

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 O-O 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 r th attempt to resolve the collision probes position

$$d + r^2$$

with wraparound taken into account.

- a) Assuming the following hashing function

$$H(x) = (x \bmod 9) + 1 \quad \text{size} = 9$$

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

23

68

32

86

- b) Using the hashing function

$$H(x) = (x \bmod 10) + 1 \quad \text{size} = 10$$

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