

## MEDS 6455 Introduction to Systems Biology

### Home Assignment for Lecture 6.

Due: October 17th, 2012.

#### Part 1. Introduction to rule-based modeling

Check <http://vcell.org/bionetgen/tutorial.html> Follow a tutorial and create a model. More learning resources are available at <http://vcell.org/bionetgen/resources.html>. Lecture 6 in your dropbox has details on BNGL writing.

#### Part 2. Rule-based version of Vilar et al. (PNAS, 2002) model.

- a) Create and simulate in BioNetGen a rule-based version of Vilar model (given to you as a previous assignment, <http://www.ncbi.nlm.nih.gov/pubmed/11972055>, also in the dropbox) under assumption that  $D_A$  and  $D_R$  are parts of the same DNA strand. **Hints:** (1) define both genes as components of single multi-component DNA  $D(p,r)$ , where  $p$  is a activator  $A$  promoter region and  $r$  is a repressor  $R$  promoter. (2) Degradation is just  $R \rightarrow$  trash, you need to specify trash molecule type. (3) Use `simulate_ode({suffix=>ode,t_start=>0,t_end=>200,n_steps=>1000});` same for `_ssa`.

**Investigate the following cases. Which case corresponds to the original Vilar model?**

- i.  $A$  can bind to either activator promoter or repressor promoter, but not to both. Hint:  $D(p,r) + A(d)$
- ii.  $A$  can bind to activator promoter and repressor promoter independently. Hint:  $D(p) + A(d)$
- iii. There are 2 activator promoters and 1 repressor promoter, and  $A$  can bind independently to any of them. Hint:  $D(p,p,r)$
- iv. There are 1 activator promoter and 2 repressor promoters, and  $A$  can bind independently to any domain.
- v. 2 activator promoters, 2 repressor promoters, independent binding
- vi. 2 activator promoters, 1 repressor promoter, need both activator promoters bound to two  $A$ 's to activate mRNA<sub>A</sub> transcription.
- vii. 1 activator promoter, 2 repressor promoters, need both repressor promoters bound to two  $A$ 's to activate mRNA<sub>R</sub> transcription.