國立中山大學 112 學年度
碩士班暨碩士在職專班招生考試試題

科目名稱：作業系統與資料結構【資工系碩士班甲組】

INSTRUCTIONS: If any question is unclear or you believe some assumptions need to be made, state your assumptions clearly at the beginning of your answer.

1. What are printed by each of the following C program?

   (a) (5%)
   ```c
   int a=40, b=24;
   printf("%d \n",(a&(~b))|((~a)& b));
       // ~: bitwise NOT; &: bitwise AND; |: bitwise OR
   ```

   (b) (10%)
   ```c
   int b[ ]={ 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42};
   int h(int i) {
       if (i==1)  {
           printf("%d  ", b[i]);
           return (b[1]);
       }
       else  if (i % 2 == 0) {
           printf("%d   ", b[i]);
           b[i/2] += i/2;
           return (h(i/2));
       }
       else {
           b[i+1] ++;
           return (h(i+1));
       }
   }
   int main( )
   {
       h(9);
   }
   ```

2. The pseudo code for the insertion sort is given as follows.
   ```
   Read input elements into a[ ]; //stored in a[1], a[2], ..., a[n]
   for i = 2 to n do
   {
       j = i;
       while (j >= 2) and  (a[j] < a[j-1]) do
       {
           Swap(a[j], a[j-1]); // exchange a[j] and a[j-1]
           j = j-1;
       }
   }
   ```

   (a) (5%) Suppose that the input elements are 3, 9, 6, 5, 8, 2. How many times (counts) are needed for the execution of Swap( )?

   (b) (5%) Suppose that the input is a permutation of $\{1,2,3,..., n\}$. What permutation will make Swap( ) be executed the least times? How many times?

   (c) (5%) Suppose that the input is a permutation of $\{1,2,3,..., n\}$. What permutation will make Swap( ) be executed the most times? How many times?

3. (10%) Suppose that there are 6 data elements A, B, C, D, E, F with their searching frequencies 4, 9, 1, 6, 8, 7, respectively, where $A < B < C < D < E < F$. Please present the optimal binary search tree built with these 6 elements such that the searching cost is minimized.

4. (10%) The stamp cost problem (SCP) is to stick the exact cost of stamps on an envelope. In the post office, there are five types of stamps:1, 2, 3, 4, 5 dollars. You are asked to calculate all possible combination ways for getting j dollars. Let $g(i,j)$ denote the number of combination ways for j dollars, where only stamps with 1, 2, ...,i dollars are used. Note that i and j are both positive integers, $1 \le i \le 5$ and $1 \le j \le n$ (an integer constant). For example, $g(2, 3)=2$, since there are two ways for constituting 3 dollars with 1-dollar and 2-dollar stamps: 1+1+1 and 1+2. As another example, $g(3, 4)=4$, since four ways can be used to get 4 dollars with 1-dollar, 2-dollar and 3-dollar stamps: 1+1+1+1, 1+1+2, 2+2 and 1+3. However, the stamps with 3-dollar and 4-dollar have been sold out (no such stamps) today. Other stamps are assumed to be unlimited. Please give the recursive formula to calculate $g(i,j)$. You can assume that $g(i,0)=1$, $g(i,j)=0$ for $1 \le i \le 5$ and $j \le -1$.

5. (a) (7%) What are the seven common components in a process control block?

   (b) (3%) What are the purposes of mutex, semaphore, and condition variable?

6. (a) (6%) What is the difference of the binding of instructions and data to memory addresses in compile time, load time, and execution time?

   (b) (4%) How to solve the thrashing problem by using the working-set model?

7. (a) (6%) Explain sequential, direct, and index accesses for a file.

   (b) (4%) What are consistency semantics for a file system?

8. (a) (4%) Explain how the deadlock prevention scheme works.

   (b) (3%) Explain three latencies concerned by a real-time system.

   (c) (3%) Give three reasons not to use caching in a distributed file system.

9. (10%) Explain the following terms:

   (a) vectored I/O

   (b) safety-critical system

   (c) logic bomb

   (d) turnaround time

   (e) race condition