Part 1.

Read the paper, *The Hidden Geometry of Complex, Network-Driven Contagion Phenomena* by Brockmann & Helbing (link). Provide a concise (less than one page) critical summary of the paper. You should structure your discussion around key concepts from the paper, what you find interesting or novel, and connections to ideas and methods covered in this module. Your summary will be marked based on its clarity, originality, and interpretation.

Part 2.

You will now develop a Python implementation of the SIR metapopulation model from the paper. The flux, F_{nm}, will be modeled using the Global Transnational Mobility Dataset. The simulation will then be based on country-to-country travel rather than the inter-airport travel analyzed in the paper. The dataset and code for importing it into NetworkX have been provided in the the project directory of the class repo.

See the code documentation for details on what the dataset contains and how the graph is generated.

1) Analyze the basic properties of the mobility network (provided in the networkX graph, *G*). Create 1-3 figures which illustrate important features, and concisely present your findings in your report. The code used to generate the figures should be placed in the *network* function in your Python file.

2) Now, develop code to simulate the paper's SIR model (equation 3). Add this code to *modelBH*. Note that default values for a number of model parameters have been set, however you should feel free to vary these as you develop and then use your code. In your report, provide a brief description of your implementation and comment on its cost and efficiency. An exhaustive analysis of the cost is not required.

3) Finally, add code to *analyze* which computes and returns the effective distance, D_{mn} (equation 5) with *G* provided as input. You should then analyze if/to what degree the analytical framework presented in the paper carries over to the model considered here. Pick 1-3 key points and use simulation results to critically assess how well Brockmann & Helbing's ideas apply to this country-to-country epidemic spreading model. A detailed reproduction of calculations and figures from the paper should be avoided. Add your analysis and corresponding figures to your report. Add the code which generates these figures to *analyze*.

Your entire report should be no more than 7 pages including figures.