Local Interactions, Learning and Automata Networks in Games.

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This dissertation is an attempt to expand the domain of game theory into the sphere of evolving, potentially non-equilibrium systems. We especially focus our attention on studying the eœects of local interactions, learning, and adaptation, using automata networks as a modelling tool.

Chapter 1 (ıAdaptive Strategiesȷ) provides a general introduction into the topic and a general literature review. It further investigates meaning of adaptation and adaptive strategies in a game-theoretic framework. It is shown on example of best response and imitation that in many cases, a less rational, but more adaptive strategy may provide a payoœ on the level of the population as well as on an individual level, superior to the payoœ of a more rational strategy.

In the Chapter 2 (ıCooperation and Local Interactions in the Prisoners' Dilemma Gameȷ) we consider a population of players playing a Prisoners' Dilemma Game in a local interaction setting, using a formalism of automata networks. SuŒcient conditions for existence of an equilibrium where cooperation coexists with non-cooperation (a mixed equilibrium) are derived and properties of an equilibrium are discussed. In a mixed equilibrium the highest payoœ will be obtained by a cooperator. For a special one-dimensional case the equilibrium set is fully characterized. We further consider a model where agents can choose (to some extent) whom of their neighbors they want to play with. Results of computer simulations are reported. The most striking feature of simulations is the fact that very organized structures can be observed starting with completely random initial conditions.

Chapter 3 (ıBest Response Dynamics and Neural Networksȷ) considers a population of players in a setting that allows to analyze local as well as global interaction. Using the formalism of automata networks we show that best response is a special case of a biased majority (minority) imitation. For a population of best response players we ørst discuss the known properties of the deterministic dynamics as a preparation and reference for stochastic dynamics. The stochastic dynamics of the system will always have a stationary distribution. It turns out that in a special case of asynchronous updating and logistic noise this distribution is of Boltzmann type. We further show that with a Boltzmann distribution, the long-run equilibria are associated with a minimum of a cost function deøned in the paper. Comparison of our results with the existing literature suggests robustness of the previous long-run equilibrium results.

In the case of dicerentiation games, we demonstrate the sensitivity of long-run equilibrium to the choice of interaction structure.

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