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Criticality in finite dynamical networks THIMO ROHLF, Santa Fe Institute, NATALI GULBAHCE, CHRISTOF TEUSCHER, Los Alamos National Laboratory — It has been shown analytically and experimentally that both random boolean and random threshold networks show a transition from ordered to chaotic dynamics at a critical average connectivity K_c in the thermodynamical limit [1]. By looking at the statistical distributions of damage spreading (damage sizes), we go beyond this extensively studied mean-field approximation. We study the scaling properties of damage size distributions as a function of system size N and initial perturbation size $d(t = 0)$. We present numerical evidence that another characteristic point, K_d exists for finite system sizes, where the expectation value of damage spreading in the network is independent of the system size N. Further, the probability to obtain critical networks is investigated for a given system size and average connectivity k. Our results suggest that, for finite size dynamical networks, phase space structure is very complex and may not exhibit a sharp order-disorder transition. Finally, we discuss the implications of our findings for evolutionary processes and learning applied to networks which solve specific computational tasks. [1] Derrida, B. and Pomeau, Y. (1986), Europhys. Lett., 1, 45-49

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