

一、選擇題（單選）24 題，每題 2.5 分，共 60 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」，否則不予以計分。

Suppose we wish to build a campus database containing tables of records about student profiles, courses registered, and grades. The following are some example fields and data in the database:

Student\_ID, Student\_Name, Student\_Address, Course\_ID, Course\_Name, Instructor\_ID, Instructor\_Name, Classroom, Course\_Schedule (e.g., Wed. 9~12AM), Grade ...

A good database design practice is to avoid too much data overlapping between tables. Answer the following two questions related to this.

- Which of the following design is better (although not the best) than the others?
  - A single table containing all fields of data needed for the database.
  - Two tables, one contains students' profiles (Student\_ID, Student\_Name, Student\_Address), while the other contains all the other fields.
  - Three tables, the 1<sup>st</sup> table contains students' profiles (Student\_ID, Student\_Name, Student\_Address), the 2<sup>nd</sup> table contains Student\_ID and the courses (Course\_ID, Course\_Name) they registered, the instructors (Instructor\_ID, Instructor\_Name), and grades, and the 3<sup>rd</sup> table contains the classroom information (Course\_Name, Classroom, Course\_Schedule).
  - A table for students' profiles (Student\_ID, Student\_Name, Student\_Address), a table for each course containing the registered students' names and their grades (i.e., Student\_ID, Course\_ID, GRADE), a table of instructors containing the faculty ID of each instructor, his name, and the courses s/he teaches (Instructor\_ID, Instructor\_Name, Course\_ID), a table of classrooms containing the classrooms, the courses and time of the courses at each classroom (Classroom, Course\_ID, Course\_Schedule).
  - A table containing (Student\_ID, Student\_Name), a table containing (Student\_Name, Student\_Address), a table for each course containing the registered students' names and their grades (Student\_Name, Grade), a table for each instructor containing his ID, name and the courses s/he teaches (Instructor\_ID, Instructor\_Name, Course), a table for each classroom containing the courses and time of the courses using the classroom (Classroom, Course\_Name, Course\_Schedule).
- Suppose we wish to have a table for each course containing the grade of each registered student. Which of the following design is better than the others? (A) The table contains just two fields: Student\_Name, Grade. (B) The table contains just two fields: Student\_ID, Grade. (C) The table contains three fields: Student\_ID, Student\_Name, Grade. (D) The table contains three fields: Student\_Name, Instructor\_ID, Grade. (E) The table contains four fields: Student\_ID, Student\_Name, Instructor\_ID, Grade.
- Which of the following SQL command selects all the records in the "Customers" table whose "Country" field is "Taiwan" and "City" field is either "Taipei" or "Kaohsiung"?
  - SELECT \* FROM Customers WHERE Country='Taiwan' AND (City='Taipei' OR City='Kaohsiung');
  - SELECT ALL FROM Customers WITH Country='Taiwan' AND (City='Taipei' OR City='Kaohsiung');
  - SELECT \* FROM Customers WHERE Country='Taiwan', City='Taipei' OR 'Kaohsiung';
  - SELECT ALL FROM Customers AND Country='Taiwan' AND (City='Taipei' OR City='Kaohsiung')
  - none of the above.
- Which of the following about relational databases is wrong? (A) the model organizes data into one or more tables of columns and rows (B) a row in a table corresponds to a record of data (C) a primary key uniquely identifies each record in a table (D) a foreign key in one table corresponds to a primary key in another table (E) all of the above are correct (choose this only if none of the above can be chosen).
- Which of the following about database normalization is wrong? (A) the process reduces data redundancy (B) the process improve data integrity (C) the 1<sup>st</sup> normal form ensures that each row in a table should be identified by primary key and no rows of data should have repeating group of column values (D) if a table satisfies 2<sup>nd</sup> normal form, then it must satisfy 1<sup>st</sup> normal form as well (E) all of the above are correct (choose this only if

- none of the above can be chosen).
6. New applications, processes, products, or business models that aim at providing financial services by making use of software and modern technology: (A) Bank 3.0 (B) Bank 4.0 (C) Fintech (D) Digital Finance (E) Financial Revolution.
  7. Which of the following techniques plays a key role in AlphaGo that beat a 9-dan professional Go player in March 2016? (A) biomedical informatics (B) genetic algorithm (C) deep learning (D) expert system (E) cognitive learning.
  8. Which of the following is not widely regarded as a characteristic of big data? (A) high volume (B) high velocity (C) high variety (D) potentially high value (E) all of the above are characteristics of big data.
  9. A technique for transferring multimedia so that media data can be constantly received by and presented to an end-user while being delivered by a provider: (A) multimedia authoring (B) streaming (C) live broadcasting (D) multicasting (E) real time media.
  10. Which of the following best describes economic and social inequality with regard to access to, use of, or impact of information and communication technologies (ICT)? (A) information asymmetry (B) information inequality (C) digital divide (D) knowledge gap (E) digital right.
  11. Which of the following is wrong? (A) In an odd parity system the total number of bit '1' in a word, including the added parity bit, is always an odd number (B) If the word (including parity bit) is 0110 1011 1, then in an odd parity system we can absolutely be sure that the word has an error inside (C) if the word (including parity bit) is 0110 1001 0, then in an even parity system we can absolutely be sure that the word has no error inside (D) parity bit is used to detect errors (E) all of the above are correct (choose this only if none of the above can be chosen).
  12. When cache is full, some elements need to be removed to empty space for new elements. Which of the following strategies in general has better performance than the others? (A) remove the element which has been used the least number of times during its stay in the cache (B) remove the element which has been used the most number of times during its stay in the cache (C) remove the element which has not been used the longest time since it enters the cache (D) remove the element which stays in the cache the longest time (E) replace the element which stays in the cache the shortest time.
  13. A type of firmware used to perform hardware initialization during the booting process of a computer: (A) BIOS (B) CMOS (C) ROM (D) kernel (E) DOS.
  14. An implementation of virtual memory usually divides a virtual address space into blocks of contiguous virtual memory addresses, referred to as \_\_\_\_\_, so that they can be swapped between real memory and external storage. (A) segments (B) pages (C) sectors (D) zones (E) none of the above.
  15. Which of the following is not a primary concern of using RAID (redundant array of independent disks)? (A) improve fault tolerance (B) improve system performance (C) improve data security (D) increase storage capacity (E) all of the above are correct (choose this one only if none of the above can be chosen).
  16. Which of the following best describes Kickstarter.com? (A) a P2P lending site (B) a crowdsourcing site (C) a crowdfunding site (D) a microfunding site (E) a C2C e-commerce site.
  17. Which of the following terms is commonly used to describe sites like Udacity, Coursera, and edX? (A) self-paced online courses (B) massive open online courses (C) major online open courses (D) self-learning open online courses (E) flipped open online courses.
  18. Which of the following descriptions about Ethernet is wrong? (A) it is commonly used in local area networks (LANs) (B) it uses random backoff to resolve collisions (C) it is a bus based broadcast network (D) 10BASE-T and 100BASE-TX are commonly used cables for Ethernet networks (E) all of the above are correct (choose this only if none of the above can be chosen).
  19. Which of the following about TCP/UDP port assignments is wrong? (A) HTTP uses port 80 (B) File Transfer Protocol (FTP) control uses port 21 (C) port numbers range from 0 to 65536 (D) port numbers 0~2048 are reserved for privileged services and designated as well-known ports (E) all of the above are correct (choose this only if none of the above can be chosen).
  20. Which of the following about the Open Systems Interconnection (OSI) reference model is wrong? (A) Layer 3 is Network Layer (B) Layer 5 is Session Layer (C) SMTP belongs to Layer 7 (D) TCP belongs to Layer 4 (E) all of the above are correct (choose this only if none of the above can be chosen).
  21. Which of the following about object-oriented programming is wrong? (A) Java is an object-oriented programming language (B) C++ is an object-oriented programming language (C) code reuse is achieved

- mainly via polymorphism (D) the concept of “data encapsulation” is used to hide data from misuse (E) all of the above are correct (choose this only if none of the above can be chosen).
22. Which of the following about operating systems is wrong? (A) OS X is used in Apple’s desktops/laptops (B) Android is a mobile operating system based on the Linux kernel (C) Unix family are open source (D) currently Microsoft Windows dominates desktop operating systems (E) all of the above are correct (choose this only if none of the above can be chosen).
23. Which of the following about system development tools is wrong? (A) a class diagram is a visual representation of a project schedule such as the project status and the length of an activity and the time spent on completing a task. (B) a decision tree is a graph that uses a branching method to illustrate every possible outcome of a decision (C) an entity-relationship diagram (ERD) is a graphical representation of an information system that shows the relationship between people, objects, places, concepts or events within that system (D) a flowchart is a type of diagram that represents an algorithm, workflow or process, showing the steps as boxes of various kinds, and their order by connecting them with arrows (E) All of the above are correct (choose this only if none of the above can be chosen).
24. Which of the following technology descriptions is wrong? (A) 悠遊卡 (Easy Card) uses NFC technology (B) RFID can be used in supply chain management to track products (C) animal tracking chips typically use RFID (D) currently our ETC (Electronic Toll Collection (Taiwan)) uses LTE technology to track cars (E) All of the above are correct (choose this only if none of the above can be chosen).

二、問答題 2 題，每題 20 分，共 40 分。  
請在答案卷內依序作答，否則不予以計分。

1. When implementing the operations for a binary search tree, the notion of “inorder successor” (alternatively, inorder predecessor) is very useful.
- (a) Define the notion and explain why it is needed using examples.
- (b) Implement an algorithm in C, C++, or Java (choose one programming language) for finding the inorder successor of a given node. The more efficient your implementation is, the more points you will be credited.
2. Balanced search trees, such as AVL, 2-3, and red-black trees, are very efficient data structures for storing and searching key values.
- (a) Insert the key values 1, 2, 5, 7, 6, 4, and 3 (in this order) into an empty AVL (or 2-3 or red-black) tree. Please show the resulting tree after the insertion of each key value.
- (b) Prove that the height of an AVL (or 2-3 or red-black) tree storing  $n$  key values is  $O(\log n)$ .

Note again that you only need to complete the above tasks for one of the three kinds (AVL, 2-3, and red-black) of balanced search trees.

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