ECS – Athens TPT-09

(*Emergence in Complex Systems*)

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Examples of possible answers

[Q1]. Imagine a mutation in a butterfly species that makes the insect taste disgusting for predatory birds. This mutation benefits the whole population, as birds tend to avoid feeding on these butterflies altogether. Will the mutation be selected, and why?

No, it won't be selected as it benefits non-mutants even more. In real butterfly species, disgusting taste is a side-effect of caterpillars eating toxic plants.

[Q2]. Is pack hunting (as illustrated by the African dogs example) an example of reciprocal cooperation? Explain.

Reciprocal cooperation is based on the Prisoner's dilemma. In the example about pack hunting, participating in the hunt is always beneficial, at least for small investments, regardless of what other individuals do.

[Q3]. Explain what the exploration/exploitation dilemma consists of for ants solving the TSP (travelling salesperson problem).

Exploitation (of previous known good solutions) consists of following pheromone laid down on the graph. Exploration comes from randomness and from the temptation to reach nearby cities.

[Q4]. How do the ant foraging experiments illustrate: (1) self-organization; (2) emergence; and the presence of feedback?

Self-organization can be seen by the fact that a collective is able to meet the goal (collect food) efficiently (e.g. close food sources exploited sooner and more efficiently). Emergence is seen in the apparition of tracks, which represent a simple pattern as compared to random foraging. Positive feedback comes from the pheromone (more pheromone leads to more ants and thus to more pheromone). Negative feedback come from pheromone evaporation, food exhaustion, crowding.

[Q5]. Where does individuals' expected payoff come from in social signaling models?

From attracting friends.

[Q6]. How does an *Evolutionarily Stable Strategy* (ESS) differ from a *Nash equilibrium*?

An equilibrium is Nash if no unilateral departure is detrimental. It is an ESS if a population playing the strategy cannot be invaded by a small proportion of mutants.