

```
1 // Project 13.2      Taylor Somma      CS501
2
3 /*
4 13.2 Modify the dfs.java program (Listing 13.1) to use adjacency lists rather than an
adjacency matrix. You can obtain a list by adapting the Link and LinkList classes from the
linkList2.java program (Listing 5.2) in Chapter 5. Modify the find( ) routine from LinkList
to search for an unvisited vertex rather than for a key value.
5
6 Lafore, Robert (2002-11-16). Data Structures & Algorithms in Java (Kindle Locations 7318-
7321). Pearson HE, Inc.. Kindle Edition.
7
8 */
9 class graphNode
10 {
11     private String label;
12     private adjacencyList neighborList;
13     public int numNeighbors;
14     private boolean isVisited;
15
16     public graphNode(String newLabel)
17     {
18         label=newLabel;
19         numNeighbors=0;
20         isVisited=false;
21         neighborList = new adjacencyList();
22     }
23
24     public boolean isUnvisitedNeighbors()
25     {
26         return neighborList.isUnvisitedNeighbors();
27     }
28
29     public void setVisited(boolean isVisitedIn)
30     {
31         isVisited=isVisitedIn;
32     }
33
34     public boolean isVisited()
35     {
36         return isVisited;
37     }
38
39     public adjacencyList getNeighborList()
40     {
41         return neighborList;
42     }
43
44     public void printNeighborList()
45     {
46         neighborList.setFirstNodeAsCurrentNode();
47         for (int x=0;x<neighborList.returnNumNeighbors();x++)
48         {
49             System.out.print(neighborList.getCurrentNode().getLabel()+" , ");
50             neighborList.getNextNode();
51         }
52     }
53
54     public graphNode getNextUnvisited()
55     {
56         neighborList.setFirstNodeAsCurrentNode();
```

```
57     for (int x=0;x<neighborList.returnNumNeighbors();x++)
58     {
59         System.out.println("gNU at "+neighborList.getCurrentNode().getGraphNode().getLabel());
60         if (neighborList.getCurrentNode().getGraphNode().isVisited()==false)
61         {
62             return neighborList.getCurrentNode().getGraphNode();
63         }
64         neighborList.getNextNode();
65     }
66     return null;
67 }
68 public int returnNumNeighbors()
69 {
70     return numNeighbors;
71 }
72
73 public void addNeighbor(graphNode newNeighbor)
74 {
75     neighborList.addNode(newNeighbor);
76     newNeighbor.getNeighborList().addNode(this);
77     newNeighbor.numNeighbors++;
78     numNeighbors++;
79 }
80
81 public String getLabel()
82 {
83     return label;
84 }
85 }
86
87 class graphListNode
88 {
89     private graphNode graphNodeValue;
90     private graphListNode nextNode;
91     private graphListNode previousNode;
92
93     public graphListNode(graphNode newNode)
94     {
95         graphNodeValue = newNode;
96         nextNode=null;
97         previousNode=null;
98     }
99
100    public String getLabel()
101    {
102        return graphNodeValue.getLabel();
103    }
104
105    public graphNode getGraphNode()
106    {
107        return graphNodeValue;
108    }
109
110    public boolean isVisited()
111    {
112        return graphNodeValue.isVisited();
113    }
114
115    public void setAsVisited(boolean isVisitedIn)
116    {
117        graphNodeValue.setVisited(true);
```

```
118     }
119
120     public void setNext(graphListNode neighborNode)
121     {
122         nextNode = neighborNode;
123     }
124
125     public void setPrevious(graphListNode neighborNode)
126     {
127         previousNode = neighborNode;
128     }
129
130     public graphListNode getNext()
131     {
132         return nextNode;
133     }
134
135     public graphListNode getPrevious()
136     {
137         return previousNode;
138     }
139 }
140
141
142 class adjacencyList
143 {
144     private graphListNode firstNode,currentNode;
145     private int numNeighbors;
146
147     public adjacencyList()
148     {
149         firstNode=null;
150         numNeighbors=0;
151     }
152     // Calling this function for an adjacency list belonging to a node adds the new node as a
neighbor
153     public void addNode(graphNode newNode)
154     {
155         graphListNode newListNode = new graphListNode(newNode);
156         if (firstNode==null)
157         {
158             firstNode=newListNode;
159             currentNode=newListNode;
160             numNeighbors++;
161         }
162         else
163         {
164             while (currentNode.getNext()!=null)
165             {
166                 currentNode=currentNode.getNext();
167             }
168             newListNode.setPrevious(currentNode);
169             currentNode.setNext(newListNode);
170             currentNode=currentNode.getNext();
171             numNeighbors++;
172         }
173     }
174
175     public int returnNumNeighbors()
176     {
177         return numNeighbors;
```

```
178     }
179
180     public void setFirstNodeAsCurrentNode()
181     {
182         currentNode=firstNode;
183     }
184
185     public boolean isUnvisitedNeighbors()
186     {
187         currentNode = firstNode;
188         while (currentNode!=null)
189         {
190             if (currentNode.isVisited()==false)
191             {
192                 return true;
193             }
194             currentNode=currentNode.getNext();
195         }
196         return false;
197     }
198
199     public boolean isEmpty()
200     {
201         if (firstNode==null)
202             return true;
203         else
204             return false;
205     }
206
207     public graphListNode returnFirstNode()
208     {
209         return firstNode;
210     }
211
212     public graphListNode getCurrentNode()
213     {
214         return currentNode;
215     }
216
217     //Helper Function for printing list of neighbors
218     public void getNextNode()
219     {
220         currentNode=currentNode.getNext();
221     }
222
223     public graphListNode getLastNode()
224     {
225         graphListNode currentNode = firstNode;
226         while(currentNode.getNext()!=null) //May need to add && currentNode!=null
227             currentNode=currentNode.getNext();
228         return currentNode;
229     }
230
231     public void visitNextNeighbor()
232     {
233         currentNode.getGraphNode().setVisited(true);
234         currentNode=currentNode.getNext();
235     }
236
237     public graphListNode getFirstNode()
238     {
```

```
239     return firstNode;
240 }
241 }
242
243 class dfsStack
244 {
245     private graphNode[] graphNodeStack = new graphNode[100];
246     private int firstNodeIndex, lastNodeIndex, currentNodeIndex, stackLength;
247
248     public dfsStack()
249     {
250         graphNodeStack[0]=null;
251         lastNodeIndex=0;
252         firstNodeIndex=0;
253         stackLength=0;
254     }
255
256     public void addNode(graphNode newNode)
257     {
258         graphNodeStack[lastNodeIndex]=newNode;
259         lastNodeIndex++;
260         stackLength++;
261     }
262
263     public boolean isEmpty()
264     {
265         if (stackLength<=0)
266             return true;
267         else
268             return false;
269     }
270
271     public graphNode popNode()
272     {
273         if (stackLength!=0)
274         {
275             graphNode returnNode = graphNodeStack[lastNodeIndex-1];
276             stackLength--;
277             lastNodeIndex--;
278             System.out.println("Popping node: "+returnNode.getLabel());
279             return returnNode;
280         }
281         else
282         {
283             System.out.println("The stack is empty");
284             return null;
285         }
286     }
287
288     public graphNode peakNode()
289     {
290         if (stackLength!=0)
291         {
292             graphNode returnNode = graphNodeStack[lastNodeIndex-1];
293             return returnNode;
294         }
295         else
296         {
297             System.out.println("The stack is empty");
298             return null;
299         }
300     }
301 }
```

```

300     }
301 }
302
303 public class depthFirstSearch
304 {
305
306     public static void dfs(graphNode nodeIn, dfsStack stackIn)
307     {
308         if (nodeIn==null)
309         {
310             return;
311         }
312         stackIn.addNode(nodeIn);
313         nodeIn.setVisited(true);
314         while (stackIn.isEmpty()==false)
315         {
316             //System.out.println("Entering while loop");
317             if (nodeIn.isUnvisitedNeighbors()==false)
318             {
319                 //System.out.println("Found NO unvisited nodes");
320                 stackIn.popNode();
321             }
322             else
323             {
324                 //System.out.println("Found unvisited for "+nodeIn.getLabel());
325                 graphNode visitingNode = nodeIn.getNextUnvisited();
326                 dfs(visitingNode,stackIn);
327             }
328             //System.out.println("In while loop ");
329         }
330         //System.out.println("End of dfs");
331         //System.out.println("Returning due to empty stack");
332         return;
333     }
334     public static void main(String[] args)
335     {
336         //Graph node contains all nodes in graph
337         //GraphNode is the data structure that represents each node in an
338         //adjacency list. The graphListNode contains a graphNode as its primary value. The
adjacencyList data structure has a graphListNode as its first,last and curenent data points.
Each graphListNode then has a previous and next node which can be used to traverse the
adjacency list. Get neighbors by calling the adjacecylst.first and iterate through next.
339
340         //Sample text Boston,NY,Chicago,LA,Miami,Houston, Honolulu
341
342         System.out.println("Test setup");
343         graphNode gn1 = new graphNode("Boston");
344         graphNode gn2 = new graphNode("New York");
345         graphNode gn3 = new graphNode("Chicago");
346         graphNode gn4 = new graphNode("Los Angeles");
347         graphNode gn5 = new graphNode("Miami");
348         graphNode gn6 = new graphNode("Houston");
349         graphNode gn7 = new graphNode("Honolulu");
350
351         dfsStack stackForDFS = new dfsStack();
352
353         gn1.addNeighbor(gn2);
354         System.out.println(gn1.isUnvisitedNeighbors());
355         System.out.println(gn3.isUnvisitedNeighbors());
356
357         gn1.addNeighbor(gn3);

```

```
358     gn1.addNeighbor(gn4);
359     gn2.addNeighbor(gn5);
360     gn2.addNeighbor(gn6);
361     gn4.addNeighbor(gn7);
362     System.out.println("GN1 has: "+gn1.returnNumNeighbors()+" Neighbors");
363     System.out.println("GN2 has: "+gn2.returnNumNeighbors()+" Neighbors");
364     System.out.println("GN3 has: "+gn3.returnNumNeighbors()+" Neighbors");
365     System.out.println("GN4 has: "+gn4.returnNumNeighbors()+" Neighbors");
366     System.out.println("GN5 has: "+gn5.returnNumNeighbors()+" Neighbors");
367     System.out.println("GN6 has: "+gn6.returnNumNeighbors()+" Neighbors");
368     System.out.println("GN7 has: "+gn7.returnNumNeighbors()+" Neighbors");
369     System.out.println(gn5.isUnvisitedNeighbors());
370
371     System.out.println(gn1.getLabel()+" Neighbors Are: ");
372     gn1.printNeighborList();
373     System.out.println("\n");
374     System.out.println(gn2.getLabel()+" Neighbors Are: ");
375     gn2.printNeighborList();
376     System.out.println("\n");
377     System.out.println(gn3.getLabel()+" Neighbors Are: ");
378     gn3.printNeighborList();
379     System.out.println("\n");
380     System.out.println(gn4.getLabel()+" Neighbors Are: ");
381     gn4.printNeighborList();
382     System.out.println("\n");
383     System.out.println(gn5.getLabel()+" Neighbors Are: ");
384     gn5.printNeighborList();
385     System.out.println("\n");
386     System.out.println(gn6.getLabel()+" Neighbors Are: ");
387     gn6.printNeighborList();
388     System.out.println("\n");
389
390     dfs(gn1,stackForDFS);
391
392
393 }
394 }
```