中原大學 104 學年度 ☑上學期 **考試題卷** ☑期中

科目名稱：資料結構　開課班級：資工二甲/資工二乙　油印份數：99/66
考試時間：11 月 11 日 第 3 節　科目代號：CS103D/CS103E　教師姓名：吳宜鴻
☑不可使用計算機、翻譯機或手機　☑可以使用紙本字典　本份試題共 4 頁，本版面為第 1 頁
☑直接在命題紙上作答（背面可作為計算用紙）　☑評分將不予部分給分，作答務必力求完整

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I. Single-Choice Problems (50%) 每題 3 分，共 20 題，答錯一題倒扣 1 分，超出 50 分以 50 分計

A 1. A recursive binary search on a sorted array of 100 elements has _____ base cases. (A) 2 (B) 99 (C) 100 (D) 101

B 2. Given the array-based implementation of ADT List, how many data movements will the following algorithm perform on a list of 10 items? (A) 40 (B) 126 (C) 135 (D) 145

```
reverseList5(in aList:List, out success:boolean)
 for (i = 1 to aList.getLength() - 1)
 {   aList.retrieve(1, dataItem, success);
     aList.insert(aList.getLength() – i + 2, dataItem, success);
     aList.remove(1, success);
 }
```

D 3. Which of the following statements inserts a new node, pointed to by newPtr, at the beginning of a linked list? (A) newPtr->next = cur; pre->next = newPtr; (B) pre->next = cur; newPtr->next = cur; (C) newPtr->next = NULL; (D) newPtr->next = head; head = newPtr;

D 4. Which of the following strings is in the language defined by the following grammar? (A) 0b1 (B) 00a1 (C) 00b11 (D) 00a11

<X> = a | 0<Y>
<Y> = b | <X>1

A 5. Using a stack to check balanced braces, if the stack is empty when reaching the end of the string, there must be _____? (A) balanced braces (B) no "}" (C) more "{" than "}" (D) more "}" than "{"

C 6. Which of the following statements will delete the first node, pointed to be cur, from a circular linked list? (A) tail = head->next; (B) head = tail->next; (C) tail->next = tail->next->next; (D) head->next = head->next->next;

B 7. To find a recursive solution for a problem, which of the following conditions is NOT necessary? (A) it is defined in terms of smaller problems (B) a numerical variable is denoted as the problem size (C) every recursive call reduces the problem size (D) there are at least one base cases

C 8. For an array containing 2, 3, 6, 9, 13, 16, and 19, what value does a recursive binary search algorithm return when it searches for 9? (A) -1 (B) 1 (C) 3 (D) 6

A 9. A recursive function fact(n) that finds the factorial of a natural number n would call itself _____ times in total if the base case is n=1. (A) n (B) n-1 (C) n+1 (D) n+2

C 10. In the recursive solution to _____, the problem size is decreased by half at each recursive call. (A) calculating the factorial (B) Towers of Hanoi (C) finding the maximum (D) finding the k-th smallest

B 11. Which of the following is TRUE for doubly linked lists with a dummy head? (A) the precede pointer of the last node has the value NULL (B) the next pointer of the last node has the value NULL (C) the next pointer of the last node references the dummy head (D) the precede pointer of the dummy head references the last node

B 12. What will the recursive algorithm FX(s) display? (A) string s (B) string s backward (C) nothing (D) the first character of string s repeated as many times as the length of s

```
FX(in s: string)
 if (s is not empty)
 {   FX(the string beginning at the second character of s)
     Display the first character of s
 }
```

C 13. Given 4 disks in the Towers of Hanoi problem, the recursive algorithm needs to calls the same function at most _____ times. (A) 15 (B) 16 (C) 22 (D) 31

A 14. Which of the following is NOT the benefit of modularity? (A) it runs faster (B) it is easier to modify (C) it isolates errors (D) it eliminates redundancies

B 15. After execution of the following codes, line ___ will cause a memory leak. (A) 1 (B) 2 (C) 3 (D) 4

```
int *p = new int, *q = new int;     // line 1
p = q;                              // line 2
delete p;                           // line 3
q = NULL;                           // line 4
```

C 16. Which of the following is a prefix expression? (A) a b c + / (B) a / (b + c) (C) / a + b c (D) * a b c / +

D 17. An algorithm that uses a stack to implement a non-recursive solution to the HPAir problem draws the conclusion that there exists a path from the origin to the destination only after it has _____. (A) backtracked to the origin (B) backtracked to a city (C) reached a city (D) reached the destination

D 18. Which of the following statements will delete a node, pointed to by cur, from a doubly linked list? (A) cur->precede=cur->next; cur->next=cur->precede; (B) (cur->precede)->next=cur->next; cur->next=cur->precede; (C) cur->next=(cur->precede)->next; cur->precede=(cur->next)->precede; (D) (cur->precede)->next=cur->next; (cur->next)->precede=cur->precede;

A 19. Which of the following belongs to the three basic types of operations on a data collection? (A) Remove data from a data collection (B) Move data to another data collection (C) Compute the statistics about all data in a data collection (D) Connect the data in a data collection

D 20. Fill the blanks in the following recursive algorithm that reverses the order of items in the array. (A) low, high-1 (B) low-1, high+1 (C) low+1, high (D) low+1, high-1

```
Algorithm ReverseArray(anArray, low, high)
 if low < high then
   Swap anArray[low] and anArray[high]
   ReverseArray(anArray, _____, _____)
 return
```

II. Simple-Answering Problems (50%) 每一空格 3 分，共 11 空格，無倒扣，超出 30 分以 30 分計

30

1. Complete the pseudo codes in terms of the ADT **List** operations.

(i) Exchange the first element and the last element in a list.

```
void swapFirstLast(in aList, out success)
    aList.retrieve(1, firstItem, success);
    aList.retrieve( (1) aList.getLength(), lastItem, success);
    aList.remove(1, success);
    aList. (2) remove (aList.getLength(), success);
    aList.insert( (3) aList.getLength()+1, firstItem, success);
    aList.insert(1, lastItem, success);
```

Operation Contract for the ADT **List**
createList()
destroyList()
isEmpty():boolean
getLength():integer
insert(**in** index, **in** newItem, **out** success)
remove(**in** index, **out** success)
retrieve(**in** index, **out** dataItem, **out** success)

(ii) Reverse the order of all elements in a list.

```
void reverseElementOrder(in aList, out success)
for (int i = 1; i < (4) aList.getLength(); ++i)
{   aList.retrieve(1, dataItem, success);
    aList.remove(1, success);
    aList.insert( (5) aList.getLength()-i, dataItem, success);
}   end for
```

2. Consider the language defined by the following grammar to answer the following questions.

<S> = <D> | <S> <U> | <D> <S>
<D> = 1 | 0
<U> = A | B

(i) Write all strings in the language that have less than three characters.
Answer: (6) 0, 1, 1A, 1B, 0A, 0B, 00, 01, 10, 11

(ii) Is the string 11AB00AB included in this language?
Answer: (7) NO

(iii) Modify the above grammar to define a language of bit-strings that the first character must be 0 and the last character must be 1.
Answer: (8) <S> = <0><D><1>
<D> = 1 | 0 | <D>1 | <D>0

3. Let aStack be a variable that can support stack operations such as ***isEmpty***, ***push*** and ***pop***. Complete the following pseudo code to determine whether the parentheses in the given expression are balanced.

```
isBalanced(string str): bool
balancedSoFar = true;
while (not end of string && balancedSoFar)
{   Read the next character ch from str;
    if (ch is '(')
        aStack. (9) push (ch);
    else if (ch is ')')
    {   if (!aStack.isEmpty())
            aStack. (10) pop ();
        else balancedSoFar = (11) false;
    }   end if
}   end while
if (balancedSoFar && aStack.isEmpty())
    return true;
else return false;
```


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III. Advanced Problems (20%) 每一空格 3 分，共 7 空格，無倒扣，超出 20 分以 20 分計

1. Give short C++ codes as an example to explain the meaning of each term. ***Get no point if there is no code!***

(i) encapsulation:
Answer: (1) 封裝是將程式碼藏起來，只提供使用者用到的 Operator 及其說明，其於皆不可從外部使用。
No code?

(ii) inheritance:
Answer: (2)
```
class ex : pubic exsuper
{   :
};
```
繼承可以用父類別的非 private 的 data members 及 methods.

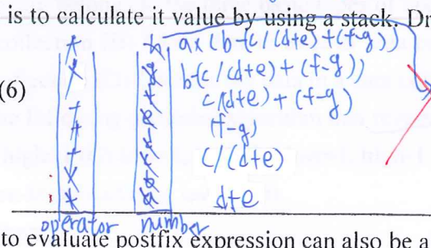
(iii) overloading:
Answer: (3)
```
bool ex::insert(string input, int index);
bool ex::insert(char ch, int index);
```
除參數外，其它皆相同

(iv) overriding:
Answer: (4)
可以有多個 Object
ex a();
ex b();

2. Given the infix expression (a * (b – (c / (d + e)) + (f – g))) + h, answer the following questions about evaluating it by using a stack.

(i) The first step transforms it into the postfix expression:
Postfix expression: (5) abcde+/fg-+-xh+

(ii) The second step is to calculate it value by using a stack. Draw the content of stack after each operators is calculated.
Content of stack: (6)



(a*(b-(c/(d+e))+(f-g)))+h

(iii) The above way to evaluate postfix expression can also be applied to prefix expression. Explain how.
Answer: (7) +*a-b+/c+de-fgh
數錯