Complex Networks Project Proposal

Modelling power grid network

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The aim of this document is to propose the project and initially plan the work to be carried out as a part of the Complex Networks (CN) course. The project to be completed as a part of the course will incorporate the complex networks simulation framework described throughout the course. We will use Python *numpy*'s library implementation of the complex networks concepts to develop and visualize the solution.

The problem
Electrical grids consist of various elements such as power stations, transformation stations, substations, and transmission lines. These elements of the power grid can potentially be an object of a hostile attact, or can suffer from a critical failure due to various factors. These factors include atmospheric conditions, external power gird network influences, or systemic failures. Such failures can have significant consequences on the overall power grid of a country. An example of such failure would be the blackout around Orchard Road in Singapore on the 13th of December 2015. This failure had a negative impact on the economy of the area forcing several shops to close early. Through development of a simulation of such failures identifying the most critical aspects of the power grid network, we will be able to devise a contingency plan for such failures as well as attempt to focus on mitigating these.

The Task
We aim to develop a simulation of response of a power grid network to failures or downgrades in the system. This will include devising a network of electrical supply grid elements. Such network will be developed with the use of *numpy* library. We will emulate transmission lines by assigning a capacity to each transmission line. This would allow us to see how impact of a node outage propagates to other elements of the network. And, subsequently, what impact it has on the overall system.

The Solution
To implement the network, and solve the issue we will implement the following strategy.

We will use the avaialable power network of the US. We will asign a capacity to each edge of the network to represent its capacity to transport electricity. Subsequently, we will devise a maximum amount of electricty produced or consumed by each node. We will then remove nodes from the network and/or decrease capacities. Finally, we will observe how it impacts the system. This would allow us to infer how the power grid network behaves under such conditions.

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