Proposition de stage de M2
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Comparing temporal networks

Abstract:
Many data sets find a convenient representation in terms of networks: elements are seen as nodes and relationships between these elements are represented as links. Moreover, an increasing number of data contain temporal information about these relationships: they are then represented as temporal networks, in which an edge between two nodes is replaced by a set of events with the time at which they occur (e.g., communication events between two persons) [1].

As researchers are confronted with such data sets representing systems of different nature, or the same system observed in different periods, an important issue concerns the ability to compare them, developing similarity measures to yield meaningful comparisons and potentially classify data sets in different categories.
 A number of methods to compare static networks have thus been put forward [2,3,4], even if the field remains quite open. Some methods consider a set of features that serve as a graph "signature" and compare these signatures among graphs [4]. Other methods are based on the set of distances between nodes in the graph [2,3].

The case of temporal networks has not been addressed yet. It is however of central interest, for instance to identify relevant changes in the network dynamics, to classify types of networks and to validate models. The internship will consist in exploring several avenues to define comparison methods between temporal networks. Some methods could be generalized from static graph ones while others could use some fundamentally temporal properties of the temporal network. Examples include, but are not limited to:

- Defining a "signature" from a set of structural and temporal statistics of the network.
- Use the span-core decomposition of temporal graphs [5] to define a signature
- Define "portraits" of temporal networks based on the temporal distances (lengths of causality-respecting paths) between nodes
- Compare static representations of temporal graphs such as supra-adjacency ones or weighted event graphs [6].

The approach will be strongly data-driven: these methods will be developed directly on a series of available data sets of temporal networks in order to understand their advantages and limitations and to adjust them accordingly.

Required profile: physicist trained in complex systems with good numerical (coding) skills, preferentially in python.

References
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