國立臺北科技大學 112 學年度碩士班招生考試

系所組別：2210 電子工程系碩士班甲組

第一節　計算機概論　試題

注意事項：

1. 本試題共八大題，共 100 分。
2. 不必抄題，作答時請將試題題號及答案依照順序寫在答案卷上。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

1. (10%) Assume that initially we have

   ```
   int x=0; int y=0;
   ```

   What could the output of the concurrent execution of process A and process B be?
   (Please list all possible outputs)

   ```
   Process A

   while(x==0) {
       do-nothing;
   }
   printf("a");
   y=1;
   y=0;
   printf("d");
   y=1;
   ```

   ```
   Process B

   printf("b");
   x=1;
   while(y==0){
       do-nothing;
   }
   printf("c");
   ```

2. (20%) Consider a system has 4 physical pages and initially these pages are empty. The system is given a reference string 1,2,3,4,2,5,6,2,3,2,1,6,7.

   (a) How many page faults will occur when the system uses the first-in first-out (FIFO) replacement scheme? (2%)
   (b) Based on (a), what are the remaining pages after the reference string completed? (3%)
   (c) How many page faults will occur when the system uses the least-recently-used (LRU) replacement scheme? (2%)
   (d) Based on (c), what are the remaining pages after the reference string completed? (3%)
   (e) Is it possible to increase the number of physical pages to reduce page faults for FIFO? Why or why not? (5%)
   (f) Is it possible to increase the number of physical pages to reduce page faults for LRU? Why or why not? (5%)

3. (20%) Fill the blanks from (a) to (e) below to complete the functionality of using binary semaphore to implement counting semaphore. You can use *wait()* and *signal()* functions to decrement and increment semaphore variables. The variable C represents available resources in the system. (Each blank is 4%)

   ```
   Data structure
   ● Binary semaphore S1 and S2
   ● int C
   ● Initial S1=1,S2=0,C=N
   ```

   ```
   Wait_counting ()
   {
       wait (S1);
       C --;
       if (C < 0){
           ___(a)___
           ___(b)___
       }
       ___(c)___
   }
   ```

   ```
   Signal_counting ()
   {
       wait (S1);
       C++;
       if (C <= 0)
           ___(d)___
       else
           ___(e)___
   }
   ```

4. (10%) (a) Given a set {1, 5, 0, 6, 2, 3, 4}, please show the procedure of constructing a maximum heap tree. (5%)
   (b) Please show the detail procedure of sorting the above integer set (in decreasing order) by heap sort. (5%)

5. (10%) Please implement the fib function called by line 8, i.e., `printf("%d, ", fib(i));`. The implemented fib function should be a recursive function, and the function prototype of fib is `int fib(int n);`

   ```
   int main() {
       int n, i = 0, c;

       printf("Please enter term numbers: ");
       scanf("%d", &n);
       printf("Fibonacci Series: ");
       for (i = 0 ; i < n ; i++ )
       {
           printf("%d, ", fib(i));
       }
       printf("\n");
       return 0;
   }
   ```

   Simple input and output:

   ```
   Please enter term numbers: 9
   Fibonacci Series: 0, 1, 1, 2, 3, 5, 8, 13, 21,

   Please enter term numbers: 4
   Fibonacci Series: 0, 1, 1, 2,
   ```

注意：背面尚有試題

6. (10%) Short answers

(a) Please briefly describe the functionality of each layer of OSI 7-layered model. (7%)

(b) What is context switch? (1%)

(c) What is interrupt service routine? (1%)

(d) What is thrashing? (1%)

7. (10%) Consider the following program with fork function

(a) How many processes are created by the program shown below (including the initial parent process) ? (3%)

(b) Draw a tree structure to illustrate the parent-child relationship in the example. (4%)

(c) Provide printf outputs. (3%)

```c
#include <stdio.h>
#include <stdlib.h>
#include <sys/types.h>
#include <unistd.h>

int main(void)
{
    int x = 3;
    pid_t p1, p2, p3;

    p1 = fork();
    printf("pt_1: %d\n",x);
    if (p1 == 0) {
        p2 = fork();
        if (p2 == 0) {
            x -= 1;
            printf("pt_2: %d\n",x);
            exit(0);
        }
        x+=2;
        printf("pt_3: %d\n",x);
        exit(0);
    }

    wait(NULL);
    p3 = fork();
    if (p3 == 0) {
        x++;
        printf("pt_4: %d\n",x);
        exit(0);
    }
    x+=5;
    printf("pt_5: %d\n",x);

    wait(NULL);
    printf("pt_6: %d\n",x);

    return 0;
}
```

8. (10%) Use C, Python, or Java programming language to print the following shape (according to the user inputted "Layers"). Note that your program should be executable and include all the details. The grade will be evaluated by the correctness and the quality of your program.

```
Layers? 3
***
 **
  *
```

```
Layers? 5
*****
 ****
  ***
   **
    *
```

```
Layers? 7
*******
 ******
  *****
   ****
    ***
     **
      *
```