CSE250  Assignment 9 Answer Key  Spring 2022

1. **Draw**
   - Right rotation at the binary tree
   - Draw the binary search tree
   - Search

causes imbalance at draw. Taller inner grandchild case needs a double rotation.

Now imbalance at multiple nodes, but fix the lowest one first. Taller inner case again.

**Search**
- Draw the binary tree
- Search
- Results

**Taller outer case**
- So only one rotation

**Inserting**
- Draw the binary tree
- Inserting
- Results

The last two words cause two more imbalances. Since they quit unrelated subtrees, can do in parallel.

**Given**
- Draw the binary tree
- Given
- Order
- Sentencing the this words
- So we do left rotate at draw before right or inserting

**Duplicate**
- Draw the binary tree
- Allowing duplicate of results

**Kets**
- Search
- Inserting
- Draw
- Binary from in
- Order
- Sentence the this words
- Allowing duplicate of results
The insertion of "kets" causes an imbalance at inserting. Once again, we have a "taller inner case" so we have to relate an "order" too. The resulting whole tree:

To remove the three occurrences of "the" we can simply delete the two lower over. The last one can be replaced by its inorder predecessor "that" or the successor "this". Shaving the tree:

With the latter too—and with other forms obtained by putting new equal keys rightward rather than leftward (see A.I.Keys) the right subtree of the root is much smaller than the left subtree (15 vs. 12 nodes). But it does not cause a height imbalance. So that is the final tree.

It is curious that one of 19 different words
- none have 6
- only one each go to brothers 1 & 2
- (I see this kind of "lumpy randomness" all the time in my chess data.)

Using append rather than print:

3. Can heap either (a) insert and fixUp

2. Sum

<table>
<thead>
<tr>
<th>draw</th>
<th>the</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>13</td>
</tr>
<tr>
<td>43</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>21</td>
</tr>
<tr>
<td>39</td>
<td>28</td>
</tr>
<tr>
<td>21</td>
<td>54</td>
</tr>
<tr>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>13</td>
<td>23</td>
</tr>
<tr>
<td>28</td>
<td>23</td>
</tr>
</tbody>
</table>

- draw-sentence (there are 12 words)
- duplicate would reverse each list


Non-Circled Elements need fix

FixDown First

It's coincidental that 3 was the last element for each pop.