Linear Gene Networks

Clayton W. Seitz

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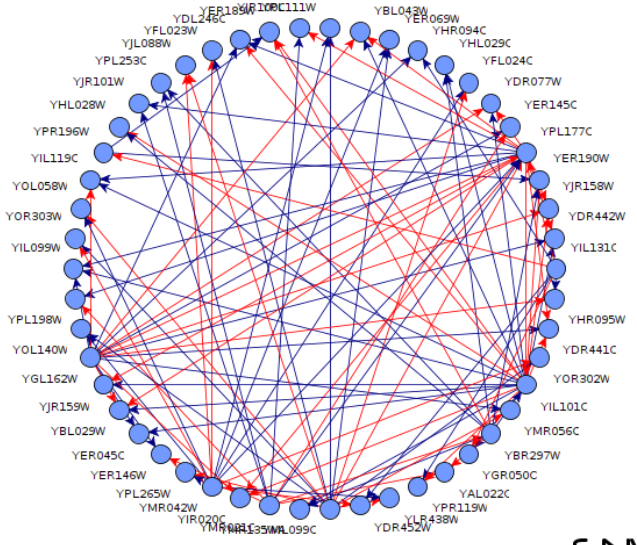
Outline

Example gene regulatory network in yeast



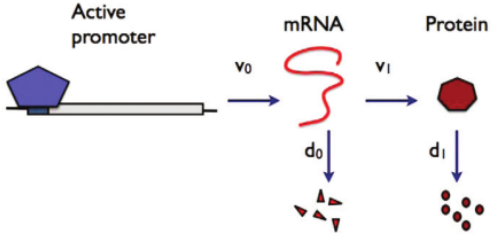
GNW
lis.epfl.ch/gnw

Linear dynamics of transcription and translation

Assumptions: gene-gene interactions are linear, noise is Gaussian, long protein lifetimes

$$\dot{x}_i = \sum_j m_{ji} y_j - \alpha_i x_i + \eta_i$$

$$\dot{y}_i = r_i x_i - \beta_i y_i + \xi i$$



If we assume that $\dot{y}_i \approx 0$ we have a Langevin equation for $x(t)$

For example, a three-dimensional gene network:

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} -\alpha_1 & m_{21} & m_{31} \\ m_{12} & -\alpha_2 & m_{32} \\ m_{13} & m_{23} & -\alpha_3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} \eta_1 \\ \eta_2 \\ \eta_3 \end{bmatrix}$$

Ornstein-Uhlenbeck process

Existence of an equilibrium distribution
Gaussian distribution
Conditional distributions of multivariate Gaussian

Bayesian network for a multivariate Gaussian

Bayesian inference of model parameters