软件学院本科生 2018——2019 学年第 2 学期算法导论课程期末考试试卷（A 卷）

专业：　　年级：　　学号：　　姓名：　　成绩:

草　稿　区

得分

一 、选择题（本题共 30 分，每小题 3 分）

1. In algorithm analysis, Θ indicates (　　)

A. Asymptotic lower bound　B. Asymptotic upper bound　C. Non-tight upper bound　D. Asymptotically tight bound

2. In the algorithm complexity analysis, which definition of O is correct? (　　)

A．If there are constants $\varepsilon > 0$ and $n_0 \geq 0$, so that for all $n \geq n_0$, there is $T(n) \geq \varepsilon \cdot f(n)$, then $T(n)$ is $O(f(n))$

B．If there are constants $c > 0$ and $n_0 \geq 0$, so that for all $n \geq n_0$, there is $T(n) \leq c \cdot f(n)$, then $T(n)$ is $O(f(n))$

C．If there are constants $\varepsilon > 0$ and $n0 \geq 0$, so that for all $n \leq n0$, there is $T(n) \geq \varepsilon \cdot f(n)$, then $T(n)$ is $O(f(n))$

D．If there are constants $c > 0$ and $n_0 \geq 0$ so that for all $n \leq n_0$, there is $T(n) \leq c \cdot f(n)$, then $T(n)$ is $O(f(n))$

3. An unordered list contains n distinct elements. What is the minimum number of comparisons required to find an element in this list that is neither maximum nor minimum? (　　)

A．$O(1)$　　B. $O(\log n)$　　C. $O(n \log n)$　D. $O(n)$

4. Given two arrays $\boldsymbol{A}= \boldsymbol{a}1, \boldsymbol{a2}, \cdots, \boldsymbol{an}$; $\boldsymbol{B} = \boldsymbol{b1}, \boldsymbol{b2}, \cdots, \boldsymbol{bn}$, each array contains n numbers and is arranged in ascending order. Please merge them into one ascending array. What is the running time? (　　)

A. $O(n)$　B. $O(\log n)$　C. $O(n \log n)$　D. $O(n^2)$

5. The asymptotic expression of the function $32^n+10n\log n$ is (　　)

A．$32^n+n\log n$　　B. 32^n　　C. $n \log n$　D. $10n \log n$

6. Consider the following pairs of functions $f(n)$, $g(n)$. Which pair of the functions are as follow, that $f(n)$ is $O(g(n))$ and $g(n)$ is not $O(f(n))$? ( )

A. $f(n) = n^3, g(n) = n^2 \log(n^2)$

B. $f(n) = \log n, g(n) = 10 \log n$

C. $f(n) = 1, g(n) = \log n$

D. $f(n) = n^2, g(n) = 10 n \log n$

7. The running time of the following code is ( )

```
i=k=0
while(k<n){
   i++;
   k+=i;
}
```

A. $O(n)$ B. $O(\log n)$ C. $O(n \log n)$ D. $O(n^{\frac{1}{2}})$

8. The main difference between greedy algorithms and the dynamic programming algorithms is ( )

A. Optimal substructure B. Greedy choice C. Construct optimal solution D. Define the optimal solution

9. In solving the cache problem, to obtain the minimum number of evictions, which is the optimal scheduling scheme? ( )

A. Most Recently Used B. Nearest in the Future C. Least Recently Used D. Farthest in the Future

10. Which of the following questions cannot be solved with a greedy algorithm? ( )

A. 0-1 knapsack problem

B. Shortest path problem

C. Single-linkage clustering problem

D. Optimal caching problem

草 稿 区

得分

二 、填空题（本题共 20 分，每空 2 分）

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1. Steps to design a dynamic programming algorithm：
   a) Break up a problem into a series of_____;
   b) Combine_____to_____to form solution to_____.
2. Rank the following functions: $\log\sqrt{n}$, $\log n$, $\sqrt{n}$, n，$n\log\sqrt{n}$, $n!$, 2^n by order of growth in increasing sequence.
   _____
3. There is an ordered array A of n numbers. The running time required for determining whether a given number p belongs to this array is _____.
4. We use the greedy algorithm to solve the optimal loading problem. It aims to load the maximum number of containers onto the ship under the ship's load capacity (载重量). The key step is to sort the containers in the ascending order of their weights, so the running time of this algorithm is _____ when the number of containers is n.
5. Every greedy choice made in the greedy algorithm is a _____ optimal choice.
6. In the single-linkage k-clustering algorithm, _____algorithm is used to form the minimum spanning tree. It should stop before adding the last _____ edge (suppose that graph G has m edges and n (n can be very large) nodes, and will be divided into k clusters).

得分

三 、简答题（本题共 20 分）

1. You are given currency denominations {1, 2, 5}.

   c) Devise a method to pay amount to a customer using the fewest number of coins, and describe its idea in terms of pseudo code;
   d) Give the fewest number of coins you need to pay 11 to a customer. **(本小题 12 分)**

草 稿 区

2. A special 0-1 knapsack problem: the lighter the item, the higher the value of the item. Let N=6, C=20, P= (4,8,15,1,6,3), W = (5, 3, 2, 10, 4, 8), where N is the number of items, C is the capacity of the knapsack, P contains the values of the items, and W contains the weights of the items. For this 0-1 knapsack problem, how to put the items in the knapsack to get the maximum overall value in it (please describe your method in pseudo code)? How much is the maximum total value? **(本小题 8 分)**

草 稿 区

得分

四 、综合题（本题共 30 分）（注：凡是要求设计算法的题目，请写出详细的伪代码）

1. A traveler wants to drive from A to B. The distance between A and B is $\boldsymbol{s}$. There are $\boldsymbol{n}$ gas stations between A and B. The distance from the starting point A to the $\boldsymbol{i}$**-th** gas station is $\boldsymbol{d_i}$ km ($\boldsymbol{0 = d_1 < d_2 < \cdots < d_n \leq s}$). If the car is full of gas, it can travel for $\boldsymbol{m}$ km. The tank (油箱) is empty when the traveler starts. How to refuel (加油) with the smallest number of refueling driving from A to B? **(本小题 15 分)**
   a) Describe the strategy that can solve this problem;
   b) Devise an algorithm to implement (实现) the strategy;
   c) Analyze the running time of the algorithm.

草 稿 区

2. A connected network G is shown below. Please use the Kruskal algorithm to form the minimum spanning tree T.
   a) Please give the edges in the order that are added to the edge set TE of T during the execution of the algorithm.
   b) Explain the greedy strategy and the core idea of the algorithm.
   c) Briefly analyze the running time of this algorithm. **(本小题 15 分)**