Applications of network science

In infectious disease research

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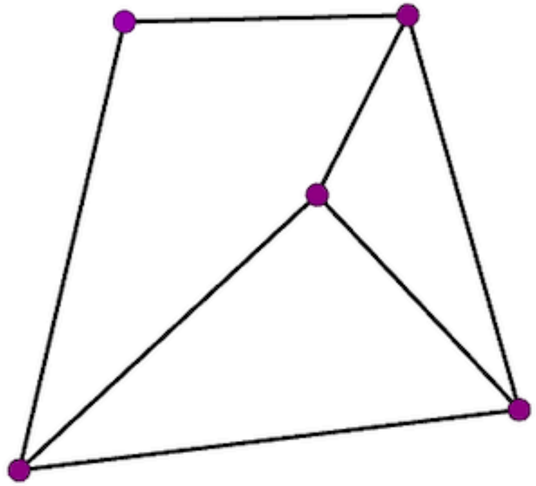

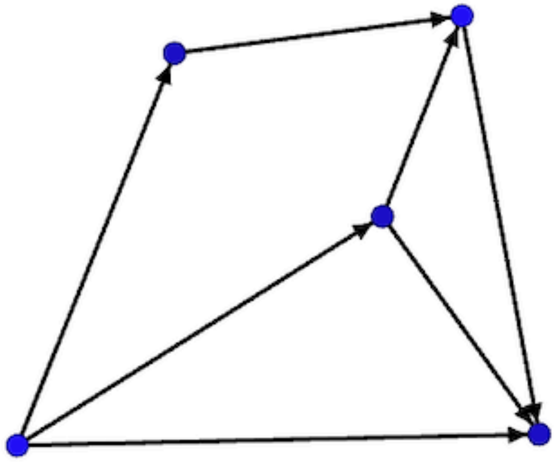

What are graphs?

A GRAPH IS A MATHEMATICAL STRUCTURE IN THE FORM $G = (V, E)$

V IS THE SET OF NODES,

E IS THE SET OF EDGES, $E \subset V \times V$

A GRAPH CAN BE UNDIRECTED, IN THIS CASE THERE IS NO DIFFERENTIATION BETWEEN THE ENDNOTES OF THE EDGES.

OR, IT CAN ALSO BE DIRECTED, IN THIS CASE THE EDGES HAVE A CLEAR DIRECTION WITH A SOURCE NODE AND A TARGET NODE.

Some basic concepts

- Path: A closed sequence of vertices and edges
- A graph is connected if and only if there is a path between any two nodes in it.
- Length of a path: The number of edges on the path
- Shortest path between two nodes is a path between them with minimal length (This length defines the distance of these two nodes)

Weights

- A weight is a function that assigns a quantitative measure to each edge.
- The metric is unique, common metrics are capacity, length, time needed for passing, etc..
- The length of a path in a weighted graph is the sum of the weights of all edges.
- The definition of distance changes accordingly.

Centralities

- (Normalized) Closeness centrality of a node: the average length of the shortest path between the node and all other nodes in the graph. In this definition the lower the value is, the more central the respective node is.
- Betweenness centrality of a node: the number of times a node acts as a bridge along the shortest path between two other nodes.
- These centralities can be defined also for edges in a similar way.

Who are the superspreaders?

- The ones with high degree (number of neighbours)?
- The ones with high centralitity? If so, then based on which centrality measure?
- k-shell decomposition?

Further ideas

Slides removed.