A Probabilistic Approach for Inferring Repression Kinetics from Expression Time-Series

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Many attempts have been done to infer regulatory connections from expression data. A fundamental problem, though, is that the relevant sizes between which such a functional connection exists are the level of activated protein of the regulating gene, and the RNA transcription rate of the regulated gene. In most experiments, the first size is hidden, while the second is measured.

We suggest two methods for learning both the circuitry and the kinetic parameters of a jointly repressed module of genes, given partial knowledge on the circuit wiring. In these methods we explicitly model the dynamics of the hidden repressors. We apply these methods on data from E. Coli promoter activity measurements (Alon, 2001) collected during a recovery period from a stress condition.

The first approach uses a partial probabilistic model, combined with pre-processing of the data. The second uses a fully probabilistic generative model, accounting for different possible noise phenomena.

Both methods use likelihood-based scores, which allow the comparison of different wiring architectures. The models are analyzed in terms of their predictive abilities on test data, and the quality of hidden parameter reconstruction.