

Theory of Algorithms

Solution time: 90 min.

Name:																		
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Test (5 scores)

In the below table all the **Statements** are *true* or *false*. Give your answers to the column **Answer**: **0**: false, **2**: true, **1**: you do not know the answer. Leave empty the column **Difference**. The differences between the right and your answers will be written into column **Difference**. *The empty answer means 2 differences*. The score **S** of the test is calculated: $S=5-D$, if $S<0$ then $S=0$, where **D** is the sum of the differences.

	Statements	Ans. 0..2	Diff. 0..2
1.	The height of an n -node B-tree is $O(\lg n)$, thus all dictionary operations take $O(\lg n)$ time.		
2.	$3n^2+100n-1 = O(n^3)$.		
3.	$f(n) = o(g(n))$ if and only if $g(n)=\Omega(f(n))$.		
4.	The running time of the worst case of bucket sort is $O(n)$.		
5.	The height of a heap as a binary tree is $O(n)$.		
	Sum of the differences		

Exercises (15 scores)

1. Give the result of inserting below given keys (in order) into an empty hash table sized $m=11$ using double hashing as open addressing method. (3 scores)

$$h(k, i) = (h_1(k) + i h_2(k)) \bmod m, \quad h_1(k) = k \bmod m, \quad h_2(k) = 1 + (k \bmod (m-1)).$$

10, 22, 31, 4, 15, 28, 17, 88, 59

2. What B-tree is built by inserting the following keys (in order) into an initially empty tree? Let the minimum degree of B-tree be 3. (4 scores)

F, S, Q, K, C, L, H, T, V, W, M, R, N, P, A, B, X, Y, D, Z, E

3. What tree is built by the HUFFMAN algorithm for the following characters and occurrences? Give the total number of bits that is necessary to code the entire file with the fixed-length code and Huffman code? (3 scores)

a: 23, b: 15, c: 12, d: 13, e: 6, f: 10, g: 4, h: 17

4. Give the prefix function π of the string-matching automaton for the pattern $P = \text{ababbabbababbababbabb}$ over $\Sigma = \{a, b\}$. (2 scores)

5. What values of d are calculated by the MODULAR-EXPONENTIATION with below given data? (3 scores)

$a=2, b=15, n=5$

Rating: 0-9:1, 10-12:2, 13-15:3, 16-18:4, 19-20:5.