

四川大学期末考试试题（闭卷）
(2020——2021 学年第 1 学期) A 卷

课程号: 304133030 课序号: 01 课程名称: 数据结构与算法分析（全英文）
任课教师: 徐文政 成绩:
适用专业年级: 计算机学院 2019 级试验班 学生人数: 14 印题份数: 16
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: _____

Instructions to Candidates

This is a closed-book examination.

There are SEVEN problems in this examination paper.

The total marks of this examination paper are 100.

The mark of each question is indicated at the end of the question.

Write down your answers on the answer sheets provided.

Time Allowed: **2 hours.**

Approved calculators may be used (Get permission from the invigilator).

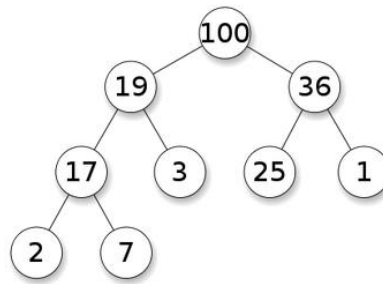
1. Fill blanks (2.5 points *4=10 points) .

Given an *undirected* graph with n vertices, there are at least () edges, at most () edges in the graph. On the other hand, given a *directed* graph with n vertices, there are at least () edges, at most () edges in the graph.

2. Please answer the following question (15 points)

Given the structure of a max heap with 9 keys in the following. Usually an array is used to store a heap. Given an array A with its size 9. Please show how does the array store the heap? Assume that a key is stored at array $A[i]$, where are its *left* and *right* children stored in the array, respectively? Also,

where is its *parent* stored in the array?



3. Please answer the following question (15 points)

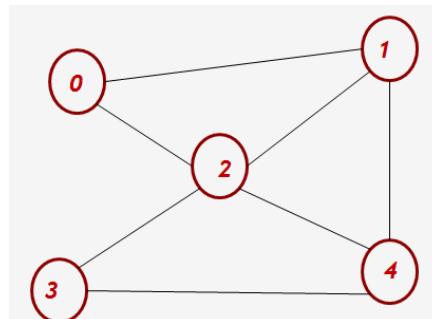
Given keys 4371, 1323, 6173, 4199, 4344, 9679, 1989, and a hash function:

$h(x)=x\%10$, show the resulting with a Hash table using *linear probing*, i.e., the hash table size $m=10$, $h_i(x)=[x+i]\%10$, $i\geq 0$.

Requirement: show at which location each key is stored.

4. Please answer the following question (15 points)

Given an undirected graph as follow, please show its *adjacency matrix* and *adjacency list* representations, respectively.



5. Program (15 points)

Write a recursive function named *largerCount* that, given the pointer to the root of a binary search tree (BST) and a key K , returns the number of nodes with their key values $\geq K$. Function *largerCount* should visit as few nodes in the BST as possible.

Requirement: Please first describe the basic idea behind. Then, write down your algorithm.

6. Please answer the following question (15 points)

Given a recurrence relationship $T(n)=n+4.T(n/2)$, where $T(1)=1$. Assume that $n=2^k$, where k is a positive integer.

Please derive the closed form of $T(n)$ in detail and given a tight upper bound on $T(n)$ with the big O notation.

7. Please answer the following question (15 points)

Given a connected, undirected graph, assume that the graph represents a computer network, where each vertex in the graph represents a host, a server, or a router, and each edge $e=(u,v)$ represents the link that connects the two vertices u and v . Also, each edge $e=(u,v)$ is associated a weight $p(e)$, which is the reliability of the edge, where $0 \leq p(e) \leq 1$.

Consider the problem of finding the maximum reliable paths from a source vertex s to other vertices in the graph, where a maximum reliable path P from vertices s to t is an s - t path, such that the product of the reliabilities of the edges in the path is maximized, i.e., $\prod_{e \in P} p(e)$ is maximized.

Please show a solution to the problem.

Requirement: Please first describe the basic idea of your solution. Then prove that the solution indeed is the maximum reliable path is G.

– End –