Sparse associative memories

L

number of neurons per cluster l

number of clusters c

number of erased clusters c_e

number of messages : m

number of activities per cluster : a

density : d

edge : (i, j)

probability for i and j to be active in their respective clusters for one message : $\frac{a}{l}$

probability of the edge not being added in the network for one message : $1 - \left(\frac{a}{l}\right)^2$

$$d = 1 - \left(1 - \left(\frac{a}{l}\right)^2\right)^m$$

gap with density in simulations : under 1 percent

probability for a vertex v to achieve the maximum score, that is to mean $a(c - c_e)$: $d^{a(c-c_e)}$

probability for a vertex v not to achieve the maximum : $1 - d^{a(c-c_e)}$

probability for none of the vertices of one erased cluster, excepting the correct ones, to achieve the maximum : $\left(1 - d^{a(c-c_e)}\right)^{l-a}$

probabilities for none of the vertices in any erased cluster, excepting the correct ones, to achieve the maximum in their respective cluster : $\left(1 - d^{a(c-c_e)}\right)^{c_e(l-a)}$

Whence error rate is :

$$P_{err} = 1 - \left(1 - d^{a(c-c_e)}\right)^{c_e(l-a)}$$

The simulations agree with the analytical result.

For one iteration (for erasures, not for errors), winner takes all is the same as a-winners take all.

For multiple iterations a-winner take all is an improvement.

"a-Winners take all" better than "winner takes all" with errors instead of erasures.