Network Science

Lecture 21: September 24, 2009 Lecturer: Stephen Eubank

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Introduction to Networks:

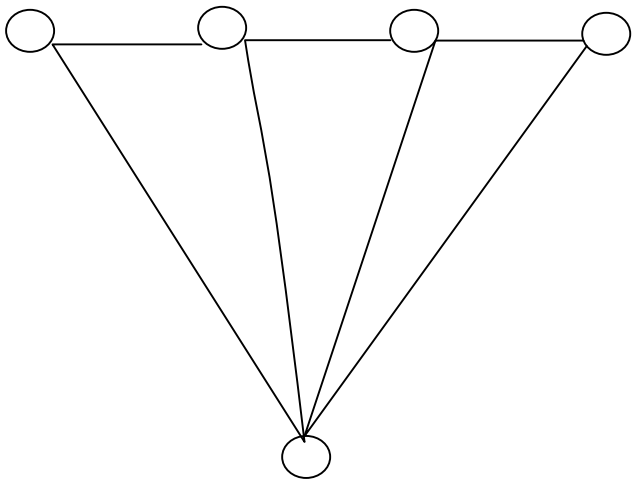

Figure 21.1:

What is the probability that node 3 is infected at time step 2 ? i,e $p_2(3) =?$ We sum over all possible routes by which node 3 could be infected at time step 2.

$$p_2(3) = p(3|2,5)p(2,5) + p(3|\overline{2},5)p(\overline{2},5) + \cdots$$

The problem is that we need to know the joint distribution $p(2,5)$ etc, which is difficult to compute since it doesn't factorize. The existance of loops in the network makes it harder.

Alternative Representation:.

1. A node represents an entire configuration, and edges represents transition probabilities.
2. A Markov model where the transition probabilities are just represented as a matrix.

$$p(C') = \sum_{C} p(C'|C)[(C)$$

$$p(S_{t+1}, I_{t+1}) = \sum_{S',I'} p(S, I|S', I')p(S', I')$$

$$\overline{I}_{t+1} = I(pd_s).$$

This overcounts because two infectious nodes could be neighbors of the same susceptable node.

$$\overline{I}_{t+1} = IpS.$$

This is the discrete time version of teh usual SIR epidemic equation

$$\frac{dI}{dt} = \beta SI - \alpha I$$

where α is the recovery rate.