CISC-235*
Test #2
March 2, 2017

Student Number (Required) ______________________

Name (Optional) ________________________________

This is a closed book test. You may not refer to any resources.

This is a 50 minute test.

Please write your answers in ink. Pencil answers will be marked, but will not be re-marked under any circumstances.

The test will be marked out of 50.

<table>
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<tr>
<th>Question</th>
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<td><strong>TOTAL</strong></td>
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Question 1 (10 marks)

Write a function that searches a binary search tree $T$ for a specific value $x$. If $x$ is in the tree, the function returns the depth at which the value was found. If $x$ is not in the tree, the function returns -1. You may assume that the depth of the root is 0.

Your function can be recursive or iterative, as you choose.
Question 2 (10 marks)

Here is a binary tree. The square vertices represent empty leaf-nodes. Either explain why this tree cannot be legally coloured as a Red-Black Tree, or give it a legal Red-Black colouring.
Question 3 (10 marks)

What is the big-O (worst case) complexity of the total time required to build a Red-Black tree containing n values (i.e. what is the order of the total time required to perform n insertions, starting with an empty tree)? Explain your answer.
Question 4 (10 marks)

Here is a Red-Black Tree. Show the tree that results after the value 12 is inserted into this tree.

In this drawing ☐ signifies a Red vertex

You may draw your solution on the next page.
Question 5 (10 marks)

Consider a hash table of size 7 with hash function \( h(k) = k \mod 7 \). Draw the table that results after inserting the values 19, 26, 17, 3, 18, in that order ...

a) when collisions are resolved by chaining [2 marks]

\[ 
\begin{array}{c|c|c|c|c|c|c}
  \hline
  & & & & & & \\
  \hline
\end{array}
\]

b) when collisions are resolved by linear probing [4 marks]

\[ 
\begin{array}{c|c|c|c|c|c|c}
  \hline
  & & & & & & \\
  \hline
\end{array}
\]

c) when collisions are resolved by quadratic probing using \( c_1 = 1 \) and \( c_2 = 1 \)

\[ 
\begin{array}{c|c|c|c|c|c|c}
  \hline
  & & & & & & \\
  \hline
\end{array}
\]
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<th>k mod 7</th>
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<td>3</td>
<td>3</td>
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<tr>
<td>17</td>
<td>3</td>
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<td>18</td>
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<td>5</td>
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<td>26</td>
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