Project Documentation

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Assignment: Project 4

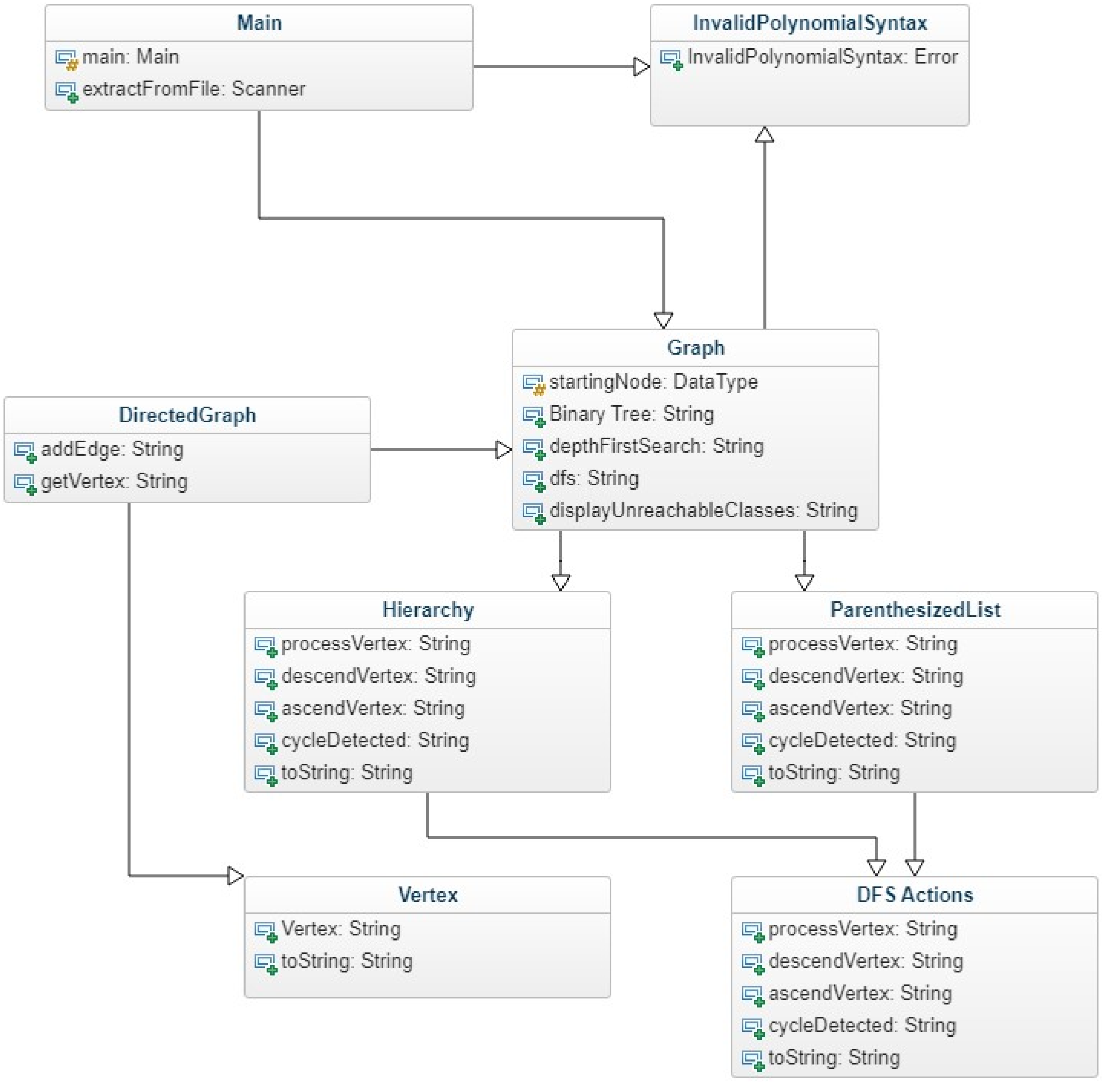
Date: October 12, 2020

Problem Statement: A program that accepts information contained in a file about the class dependencies in a Java program and creates a directed graph from that information. From the directed graph, it produces two different kinds of displays of those dependency relationships.

Analysis: File used:

```
ClassA ClassC ClassE ClassJ

ClassB ClassD ClassG

ClassC ClassA

ClassE ClassB ClassF ClassH

ClassJ ClassB

ClassI ClassC
```

Design (for project assignments only):



Code:

```
package BeckProject4;


/* File: Project 4 - Main Class
 * Author: Dan Beck
 * Date: October 10, 2020
 * Purpose: Executes the program. Scans a selected file and generates the output
 */


import java.io.File;
import java.io.FileNotFoundException;
import java.util.NoSuchElementException;
import java.util.Scanner;
import javax.swing.JFileChooser;
import javax.swing.JOptionPane;


public class Main
{
	static DirectedGraph graph = new DirectedGraph();


	/************************************************************************
********
    * DESCRIPTION: extract from file
    * Allows user to select file
    * Evaluates the lines from file

*******************************************************************************
/
   public void extractFromFile()
   {
      //Allows user to select file and reads lines from the file
      JFileChooser fileChooser = new JFileChooser();
      fileChooser.setFileSelectionMode(JFileChooser.FILES_AND_DIRECTORIES);
      fileChooser.setCurrentDirectory(new File(System.getProperty("user.dir")));
      int status = fileChooser.showOpenDialog(null);

      if (status == JFileChooser.APPROVE_OPTION)
      {
         File file = fileChooser.getSelectedFile();
         try
         {
                  //scans each line. Creates one expression from each line
            Scanner scan = new Scanner(file);
            if (file.isFile())
            {
                  //loop to create the list
               while (scan.hasNextLine())
               {
                  String edgeString = scan.nextLine();
                  String[] edge = edgeString.split(" ");
                  // Marks the first node of the graph
                  // DFS starts from this node
                  if (graph.startingNode == null)
                  {
                  graph.startingNode = graph.getVertex(edge[0]);
                  }

                  // add edges to the Directed graph
                  // First node of the Line - All other nodes
                  for (int i = 1; i < edge.length; i++)
                  {
                  graph.addEdge(edge[0], edge[i]);
                  }
               }//end while (scan.hasNextLine())
            }// if (file.isFile())
            scan.close();
         }//end try
         catch (NoSuchElementException nse)
         {
            JOptionPane.showMessageDialog(JOptionPane.getRootFrame(), "The selected
file is empty!");
         }//end catch (NoSuchElementException nse)
         catch (FileNotFoundException fnf)
         {
            JOptionPane.showMessageDialog(JOptionPane.getRootFrame(), "File can not be
found!");
         }//end catch (FileNotFoundException fnf)
      }//end if (status == JFileChooser.APPROVE_OPTION)
   }//end public static void extractFromFile()


/***********************************************************************************
**
    * DESCRIPTION: Main
    * Initializes main
    * Starts Depth First Search
    * Allows results to be displayed

************************************************************************************
/
   public static void main(String[] args)
         {
               // Initializing Main Class
               new Main().extractFromFile();

               // Starting Depth First Search Utility to complete the DFS
               graph.depthFirstSearch();

               // Display Parenthesized List after processing the vertices
               System.out.print("Hierarchy: ");
               System.out.println(graph.parenthesizedList.toString());
```

```
		// Display Hierarchy after processing the vertices
		System.out.println("Parenthesized List: ");
		System.out.println(graph.hierarchy.toString());

		// Display all the nodes that remained unreachable in the searching process
		graph.displayUnreachableClasses();
	}//end main
}//end public class Main
package BeckProject4;

/* File: Project 4 - Graph
 * Author: Dan Beck
 * Date: October 11, 2020
 * Generates a graph based on the file selected
 */

import java.util.*;

public class Graph<V>
{
	//Starting point of the graph
	public V startingNode = null;

	//Maps the vertex name (String) to a corresponding Vertex
```

```
        Map<String, V> vertices = new HashMap<>();


        //Adjacency representation of the graph
        Map<V, ArrayList<V>> adjacencyList = new HashMap<>();


        //Track if a node/vertex is visited in the searching process
        Set<V> visited = new HashSet<>();


        //Representation utility
        ParenthesizedList hierarchy = new ParenthesizedList();
        Hierarchy parenthesizedList = new Hierarchy();


        //Tracks if the graph contains a circle
        boolean cycle;
        Set<V> discovered = new HashSet<>();


        /********************************************************************************
*********
    * DESCRIPTION: Depth First Search
    * initializes the DFS with all other related attributes

****************************************************************************************
/
        public void depthFirstSearch()
        {
                // Marking cycle flag as false
        cycle = false;
        // Starting DFS from the first node of the input data
        dfs(startingNode);
    }//end public void depthFirstSearch()

    /*********************************************************************
********
  * DESCRIPTION: DFS
  * Search in the adjacency list in Depth-First-Order

*****************************************************************************
/
    private void dfs(V node)
    {
        // check if the node is already visited in and not completed discovering it's
child yet
        // If so, a cycle has been detected
        if (discovered.contains(node))
        {
            cycle = true;

            // Perform DFS Actions Cycle Detected operation
            hierarchy.cycleDetected();
            parenthesizedList.cycleDetected();
            return;
        }//end if (discovered.contains(node))
```

```
//Perform DFS Actions Vertex Add operation

hierarchy.processVertex((Vertex) node);

parenthesizedList.processVertex((Vertex) node);


//Perform DFS Actions Descend Vertex operation

hierarchy.descendVertex((Vertex) node);

parenthesizedList.descendVertex((Vertex) node);


//add the node to the discovery list

discovered.add(node);


//mark the node as visited

visited.add(node);


//discover all of it's child

ArrayList<V> list = adjacencyList.get(node);

if (list != null)

{

        for (V u : list)

                dfs(u);

}//end if (list != null)



// Perform DFS Actions Ascend Vertex operation

hierarchy.ascendVertex((Vertex) node);
```

```
                parenthesizedList.ascendVertex((Vertex) node);


                // this node has discovered completely and remove it from the discovered list
                discovered.remove(node);


        }//end private void dfs(V node)


        /*************************************************************************
********
   * DESCRIPTION: Display Unreachable Classes
   * Prints all the unvisited nodes/classes

*************************************************************************************
/
        public void displayUnreachableClasses()
        {
                // Loop all over the adjacency list
                for (Map.Entry<V, ArrayList<V>> entry : adjacencyList.entrySet())
                {
                        // for each entry check if there is any unvisited/undiscovered
node/class
                        if(entry.getValue().size()>0)
                        {
                                // if found one print it and mark it as visited to avoid double
printing
                                // check the node itself
                                if(!visited.contains(entry.getKey()))
                                {
                                    System.out.println("Unreachable: " + entry.getKey());
                                    visited.add(entry.getKey());
                                }//end if(!visited.contains(entry.getKey()))

                                // check all of it's adjacent nodes
                                for (V vertex : entry.getValue())
                                {

                                    if(!visited.contains(vertex))
                                    {
                                        System.out.println("Unreachable: " + vertex);
                                        visited.add(vertex);
                                    }//end if(!visited.contains(vertex))
                                }//end for (V vertex : entry.getValue())
                        }//end if(entry.getValue().size()>0)
                }//end for (Map.Entry<V, ArrayList<V>> entry : adjacencyList.entrySet())
        }//end public void displayUnreachableClasses()
}//end public class Graph<V>

package BeckProject4;

/* File: Project 4 - Hierarchy
 * Author: Dan Beck
 * Date: October 11, 2020
 * Generates the hierarchy string
 */

import java.util.LinkedList;
import java.util.Queue;

public class Hierarchy implements DFSActions<Vertex>
{
        Queue<String> res = new LinkedList<>();

        /*************************************************************************
********
    * DESCRIPTION: processVertex
    * adds vertex to the string

********************************************************************************
/
        @Override
        public void processVertex(Vertex vertex)
        {
                res.add(vertex.toString());
        }//end public void processVertex(Vertex vertex)

        /*************************************************************************
********
    * DESCRIPTION: descendVertex
    * adds opening parentheses
```

```
********************************************************************************
/
        @Override
        public void descendVertex(Vertex vertex)
        {
                res.add("(");
        }//end public void descendVertex(Vertex vertex)

        /************************************************************************
********
    * DESCRIPTION: ascendVertex
    * adds closing parentheses

********************************************************************************
/
        @Override
        public void ascendVertex(Vertex vertex)
        {
                res.add(")");


        }//end public void ascendVertex(Vertex vertex)


        /************************************************************************
********
    * DESCRIPTION: cycleDetected
    * adds asterisk when cycle is detected
```

```
********************************************************************************
/
	@Override
	public void cycleDetected()
	{
		res.add("*");
	}//end public void cycleDetected()

	/*************************************************************************
********
   * DESCRIPTION: toString
   * generates the hierarchy list

********************************************************************************
/
	@Override
	public String toString()
	{

		String build = "";

		int size = 0;

		while (res.size() > 0)
		{
			String makeString = res.peek();
```

```
res.remove();

if (makeString == "(")
{
        if (res.peek() == ")")
        {
                res.remove();
                continue;
        }//end if (res.peek() == ")")
        else if (res.peek() == "*")
        {
                build += res.peek() + " ";
                res.remove();
                res.remove();
                continue;
        }//end else if (res.peek() == "*")
}//end if (makeString == "(")

if(makeString=="(")
{
        size++;
}//end if(makeString=="(")
else if(makeString==")")
{
        --size;
```

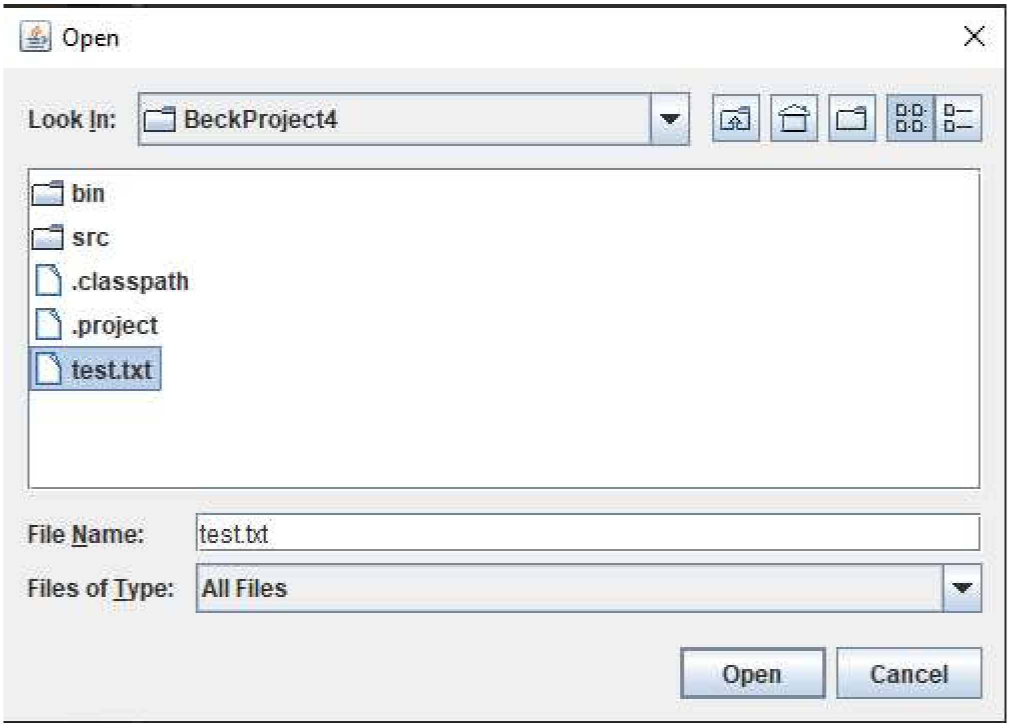
```
            }//end else if(makeString==")")


            if(makeString=="(" || makeString==")")
            {
                continue;
            }//end if(makeString=="(" || makeString==")")


            if(makeString!="*")
            {
                build += "\n";
            }//end if(makeString!="*")
            for (int i = 0; i < size; i++)
            {
                build += "\t";
            }//end for (int i = 0; i < size; i++)


            build += makeString + " " ;


        }//end while (res.size() > 0)


        build += "\n";
        return build;


    }//end public String toString()
}//end public class Hierarchy implements DFSActions<Vertex>
```

```
package BeckProject4;

/* File: Project 4 - Vertex
 * Author: Dan Beck
 * Date: October 11, 2020
 * Sets the vertex
 */

public class Vertex
{
	private String name;

	public Vertex(String name)
	{
		this.name = name;
	}//end public Vertex(String name)

	@Override
	public String toString()
	{
		return name;
	}//end public String toString()
}//end public class Vertex
```

```
package BeckProject4;


/* File: Project 4 - DFS Actions
 * Author: Dan Beck
 * Date: October 11, 2020
 * creates the interface for DFS actions
 */


public interface DFSActions<V>
{
	public void processVertex(V vertex);


	public void descendVertex(V vertex);


	public void ascendVertex(V vertex);


	public void cycleDetected();
}//end public interface DFSActions<V>
package BeckProject4;


/* File: Project 4 - Directed Graph
 * Author: Dan Beck
 * Date: October 11, 2020
 * builds the directed graph from the graph onformation
 */
```

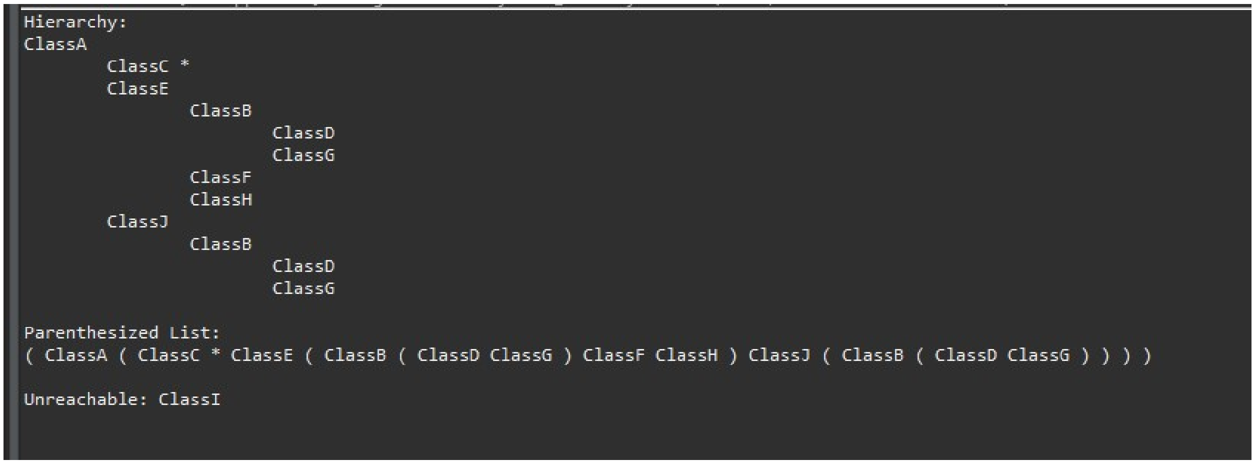
```
import java.util.ArrayList;


public class DirectedGraph extends Graph<Vertex>

{

        /***********************************************************************
********

   * DESCRIPTION: Add Edge

   * creates a directed edge and add it to the graph

   * u Node have a edge from (source node)

   * v Node have a edge to (destination node)

*******************************************************************************
/

        public void addEdge(String u, String v)

        {

                // Check if th source node already has some connected edges

                ArrayList<Vertex> list = adjacencyList.get(getVertex(u));




                // if already not in the Adjacency list

                // Map it to a new Vertex and initialize

                if (list == null)

                {

                        list = new ArrayList<>();

                }//end if (list == null)
                // add a edge to source to destination
                list.add(getVertex(v));

                // update the adjacency list
                adjacencyList.put(getVertex(u), list);

        }//end public void addEdge(String u, String v)

        /*************************************************************************
********
   * DESCRIPTION: getVertex
   * checks if a node is already mapped to a vertex
   * u node(String) to be mapped
   * returns the mapped correspond vertex of the node

********************************************************************************
/
        public Vertex getVertex(String u)
        {
                // if this node(String) showed up for the first time
                // map it to a correspond vertex
                if (!vertices.containsKey(u))
                {
                        vertices.put(u, new Vertex(u));
                }//end if (!vertices.containsKey(u))
        return vertices.get(u);
    }//end public Vertex getVertex(String u)
}//end public class DirectedGraph extends Graph<Vertex>
```

Output:



File Name: test.txt

Files of Type: All Files



```
Hierarchy:
ClassA
        ClassC *
        ClassE
                ClassB
                        ClassD
                        ClassG
                ClassF
                ClassH
        ClassJ
                ClassB
                        ClassD
                        ClassG

Parenthesized List:
( ClassA ( ClassC * ClassE ( ClassB ( ClassD ClassG ) ClassF ClassH ) ClassJ ( ClassB ( ClassD ClassG ) ) ) )

Unreachable: ClassI
```

Reflection: Although this project seemed to tie a lot of the other items from previous projects, this one was the most difficult of them. It took a while to build out how the graph would be laid out but the knowledge of this seems valuable.