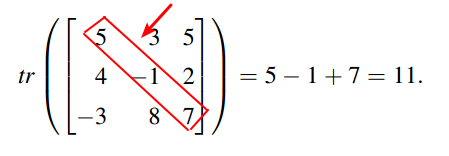
Comparing the Q algorithm and Quiring algorithm:

When running the Quiring algorithm we output a set of aggregates and the modularity matrix.

To calculate the modularity from this output we can take the trace of the last modularity matrix and divide by 2.



When testing the simple 7 node graph on the Quiring algorithm the final modularity we derive is 0.3671875 with a clustering of {1,2,3,4} and {5,6,7}.

On the other hand, the Q algorithm calculates the modularity value by taking the ratio of edges inside modules to the total edges.

When passing the same graph into this algorithm we get a very different modularity of 1.0. This means all the nodes get clustered together in the same module {2,1,3,4,5,6,7}.

To further test the Q algorithm the nodes were reordered to see if order impacted clustering.

This involved re-ordering the node id’s, module attributes, and the initial ordering of the modules.



So, the code above was replaced with the following where node 3 and 7 are switched.

Text

Description automatically generated

The modularity of this data comes out to 0.875 different from the previously calculated 1.0. The clustering of the modules is: {2,1,3} and {5,7,4,6}.

This indicates that changing the order of nodes in a graph produces significant variability with the Q algorithm.

Since this reordered data produced a similar clustering too the Quiring algorithm, we can compare their outputs.

|  |  |  |
| --- | --- | --- |
|  | Q algorithm (with reordered data) | Quiring Algorithm |
| Modularity Value | 0.875 | 0.3671875 |
| Clustering | {2,1,3} and {5,7,4,6} | {1,2,3,4} and {5,6,7} |

Both algorithms produced very similar clustering but the modularity value from the Q algorithm was 0.875 while the Quiring algorithm produced a modularity value of 0.367185. In theory, the modularity values should be relatively similar.

To crosscheck modularity values we can pass in the quiring algorithm’s clustering into the CalcModularityQ() function with the following setup:



The CalcModularityQ() function produces a modularity value of 0.875.

Since the value is the same as that produced by the Q algorithm that means the way in which both algorithms calculate modularity produces significant difference and cannot be compared. Paraphrased, we currently cannot establish an apples-to-apples comparison between both algorithms.

**Testing on a 17 node graph:** 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17

To see if more complex graphs cause such issues we tested a 17 node graph.

Interestingly, when run on the Quiring algorithm the graph produced a modularity of 1 which meant all the modules were grouped together.

How the algorithm grouped the modules:

12 3 4 58 6 7 910 11 12 13 1415 16 17

12 34 58 67 910 1112 1316 1415 17

1234 5867 9101112 13161415 17

1234(17) 5867 9(10)(11)12 13(16)(14)15

1234(17)(13)(16)(14)15 5867 9(10)(11)12

1234(17)(13)(16)(14)(15)(9)(10)(11)12 5867

1234(17)(13)(16)(14)(15)(9)(10)(11)(12) 5867 *[1 whole module]*

The final adjacency matrix produced was

[,1]

[1,] 40

The Q algorithm produced a modularity of 0.85.

The final modules grouped by this algorithm were:

1234 5678 9(10)(11)(12)(17) 13(14)(15)16

These modules actually match up with line 4 of clustering by the Quiring algorithm. However, this is the last step of clustering produced by this algorithm while the Quiring algorithm continues to cluster past this point. This is because the Quiring algorithm’s exit condition is triggered only when the only positive entries in the modularity matrix belong to its main diagonal.

So, it looks like the Quiring algorithm does a good job of putting everything into modules but the result doesn’t really mean anything.

Testing on a 130 node graph:

Testing Data:

Programs are timed without printing to the console or any file

Dr.Tipton’s simple 7 node test:

|  |  |  |
| --- | --- | --- |
|  | Q algorithm | Quiring Algorithm |
| Modularity Value | 1 | 0.3671875 |
| Clustering | { 2 1 3 4 5 6 7} | {1,2,3,4} and {5,6,7} |
| Time | 0.17 sec | 0.17 sec |

17 node test:

|  |  |  |
| --- | --- | --- |
|  | Q algorithm | Quiring Algorithm |
| Modularity Value | 0.85 | 1 |
| Clustering | { 2 1 3 4} , { 6 5 7 8}, { 10 9 11 12 17}, { 14 13 15 16 } | { 1 2 3 4 17 13 16 14 15 9 10 11 12 5 8 6 7} |
| Time | 0.19 sec | 0.2 sec |