

國立中山大學 102 學年度碩士暨碩士專班招生考試試題

科目名稱：資料結構【資管系碩士班丙組】

題號：442003

※本科目依簡章規定「不可以」使用計算機

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A. Multiple choices: 10 questions, 5% each

1. Here is the code for an integer variable n:

```
while (n > 0)
{
    n = n/10; // Use integer division
}
```

What is the worst-case time analysis for the above loop?

- A. $O(1)$
 - B. $O(\log n)$
 - C. $O(n)$
 - D. $O(n^2)$
2. Is it possible for a method of a class to activate another method of the same class?
- A. No.
 - B. Yes, but only public methods.
 - C. Yes, but only private methods.
 - D. Yes, both public and private methods can be activated within another method.
3. Given the method implementation using the Location type as follows:

```
public static void f(int i, Location k)
{
    i += 1;
    k.shift(2, 0);
}
```

Suppose that a main program has an integer variable m (equal to zero), and a Location object n (with n.getX() equal to zero). Then the main program calls f(m,n); What are the values of m and n.getX() after the method f finishes?

- A. Both m and n.getX() are still 0.
 - B. m is now 1, but n.getX() is still 0.
 - C. m is still 0, but n.getX() is now 2.
 - D. m is now 1, and n.getX() is now 2.
4. Given the method implementation as follows:

```
public static foo(int[ ] b)
{
    b[0]++;
}
```

What is printed by these statements?

```
int[ ] x = new int[100];
x[0] = 2;
foo(x);
System.out.println(x[0]);
```

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- A. 0
- B. 1
- C. 2
- D. 3

5. Which boolean expression indicates whether the numbers in two nodes (p and q) are the same. Assume that neither p nor q is null.

- A. $p == q$
- B. $p.data == q.data$
- C. $p.link == q.link$
- D. None of the above.

6. What kind of list is best to answer questions such as "What is the item at position n?"

- A. Lists implemented with an array.
- B. Doubly-linked lists.
- C. Singly-linked lists.
- D. Doubly-linked or singly-linked lists are equally best

7. Consider the following pseudo code:

```
declare a stack of characters
while ( there are more characters in the word to read )
{
    read a character
    push the character on the stack
}
while ( the stack is not empty )
{
    pop a character off the stack
    write the character to the screen
}
```

What is written to the screen for the input "oranges"?

- A. oage
- B. oranges
- C. segnaro
- D. oorraannggeess

8. What is the value of the postfix expression 6 3 2 4 + - *:

- A. Something between -15 and -100
- B. Something between -5 and -15
- C. Something between 5 and -5
- D. Something between 5 and 15
- E. Something between 15 and 100

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9. Given the method declaration as follows:

```
void quiz(int i)
{
    if (i > 1)
    {
        quiz(i / 2);
        quiz(i / 2);
    }
    System.out.print("*");
}
```

How many asterisks are printed by the method call quiz(5)?

- A. 3
- B. 4
- C. 7
- D. 8
- E. 9

10. What is the minimum number of nodes in a full binary tree with depth 3?

- A. 3
- B. 4
- C. 8
- D. 11
- E. 15

B. Answer the following questions

11. (20%, 5% each)

- (a) True or False. In a breadth-first traversal of a min heap, the first item printed out is always the smallest one. If true, explain why; if false, give an example where it is false.
- (b) True or False. In a preorder traversal of a binary search tree, the first item printed out is always the smallest one. If true, explain why; if false, give an example where it is false.
- (c) If you are sorting a million items, how much faster (roughly) is a heap sort than an insertion sort? (Note: $\log(1,0000,000) = 20$.)
- (d) Considering the following rules for sorting a string:

- (1) $ba \rightarrow ab$
- (2) $ca \rightarrow ac$
- (3) $cb \rightarrow bc$

Step by step list how you use the “least-used first” conflict resolution strategy to complete the sorting for string “cbaca”.

12. (8%, 2% each)

What is the order of each of the following tasks? (Choose from $O(1)$, $O(\log_2 n)$, $O(n)$, $O(n \log_2 n)$, $O(n^2)$, $O(2^n)$; each order may appear more than once.)

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- (a) Popping an item off a stack containing n items.
- (b) Performing a Towers of Hanoi algorithm with n disks.
- (c) Using quicksort to sort an array of n integers, in the average case.
- (d) Inserting a single item into a binary search tree containing n items, in the average case.

13. (6%)

A stack of integers aStack has the following private data:

top: 4 (the array index starts counting from 0)

items: 8 0 0 4 7 10 -43223 0 78623 -87899

What is the output of the following code?

```
int x;
while (!aStack.isEmpty()){
    aStack.pop(x);
    cout << x << " ";
}
```

14. (8%)

What is the output of the following program?

```
#include<iostream>
int binarySearch(const int anArray[], int first, int last, int value){
    cout << "binarySearch: first = " << first
        << ", last = " << last << ".\n";
    if (first > last)
        return -1;
    else{
        int mid = (first + last)/2;
        if (value == anArray[mid])
            return mid;
        else if (value < anArray[mid])
            return binarySearch(anArray, first, mid-1, value);
        else
            return binarySearch(anArray, mid+1, last, value);
    } // end else
} // end binarySearch
int main(){
    int a[] = {1,4,5,10,12,18,25,31,107};
    cout << binarySearch(a,0,8,12) << endl;
    cout << binarySearch(a,0,8,15) << endl;
}
```

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15. (8%)

Write the pseudo code of a depth first search-based algorithm to determine the minimal spanning tree (MST) of a graph. Use your algorithm to find the MST for a graph $G = (V, E)$, $V = \{1, 2, 3, 4, 5, 6\}$, $E = \{(1, 2), (2, 3), (3, 4), (4, 5), (1, 5), (2, 4), (2, 6), (1, 6), (4, 6), (5, 6)\}$, and the cost for above edges are $\{16, 5, 9, 6, 10, 8, 11, 21, 14, 19\}$, respectively.

