Final Exam S'99

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1. (10%) Sorting

Write the result of F at the end of each step in the following two algorithms.

F = (12, 2, 16, 30, 8, 28, 4, 10, 20, 6, 18)

(a) (5%) Insertion Sort

(b) (5%) Quick Sort

2. (20%) Search

(a) (5%) Work through *sequential* and *binary* search on an ordered file with keys (1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16) and determine the number of key comparisons made while searching for the keys 2, 10, and 15.

(b) (15%) Fibonacci search is a search alternative. Unlike binary search that equally divides the remaining file, Fibonacci search splits the subfile according to the Fibonacci sequence,

0, 1, 1, 2, 3, 5, 8, 13, 21, 34, ...

which is defined as $F_0 = 0$, $F_1 = 1$, and

$$F_i = F_{i-1} + F_{i-2}, \quad i>2$$

The algorithm is summarized as follows. Assume that the number of record is one less than some Fibonacci number, $n = F_a - 1$. The comparison of key k is made with $f[F_{a-1}]$.key with the following outcomes:

(1) $k < f[F_{a-1}]$.key in which case the subfile from 1 to $F_{a-1} - 1$ is searched and this file has one less than a Fibonacci number of records.

(2) $k = f[F_{a-1}]$.key in which case the search terminates successfully.

(3) $k > f[F_{a-1}]$.key in which case the subfile from $F_{a-1} + 1$ to $F_a - 1$ is searched and the size of this file is $F_{a-2} - 1$.

Assume the number of record is 20, please redo (a) with Fibonacci search algorithm for the keys 2, 10, 15 again. Note that $F_5 = 5$, $F_6 = 8$, and $F_7 = 13$.

3. (10%) File structure

(a) (5%) Explain how a poorly chosen hash function can result in a hashed file system becoming little more than a sequential file.

(b) (5%)Summarize the distinction between a file system and a database system.

4. (20%) Database System

(a) (10%) Using the commands SELECT, PROJECT, and JOIN, write a sequence of instructions to answer each of the following questions about parts and their manufacturers in terms of the database shown in Fig. 1:

(i) Which companies makes Bolt 2Z?

(ii) Obtain a list of the parts made by Company X along with each part's cost.

(iii) Which companies make a part with weight 1?

(b) (10%) Write a SQL statement for the following query from the database in Fig.2, and output the resultant relation. (Note that S = Supplier, P = Parts)

Get all pairs of supplier number such that the two suppliers concerned are co-located (i.e., located in the same city).

5. (20%) Operating system

(a) (10%) Summarize the booting process.

(b) (10%) A banker with only $100,000 loans $50,000 to each of two customers. Later, both customers return with the story that before they can repay their loans they must each borrow another $10,000 to complete the business deals in which their previous loans are involved. The banker resolves this deadlock by borrowing the additional funds from another source and passing on this loan (with an increase in the interest rate) to the two customers. Which of the three conditions for deadlock has the banker removed?

6. (20%) Networking

(a) (15%) Explain the following terms: CSMA/CD, DNS, client/server model, packet switched network, and router.

(b) (5%) Describe the difference between connection-oriented and connectionless approach, and give one transport layer protocol for each.

PART relation

PartName	Weight
Bolt 2X	1
Bolt 2Z	1.5
Nut V5	0.5

MANUFACTURER relation

CompanyName	PartName	Cost
Company X	Bolt 2Z	.03
Company X	Nut V5	.01
Company Y	Bolt 2X	.02
Company Y	Nut V5	.01
Company Y	Bolt 2Z	.04
Company Z	Nut V5	.01

Fig. 1.

S

S#	SNAME	STATUS	CITY
S1	Smith	20	London
S2	Jones	10	Paris
S3	Blake	30	Paris
S4	Clark	20	London
S5	Adams	30	Athens

P

P#	PNAME	COLOR	WEIGHT	CITY
P1	Nut	Red	12	London
P2	Bolt	Green	17	Paris
P3	Screw	Blue	17	Rome
P4	Screw	Red	14	London
P5	Cam	Blue	12	Paris
P6	Cog	Red	19	London

SP

S#	P#	QTY
S1	P1	300
S1	P2	200
S1	P3	400
S1	P4	200
S1	P5	100
S1	P6	100
S2	P1	300
S2	P2	400
S3	P2	200
S4	P2	200
S4	P4	300
S4	P5	400

Fig. 2