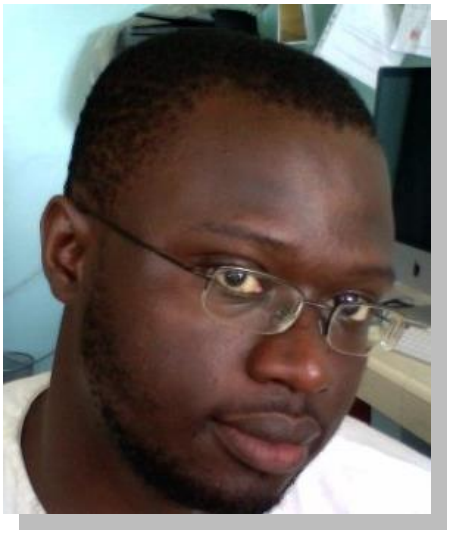
CoCo Seminar Series
Fall 2015

A Gene Regulatory Network for Artificial Cells Proliferation Control



Dr. Jean Marie Dembele
UFR SAT, Université Gaston Berger, Senegal

Wednesday September 16th, 2015
8:30-9:30am
Engineering Building R-3
(SSIE Conference Room)

Mitosis and apoptosis, nutriment controlling, taxis and diffusion, are some basic cell processes that can give an interesting insight into some aspects of biological self-organization. Indeed, combining such processes can result in constructive complexity giving rise to functional artifacts (tissues, organs…). This is the purpose of this work: building a "virtual laboratory" to make assumptions, test theories, explore scenarios and increase knowledge on some biological phenomena. In our agent-based modeling approach – producing an artificial cell – we first have to represent physical processes for spatial dynamics of taxis and diffusion in a realistic and accurate way. Those dynamics are hereafter simulated using Smoothed Particle Hydrodynamics (SPH) approximations fields. Once the physical behaviors implemented, our artificial cell needs to "learn" how to choose (and execute) a biological primitive (mitosis, apoptosis, nutriment saving or releasing). In this second part, we build a Gene Regulatory Network (GRN) to provide our cell with an autonomous mechanism to select the suited biological primitive depending on spatial and temporal conditions. The idea is to start from random GRNs and make them evolve with a genetic algorithm. Running intensive and repetitive parallel simulations allows us to test different GRNs and keep, on each generation, the ones that satisfy an indicated fitness function. At the end of the genetic algorithm, the resulting GRN gives, from a single cell, interesting cell development.

Dr. Jean Marie Dembele is an Assistant Professor of Computer Science at Université Gaston Berger in Saint-Louis, Senegal, and a Visiting Faculty of the CoCo Center at Binghamton University. His research interests include agent-based modelling, dynamical systems, aggregation phenomena, and complex systems in general.

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