Clique Finder in Bipartite Graphs

Asad Ali

Implementation Explanation

1. The algorithm uses a brute force technique for finding all the cliques and that of the user specified density. (Combination logic)
2. The algorithm first generates a random graph based on the density provided by the user, and then distinct combinations are generated for the total number of nodes in the two partitions of the graph.
3. Then those combinations are compared against each other to find if there exists a clique between them or not.
4. If a clique is found then its node numbers are recorded and are displayed on the screen as well as a separate clique is also shown for clarity.
5. Density time relationship chart / graph has also been implemented, which first record the time taken for finding cliques of user specified density and after accumulating a few results (10) you can plot the graph.

Additional Features

1. The program is also capable of finding cliques of unequal size from a given random graph. Use the findUEClique button to perform this job.
2. The program also displays the cliques in the order of highest to lowest based on the number of vertices involved in the clique.

Observations

1. If the density of the graph is greater than 70% then the clique finding algorithm works faster and finds the cliques in less time.
2. Where as if the density of the graph is set to less than 60% then the clique finding brute force technique takes more time. In fact Extra ordinary.
3. The range in between the above mentioned two is a fuzzy one.
4. The **reason** for the above phenomenon is that, with the graph density set to greater than or equal to 70% the nodes within the graph are more compactly bonded (more cliques of bigger size) so when the clique finding algorithm runs on such a graph it identifies the biggest or largest clique first and then the smaller one, but as some bigger clique is identified to be present more nodes tend to disqualify the combinational test so the number of comparisons required significantly falls as soon as some bigger clique is identified.
5. Also as the number of nodes grows in the graph the number of combinational comparisons required to perform the task also increase resulting in the increase in the time for clique finding.

Program In Execution:

Below are few snapshots of the program in execution, they effectively portray the functionality that has been implemented in the program and the result it provides.

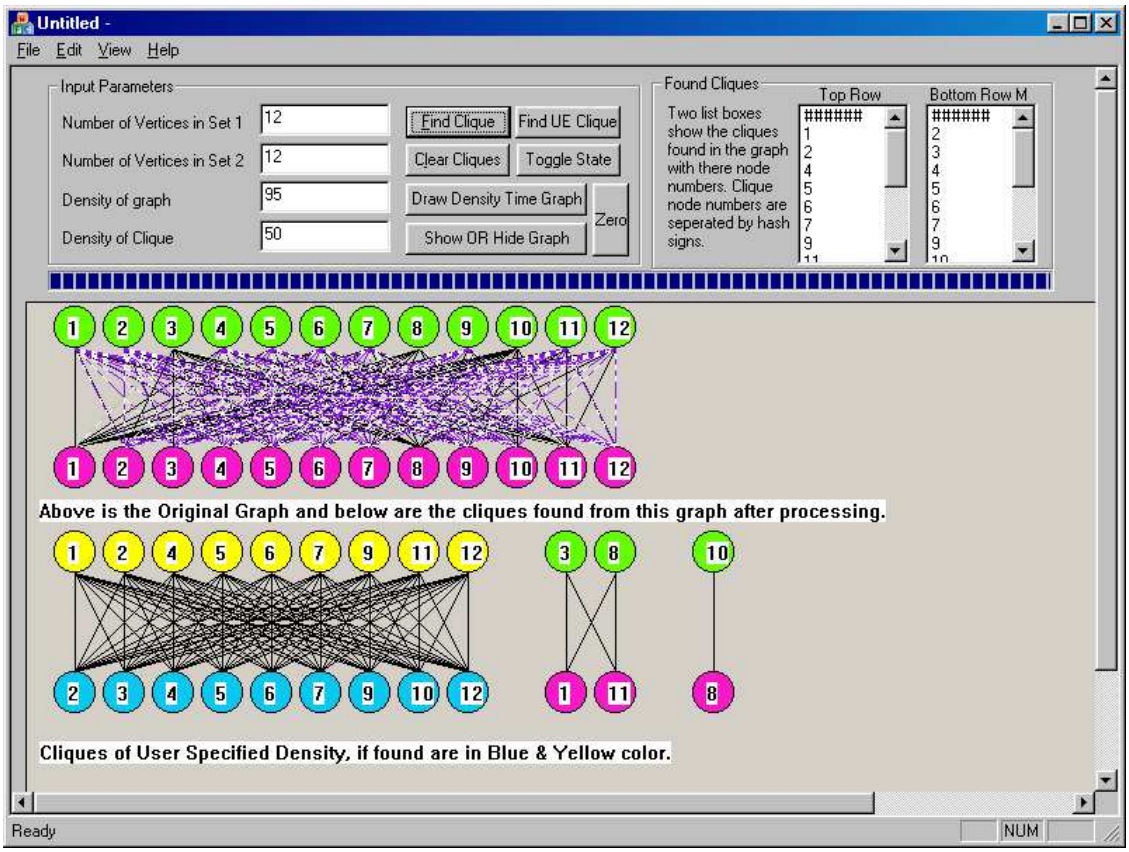

Figure 1 Clique with nodes in yellow and blue color is that of user specified density.

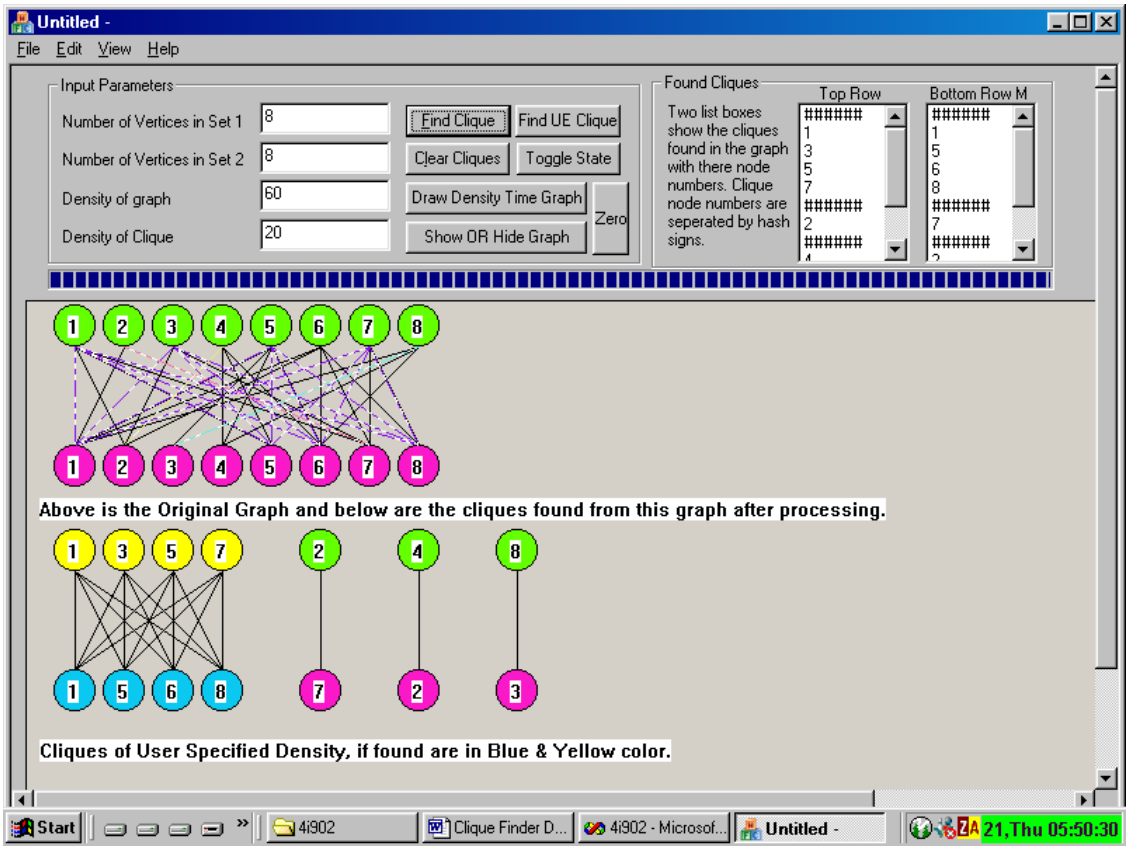
Untitled -
File Edit View Help
Input Parameters
Number of Vertices in Set 1
8
Number of Vertices in Set 2
8
Density of graph
60
Density of Clique
20
Find Clique
Find UE Clique
Clear Cliques
Toggle State
Draw Density Time Graph
Show OR Hide Graph
Zero
Found Cliques
Two list boxes show the cliques found in the graph with there node numbers. Clique node numbers are seperated by hash signs.
Top Row
Bottom Row M
Above is the Original Graph and below are the cliques found from this graph after processing.
Cliques of User Specified Density, if found are in Blue & Yellow color.
Start
4i902
Clique Finder D...
4i902 - Microsof...
Untitled -
21,Thu 05:50:30

Figure 2

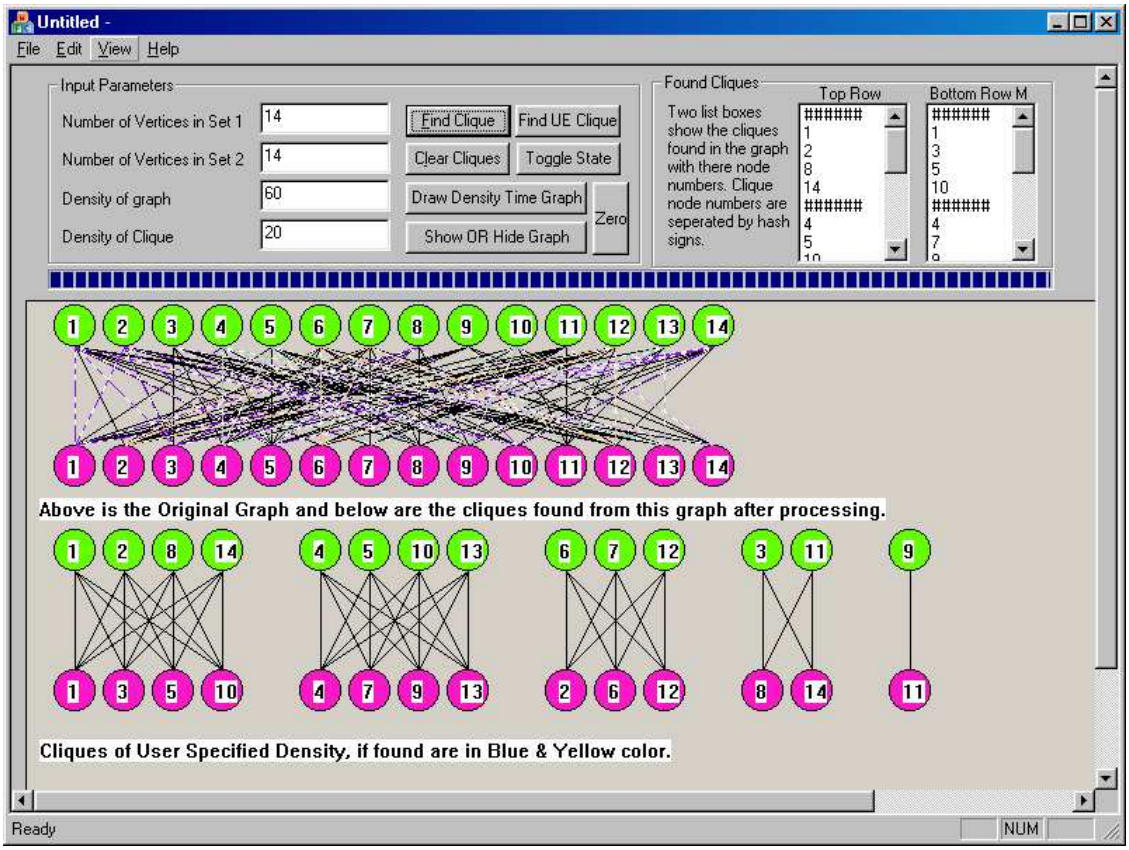
Untitled -
File Edit View Help
Input Parameters
Number of Vertices in Set 1
14
Number of Vertices in Set 2
14
Density of graph
60
Density of Clique
20
Find Clique
Find UE Clique
Clear Cliques
Toggle State
Draw Density Time Graph
Show OR Hide Graph
Zero
Found Cliques
Two list boxes show the cliques found in the graph with there node numbers. Clique node numbers are seperated by hash signs.
Top Row
Bottom Row M
Above is the Original Graph and below are the cliques found from this graph after processing.
Cliques of User Specified Density, if found are in Blue & Yellow color.
Ready
NUM

Figure 3

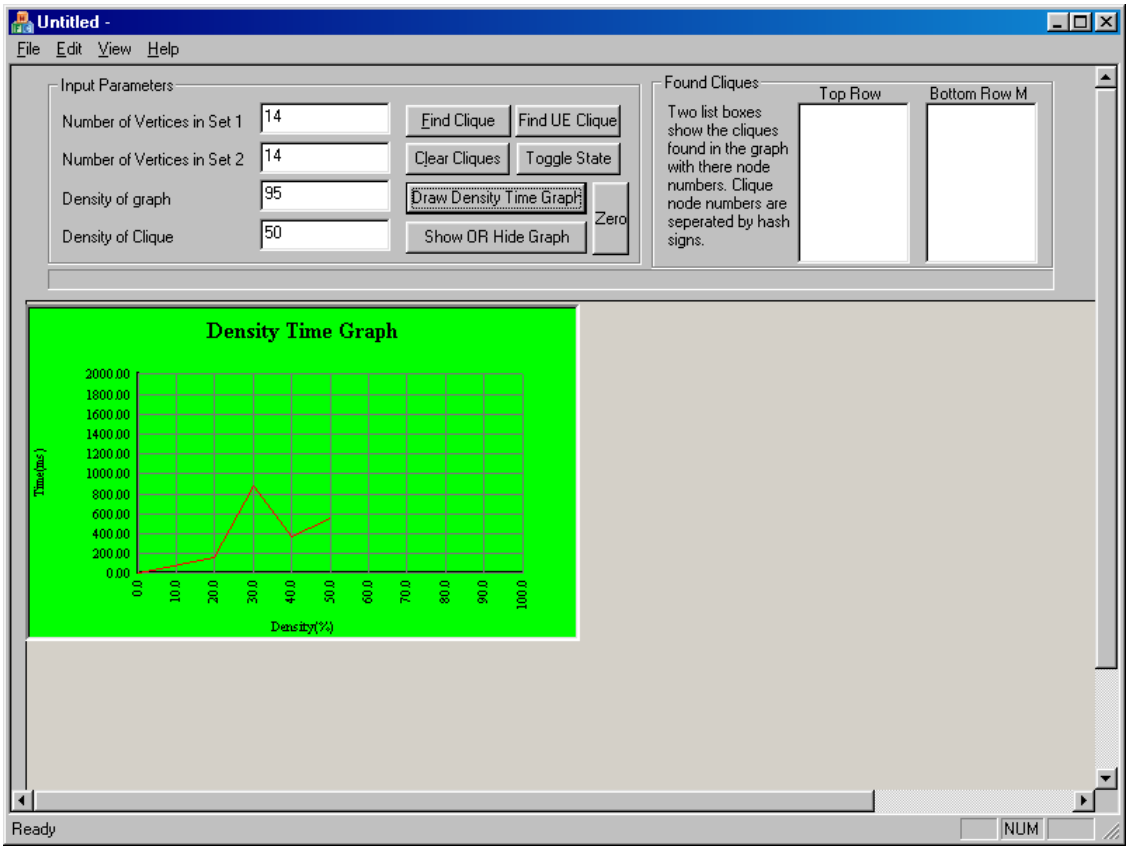

Figure 4 Shows a density time graph for 5 clique searches of user specified clique density

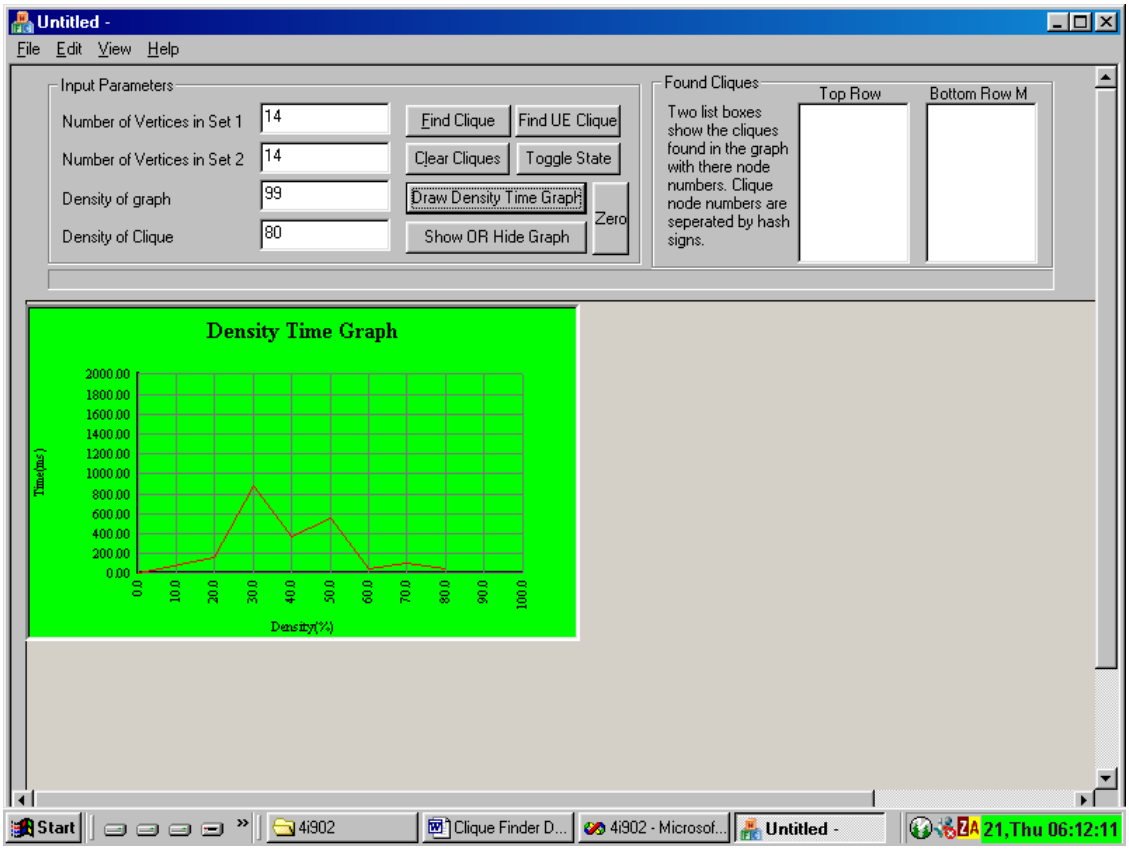
Untitled -
File Edit View Help
Input Parameters
Number of Vertices in Set 1
14
Number of Vertices in Set 2
14
Density of graph
99
Density of Clique
80
Find Clique
Find UE Clique
Clear Cliques
Toggle State
Draw Density Time Graph
Show OR Hide Graph
Zero
Found Cliques
Two list boxes show the cliques found in the graph with there node numbers. Clique node numbers are seperated by hash signs.
Top Row
Bottom Row M
Density Time Graph
Time(ms)
Density(%)
Start
4i902
Clique Finder D...
4i902 - Microsof...
Untitled -
21,Thu 06:12:11

Figure 5

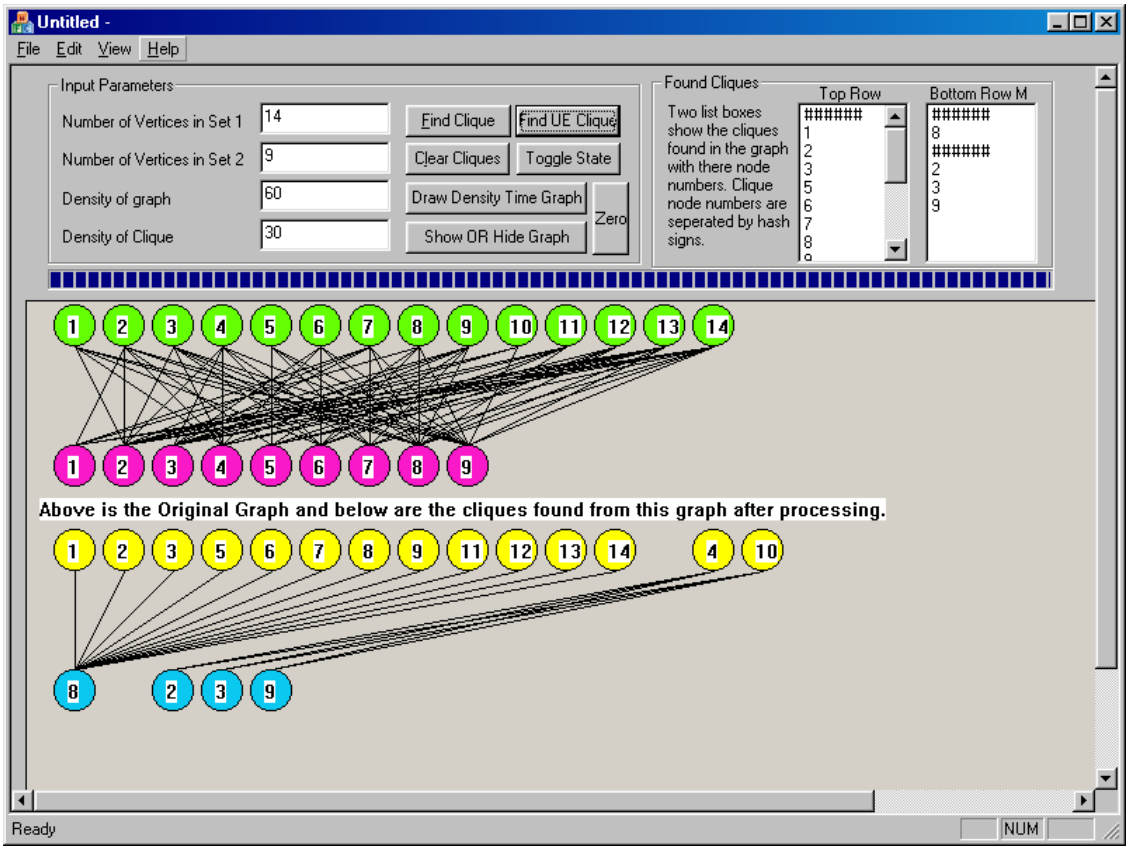

Figure 6 Cliques of Un equal size as identified by the program

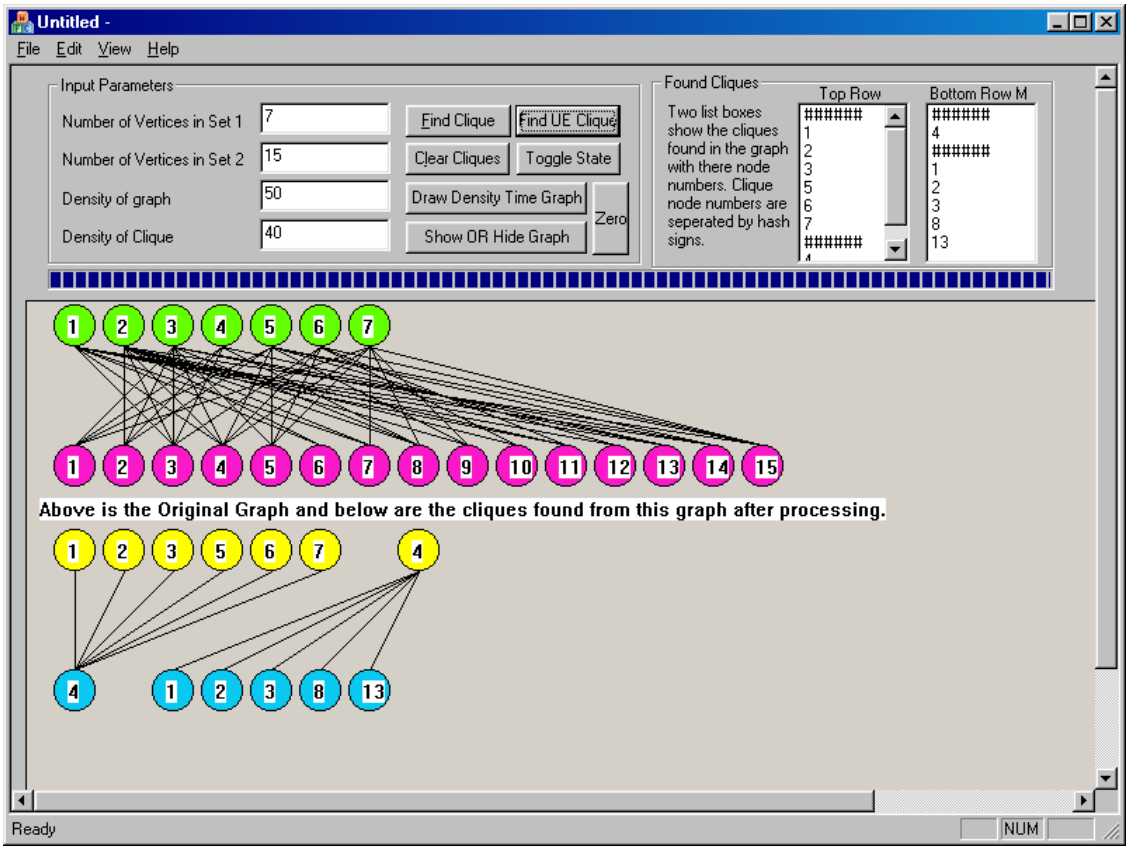

Figure 7 Another example of cliques of unequal size.

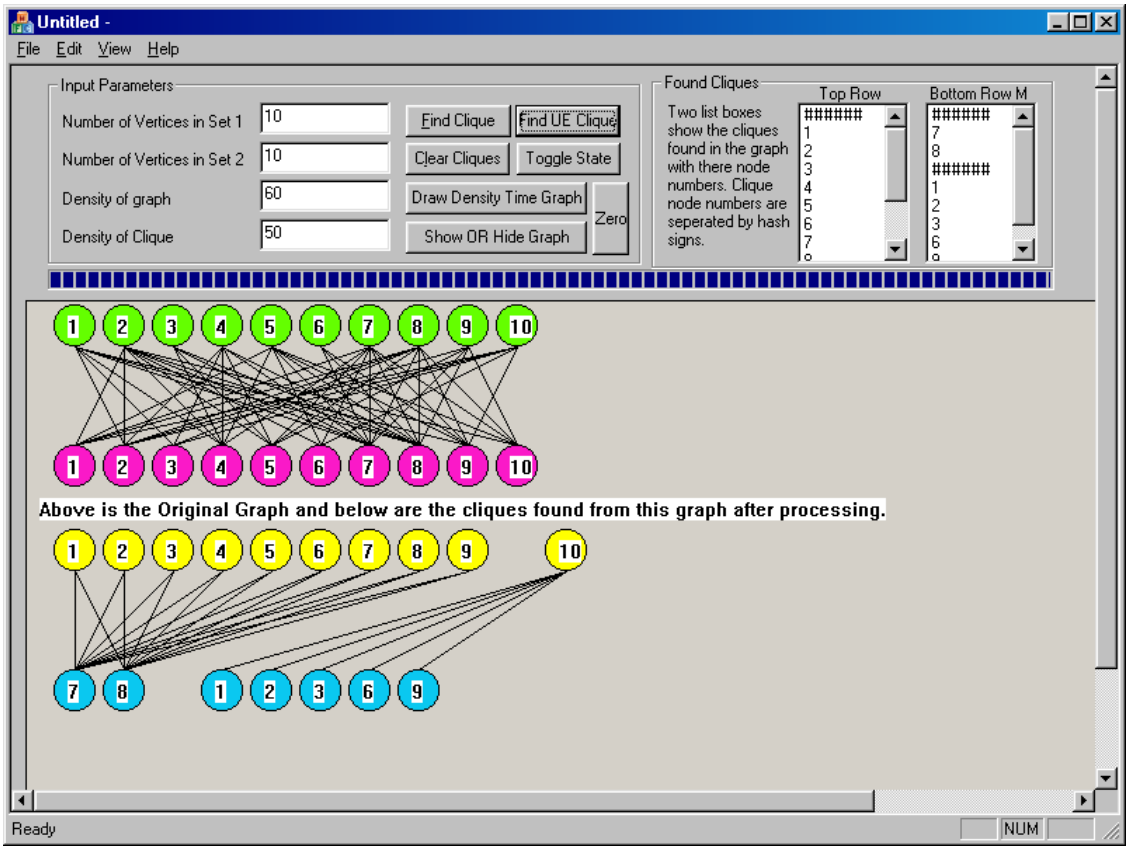
Untitled -
File Edit View Help
Input Parameters
Number of Vertices in Set 1
10
Number of Vertices in Set 2
10
Density of graph
60
Density of Clique
50
Find Clique
Find UE Clique
Clear Cliques
Toggle State
Draw Density Time Graph
Show OR Hide Graph
Zero
Found Cliques
Two list boxes show the cliques found in the graph with there node numbers. Clique node numbers are seperated by hash signs.
Top Row
Bottom Row M
Above is the Original Graph and below are the cliques found from this graph after processing.
Ready
NUM

Figure 8