Risk Propagationch:risk-propagation

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Risk propagation is a message-passing algorithm that estimates an individual's infection risk by considering their demographics, symptoms, diagnosis, and contact with others. Formally, a risk score $_t$ is a timestamped infection probability where $\in [0, 1]$ and $t \geq 0$ is the time of its computation. Thus, an individual with a high risk score is likely to test positive for the infection and poses a significant health risk to others. There are two types of risk scores: symptom scores, or prior infection probabilities, which account for an individual's demographics, symptoms, and diagnosis Menni2020; and exposure scores, or posterior infection probabilities, which incorporate the risk of direct and indirect contact (i.e., sustained, proximal interaction) with others.

Given their recent risk scores and contacts, an individual's exposure score is derived by marginalizing over the joint infection probability distribution. Naively computing this marginalization scales exponentially with the number of variables (i.e., individuals). To circumvent this intractability, the joint distribution is modeled as a factor graph, and an efficient message-passing procedure is employed to compute the marginal probabilities with a time complexity that scales linearly in the number of factor nodes (i.e., contacts).

Let $= (, ,)$ be a factor graph where is the set of variable nodes, is the set of factor nodes, and is the set of edges incident between them Kschischang2001. A variable node equation* : $\rightarrow \{0, 1\}$