CMPT 280

Topic 8: Trees

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References

• Textbook, Chapter 8

Reading Refresher

- In general, how many children may a tree node have?
- What is a binary tree?
- Define ancestor, descendent, sibling, level, and height.
- What is a leaf node? Internal node?
- Why is a tree considered a container?
- What pieces of data must be in a binary tree node?

Implementing a Simple Tree

 Our goal for this topic is to finish implementing the simple linked tree that was begun in Chapter 8 of the textbook readings.

A Simple Binary Tree ADT

Name: SimpleTree<G>

Sets:

T: set of trees containing elements from G

 \widehat{G} : set of elements allowed in the trees

 $B: \{\mathbf{true}, \mathbf{false}\}$

Signatures:

 $newTree < G > : \rightarrow T$

T.initialize (t_1, g, t_2) : $T \times G \times T \to T$

 $T.\mathsf{isEmpty} \colon \to B$

 $T.\mathsf{rootItem} : \not \to G$

 $T.\mathsf{rootLeftSubtree} : \not \to T$

 $T.\mathsf{rootRightSubtree} : \not \to T$

Preconditions: For all $t \in T$

 $t.\mathsf{rootItem}$: t is not empty

t.rootLeftSubtree: t is not empty t.rootRightSubtree: t is not empty

Semantics: For $t, t_1, t_2 \in T$, $g \in G$

newTree<G>: construct a new empty tree

to hold elements from G.

t.initialize(t_1 , g, t_2): initialize t to have root g, left subtree t_1 and right subtree t_2 t.isEmpty: return true if t is empty, false

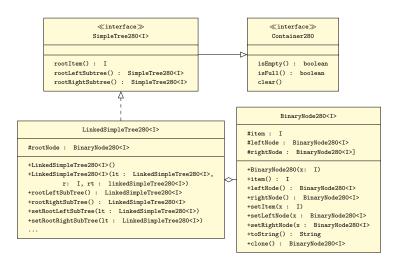
otherwise

t.rootltem: returns the root element of t. t.rootLeftSubtree: returns the left subtree of t

t.rootRightSubtree: returns the right

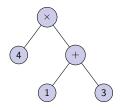
subtree of t.

Implementation of a Linked Tree in lib280

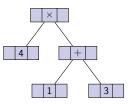


Views of Linked Representation of a Binary Tree

Conceptual View:

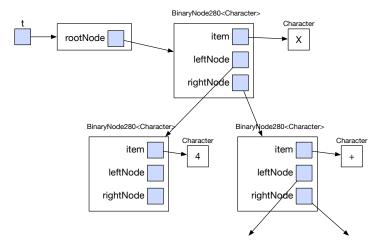


Structural View:



Views of a Linked Representation of a Binary Tree

Implementation View:



- Write the class header for BinaryNode280<I>
- Write the declaration of the instance variables for BinaryNode280<I>.
- Write the headers for the constructor and methods of BinaryNode280<I>.

(In other words, write everything for the class except the method bodies.)

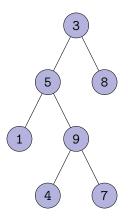
Demo 1

• Let's write the item, leftNode, and rightNode methods...

• Fill in the method bodies for setItem, setLeftNode, setRightNode, and toString.

- Implement the LinkedSimpleTree280<I> class.
- We'll start off working together, then we'll break into small groups for implementing some of the methods.

 Write program that will build the following tree using LinkedSimpleTree280<I>:



Next Class

• Next class reading: Chapter 9: Tree Traversals.