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（B 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. $T(n)$ represents the running time of the algorithm when the input scale is n. Which one is the most efficient? (　　)

A. $\mathrm{T(n)} = \mathrm{T(n-1)} + 1, \mathrm{T(1)} = 1$　　B. $\mathrm{T(n)} = 2\mathrm{n}^2$

C. $T(n) = T(n/2) + 1$，$T(1) = 1$　　D. $T(n) = 3nlog2n$

2. Which one is true about the asymptotic symbol? (　　)

A. $\mathrm{f(n)} = \Theta(\mathrm{g(n)}), \mathrm{g(n)} = \Theta(\mathrm{h(n)}) \Rightarrow \mathrm{f(n)} = \Theta(\mathrm{h(n)})$

B. $\mathrm{f(n)} = \mathrm{O(g(n))}, \mathrm{g(n)} = \mathrm{O(h(n))} \Rightarrow \mathrm{h(n)} = \mathrm{O(f(n))}$

C. $\mathrm{O(f(n))} + \mathrm{O(g(n))} = \mathrm{O(min\{f(n), g(n)\})}$

D. $\mathrm{f(n)} = \mathrm{O(g(n))} \Leftrightarrow \mathrm{g(n)} = \mathrm{O(f(n))}$

3. In the single-linkage k-clustering algorithm, suppose that graph G has n nodes (n can be very large) and m edges, and it will be divided into k clusters. Kruskal algorithm is used to form the minimum spanning tree. It should stop before adding (　　) edge.

A. The last k edge　　B. The last k-1 edge　　C. The last k-2 edge　　D. The last one edge

4. Which of the following question cannot be solved with a greedy algorithm? (　　)

A. Weighted interval scheduling problem　　B. Shortest path problem

C. Single-linkage clustering problem　　D. Optimal caching problem

5. The running time of using dynamic programming to solve the maximum subarray problem is ( )

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

6. G is an undirected graph with n nodes. Which of the following is not a requirement for G to be a tree? ( )

A. G is connected B. G does not contain a circle C. G is a bipartite graph (二部图) D. G has $n-1$ edges

7. The running time of the Kruskal algorithm to form the minimum spanning tree is ( ) (Let n be the number of nodes and m be the number of edges)

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

8. The asymptotic expression of the function 2^n+10nlg$n$ is ( )

A. 2^n+nlg$n$ B. 2^n C. n lg$n$ D. 10n lg$n$

9. Which of the following is not the key to designing a dynamic programming algorithm? ( )

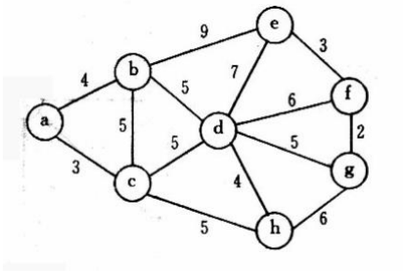
A. Divide the problem into multiple subproblems

B. Select local judgment rules

C. Obtain the recursive relationships between stages

D. Describe the structure of the optimal solution

10. Below is an undirected weighted graph, and you will form the minimum spanning tree by the Prim algorithm. The following four choices show the process of adding nodes, which one is wrong? ( )



A. acbdhegf B. acbhdegf C. acbdhgef D. acbdehgf

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二 、填空题（本题共 20 分，每空 2 分）

1. Rank the following functions: $4n^2$，$\log n$，n^3，$20n$，2，$n!$ in ascending order based on their asymptotic expression _____
2. The running time of the following code is _____.

```
s=0；
while(s<n){
    if(s==0) s=s+1；
    else s=s*2;
}
```

3. Using binary search to search for an element in a sorted list with n elements. In the best case, the running time is _____. In the worst case, the time complexity is _____.
4. The running time of the Kruskal algorithm to form the minimum spanning tree is _____(n is the number of nodes of the undirected graph, m is the number of edges).
5. The three basic methods for proving that a problem can be solved with a greedy algorithm are _____, _____ _____and_____.
6. The basic idea of the dynamic programming algorithm is to divide the problem into a series of _____, solve_____first, and get the solution of the original problem.

得分

三、简答题（本题共 20 分）

1. Given 12 activities $A =< a_1, a_2, \dots\dots, a_{10}, a_{11}, a_{12} > and$ their start time (s_i) and finish time (f_i) as follows. Devise an efficient method that computes a schedule including maximum number of activities.

i	1	2	3	4	5	6	7	8	9	10	11	12
s_i	44	7	37	83	27	49	16	44	44	58	27	26
f_i	86	25	96	89	84	62	17	70	84	94	79	57

a) Describe the efficient method such as GREEDY-ACTIVITY-SELECTOR in terms of pseudo code;
b) Give the correct solution schedule of the above table with proper steps. （本小题 10 分）

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2. Table 1 shows men's preference ranking for women, and table 2 shows women's preference ranking for men. After matching men and women, if man A and woman B are not matched, A prefers B than his assigned partner, and B prefers A than her assigned partner, we say (A, B) is an unstable pair and the matching is unstable. Please devise a stable matching method and describe the core idea in terms of pseudo code. （本小题 10 分）

Table 1

Man	1st choice	2nd choice	3rd choice
Xavier	Alice	Bessie	Chelsea
Yale	Bessie	Alice	Chelsea
Zeus	Bessie	Alice	Chelsea

Table 2

Man	1st choice	2nd choice	3rd choice
Alice	Yale	Xavier	Zeus
Bessie	Xavier	Yale	Zeus
Chelsea	Xavier	Yale	Zeus

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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. Suppose that there are n items, each has a weight and a value. You have a knapsack and your task is to select items with the maximum overall value and put them to your knapsack without exceeding your knapsack's capacity (承重).

   a) Which type of algorithm should be used for solving this problem, and what is the core idea of this type of algorithm?
   b) Describe the core idea of solving this problem.
   c) Suppose there are 5 items with weights {2, 2, 6, 5, 4} and their corresponding values are {6, 3, 5, 4, 6}, respectively, and your knapsack's capacity is 10, please calculate the maximum value you can put in your knapsack. （本小题 18 分）

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2. There are several containers that need to be loaded onto a ship with load capacity (载重) c. The weight of the i-th container is W_i. Please devise an optimal loading method which loads the maximum number of containers under the ship's load capacity. Answer the following two questions:

   a) Prove that the above optimal loading problem can be solved using greedy algorithm.
   b) Describe your optimal loading method with pseudo code.（本小题 12 分）

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