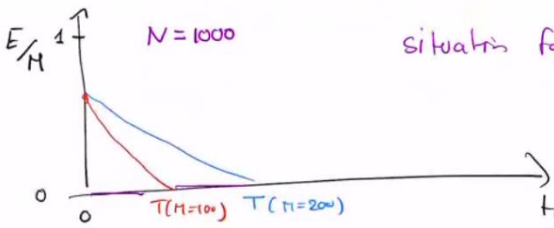
27- Phase transition in optimization problems: the RWSAT algorithm and its behaviour.

RWSAT (random walk SAT) can be used to find solution to any SAT problem, in particular XORSAT problems.

Pseudocode:

- ➔ N variables, M equations, k variables per equation
- ➔ Initialize all N variables at random
- ➔ Compute E # of UNSAT equations
- ➔ t=0 # number of iterations
- ➔ while E>0 and t< tmax:
    - choose at random one of the non-sat equations
    - choose at random one of its k variables
    - set this variable to its complement # 1 -> 0, 0 -> 1
    - compute E #might have worse energy than before the change
    - t = t + 1
- ➔ print E, t # t is time to solution

How does this RWSAT algo behaves?



time to solve the problem.

situation for α small
$\alpha < 1/3$

$\alpha < 1/3$ $\left\{ \langle T_{res} \rangle = N\, t_{res}(\alpha) \right.$
average time to solve the problem

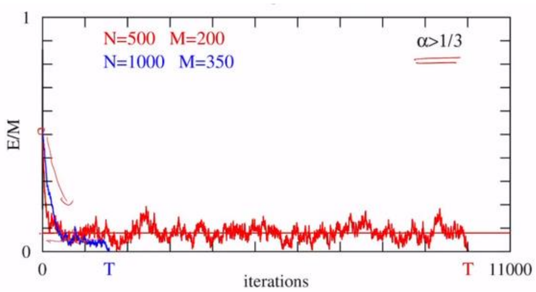
Resolution time is linear with N, with a coefficient that increases with M

We see that a solution is found ($E=0$) in a time which increases with M (or $\alpha = \frac{M}{N}$)

HOWEVER, when α = M/N increases, the average execution time becomes exponential

$\alpha > 1/3$ and of course $\alpha < \alpha_c = 0.9179$

$$\left\{ \begin{array}{l} \langle T_{res} \rangle = \exp(N \tau_{res}) \\ \tau_{res} = \tau_{res}(\text{alpha}) \end{array} \right.$$



as we get to 0, we start oscillating