

四川大学期末考试试题（闭卷）

（2019~2020 学年第 1 学期）

A 卷

课程号: 311076040 课程名称: 数据结构与算法 任课教师: _____

适用专业年级: 软件工程 2018 级 学号: _____ 姓名: _____

考生承诺

我已认真阅读并知晓《四川大学考场规则》和《四川大学本科学生考试违纪作弊处分规定（修订）》，郑重承诺：

- 1、已按要求将考试禁止携带的文具用品或与考试有关的物品放置在指定地点；
- 2、不带手机进入考场；
- 3、考试期间遵守以上两项规定，若有违规行为，同意按照有关条款接受处理。

考生签名: _____

| 题 号 | 一 (30%) | 二 (40%) | 三 (20%) | 四 (10%) |
|------|---------|---------|---------|---------|
| 得 分 | | | | |
| 卷面总分 | | 阅卷时间 | | |

- 注意事项: 1. 请务必将本人所在学院、姓名、学号、任课教师姓名等信息准确填写在试题纸和添卷纸上;
2. 请将答案全部填写在本试题纸上;
3. 考试结束, 请将试题纸、添卷纸和草稿纸一并交给监考老师。

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一、单项选择题（本大题共 15 小题，每小题 2 分，共 30 分）

提示：在每小题列出的四个备选项中只有一个是符合题目要求的，请将其代码写在答题纸上。错选、多选或未选均无分。

1. For an air traffic control system, the most important metric is: ().
A. The best-case upper bound.
B. The average-case upper bound.
C. The worst-case upper bound.
D. The best-case lower bound.
2. Consider the following definition of a recursive function ff.

```
int ff(int n) {  
    if(n == 0) return 1;  
    return 2 * ff(n - 1);  
}
```


If $n > 0$, what is returned by $ff(n)$? ().
A. $\log_2 n$
B. n^2
C. 2^n
D. $2 * n$

注：试题字迹务必清晰，书写工整。

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教务处试题编号: 311-6



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3. If a data element requires 4 bytes and a pointer requires 2 bytes, then a linked list representation will be more space efficient than a standard array representation when the fraction of non-zero elements is less than about: ().
- A. $2/3$
B. $3/4$
C. $1/3$
D. $1/2$
4. Which statement is not correct among the following four: ().
- A. In a BST, the left child of any node is less than the right child, but in a heap, the left child of any node could be less than or greater than the right child.
B. The number of empty subtrees in a non-empty binary tree is one more than the number of nodes in the tree.
C. A general tree can be transferred to a binary tree with the root having only left child.
D. A heap must be a full binary tree.
5. The golden rule of a disk-based program design is to: ().
- A. Minimize the number of disk accesses.
B. Eliminate the recursive calls.
C. Improve the basic operations.
D. Reduce main memory use.
6. The function of replacement selection sort is to ().
- A. Select the maximal element.
B. Generate the initial sorted merge files.
C. Merge the sorted file.
D. Replace some record.
7. Assume the preorder traversal sequence of a binary tree T is ABEGFCDH, the inorder traversal sequence of T is EGBFADHC, then the postorder traversal sequence of T will be ().
- A. GEFBHDCA
B. EGFBHDCA
C. GEFBDHCA
D. GEBFDHCA
8. Consider the following C++ code fragment.
- ```
x=191; y=200;
while(y>0)
 if(x>200){x=x-10; y--;}
 else x++;
```
- What is its asymptotic time complexity? ( )



- A.  $\Theta(1)$   
B.  $\Theta(n)$   
C.  $\Theta(n^2)$   
D.  $\Theta(n^3)$
9. When sorting  $n$  records, Selection sort will perform how many swaps in the worst case? ( )  
A.  $\Theta(\log n)$   
B.  $\Theta(n)$   
C.  $\Theta(n \log n)$   
D.  $\Theta(n^2)$
10. The single-source shortest path problem can be used to: ( ).  
A. Sort all of the graph vertices by value.  
B. Sort all of the graph vertices so that each vertex is listed prior to any others that depend on it.  
C. Sort all of the graph vertices by distance from the source vertex.  
D. None of the above.
11. In external sorting, a run is ( ).  
A. A sorted sub-section for a list of records.  
B. One pass through a file being sorted.  
C. The external sorting process itself.  
D. An external sorting method.
12. The priority queue is a structure implementing ( ).  
A. inserting item only at the rear of the priority queue.  
B. inserting item only at the front of the priority queue.  
C. deleting item according to the priority of the item.  
D. first in/first out
13. When using the weighted union rule for merging disjoint sets, the maximum depth for any node in a tree of size  $n$  will be ( ).  
A. nearly constant  
B.  $\Theta(\log n)$   
C.  $\Theta(n)$   
D.  $\Theta(n \log n)$
14. The output from scanning a minimum heap with level traversal algorithm ( ).  
A. must be an ascending sequence.  
B. must be descending sequence  
C. must have a minimum item at the head position.  
D. must have a minimum item at the rear position.



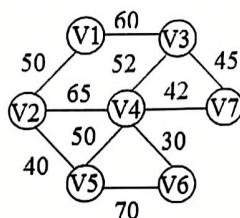
15. If a binary tree has 13 nodes with two degrees and 6 nodes with one degree, how many nodes are there with zero degree? (    )
- A. 7  
B. 15  
C. 14  
D. uncertain

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## 二、应用题（本大题共 5 小题，每小题 8 分，共 40 分）

提示：有求解过程的要尽量给出解题步骤，只有最终答案会酌情扣分。

1. List the order in which the edges of the graph in below figure are visited when running Prim's MST algorithm starting at Vertex V5. show the final MST.



2. Given sequence 43, 02, 80, 48, 26, 57, 15, 73, 21, 24, 66, select the value 57 as pivot, please write the Quicksort partition steps for pivot 57.
3. Using closed hashing, with double hashing to resolve collisions, insert the following keys into a hash table of thirteen slots (the slots are numbered 0 through 12). The hash functions to be used are H1 and H2, defined below.
- Keys: 2, 8, 31, 20, 19, 18, 53, 27
- $$H1(k) = k \% 13$$
- $$H2(k) = \text{Rev}(k+1) \% 11$$
- Function Rev(k) reverses the decimal digits of k, for example, Rev(31)=13, Rev(2)=2
- Please show the hash table after all eight keys have been inserted. Be sure to indicate how you are using H1 and H2 to do the hashing.
4. You are given a series of records key/pointer pairs whose keys are: 23, 48, 12, 10, 33, 49, 20, 18, 15, 21, 45, 47, 52, 31, 28.
- (1) Please show the B+ tree of order 4 that results from inserting these records. Assume that the leaf nodes are capable of 5 key/pointer pairs.
- (2) Show the result of deleting the record whose key is 18 from the B+ tree of (1)



5. You are given a series of values stored in an array: 10, 5, 12, 3, 2, 1, 8, 16, 29, 4
- (1) Show the max-heap that results from running **buildHeap** on the above values;
  - (2) show the heap that results from deleting the maximum value from the max-heap you just build in (1).

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三、编程、设计及分析题（本大题共 2 小题，第 1 小题 8 分，第 2 小题 12 分，共 20 分）。

提示：每小题给出了一个程序设计要求，请按照要求写出源程序代码，如果源程序代码中出现语法错误或逻辑错误，则酌情扣分。

1. Write a function to determine whether two binary trees are the same.
2. Write a function  $\text{search}(A, n, k)$  to find the  $k^{\text{th}}$  ( $1 \leq k \leq n$ ) smallest element in the first  $n$  ( $n \geq 1$ ) elements of array  $A$ . Each element in array  $A$  is distinct. For instance,  $A = \{39, 18, 22, 96, 12, 62, 52, 33, 90\}$ ,  $\text{search}(A, 6, 3)$  will return 22. What is the running time of your algorithm?

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四、分析题（本大题共 1 小题，共 10 分）。

提示：根据自己的理解和知识背景，对题目给出分析和阐述。

Please give examples of where the prim's algorithm and Dijkstra's algorithm are used in real life.

