**CS2650: Distributed Multimedia Systems**

**Final Project**

**Social Network Analysis: Links Relationships**

**Introduction**

A slow intelligence system is a system with multiple decision cycles. There are six characteristics of slow intelligence system, including enumeration, propagation, elimination, adaptation, concentration, and slow/fast decision cycle. Social network is one of the natural slow intelligence systems. It would have these characteristics to form its decision cycle. There are a lot of aspects of social networks, and the topic of link relationships is a hot topic to discuss. Two concepts of link relationships are nodes and links. Nodes mean each actor or participator in a social network, and links mean the relationships between nodes. In this project, I would analyze the link relationships between each member in a social network with some measures of social network analysis.

**Method**

The PTT is the most popular BBS in Taiwan, and the largest BBS in the Chinese-speaking community (Chang, 2009). There are many categories of boards within PTT, such as entertainment, sport, life, and campus. ShuangHe is one board of life, and the topics are all about the Zhonghe City and Yonghe City in Taiwan. In this board, there are link relationships between each participator. Therefore, I would analyze the link relationships within ShuangHe to investigate the evolution of link relationships in ShuangHe with the measures of social network analysis, including size, density, clique, and degree.

In order to observe the dynamic status, I would collect manually three months data, including September, October, and November in 2010, and then divide them into three parts to investigate the changes of link relationship. I would code participators with number to represent each poster, and each number represents each node. The tools I would use are UCINET, NetDraw, and PIPE2. UCINET is for analysis; NetDraw is for visualization; PIPE2 is for PetriNet concept.

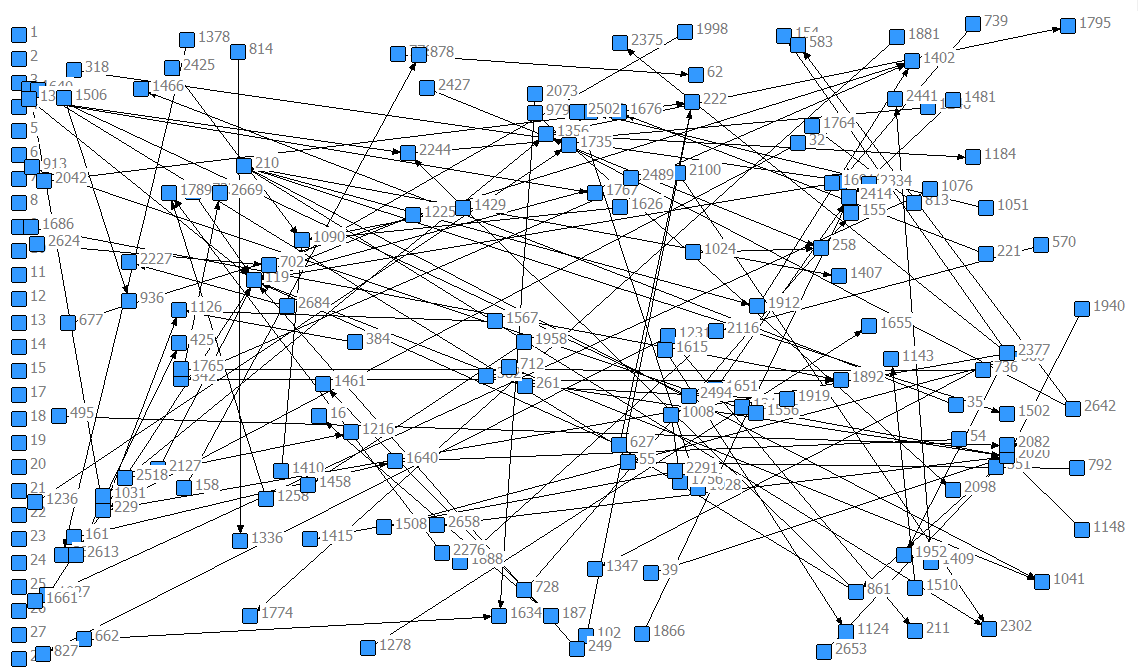
**Result**

In this part, there are one communigram of whole network and four measures to show the result of the link relationships in ShuangHe, including size, density, clique, and degree. Size means the number of nodes involve in a social network. Density shows the link degree of nodes. If the degree is higher, the relationship of the network is closer. Clique means the whole network would form several subgroups which some nodes have links. In general, we will analyze the subgroup which has three nodes at least. Degree means the direct links of each node, including incoming links and outcoming links.

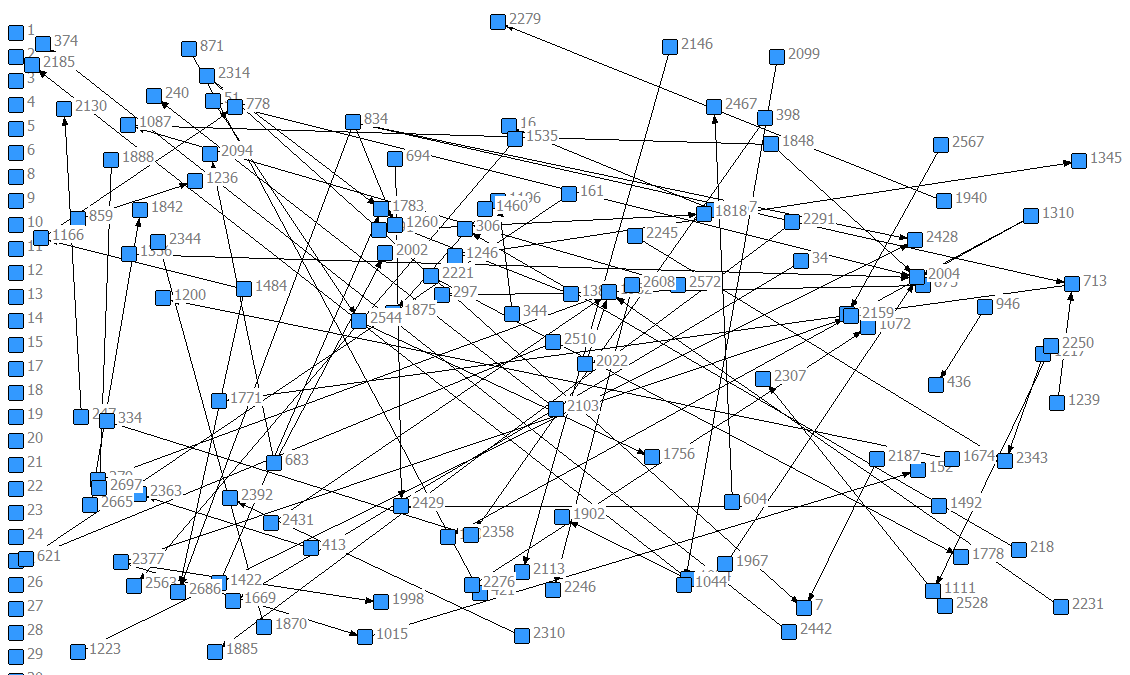
**Communigram of Network**

The communigram of network shows the directed link relationships of the all nodes in the social network. There are two types about the posts: thread, which has at least one post and one reply, and isolate, which only has one post without reply. Therefore, there are links for threads, and the isolates locate at the left side of the diagram. The followings are communigram of the three months network.

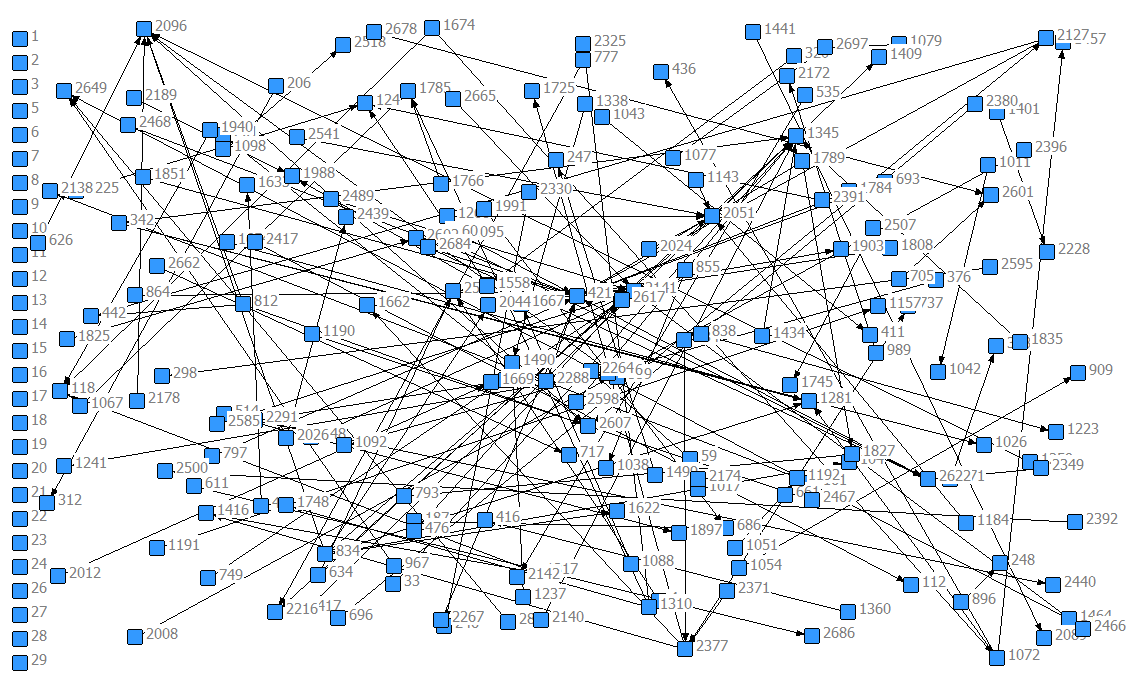
September



October



November



**Four measures of social network analysis**

Size

Size shows the number of nodes involve in the network. There are 1228 participators in September, 1116 participators in October, and 1088 participators in November. The participators in each month would overlap; therefore, the total participators are 2699.

|  |  |  |
| --- | --- | --- |
| September | October | November |
| 1228 nodes | 1116 nodes | 1088 nodes |

Table 1: The size in three months

Density

Density shows the link degree of nodes. If the degree is higher, the relationship of the network is closer. This density of the network is too low to show the number in UCINET, because there are many isolate posts. Therefore, ShuangHe is a sparse social network.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| September | | October | | November | |
| Density | No. of Links | Density | No. of Links | Density | No. of Links |
| 0.0000 | 113.0000 | 0.0000 | 77.0000 | 0.0000 | 143.0000 |

Table 2: The density and number of links in three months

Clique

Clique means the whole network would form several subgroups which some nodes have links. In general, we will analyze the subgroup which has three nodes at least. For the dataset, there are 27, 21, 34 cliques found, respectively. The members of each clique in each month are similar, which means many participators involve in many cliques in each month. For example, nodes 718, 834, and 1260 are in clique 1 to 4 in October. It also occurred in September and November. The number of members in a clique is from three participators to sixteen participators. The size of cliques varies.

|  |  |  |
| --- | --- | --- |
| September | October | November |
| 27 cliques | 21 cliques | 34 cliques |
| 1: 119 249 261 627 640 1027 1225 1310 1691 1733 1767 1998 2127 2244 2489  2: 119 640 861 1246 1310 1767 2244  3: 119 640 861 1310 1767 2244 2494  4: 119 222 249 261 627 1027 1225 1310 1691 1733 1998 2127 2489  5: 119 249 261 627 1027 1225 1310 1691 1733 1919 1998 2127 2489  6: 102 119 222 627 2042  7: 16 187 1461  8: 32 154 229 408 1126 1347 1952 2375 2377  9: 32 229 384 408 1126 1567 2377  10: 39 382 1148 1314 1940 2020 2653 2658  11: 54 161 1640  12: 210 1041 1402 1407 1502 1912 2302  13: 210 1041 1407 1502 1912 2100 2302  14: 210 712 1041 1407 1502 1912 2302  15: 210 342 677 1402 1912  16: 211 827 1231  17: 258 1024 2427  18: 342 677 1402 1892 1912 2669  19: 342 1402 1686 1892 2669  20: 351 640 861 1246 1310 2244  21: 351 640 861 1310 2244 2494  22: 570 1888 2116  23: 583 1031 1184 1356 1795 2642  24: 662 1634 2073  25: 1090 1410 1429 1626 2425  26: 1258 1789 2276  27: 1481 1651 1866 2414 1795 2642  24: 662 1634 2073  25: 1090 1410 1429 1626 2425  26: 1258 1789 2276  27: 1481 1651 1866 2414 | 1: 713 834 1239 1260 1771 2428 2686  2: 713 834 1260 1388 2428 2686  3: 713 834 1260 1484 2428 2686  4: 713 834 1223 1260 2428 2686  5: 834 1166 1484 2686  6: 778 1166 1484 2686  7: 7 1783 2187 2314  8: 7 1422 1783 2314  9: 51 1310 1356 1506 1848 1967 2004  10: 51 1087 1310 1356 1848 1967 2004  11: 51 1310 1356 1848 1967 2004 2544  12: 51 1756 2004 2544  13: 152 1015 1998 2159 2377  14: 161 621 2510  15: 279 1962 2022 2231 2431  16: 334 398 2358  17: 683 2002 2094  18: 694 1492 2429  19: 1024 1902 2185  20: 1087 1848 2004 2572  21: 1217 2245 2343 | 1: 104 342 834 1072 1281 1622 1654 2044 2096 2617  2: 342 436 834 1072 1281 1457 1654 1674  3: 342 834 1026 1072 1281 1345 1654  4: 33 342 417 634 1026 1281 1345 1434 1835 2140 2598  5: 118 436 1072 1281 1457 1674  6: 104 359 626 812 834 1259 1281 1622 2044 2096 2178 2607 2617  7: 104 476 834 1281 1622 2044 2096 2617  8: 4 25 124 253 320 634  9: 4 25 253 634 1345  10: 25 124 253 320 1225 2391  11: 85 2291 2440  12: 187 686 1991  13: 33 253 342 417 634 1345 1434 1835 2140 2598  14: 261 359 442 626 812 834 1259 2096 2178 2380 2607  15: 288 967 1464 2649  16: 334 737 1317 1416 1662 1725 2371 2377  17: 334 661 737 1416 1662 1725 2371 2377  18: 421 442 693 696 797 1095 1784 1789 1808 1851 2127 2267 2288 2468 2622 2684  19: 421 693 797 1095 1784 1789 1808 1851 2127 2160 2267 2288 2349 2468 2622 2684  20: 421 693 797 1095 1784 1789 1808 1827 1851 2127 2267 2288 2468 2622 2684  21: 421 793 1789 1827  22: 421 442 696 812 2127  23: 442 812 2096 2127 2607  24: 448 749 864 2141 2466 2489 2585 2665  25: 705 2601 2678  26: 777 1143 1184 1268 1409 2024 2051 2216 2541  27: 1067 1310 1748 1766 1785 2325  28: 1077 1079 2697  29: 1088 1667 1903  30: 1237 1338 1490  31: 118 1317 1416 2377  32: 118 1317 1416 1674 1940  33: 118 1072 1317 1674 1940  34: 1558 1988 2189 |

Table 3: The cliques in three months

Degree

Degree means the direct links of each node, including incoming links and outcoming links. The followings show the result with at least 2 outdegree and indegree, because there are too results with many 1 and 0 degree. For outdegree, there are some nodes appearing in two or three months, such as 834, 2377, 1310, 342, and 1310, and most of them have higher outdegree. For indegree, there are no the same nodes in three months. In addition, there are four nodes appearing in both outdegree and indegree, such as 1356, 1789, 2051, 2377.

OutDegree

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| September | | October | | November | |
| Nodes | OutDegree | Nodes | OutDegree | Nodes | OutDegree |
| 210  187  229  627  861  1231  2642 | 5.000  5.000  4.000  3.000  2.000  2.000  2.000  2.000  2.000  2.000  2.000 | 51  683  1024  1484  1848  2314 | 4.000  3.000  2.000  2.000  2.000  2.000  2.000  2.000  2.000 | 812  1072  25  634  1317  1674  2127  2291  2684 | 6.000  3.000  3.000  3.000  3.000  3.000  2.000  2.000  2.000  2.000  2.000  2.000  2.000  2.000  2.000 |

Table 4: The outdegree in three months

Note: a – nodes appear in outdegree table across three months

b – nodes appear in both outdegree and indegree in three months

InDegree

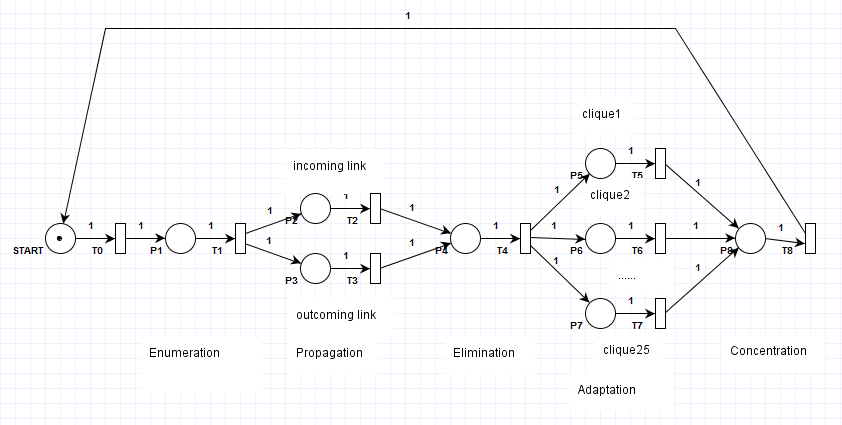
|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| September | | October | | November | |
| Nodes | InDegree | Nodes | InDegree | Nodes | InDegree |
| 119  2020  1090  222  1126  2244  258  1041  1634  1640  1892  2116  2302 | 11.000  7.000  4.000  3.000  3.000  3.000  3.000  2.000  2.000  2.000  2.000  2.000  2.000  2.000  2.000 | 2004  1962  7  621  713  1087  1260  1783  2343  2358  2428  2429  2686 | 5.000  4.000  2.000  2.000  2.000  2.000  2.000  2.000  2.000  2.000  2.000  2.000  2.000 | 421  1345  2141  2096  1281  2607  118  124  253  1785  2622  2649  442  686  1416  1490  1988  2216  2601  2617  2697 | 13.000  8.000  7.000  6.000  5.000  4.000  4.000  3.000  3.000  3.000  3.000  3.000  3.000  3.000  2.000  2.000  2.000  2.000  2.000  2.000  2.000  2.000  2.000 |

Table 5: The indegree in three months

Note: b – nodes appear in both outdegree and indegree in three months

**Discussion**

Based on the characteristics of slow intelligence system, the social network could be described as follows.



Enumeration

In the beginning, participators would enter ShuangHe with registration. The concept could be described by size measure. For three months, total nodes are 2699, which means there are 2699 participators entered the social network during the period of time. For each month, there are 1228 nodes in September, 1116 nodes in October, and 1088 nodes in November. It shows that the number of participators is decreasing. The reason could be that most participators are students in PTT, and September is their summer vacation and November is their midterm, which would influence the participation. Beside, the number of participators in three months is greater than 1000, which means the number of participators is stable.

Propagation

Participators would initiate or reply a post to propagate their thoughts or questions. The concept could be described by degree measure, and there would be two kinds of activities, including incoming link and outcoming link. Indegree represents incoming link, which means participators post a message, and get some replies. Outdegree represents outcoming link, which is that participators reply others’ post. For indegree, there are no the same nodes in each month, and it shows that there are many different participators post the messages in each month. For outdegree, there are some nodes appearing in two or three months, and most of them have higher outdegree. It shows that these participators like to propagate their knowledge or thoughts, and they could be the core participators. Besides, there are four participators appearing in both outdegree and indegree, but most of them have higher indegree and lower outdegree; it is probably that these participators would initiate rather than reply.

Elimination

Participators would stay or leave the social network. From the result of outdegree, we can find some participators stay in ShuangHe and continuously reply others’ post. However, some participators may stay without posting, and it does not show on the record; we will say that these participators are diving. Therefore, we cannot know who stay or leave actually.

Adaptation

There are several cliques formed in each month, 27, 21, 34 cliques, respectively, because of the number of links in each month. The members of some cliques in each month are the same, which means that the participators would join different cliques to share their thoughts. However, there are scarcely same participators in cliques across three months. Therefore, the cliques are changing all the time.

Concentration

The issues in ShuangHe are all about the Zhonghe City and Yonghe City in Taiwan, such as travel, food, and sports.

**Conclusion**

ShuangHe is a very sparse social network, although there are many participators. It is because the ecology of PTT is that participators would join different boards by posting or diving, and there is no the function of friending to stick participators. Some participators stay and post, and little by little, they could become the opinion leader in the social network. Besides, the evolution of link relationships in ShuangHe is a recycle of slow intelligence system. It goes through the whole process and back to the original step.

**Simulation Display**

