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## Modelling plant-pollinator interactions with mixtures of linkage rules

It is common to represent a mutualistic network as a bipartite graph in which nodes represent plant and pollinator species and lines represent interactions between plant pollinator pair. Many pollination ecologists recognize that a pollinator species that has a colour preference may be expected to have higher visit frequencies for plants of that colour. In contrast, no visits may be expected between flowers with long tubal lengths and insects with shorter proboscises. Hence a model for plant-pollinator species interaction probabilities should take these linkage rules into account. A pollinator species that has a colour preference may be expected to have higher visit frequencies for plants of that colour. In contrast, no visits may be expected between flowers with long tubal lengths and insects with shorter proboscises. Hence a model for plant-pollinator interaction probabilities should take these linkage rules into account.

Unfortunately, ecologists do not always know how many, or even which, traits are the main contributors to observed interactions. The Latent Dirichlet Allocation (LDA) model from artificial intelligence has been typically used to model text in a document as a finite mixture of topics, where each topic has a different distribution over the words in a vocabulary. Define an interaction group as a cluster of plant and pollinator species such that the probability of an interaction between plants and pollinators within an interaction group is higher than that between plant and pollinators across interaction groups. Then, the LDA model can be thought to model a pollinator species as a finite mixture of (latent) interaction groups in which plant and pollinator pairs that share common linkage rules are placed in the same interaction group. Although LDA requires that the number of interaction groups be known, we propose using a penalized score, such as the Bayesian information criterion to learn how many interaction groups best describe the observed interactions for a given dataset.

We present results from a simulation study that investigates the accuracy of interaction group identification under different network properties such as network size, number of interaction groups, and level of nestedness. The effectiveness of LDA did not depend on network size or the number of actual interaction groups. However, the accuracy of LDA decreased as the amount of nestedness increased.

Finally, we demonstrate the LDA on a real network of plants and pollinators in the Alpine meadow region.