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 5 日(五) 第 二 節

I. Multiple Choice (40%, 4 points for each)

1. In an operating system, multiprogramming without swapping is called ____; whereas multiprogramming with swapping is called _____.
   a. partitioning, paging
   b. partitioning, segmenting
   c. queuing, paging
   d. queuing, segmenting

2. An operating system can place resource restrictions on processes to prevent ____; however, too many resource restrictions can cause ____.
   a. thrash, segmentation
   b. segmentation, thrash
   c. starvation, deadlock
   d. deadlock, starvation

3. _____ is a unary operator, and _____ is a binary operator.
   a. Intersection, difference
   b. Intersection, update
   c. Project, difference
   d. Project, update

4. A(n) _____ backup copies the files that have changed since the last full backup.
   a. striping
   b. mirroring
   c. incremental
   d. differential

5. Which of the following is NOT true about the NoSQL database:
   a. Does not require a fixed schema
   b. Horizontally scalable
   c. Non-relational database management system
   d. Best suited for complex queries

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5日(五) 第二節

6. ____ memory is able to provide related information
   a. Associative
   b. Assistive
   c. Horizontal
   d. Vertical

7. ____ stores the information that most readily available for the CPU operation.
   a. Random-access memory
   b. Read-only memory
   c. Cache
   d. Register

8. Which of the following feature is not included in the OOP?
   a. Abbreviation
   b. Encapsulation
   c. Inheritance
   d. Polymorphism

9. Which of the following diagram is not included in the UML?
   a. Behavior diagram
   b. Essential diagram
   c. Structure diagram
   d. Interaction diagram

10. When analyzing customers' transactional data, ____ helps you to examine products that have an affinity for each other.
    a. Accumulated analysis
    b. Accustomed analysis
    c. Association analysis
    d. Asynchronous analysis

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 5 日(五) 第 二 節

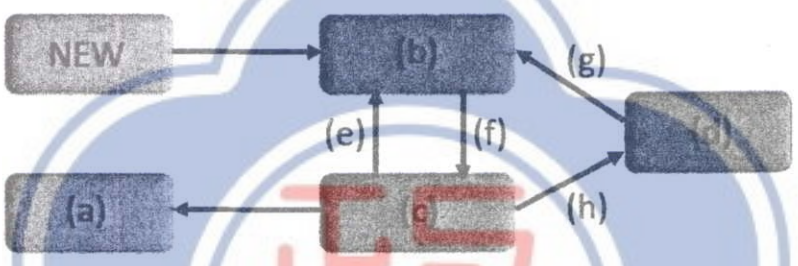
II. Answer the following questions (60%)

1. Calculate the big-O notation for taking an array of N random numbers and inserting them into an empty priority queue (4%)

2. The node sequence KSGJVOLTN is the result of inorder traversal, draw the tree (4%)

3. The node sequence DLZSHFCOE is the result of postorder traversal, draw the tree (4%)

4. Fill in the blanks of the OS process state diagram and briefly explain each component (24%, 3 points for each)



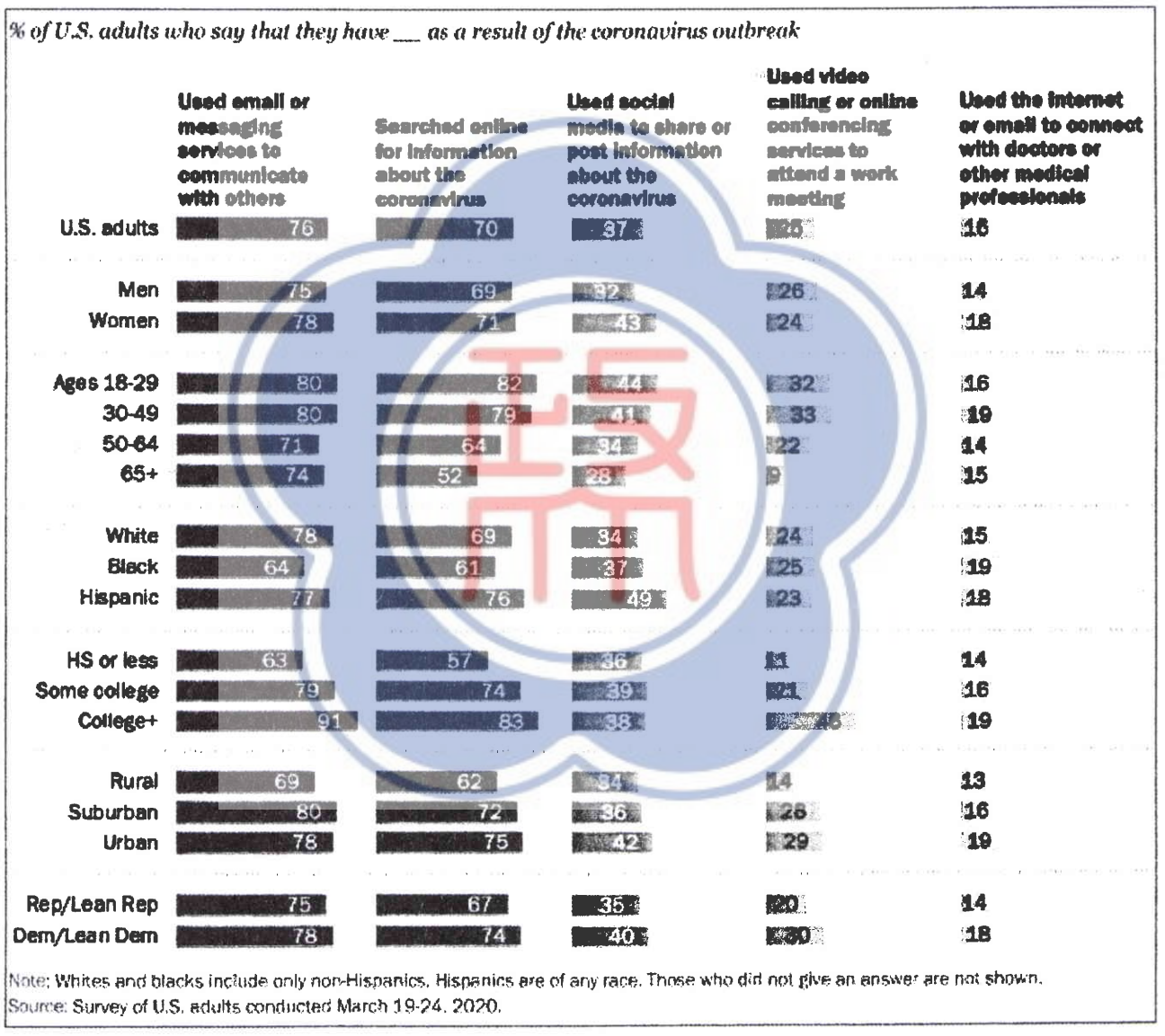
5. Compare the differences between CNN and RNN (24%, 6 points for each)
   a) Definitions
   b) Type of data
   c) Length of input
   d) Applications

備 註	一、作答於試題上者，不予計分。 二、試題請隨卷繳交。

考 試 科 目	管理資訊系統	系 所 別	資訊管理系/資管組	考 試 時 間	2 月 5 日(五) 第 4 節

Short Essay Questions

1. The COVID-19 outbreak has led many countries to issue stay-at-home orders. The Pew Research Center has investigated how Americans are using the Internet to stay connected and track information during the outbreak. The figure below shows part of the survey conducted in March 2020. Please identify and explain the key findings from the information below. (20%)



Source: Pew Research Center

考試科目	管理資訊系統	系所別	資訊管理系/資管組	考試時間	2月 5日(五) 第 4 節

2. Digital technologies have unleashed a new era of smart, connected products, which combine hardware, software, data, sensors, and connectivity in myriad ways. The Apple Watch NikePlus is one of such products. Please illustrate how the Apple Watch NikePlus operates to link a variety of devices, networks, data, and services together. (10%) Take Nike, please describe how this product has influenced the company's competitive forces and competitive advantage. (10%)

3. Sharing economy is highlighted by Time Magazine as one of the 10 ideas that will change the world. Firms and entrepreneurs are having great interests in placing assessment of the sharing economy applications and forming new business models. What exactly is sharing economy? Please explain your answer, and provide one case exemplar. (10%) How does this exemplar manage to map the economics, social, and technological attributes in its sharing economy application? (10%)

4. Sundar Pichai, Google's boss, has described the developments in Artificial Intelligence (AI) as "more profound than fire or electricity". However, it has been found that AI's progress has lagged in many companies. For example, the self-driving lorry firm Starsky Robotics based in San Francisco, closed down in March 2020. Its founder, Stefan Seltz-Axmacher, stated that the driverless cars show the limits of today's AI. To effectively develop AI-based driverless cars, what people, organization, and technology issues need to be addressed? (15%) Considering the driverless cars, what trends do you see pushing or hindering innovation in AI technologies? (5%)

5. Fake news has long been a problem, but it becomes increasingly critical when it spreads on social media. Can you identify what do consuming news on social media differ from other media providing news (e.g. TV news, newspapers, and news websites)? Please describe three main characteristics of social media fake news. (15%) Which one of these three do you think is the most critical? Why? (5%) (To add depth to your answer, please provide cases or events.)

備註	一、作答於試題上者，不予計分。 二、試題請隨卷繳交。

國立政治大學 110 學年度碩士暨碩士在職專班招生考試試題

考試科目	計算機概論	系所別	資訊管理學系／科技組 (4162)	考試時間	2 月 5 日(五) 第二節

一、是非題（共 10 題，佔 30 分，答對每題 3 分，**請使用 O 表示正確；X 表示錯誤**。）

1. 以下是一組基於 Hamming distance 所設計的 error-correcting code，於 unreliable data transfer channel 收到 010100 的 bit pattern 時，其修正後值為 D。

Symbol	Code
A	000000
B	001111
C	010011
D	011100
E	100110
F	101001
G	110101
H	111010

2. IEEE 802.11ax (Wi-Fi 6) 的理論最高速率為 9.6 Gbps，若在只有一台手機以及 AP 的單純網路環境下，傳遞 8K (7680 * 4320) 解析度、真彩 (24-bit) 未壓縮的 120 fps 串流影片會是順暢的。
3. 在分時多工 (time-sharing, multitasking) 的作業系統中，多個 processes 可以輪流在 CPU 上執行。在切換不同 process 時，需要進行 context switch，流程通常是由主機板上的 timer circuit 觸發一個 CPU interrupt，然後由 kernel 的 handler 進行切換。
4. 比特幣使用 P2P 網路來傳遞交易訊息，當有越多 P2P 使用者參與比特幣網路時，該網路的安全性就越低。
5. 考慮經典的 Dijkstra's Algorithm 中，若有 V 個節點以及 E 個邊，完成計算最短路徑其 worst-case 時間複雜度是 O(|V|+|E|)，因為最糟的情況是演算法需要遍歷所有的節點，而每一次遍歷節點時都需要再遍歷所有的邊。
6. 在程式語言中，pass by reference 會比 pass by value 較有效率，尤其在該參數是表示一個較大的資料塊時。但 pass by reference 的缺陷是對資料的安全性較無保護。
7. 傳統的軟體開發生命週期為 requirement analysis, design, implementation, testing。若開發方要求所有的 requirement specification 文件必須要在 design 階段之前完成，那麼此類型的開發方法稱之為 waterfall model。
8. 根據 T1, T2 資料表，執行 SQL 語法 SELECT * FROM T1 RIGHT JOIN T2 ON T1.ID=T2.ID; 以及 SELECT * FROM T2 LEFT JOIN T1 ON T1.ID=T2.ID; 若不論欄與列的排列順序，這兩者查詢出來的資料是一樣的。
9. CNN (convolutional neural network) 在進行運算時，會考慮局部區域的資料 pattern。RNN (recurrent neural network) 在進行運算時，會考慮連續區域的資料 pattern。
10. 在類神經網路演算法中，使用 dropout layer 的理由是避免 overfitting。使用整流線性單位激發函數 (ReLU, Rectified Linear Unit) activation function 是為了模擬線性的輸入輸出關係。

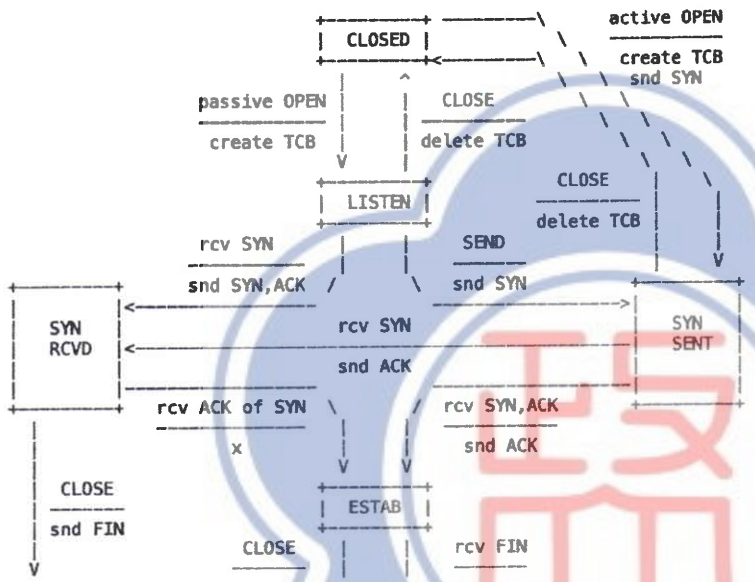
國立政治大學 110 學年度碩士暨碩士在職專班招生考試試題

考 試 科 目	計算機概論	系 所 別	資訊管理學系／科技組 (4162)	考 試 時 間	2 月 5 日(五) 第二節

二、問答題（共 8 大題，佔 70 分，每題配分標於題目後）

1. 蘋果公司於 2020 年 11 月發表基於 ARM 架構的 M1 SoC 晶片，有別於一般 PC 採用的 Intel x86-64 架構，請試說明分屬 RISC 與 CISC 兩類型 CPU 有何設計理念上的差別？並說明各自優劣（8 分）

2. 下圖為 RFC 793 部分的 finite state machine。 (a) 當 client 位於 SYN_SENT 狀態時，若收到 server 回傳 SYN 事件，請問該 client 應當如何處置？ (b) 當 server 位於 SYN_RCVD 狀態時，若無收到任何來自於 client 訊息而導致 timer timeout，請問該 server 應當如何處置？（8 分）



3. 試說明在機器學習領域中，何謂「損失函數 (loss function)」以及其意涵為何？並說明 MSE (Mean Square Error) 以及 Cross Entropy 的概念與適用時機？請多以專業術語答題。（12 分）

4. 下圖為區域網路中的一個封包，試說明其用處以及應如何回應該封包。（8 分）

```
› Frame 27: 42 bytes on wire (336 bits), 42 bytes captured (336 bits) on interface en0, id 0
⌄ Ethernet II, Src: Google_6e:ad:d5 (20:df:b9:6e:ad:d5), Dst: Broadcast (ff:ff:ff:ff:ff:ff)
  › Destination: Broadcast (ff:ff:ff:ff:ff:ff)
  › Source: Google_6e:ad:d5 (20:df:b9:6e:ad:d5)
    Type: ARP (0x0806)
⌄ Address Resolution Protocol (request)
    Hardware type: Ethernet (1)
    Protocol type: IPv4 (0x0800)
    Hardware size: 6
    Protocol size: 4
    Opcode: request (1)
    Sender MAC address: Google_6e:ad:d5 (20:df:b9:6e:ad:d5)
    Sender IP address: 192.168.1.113
    Target MAC address: 00:00:00_00:00:00 (00:00:00:00:00:00)
    Target IP address: 192.168.1.106
```

考試科目	計算機概論	系所別	資訊管理學系／科技組 (4162)	考試時間	2 月 5 日(五) 第二節

5. 試說明何謂推薦系統中的「冷啟動 (Cold Start)」問題、「探索-利用困境 (Exploration-Exploitation Dilemma)」以及「稀疏性 (Sparsity)」問題？請分別提出在人工智慧系統中，如何解決這三個問題。請多以專業術語答題。(12 分)

6. 下圖為區域網路中的一個封包，試說明其用處以及應如何回應該封包。(4 分)

```
› Frame 27: 42 bytes on wire (336 bits), 42 bytes captured (336 bits) on interface en0, id 0
˅ Ethernet II, Src: Google_6e:ad:d5 (20:df:b9:6e:ad:d5), Dst: Broadcast (ff:ff:ff:ff:ff:ff)
  › Destination: Broadcast (ff:ff:ff:ff:ff:ff)
  › Source: Google_6e:ad:d5 (20:df:b9:6e:ad:d5)
    Type: ARP (0x0806)
˅ Address Resolution Protocol (request)
    Hardware type: Ethernet (1)
    Protocol type: IPv4 (0x0800)
    Hardware size: 6
    Protocol size: 4
    Opcode: request (1)
    Sender MAC address: Google_6e:ad:d5 (20:df:b9:6e:ad:d5)
    Sender IP address: 192.168.1.113
    Target MAC address: 00:00:00_00:00:00 (00:00:00:00:00:00)
    Target IP address: 192.168.1.106
```

7. 函式 SHA256(int)為一雜湊函式 (Hash Function)，此函式可接受任意大小之正整數為參數，其函式輸出值域範圍為 $[0, 2^{256}-1]$。今有一已知的任意大小之正整數定值 X，且有另一正整數值 c (c 的儲存空間為 4-byte 長)。(9 分)
   (a) 試求出 SHA256(X) = 0 之機率。
   (b) 試求出 SHA256(X) < T 之機率。$0 <= T <= 2^{256}-1$。
   (c) 試問平均要嘗試幾次不同的 c 值，可使 SHA256(X+c) < T。令 $T = 2^{218}$。

8. 請寫 pseudocode 來解決以下問題。若給定一個陣列 arr，內含若干個非負整數，你必須以下列規則輸出排序後的陣列。排列規則為將該陣列內的整數改以二進位方式表示，陣列排列以該數字之二進位含有多少個 1 來遞增排列。若兩數字具有共同數量的 1，則以 10 進位大小遞增排列。
   例如，輸入 arr = [0,1,2,3,4,5,6,7,8]，則輸出[0,1,2,4,8,3,5,6,7]，因為 0 的二進制表示方式中沒有任何 1，而 1, 2, 4, 8 的二進制表示方式皆含有 1 個 1，而 7 的二進制表示方式含有 3 個 1。(9 分)

備註	一、作答於試題上者，不予計分。 二、試題請隨卷繳交。

國立政治大學 110 學年度碩士班暨碩士在職專班招生考試試題

考試科目	資料結構	系所別	資訊管理學系/科技組	考試時間	2 月 5 日(五) 第四節

I. （45%）Consider the following keys: 2, 4, 26, 25, 13, 14, 51, 9, 17, 43, 68

1. (15%) Insert the keys into a min heap one by one. Reconstruct the heap when it violates the heap order (for all node v, v.key > v.parent.key). Show each step and the final result.
2. (15%) Insert the keys into a hash table that handles collision with double hashing. Let N=17. h(k) = k mod 17. d(k) = 13-k mod 13. Show each step and the final result.
3. (15%) Insert the keys into an AVL tree one by one. Reconstruct the AVL tree when it violates the AVL property (for all node v, | v.leftsubtree.height - v.rightsubtree.height | <=1). Show each step and the final result.

II. (25%)To sort the above keys in I, describe a sorting algorithm

1. (10%) that uses the heap constructed in I.1
2. (15%) that uses the AVL tree constructed in I.3

III. (30%) Describe an algorithm to evaluate the expression 13 + 5 - 6 * 3 < 4 - 6 + 9 / 3

1. (15%) that uses recursive call on the binary tree representation of the expression
2. (15%) that uses two stacks for operators and operands (values) respectively

備註	一、作答於試題上者，不予計分。 二、試題請隨卷繳交。