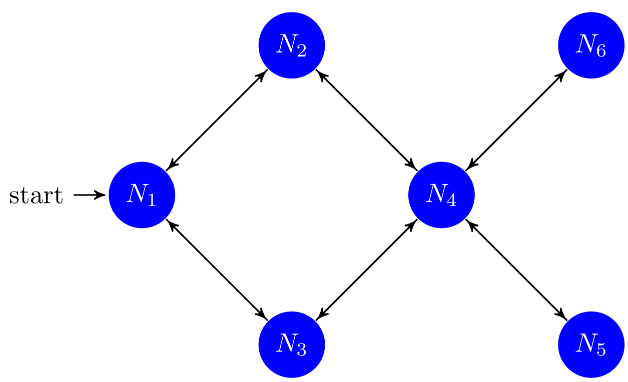
1 Write down the settings of the game

source: http://en.wikipedia.org/wiki/Adjacency_matrix

We model the network through an undirected Graph $G =< V, E >$ where $|V|$ denotes the number of resources in the network and $|E|$ the number of connections. We can convert this to a adjacent matrix where we can represent which vertices of the graph are neighbours of other vertices.

For our graph we have an $|V| \times |V|$ matrix with on every entry a_{ij} a 1 as value if there is a connection between node V_i and V_j and with zeros its diagonal. Because our graph is undirected we have a symmetric matrix.

"If A is the adjacency matrix of the directed or undirected graph G, then the matrix A^n (i.e., the matrix product of n copies of A) has an interesting interpretation: the entry in row i and column j gives the number of (directed or undirected) walks of length n from vertex i to vertex j. If n is the smallest non-negative integer, such that for all i ,j , the (i,j)-entry of $A^n > 0$, then n is the distance between vertex i and vertex j." [Wikipedia]



The adjacent matrix becomes this matrix $[A]$:

$$\begin{array}{c} \\ N_1 \\ N_2 \\ N_3 \\ N_4 \\ N_5 \\ N_6 \end{array}
\begin{array}{c}
\begin{array}{cccccc} N_1 & N_2 & N_3 & N_4 & N_5 & N_6 \end{array} \\
\begin{pmatrix}
0 & 1 & 1 & 0 & 0 & 0 \\
1 & 0 & 0 & 1 & 0 & 0 \\
1 & 0 & 0 & 1 & 0 & 0 \\
0 & 1 & 1 & 0 & 1 & 1 \\
0 & 0 & 0 & 1 & 0 & 0 \\
0 & 0 & 0 & 1 & 0 & 0
\end{pmatrix}
\end{array}$$

Matrix $A \times A = A^2$ becomes the matrix with the number of paths with 2 steps from N_i to N_j: We denote this matrix as matrix *[B]*

$$\begin{array}{c c}
 & \begin{array}{cccccc} N_1 & N_2 & N_3 & N_4 & N_5 & N_6 \end{array} \\
\begin{array}{c} N_1 \\ N_2 \\ N_3 \\ N_4 \\ N_5 \\ N_6 \end{array} & \begin{pmatrix} 2 & 0 & 0 & 2 & 0 & 0 \\ 0 & 2 & 2 & 0 & 1 & 1 \\ 0 & 2 & 2 & 0 & 1 & 1 \\ 2 & 0 & 0 & 4 & 0 & 0 \\ 0 & 1 & 1 & 0 & 1 & 1 \\ 0 & 1 & 1 & 0 & 1 & 1 \end{pmatrix}
\end{array}$$

Matrix $A^2 \times A = A^3$ becomes the matrix with the number of paths with 3 steps from N_i to N_j: We denote this matrix as matrix *[C]*

$$\begin{array}{c c}
 & \begin{array}{cccccc} N_1 & N_2 & N_3 & N_4 & N_5 & N_6 \end{array} \\
\begin{array}{c} N_1 \\ N_2 \\ N_3 \\ N_4 \\ N_5 \\ N_6 \end{array} & \begin{pmatrix} 0 & 4 & 4 & 0 & 2 & 2 \\ 4 & 0 & 0 & 6 & 0 & 0 \\ 4 & 0 & 0 & 6 & 0 & 0 \\ 0 & 6 & 6 & 0 & 4 & 4 \\ 2 & 0 & 0 & 4 & 0 & 0 \\ 2 & 0 & 0 & 4 & 0 & 0 \end{pmatrix}
\end{array}$$

So for A^N every a_{ij} entry gives the number of paths with N steps from N_i to N_j.

With this knowledge we can calculate in how many steps a node is infected. A calculates which nodes are infected after 1 step, A^N calculates which nodes are infected in N steps.. So if we want to know how many nodes are infected after 3 steps we have to add every matrix $(A + A^2 + A^3)$ and see which entry is a non zero entry.

What do we need for an algorithm

Graph network $G =< V, E >$

Graph matrix $[A]$ which is $|V| \times |V|$

Attack vector $[X]$ which is $1 \times |V|$

cummulative matrix $[M]$ which is $|V| \times |V|$

state matrix $[T]$ which is $|V| \times |V|$

Reset vector $[R]$

duration d

time n

rate δ_0 of defender and δ_1 of attacker

Initialisation algorithm:

```
initialisatie
d=0
```

```
A=basismatrix
M=A^{0}
n=0
\delta_{0}
\delta_{1}
X
R
controller = defender



Algorithm
n:= n + 1;
Check who is in control? ( through modulo )
if ( defender & controller=defender)
d:= d + 1;

if ( defender & controller=attacker )
G = X \times R  (flippen ten voordele van defender)
d = 0
controller = defender

if ( attacker & controller=defender )
controller=attacker
..

if ( attacker & contoller=attacker )
d:= d + 1
M = M x A
T = T + M
G = X x T
```