

# 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 :  $1 - \left(\frac{a}{l}\right)^2$

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

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

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

The analytical result agree with the simulations.  
 For one iteration, winner takes all is the same as winners take all.  
 Winners take all better with errors instead of erasures.