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| 考 試 科 目 | 計算機概論 | 系 所 別 | 資訊管理學系/資管組 | 考 試 時 間 | 2 月 7 日(五) 第二節 |
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I. Multiple Choice (48%, 4 points for each)

1. _____ is the data communication method used by clients and servers to exchange data on the Internet; whereas _____ is designed for the exchange of data on the Web.

- a) HTTPS, UML
- b) HTTPS, XML
- c) URL, UML
- d) URL, XML

2. _____ can be used to prevent database inconsistency

- a) Two-step rollback
- b) Two-phase commit
- c) Two-phase rollback
- d) Two-phase transaction

3. _____ is the technique for controlling access to the resources in a multitasking OS.

- a) Semaphore
- b) Interrupt
- c) Dispatcher
- d) Reboot

4. _____ would not be contained in an OS's process table

- a) The priority of the process
- b) The status of the process
- c) Memory address
- d) Machine code

5. The simplest RAID storage design writes data on different drives at the same time is _____.

- a) duplicating
- b) mirroring
- c) partitioning
- d) striping

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註

一、作答於試題上者，不予計分。
二、試題請隨卷繳交。

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|---------|-------|-------|------------|---------|----------------|

6. In a RAID design, _____ can split data, instructions, and information across multiple drives in the array.
- a) duplicating
 - b) mirroring
 - c) partitioning
 - d) striping
7. Which of the following statement(s) is true?
- a. Firmware consists of ROM or memory chips that store permanent instructions, such as start-up instructions
 - b. Ethernet is in the data link layer, which transfers data between the network nodes
 - c. ASCII can map characters to numeric values that allow a machine to process
 - d. TCP/IP is in the presentation layer, which is responsible for delivering information to the application layer
- a) abc
 - b) abd
 - c) bcd
 - d) abcd
8. Which of the following statement(s) is true?
- a. Stack is based on last-in-first-out principle; whereas Queue is based on first-in-first-out principle.
 - b. In a queue: offer() is used to add an item, and remove() is used to retrieve an item.
 - c. In a stack: push() is used to add an element to the collection, and pop() is used to remove the most recently added element.
 - d. The peek() method can be implemented to view the first element in both the Queue and Stack structures.
- a) abc
 - b) abd
 - c) bcd
 - d) abcd

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|---------|-------|-------|------------|---------|----------------|

9. Which of the following statement(s) is true about sorting?

- a. Merge sort always outperform than selection sort.
- b. Selection sort and heap sort can have similar time complexity in the worst case scenario.
- c. Both quick sort and merge sort use the divide and conquer algorithm
- d. The heapsort algorithm first turns the data into a max heap

- a) abc
- b) acd
- c) bcd
- d) abcd

10. Which of the following is NOT true about digital security?

- a) passphrase is a sequence or combination of words, which often contains mixed capitalization and characters
- b) biometrics device authenticates a person's identity by translating his/her physiological or behavioral characteristics into an analog code
- c) symmetric key encryption allows the originator and recipient to use the same secret key to encrypt and decrypt data
- d) a user account enables a user to sign in to a network or computer, which defines who can access resources and when they can access the resources.

11. Which of the following is NOT true about digital storages?

- a) non-volatile NAND flash memory is often used in a solid-state drive
- b) a computer can have both a solid-state drive and a hard disk
- c) defragmentation can optimize the performance in both a solid-state drive and a hard disk
- d) a solid-state drive has quicker access times and runs quieter than a hard disk

12. Which of the following is NOT true about computing components?

- a) a machine cycle includes fetch, decode, execute, and store operations
- b) cache level-1 is built into the processor chip, whereas cache level-2 is separate from the chip and on the motherboard.
- c) a processor contains a control unit, interpreting and executing instructions in memory, and an arithmetic logic unit, performing calculations on the data in memory
- d) registers are at the top of the memory hierarchy, which provide the fastest way to access instructions



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|---------|-------|-------|------------|---------|------------------|

II. Answer the following questions (52%)

1. What sequence of values will be printed in the following instructions (3%)

```
i = 4
while (i < 7):
    print(i)
    i = i + 2
print(i)
while (i > 2):
    print(i)
    i = i - 2
```

2. Given the following Java code:

```
public class StackExample implements StackGroup
{
    int[] StackEntry = new int[10];
    int StackCnt = 0;

    public void push(int NewStackEntry)
    {
        if (StackCnt < 10)
            StackEntry[StackCnt++] = NewStackEntry;
    }
}
```

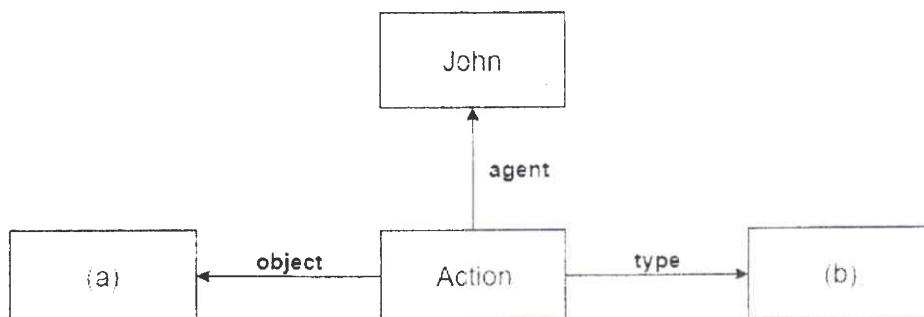
After executing the following statements:

```
StackGroup Stack1, Stack2;
Stack1.push(1);
Stack2.push(5);
Stack2.push(9);
```

- (a) What would be the value of StackEntry[0] associated with Stack1 after executing the above statements (3%)
- (b) What would be the value of StackEntry[0] associated with Stack2 after executing the above statements (3%)
- (c) What would be the value of StackEntry[1] associated with Stack2 after executing the above statements (3%)

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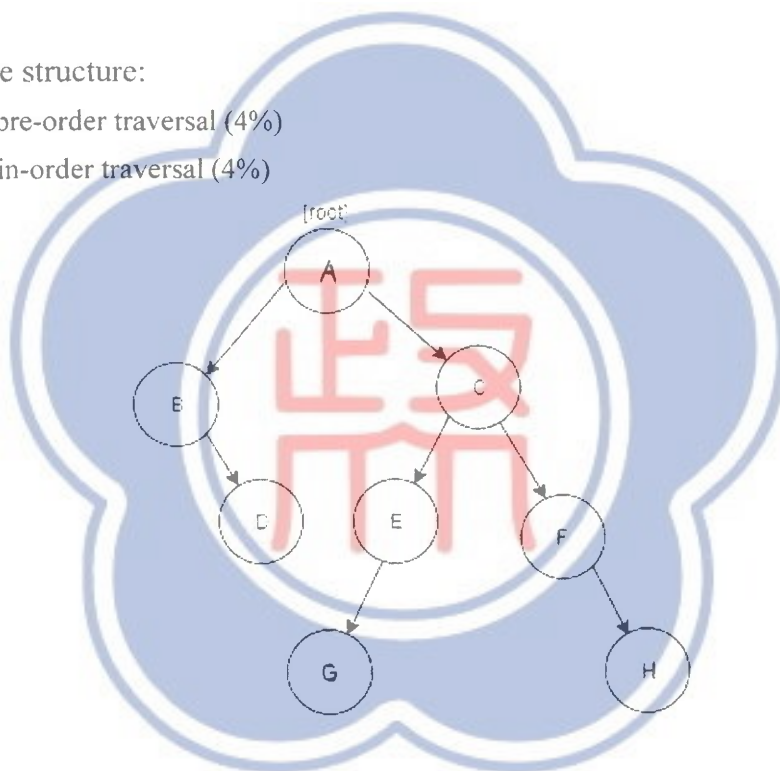
3. Given the semantic net below, fill in (a) and (b) to reflect the meaning of the sentence "John plays volleyball." (6%, 3 points for each).



4. Given the following tree structure:

(a) what is the output in pre-order traversal (4%)

(b) what is the output in in-order traversal (4%)



5. Given an array containing these input digits: 35794814

(a) Perform a *merge* sort and explain the processes (4%)

(b) Perform an *insertion* sort and explain the processes (4%)

6. What are the differences between the SQL and NoSQL databases, regarding to the:

(a) definition (4%)

(b) scalability (4%)

(c) structure (4%)

(d) best used for (i.e., when to use SQL instead of NoSQL, and vice versa) (6%)

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|---------|--------|-------|------------|---------|----------------|

Short Essay Questions:

1. Please describe the function of risk assessment and explain how it is conducted for information systems (20%).
2. What are the main strategic business objectives of information systems? How can firm create strategic business value from big data analytics? (20%).
3. Currently, QR Codes and Near Field Communication (NFC) systems both show increasing promise for mobile payment services. For example, the former systems enable users to access the information stored in a two-dimensional bar code, while the latter systems allow two devices to connect and share information in close proximity of each other. Nevertheless, they respectively have their own concerns regarding information security. Can you list and describe such concerns? (20%)
4. Autonomous vehicles have the potential to increase traffic efficiency and reduce traffic accidents. However, it is very difficult for autonomous vehicles to make moral decisions. For example, is it always acceptable for a self-driving car to avoid a scooter by swerving into a wall, considering that the probability of survival is greater for the rider of the scooter than for the passenger of the car? In your opinion, how can information systems help autonomous vehicles address such situations? (20%)
5. Blockchain technology uses distributed and open ledgers to provide a trust mechanism and intelligent data management, if desired without central control. Blockchain technology is thus generally expected to revolutionize information authentication and sharing. On the other hand, there are reports of blockchain security breaches, excessive energy consumption, and inadequate usability. Can you identify and describe any theories that support the proposition that the benefits of blockchain may (or may not) justify firm investment? (20%)

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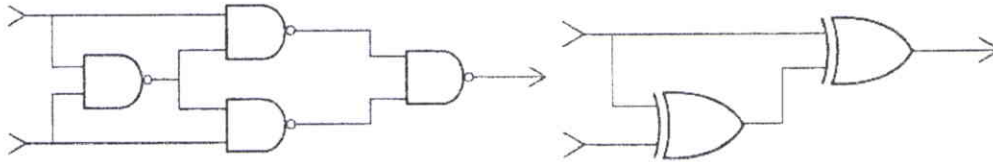
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- 二、試題請隨卷繳交。

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|---------|-------|-------|----------------------|---------|----------------|

一、是非題（共 10 題，佔 20 分，答對每題 2 分，請使用 Y 或 O 表示正確；N 或 X 表示錯誤。）

1. 當輸入皆為 1 時，以下兩組邏輯閘的輸出皆為 1。



2. 在 IEEE 802.11b 的環境中，若只有一台主機以及一台 AP，傳遞 Full HD 24-bit 的未壓縮 30 fps 串流影片會是順暢的。
3. ICMP 封包的 IP header 中，其 protocol field 為 0x01；而 TCP 封包為 0x06，UDP 封包為 0x11。這三者為常見的 network layer protocols。
4. 在現代的作業系統核心 (kernel) 與 CPU 中，MMU (memory management unit) 是利用 page tables 實現虛擬記憶體的 memory map 功能。這個功能可以節省 physical memory 的使用。
5. $(P \text{ OR } Q)$ 與 $(\text{not } P)$ 兩式可邏輯推導至 $(\text{not } Q)$ 。
6. 若將 Tower of Hanoi 遊戲的最少移動次數表示為 $H(n)$ ， n 表示遊戲共有 n 個 disks。其 $H(1) = 1, H(2) = 3, H(3) = 7, H(n) = 2^n - 1$ 。而使用單純的 recursion 計算 Fibonacci 數 $F(n) = F(n-1) + F(n-2)$ 時，其時間複雜度也是 $O(2^n)$ 。
7. 在軟體工程中的白箱測試 (white-box testing) 中，進行 code coverage 測試時，測試工程師需要設計 test cases 將所有的 statement 都至少執行過一次。而黑箱測試 (black-box testing) 則因為無法取得 source code，所以在測試時不需要 programming knowledge。
8. 根據以下 Customers 資料表，執行 SQL 語法 `SELECT COUNT(ID), Country FROM Customers GROUP BY Country;` 後，共會產生 4 筆資料。執行 `SELECT COUNT(ID), Country FROM Customers;` 後，共會產生 5 筆資料。

| ID | CustomerName | City | PostalCode | Country |
|----|--------------------------|-------------|------------|---------|
| 1 | Alfreds Futterkiste | Berlin | 12209 | Germany |
| 2 | Ana Trujillo Emparedados | México D.F. | 05021 | Mexico |
| 3 | Antonio Moreno Taquería | México D.F. | 05023 | Mexico |
| 4 | Around the Horn | London | WA1 1DP | UK |
| 5 | Berglunds snabbköp | Luleå | S-958 22 | Sweden |

9. 在類神經網路演算法中，使用 L2-norm loss function (least squares error, LSE) 的主要目的是該函式是可微分的 (differentiable)，求其解較容易。而使用 L2 regularization 其主要目的是避免 overfitting。以上兩者無法同時使用。
10. K-Nearest Neighbor 是一種 supervised classification 演算法；k-means 是一種 unsupervised clustering 演算法。兩者的 k 值皆可由人工設定。

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|---------|-------|-------|----------------------|---------|----------------|

二、選擇題（共 5 題，佔 20 分，每題 4 分，請選出所有的正確選項）

1. 下列資訊安全原理之敘述，何者正確？

- (A) 甲方使用非對稱式加密演算法傳送資料至乙方，若要確保資料只能由乙方解讀，應使用甲方之公鑰加密資訊。
- (B) 甲方使用非對稱式加密演算法傳送資料至乙方，若要確保資料確實來自甲方，應使用甲方之密鑰加密資訊。
- (C) 甲方使用非對稱式加密演算法傳送資料至乙方，若要確保資料內容正確未被竄改，應使用甲方之密鑰加密資訊。
- (D) 甲乙兩方若要確保不產生中間人攻擊 (man-in-the-middle attack)，加密資訊前兩方應使用公開金鑰基礎建設 (Public Key Infrastructure, PKI) 取得一次性的對稱式加密金鑰。但 PKI 需要憑證頒發機構 (Certificate Authority, CA) 的支援。

2. 下列資料庫正規化 (normalization) 之敘述，何者正確？

- (A) 正規化的程度越高，資料的重複性會降低
- (B) 正規化的程度越高，資料存取效能亦會越高
- (C) 正規化的程度越高，資料表格的數量亦會增多
- (D) 正規化程序可避免更新異常

3. 下列作業系統之敘述，何者正確？

- (A) 虛擬機器 (virtual machine) 和容器 (container) 的不同在於目前容器內外的作業系統必須是相同的，而虛擬機器內外的作業系統架構 (architecture) 可以不同。
- (B) 若一個 Linux 檔案的存取權限為 655，則此檔案擁有者之外的使用者可以執行該檔案。
- (C) 作業系統的分頁大小 (page size) 越大，page fault 的機率就越大。
- (D) 一組 parent 與 child process 會在 fork 時共享記憶體分頁 (page)，一旦分頁內容被其中一個 process 修改，在 CoW 的情況下，另一個 process 也會因為共享分頁而同步被修改。

4. 下列網際網路之敘述，何者正確？

- (A) 連線 HTTP 與 SMTP 之前，可能需要 DNS server 幫忙解析 domain name。
- (B) P2P 檔案傳輸服務的瓶頸在於檔案持有者的上傳頻寬、下載者的最小頻寬、上傳頻寬的總和
- (C) Web proxy 可以減輕對外頻寬的負擔；local DNS server 可以減輕 root DNS server 的負擔。
- (D) 一個 TCP 的 socket 是以 src IP、dst IP、src port、dst port 四個值定義。

5. 下列無線網路技術之敘述，何者正確？

- (A) CSMA/CD 機制可以偵測 collision，CSMA/CA 機制可以避免 collision。
- (B) Hidden Terminal Problem 只會出現在無線網路的環境，且 RTS/CTS 可以完全避免此問題。
- (C) 802.11 frame 的 MAC address 在每一個 Layer 2 的 hop 之後，都會更換。
- (D) IP datagram 的 IP address 在每一個 Layer 3 的 hop 之後，都會更換。

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|---------|-------|-------|----------------------|---------|----------------|

三、問答題（共 7 大題，佔 60 分，每題配分標於題目後）

- 試說明 NAT (network address translation) 運作之原理與 NAT table 建立與使用之步驟。(8 分)
- 假定下方左資料表名為 scores，請寫出一個或複合多個 SQL 語法產生其右方之資料表，其內容為 scores 資料表之排名 (Rank)。請注意同分之 entries 應有相同的 Rank 值，並且下一個 Rank 值應為接續之數字，不應跳過。注意：可使用標準 COUNT, DISTINCT, VIEW、ORDER BY、GROUP BY 語法，勿使用個別 SQL server 特殊之 rank 或 dense_rank 語法。本題分階段給分。(8 分)

| Id | Score | Score | Rank |
|----|-------|-------|------|
| 1 | 3.50 | 4.00 | 1 |
| 2 | 3.65 | 4.00 | 1 |
| 3 | 4.00 | 3.85 | 2 |
| 4 | 3.85 | 3.65 | 3 |
| 5 | 4.00 | 3.65 | 3 |
| 6 | 3.65 | 3.50 | 4 |

- 試說明在機器學習領域中，何謂「模型 (model)」？以及如何評估模型的有效性？(8 分)
- 試說明何謂「生成對抗網路 (Generative Adversarial Network, GAN)」以及「潛在空間 (latent space)」於 GAN 中的用途？請多以專業術語答題。(8 分)
- 試說明雲端運算的三個服務模型：IaaS、PaaS、SaaS。(8 分)
- strstr() 是各種程式語言中常見的字串函式，其定義是回傳某子字串 (sub-string) 出現於另一字串第一次出現之位置 (位置 index 從 0 開始計數)。請使用任意語言實作該函式。該函式應接收兩個字串變數 s 與 t 作為參數。該函式回傳一整數，表示 s 子字串在 t 字串之中第一次出現的位置。若 s 為空字串，則回傳 0。若 s 不為 t 的子字串，則回傳 -1。注意：若實作之答案包含其他內建字串函式，則不予計分。(8 分)
- (a) 請寫一個 pseudocode function，而該函式可判別 (return True or False) 一個輸入的正整數 n 是否為 2 的次方數，例如：1, 2, 4, 16, 32, 64, ...。(4 分) (b) 請再實作 a 小題，但請勿使用任何廣義的 loop 或 recursion，並請附上註解說明之。(8 分)

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|---------|------|-------|------------|---------|------------------|

Answer the following questions:

1. Find the longest common subsequence of X and Y, where

X = BAACBBSCHAA

Y = ABABCSCAH

1.1 (6%) Let $L[i, j]$ denote the longest common subsequence of $X[0..i]$ and $Y[0..j]$. ($X[0..-1]$ and $Y[0..-1]$ denote an empty string.). Show the equivalence relation on $L[i, j]$ with $L[i-1, j-1]$, $L[i-1, j]$ and $L[i, j-1]$ and the base cases.

1.2 (10%) Describe a dynamic programming algorithm with the above equivalence relation to find the longest common subsequence between two strings $X[0..m]$ and $Y[0..n]$.

1.3 (10%) Run the algorithm on the above X and Y and show the complete table on $L[i, j]$ ($-1 \leq i \leq 10$, $-1 \leq j \leq 8$) to derive the value of $L[10, 8]$.

2. AVL Binary Search Trees:

2.1 (10%) Build an AVL binary search tree by inserting the following keys. (Hint: rebalance tri-nodes when the difference of heights of sub trees is larger than 1)

5, 6, 12, 7, 11, 35, 28, 16, 13, 29, 20, 2, 58, 18, 22, 42.

2.2 (5%) From 2.1, show the tree after removing the key 22

2.3 (5%) From 2.2, show the tree after removing the key 35

3. Hash Tables:

Consider a hash table storing the following keys:

98, 77, 19, 29, 41, 82, 12, 108, 53, 25, 54, 42.

Let $N=17$. $h(k) = k \bmod 17$.

3.1 (8%) Show the hash table that handles collision with separate chaining.

3.2 (8%) Show the hash table that handles collision with linear probing.

3.2 (8%) Show the hash table that handles collision with double hashing. (Let $d(k) = 11 - k \bmod 11$.)

4. Graph Constructions:

Tom plans to travel around Taiwan. Below is the cost between two places (undirected).

Taipei, Kaoshiung, 850

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| <p>Taipei, Taidong, 750 Taipei, Hualian, 500 Hualian, Taidong, 350 Hualian, GreenIsland, 1650 Taidong, Kaoshiung, 450 Taidong, GreenIsland, 800 Kaoshiung, Kenting, 400 Taidong, Kenting, 550 Taipei, Taichung, 400 Taichung, Nanto, 200 Nanto, Hualian, 700</p> <p>4.1 (10%) Draw an edge-list structure to represent the graph. A node carries the name and an edge carries the edge.</p> <p>4.2 (10%) Define a DFS algorithm to traverse all the nodes. Run the algorithm starting from “Taipei” and show the nodes and edges that are visited.</p> <p>4.3 (10%) Define a BFS algorithm to traverse all the nodes. Run the algorithm starting from “Kaoshiung” and show the nodes and edges that are visited.</p> | | | | | |