

國立交通大學九十二學年度碩士班入學考試試題

141.

科目名稱：資料結構(101, 111, 121, 131) 考試日期：92年4月20日 第1節

系所班別：資訊科學系 組別：甲組~戊組

第1頁, 共6頁

*作答前, 請先核對試題、答案卷(試卷)與准考證上之所組別與考試科目是否相符!!

1. (3pts) Which is the least essential operation to define for (pure) stack data type?
甲、boolean empty() - Tests if this stack is empty
乙、Object peek() - Looks at the object at the top of this stack without removing it from the stack.
丙、Void push(Object item) - Pushes an item onto the top of this stack.
丁、Object pop() - Removes the item at the top of this stack and returns that item as the value of this function.
戊、size() - Returns the number of items in this stack.

2. (3pts) An implementation of the stack data type is sketched below:

```
Object[] items = new Object[1];
int top = -1;

boolean empty(){ return top == -1; }
void push(Object obj) {
    if (top == items.length - 1) {
        enlarge ();
    }
    items[++top] = obj;
}
private void enlarge ()
{
    Object[] tmp = new Object[items.length * 2];
    for (int i=0; i < items.length; i++) {
        tmp[i] = items[i];
    }
    items = tmp;
}
Object pop() {
    Object obj = items[top];
    items[top--] = null;
    return obj;
}
Object peek() { return items[top]; }
```

What is the worst case time complexity best characterizing the push() operation, assuming n is the total number of operations applied to the stack.

- 甲、O(1)
乙、O(log n)
丙、O(n)
丁、O(n log n)
3. (3pts) As in Question 3, what is the worst case time complexity best characterizing pop()?
甲、O(1)
乙、O(log n)
丙、O(n)
丁、O(n log n)
4. (3pts) As in Question 3, what is the amortized time complexity best characterizing push()?
甲、O(1)
乙、O(log n)
丙、O(n)
丁、O(n log n)

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系所班別：資訊科學系 組別：甲~戊組 第2頁, 共6頁

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5. (3pts) The figure below shows a maze where A is the entrance, Y the exit, and gray cells the walls. Assume one can move in four directions (north, south, east, and west). To search for a feasible path from A to Y, it is natural to use a stack to record visited paths while in the middle of the maze..

A	B	C	D	E
F	G	H	I	J
K	L	M	N	O
P	Q	R	S	T
U	V	W	X	Y

Assume that after entering a cell its neighboring, not-yet-visited cells are tried in alphabetical order. What is the least likely configuration of the stack during the search (assuming stack grows to the right)?

甲、ABGLMRW

乙、ABGLMNOJ

丙、ABGLKPU

丁、ABCD

6. (3pts) Which is the infix representation of the postfix expression $abc+d*e/f--g+$, assuming normal operator priority?

甲、 $(a - (b + c) * d / e - f) + g$

乙、 $a + (b + c) * (d / e) - f + g$

丙、 $a - ((b + c) * d / e - f) + g$

丁、 $(a - (b + c) * d / e) - f + g$

7. (3pts) Which code segment below implements the removal operation correctly for singly linked lists?

甲、

```
ListItem remove (ListItem item) {
    ListItem next = item.next;
    item.next = null;
    return next;
}
```

乙、

```
ListItem remove (ListItem item) {
    item.next = item.next.next;
    return item.next;
}
```

丙、

```
ListItem remove (ListItem item) {
    if (item.next == null) return null;
    ListItem next = item.next;
    item.next = next.next;
    return item.next;
}
```

丁、

```
ListItem remove (ListItem item) {
    if (item == null || item.next == null) return null;
    ListItem next = item.next;
    item.next = next.next;
    return next;
}
```


國立交通大學九十二學年度碩士班入學考試試題

科目名稱：資料結構(10, 11, 12, 13) 考試日期：92年4月20日 第1節

系所班別：資訊科學系 組別：甲~戊組 第3頁, 共6頁

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8. (3pts) Which code segment below implements the insertion operation correctly for doubly linked circular lists?

甲、

```
void insert (DListItem anchor, DListItem item) {
    item.right = anchor;
    item.left = anchor.left;
    anchor.left.left = item;
    anchor.left = item;
}
```

乙、

```
void insert (DListItem anchor, DListItem item) {
    item.left = anchor;
    item.right = anchor.right;
    anchor.right = item;
    anchor.right.left = item;
}
```

丙、

```
void insert (DListItem anchor, DListItem item) {
    item.left = anchor;
    item.right = anchor.right;
    anchor.right.left = item;
    anchor.right = item;
}
```

丁、

```
void insert (DListItem anchor, DListItem item) {
    item.right = anchor;
    item.left = anchor.left;
    anchor.right.left = item;
    anchor.right = item;
}
```

9. (3pts) Following the conventions of LISP, assume nodes with two data members: HEAD and TAIL. If $A = ((a(bc)))$, then $HEAD(A) = (a(bc))$, $TAIL(A) = NIL$, $HEAD(HEAD(A)) = a$, and $TAIL(HEAD(A)) = ((bc))$. $CONS(A, B)$ gets a new node T , stores A in its HEAD, B in its TAIL, and returns T . B must always be a list. If $L = a$ and $M = (bc)$, then $CONS(L, M) = (abc)$ and $CONS(M, M) = ((bc)bc)$. Three other useful functions are: $ATOM(X)$ which is true if X is an atom else false, $NULL(X)$ which is true if X is NIL, else false. $EQUAL(X, Y)$ which is true if X and Y are the same atoms or equivalent lists, else false. Which operations below extracts a from the list $A = (bc(a(cat)))$, assuming H HEAD and T TAIL?

甲、 $H(T(T(H(T(T(A))))))$

乙、 $H(T(T(A)))$

丙、 $H(T(T(T(T(A)))))$

丁、 $H(T(H(T(H(T(T(A))))))$

10. (3pts) As in question 9, which function below implements the APPEND operation that concatenates two lists into one?

甲、

```
List APPEND (List a, List b) {
    return CONS(HEAD(a), APPEND(TAIL(a), b));
}
```

乙、

```
List APPEND (List a, List b) {
    return NULL(b) ? a : APPEND(CONS(a, HEAD(b)), TAIL(b));
}
```

丙、

```
List APPEND (List a, List b) {
    return NULL(a) ? b : CONS(HEAD(a), APPEND(TAIL(a), b));
}
```

丁、

```
List APPEND (List a, List b) {
    return NULL(a) ? b : APPEND(TAIL(a), CONS(HEAD(a), b));
}
```

國立交通大學九十二學年度碩士班入學考試試題

科目名稱：資料結構(101)¹⁴¹ (21.13) 考試日期：92年4月20日 第1節

系所班別：資訊科學系 組別：甲~戊組 第4頁, 共6頁

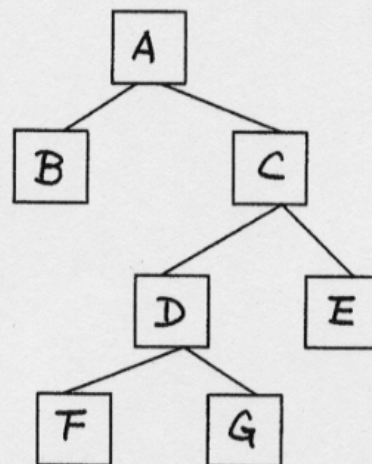
*作答前, 請先核對試題、答案卷(試卷)與准考證上之所組別與考試科目是否相符!!

11. Given a preorder traversal ABCDEFGHIJ:

- (a) (2 pts) Does such a traversal sequence uniquely define a binary tree ?
- (b) (3 pts) Now suppose you are also given another inorder traversal CBEDAHGIFJ. Does such a pair of traversal sequences, i.e. preorder and inorder, uniquely define a binary tree ?
- (c) (5 pts) Construct a possible binary tree that corresponds to the preorder and the inorder sequences.

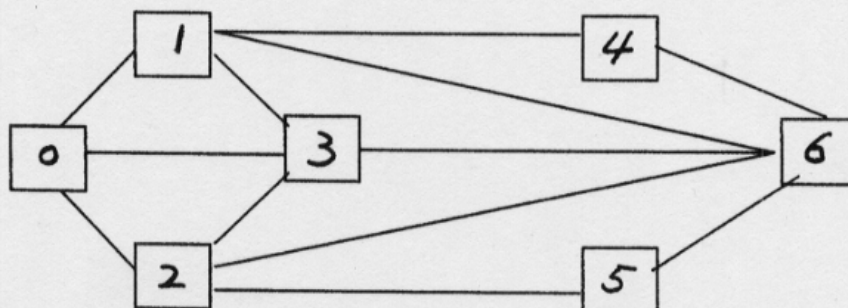
12. Draw the internal memory representation of the following binary tree, using

- 甲、(2 pts) array representation (i.e. sequential representation)
- 乙、(2 pts) linked representation
- 丙、(2 pts) Write the inorder and the level-order traversal sequences.



13. (6 pts) For any nonempty binary tree, prove that if n_0 is the number of leaf nodes and n_2 the number of nodes of degree 2, then $n_0 = n_2 + 1$.

14. Given the following undirected graph:



- 甲、(3 pts) show its adjacency matrix
- 乙、(3 pts) show its adjacency list

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系所班別：資訊科學系 組別：甲組~戊組 第 5 頁, 共 6 頁

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- 丙、(3 pts) show its sequential representation, using a one-dimensional array
- 丁、(3 pts) show the depth-first spanning tree, starting from node 0 and in the alphabetical order.
- 戊、(3 pts) show the breadth-first spanning tree, starting from node 0 and in the alphabetical order.

FIGURES ARE IN THE NEXT PAGE.

15. (5pts) Given is a min-max heap as shown in Figure 1. Consider the insertion operation in a min-max heap. Suppose we are insertion a key j into that min-max heap. We know that j is first inserted as a right son of 10. To move j to its correct location, we first compare j against 10. Show that if $j > 10$, the final location of j will be in the max-level.
16. (a.) (5pts) Given is an n internal nodes binary search tree (so there are $n-1$ external nodes). Supposed all the nodes in this binary search tree have equally probability to be accessed. What is the cost for the optimal binary search tree? (What is your reason?)
(b.) (5pts) If all the nodes (internal nodes and external nodes) have different access probability, try your best to explain how to establish the optimal binary search.
17. (3pts) What is the resulted AVL-tree after insertion 4 into the AVL tree shown in Figure 2.
18. (5pts) What are the 2-3-trees after (a.) first insertion 15, (b) then insertion 12 into the 2-3-tree shown in Figure 3.
19. (4pts) When we say $\Theta(n \log n) + O(n \log n)$, what is result after such addition? What are your reasons?
20. Answer TRUE or FALSE. (6pts)
 - 甲、Quick sort has the best performance in sorting n numbers. It takes average $O(n \log n)$ time. Thus the best possible sorting algorithm needs $\Omega(n \log n)$ comparisons to sort n numbers.
 - 乙、 $\Theta(n \log n)$ can better describe the time required to merge-sort n numbers than $O(n \log n)$.
 - 丙、 $\Theta(n^2)$ can better describe the time required to selection-sort n numbers than $O(n^2)$.

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系所班別：資訊科學系 組別：甲組 ~ 戊組 第6頁, 共6頁

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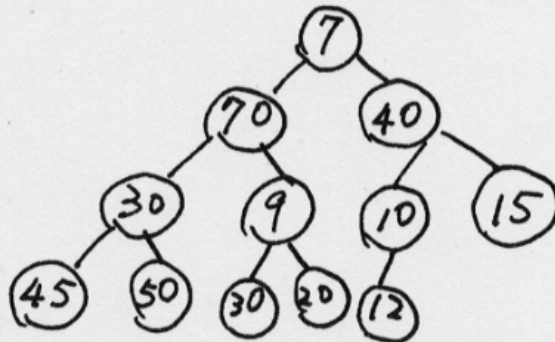


Figure 1

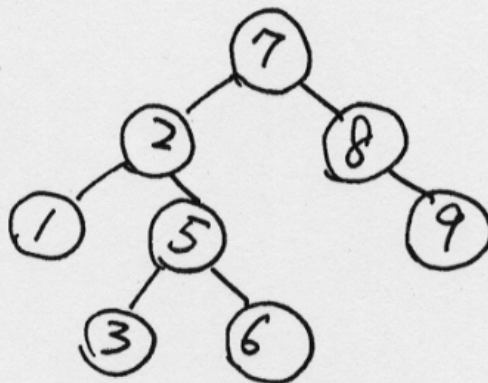


Figure 2

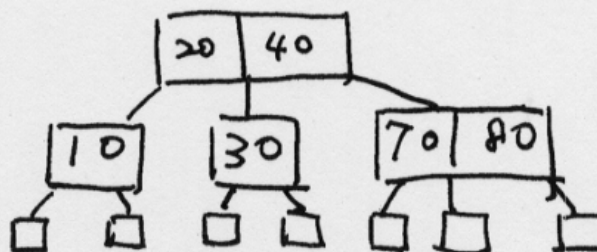


Figure 3