

Network analysis with Cytoscape

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in lecture on system's biology

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Outline

- 1 Introduction
- 2 Code
- 3 Results
- 4 Conclusion
- 5 Resources

Outline

1 Introduction

2 Code

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...why should we care about glycolysis and gluconeogeneses

... basic setup of our two networks ... how we modelled them and what did not work (CellDesigner) ...

Outline

1 Introduction

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Plugin for calculation of Katz's Index

Definition (Katz's Index)

...

We considered two cases: α small and $\alpha = \frac{1}{\lambda_{max}}$.

Plugin for calculation of Katz's Index - α small

Listing 1: Necessary import statements

```
1 package katz.plugin;  
2  
3 import java.util.List;  
4 import java.awt.event.ActionEvent;  
5 import javax.swing.JOptionPane;  
6 import java.text.DecimalFormat;  
7  
8 import cytoscape.plugin.CytoscapePlugin;  
9 import cytoscape.util.CytoscapeAction;  
10 import cytoscape.Cytoscape;  
11 import cytoscape.CyNetwork;  
12 import cytoscape.CyEdge;  
13 import cytoscape.view.CyNetworkView;  
14  
15 import Jama.Matrix;
```


Plugin for calculation of Katz's Index - α small

Listing 2: Basic class definition

```
16 public class KatzPlugin extends CytoscapePlugin {
17
18     public KatzPlugin() {
19         KatzPlugin.MolbiPluginAction action = new KatzPlugin.MolbiPluginAction();
20         action.setPreferredMenu("Plugins.Molbi");
21         Cytoscape.getDesktop().getCyMenus().addAction(action);
22     }
23
24     public String describe() {
25         return "Plugin to calculate the topological Katz Index for networks";
26     }
27
28     public class MolbiPluginAction extends CytoscapeAction {
29
30         public MolbiPluginAction() {
31             super("Katz's Index (alpha = 0.1)");
32         }
33
34         @Override
35         public void actionPerformed(ActionEvent ae) {
36             run();
37         }
38     }
39 }
```

Plugin for calculation of Katz's Index - α small

Listing 3: Run method (I)

```
38     private void run() {
39
40         CyNetwork network = Cytoscape.getCurrentNetwork();
41         CyNetworkView view = Cytoscape.getCurrentNetworkView();
42         int N = network.getNodeCount() + 1;
43
44         if (N == 1) {
45             JOptionPane.showMessageDialog(view.getComponent(), "No network/view
46                                     loaded.");
47             return;
48         }
49
50         double [][] A = new double[N][N];
51         for (double[] row : A) Arrays.fill(row, 0.0);
52
53         for (CyEdge edge : (List<CyEdge>) network.edgesList()) {
54             int i = Math.abs(edge.getSource().getRootGraphIndex());
55             int j = Math.abs(edge.getTarget().getRootGraphIndex());
56             A[i][j] = 1;
57         }
58     }
```

Plugin for calculation of Katz's Index - α small

Listing 4: Run method (II)

```
57         Matrix M = new Matrix(A);
58         Matrix I = Matrix.identity(N, N);
59         Matrix IVec = new Matrix(N, 1, 1.0);
60
61         double alpha = 0.1; // emulates degree centrality
62         double [][] values = ((I.minus(M.transpose()).times(alpha)).inverse()).
            minus(I).times(IVec).toArrayCopy();
63
64         StringBuilder sb = new StringBuilder();
65         DecimalFormat df = new DecimalFormat("#0.000");
66
67         for (int i = 1; i < N; i++) {
68             if (i % 10 == 0) sb.append("\n");
69             sb.append("C(").append(i).append("): ").append(df.format(values[i]
70                 [0])).append(" ");
71         }
72         JOptionPane.showMessageDialog(view.getComponent(), "All done.\n" + sb);
73         view.redrawGraph(false, true);
74     }
75 }
76 }
```

Plugin for calculation of Katz's Index - $\alpha = \frac{1}{\lambda_{max}}$

Listing 5: Run method (II)

```
57      Matrix M = new Matrix(A);
58      Matrix I = Matrix.identity(N, N);
59      Matrix IVec = new Matrix(N, 1, 1.0);
60
61      double[] eigs = M.eig().getRealEigenvalues();
62      double alpha;
63      Arrays.sort(eigs);
64
65      if (eigs[eigs.length - 1] == 0) alpha = 1.0;
66      else alpha = 1.0 / eigs[eigs.length - 1];
67
68      double[][] values = ((I.minus(M.transpose()).times(alpha)).inverse()).
        minus(I).times(IVec).toArrayCopy();
69      StringBuilder sb = new StringBuilder();
70      DecimalFormat df = new DecimalFormat("#0.000");
71
72      for (int i = 1; i < N; i++) {
73          if (i % 10 == 0) sb.append("\n");
74          sb.append("C(").append(i).append("): ").append(df.format(values[i
            ][0])).append(" ");
75      }
76
77      JOptionPane.showMessageDialog(view.getComponent(), "All done.\n" + sb);
78      view.redrawGraph(false, true);
79  }
80 }
81 }
```

Plugin for calculation of Randic's Index

Definition (Randic's Index)

...

Plugin for calculation of Randic's Index

Listing 6: Necessary import statements

```
1 package katz.plugin;  
2  
3 import java.util.List;  
4 import java.awt.event.ActionEvent;  
5 import javax.swing.JOptionPane;  
6 import java.text.DecimalFormat;  
7  
8 import cytoscape.plugin.CytoscapePlugin;  
9 import cytoscape.util.CytoscapeAction;  
10 import cytoscape.Cytoscape;  
11 import cytoscape.CyNetwork;  
12 import cytoscape.CyEdge;  
13 import cytoscape.view.CyNetworkView;  
14  
15 import Jama.Matrix;
```

Plugin for calculation of Randic's Index

Listing 7: Basic class definition

```
16 public class RandicPlugin extends CytoscapePlugin {
17
18     public RandicPlugin() {
19         RandicPlugin.MolbiPluginAction action = new RandicPlugin.MolbiPluginAction();
20         action.setPreferredMenu("Plugins.Molbi");
21         Cytoscape.getDesktop().getCyMenus().addAction(action);
22     }
23
24     public String describe() {
25         return "Plugin to calculate the Index of Randic for networks";
26     }
27
28     public class MolbiPluginAction extends CytoscapeAction {
29
30         public MolbiPluginAction() {
31             super("Randic's Index");
32         }
33
34         @Override
35         public void actionPerformed(ActionEvent ae) {
36             run();
37         }
38     }
39 }
```

Plugin for calculation of Randic's Index

Listing 8: Run method

```
38     private void run() {
39         CyNetwork network = Cytoscape.getCurrentNetwork();
40         CyNetworkView view = Cytoscape.getCurrentNetworkView();
41         int N = network.getNodeCount();
42
43         if (N == 0) {
44             JOptionPane.showMessageDialog(view.getComponent(), "No network/view
45                                     loaded.");
46             return;
47         }
48
49         Double IRandic = 0.0;
50         for (CyNode node : (List<CyNode>) network.nodesList())
51             // otherwise Randic's Index will be +infinity!
52             if (network.getDegree(node) != 0)
53                 IRandic += Math.pow(network.getDegree(node), -0.5);
54
55         JOptionPane.showMessageDialog(view.getComponent(), "All done.\nRandic
56                                     Index " + IRandic);
57         view.redrawGraph(false, true);
58     }
```


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2 Code

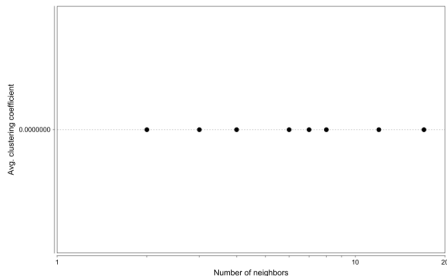
3 Results

4 Conclusion

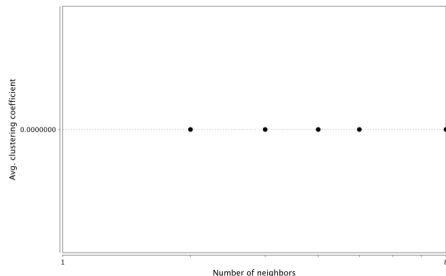
5 Resources

Results I

...give example results from network 1 and network2



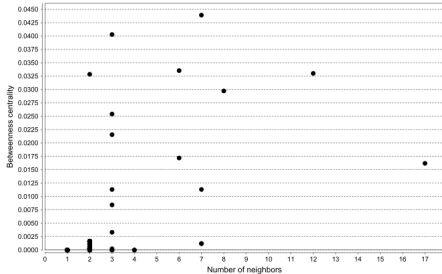
(a) Glyco1



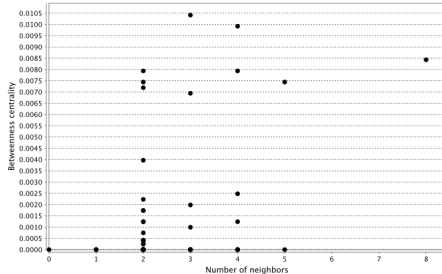
(b) Glyco2

Fig. 1: Average Clustering Coefficient Centrality

Results II



(a) Glyco1



(b) Glyco2

Fig. 2: Betweenness Centrality

Results ...

... more results ...

Differences

To other groups

...

Problems

To other groups

...

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Conclusion

Benefits of cytoscape

...

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Git repository

`git://gitorious.org/cytoscape-plugins/cytoscape-plugins.git`