

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	02 月 2 日(五) 第一節
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I. Multiple Choices (40%, #1-16: 2 points for each, #17-18: 4 points for each):

1. Which is the capability of control the access of multiple threads to any shared resource?
 - a. Serialization
 - b. Synchronization
 - c. Internationalization
 - d. None of the above
2. Which frames are used to transport user data and control information relating to user data (piggybacking)?
 - a. I-frames
 - b. S-frames
 - c. V-frames
 - d. None of the above
3. Which data structure does not keep its elements in any type of order?
 - a. set
 - b. queue
 - c. list
 - d. stack
4. If a set was implemented using a linked list, then what complexity would be testing for containment have?
 - a. $O(1)$
 - b. $O(\log_2 n)$
 - c. $O(n)$
 - d. $O(n^2)$
5. If we insert into an empty binary search tree the following sequence of nodes with the specified keys, what will be the result?
Keys: 6, 7, 9, 12, 13, 25, 44
 - a. the tree will resemble a list
 - b. the tree will be balanced
 - c. the root will have key = 12
 - d. the root will have key = 44
6. In Java, a class that depends on the interfaces of many other classes is said to be:
 - a. cohesive
 - b. incohesive
 - c. loosely coupled
 - d. strongly coupled

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7. In Java, a class's public interface exposes a coherent set of functionality closely related to a single concept. This class is:
- coherent
 - focused
 - cohesive
 - coupled
8. Which of these sorts (mergesort, quicksort, heapsort, insertion sort) uses the most memory?
- quicksort
 - insertion sort
 - heapsort
 - mergesort
9. Suppose thread one is downloading a 800KB file while another thread is processing the same file on a single CPU machine. Suppose further that one time slice allows the first thread to download about 10KB and that the second thread can process 10KB of the file in one time slice. Approximately how does the time to complete the entire job compare to having a single thread do the work?
- the threaded way will be twice as fast
 - the threaded way will be twice as slow
 - the time depends heavily on the thread scheduler
 - both ways will take about the same time
10. Under what conditions are locks unnecessary for multi-threaded programs?
- when the threads are all of the same class
 - when the threads are different classes
 - when the threads do not share data
 - when the shared data only has a single method
11. Which of the following scenarios may not cause a deadlock among two threads?
- thread one is in an infinite loop and has acquired a lock
 - both threads are in an infinite loop, and one thread has acquired a lock
 - both threads are in an infinite loop, and both threads have acquired locks
- I
 - II
 - III
 - I, II and III
12. When a socket is created, which Internet address is used?
- The address of the computer to which you want to connect
 - The address of your computer
 - The address of your ISP
 - The address of your proxy

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13. How many recursive calls are made from the original call to fib(4) (not counting the original call)?

```
int fib(int n) { // assumes n >= 0
    if (n <= 1)
        return n;
    else
        return (fib(n - 1) + fib(n - 2));
}
```

- a. 1
- b. 2
- c. 4
- d. 8

14. A unique permutation is one that is different from any other generated permutation. How many unique permutations does the string "aaa" have?

- a. 0
- b. 1
- c. 2
- d. 3

15. Why does the best recursive method usually run slightly slower than its iterative counterpart?

- a. testing the terminating condition takes longer
- b. each recursion method call takes processor time
- c. multiple recursive cases must be considered
- d. checking multiple terminating conditions take more processor time

16. The ____ standard defines interfaces and methods to analyze and modify the tree structure that represents an XML document.

- a. JAXP
- b. SAX
- c. DOM
- d. API

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The following code applies to questions 17-18

```
public interface Moveable{ void move();}

public abstract class Animal implements Moveable{
    private String name;
    public abstract void eat();
    public void move(){System.out.println("animal moves");}
    public void sleep(){..}
}

public class Mammal extends Animal{
    public void eat(){System.out.println("gimme meat!");}
    public void regulateTemperature(){..}
}

public class Human extends Mammal{
    public void think(){..}
    public void move(){System.out.println("human walks");}
}
```

7. What is the result of executing the following code:

```
Movable m = new Mammal();
m.eat();
```

- a. invoke Animal eat() method
- b. invoke Movable eat() method
- c. invoke Mammal eat() method
- d. compiler error

18. What is the result of executing the following code:

```
Animal a = new Human();
Movable m = a;
m.move();
```

- a. invoke Animal move() method
- b. invoke Movable move() method
- c. invoke Human move() method
- d. compiler error

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II. Answer the following questions (60%):

1. (15%, 5 points for each) Describe the output for the following sequence of

- Stack operations: push(6), push(3), pop(), push(8), pop()
- Queue operations: enqueue(9), enqueue(8), enqueue(3), dequeue(), enqueue(7), dequeue(), dequeue()
- Deque operations: addFirst(2), addFirst(9), addLast(6), removeLast(), last(), first(), removeFirst()

2. (20%, 2 points for each) Suppose an algorithm takes 5 seconds to handle a data set of 1,000 records. Fill in the following table, which shows the approximate growth of the execution times depending on the complexity of the algorithm.

For example, because $3,000^2/1,000^2=9$, the algorithm would take 9 times as long, or 45 seconds, to handle a data set of 3,000 records.

	$O(n)$	$O(n^2)$	$O(n^3)$	$O(n \log(n))$	$O(2^n)$
1,000	5	5	5	5	5
2,000	10				x
3,000		45			x
10,000					x

3. (15%) Write a recursive method in JAVA, void reverse () that reverses a sentence. For example:

```
Sentence greeting = new Sentence("Hello!");
```

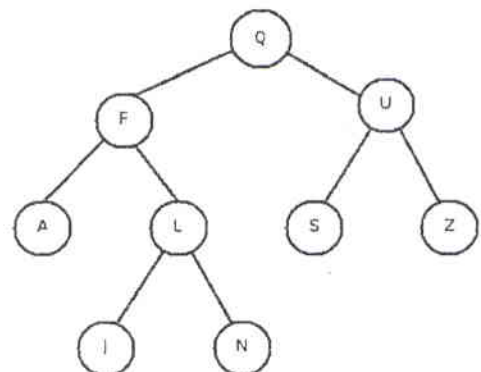
```
greeting.reverse();
```

```
System.out.println(greeting.getText());
```

Prints the string "!!olleH". Implement a recursive solution by removing the first character, reversing a sentence consisting of the remaining text, and combining the two.

4. (10%, 5 points for each) Given the following tree T, please visit nodes in T with three traversal methods.

- What is the POSTORDER traversal of T?
- What is the INORDER traversal of T?



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- 一、作答於試題上者，不予計分。
- 二、試題請隨卷繳交。

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I. True/False (12%): Write True or False to answer each question. Note: T, t, F, f are not acceptable answers.

1. What the firm performs is not big data but simply business analytics: “近年來Big Data 的關注度日益提高。當各種服務的「使用數據」與「使用者資訊」結合，這些數據可能產生無限商機。《TOP Survey》以這樣的市場為出發點，提供免費在線調查工具，除了協助企業能精準觸及目標客群，快速查閱受訪者的喜好與反饋。”

2. In order to enjoy benefits of discovering customer's purchase pattern from operational data, firms simply buy and install BI solutions from hardware and software vendors.

3. The purpose of a web server software is to receive HTTP requests and return requested web pages. So, we need a web server software like Apache to execute web applications.

4. A firm requiring a lot of data transmissions in daily operations cannot benefit from cloud computing.

II. Multiple Choice (12%): Write the Capital letter ONLY that represents the best answer to the questions below.

1. Which of the following business can benefit from cross-side network effects?

- A. Adidas's e-commerce site
- B. Yelp's e-commerce site
- C. FamilyMart's supply chain network

2. Cloud computing refers to computing resources over the Internet. Which of the following are instances of cloud computing?

- A. 博客來's product information and purchase services, and Dropbox's data access service
- B. 政大大學報's news service, and salesforce's platform service for CRM applications
- C. Google's information search service, and Azure App Service

3. On 21st October 2016, people in the eastern seaboard of states had some trouble accessing their usual sites and services throughout the day, from Spotify and Reddit to the New York Times. All is because of Dyn, an Internet service provider, is under the attack of DDoS. Based on the description above, can you guess what the service that Dyn is provided?

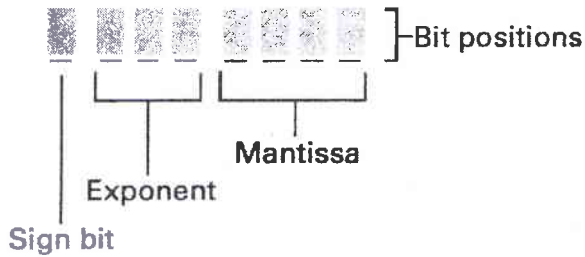
- A. TCP/IP
- B. DNS
- C. HTTP

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<p>4. In 2017, The Federal Communications Commission today announced its plan to deregulate the broadband industry and eliminate net neutrality rules. Which of the following has the largest negative impacts?</p> <p>A. ISP</p> <p>B. Netflix</p> <p>C. customers</p>					
<p>III. Essay Questions (76%)</p> <p>1. According to chinatimes (13/06/2017), “全球企管軟體供應商 SAP 宣布，將與 3C 通路商全國電子合作，協助全國電子導入 SAP 商務解決方案 (Business Suite)”-20%</p> <p>(a) According to the ERP consultant, the solution can save the company 10% of operating expenses. Do you agree that statement? Please provide your rationale.-8%</p> <p>(b) Due to the high costs of on-premises packaged ERP, cloud computing is one good alternative for firms. Can you explain why 全國電子 choose not to use cloud-based ERP?-12%</p> <p>2. Omnichannel retailing is a critical topic in recent years. -23%</p> <p>(a) What is omnichannel retailing? Can you provide an example?-8%</p> <p>(b) Amazon has expanded from online to offline recently. Can you explain why Amazon chooses to do so?-15%</p> <p>3. Recently, Happy Fresh and 吉甲地 announced to stop operations. In contrast, Welcome (頂好) initiate “頂好新鮮 Go” in Taipei this year (2017). What factors/dimensions would you consider in order to sell produces online?-15%</p> <p>4. Block chain is a key trend recently. Can you use copyright registration as the context to explain how block chained is applied? How is it better than the current system? Are there any shortcomings?-18%</p>					
備 註	<p>一、作答於試題上者，不予計分。</p> <p>二、試題請隨卷繳交。</p>				

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一、選擇題（共 20 題，佔 40 分，答對每題 2 分，答錯不倒扣）

1. 若八位元之浮點數字設計如下，請問下列何者數字無法被表示？



- (A) $1/2$
 (B) $-3/4$
 (C) $21/8$
 (D) $-7/16$
2. 以下二進位的位元數值何者不符合 even parity？
 (A) 010101001
 (B) 101010100
 (C) 010101001
 (D) 100010100
3. 以下運算何者結果為 1？
 (A) $10010101 \text{ AND } 01101010$
 (B) $10100101 \text{ OR } 10101000$
 (C) $10010101 \text{ XOR } 10101010$
 (D) $00000011 \gg 2$
 (E) 以上皆非
4. 以下二進位數字 1110.0111 所對應之十六進位數字為何？
 (A) 14.4375
 (B) E.4375
 (C) 14.7
 (D) E.7
 (E) 以上皆非
5. 以下作業系統之描述，何者錯誤？
 (A) 在分時 (time-sharing) 的作業系統中，程序 (process) 交換的動作稱為 context switch。
 (B) 若程序 (process) 需要使用作業系統核心 (kernel) 的功能，可以呼叫 system call。
 (C) 主機板上的 clock 會定時向 CPU 發出 interrupt。
 (D) 作業系統中保存所有程序 (process) 的資料結構稱為 process table。
 (E) 以上皆正確。

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<p>6. 下列哪一選項並不是造成資源 deadlock 的主要原因？</p> <p>(A) 使用共享的資源 (sharable resource)</p> <p>(B) 分階段要求使用資源 (request on partial basis)</p> <p>(C) 不可中斷其他 process (no preemption)</p> <p>(D) 多任務的設計 (multi-tasking)</p> <p>7. 若某一電腦的 instruction pointer 之長度為 16 bits，請問其主記憶體最多為多少位元？</p> <p>(A) 16</p> <p>(B) $16 * 8$</p> <p>(C) 2^{16}</p> <p>(D) $2^{16} * 8$</p> <p>(E) 以上皆非</p> <p>8. 以下網路技術之敘述何者錯誤？</p> <p>(A) 802.11ac 採用星狀 (star) 的網路拓樸 (topology)。</p> <p>(B) 802.11b 採用 CSMA/CA 的網路協定。</p> <p>(C) 802.3 採用 bus 的網路拓樸 (topology)。</p> <p>(D) 802.3 協定在發出封包前會先進行 carrier sense 的動作。</p> <p>(E) 以上皆正確。</p> <p>9. 以下網際網路技術之敘述何者錯誤？</p> <p>(A) DNS 服務負責解析 URL 以及 email server 的 domain name。</p> <p>(B) FTP 傳輸協定不具有加密帳號功能。</p> <p>(C) SMTP 協定是文字型的 email 通訊協定，無法傳輸圖片或檔案。</p> <p>(D) POP3 協定可將電子郵件下載至 email client 當中。</p> <p>(E) 以上皆正確。</p> <p>10. 以下關於 IP 網路之敘述何者正確？</p> <p>(A) TCP 協定具有 flow control 以及 congestion control 之設計，因此 TCP 為 reliable 的 transport layer protocol。</p> <p>(B) UDP 協定在設計上不具有 retransmission 之功能。</p> <p>(C) IP 協定規定了如何在路由器 (router) 之間轉送封包。</p> <p>(D) ICMP 的封包被包含在 IP 封包之內，屬於第四層協定。</p> <p>(E) 以上皆正確</p> <p>11. 對於一個 sorted list 來說，binary search 演算方法的平均時間效率為？</p> <p>(A) $O(\log n)$</p> <p>(B) $O(n \log n)$</p> <p>(C) $O(n)$</p> <p>(D) $O(n^2)$</p> <p>(E) 以上皆錯誤</p>					

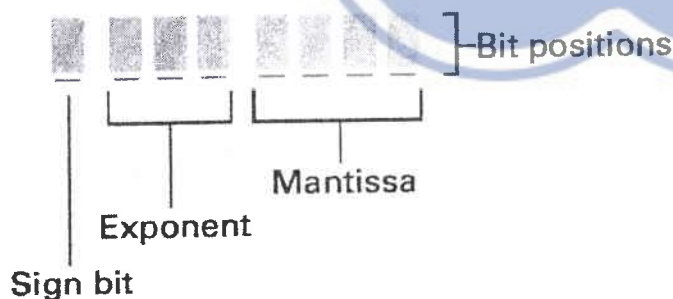
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<p>12. 以下關於複雜度的公式何者錯誤？</p> <p>(A) $\text{mod}(n) = O(1)$; $\text{mod}()$ is the modulo operation.</p> <p>(B) $\text{md5}(n) = O(n)$, $\text{md5}()$ is Message-Digest Algorithm and n is the size of message.</p> <p>(C) $3n^2 + 2n + 1 = O(n^2)$</p> <p>(D) $2^n + n! + n^2 + \log n + n + 1 = O(2^n)$</p> <p>(E) 以上皆正確</p> <p>13. 針對運算式 $x+y*z$，以下何者敘述錯誤？</p> <p>(A) 其 prefix 表示式為 $+x*yz$</p> <p>(B) 其 postfix 表示式為 $xyz*+$</p> <p>(C) 其 expression tree 的 root 為 $+$ 號</p> <p>(D) 其 expression tree 為 binary tree</p> <p>(E) 以上皆正確</p> <p>14. MVC (model-view-control) 為軟體工程中常見的軟體開發架構，請問下列敘述何者為錯誤？</p> <p>(A) Model 使資料庫專家進行資料管理和設計。</p> <p>(B) View 使介面設計人員進行圖形介面設計</p> <p>(C) Control 使程式設計師編寫邏輯與流程，轉發請求 (request)、處理請求。</p> <p>(D) MVC 的優點是耦合性低、重用性高、降低系統結構的複雜性。</p> <p>(E) MVC 的缺點是較不適合小型的開發專案。</p> <p>15. 下列關於資料結構的敘述何者錯誤？</p> <p>(A) 在 stack 中，物件項目 (entry) 的增加或移除都會在 top 的位置。</p> <p>(B) 在 queue 中，物件項目 (entry) 的增加或移除都會在 head 的位置。</p> <p>(C) 在 tree 中，root 沒有 parent。</p> <p>(D) 在 tree 中，leaf 沒有 child。</p> <p>(E) 以上皆正確。</p> <p>16. 下列資料庫的原理敘述何者錯誤？</p> <p>(A) SELECT operation 作用在資料表 (table) 的列 (row) 上。</p> <p>(B) PROJECT operation 作用在資料表 (table) 的欄 (column) 上。</p> <p>(C) JOIN operation 若作用在兩個資料表 (分別有 5 列與 7 列) 時，共會產生 35 列資料。</p> <p>(D) 以上皆正確。</p> <p>17. 以下關於 relational database 之敘述，何者錯誤？</p> <p>(A) Primary key 不為空值。</p> <p>(B) Relational database 通常可以保持資料的簡潔，減少重複的 (redundancy) 資料。</p> <p>(C) 將一個 relation 拆分為多個 relation 時，可能會造成資料遺失 (lossless decomposition)。</p> <p>(D) Foreign key 必為同一表格 (table) 之 primary key。</p> <p>(E) 以上皆正確。</p>					

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18. 資料探勘 (data mining) 是指發掘數據中隱藏關係的技術。請問下列何者說明有誤？
- (A) 監督式的學習演算方法必須在訓練時給定目標 (target)。
 - (B) 非監督式的學習演算方法不需要在訓練時給定目標 (target)。
 - (C) Outlier analysis 的目的是辨識出資料集中是否有不符合基準 (norm) 資料的資料點。
 - (D) 分群 (clustering) 演算方法的精神是將資料根據相似度區分為多群。
 - (E) 以上皆正確。
19. 以下關於資訊安全偵測技術的敘述何者錯誤？
- (A) 誤用 (misuse) 偵測技術有高偵測率。
 - (B) 誤用 (misuse) 偵測技術有低誤判率。
 - (C) 異常 (anomaly) 偵測技術可能發現過去沒有見過的新攻擊。
 - (D) 異常 (anomaly) 偵測技術描述的是正常 (norm) 的行為。
 - (E) 以上皆正確。
20. 以下程式敘述何者錯誤？
- (A) Java 是物件導向的程式語言。
 - (B) Python 需要 interpreter 才能執行。
 - (C) C 是 imperative 的程式語言。
 - (D) Machine language 是 declarative 的程式語言。
 - (E) 以上皆非

二、問答題 (共 7 大題，佔 60 分，每題配分標於題目後)

- 請說明物件導向的程式語言中，其兩個重要概念：(a) 封裝、(b) 繼承。(8 分)
- 請依下圖例說明浮點數運算的兩個重要概念：(a) overflow、(b) truncation error (或稱之為 round-off error)。(8 分)



- 試說明在一個網頁登入帳密的情況下，以下的輸入會造成何種資料庫的攻擊效果？並解釋其攻擊成功的原因與解決辦法。(8 分)

UserID:

Password:

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<p>4. 請寫出以下 pseudocode 之輸出內容。(4 分)</p> <pre> for (i=1; i<5; i++) for (j=i; j<13; j++) if (i*j % 3 == 1) print(i, j, '\n') // 輸出 i,j 與一個換行字元 </pre> <p>5. 試以記憶體之觀點說明以下 call by value 的 function call 為何無法交換 main() 中的 a 與 b 值？並請寫出修正後的 main() 以及 swap() 兩個函式。(8 分)</p> <pre> void swap(int a, int b) { int temp = a; a = b; b = temp; } int main() { int a = 1; int b = 0; swap(a, b); return 0; } </pre> <p>6. 一個 self-dividing number 是指一個十進位的整數數字可以被其每一個位數的數字整除。例如，數字 128 可以被 1、2 與 8 整除，亦即 $128 \% 1 == 0$, $128 \% 2 == 0$, and $128 \% 8 == 0$。注意：self-dividing number 是不可以包含 0 這個數字的！請寫一份 pseudocode 可以列出介於 0 至 100 之間的 self-dividing number。注意：請只寫出 pseudocode，而不需要輸出答案。(12 分)</p> <p>7. 迴文 (palindrome) 是指一個字串正讀與反讀其結果都相同。例如：abba、abcdcba、qwertyrewq。請設計一函式能判斷輸入之字串是否為迴文，若是迴文則回傳 true；若非則回傳 false。(12 分)</p>					
備 註	<p>一、作答於試題上者，不予計分。</p> <p>二、試題請隨卷繳交。</p>				

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2 日(五) 第三節
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I. Answer Yes (O)/No (X) for the following descriptions (40%):

- _____ : The idea of the Divide and Conquer approach is to find the optimum solution by exhaustively searching all possible solutions
- _____ : The idea of the Dynamic Programming approach is to define global optimum in terms of optimal sub problems. Sub problems may overlap. One can solve and store the results of sub problems bottom-up to accelerate the computation.
- _____ : In a heap, any value in the left subtree of a node is less than any value in the right subtree of the same node
- _____ : Removing a key takes $O(n)$ time in a balanced binary search tree with n nodes
- _____ : An AVL tree is a binary search tree where for every internal node, the heights of its children are the same
- _____ : In a splay tree, splaying a node means moving the node to the root
- _____ : While using an unsorted list to implement a map with n nodes, $get(k)$ takes $O(1)$ time
- _____ : While using a balanced binary search tree to implement a map with n nodes, $remove(k)$ takes $O(\log n)$ time
- _____ : A hash function maps a key to an integer in a fixed interval, e.g., $[0, N-1]$ for a hash table associated with an Array of size N
- _____ : In a hash table, collision occurs when different keys are mapped to the same index.
- _____ : Liner probing handles collisions by letting each cell in the table point to a linked list
- _____ : Separate chaining handles collisions by putting the colliding items in the next available table cell
- _____ : Hashing is more efficient when the load factor (the number of stored elements / the size of the Array) is higher
- _____ : The sum of the degrees of all vertices is equal to two times the number of nodes in a graph
- _____ : The number of edges in a directed graph is less than $n(n-1)/2$ (n is the number of vertices in the graph)
- _____ : Checking whether two vertices are adjacent takes $O(n)$ time in an edge-list graph with n vertices
- _____ : Checking whether an edge is incident to a vertex takes $O(n)$ time in an adjacency-matrix graph with n vertices
- _____ : Removing a vertex takes $O(n^2)$ time in an adjacency-matrix graph with n vertices
- _____ : The idea of the Greedy approach is to divide the problem into sub problems that can be solved independently, and conquer the results
- _____ : The minimum spanning tree of a weighted graph must include the edge that has the minimum weight

II. Answer the following questions (60%):

- A matrix-chain-product is to compute the product of a matrix chain such as $A_0 \times A_1 \times \dots \times A_{n-1}$, where A_i is a $d_i \times d_{i+1}$ matrix. Consider a simple example $A = A_0 \times A_1 \times A_2$ with $d_0=3$, $d_1=100$, $d_2=5$, and $d_3=5$.

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2日(五) 第三節
<p>One can compute the matrix-chain-product in the way $((A_0 \times A_1) \times A_2)$ with 1575 operations. That is, taking 1500 $(3 \times 100 \times 5)$ operations to first compute $A' = A_0 \times A_1$ and then taking 75 $(3 \times 5 \times 5)$ operations to compute the result $A = A' \times A_2$. One can also compute the matrix-chain-product in the way $(A_0 \times (A_1 \times A_2))$ with 4000 operations. That is, taking 2500 $(100 \times 5 \times 5)$ operations to first compute $A' = A_1 \times A_2$ and then taking 1500 $(3 \times 100 \times 5)$ operations to compute the result $A = A_0 \times A'$. As one can see, the order of computation sequence matters. The question is how to find an optimal way to parenthesize the matrixes.</p> <p>A matrix-chain-product problem is to find an optimal way to compute the product of a given matrix chain with the minimal number of basic (multiplication) operations.</p> <p>1.1. Use a greedy algorithm.</p> <ol style="list-style-type: none"> (10%) Describe your strategy. (5%) Show an example that it works. (5%) Show a counterexample that it does not work. <p>1.2. Use a dynamic programming algorithm. Assume $N(i, j)$ denotes the minimal number of operations to compute the product of $A_i \times \dots \times A_j$. The optimal solution $N(i, j)$ is to find k in $[i, j]$ such that it is minimal: the sum of two optimal sub problems, $N(i, k)$ and $N(k+1, j)$, plus the number of operations for the last multiplication on the results of the two sub problems.</p> <ol style="list-style-type: none"> (10%) Show the characterizing equation on $N(i, j)$ with the above optimal relation. (10%) Solve $A = A_0 \times A_1 \times A_2 \times A_3$ with $d_0=3, d_1=10, d_2=5, d_3=5$, and $d_4=6$ with the equation by bottom up computation. Hint: Build a 4 by 4 table for the value of $N(i, j)$. Initially for $i = 0..3, N(i, i) = 0$. $N(0, 3)$ is the result. <p>2. Consider the following keys: 19, 39, 28, 5, 36, 18, 25, 26, 33, 53.</p> <ol style="list-style-type: none"> (10%) Show a hash table that handles collisions with double hashing. Let $N = 17, h(k) = k \bmod 17, d(k) = 13 - (k \bmod 13)$. (10%) Build an AVL tree with the above keys. Insert each key step by step and rebalance the tree when it violates the AVL tree property. 					
備註	<p>一、作答於試題上者，不予計分。 二、試題請隨卷繳交。</p>				