Learning how to use Gephi

1. Getting started
   (a) Download Gephi (`https://gephi.org`), a software for graph visualization and analysis
   (b) Using Menu `File>Open`, open the **small network** downloaded from the page of the class.
   (c) Using panel `Spatialisation/Layout` (bottom left), change the layout. Try in particular *Fruchterman Reingold*, *Yifan Hu*, *expansion*, *noverlap*, *ForceAtlas 2*. Try to play with the parameters of ForceAtlas 2 (*prevent overlap, etc.*, *LinLog mode*, etc.).
   (d) You can move nodes by dragging them. Right clicking on them provide additional functionalities.
   (e) Zoom in/out using the wheel of your mouse (or of your trackpad. NOT the zoom gesture). The position of the cursor is the center of the zoom
   (f) By clicking with the right button of your mouse on the background and dragging, you can move the window/graph around.
   (g) Using the *Appearance* panel(top left), assign the **size** of nodes to be proportional to their degree.
   (h) Using the *Layout* panel (bottom left), change the layout to adapt to these new sizes.(`prevent overlap` or `eviter le recouvrement`.
   (i) Use the button `T` at the bottom to display the name of nodes. Using another option at the bottom, make **node names proportional to node size**.
   (j) Go to `Preview/Previsualisation` tab. A l'aide du bouton `refresh/rafraichir`, show a finer version of the visualization. You can export it in PDF or PNG.

2. Computing network properties.
   (a) Using Menu `File>Open`, open the network called airports from the page of the class.
   (b) Have a look at the `Data Laboratory/Laboratoire de données` window, accessible by clicking on the tab of the same name at the top of your window. Check the data for both Nodes and Edges (panels on the top left)
   (c) Go back to `Overview` window, and, using the `statistics` panel (right), compute the average degree. Interpret the degree distribution.
   (d) Go back to the `Data Laboratory` window, and observe that new columns have been created when you computed statistics.
   (e) Check that you can now change the color and size of nodes (Appearance, top-left) based on those statistics. Make the size corresond to the degree and color to countries (this information is present in the dataset).
   (f) Compute the clustering coefficient, the average distance/average path length, and the graph density
   (g) Would you say (informally, without comparing with a null model at this point) that this graph is a *small world* network ?
   (h) Still using the Statistics panel, computer how many connected components there are in the graph. Would you say that there is a giant component in the graph ?

3. Centralities
   (a) In Gephi, some centralities need to be computed explicitly like PageRank, but many others are computed when it is convenient, in particular when you compute the average path length, it computes the Betweeness, Closeness, and a few other centralities. Compute those centralities, and check that you can attribute node sizes and colors to nodes according to those centralities.
   (b) From the data laboratory, you can now check the values of centralities of the different nodes. Try to sort nodes by descending order of some centralities.

(c) How do you explain that, for some centralities, nodes of small degrees have very high values ? Is it normal? Desired?

(d) We would like to see more clearly the difference between some centralities. Use the *spline* option in the color/size selector, and palette choices.

4. Community detection

(a) Community corresponds to graph clustering, i.e., searching for groups of nodes strongly connected together and more weakly connected to the rest of the graph.

(b) Compute the modularity statistics.

(c) Visualize communities using node colors. Note that you should use the `partition` tab, not `ranking`.

(d) Compare visually the communities found with the "country" property. Remark similarities and differences

(e) Using the data laboratory, save the communities by copying the values into a new columns

(f) Recompute the modularity with a different `resolution parameter`, and search for larger/smaller communities.

5. Spatial graph

(a) From Menu `Tools>Plugins`, install the plugin called `geolayout`. You need to restart Gephi (Remember to save your work if you want to keep your changes...)

(b) You can now find geolayout among layouts. Use Mercator to position nodes according to their longitude and latitude.

(c) Make the graph readable (avoid nodes being too large/small...)

6. Filtrering nodes and edges

(a) Using the filter option on the right, filter nodes according to their closeness, keep only those with a large value. (`Range`)

(b) Apply a layout again. How does it behaves regarding the filtered graph?

(c) Filtering what seems to make sense, create a readable and interpretable graph.

7. Challenge

(a) Try to visualize the core/periphery property of closeness. Several problems prevent to see it at first, but it is here indeed...