Report for the Course Modelling in Computational Science, HT23

Project 2: Cell reprogramming

Theo Koppenhöfer

(with Jimmy Gunnarson)

Lund

October 1, 2023

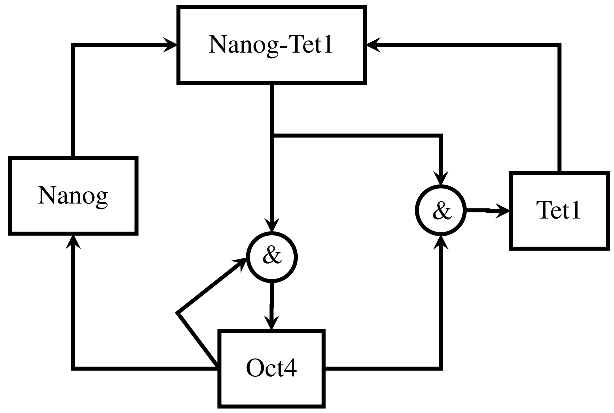

Figure 1: A flowchart showing the dependence of the transcription factors.

Introduction

The setup

The default parameters are given by We implemented the model as given in [1]. One

Parameter	value
Over expression N_{over}	0
Over expression O_{over}	0
Over expression T_{over}	0.05
Probability p_N	1
Probability p_O	1
Probability p_T	1
Hill coefficient K_{NT}	0.2
Leukemia inhibiting factor LIF	0
Dissociation constant K_d	0.1
Dissociation constant K_O	0.3
Dissociation constant K_{NT}	0.2

Table 1: Default parameter choices

can obtain the differential equations

$$\partial_t[N_{\text{total}}] = N_{\text{over}} + \text{LIF} + p_N \cdot \frac{\frac{[O_{\text{total}}]}{K_O}}{1+\frac{[O_{\text{total}}]}{K_O}} - [N_{\text{total}}]$$

$$\partial_t[O_{\text{total}}] = O_{\text{over}} + \text{LIF} + p_O \cdot \frac{\frac{[O_{\text{total}}]}{K_O}}{1+\frac{[O_{\text{total}}]}{K_O}} \cdot A([NT], O_{\text{total}}) - [O_{\text{total}}]$$

$$\partial_t[T_{\text{total}}] = T_{\text{over}} + p_T \cdot \frac{\frac{[O_{\text{total}}]}{K_O}}{1+\frac{[O_{\text{total}}]}{K_O}} \cdot A([NT], T_{\text{total}}) - [T_{\text{total}}]$$

where

$$A([NT], O_{\text{total}}) = A([T_{\text{total}}]) = \frac{\left(\frac{[NT]}{K_{NT}}\right)^n}{1+\left(\frac{[NT]}{K_{NT}}\right)^n}.$$

The experiments

Variiying Nanog, Oct4 and Tet1 seperately

Our first experiment series was taken from [1]. In the

Conclusion

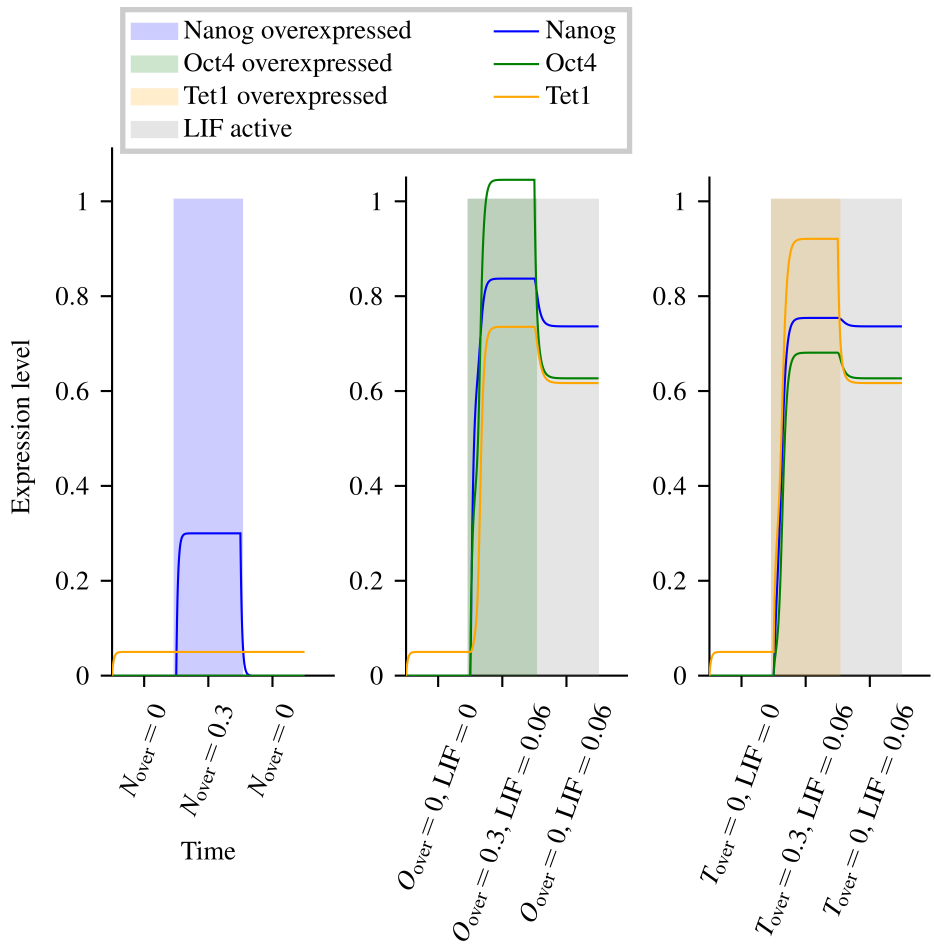

Figure 2: Overexpression of 0.3.

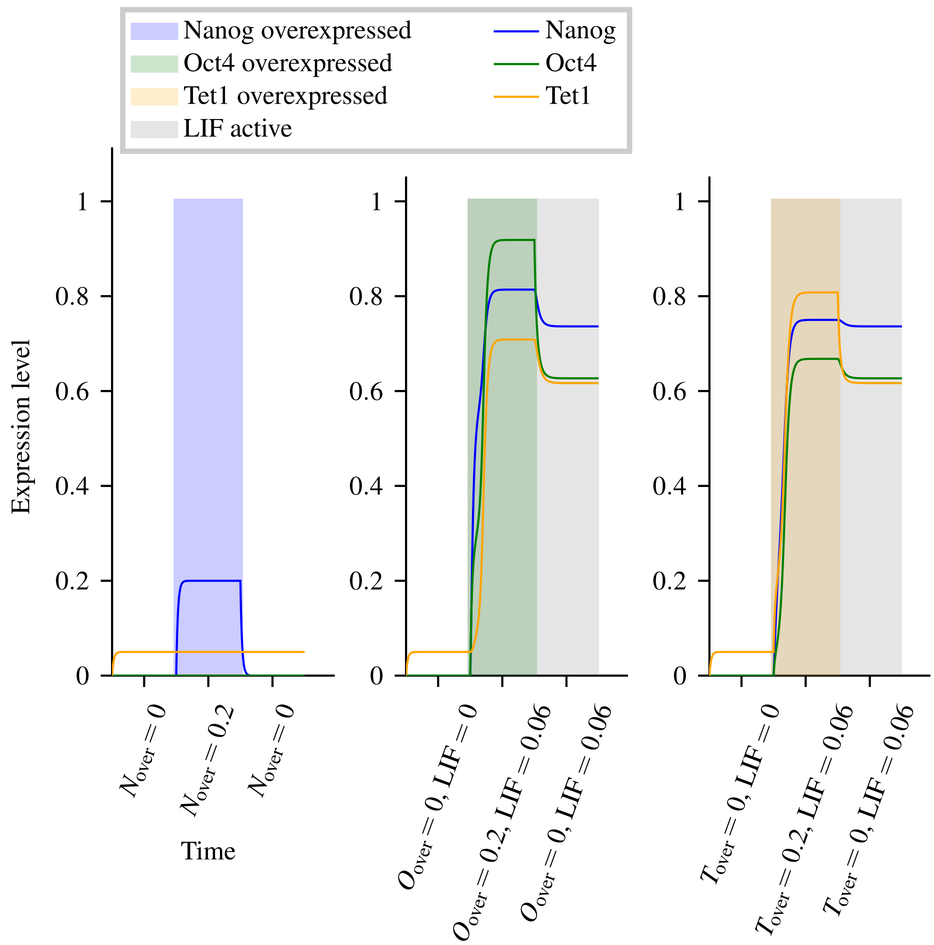

Figure 3: Overexpression of 0.2.

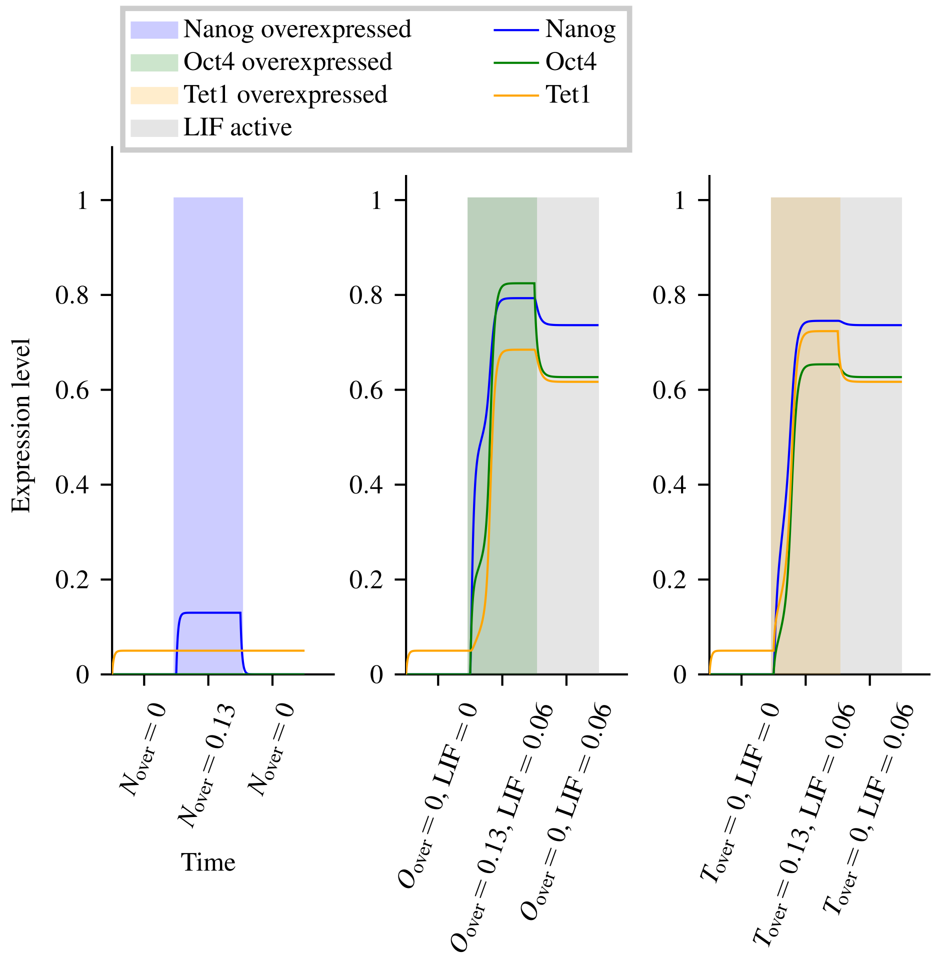

Figure 4: Overexpression of 0.13.

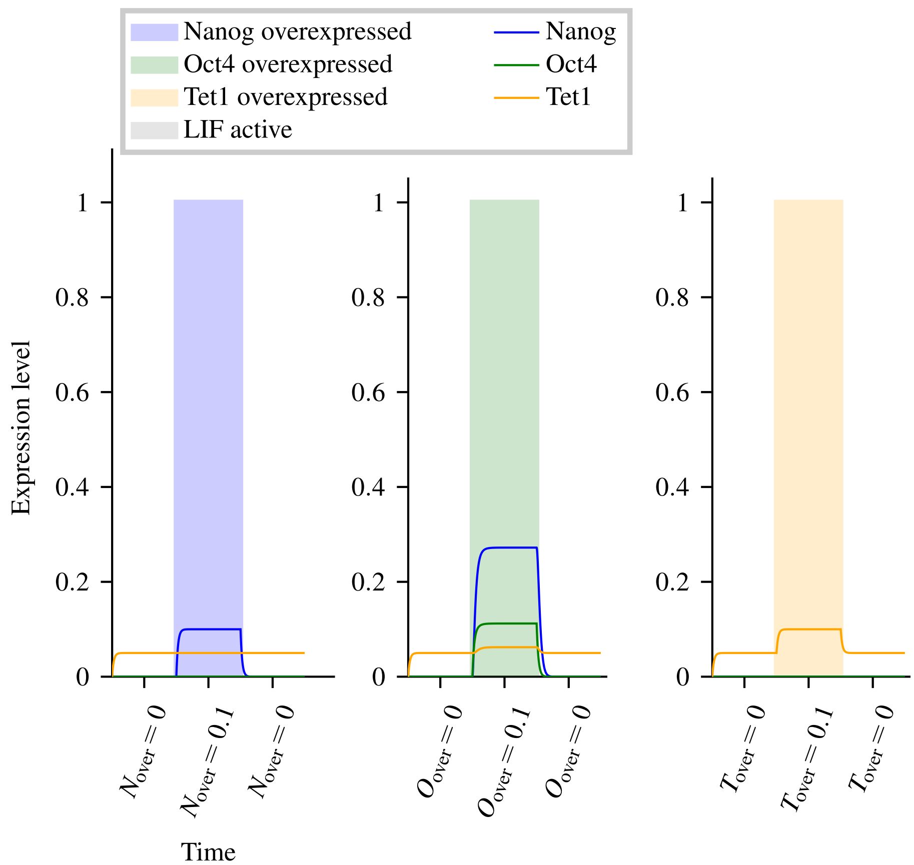

Figure 5: Overexpression of 0.1.

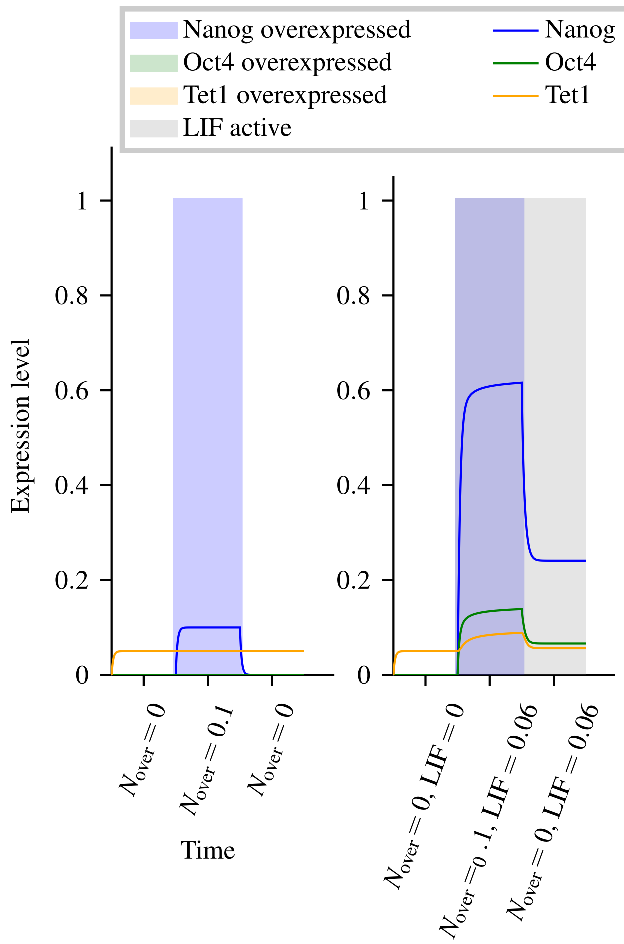

Figure 6: Nanog and Oct4 active.

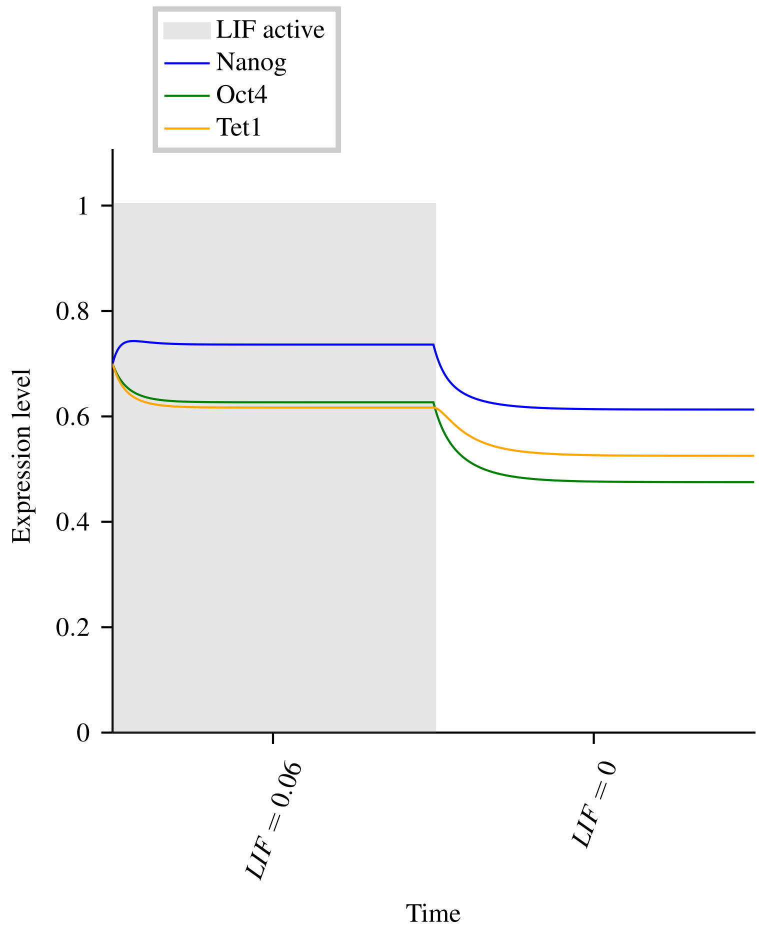

Figure 7: Withdrawing LIF.

Bibliography

[1] V. Olariu, C. Lövkvist, and K. Sneppen, "Nanog, oct4 and tet1 interplay in establishing pluripotency," *Scientific Reports*, vol. 6, no. 1, p. 25 438, May 2016, ISSN: 2045-2322. DOI: 10.1038/srep25438. [Online]. Available: https://doi.org/10.1038/srep25438.

[2] computational-science-HT23, *Github repository to the project.* Online, 2023. [Online]. Available: https://github.com/TheoKoppenhoefer/computational-science-HT23.

[3] V. Olariu, *Modelling in computational science, bern01, 7.5hp, Practical and theoretical knowledge of numerical methods used for solving ode modells for real life science problems.* BERN01, University of Lund, Sep. 2023.