COMPLEX NETWORKS - SPRING 2024
HOMEWORK 4

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- DUE on 04/20/2025 11:59pm C.T.
- This is a group porject. Each group only needs to submit one file.
- All files should be typed.
- Please name your file as follows: $Lastname Initials - MAP6306quiz1.pdf$. If your name is David Roberts, file name is $Roberts AD - MAP6306quiz1.pdf$.
- Try to keep the file size less than 4MB.
- You can resubmit the quiz if you want. Please specify which one is the one to be graded. Otherwise I will grade the most recent version.
- DO NOT EMAIL me the quiz. All quizzes are submitted via Canvas.

(1) Consider following data sets (you can download the data here https://websites.umich.edu/ mejn/netdata/
   (a) Zachary's karate club
   (b) American College football
   (c) Power grid

   Report the questions below for each network:
   (a) Use Gephi to plot the network. Make sure to use centrality and com-
       munities so that you can show the properties of the network.
   (b) Use Gephi to find how many communities this network has.
   (c) What is the modularity for the community detection?
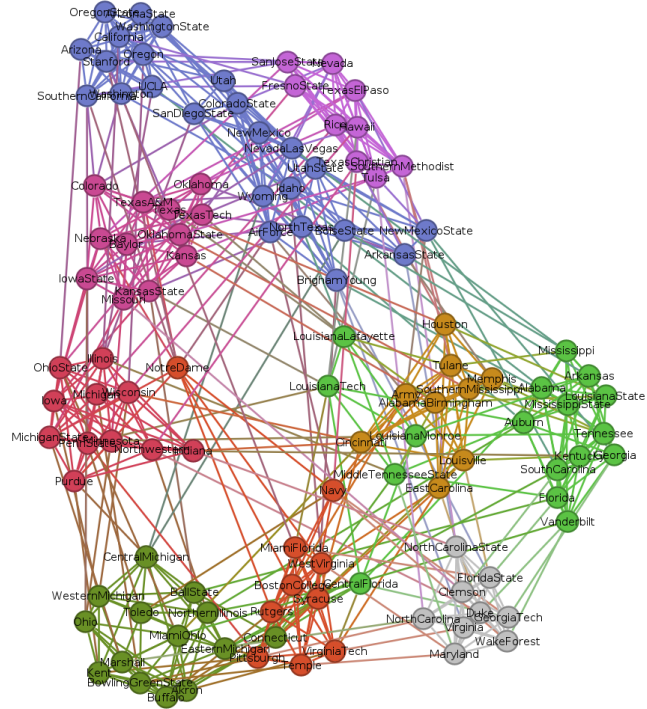
Answers:

(1) Use Gephi to plot the network.

   (a) Plot **Zachary's karate club** network with Gephi.

Each node represents a member of the karate club and each edge
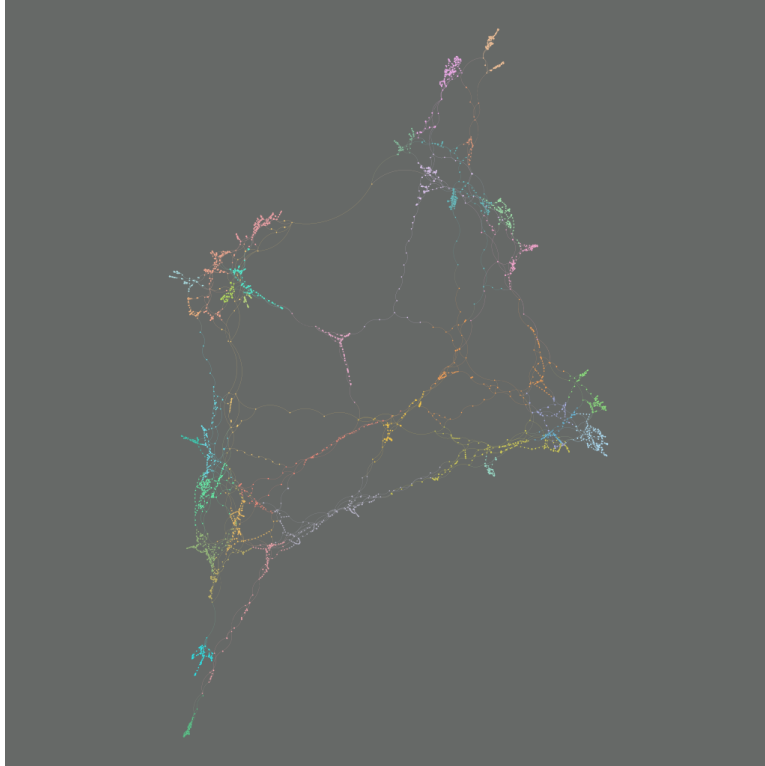represents a social interaction between two members.
There are 34 nodes and 78 edges

(b) Plot **American College football** network with Gephi.

The football network represents games played between Division IA college teams during regular season in Fall 2000. The nodes have calues that indicate to which conferences they belong.
We can observe that the algorithm detected 9 communities, which is close to the actual 12 NCAA conferences. This indicates that there are also inter-conference games.

(c) Plot **Power grid** network with Gephi.

The **Power grid** network represents the topology of the western states power grid of the United States. We can observe that tehre are tighly clustered groups which demonstrates that the way how the network is organized is dependent on the infrastructure and their geographical location and importance most likely.
There are 4941 nodes and 6594 edges

(2) Use Gephi to find how many communities this network has.

    (a) Use Gephi to find how many communities there are in the **Zachary's karate club** network.

        There are 4 communities in the **Zachary's karate club**

    (b) Use Gephi to find how many communities there are in the **American College football** network.

        There are 9 communities in the **American College football**

    (c) Use Gephi to find how many communities there are in the **Power grid** network.

There are 39 communities in the **Power grid**

(3) What is the modularity for the community detection?

    (a) What is the modularity for the community detection in the **Zachary's karate club** network?

        Modularity Score: 0.416

    (b) What is the modularity for the community detection in the **American College football** network?

        Modularity Score: 0.604

    (c) What is the modularity for the community detection in the **Power grid** network?

        Modularity Score: 0.931