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**一、(50%)**

最近 iOS7 推出 iBeacon 定位技術，運用此技術，智慧型手機的 APP 可以將定位的準確度提高到僅有數公分的誤差（相較於 GPS 的精度約為十公尺），美國許多商家已經開始測試這種服務，請同學運用此技術，構想一個新的賣場或博物館的 APP，並從以下項目詳述你的構想：1. 概念描述 2. 使用流程圖 3. 分析與比較此新服務與舊有服務的優點。

**二、(50%)**

請推薦並分析一項(款)具創新服務的設計應用(可不侷限於 APP，可以為一服務方法；或系統應用；或互動裝置；或創意平台等等)；分析重點請依下列逐一陳述並試申論之：包含 1. 為何推薦的理由？2. 創新之處為何？3. 對服務價值你的定義為何？4. 系統評估你所採用的標準為何？（例如：以易學、易用、易記、少出錯、多滿意來評估；或是「五感行銷」的角度評估，或是請自行訂定指標，亦歡迎具創意、天馬行空的想法指標）5. 若此「創新服務的設計應用」未來需深化精進，改良之處為何？
申論題（一大題，內有三小題，佔總分 50%）

一、國際媒體研究機構 Latitude 於 2012 年提出敘事四元素：沈浸 immersion、互動 interactivity、整合 integration、影響 impact。這四個元素的組合，會帶來不同的說故事與聽故事的經驗。

請回答下列三個小題：

1. 請簡單界定這四個元素。
2. 您認為這四個元素應用於不同媒介時，例如傳統媒介（如：報紙、雜誌、廣播、電視）、與數位媒介（如：電腦、平板、智慧型手機），會有什麼樣的比重差異？請在傳統媒介與數位媒介中，各舉一個平台（不限於上述媒介）為個案分析。
3. 試著寫下一個小故事（原創、引用、或改編，都可以，不必太長，請注意考試時間），您認為這個故事用了哪些元素？在哪一種媒介平台最能展現這些元素的特性？

申論題

二、（50%） 故事(內容)為行銷之未來趨勢，假設你受聘為某產品 a 在母親節的前一週推出建立品牌形象 b 的行銷企劃。請設計你的故事並說明它可以成功的理由。你必需納入以下 3 項條件：(1)連結行動與社會媒介; (2)含文化元素; (3)含遊戲元素。

（註 a: 產品類型請自定; 註 b: 品牌形象請自定;）
1. Explain the following technologies/terms and their influence on current digital content related implementations: (20%)
   1) Folksonomy
   2) Digital Rights Management
   3) Digital Publishing
   4) Big Data

2. Elaborate your experience and observation about recent digital content applications on mobile devices? (10%)

3. Describe your knowledge about digital archives and the potential usages of those collected digital contents. (10%)

4. What is Multimedia Data Mining? Can you give some examples on current digital content related applications that utilize Multimedia Data Mining technology? Can you explain their technical details? (10%)
5. **[Analog to Digital Conversion]** Sampling and quantization are two processes to convert an analog signal into its digital representation. (1) State the Nyquist-Shannon sampling theorem. (5%) (2) Illustrate rounding quantization with a simple example. (5%)

6. **[Video Compression]** In motion-compensation-based video compression algorithms, each image is divided into macroblocks of size NxN. After the first frame, only the motion vectors and difference macroblocks need be coded. The following pseudo-code demonstrates a sequential search process for motion vectors:

**Note:** MAD (Mean absolute difference) is defined as:

\[
\text{MAD}(i, j) = \frac{1}{N^2} \sum_{k=0}^{N-1} \sum_{l=0}^{N-1} |C(x+k, y+l) - R(x+i+k, y+j+l)|
\]

where \(C(x+k, y+l)\) are the pixels in the macroblock in the Target (current) frame and \(R(x+i+k, y+j+l)\) are the pixels in the macroblock in the Reference frame.

Procedure Motion-vector MV: sequential search
BEGIN
  \_*Initialization_*
  min_MAD=LARGE_NUMBER;
  for i=-p to p
    for j=-p to p
      \{ 
        current_MAD=MAD(i, j);
        if current_MAD < min_MAD
          \{ 
            min_MAD= current_MAD;
            u = i; //Get the coordinates for MV */
            v = j ;
          \}
    \}
END

(1) Show that the complexity for the sequential search for a single macroblock is \(O(p^2N^2)\). (5%)
(2) Assume that \(p=15\) and \(N=16\). Compute the total number of operations needed per second to estimate the motion vectors for a video of resolution 720x480 and 30 frames per second. (5%)
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7. **[Number system]** A base-3 representation has three digits: 0, 1, 2.
   
   (1) Convert 1201_3 into its equivalent binary representation. (2%)
   
   (2) How many bits are required to store a five-ternary-digit number? (2%)
   
   (3) Use the binary-coded-ternary representation (i.e., 0→00, 1→01, 2→10) to encode 1201_3. How many bits are required to store a length N ternary number using binary-coded-ternary representation? (4%)
   
   (4) Design a logic circuit to compute the Hamming distance between two binary-encoded ternary digits. (2%)

8. **[Multimedia Communication]** Illustrate the concepts of unicast, multicast, and broadcast with simple drawings. (10%)

9. **[QoS]** (1) IP networks are often described as ‘best-effort’ networks. Why? (3%) (2) What does ‘QoS’ stand for? (3%) (3) Explain packet jitter in computer networks. (4%)
可用中文或英文回答

1. (10%) A binary tree is stored in an array as follows: \{1,2,3,4,5,6,7,8,9,10,11\}.
   (a) What is the definition of a binary heap?
   (b) Please adjust the binary tree into a max-heaps. (Give your answer in the form of a tree AND in the form of an array.)

2. (15%) Consider an AVL tree, a 2-3 tree, and a splay tree. Initially suppose each tree contains only a root node with key 1. First insert these keys in the given order: 2, 3, 4, 5. Next remove these keys in the given order: 1, 2, 3. Redraw each tree after each operation is complete. (It is not required to show the heights of each node in the AVL tree.)

3. (15%) Big-Oh and Run Time Analysis:
   (a) Describe the running time of the following pseudo-code in Big-Oh notation in terms of the variable \texttt{n}.
   Assume all variables used have been declared.

   ```
   int foo(int k) {
       int cost;
       for (int i = 0; i < k; ++i) {
           cost = cost + (i * k);
       }
       return cost;
   }
   ```

   (1) \texttt{ans = foo(n)};

   (2) int sum;
       for (int i = 0; i < n; ++i) {
           if (n < 1000)
               sum++;
           else
               sum += foo(n);
       }
(3) for (int i=0; i < n+100; ++i){
    for (int j = 0; j < i * n; ++j){
        sum = sum + j;
    }
    for (int k = 0; k < n + n + n; ++k){
        c[k] = c[k] + sum;
    }
}

(4) for (int j=4; j < n; j=j+2){
    val = 0;
    for (int i = 0; i < j; ++i) {
        val = val + i * j;
        for (int k = 0; k < n; ++k){
            val++;
        }
    }
}

(5) for (int i=0; i < n*1000; ++i){
    sum = (sum * sum)/(n * i);
    for (int j = 0; j < i; ++j) {
        sum += j * i;
    }
}

(b) Consider the following function. Write down the complete recurrence relation, T(n), for the running time of mystery(n). Be sure you include a base case T(0). (You do not have to actually solve this relation)

```c
int mystery(int n) {
    int answer;
    if (n > 0) {
        answer = (mystery(n-2)+3 * mystery(n/2) + 5);
        return answer;
    }
    else
        return 1;
}
```
4. (10%) Suppose that smaller number node is visited first. According to the following graph,

(a) Draw the depth-first spanning tree starting from node 1.
(b) Write the back edges of the depth-first spanning tree in (a).
5. [10 pts] Given the following code segments. List the error(s) / issue(s) and the fix(es).

(a) [5 pts]

```c
#include <stdio.h>

int main()
{
    float result = 7.0 / 22.0;
    printf("The result is %d.\n", result);
    return 0;
}
```

(b) [5 pts]

```c
#include <stdio.h>
#define QUAD(x) (x * x * x)

int main()
{
    int counter = 2;
    printf("%d\n", QUAD(counter+3));
    return 0;
}
```

6. [30pts] Please write down the results of the following programs:

(a) [5 pts]

```c
#include <stdio.h>

int main()
{
    int i;
    for ( i = 1 ; i < 15 ; i++ )
    {
        if ( i % 3 == 0 )
        {
            printf("%d\n", i);
        }
    }
    return 0;
}
```
(b) [5 pts]

```c
#include <stdio.h>

int main() {
    int i = 1;
    while( i <= 4 ) {
        switch ( i % 2 ) {
            case 0:
                printf("a\n");
                break;
            case 1:
                printf("b\n");
                break;
        }
        i++;
        if ( i > 4 ) {
            break;
        }
    }
    return 0;
}
```

(c) [10 pts]

```c
#include <stdio.h>

int main() {
    int a = 0;
    int b = 1;
    int n = 20;
    for ( a = 1; a <= n; a++ ){
        if (a % 3 == 0) continue;
        else{
            b = a < n/2 ? b * 2 : b * 1;
        }
    }
    printf("%d %d",a,b);
    return 0;
}
```
7. [10 pts] Try to write down a program: Calculate n! by using the while loop. The program can read an input n from standard input and print the result on standard output.

```c
#include <stdio.h>

int main(void) {
    //write your code here
}
```