BASE ALGORITHM:

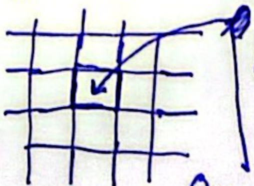
I. INITIALISE THE STARTING STATE ($t=0$)

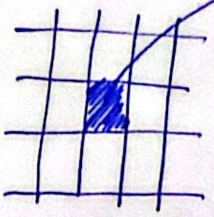
↳ $\frac{\alpha}{N}$ portion of the traders are active => placed randomly on the grid.

↳ Set parameters p_e, p_d, p_h, A, a, h

II. APPLY PERCOLATION RULES

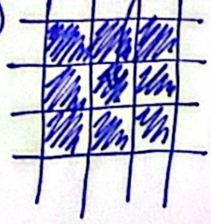
- 3 options:

1. 

$\boxed{\text{with } \boxed{p_e}}$ =>  ± 1 (GOES ACTIVE)

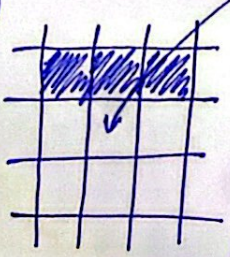
0 surrounded by 0s

2. ± 1 surrounded by ± 1s

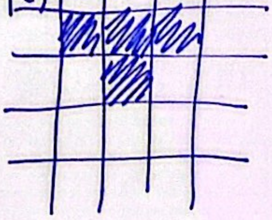


$\boxed{\text{with } p=1}$ => STAYS ± 1 (ACTIVE)

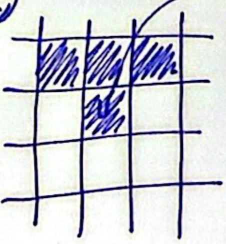
3. 0 surrounded by 0s and ± 1s



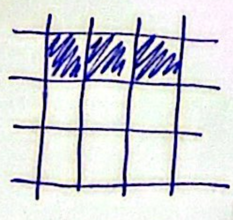
Let $N_{\pm 1}$ denote the number of ± 1s in the V.N. neighborhood system

$\boxed{1-(1-p_h)^{N_{\pm 1}}}(1-p_e)$ =>  GOES ACTIVE

4. ± 1 surrounded by 0s and ± 1s



Let N_0 denote the number of 0s in the V.N. neighborhood system

$\boxed{1-(1-p_d)^{N_0}}$ =>  GOES INACTIVE

III. APPLY STOCHASTIC RULES

EVERY ACTIVE TRADER __AFTER__ THE PERCOLATION PROCESS WILL GET A NEW VALUE FROM THE SET $\{\pm 1\}$.

$$p_i^k(t) = \frac{1}{1 + e^{-2 I_i^k(t)}} \qquad I_i^k(t) = \frac{1}{N^k(t)} \sum_{j=1}^{N^k(t)} A_{ij}^k(t) G_j^k(t) + h_i^k$$

← we assume that every trader is connected in a cluster ⇒ full graph.

$$A_{ij}^k(t) = A\, \xi^k(t) + a\, \eta_{ij}(t)$$

Cluster specific   trader pair specific

$$h_i^k(t) = h\, \varphi_i^k(t)$$ ← trader specific

$$\xi^k,\ \eta_{ij},\ \varphi_i \sim U(-1, 1)$$

IV. CALCULATE THE NEW PRICE

$$x(t) = \sum_{k=1}^{N_{cl}(t)} \sum_{i=1}^{N^k(t)} N^k(t) G_i^k(t)$$

↳ overweight big clusters

$$\boxed{P(t+1) = P(t) \cdot e^{x(t+1)}}$$

V. REPEAT FROM II. ~~the~~ UNTIL THE MODEL IS IN STABLE STATE

$$e^{r(t)} = \frac{P(t+1)}{P(t)}$$

$$r(t) = \ln P(t+1) - \ln P(t)$$

$$\frac{dP}{dt} = \beta x P$$

$$\Downarrow$$

if $dt \Rightarrow \Delta t = 1$

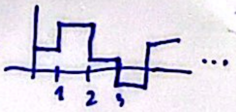
$$\frac{1}{P} dP = \beta x(t) dt$$

$$\ln P = \beta \int x(t)\, dt$$

$$P = e^{\beta \int x(t) dt}$$

$\hookrightarrow \beta = 1$ (PAPER REFERENCE)

$$P = e^{\int x(t) dt}$$

$x \Rightarrow$ 

$$\hookrightarrow P(t) = e^{\int_0^t x(\tau) d\tau}$$

$$P(t) = e^{\sum_{i=0}^{t} x(i)}$$

$$e^{r(t)} = \frac{P(t+1)}{P(t)} = \frac{e^{\sum_{i=0}^{t+1} x(i)}}{e^{\sum_{i=0}^{t} x(i)}} = e^{\sum_{i=0}^{t+1} x(i) - \sum_{i=0}^{t} x(i)} = e^{x(t+1)}$$

$$e^{r(t)} = e^{x(t+1)}$$

$$\boxed{r(t) = x(t+1)}$$