ID2222 Data Mining

Homework 4: Graph Spectra

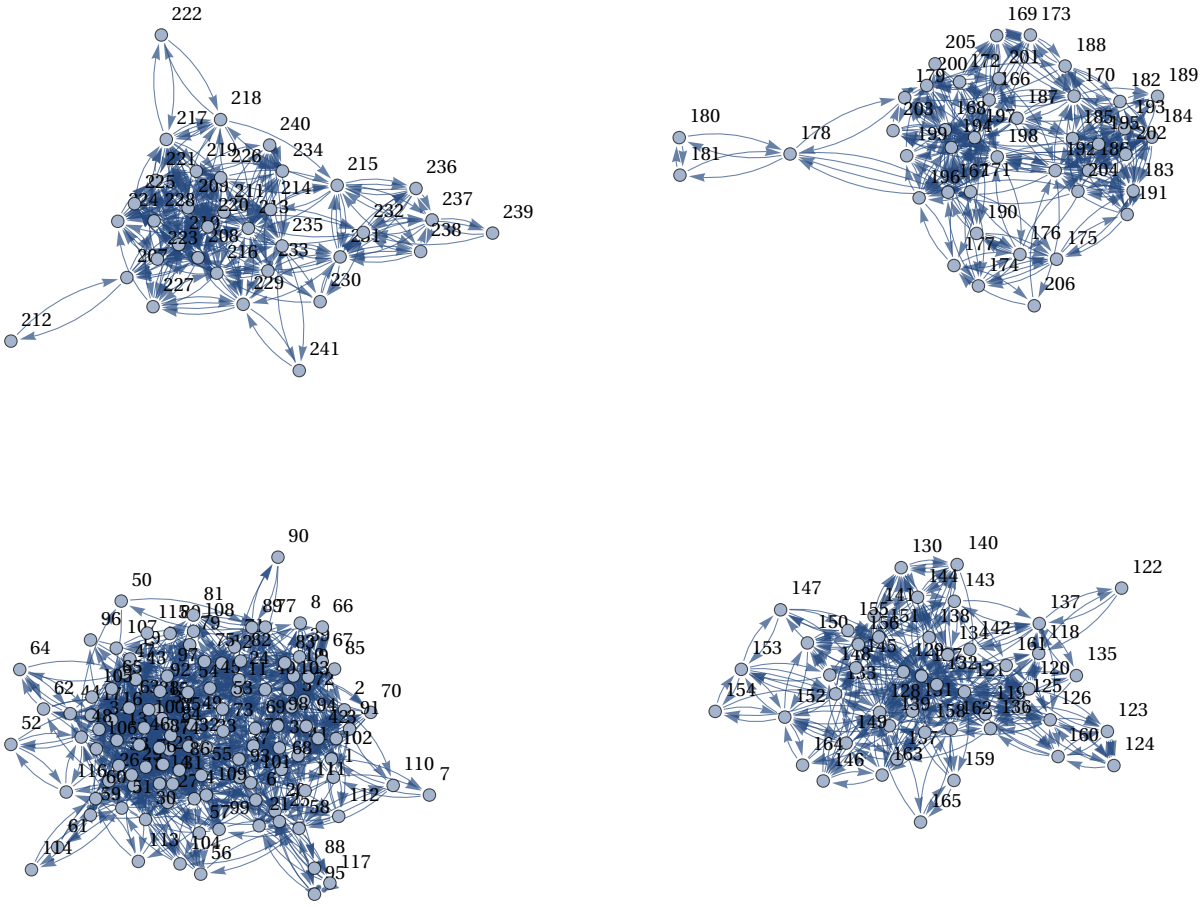
Graph 1

Kim Hammar
KTH Royal Institute of Technology

Konstantin Sozinov
KTH Royal Institute of Technology

Graph Import

```
SetDirectory[NotebookDirectory[]];
edgeList = Import["example1.csv","Data"];
graph = Graph[DirectedEdge@@@ edgeList,VertexLabels→"Name"];
```



General Graph Properties

Edge Count

```
EdgeCount[graph];
```

2196

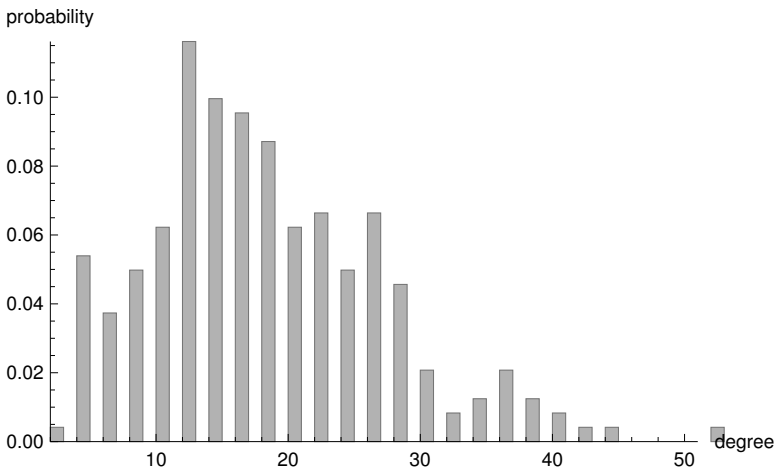
Vertex Count

```
VertexCount[graph];
```

241

Degree Distribution

```
Histogram[VertexDegree[graph],{1},"Probability",AxesLabel→{"degree","probability"}];
```



Global Clustering Coefficient

```
GlobalClusteringCoefficient[graph];
```

$$\frac{1008}{4013}$$

Graph Communities

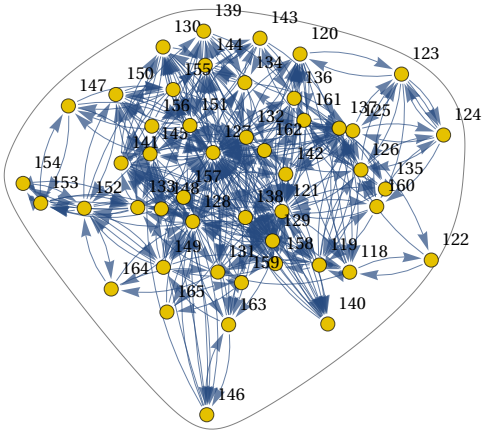
Communities Count

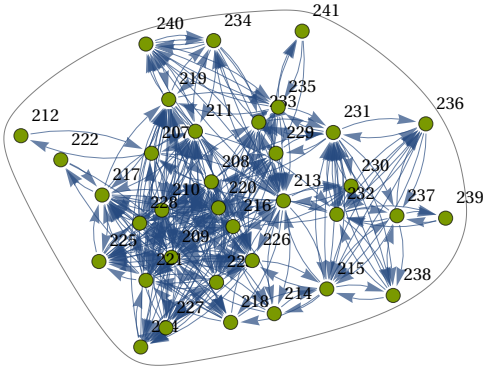
```
Length[FindGraphCommunities[graph]];
```

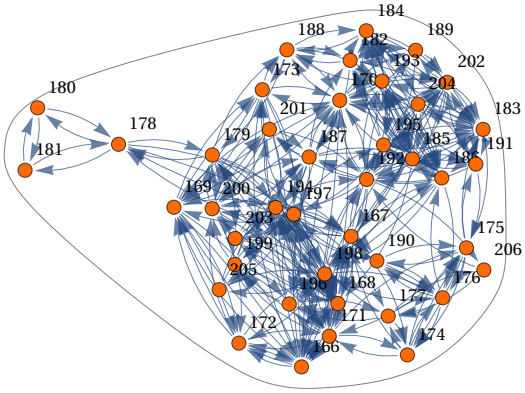
5

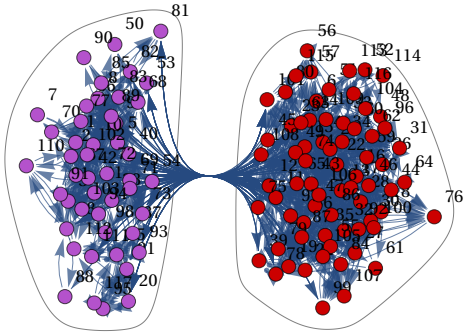
Communities Plot

```
CommunityGraphPlot[graph];
```









Graph Spectra

Graph Spectra

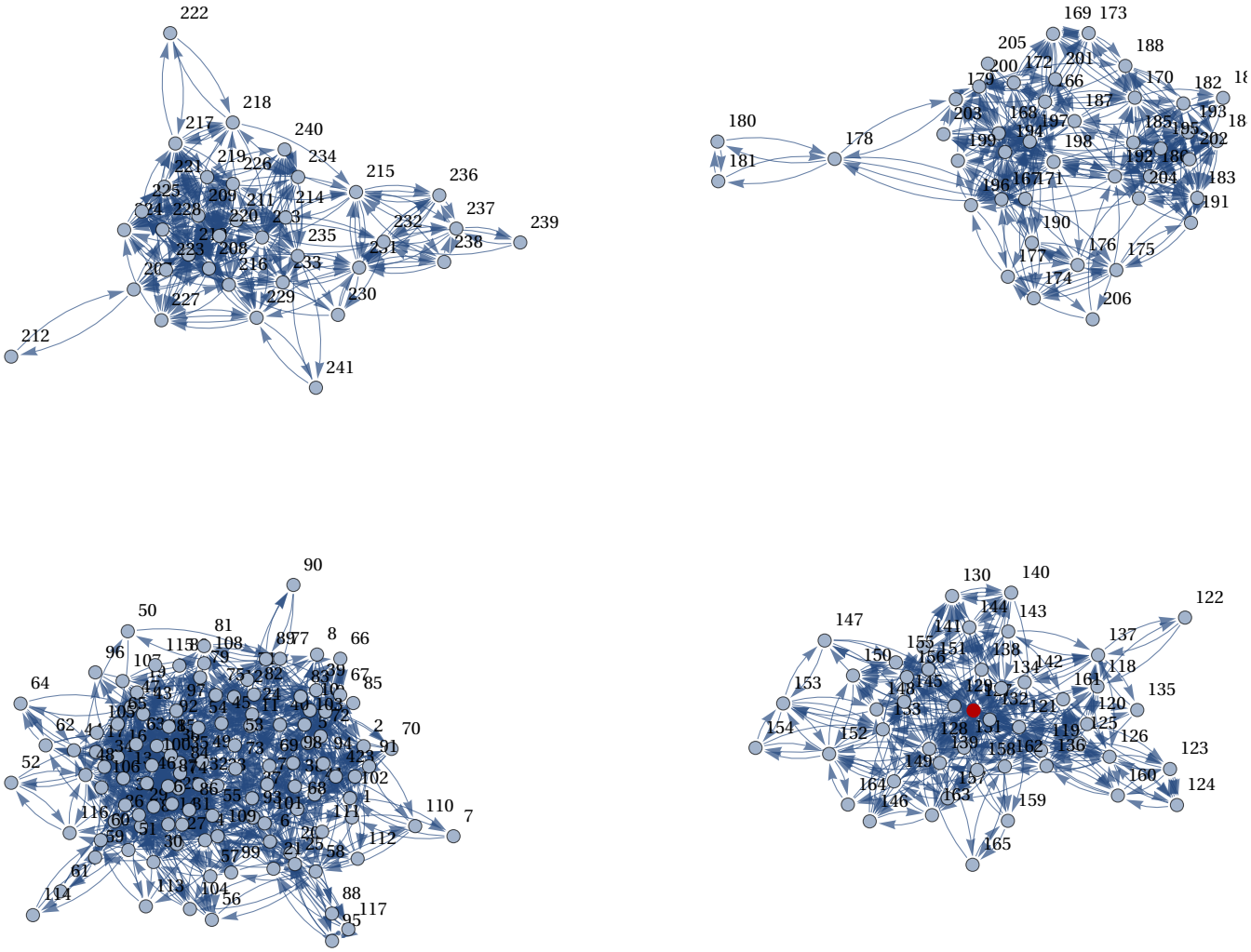
```
A = AdjacencyMatrix[graph];
{eigenVals,eigenVecs} =Eigensystem[N[A]];
laplacian = KirchhoffMatrix[graph];
{minEigenVal, minEigenVec} = Eigensystem[N[A], -1];
```

Node Centralities

PageRank Centrality

```
MaxPageRankCentralNode = VertexList[graph][[Position[PageRankCentrality[graph],
Max[PageRankCentrality[graph]]][[1]]]];
HighlightGraph[graph, MaxPageRankCentralNode];
```

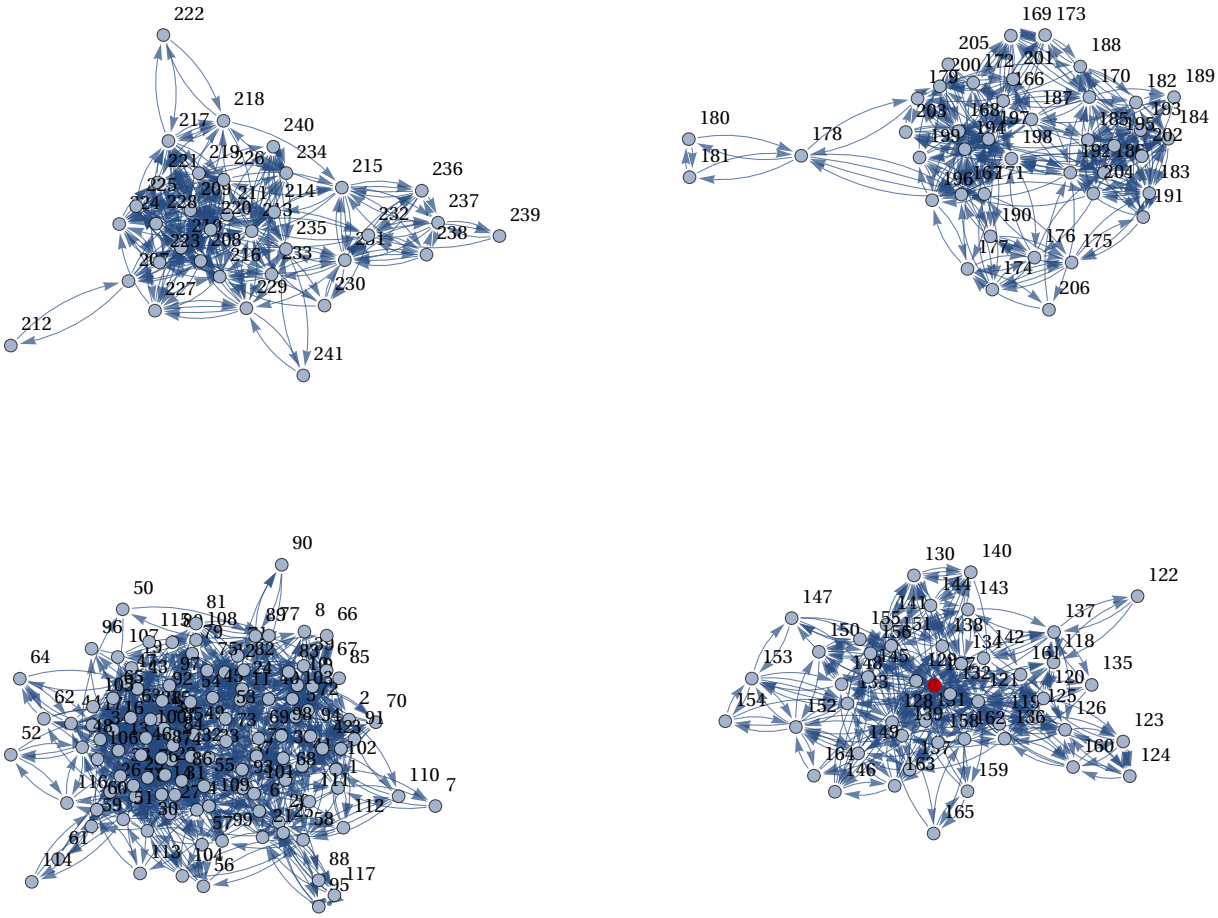
{127}



Degree Centrality

```
MaxDegreeCentralNode = VertexList[graph][[Position[DegreeCentrality[graph],
Max[DegreeCentrality[graph]]][[1]]]];
HighlightGraph[graph, MaxDegreeCentralNode];
```

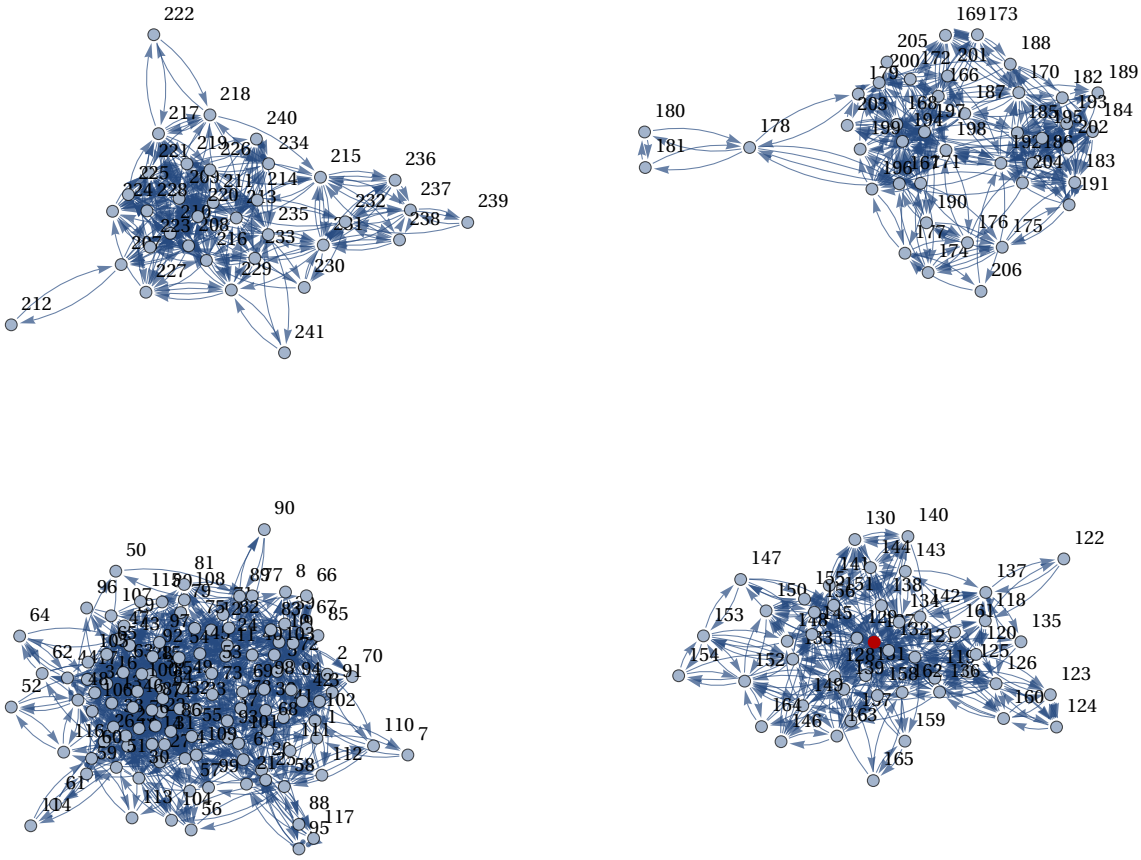
{127}



Closeness Centrality

```
MaxClosenessCentralityNode = VertexList[graph][[Position[ClosenessCentrality[graph],
Max[ClosenessCentrality[graph]]][[1]]]];
HighlightGraph[graph, MaxClosenessCentralityNode];
```

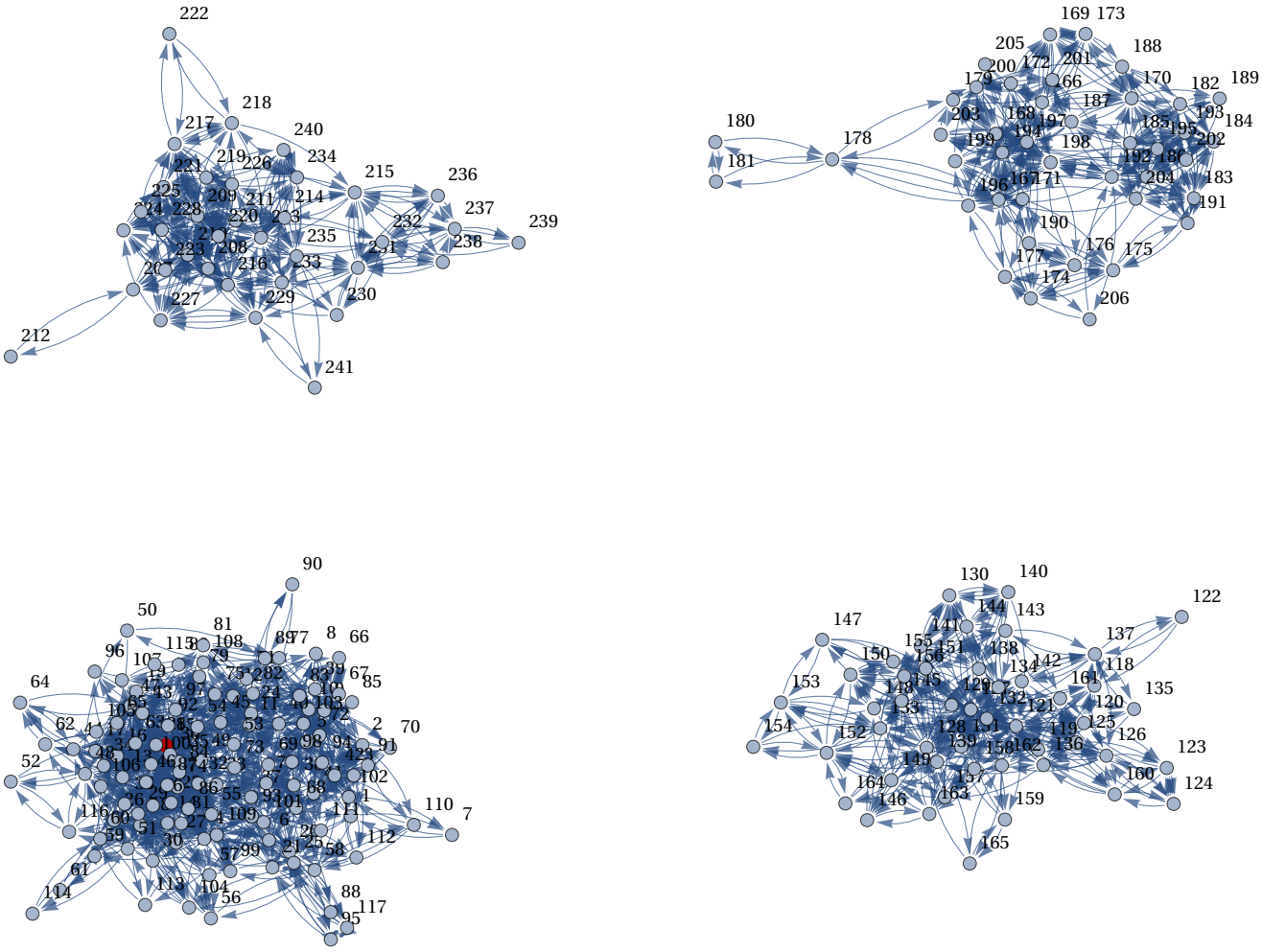
{127}



Betweenness Centrality

```
MaxBetweenessCentralityNode = VertexList[graph][[Position[BetweennessCentrality[graph],
Max[BetweennessCentrality[graph]]][[1]]]];
HighlightGraph[graph, MaxBetweenessCentralityNode];
```

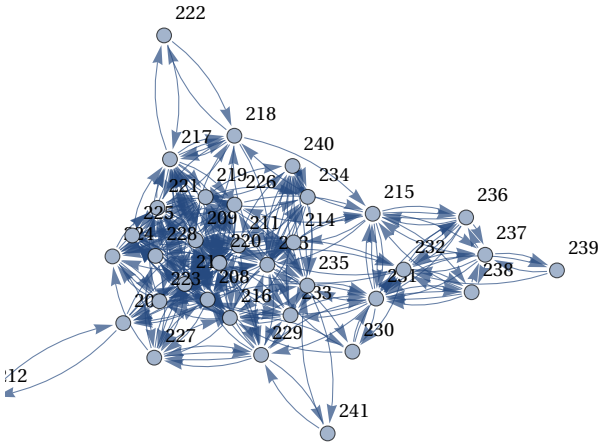
{15}

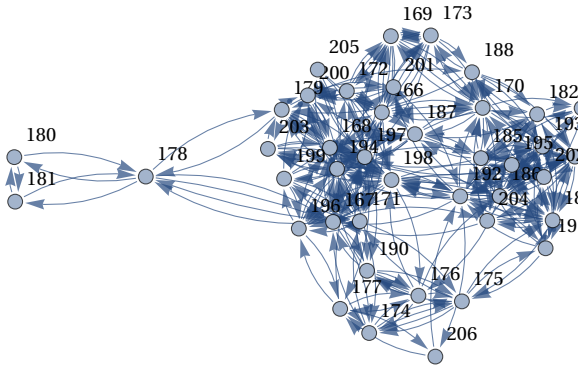


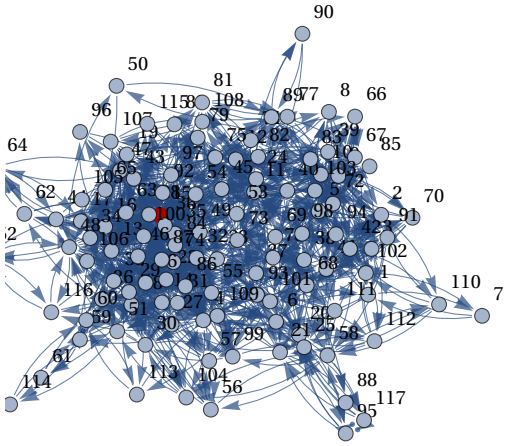
EigenVector Centrality

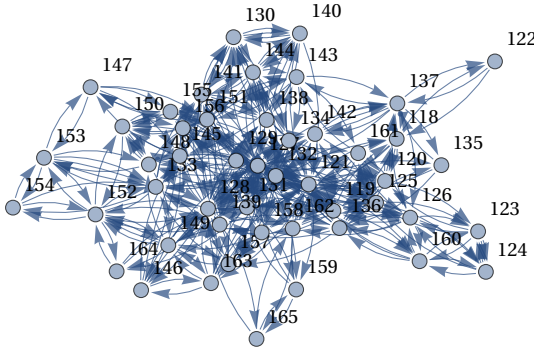
```
MaxEigenVectorCentralityNode = VertexList[graph][[Position[EigenvectorCentrality[graph]
Max[EigenvectorCentrality[graph]]][[1]]]];
HighlightGraph[graph, MaxEigenVectorCentralityNode];
```

{15}





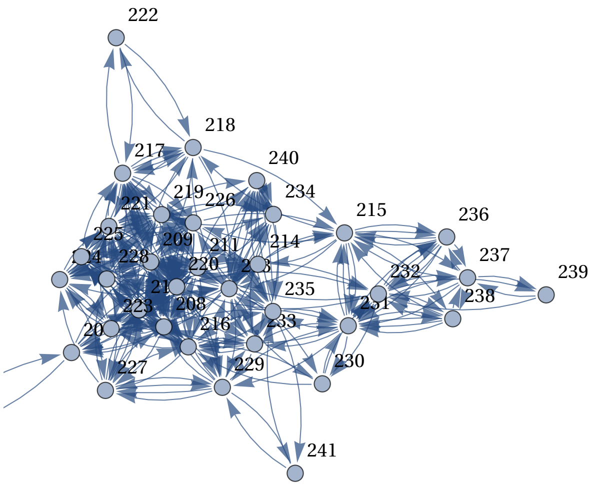


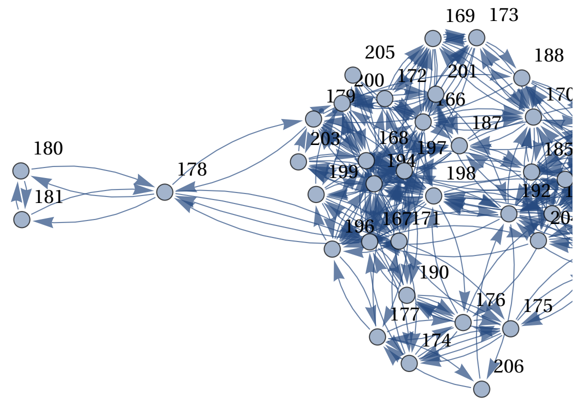


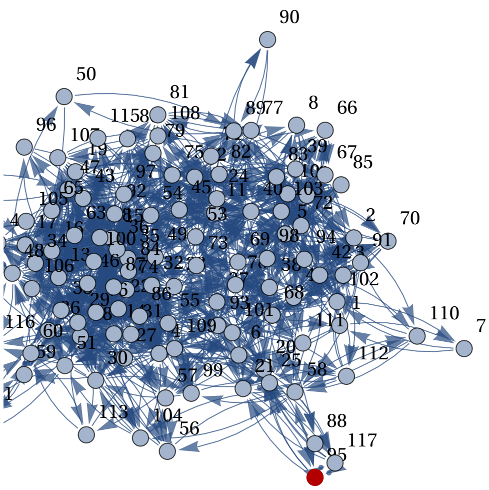
Clustering Coefficient

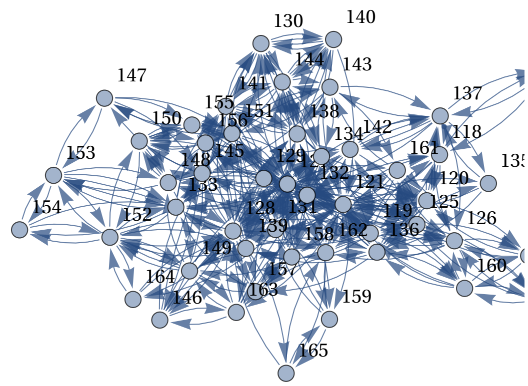
```
MaxClusterNode = VertexList[graph][[Position[LocalClusteringCoefficient[graph],
Max[LocalClusteringCoefficient[graph]]][[1]]]];
HighlightGraph[graph, MaxClusterNode];
```

{95}


222
218
217
240
234
215
236
237
239
238
232
231
230
229
227
241
235
233
216
208
219
226
221
225
209
211
214
220
223


169
173
205
188
180
178
181
203
199
198
187
196
190
176
175
177
174
206
192
197
200
201
166
168


90
50
81
96
108
8
66
39
85
70
91
102
110
7
112
88
117
113
104
56
99
58
111
109


130
140
143
147
137
118
153
154
152
126
160
164
146
163
159
165
150
155
142
161
120
125
119
136