COMP 490 Proposal
Concordia University Computer Science Department

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Project Title:
Adding new broadcasting algorithms and graph generators to NetworkX.

Introduction:

- Broadcasting is an information disseminating problem in a connected network of transmitting a message from an originator vertex to all other vertices as quickly as possible. It is well known that finding the broadcast time for any random vertex in an arbitrary graph is NP-complete. However, it has been proven that this problem can be solved in polynomial time for a certain class of graphs [2].
- The dissemination process is as follows; the originator begins by placing a series of calls along the communication lines of the network. Every time the informed nodes help the originator in distributing the message. Every call is assumed to take place in discrete units of time. The broadcasting must be completed as quickly as possible subject to the following constraints:
    - Each call requires one unit of time.
    - A vertex can only participate in one call per unit of time.
    - Each call only involves two adjacent vertices: a sender and a receiver.
- The broadcast time b of a vertex u in a graph G is the minimum number of time units required to complete the broadcasting. The broadcast time of a graph G is the maximum broadcast time of any random originator vertex $u \in G$.
- As an example, the broadcast time of a cycle graph with 6 vertices is 3; more generally: $b(C_n) = ceil(\frac{n}{2})$. For the complete graph $b(K_n) = ceil(log_2 n)$.
- NetworkX is an open source python package for the creation, manipulation and analysis of complex networks [1]. A tutorial to get started can be found here, along with many examples here. NetworkX also provides APIs for graph generation and visualization along with many graph algorithms.

Goals:

- The main objective of the project is to expand on NetworkX's vast array of graph algorithms by introducing broadcasting and related heuristics, while also adding graph generators.
- Researchers will greatly benefit from having readily available broadcasting algorithms for running simulations and building efficient networks in their research work.
- Professionals who are already utilizing NetworkX will be able to seamlessly incorporate broadcasting algorithms into their existing implementations, thanks to the updates in the algorithms API.

References:

- [1]: Aric A. Hagberg, Daniel A. Schult and Pieter J. Swart, "Exploring network structure, dynamics, and function using NetworkX", in Proceedings of the 7th Python in Science Conference (SciPy2008), Gäel Varoquaux, Travis Vaught, and Jarrod Millman (Eds), (Pasadena, CA USA), pp. 11–15, Aug 2008
- [2]: H.A. Harutyunyan, G. Laza, E. Maraachlian. Broadcasting in necklace graphs. In Proceedings of the 2nd Canadian Conference on Computer Science and Software Engineering, C3S2E 09, pages 253256. ACM, 2009