

# 國立彰化師範大學 98 學年度碩士班招生考試試題

系所：數位學習研究所

科目：資料結構

☆☆請在答案紙上作答☆☆

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1. 求取兩個正整數之最大公因數(greatest common divisor)，請回答下列問題：

(a) 請使用 C 語言，撰寫遞迴(recursive)程式，實作 GCD(x, y)，其中 x 與 y 分別為兩正整數。(5%)

(b) 承(a)題，撰寫迭代(iteration)程式，如 do...while 或 while...，實作 GCD(x, y)。(5%)

2. 如下程式：

```
int f(int n) {  
    if (n==0) return 0;  
    if (n==1) return 1;  
    if (n==2) return 2;  
    return (f(n-1)-f(n-2)+f(n-3));  
}
```

請問 f(5)共被呼叫幾次？包含 f(5)。(5%)

3. 關於堆疊(stack)與佇列(queue)，請回答下列問題：

(a) 下列程式片段，為 stack 的 push 運算，請填充格：(5%)

```
#define maxsize 200  
int stack[maxsize];  
int top=1;  
void push(int element) {  
    if(IsFull()) StackFull();  
      
}
```

(b) 使用 linked list 實作 queue 的程式宣告如下：

```
typedef struct queue *queue_pointer;  
typedef struct queue {  
    element item;  
    queue_pointer link;  
};
```

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```
queue_pointer front, rear;
```

自鏈結佇列的前端刪除元素，請填充格：(10%)

```
element deletequeue(queue_point *front)
```

```
{ queue_pointer temp=*front;
```

```
element item;
```

```
if(IsEmpty(*front)) {
```

```
fprintf(stderr, "The queue is empty!");
```

```
exit(1);
```

```
}
```


```
free(temp);
```

```
return item;
```

```
}
```

(c) 撰寫一個演算法來描述如何利用 stack 計算一個後置算術式子(postfix expression)的值。(10%)

(d) 以後置算術式子： $20 \ 5 \ 3 + 6 * 8 \ 3 - \% \ 1 + /$ ，其中%為“取餘數運算子”，說明(c)題演算法的執行情況。(10%)

4. Which of the following statements is incorrect? (4%)

(A)  $5n^2 - 6n = O(n^2)$

(B)  $10n^{100} + 2^n = O(n^{100})$

(C)  $99n + 1 = O(n)$

(D)  $100 + 5 = O(1)$

5.  $\Theta(n)$  and  $O(n)$  actually are set of functions. But we often say  $\Theta(n) + O(n)$ . Which one is the best to present the result of the addition? (4%)

(A)  $\Omega(n)$

(B)  $O(n)$

(C)  $\Theta(n)$

(D)  $o(n)$

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6. Minimum spanning tree of a weighted graph can be solved by using the Kruskal's algorithm. Given a weighted graph  $G=(V,E)$ , there are  $|V|$  vertices and  $|E|$  edges.

請選出錯誤的敘述：(4%)

- (A) Kruskal's algorithm is a greedy approach, i.e., we iteratively select the least weight edge and test if the edge can be a tree edge.
- (B) To select the least weight edge can be implemented by using a heap or presorting the edges by their weights. Using a heap could be more efficient than presorting the edges.
- (C) To test whether a selected edge is a tree edge, we can use the Union-Find algorithm. The testing takes  $O(|V| \alpha(m,n))$  time, where  $\alpha(m,n)$  is the inverse of the Ackermann's function.
- (D) There could be many spanning trees that are all minimum spanning tree in  $G$ .

7. Consider the following algorithm. (15%)

- (1) When  $n=5$ ,  $x=?$
- (2) When  $n=16$ ,  $x=?$
- (3) What is the time complexity of this program?

```
Input: n
Output: x
Begin
x ← 0; i ← 1
while i ≤ n do {
j ← 2
i ← i+1
While j ≤ n do {
x ← x+1
j ← j * j
}
}
End
```

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8. Briefly explain the following terms: (15%)

- (1) AOV network
- (2) Binary search tree
- (3) Min-max heap
- (4) Priority queue
- (5) Biconnected component

9. Show your hash table, which contains 5 buckets and each bucket containing at most 3 records, after inserting 15, 17, 26, 24, 11, 12, 9, 20, 8, 25, 30 if the hashing function is based on division and the overflow handling is linear open addressing. Calculate the average number of probes associated with your hash table. (8%)