Creating Networks

Dr. Foote's Example

This first cell is setup code. It loads a bunch of libraries that we will use later on, so you will need to run this cell before your run any other cells. If you get an error, then you may need to install the libraries. See Lab 1 for instructions on how to do that.

```
knitr::opts_chunk$set(echo = TRUE)
# import the libraries needed
library(igraph)
library(ggraph) # If you get an error run install.packages('ggraph')
library(tidygraph) # If you get an error run install.packages('tidygraph')
library(readxl) # If you get an error run install.packages('tidyverse')
set_graph_style(family='sans')
```

The goal

The goal of this assignment is very simple - learn how to create a network in R.

We will talk about three main ways to do this, but we will start with the hardest first.

Networks from two spreadsheets

I think it's really useful to think of networks as two spreadsheets. The first spreadsheet is a list of edges and their attributes (a.k.a. an edgelist) and the second is a list of nodes and their attributes.

We'll start by creating a simple edgelist, using made up names.

Exercise

In Excel (or LibreOffice or Google Sheets) open a new spreadsheet, and create a spreadsheet that looks like this:

From	To
John	Ida
Elwyn	Ida
Okan	Axelle
John	Axelle
Axelle	Ida

Save the spreadsheet to your computer as an XLSX file called `edges.xlsx`; make sure to save it to the same folder as this file.

Uncomment the code below (by deleting the # symbol) and run it.

```
edgelist <- read_excel("/home/jeremy/Teaching/can-s26.jeremydfoote.com/assignments/r_lab_exam
```

Look down at the R console (the bottom window) and see if it worked. You might get an error here that says something like `there is no function called 'readxl'`. If you get that, then you need to run `install.packages('tidyverse')` in the console (this is in the bottom window). It will take a while to install, but if it works correctly your code above should work.

You may also get an error that's something like `could not find function "read_excel"`. If you get that, then you need to run the cell at the top of this page (the one that starts with `knitr::opts_chunk$set(echo = TRUE)`). This will load the libraries that we need to run the rest of the code.

Finally, you might get an error that says something like `Error: path does not exist: './edges.xlsx'`. This means that R can't find the file. Make sure that you saved the file to the same folder as this file. If you need to, you can right-click the filename and select `Copy Path` to get the full path to the file. Replace `./edges.xlsx` with the full path.

To test if everything worked right, uncomment the following code to show all of the edges in R.

```
edgelist
```

```
# A tibble: 5 x 2
  From    To
```

```
   <chr>   <chr>
1 John    Ida
2 Elwyn   Ida
3 Okan    Axelle
4 John    Axelle
5 Axelle Ida
```

(Note: the "#" symbol "comments out" code - this means that anything after the # in a given line will be ignored by R)

Excercise

Next, we will create a table of attributes for the people in our network, and import that, too.

Do the same thing again - open a new spreadsheet, and this time make it look like this:

Name	Age	Gender	Major
John	22	M	COM
Elwyn	23	M	SOC
Okan	25	F	COM
Ida	19	F	SOC
Axelle	20	T	COM

Make sure that the spelling (including capitalization) is the same as in your edgelist file.

Again, save it to this folder, as `node_atts.xlsx`.

Here is my import code, which should work if you saved it to this folder:

```
node_atts <- read_excel("/home/jeremy/Teaching/can-s26.jeremydfoote.com/assignments/r_lab_exa
```

Uncomment and run the following code to check that it worked.

```
node_atts
```

```
# A tibble: 5 x 4
  Name     Age Gender Major
  <chr>  <dbl> <chr>  <chr>
1 John      22 M      COM
2 Elwyn     23 M      SOC
3 Okan      25 F      COM
4 Ida       19 F      SOC
5 Axelle    20 T      COM
```
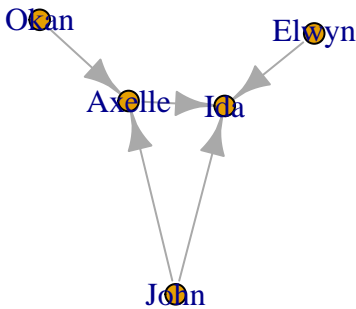
Importing into R

Finally, we'll create a network "object" using these files. So far, what we've done is take our two spreadsheets, converted them into a format that R can understand (called a `tibble`), and saved them as the variables `edgelist` and `node_atts`. Creating a network objects tells R that these represent a network, so that it can create visualizations, get network statistics, etc.

We do this by running `graph_from_data_frame`. This is a function that takes in the arguments `d`, `vertices`, and `directed`.

- `d` is the edgelist
- `vertices` is the node attributes
- `directed` is whether this is a directed or undirected graph.

If you've done everything right, then when you uncomment the code below, it should produce a network plot.

```
G <- graph_from_data_frame(d = edgelist,
                           vertices = node_atts, directed = T)
plot(G)
```


The one piece of code from above that we haven't talked about is `G <-`. This saves the network to the variable `G` and then `plot(G)` makes a basic plot of it.

If this doesn't work, the most likely culprit is a typo in either the edgelist or the node attributes. Check the spelling and capitalization of the names in both files.

Tidygraph networks

Finally, to make things even more confusing, for lots of the cool things we'll be doing in future lessons, we need to take one more step, and turn this from a normal network object into a `tidygraph` network object.

To do this, we take `G` (the network object we just created) and run `as_tbl_graph()` on it.

Uncomment the code below and run it. If it worked, then you should see a text output with two tables:

`Node Data` and `Edge Data`

```
G <- as_tbl_graph(G)

G
```

```
# A tbl_graph: 5 nodes and 5 edges
#
# A directed acyclic simple graph with 1 component
#
# Node Data: 5 x 4 (active)
  name     Age Gender Major
  <chr>  <dbl> <chr>  <chr>
1 John      22 M      COM
2 Elwyn     23 M      SOC
3 Okan      25 F      COM
4 Ida       19 F      SOC
5 Axelle    20 T      COM
#
# Edge Data: 5 x 2
   from    to
  <int> <int>
1     1     4
2     2     4
3     3     5
# i 2 more rows
```

Loading data from R packages

Now that you've learned the hardest way to load network data, let's learn a few easier ways. One is by loading it from pre-created packages. One of the biggest, fairly straightforward packages is called `networkdata`.
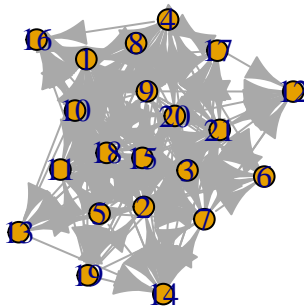
Unfortunately, it's a little bit trickier to install this package than other packages. You will need to run `install.packages("remotes")` in the terminal (the bottom pane), and when that is done run `remotes::install_github("schochastics/networkdata")`, also in the terminal.

If it works, then you should be able to load the package when you uncomment the code below.

```r
library(networkdata)
```

Now, you will have access to the networks from the package. Run `data(package='networkdata')` to see all of the options. This code shows an advice network from a high-tech firm:

```r
# This code turns the ht_advice network object into a tidygraph object, and saves it as G
G <- as_tbl_graph(ht_advice)
plot(G)
```
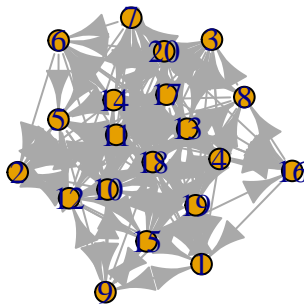
Random networks

Finally(!), the last thing you can do is to create random networks in R. There are a ton of options, so I'll just show you one.

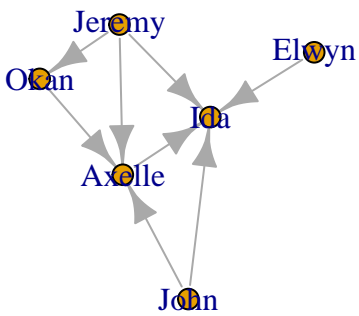This is a Erdos-Renyi graph, where each edge is created randomly.

```
G = play_gnp(20, .4)

plot(G)
```
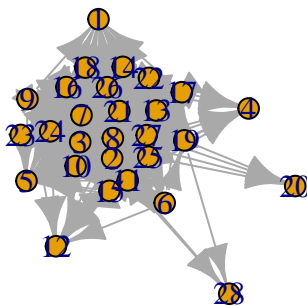

Exercises

1. See if you can figure out how to add another person to the network you created, following all of the steps above. Do this by creating new spreadsheets in Excel, something like `edgelist_2.xlsx` and `node_atts_2.xlsx`. Make sure to give the new person node attributes and at least one edge. Use `graph_from_data_frame` to create a new network object and `as_tbl_graph` to change it into a `tidygraph` network object.

Finally, create a new network plot with the new person.

2. Above, we loaded the `ht_advice` network. Figure out how to load the `ffe_elite` network from `newtorkdata` as a `tidygraph` object, and plot it.

3. The `play_gnp()` function above has two parameters, which have the values `20` and `.4`.

Try changing the values and observing the result. What do you think each of these parameters do?

YOUR ANSWER HERE

4. A list of a bunch of possible random graphs is listed at https://tidygraph.data-imaginist.com/reference/index.html under "Graph Creation". See if you can figure out how to make a ring graph with 20 nodes.