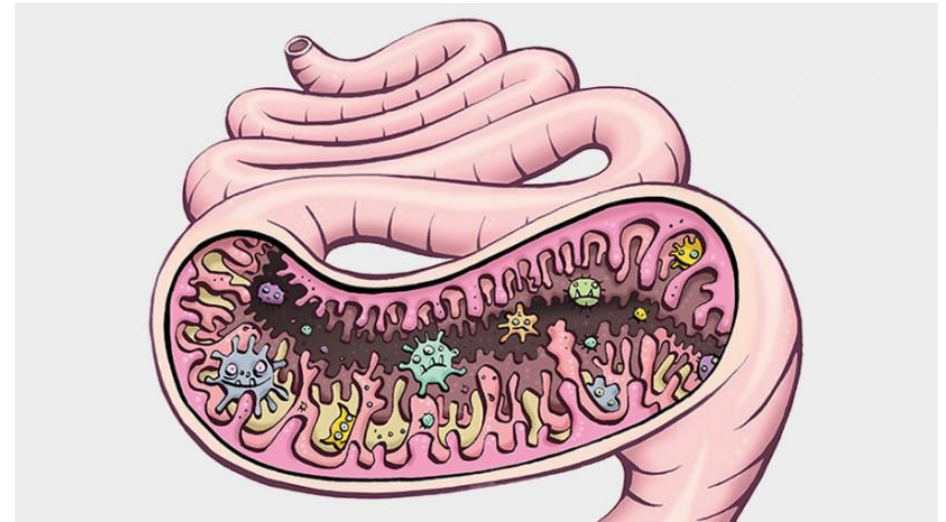


Modelling Gut Micobiota In Petri nets With Snoopy

Leila Ghanbar
1st year PhD student in Computer Science and System
Biology

Gut Microbiota



Human body hosts symbiotic microorganisms on a massive scale.

Prokaryotic, fungi, archaea.

Affect health, behaviour & diseases in human

Each human → a unique microbiota universe

Modelling human-gut microbiota can play a crucial role in

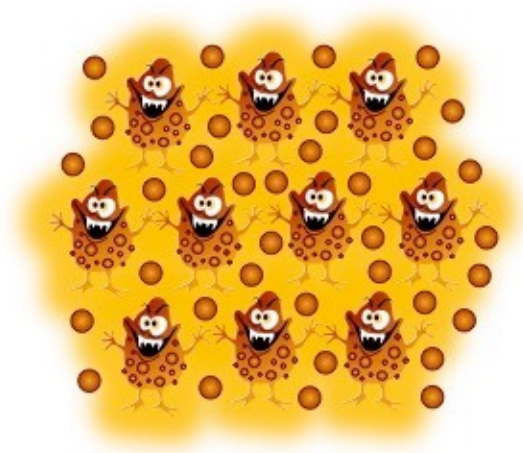
disease - personalized medicine

health - personalized nutrition

- Quorum sensing: cell-cell communication in bacteria



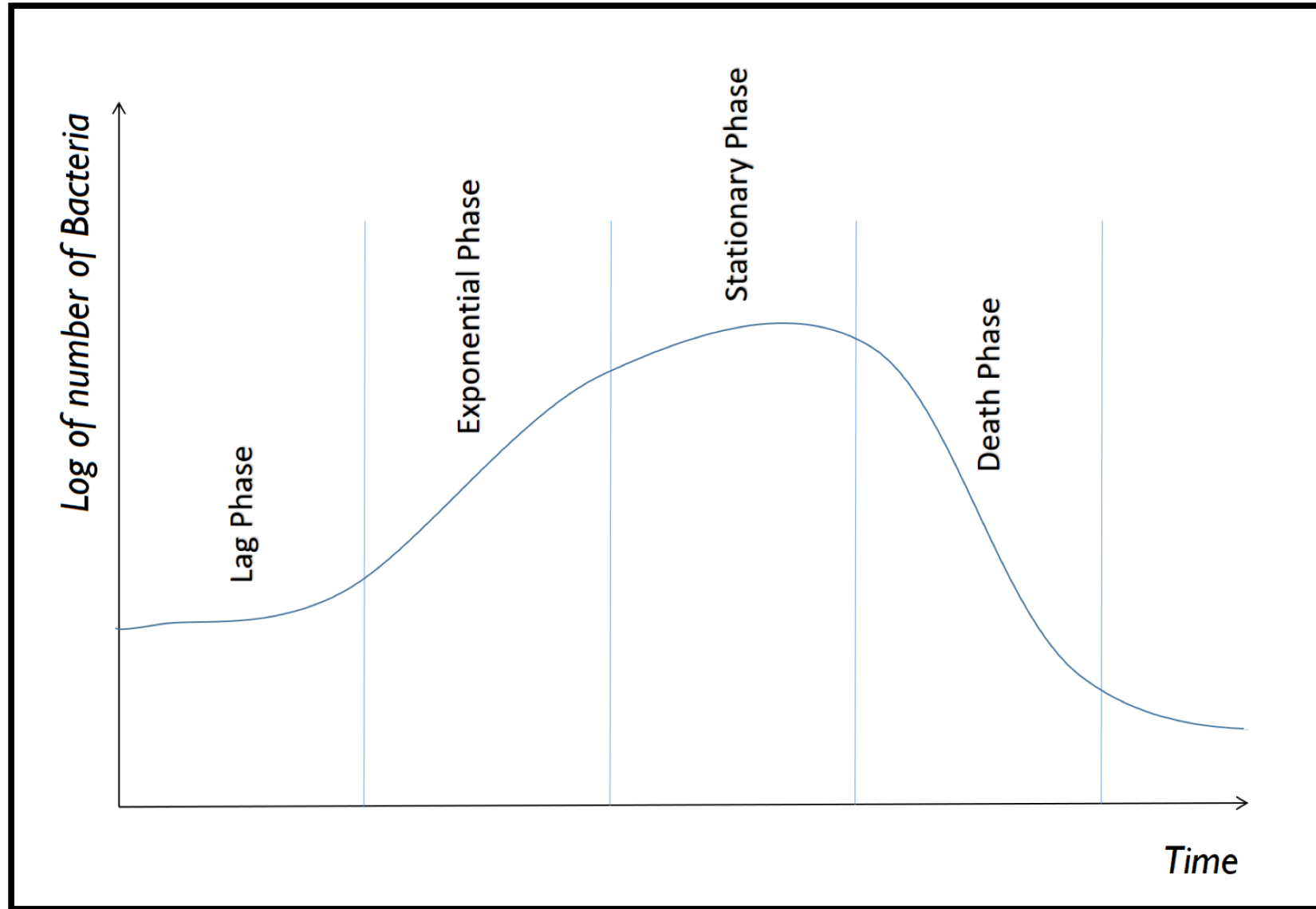
Low cell density:
No AI-2 detection
No changes in cell behaviour



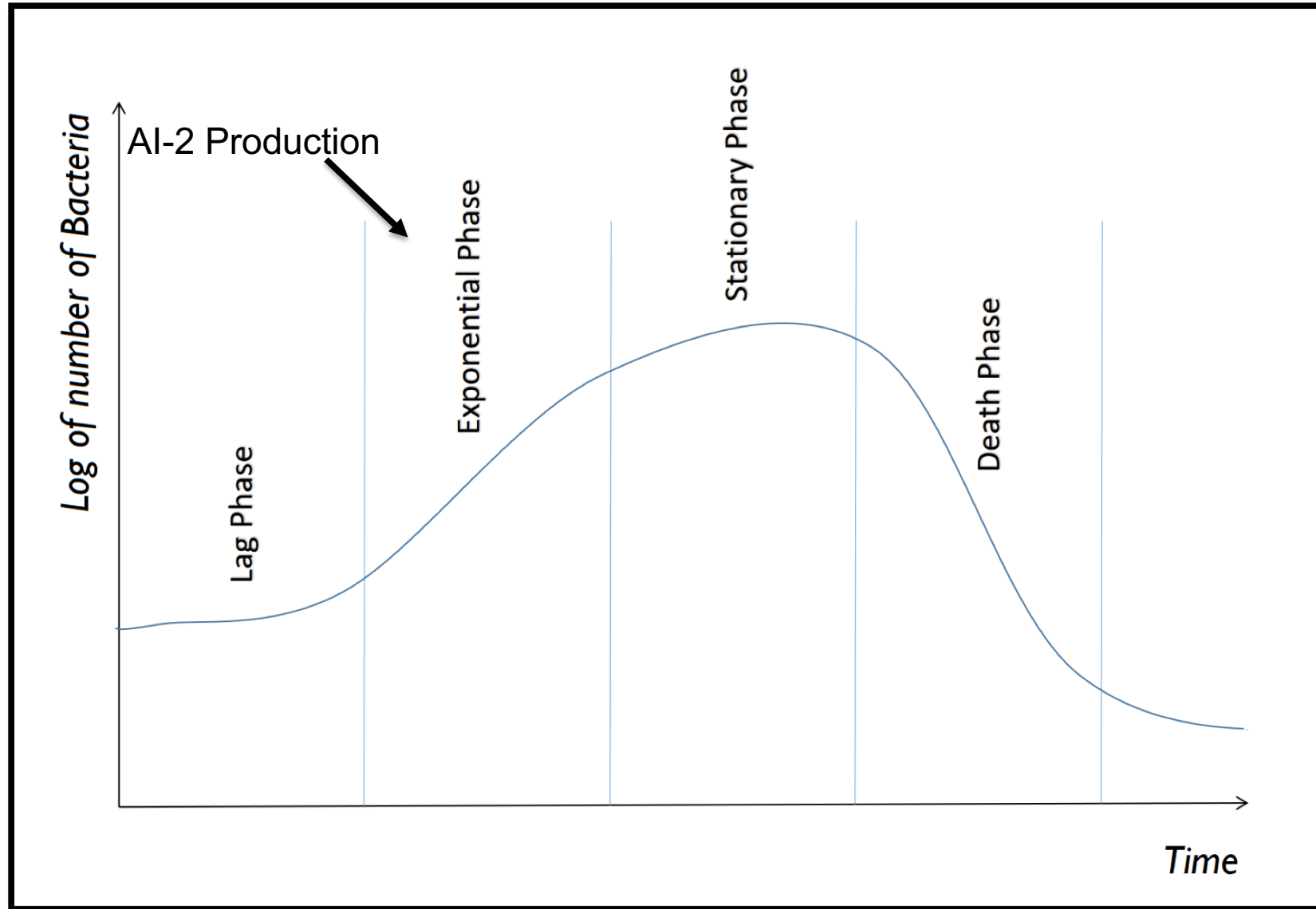
High cell density:
AI-2 is detected
Genes expression will change

One of the changes:
BIOFILM FORMATION

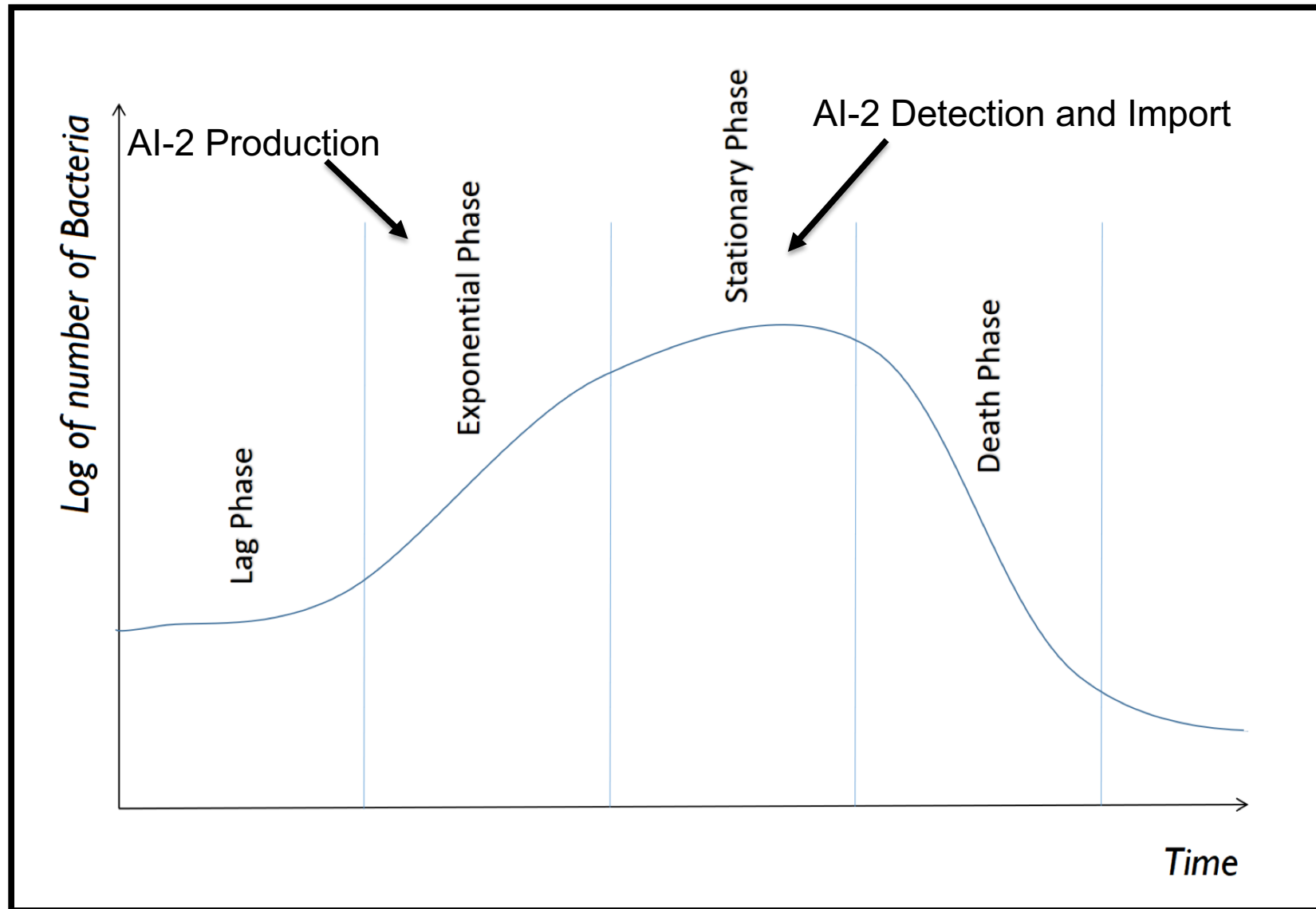
Bacteria Life



Bacteria Life



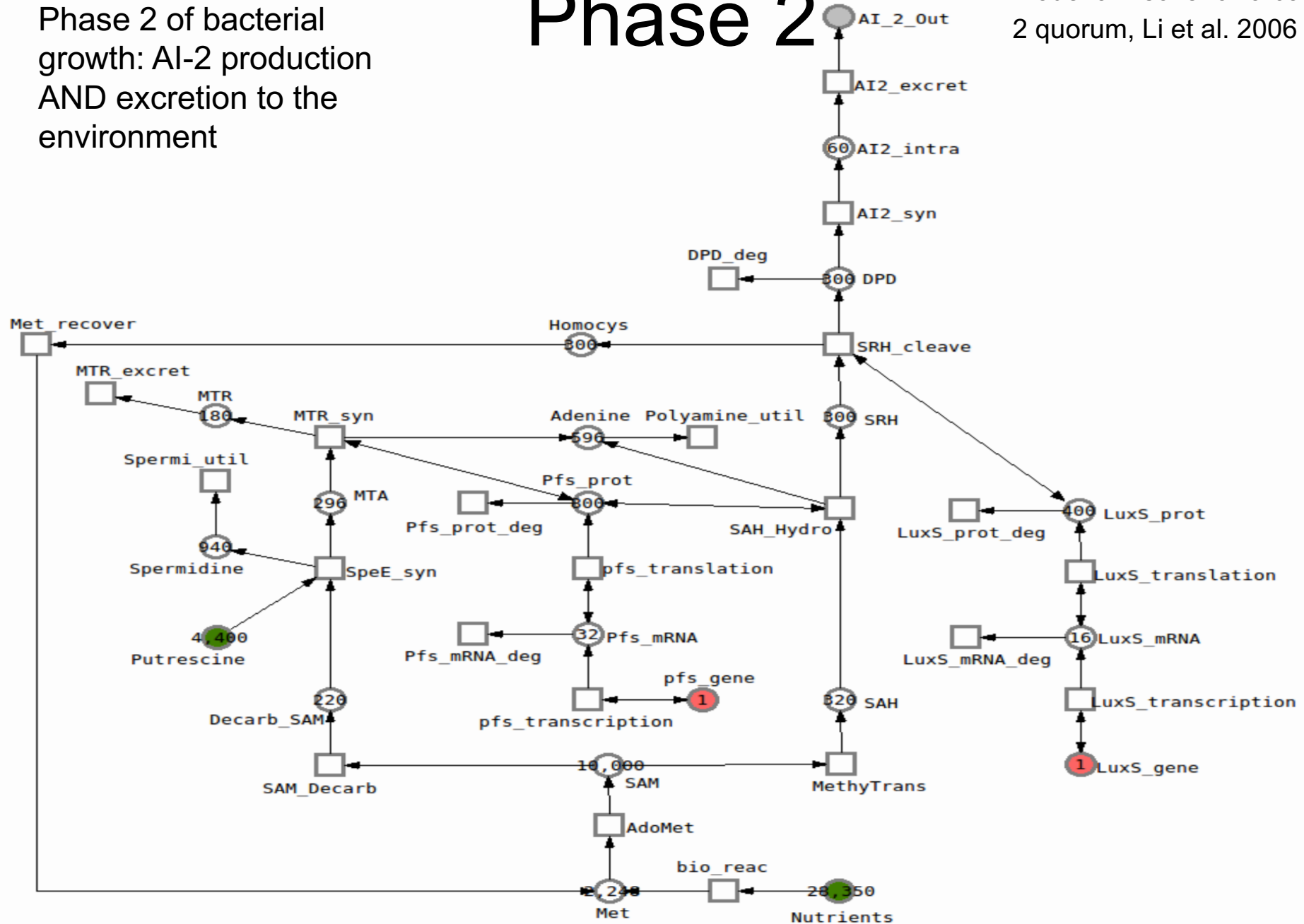
Bacteria Life



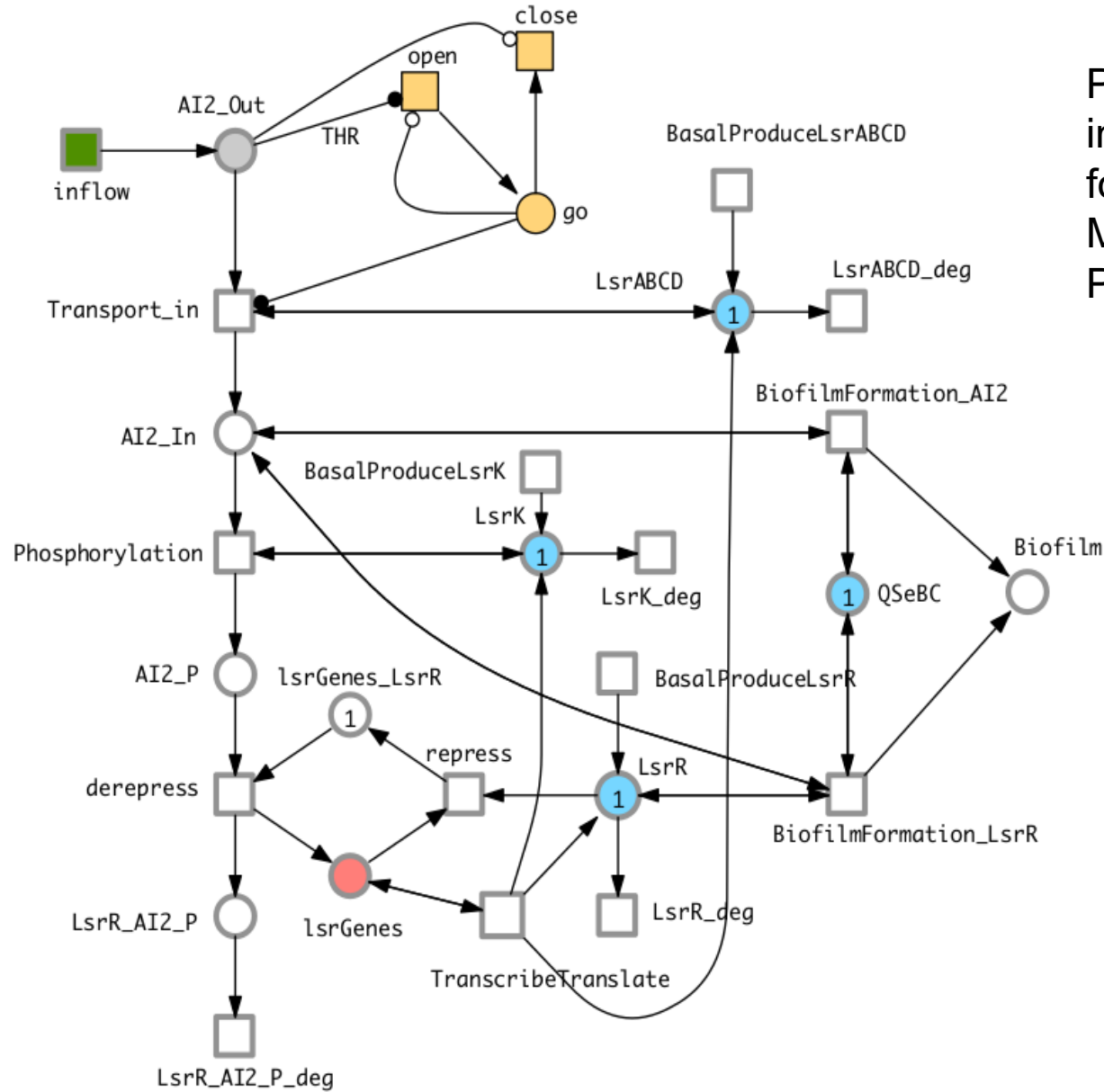
Phase 2 of bacterial growth: AI-2 production AND excretion to the environment

Phase 2

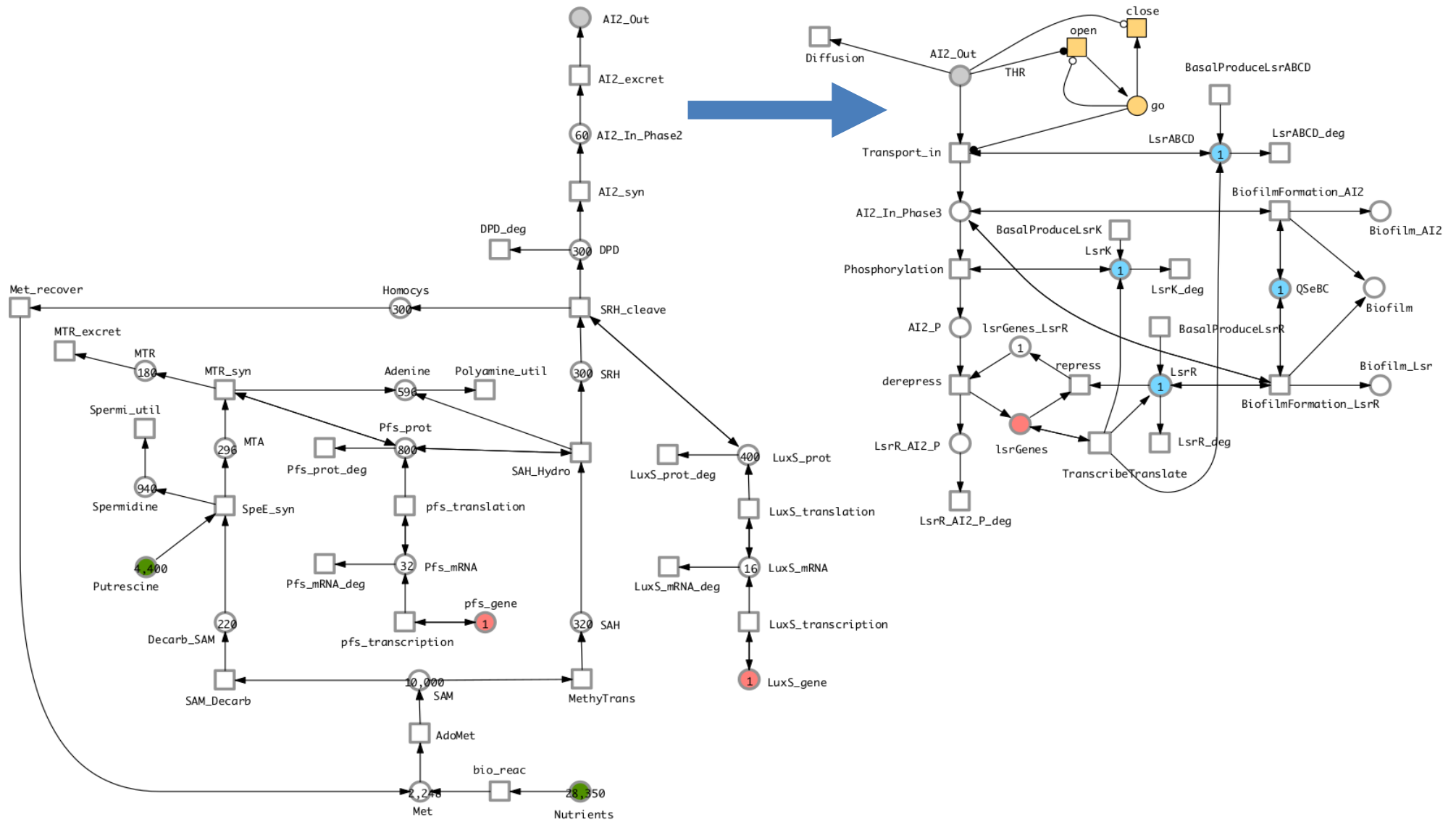
Reference: A stochastic model of Escherichia coli AI-2 quorum, Li et al. 2006



Phase 3



Phase 3 of bacterial growth:
importing AI-2 AND biofilm
formation regulated by AI-2
Modelled by Leila Ghanbar and
Professor Monika Heiner

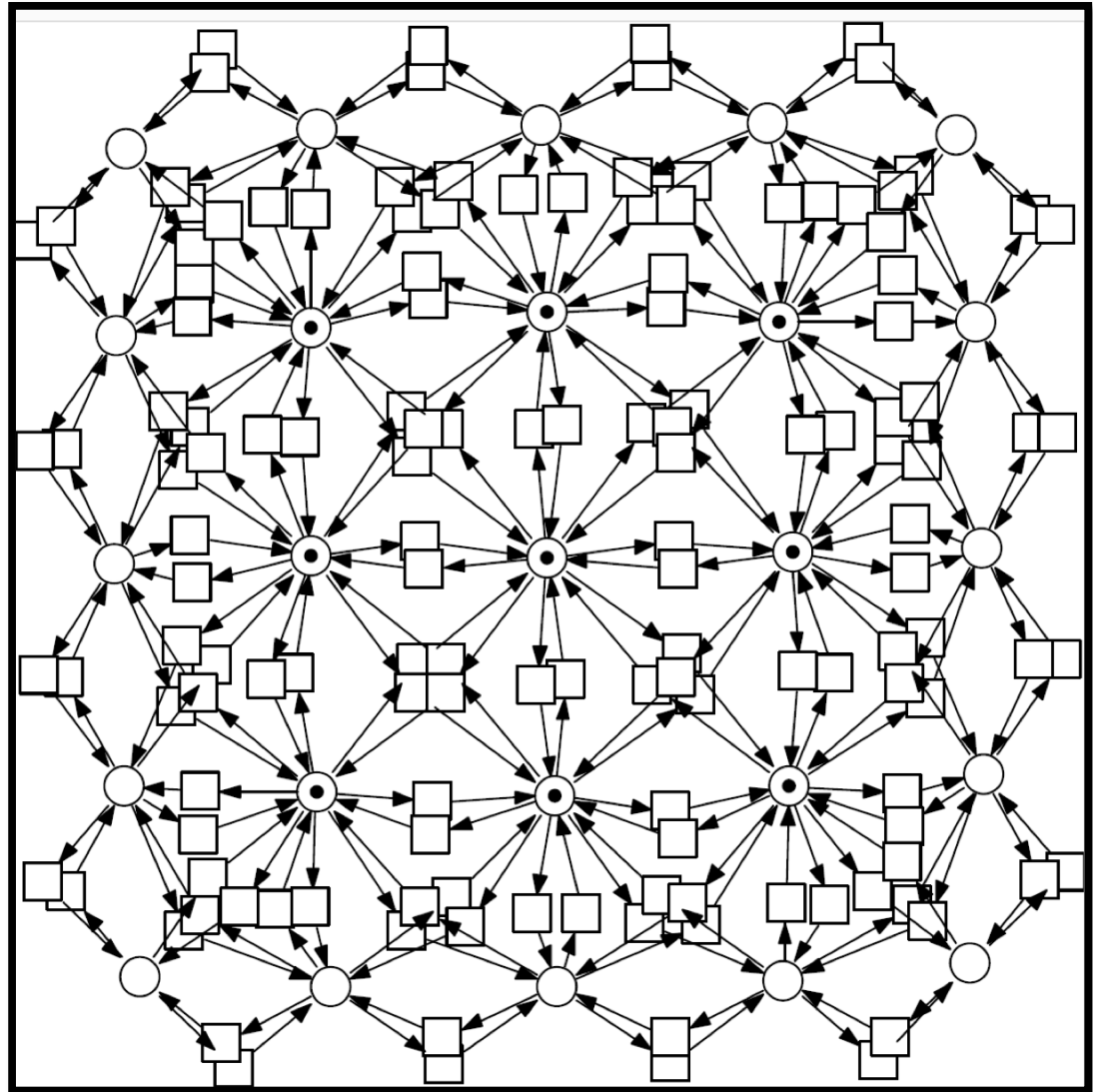


Combining the models

Reference: Spatial quorum sensing modelling using coloured hybrid Petri nets and simulative model checking, David Gilbert, Monika Heiner, Leila Ghanbar, Jacek Chodak (2018)

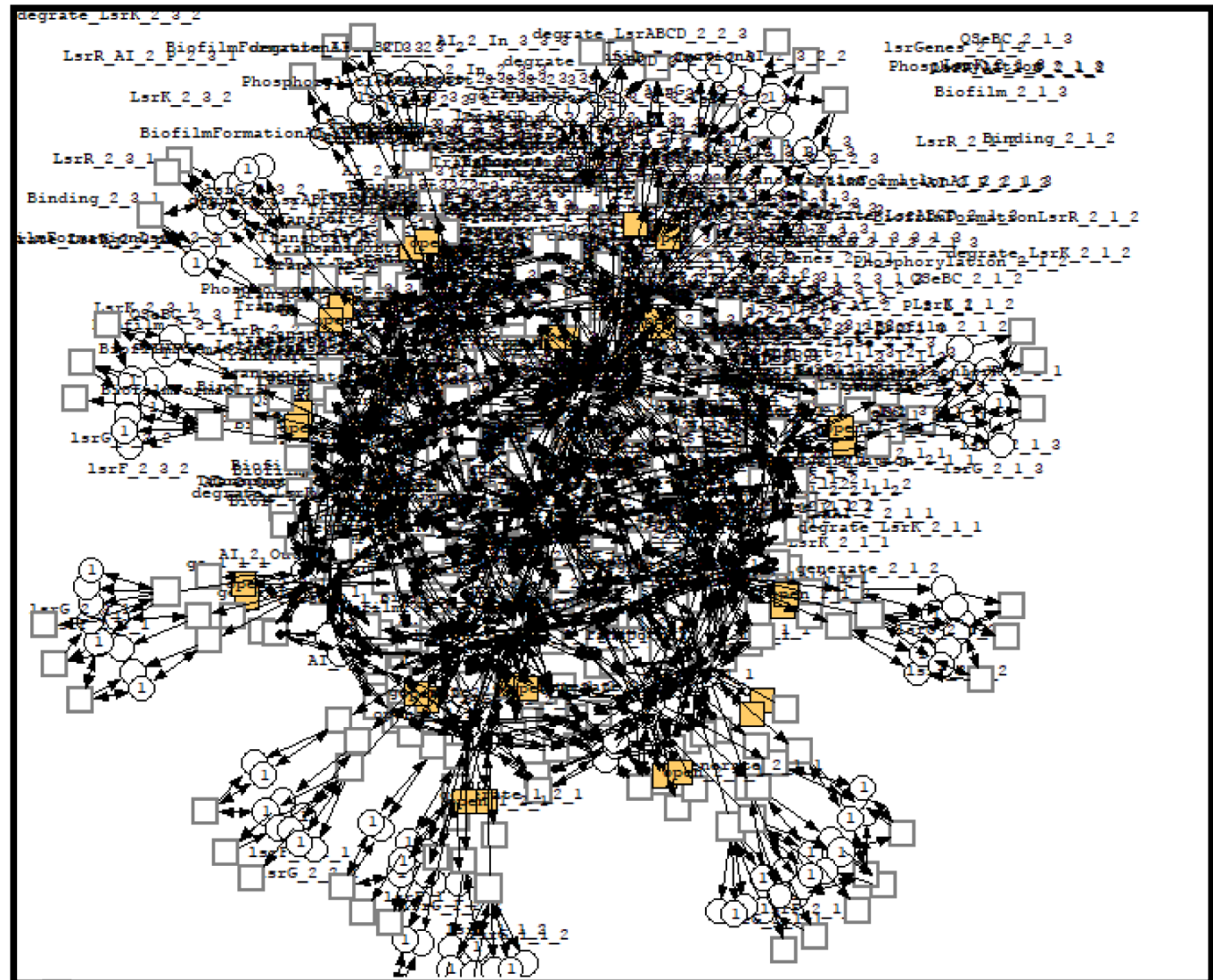
3D Models with Colour Petri nets

3D model of Diffusion



3D Models with Colour Petri nets

3D model of Biofilm Formation



Results

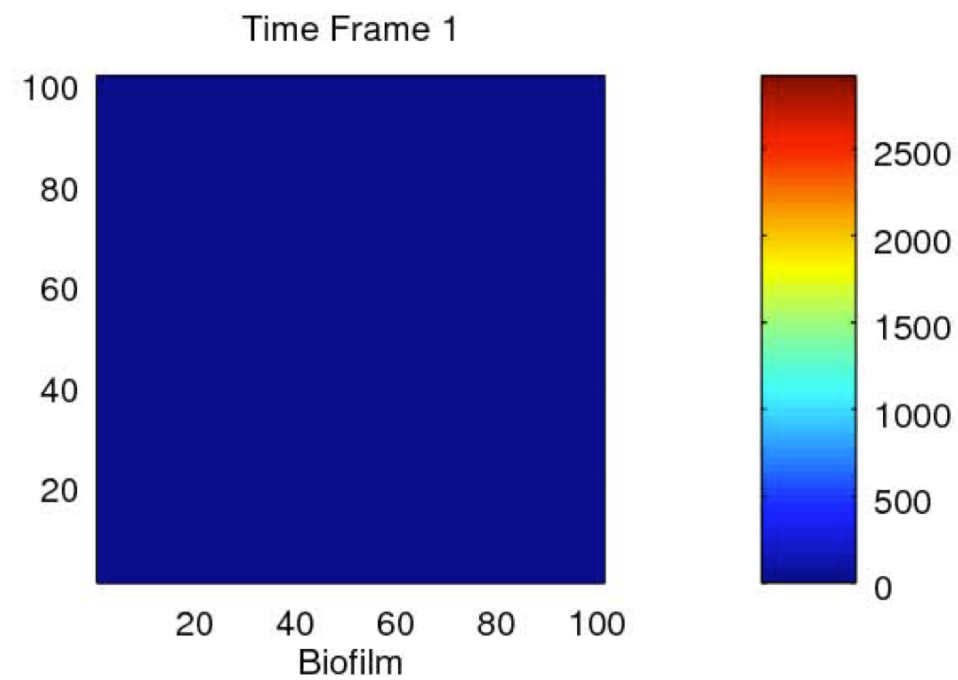
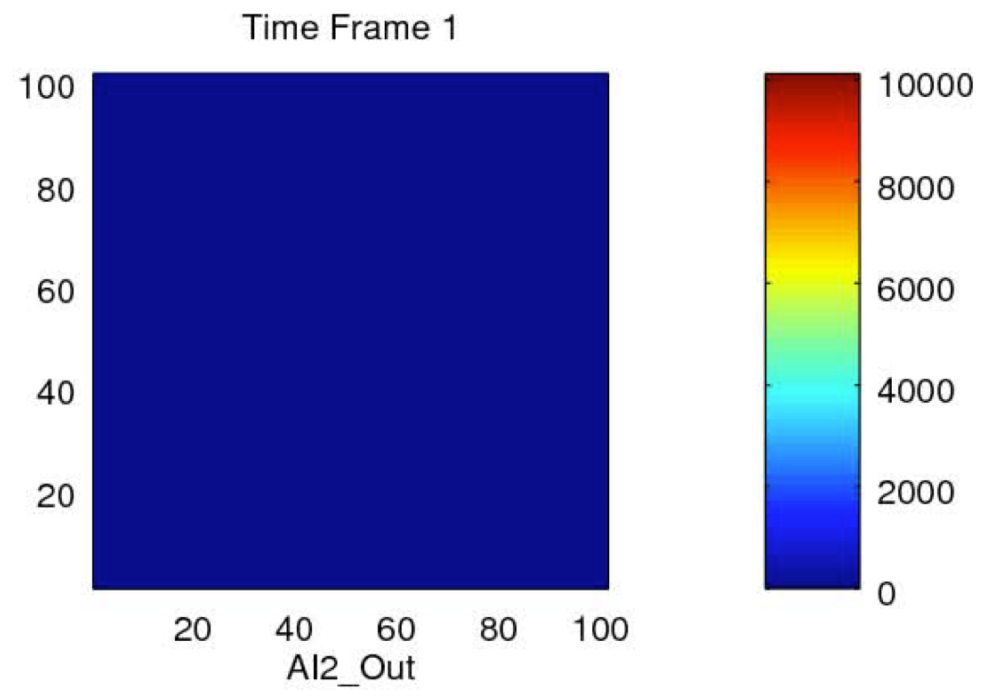
Colony	AI2_Out	Biofilm
R0	13,374.49	0.68
R2	308,478.60	55,468.61
R5	326,647.00	637.79
R7	341,143.57	35.14

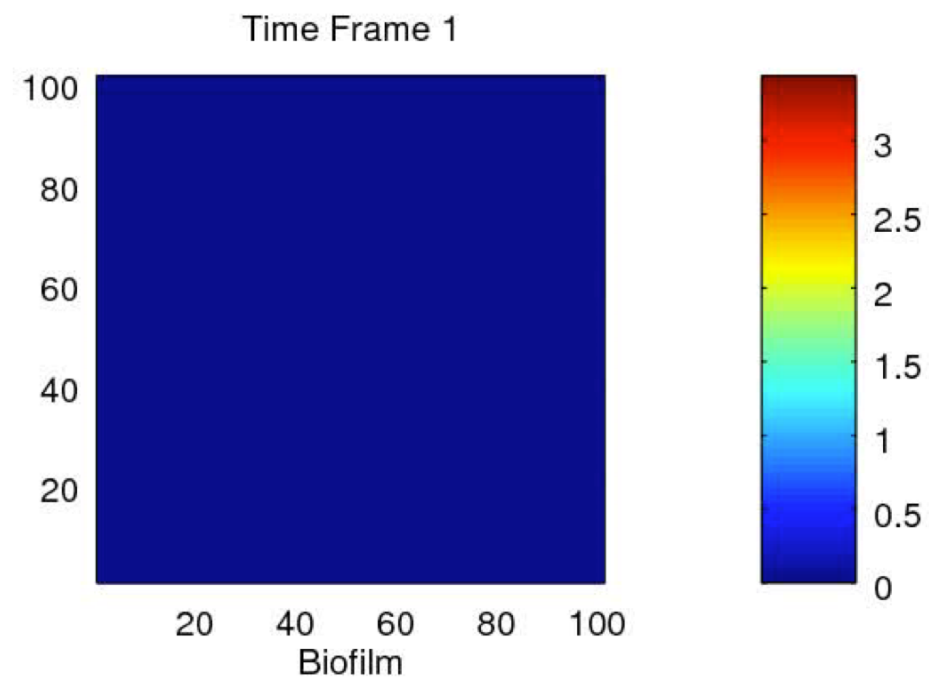
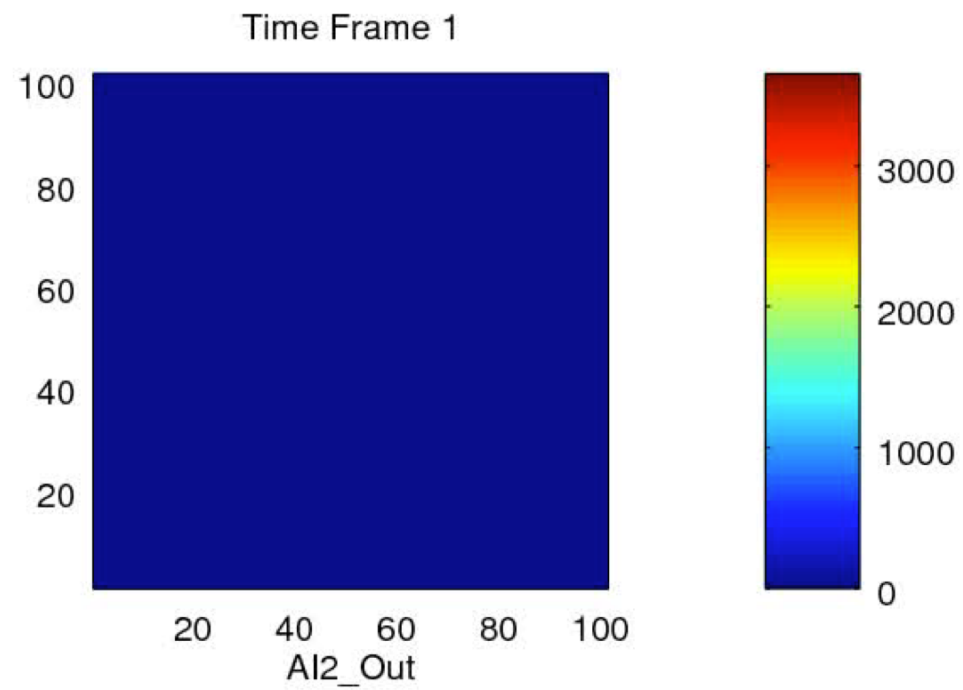
When there is only one bacteria (R0) biofilm formation is so low

When there is a compact colony (R2) biofilm formation is noticeably high

As the colony is sparser, the biofilm formation decreases.

Reference: Spatial quorum sensing modelling using coloured hybrid Petri nets and simulative model checking by: David Gilbert, Monika Heiner, Leila Ghanbar, Jacek Chodak





What is NEXT...

- Adding more details to the model
- Adding human cell interaction to the model
- Studying the connection between these two types of cells
- Studying them in a populated environment