure that the air conditioning system is able to maintain a constant temperature in the smart house [5] | * desired temperature is input/pre-set by the user; * Sensors detect temperature; * And regularly/continuously send (temperature) readings to the microprocessor; * The microprocessor compares the actual readings with the pre-set input temperature; * If the temperature is too hot/too cold the microprocessor sends signal to actuator; * To adjust temperature (no need for complex details regarding actions of a heating/cooling system); |
| Contrast the use of a distributed air conditioning system with a centralized air conditioning system for maintaining a constant temperature in a smart home [3] | * Centralized system allows control at a central point, which is then transmitted to the various rooms whilst distributed system allows individual control of settings at each unit / room so is more flexible. Centralized system will have same or constant temperature throughout the home whilst distributed system allows individual control of setting at each room; * Easier to control settings centrally whilst distributed system is more complicated to control remotely (due to limited / no connectivity of the control system); * Centralized system is more difficult to install due to the connectivity required between the various components whilst distributed system is easier to install due to fewer connection issues; * If a computer system / or any connection fails in the centralized system, the whole system is not able to function correctly whilst the distributed system as whole would still function correctly; * Centralized system is cheaper / has lower operational cost whilst distributed system is expensive as it requires additional hardware / software; * Centralized systems are difficult to expand whilst distributed systems are easily expandable because self-sufficient systems can be added or removed at any point in time without affecting the overall system; |

# Option – Database Management Systems

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| Question (Marks) | Answer |
| Outline, with respect to the primary key, how the referential integrity constraint is violated in the relation SUPPLY. [2] | * Primary Key must be unique * It cannot be repeated |
| Identify the steps to create a query to find the names of suppliers who supply perishable goods [4] | 1 for all relevant tables selected  1 for relevant field selected  1 for correct condition  1 for correct link between tables  SQL is not required; accept answers presented as an algorithm or a list of clear points that describe the action required.   * From the tables SUPPLIER JOIN/AND/UNION SUPPLY * Return the field SUPPLIER. Name Such that SUPPLIER.id=supply.supplierid and supply.nature=’p’ |
| Outline two measures that CrossCountryXL should take in order to be able to restore supplier data if it is lost [4] | * Log-based recovery; * It is important that the logs are written prior to actual modification and stored on a stable storage media, which is failsafe; * This is done by keeping the log file on stable storage media or when a transaction enters the system and starts execution, it writes a log about it; * Back up files of the current database; * Refer to them at any time to reconstitute the database; |
| Define the term schema [1] | The logical structure of the data |
| Outline the difference between data and information [2] | * Data means the raw facts that make information * Data is unprocessed values * Information is data that has value to the user/processed/put into context |
| With reference to this School Management System, distinguish between data and information [2] | * “50” is data; * “Attendance=50 days” is information; |
| Describe a problem that could arise due to concurrency in this scenario [2] | * The lost update problem; * This problem occurs (for example) when two operations by teachers, accessing the same items, have their operations interleaved in a way that makes the value of some items incorrect; * The temporary update problem; * This problem occurs when one transaction by a teacher updates a database item and then the transaction fails for some reason. Meanwhile the updated item is accessed by another transaction before it is changed back to its original value; * The incorrect summary problem; * If one transaction is calculating an aggregate of term grades/summary function on a number of database items while other transactions are updating these items, the aggregate function may calculate some values before they are updated and others after they are updated; |
| Explain which of the ACID properties of a database prevent concurrency problems [4] | * Isolation; * Prevents the modification of the same data item by two different transactions; * Consistency; * Resolves the temporary update problem |
| With a suitable example, outline rollback as a transaction operation in this School Management System [3] | * Rollback signals that the transaction has ended unsuccessfully; * For instance, the calculation of the grades (or any form of calculation in the school management system); * So that any changes that the transaction may have applied to the database must be undone; |
| Explain what is meant by durability, as a transaction property [2] | * Changes applied to that database by a committed transaction must persist in the database (like student attendance or term grade changes); * These changes must not be lost because of any failure; * This is the responsibility of the recovery subsystem of the DBMS; |
| Suggest 2 measures that the database administrator should take to prevent personnel from misusing the database systems [2] | * Granting access rights/password levels for some employees of the science research firm; * Removing access rights/password levels for some employees who (consistently) break rules; * Make the data read-only; * User accounts assigned appropriate security clearance level depending on roles; |
| State 1 implication to the science research firm’s research as a result of storing its data in a large central database [1] | * One single breach of security in a large sized database could cause the firm's research/clients to be leaked to a competitor;   Note: must state consequence for the mark |
| With specific reference to the data stored, outline 2 methods to ensure the privacy of the employee’s data in the research firm’s database [4] | * In table EMP DEPT remove EmpName or personal data from reports prepared for public distribution; * In EMP DEPT anonymize sensible individual data, such as masking some SSN characters; * When the company has to release reports that involve their employees;   Note: Do not accept encryption or restricted access — these do not apply to output. |
| Explain the difference between data matching and data mining [4] | Mining   * Use of patterns to identify trends; * To extract buried or previously unknown pieces of information from large databases;   Matching   * Comparing two sets of collected data; * To find errors in data; * It allows those holding large amounts of data to perform precise searches; |
| State 2 advantages of normalizing the database to 3rd normal form [2] | * Minimizes redundancy; * Minimizes insertion/deletion; * Remove transitive dependencies; * Among non-primary key attributes; |
| Identify 3 examples of data classification that could be used to investigate any patterns in the sales at a particular QuickCook restaurant [3] | * Customers who prefer a particular type of fast food; * The day of the week on which the maximum sales occur; * Age groups and preferences relation; * The typical combinations that sell well; * Price ranges that sell more; |
| Suggest how the time dependency of a data warehouse is useful when performing a database transaction | * The timestamp specifies the time and date of an operation; * Data can be accessed in the warehouse by any date and time order or grouping; |
| State 3 ways to ensure the quality of data as part of the clean-up procedure [3] | * Making identifiers unique; * Convert null values into standardized "Not Available/Not Provided" value; * Convert phone numbers/ZlP codes to a standardized form; * Validate address fields, convert them into proper naming, eg Street/St/St./Str; |
| State 4 differences between database views and data warehouses [4] | * Data warehouses exist as persistent storage, while a view is on demand; * Data warehouses are not relational, while a view is relational; * Data warehouses can be indexed to optimize performance, while a view cannot be indexed independent of the database; * Data warehouses provide specific support of functionalities, while a view cannot; * Data warehouses provide large amounts of integrated and temporal data; |
| State 2 precautionary measures QuickCook should take before and after loading data into the data warehouse [2] | * Disable any constraints and indexes before the load; * And enable them back only after the load completes; * The referential integrity needs to be maintained by ETL tools to ensure consistency as a lack of it can create incomplete data that might result in erroneous results after the loading process; |
| Suggest 2 features of object-oriented programming systems that can be used in a relational database environment [2] | * Polymorphism * Inheritance * Encapsulation |
| Explain 1 advantage and 1 disadvantage of using object-oriented database systems [4] | Advantages:   * Less Maintenance; * If processes within the system are encapsulated, their "behaviours" can be reused and incorporated into new ones; * More code reusability; * When a new object is created, it will automatically inherit the data attributes and characteristics of the class from which it was taken. The new object will inherit the data and behaviours from all superclasses in which it participates; * Larger variety of data types; * Unlike traditional databases (such as hierarchical, network or relational), object-oriented databases capable of storing different types of data, for example, text, numbers, pictures, voice video etc; * No impedance mismatch; * A single language interface between the Data Manipulation Language (DML) and the programming language overcomes the impedance mismatch. Most OODBMSs provide DML that is computationally sufficient and adequate compared to SQL, which is the standard language of RDBMSs;   Disadvantages:   * No support on views; * OODBMSs do not provide a "view" mechanism, which provides many advantages such as data independence, security, reduced complexity, and customization; * No support for security; * OODBMSs are not adequate on security issues; * Users cannot grant access rights on individual objects or classes; * No universal data model; * No universally agreed upon data model for an OODBMS; * This disadvantage is seen as a major drawback, and is comparable to pre-relational systems. |
| Explain the role of data validation [2] | * Data validation is checking to see if the data entered is sensible; * So that it can be processed correctly / maintains the integrity of the data; It makes sure that the data entered is in the appropriate range and/or type to avoid obtaining incorrect results; * It is performed by the computer which detects if data entered is not in the * range/of the type which is defined (by the person who set up the database); |
| Identify the steps in a query that could be constructed to produce a list of the names of courses with a duration between 40 and 80 hours [3] | 1 mark for identification of relevant field  1 mark for identification of relevant table  1 mark for correct condition  Accept any logically equivalent answers   * SELECT COURSENAME * FROM COURSETABLE * WHERE DURATION > 40 AND DURATION < 80 |
| Describe 1 function that is required to be performed on databases, other than the query function [2] | 1 for stating function  1 for short description   * Updating; * Adding/deleting/modifying entities; * Inserting; * Adding new records/entities to the table; * Deleting; * Removing entities which are not in use anymore; * Modifying; * Changing information in the table for more recent information; |
| Outline the characteristics of the 3 levels of the schema [6] | * Conceptual; * Describes the data required in the application / preliminary design with basic information, eg tables; * Logical; * Describes how the relationships will be represented in the database (using the attributes/keys/data structures); * Physical; * Describes how the data will be stored on the physical medium; |
| Explain 2 responsibilities of a database administrator [4] | 1 for responsibility, 1 for elaboration   * Installation * Monitoring * Backup/recovery * The DBA is responsible for updating/upgrading the database; * This means that new data/new relations/new attributes could be added; Some data/relations/attributes could be deleted/modified; * Another responsibility of the DBA is security; * The DBA gives/assigns access levels to users; |
| Explain, with an example, how the database administrator would use a data definition language [3] | 1 for any example of a DDL command term   * DDL is used by the database administrator during It is a subset of database query language; set up/upgrading/removal phase of database project; * With commands/statements which refer to database elements/only available to the database administrator; * It is used to create, alter and destroy a database and its contents; |
| Identify 4 consequences of poor data modelling in the design of the database [4] | * Some data objects required by the database might not be completely and accurately represented/might be missing; * May not be detailed enough to be used by the database developer for building the physical database; * It could create a database that omits data required for various reports; * It could produce results that are incorrect or inconsistent; * It may be unable/difficult to make changes; * Redundant data may be created/present; * Poor modelling may result in the wrong data type being assigned to a field and this would affect queries/searches; |
| Outline what is meant by data redundancy [2] | * Some data in a database can be found in two or more different locations / several copies of the same data; * Which takes up unnecessary space; * Data that is stored could be calculated from other data items; * Unused data; |
| Outline what is meant by referential integrity of data [2] | * A property that ensures relations between tables remain consistent/are not broken; * The rows/entities in relation must be uniquely identified; * Links must be correct / every foreign key must have the actual value of a key in another relation |
| Describe 2 ways that a database management system can be used to promote data security [4] | * Access rights; * Passwords and PIN numbers limit the access to private information to authorized users only * Audit trails; * Records of who accessed what data and what changes are made * Data locking; * Validation; * Encryption; * Backups; |
| Describe 2 characteristics of an object-oriented database [4] | * Transparent persistence; * In OODB an application can manipulate both persistent data (stored on a permanent storage device) and transient data (data manipulated by transaction); * Object identity; * Every object can be uniquely identified and is independent of its value (two equal objects actually point to same data structure in memory); * Modularity; * Complex objects can be built up from smaller ones; * Encapsulation; * Data and functionality hiding; * Inheritance (extensibility); * Supports class/type hierarchies; * Supports object-oriented features such as overriding and overloading; * Concurrency control; * A hierarchy of objects may be locked; |
| Explain concurrency in data using a database [2] | 1 for the idea that more than one person could be reading the data at the same time  1 for the idea that only one person could edit the data   * Concurrency is the ability of a database to allow multiple users/multiple transactions at the same time; * When one user is changing data but has not yet saved that data, and as long as the user performing this change has not saved the data, only he should be able to view the data he is changing; * Database should not allow other users who query the same data to view the changed unsaved data, other users should only view the original data; It is possible because changed (but unsaved) data is held in some sort of temporary file, once it is saved, it is then written to the database's physical storage in place of the original data; |
| Identify 4 operations that are used in the transformation process that integrates and normalizes data from multiple sources [4] | * Selecting (only certain) data; * Automated data cleansing — for example, date of birth stored in format dd/mm/yyyy in source database, but data warehouse stores in format yy/mm/dd; * Merging, joining data from multiple sources; * Applying data validation; * Deriving some new data (calculating, comparing); * Sorting; * Aggregation; |
| Compare classification and cluster analysis for the purpose of uncovering patterns regarding the heath of people using data mining techniques [4] | 1 for definition of classification  1 for definition of cluster analysis  1 for a health care example of each function   * Classification (is a data mining function which) assigns items in a collection to target categories/classes, and the goal is to accurately predict the target class of each case in data; * A classification model could be used in a medical database with relevant patient information recorded previously (such as age, heart rate, blood pressure) to identify whether or not the patient had a heart problem; * Cluster analysis as a data mining function that performs analysis of abstract objects grouped into classes of similar/dissimilar objects / finds clusters or groups of objects based on their similarity/dissimilarity; * Cluster analysis could be used in a medical data warehouse to categorize patients with chronic diseases in a population and to gain insight into the distribution of chronic diseases in a population/track diagnoses and drug prescriptions, etc. |
| Suggest how deviation detection techniques could be used to increase the health care organization’s knowledge about the population [2] | * Knowledge could be expanded by obtaining information about the group with the strangest behaviour/anomaly pattern detected; * Use of deviation detection techniques helps in detecting signals and detecting them earlier allowing time to take appropriate measures; * Deviation detection techniques could identify an increasing number of diarrhoea cases among children in the southern part of the city; * Measures could be taken to prevent causes of diarrhoea such as parasites, infections, food poisoning, etc; |
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