« PROPOSITION DE STAGE ET/OU DE THESE »
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Profil recherché : Physicien théorique
Gratification de stage: NON
Possibilité de poursuite en thèse : OUI
Titre du stage :

1) Non-equilibrium modeling of biological processes.
Example: is it possible to build a molecular system that can be at the same time very sensitive to small signals (hence, having high affinities for the molecules that must be sensed) and very fast in turning on and off? Are they accessible to an equilibrium system? How can energy consumption (e.g. in the form of ATP hydrolysis) provide the two features?

2) Non-equilibrium models for self-organizing systems (“origins of life”).
Example: How can self-replicating molecules emerge from a “primordial soup”? How can they replicate?
If self-replicating molecules are intrinsically unstable (which is true for example for RNA), how can they be stabilized against thermodynamic equilibrium? How are external energy sources used for?

3) Machine-learning approach to large amounts of biological data.
How can we use the emerging power of machine learning to leverage the exponentially increasing amount of data of all kinds (genomics, proteomics, biochemistry etc) to extract valuable information that can be interpreted and that can lead us to develop better and more insightful models of biological systems?
Stated otherwise: can we develop interpretable machine learning approaches to avoid the “machine learning black-box trap”?
Work to do both for applications and for method development.