M.Sc. Bioinformatics 2003-2004
SAMPLE THESES TOPICS / FIELDS

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TOPIC 1 : Study of intra-population communication

A population of individuals with common needs, capabilities, enemies etc. develops "communication" mechanisms with the aid of specialized "signals" (such as songs, whistles, crows, shrieks, threat displays etc.). Signals are directly transmitted in a long distance and allow the fast recognition of other individuals/objects/situations etc. by individuals of the same species or family that do not have immediate perceptual data at their disposition. The objective of this study is threefold : (1) study at the population level (how many and which signals are necessary, the effect of the population density and other parameters), (2) study at the developmental level (how the final signal(s) used for communication emerge from individual transmissions, which signals become dominant and why), (3) "stability analysis" of the population (what happens if one or more individuals try to deceive or cheat their conspecifics, ways of isolation, recognition of faulty signals). The study will involve simulation using individual-based modeling at an ecological population level, cellular systems not being excluded however. Heavy programming demands.

TOPIC 2 : Study of conditions of symbiosis

An ecosystem comprises more than one species that coexist in (relative) peace within a natural habitat. Parasitic species are those that "exploit" some other species (hosts) in order to survive. In certain cases mutual dependencies develop and are established that maintain the system in equilibrium. This phenomenon is called symbiosis. Instead of studying particular aspects of parasitism and symbiosis, the objective of this study is to identify the parameters that allow (and sometimes even make unavoidable) the emergence of the phenomenon, using food chains as a basis. Questions that arise in this context are for example : in which ways can a chain break and develop, in the ends or in the middle, what preconditions should hold then, do critical masses emerge and which ones, what happens in case of highly changing external environments, which populations survive better from perturbations such as local over-population or infectious epidemics, if and how could one control and drive such a system externally. The study may focus on the behavioral level foreach species or on the population level for the multi-species habitat macroscopically and in a long term perspective or use an appropriate combination of the two approaches. The study will involve simulation using individual-based modeling of populations. Heavy programming demands.