

Synthesis Activity: Network building exercise

Due Thursday, 03/24/2022 at 11:59 pm (10 points)

Material borrowed from Dr. Matthew Burton

Activity Overview

In this activity we'll be exploring how graphs and networks can be a great abstraction for elucidating the most relevant details about a system. You will get to pick any system you want, and think about how to represent that system as a network. Then, you'll generate data on the network structure of the system. Finally, you will use an online application to create a visualization of the network structure of the system, and answer some follow-up discussion questions.

You may work individually, or you may work in a group of up to 4 people. You are going to use [Flourish Studio](#), a web application for data visualization, to quickly (and prettily) look at the network representations of our systems.

If you would like, here is an [introduction \(including a video tutorial\)](#). Additionally, here is a tutorial that walks you through how to make a [graph representation of beer distribution](#).

Learning Objectives

- Understand how to represent systems as mathematical networks
- Use abstraction and representation to uncover information

Part 1: Pick a System

In this activity, you will take a social, natural, or engineered system and create a network or graph representation of that system. The goal is for you to think very explicitly about the various entities in a system and how they are interconnected. Some easy examples would be:

- Harry Potter characters
- Politicians in Pennsylvania
- Components in a personal computer

When picking a system, it might be more interesting to pick a system that doesn't have an obvious network representation. You will have to work a bit harder and be more creative, but it might be more fun!

First, in a small group, you will be creating a tabular representation of your network. This means you need to create two spreadsheets, one describing the nodes and another describing the connections.

Part 2: Create the Data

You should create two spreadsheets: a **nodes (points)** spreadsheet and an **edges (lines)** spreadsheet.

The nodes (points) spreadsheet should include FOUR columns:

1. **id** - A unique name for each node in your graph
2. **Group** - A categorical attribute for the node that indicates the color for that node. This should be a category associated with that system itself (House, Political Party, etc.)
3. **Size** - A numerical attribute for that node that indicates some quantity associated with that node (Magical power level, years of service, etc.)
4. **Description (Optional)** - An extended description of the node that appears as a popup in the network visualization.

Your spreadsheet should have *at least 15 nodes* in *at least 3 different groups*. So keep that in consideration when selecting your system. More nodes and groups with thoughtful connections will result in a more interesting graph.

The edges (lines) spreadsheet should include THREE columns:

1. **Source** - This is the id of a node in the nodes(points) spreadsheet that is the origin of a directed edge.
2. **Target** - This is the id of a node in the nodes(points) spreadsheet that is the destination of a directed edge.
3. **Value** - This is the weight or size of that edge that will be drawn to connect.

When creating your edges spreadsheet, don't connect every node to every other node, that will produce a very boring graph with no sub-structures. Spend some time thinking about when nodes are connected and how strong those links will be.

I suggest creating your spreadsheets in Google Sheets so that everyone can edit the sheet and add data at once. Then you can download those sheets as Excel files or CSVs and upload them to Flourish (as seen in the video). That said, you can use Excel or Numbers (or any other spreadsheet software) if you prefer.

Part 3: Create the Visualization

We are going to use [Flourish Studio](#), a web application for data visualization, to quickly (and prettily) look at the network representations of our systems.

1. Create an account and log into the [Flourish Studio website](#). It will easily connect to your Gmail account.
2. Start with one of the two Flourish studio network templates. You can go [here](#) to find the templates. Scroll down until you see the section titled “Network Graph”. Click either “Basic graph” or “Directional graph” depending on what kind of network you are making.
3. Click on the Data tab.
4. Upload your points (nodes) and lines (edges) spreadsheets to Flourish.
5. Inspect your network! Play around with it and see if something surprising comes out.

When you are finished, click “Export and Publish”. Download your network as an image. **You will submit this image as part of your writeup.** Additionally, please click “Publish to share and embed”. This will make your network public, and it will give you a link that you can share so that other people can see your network. **Please include this link in your writeup.** This will let the grader see your network in Flourish Studio and hover over the nodes.

Note: If you click on the “Data” tab, you will see a spreadsheet editor. You can edit this to make small changes to your network.

Part 4: Reflection

Write down answers to the following questions.

1. What was the system you selected? How did you decide to pick this system?
2. How did you determine what elements of the system would be the nodes? Was it hard or easy? Did the system naturally break down into a series of interconnected parts or did you have to exercise some creativity?
3. How did you determine the connections between those nodes? What was your method for assigning weights to the connections?
4. What insights do you see from the visual representation of your graph? Did it produce any surprising structures?

Submitting your Assignment

Create a writeup that includes a picture of your network, as well as your answers to the discussion questions in Part 4. Submit your writeup on Canvas. You only need to submit one writeup for each group. You will use Canvas’s group submission feature to do this. First, you and your teammates should join the same group. You can find instructions for how to do that [here](#). Make sure you join one of the “Network building activity” groups. Then, one (and only one) of you needs to submit the writeup, and your entire group will get credit.

Grading Rubric

Flourish network: 6 points

- Make sure your writeup includes both a picture of the network, as well as a link to your Flourish Studio project

Reflection questions: 4 points (1 point per question)