MOLECULAR COMMUNICATION IN BIOLOGICAL CELLS: FOUNDATIONAL
STUDY AND DEVELOPMENT OF COMPUTATIONAL TECHNIQUES

by

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Your abstract

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Chapter 1

Introduction

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Reference [1].

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Equations (2.1).

Chapter 2

Background

2.1 Motivation

Your background
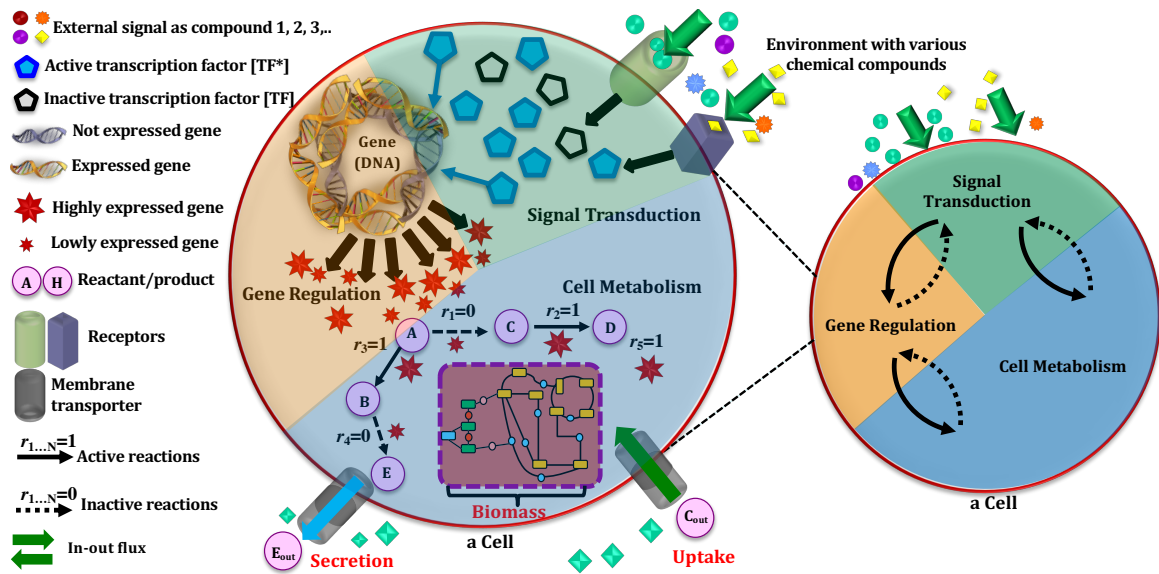
2.2 Biological Pathways

Figure 2.1: Graphical representation of the interconnection of signal transduction, gene regulation and metabolic pathways.

Algorithm 1: Probability Histograms for Equation (**??**)

Data: R simulation runs for each of I input concentrations containing values for all N simulation steps

Result: For each protein j, p_{Y_j} and $p_{X|\{y_{j,t_n}\}_{n=0}^{N}}$

1 **for** *each simulation time step t_n* **do**

2   Create $\{Z_{i,r}\}_{t_n}$ by extracting protein j concentration for each simulation run r and input concentration i

3   Map each value of $\{Z_{i,r}\}_{t_n}$ in N_{j,t_n} equally-spaced bins (with index b_{t_n}) between min and max values, expressed as $\left(\{Z_{i,r}\}_{t_n}, b_{t_n}\right)$

4 **end**

5 Obtain matrix M of size C by N by combining all the mapped bin indices b_{t_n} for each simulation run (i,r) and each time step t_n

6 Compute the multidimensional histogram considering each row of M as a datapoint: $p_{Y_j}\left(\{y_{j,t_n}\}_{n=0}^{N}\right)$

7 **for** *each bin in the multidimensional histogram* **do**

8   Take all the input values corresponding to the values $\{y_{j,t_n}\}_{n=0}^{N}$ that define the current multidimensional bin

9   Compute the histogram $p_{X|\{y_{j,t_n}\}_{n=0}^{N}}$ by mapping the input values found at Step 8 into $S_{\{y_{j,t_n}\}_{n=0}^{N}}$ equally space bins between min and max values

10   If no input value from Step 8, set $p_{X|\{y_{j,t_n}\}_{n=0}^{N}} = 0$

11 **end**

2.2.1 Gene Regulation

$$N_{j,t_n} = 1 + \log_2(C) + \log_2\left(1 + \frac{g_{Y_j(t_n)}}{\sigma_{g_{Y_j(t_n)}}}\right). \tag{2.1}$$

Table 2.1: Mutual information values for different sugars.

Sugar Type	$\tilde{H}(X)$	$\tilde{H}(X|bm(t_c))$	$\tilde{H}(X) - \tilde{H}(X|bm(t_c))$
Glucose	6.6295	5.2694	1.3601
Lactose	6.6295	5.2851	1.3444
Glucose6P	6.6295	5.8971	0.7324

Chapter 3

Conclusion and Future Directions

Your conclusion

- AAA

- BBB

Bibliography

[1] S Mahner, C Baasch, J Schwarz, S Hein, L Wlber, F Jnicke, and K Milde-Langosch. C-fos expression is a molecular predictor of progression and survival in epithelial ovarian carcinoma. *Br. J. Cancer*, 99(8):1269–1275, October 2008.