Department of Computer Science

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CMPT 250.6

Time: 50 minutes **Midterm #2 - March 18, 2005** **Closed Book**

Marks

(8) 1. Testing object-oriented software is said to be more difficult than testing traditional (functional) software. Discuss why and what makes testing 0-0 software harder.

(10) 2. Prove by induction that in an m_ary tree of height (h) there are at most m^h leaves. Note that the height of an m_ary tree in this question is the length of the longest path from the root to a leaf. Using this definition, the height of a single node m_ary tree is 0.

(10) 3. In class, we discussed the open addressing method of resolving collisions. In particular, we covered linear probing, random probing and double hashing techniques. Another probing method is called quadratic probing. Suppose that a key value initially hashes to position d and a collision results. On its first attempt to resolve the collision, the quadratic algorithm attempts to place the key at position:

$d + 1^2$

If a second attempt is necessary to resolve the collision, position:

$d + 2^2$

is probed. In general the rth attempt to resolve the collision probes position

$d + r^2$

with wraparound taken into account.

a) Assuming the following hashing function

$H(x) = (x \bmod 9) + 1$ size = 9

Find the positions where the following sequence of keys will be stored:

23
68
32
86

b) Using the hashing function

$H(x) = (x \bmod 10) + 1$ size = 10

with a table size of 10 and an initial hash position of 6, which locations will never be probed when a collision occurs?

(12) 4. Given a reference to a linked binary tree, write an Eiffel routine which returns the number of nodes in the tree that have exactly two children. The main features of LINKED_SIMPLE_TREE_UOS[G] are:

Note that to shorten the description, LS_TREE[G] is used instead of LINKED_SIMPLE_TREE_UOS[G].

is_empty : BOOLEAN
is_full : BOOLEAN
out : STRING
make
initialize (lt:LS_TREE[G]; x:G; rt:LS)_TREE[G])
root_left_subtree : LS_TREE[G]
root_right_subtree : LS_TREE[G]
root_item : G

(10) 5. Several types of trees were discussed in class.

a) Which one of these types has unique properties when compared to the others in the term of searching strategy and the final tree structure produced? What are these properties?

b) Generate a table that for four types of trees gives their average and worst time searching performances, if known.