一、選擇題（單選）28題，每題2.5分，共70分，請在每題的選項內選擇最適當的答案。
注意：答錯倒扣1分，扣至零分為止。(不答不倒扣)
※ 注意：請用 2B 鉛筆作答於答案卡，並先詳閱答案卡上之「畫記說明」。

1. [ ] Which of the following is wrong about the PCs you can buy nowadays? (A) floppy disc drive is typically not equipped (B) hard disc is typically in the range of 500GB-4TB (C) CPU clock ranges in 2-4 MHz (D) RAM is typically in the range of 4-16GB (E) all the above are correct (choose this one only if none of the above can be chosen).
2. [ ] Which of the following is wrong about file extension? (A) **.py** is a Python file (B) **.bin** is a Binary disc image (C) **.iso** is an ISO disc image (D) **.tar** is a UNIX-based archive file (E) all the above are correct (choose this one only if none of the above can be chosen).
3. [ ] Which of the following is not a file format for storing images? (A) JPEG (B) PNG (C) BMP (D) TIFF (E) all the above are image file format (choose this one only if none of the above can be chosen).
4. [ ] Which of the following storage is non-volatile? (A) ROM (B) RAM (C) DDR RAM (D) SDRAM (E) all the above are non-volatile (choose this one only if none of the above can be chosen).
5. [ ] Which of the following is wrong about CPUs? (A) CPU fetches instructions directly from RAM (B) an instruction may take several clock cycles to execute (C) ALU is the electronic circuitry that executes all arithmetic and logical operations (D) inside CPU, registers are temporary storage areas for instructions or data (E) all the above are correct (choose this one only if none of the above can be chosen).
6. [ ] Which of the following is wrong? (A) screen resolution is measured in "dpi" (B) printer resolution is measured in "dpi" (C) Full HD refers to a resolution of 1920x1080 pixels (D) Ultra HD refers to a screen resolution of 3840x2160 pixels (E) all the above are correct (choose this one only if none of the above can be chosen).
7. [ ] Which of the following device allows the communication between dissimilar networks? (A) bridge (B) gateway (C) switch (D) hub (E) router.
8. [ ] Which of the following extends a private network across a public network and enables users to send and receive data across shared or public networks as if their computing devices were directly connected to the private network? (A) Broadband Global Area Network (B) virtual private network (VPN) (C) Extranet (D) Intranet (E) none of the above.
9. [ ] Compared to 4G technology standard for broadband cellular networks, which of the following is not a major advantage of 5G? (A) higher data speeds (B) higher latency (C) massive network capacity (D) increased availability (E) lower network energy usage.
10. [ ] Which of the following is a general-purpose, developmental, modeling language in the field of software engineering that is intended to provide a standard way to visualize the design of a system? (A) Smalltalk (B) Object-oriented programming (C) JavaScript (D) UML (E) Perl.
11. [ ] Which of the following is wrong? (A) assembly code is used to directly control a computer's CPU (B) pseudocode is a plain language description of the steps in an algorithm (C) an interpreter is a computer program that directly executes instructions written in a programming language (D) a scripting language is used to write a series of commands that are interpreted one by one at runtime (E) all of the above are correct (choose this one only if none of the above can be chosen).
12. [ ] Which of the following is wrong? (A) imperative programming is a programming paradigm that uses statements that change a program's state (B) functional programming is a

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programming paradigm where programs are constructed by applying and composing functions (C) C++ belongs to imperative programming paradigm (D) Python belongs to imperative programming paradigm (E) all the above are correct (choose this one only if none of the above can be chosen).

13. [ ] In programming languages, a(n) _____ refers to a collection of rules that assign a property to various constructs in a computer program, such as variables, expressions, functions or modules, with the end goal of reducing the number of bugs by verifying that data is represented properly throughout a program. (A) variable system (B) type system (C) formal system (D) logical model (E) inference system.

14. [ ] _____ is a basic and commonly used type of predictive analysis that attempts to model the relationship between one dependent variable and a series of other variables by fitting a linear equation to observed data. (A) trend estimation (B) normal equations (C) linear regression (D) decision tree (E) multivariate normal distribution.

15. [ ] In confusion matrix, let *TP* be the number of true positives, *FP* be the number of false positive, *FN* be the number of false negative, and *TN* be the number of true negative. Then, precision refers to (A) $\frac{TP}{(TP+FP)}$ (B) $\frac{TN}{(TP+FP)}$ (C) $\frac{TP}{(TP+FN)}$ (D) $\frac{TN}{(TN+FN)}$ (E) $\frac{TP}{(TN+FN)}$

16. [ ] Continuous from the above question. Accuracy refers to (A) $\frac{TP+TN}{(TP+FP+TN+FN)}$ (B) $\frac{TN+FP}{(TP+FP+TN+FN)}$ (C) $\frac{TP+FN}{(TP+FP+TN+FN)}$ (D) $\frac{TN+FN}{(TP+FP+TN+FN)}$ (E) $\frac{TP+FP}{(TP+FP+TN+FN)}$

17. [ ] The primary purpose of a digital certificate is to prove the ownership of a _____ (A) public key (B) private key (C) secret key (D) security level (E) signature.

18. [ ] Which of the following is wrong about HTTP cookies? (A) they are stored at server side (B) they can be used to record last session established (C) they can be used to remember pieces of information that users previously entered in a form (D) they can be used to authenticate users (E) all of the above are correct (choose this one only if none of the above can be chosen).

19. [ ] The key to a content delivery network is to geographically distribute many _____ so that data can be accessed close to users. (A) load balance servers (B) proxy servers (C) routing servers (D) database servers (E) file servers.

20. [ ] _____ refers to a method of breaking into a password-protected computer or server by systematically entering every word in a dictionary as a password. (A) exhaustive attack (B) brute-force attack (C) dictionary attack (D) alphabet attack (E) verbose attack.

21. [ ] In information security, the 'C' in the "CIA triad" refers to (A) Consistency (B) Certification (C) Confidence (D) Confidentiality (E) Constancy.

22. [ ] Which of the following functions is often used in a data structure that implements an associative array that maps keys to values? (A) bin (B) point spread (C) hash (D) deconvolution (E) filter.

23. [ ] Compared to file systems, which of the following is not an advantage of database? (A) separation of data definition and the problem (B) efficient access (C) data integrity (D) reduce redundancy (E) all the above are advantage.

24. [ ] The logical structure of a database is referred to as (A) schema (B) data dictionary (C) template (D) data layout (E) data relation.

25. [ ] In the context of transaction processing, the acronym ACID refers to the four key properties for a database management system to have a valid transaction mechanism even in the event of failures. In the acronym, 'A' refers to (A) anonymity (B) availability (C) asynchrony (D) atomicity (E) none of the above.

26. [ ] Which of the following is the primary purpose of mining in blockchain-based

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cryptocurrency? (A) mint coins (B) store transactions (C) compress transactions (D) validate transactions (E) encrypt transactions.

27. [ ] In clouding computing, the service model of Microsoft Azure is best characterized as a (A) Infrastructure as a service (IaaS) (B) Platform as a service (PaaS) (C) Software as a Service (SaaS) (D) Everything as a Service (E) Data as a Service.

28. [ ] If a company uses both its computer infrastructure and Amazon's AWS to deliver services, then this type of cloud deployment model belongs to (A) Diverse Cloud (B) Community Cloud (C) Public Cloud (D) Hybrid Cloud (E) Distributed Cloud.

二、問答題，共 30 分。

※ 本大題((a)、(b) 2 小題)請於試卷內之「非選擇題作答區」標明題號依序作答。

The following C++ code fragment shows the class definition of an array-based implementation of ADT Binary Tree that stores a list of person names.

```
const int MAX_NODES = 100;

class TreeNode
{
public:
  ...
private:
  ...
  string name;              // node data – person name
  int leftchild_index;      // index to left child, -1 if no left child
  int rightchild_index;     // index to right child, -1 if no right child
  friend class BinaryTree;
};

class BinaryTree
{
public:
  ...
  void removeAllLeaf();
protected:
  void recurRemoveLeaf(int parent_id, int node_id, int left_or_right);
  // parent_id: parent node id
  // node_id: visited node id
  // left_or_right: 0 if node_id is the left child of parent_id; 1 otherwise.
private:
  ...
  TreeNode tree[MAX_NODES]; // array of tree nodes
  int root_index;           // index of root, -1 if the tree is empty
  int free_index;           // index to the first free node
                            // free nodes are chained by rightchild_index
};
```

(a) (10 points) Show the tree structure given the following data content.

```
root_index: 0
free_index: 6
tree:
```

	name	leftchild_index	rightchild_index
0	Jane	1	3
1	Bob	-1	4
2	Tom	-1	-1
3	Alan	-1	5
4	Ellen	2	-1
5	Nancy	-1	-1
6	?	-1	7
7	?	-1	8
8	?	-1	9
...	...	...	...

(b) (20 points) Write the `BinaryTree::removeAllLeaf()` that removes **ALL leaf nodes** from a binary tree. Note that you also **need to** implement the protected function `BinaryTree::recurRemoveLeaf()` called by `removeAllLeaf()` that **recursively** traverses the tree to delete all the leaf nodes.

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