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To Find Maximum Clique Using Preferential Attachment Based On Ant Colony Optimization

EECE 7065 Complex Systems and Networks

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Abstract

- The maximum clique problem is equivalent to that of finding a maximum independent set in the complementary graph.

- Therefore, finding a maximum clique in the dynamically changing complex network like an online social network has become an essential aspect of social network analysis.

- Objective: To find a maximum clique in a network, designed using preferential attachment.

Preferential Attachment (PA)

- PA is widely recognized as the principal driving force behind the evolution of many growing networks.
- PA means that when new nodes join the network linking to the existing nodes.
- Applications: Social Networking Sites (SNS), blogs, video or photo sharing networks.

Methods

- To actually develop the algorithm, we generated a network that captures the real growth process of a network using Preferential Attachment.

- Agents check for maximum clique in this network.

- The probability for linking node i with degree ki is chosen can be expressed as:

$$\prod(k_i) = \frac{k_i^{\beta}}{\Sigma_j (k_j^{\beta})}$$

- Some models assume the probability of linking i with degree ki to be linear , while in other cases it has been assumed to depends on **β** .

Ant Colony Optimization

- In the algorithm, ants are employed to travel on a model of network.
- Each ant/agents communicates with each other by means of pheromones to find the shortest path.
- But, in our project we used pheromones to repel ants instead of attracting them, to find a new clique.
- An ant will follow path to form a clique. This clique won't be entered by another ant.

Implementation

To find maximum clique:

- Bron-Kerbosch (memory consumption in social networks)

Our method:

- Run and leave (dynamic network)
- Moderate memory consumption

Results (Growth)

- Video

Results (Cliques)

- Network starts with 0 pheromone level.
- When an agent process a node it adds pheromone to the node and the pheromone spread to the neighbors nodes which reduces the priority of the node and the neighbor node.
- If two cliques share all nodes excluding the newly connected nodes then they will be fused.

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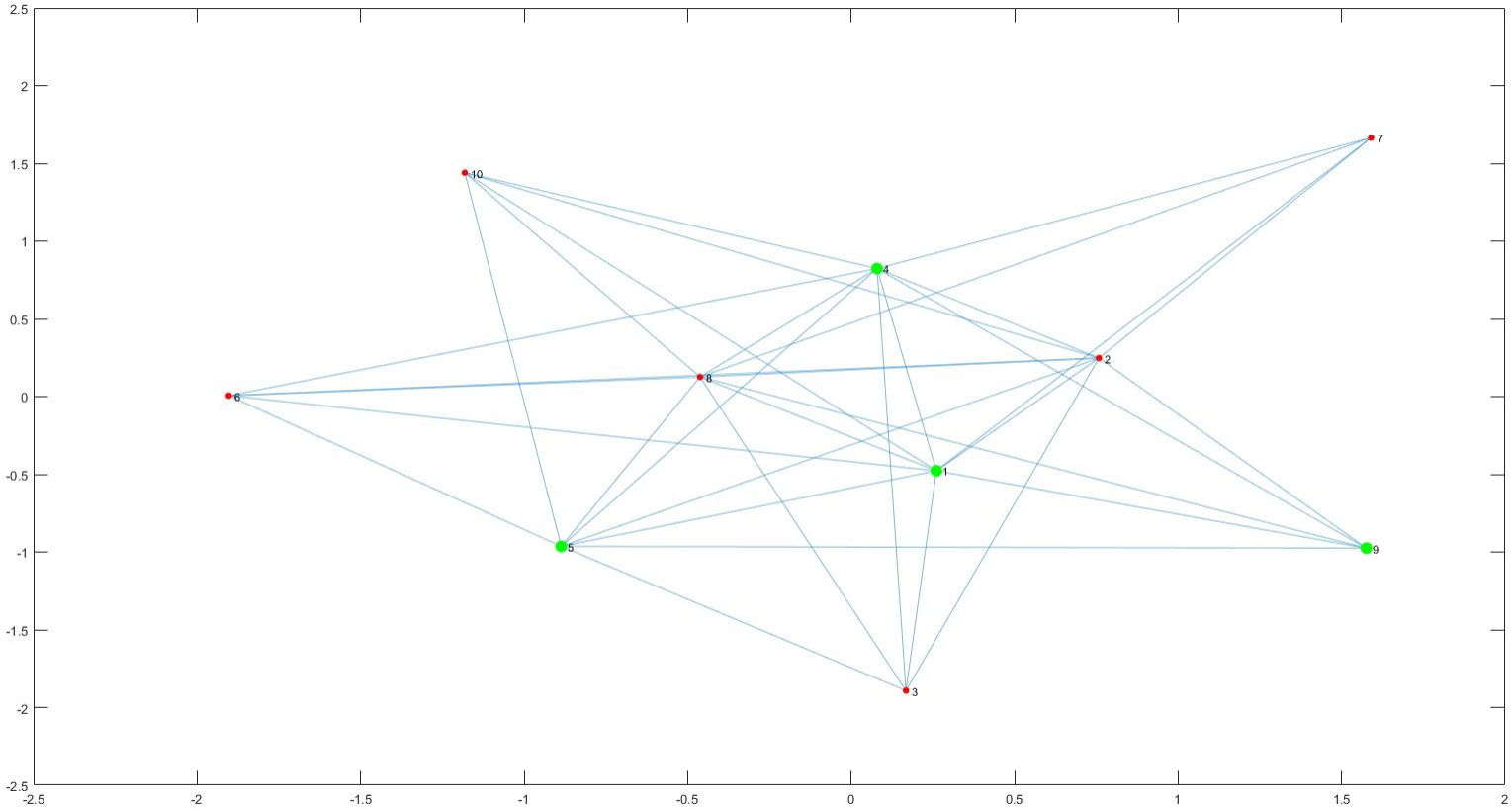
Results (Cliques)



Conclusion

- We have designed the algorithm to find maximum cliques in the generated online social network (model based on PA) by applying a modified ant colony method.

- It is not always a good solution (close to fully connected graph)

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Thank You!

Questions?