Mechanisms of knowledge diffusion in online social dynamics

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Similarly to physical and biological systems, diffusive processes are essential for the functioning of social systems, in particular, leading to collective behavior, which can be studied from extensive online empirical data. Some examples are the knowledge and innovation diffusion, spreading of news, opinions and diseases or outbreaks of emotion in online social networks. In contrast to physical systems, for example, studies of the domain wall dynamics in random media [1], social dynamics actors live on a graph whose structure evolves with the activity of actors. Moreover, human actors possess specific attributes that affect the diffusion process itself; they can be accounted for by different types of models that go beyond interactions that are standardly considered in physics. Specifically, the adequate approach [2,3] combines methods of statistical physics with agent-based models that are close to the empirical data (from which the action rules and statistical features for agents can be inferred) and graph theory analysis of the underlying social structure. First, we present this concept and define quantities that can be obtained from the online data and simulated by agent-based models.

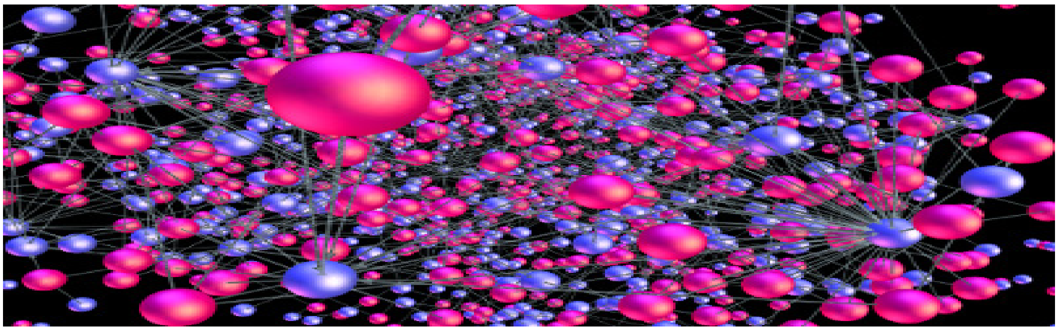

Figure 1: Segment of the bipartite network of users (blue) and questions (red nodes) from the studied Q&A data

We then discuss in more details the social processes of knowledge creation via online Questions & Answers, where the individual knowledge of actors (users, agents) is transferred to artifacts (questions or answers) and triggers more actions. We show how collective knowledge emerges through the mechanisms of self-organized criticality and co-evolution of the bipartite network, Fig. 1, both in the empirical data from StackExchange/Mathematics and the appropriate agent-based model [4,5,6]. The activity time series are sampled for varied expertise of agents; their fractal features, avalanching and temporal correlations are determined and compared with those obtained from these empirical data.

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