國立成功大學 106 學年度碩士班招生考試試題

系　　所：會計學系

考試科目：資料結構

考試日期：0214，節次：3

※ 考生請注意：本試題不可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. (20 分) This problem is about priority queues. Consider the following code fragment.

```
MaxPQ<Integer> pq = new MaxPQ<Integer>();
int N = a.length;
for (int i = 0; i < N; i++) {
   pq.insert(a[i]);
   if (pq.size() > k) pq.delMax(); /* MARK */
}
for (int i = 0; i < k; i++)
   System.out.println(pq.delMax());
```

Assume that a[] is an array of integers, MaxPQ is implemented using a binary heap, and $N \geq k \geq 1$.

(a) What does it output?

(b) What is the order of growth of its worst-case running time. Circle the best answer.

k log k　k log N　N log k　N log N　N^2

Now suppose the marked line was deleted. Repeat the previous two questions.

(c) What does it output?

(d) What is the order of growth of its worst-case running time. Circle the best answer.

k log k　k log N　N log k　N log N　N^2

2. (6 分) Modern computers have memory caches, which speed up reads and writes if they are to locations near recently-accessed memory. This makes sequential access to memory faster, in general, than random access. Circle the sorting algorithm below that you would expect to benefit least from caching?

insertion sort　mergesort　quicksort　heapsort

3. (30 分) You are applying for a job at a new software technology company. Your interviewer asks you to identify the following tasks as easy (E) or impossible (I). Explain each briefly.

(a) Build a balanced BST containing N keys using ~ 8N compares (where the array of keys are given to you in ascending order).

(b) Build a balanced BST containing N keys using ~ 8N compares (where the array of keys are given to you in arbitrary order).

(c) Build a binary heap containing N keys using ~ 2N compares (where the array of keys are given to you in arbitrary order).

(d) Build a BST containing N keys that has height at most 1 2 lg N.

(e) Design a priority queue that does insert and delete-max in ~ lg lg N compares per operation, where N is the number of items in the data structure.

4. (10 分) Consider the following binary search tree method.

```
public Key mystery(Key key) {
   Node best = mystery(root, key, null);
   if (best == null) return null;
   return best.key;
}

private Node mystery(Node x, Key key, Node best) {
   if (x == null) return best;
   int cmp = key.compareTo(x.key);
   if (cmp < 0) return mystery(x.left, key, x);
   else if (cmp > 0) return mystery(x.right, key, best);
   else return x;
}
```

(a) What does mystery(key) return. Assume key is a data type value of the specified type and not null. Choose the best answer.

A. Predecessor: the largest key in the symbol table < the search key?
B. Floor: the smallest key in the symbol table ≤ the search key?
C. Ceiling: the smallest key in the symbol table ≥ the search key?
D. Successor: the smallest key in the symbol table > the search key?
E. Get: the key in the symbol table equal to the search key if it's there; null otherwise.
F. Bad code: Null pointer exception or infinite loop on some inputs.

(b) What is the worst-case number of compares for mystery()? Assume that the BST is balanced. Circle the best answer.

1　　log N　N　　N^2　　2^N

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5. (24 分) Explain each of the following terms: A. radix sort　B. regular expression　C. depth-first search　D. minimum spanning tree.

6. (10 分) You receive the following message encoded using LZW compression.

97 98 128 129 131 132 130

Finish decoding the message. a b a b b a _____