[P16] The origin of the criticality in meme popularity distribution on complex networks

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We study the origin of the criticality in meme popularity distribution of competition induced criticality model. From the direct Mote Carlo simulations of the models, we find that the meme popularity distribution, $P(n)$ satisfies a power-law, $P(n) \sim \alpha^n$ with $\alpha \sim 3/2$ if there is an innovation process. This power-law behavior of $P(n)$ is quite robust. On the other hand, if there is no innovation, then we find that $P(n)$ is bounded and highly skewed for early transient time periods, while $P(n) \sim \alpha^n$ with $\alpha \neq 3/2$ for intermediate time periods. For the systematic approach of the meme evolution, we exactly map the models into the position dependent biased random walk. Through this exact mapping, we find that the balance between the creation of new memes by the innovation process and the extinction of old memes is the key factor for the criticality with $\alpha = 3/2$. We show that the balance for the criticality sustains for relatively small innovation rate. Therefore, the innovation processes with significantly influential memes should be the simple and fundamental processes which cause the critical distribution of the meme popularity in real social networks.