```java
import java.util.Iterator;
import java.util.NoSuchElementException;


/**
 * Stores a list of <T> elements
 *
 * @author 1828799
 *
 * @param <T> unspecified objects type T
 */
public class MyLinkedList<T> implements HansenCollection<T>,
Comparable<MyLinkedList<T>>, Iterable<T>
{
   // Instance Variables
   private ListNode _head = null;
   private ListNode _tail = null;
   private int _size = 0;


   /**
    * Creates a new MyLinkedList
    */
   public MyLinkedList(){}


   /**
    * Appends an element to the end of the list.
    *
    * @param newElement the specified element to be added
    *
    * @throws CollectionFullException (never thrown since list can never fill)
    * @throws NullPointerException if element to be added is null
    */
   @Override
   public void addElement(T newElement) throws CollectionFullException,
         NullPointerException
   {
      // Verify that the input isn't null
      if (newElement == null)
      {
         throw new NullPointerException();
      }

      // Add element using prependElement if the list is empty
      if (size() == 0)
      {
         prependElement(newElement);
      }
      else // When the list isn't empty
      {
         // Set newElement to be in the node which is the tail's next
         _tail.setNext(new ListNode<T>(newElement));

         // Update the tail
         _tail = _tail.getNext();

         // Increment the size
         _size++;

      }
   }


   /**
```

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     * Prepends an element to the list
     *
     * @param newElement the element to prepend to list
     *
     * @throws NullPointerException if element to be prepended is null
     */
    public void prependElement(T newElement) throws NullPointerException
    {
       // Create new node to hold newElement
       ListNode toPrepend = new ListNode<T>(newElement);

       // Verify that the input isn't null
       if (newElement == null)
       {
          throw new NullPointerException();
       }

       // Set the added nodes next to be the head
       toPrepend.setNext(_head);

       // Update the head to be the node holding newElement
       _head = toPrepend;

       // If size is zero then also set the new the new node to be the tail
       if (size() ==  0)
       {
          _tail = toPrepend;
       }

       // Increment the size
       _size++;
    }


    /**
     * Inserts the new element after the first instance of the specified element
     * in the list, if the specified element is in list.
     *
     * @param existingElement the element to insert the new element after
     * @param newObject the element to be added
     *
     * @throws NullPointerException if element to be inserted is null
     * @throws NoSuchElementException specified element is not in list
     * @throws CollectionFullException never thrown since never full
     */
    public void insertAfter(T existingObject, T newObject) throws
    NoSuchElementException, NullPointerException, CollectionFullException
    {
       ListNode nodeBefore = null;
       ListNode nodeToInsert = null;

       // Verify that the input isn't null
       if (existingObject == null || newObject == null)
       {
          throw new NullPointerException();
       }

       // Find node containing the existing object by identity (if it exists)
       nodeBefore = findNode(existingObject, false);

       // If the nodeBefore isn't in the list throw exception
       if (nodeBefore == null)
       {
          throw new NoSuchElementException();
       }
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      // Special Case: nodeBefore is the tail
      if (nodeBefore == _tail)
      {
         // Use addElement if nodeBefore is tail
         addElement(newObject);
      }
      else // Regular Case: nodeBefore is not the tail
      {
         // Create new node holding the newObject
         nodeToInsert = new ListNode<T>(newObject);

         // Set new node’s next to nodeBefore’s next
         nodeToInsert.setNext(nodeBefore.getNext());

         // Set nodeBefore’s next to new node
         nodeBefore.setNext(nodeToInsert);

         // Increment the size of list
         _size++;
      }
   }


   /**
    * Removes the first occurrence of the specified element from this list,
    * if it is present.
    * @param elementToRemove the specified element to be removed
    *
    * @throws NoSuchElementException if specified element is not in list
    */
   @Override
   public void removeElement(T elementToRemove) throws NoSuchElementException
   {
      // Set ListNode variable current to null
      ListNode current = _head;

      // Check for null input or an empty list
      if (elementToRemove == null || size() == 0)
      {
         throw new NoSuchElementException();
      }

      // Special Case: Element to remove is the head
      if (_head.getContents().equals(elementToRemove))
      {
         // Set head equal to head’s next
         _head = _head.getNext();
      }

      // Walk the list to find the node before one containing element to remove
      else // When element to remove isn’t the head
      {
         while (current.getNext() != null
               && !((current.getNext()).getContents().equals(elementToRemove)))
         {
            // Set current to current’s next
            current = current.getNext();
         }

         if (current.getNext() == null) // When element isn’t in the list
         {
            throw new NoSuchElementException();
         }
         else // When element is in the list
```

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            {
               // Remove the element by manipulated the node before’s next
               current.setNext((current.getNext()).getNext());
            }
         }

         // Decrement the size of the list
         _size--;
      }


      /**
       * Returns the element if element is in list
       *
       * @param elementSought the specified element to be found
       *
       * @return returns the element if found, returns null if element is not
       * found
       */
      @Override
      public T findElement(T elementSought)
      {
         // Set T object variable elementFound to null
         T elementFound = null;
         ListNode nodeFound = findNode(elementSought, true); // By equality

         // If the call findNode(elementSought) doesn’t return null
         if (nodeFound != null)
         {
            // Set elementFound to content’s of the node returned from findNode
            elementFound = (T) nodeFound.getContents();
         }

         return elementFound;
      }


      /**
       * Returns true if this list contains the specified element
       *
       * @param elementSought the specified element to be found in list
       *
       * @return true if specified element is in list
       */
      @Override
      public boolean containsElement(T elementSought)
      {
         // Use findElement to determine if elementSought is in list
         return (findElement(elementSought) != null );
      }


      /**
       * Compares the list to the specified list
       *
       * @param o the object to be compared
       *
       * @throws NullPointerException if the specified object is null
       *
       * @return Returns a negative integer, zero, or a positive integer as this
       * object is less than, equal to, or greater than specified object.
       */
      @Override
      public int compareTo(MyLinkedList<T> o)
      {
```

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      int compareValue = 0; // The compared value to be returned
      ListNode myCurrent = _head; // Starting point of this list
      ListNode otherCurrent = o._head; // Starting point of other list

      // CHECK IF OBJECT TO BE COMPARED TO IS NULL
      // if o is null
      //    throw NullPointerException

      // Walk the list and compare at each step
      while (compareValue == 0 && myCurrent != null && otherCurrent != null)
      {
         // Set compareValue to return of comparing contents of two currents
         compareValue = ((Comparable) myCurrent.getContents()).compareTo((Compar
able) otherCurrent.getContents());

         // Move each list the the next in list
         myCurrent = myCurrent.getNext();
         otherCurrent = otherCurrent.getNext();
      }

      // Check for when the lists are the same but one is longer
      if (compareValue == 0 && size() - o.size() != 0)
      {
         // When different sizes set return to be this size - other size
         compareValue = size() - o.size();
      }

      return compareValue;
   }


   /**
    * Returns false since list can never be full.
    *
    * @return always returns false since list can never be full
    */
   @Override
   public boolean isFull()
   {
      // WILL ALWAYS BE FALSE
      return false;
   }


   /**
    * Returns true if list contains no elements.
    *
    * @return true if list is empty
    */
   @Override
   public boolean isEmpty()
   {
      // Use size() to determine if list is empty
      return (size() == 0);
   }


   /**
    * Empties the list
    */
   @Override
   public void makeEmpty()
   {
      // Set head to null
      _head = null;

      // Set tail to null
      _tail = null;

      // Set size to 0
      _size = 0;
   }


   /**
    * Returns the number of elements in list
    *
    * @return the number of objects in list
    */
   @Override
   public int size()
   {
      // Return the size that is tracked throughout
      return _size;
   }


   /**
    * Creates an iterator that can iterate over your list
    *
    * @return the new iterator
    */
   public Iterator<T> iterator()
   {
      return new Iterator<T>() {

         ListNode current = _head;

         /**
          * Returns true if the iteration has more elements
          *
          * @return  true if the iteration has more elements
          */
         public boolean hasNext()
         {
            return (current != null);
         }

         /**
          * Returns the next element in the iteration
          *
          * @return the next element in the iteration
          *
          * @throws NoSuchElementException if the iteration has no more elements
          */
         public T next() throws NoSuchElementException
         {
            if (!hasNext())
            {
               throw new NoSuchElementException();
            }

            T contents = (T) current.getContents();
            current = current.getNext();

            return contents;
         }

         /**
```

```
          * Unsupported operation
          */
         public void remove(){throw new UnsupportedOperationException();}
      };
   }


   /**
    * Finds the node in the list that contains specified object, if such a node
    * is in the list.
    *
    * @param contentsOfNode the contents of the node to be found
    *
    * @return first node containing instance of specified object, null if no
    * node contains specified objects
    */
   private ListNode findNode(T contentsOfNode, boolean byEquality)
   {
      ListNode nodeFound = null; // Return value
      ListNode current = _head;

      // Walk the list to find the node containing specified elements
      while (byEquality && current != null && nodeFound == null)
      {
         // If current's contents equal contentsOfNode
         if (current.getContents().equals(contentsOfNode))
         {
            // Set nodeFound to be current
            nodeFound = current;
         }
         // Set current to current's next
         current = current.getNext();
      }

      while (!byEquality && current != null && nodeFound == null)
      {
         // If current's contents have same identity as contentsOfNode
         if (current.getContents() == contentsOfNode)
         {
            // Set nodeFound to be current
            nodeFound = current;
         }
         // Set current to current's next
         current = current.getNext();
      }

      return nodeFound;
   }


   /**
    * An inner-class for use by a Linked List to hold the contents of the list.
    * Note that this class and its methods are not public nor private, their
    * visibility is within the "package" and that includes any other classes
    * defined in the same file.  This class definition can appear INSIDE the
    * definition of a Linked List class.
    *
    * @author David M. Hansen
    * @version 2.0
    * @param < T > type of object contained by this node
    */
   class ListNode < T >
   {

      // Constructors
```

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      /**
       * Create a new ListNode holding the given object and pointing to the
       * given node as the next node in the list
       * @param objectToHold the object to store in this node
       * @param nextNode the node this node should point to. Can be null
       */
      ListNode(T objectToHold, ListNode nextNode)
      {
         p_contents = objectToHold;
         p_next = nextNode;
      }

      /**
       * Create a new ListNode holding the given object.  No next node
       * @param objectToHold the object to store in this node
       */
      ListNode(T objectToHold)
      {
         // Use the more general constructor passing null as the next
         // node
         this(objectToHold, null);
      }


      // Accessors

      /**
       * @returns Object stored within this node
       */
      T getContents()
      {
         return p_contents;
      }

      /**
       * @return the next node
       */
      ListNode getNext()
      {
         return p_next;
      }



      // Mutators

      /**
       * Set the node this node is linked to
       * @param nextNode the node to point to as our next node. Can be null.
       */
      void setNext(ListNode nextNode)
      {
         p_next = nextNode;
      }


      // Private attributes
      private T p_contents; // The object held by this node
      private ListNode p_next; // A reference to the next node

   } // ListNode


}
```

```
Note: MyLinkedList.java uses unchecked or unsafe operations.
Note: Recompile with -Xlint:unchecked for details.
```

```
Testing...



1. Creating a new MyLinkedList...
        ...Success!

2. Checking isEmpty()...
        ...Success!

3. Try finding in empty list...
        ...Success!

4. Filling list with integers 1 - 5...
        calling prependElement(1)
        Calling removeElement(1)
        Calling append(2)
        calling insertAfter(2,3)
        calling insertAfter(3,4)
        calling prependElement(5)
        calling removeElement(5)
        calling insertAfter(2,5)
        calling removeElement(5)
        calling prependElement(1)
        calling addElement(5)
        ...Success!

4a. Checking size() == 5...
        ...Success!

4b. Iterating over the list checking presence of each element via find/contains and ver
ifying the order...
        ...Success!

4c. Try to remove from iterator...
        ...Success!
java.lang.UnsupportedOperationException

4d. Iterator should be at end...
        ...Success!
java.util.NoSuchElementException

5a. Try inserting after non-existent object ...
        ...Success!
java.util.NoSuchElementException

5b. Try inserting after non-existent object in an empty list
        ...Success!
java.util.NoSuchElementException

5c. Try removing from an empty list
        ...Success!
java.util.NoSuchElementException

6a. Comparing list to itself - should be equal...
        ...Success!

6b. Comparing list to another list with equivalent elements in equivalent order - shoul
d be equal...
        ...Success!

6c. Removing head of the list...
        ...Success!
```

```
6d. Checking size() == 4 now...
        ...Success!

6d. Making sure head of list can’t be removed again...
        ...Success!

6e. Checking size() == 4 now...
        ...Success!

6f. Comparing list to a copy of itself with head removed - should NOT be equal...
        ...Success!

6g. Comparing list to a copy of itself with tail removed - should NOT be equal...
        ...Success!

6h. Comparing list to an empty list
        ...Success!

6i. Comparing two empty lists
        ...Success!

6j. list2.compareTo(list1) where List1 is < list2 though list2 is shorter
        ...Success!

7. Access an empty iterator...
        ...Success!
java.util.NoSuchElementException

8. Grand Finale! Empty a list, add a value twice with another in the middle, test the s
ize,
remove one of the duplicates, and test size again
remove the other duplicate and verify the list contains the lone remaining element...

        Empty a list...

        Add the same element twice with another in between...

        Test size...

        Remove a duplicate...

        Test size and isEmpty...

        Remove the other duplicate...
        ...Success!



25 tests passed
0 tests failed
**** Nice Job!! ****
```