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12日(三)第2節

I. Short-Answer Questions (100 points)

1. Answer the following questions about database design. (10 pts in total)
   1.1. What are data normalization and denormalization? What are their purposes? (5 pts)
   1.2. What are the star and snowflake schema? What are their key differences? (5 pts)

2. Answer the following questions about object-oriented programming. (15 pts in total)
   2.1. What are abstract data types? What is their relationship to data structures? (5 pts)
   2.2. What is inheritance? What is its purpose? (5 pts)
   2.3. What is polymorphism? What is its purpose? (5 pts)

3. Explain the meaning and purpose of hashing, encoding, and encryption. Highlight their differences and how they contribute to data processing and security. (10 pts)

4. Answer the following questions about linear models. (10 pts in total)
   4.1. Briefly explain linear regression and logistic regression. Highlight their major differences. (5 pts)
   4.2. Consider the following method to learn a binary classifier. First, label the two classes as 0 and 1. Second, learn a linear regression $y = f(\vec{x})$ using usual supervised learning. Third, decide a threshold t such that $f(\vec{x}) \geq t$ gives classification outcome 1, and $f(\vec{x}) < t$ gives classification outcome 0. Does this method make sense? Please detail your reasons. (5 pts)

5. In a software company, several teams simultaneously work on separate features in the same codebase, which is maintained using Git and GitHub. (15 pts in total)
   5.1. Briefly explain a Git workflow and a GitHub workflow. Highlight their major differences. (5 pts)
   5.2. Suppose two teams create their own feature branch from the main branch. When they attempt to merge their changes back into the main branch, the merge fails due to conflicts in the code. Explain the steps required to identify and resolve the merge conflicts. (5 pts)
   5.3. Explain how to create a pull request to commit new changes to the main branch. Your explanation should start with forking the repository and end with successfully merging the pull request. (5 pts)

6. A network packet has different headers. Please answer the following questions regarding the IP header corresponding to the Internet Protocol (IP). (15 pts in total)
   6.1. During the transmission of a network packet, which type of network device typically examines the IP address in the IP header to decide the packet's destination? (2 pts)
   6.2. Which layer of the OSI model does the action mentioned above correspond to? (2 pts)
   6.3. The IP header contains a TTL (Time to Live) field. Please explain its functionality. (2 pts)
   6.4. Do packets transmitted over a network always have an IP header? Why or why not? (3 pts)

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6.5. Suppose Host *A* wants to send a packet to Host *B*. Given their IP addresses, how do we determine whether *A* and *B* belong to the same subnetwork? (3 pts)

6.6. IP addresses are divided into private IPs and public IPs. Please explain their definitions and when each is used. Can a host with a public IP send a packet to a host with a private IP address? Why or why not? (3 pts)

7. In the following function, a, b, n are nonnegative integers. Explain what f(a,b,n) computes. (10 pts)

```
function f(a, b, n) {
  if(n==0)
    return a;
  if(n%2==0)
    return f(a, b*b, n/2);
  else
    return f(a*b, b, n-1);
}
```

8. There are a total of n courses you have to take, labeled from 0 to n - 1. You are given an array of prerequisites p, where len(p) = n, and each p[i] is an array [c1, ..., ck] indicating that you must first take courses c1, ..., ck if you want to take course i. (You may assume that all course IDs fall between 0 and n - 1.) Write a function that takes in n and p, and returns true if you can finish all courses. Otherwise, return false. (15 pts)

Example 1 Suppose that n = 3 and p = [[1, 2], [], [1]]. To take course 0, you should have finished courses 1 and 2. To take course 2, you should have finished course 1. Since you can finish the courses in the order 1, 2, 0, your function must return true.

Example 2 Suppose that n = 2 and p = [[1], [0]]. To take course 1, you should have finished course 0, and to take course 0, you should have finished course 1. This is impossible, so your function must return false.

Example 3 Suppose that n = 2 and p = [[0], []]. Since it's impossible to have finished a course before taking it, your function must return false.

To get full points, your algorithm must run in linear time, namely, O(len(p[0]) + ... + len(p[n-1])).

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 114 學年度 碩士班暨碩士在職專班 招生考試試題

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 12 日(三) 第四節

Essay Questions (100%)

1.(25%) What are the key activities involved in the implementation phase of an SCM system development project?

2.(25%) What are the primary approaches to IS installation? How can an organizational manager determine which approach to use?

3.(25%) What are the unique security threats to IoT systems? How can they be addressed?

4.(25%) In the current age of AI, the world is preparing for significant changes with excitement and fear. There are possibilities of using generative AIs and AGIs to interface with the world beyond the text. Given this, what opportunities do you think require particular attention? What are your theories?

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	計算機概論	系所別	資訊管理學系/科技組	考試時間	2月12日(三) 第2節

Short-Answer Questions (100 points)

1. Answer the following questions about linear models. (10 pts in total)
   1.1. Briefly explain linear regression and logistic regression. Highlight their major differences. (5 pts)
   1.2. Consider the following steps to learn a binary classifier. First, label the two classes as 0 and 1. Second, learn a linear regression $y = f(\vec{x})$ using usual supervised learning. Third, decide a threshold t such that $f(\vec{x}) \geq t$ gives classification outcome 1, and $f(\vec{x}) < t$ gives classification outcome 0. Does this method make sense? Please detail your reasons. (5 pts)

2. In a software company, several teams simultaneously work on separate features in the same codebase, which is maintained using Git and GitHub. (15 pts in total)
   2.1. What is a Git workflow, and what is a GitHub workflow? Highlight their major differences. (5 pts)
   2.2. Suppose two teams create their own feature branch from the main branch. When they attempt to merge their changes back into the main branch, the merge fails due to conflicts in the code. Explain the steps required to identify and resolve the merge conflicts. (5 pts)
   2.3. Explain how to create a pull request to commit new changes to the main branch. Your explanation should start with forking the repository and end with successfully merging the pull request. (5 pts)

3. A network packet has different headers. Please answer the following questions regarding the IP header corresponding to the Internet Protocol (IP). (15 pts in total)
   3.1. During packet transmission, which type of network device typically examines the IP address in the IP header to decide the packet's destination? (2 pts)
   3.2. Which layer of the OSI model does the action mentioned above correspond to? (2 pts)
   3.3. The IP header contains a TTL (Time to Live) field. Please explain its functionality. (2 pts)
   3.4. Do packets transmitted over a network always have an IP header? Why or why not? (3 pts)
   3.5. Suppose Host *A* wants to send a packet to Host *B*. Given their IP addresses, how do we determine whether *A* and *B* belong to the same subnetwork? (3 pts)
   3.6. IP addresses are divided into private IPs and public IPs. Please explain their definitions and use cases. Can a host with a public IP send a packet to a host with a private IP address? Why or why not? (3 pts)

4. Briefly describe how Dijkstra's shortest path algorithm works. Explain why it cannot handle graphs that contain negative edges. (15 pts)

5. Explain the meaning and purpose of hashing, encoding, and encryption. Highlight their differences and how they contribute to data processing and security. (15 pts)

6. In the following function, `a`, `b`, `n` are nonnegative integers. Explain what `f(a,b,n)` computes. (5 pts)

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```
function f(a, b, n) {
  if(n==0)
    return a;
  if(n%2==0)
    return f(a, b*b, n/2);
  else
    return f(a*b, b, n-1);
}
```

7. Consider the following processes. Please draw the schedules (Gantt Chart) and calculate the average waiting time for the Preemptive Shortest Job First, and Round Robin (time-quantum = 4 ms) scheduling policies, respectively. (10 pts)

Process	Arrival Time	CPU Burst Time
P1	0 ms	15 ms
P2	3 ms	7 ms
P3	5 ms	2 ms
P4	7 ms	3 ms

8. Suppose that we have a class `Agent` with the following interface. (15 pts)

```
class Agent {
  Position getPosition();        // get the current position of the agent
  bool foundFlag();              // check if the agent found a flag at the current position
  bool moveLeft();               // move one step leftward from the current position
  bool moveRight();              // move one step rightward from the current position
  bool moveUp();                 // move one step upward from the current position
  bool moveDown();               // move one step downward from the current position
}
```

Note that a move is successful only when the invocation returns `true`. (For example, suppose you call `moveLeft`. If it returns false, then the agent stays still after the invocation. Otherwise, it moves one step leftward.) Please implement a function `findFlag` that leads an agent to find a flag. The function should either return the flag's position or return `null` when no flag is reachable from the agent's starting position.

```
Position findFlag(Agent a) { … }
```

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	資料結構	系所別	資管系／科技組	考試時間	2月12日(三)第4節

Consider the following key set: 31, 82, 14, 3, 12, 6, 7, 95, 10, 162, 214, 36, 9, 2, 138, 78, 22, 56

一、

Sorting with a Priority Queue

1. (10%) Define an algorithm that sorts the key set with a heap (as a priority queue).
2. (20%) Run the algorithm on the key set and show the sorting process step by step.

二、

Sorting with an Array

1. (10%) Define an in-Place Quick Sort algorithm
2. (20%) Run the algorithm to sort the key set in an array and show the sorting process step by step.

三、

Sorting with a Binary Search Tree

1. (10%) Define a sorting algorithm with an AVL tree.
2. (20%) Run the algorithm on the key set and show the sorting process step by step.
3. (10%) Remove key 14 and key 36. Show the result of the AVL tree.

備註	一、作答於試題上者，不予計分。 二、試題請隨卷繳交。