ĆW (Sieci Hopfielda)

Algorytm sieci Hopfielda

$t = 0$, $i = 1, \ldots, n$

$$x_i(0) = \begin{cases} 0 & \text{z prawdopodowieństwem } \frac{1}{2} \quad (\text{rand}()\%2 = 0) \\ 1 & \text{z prawdopodowieństwem } \frac{1}{2} \quad (\text{rand}()\%2 = 1) \end{cases}$$

$t = 0, 1, 2, \ldots, \quad i = 1, \ldots, n$

$$u_i(t) = \left\{ \sum_{j=1}^{25} w_{ij} x_j(t) \right\} - \theta_i$$

$$x_i(t+1) = \begin{cases} 0 & \text{gdy } u_i(t) < 0 \\ x_i(t) & \text{gdy } u_i(t) = 0 \\ 1 & \text{gdy } u_i(t) > 0 \end{cases}$$

Zadanie. Implementować algorytm sieci Hopfielda i wyświetlić $x(t) = (x_1(t), \ldots, x_n(t))$ $(t = 0, 1, 2, \ldots)$.

$$x(0) \longrightarrow x(1) \longrightarrow x(2) \longrightarrow \cdots$$

$$\begin{array}{|c|c|c|c|c|}\hline \; & \; & \; & \; & \; \\ \hline & & & & \\ \hline & & & & \\ \hline & & & & \\ \hline & & & & \\ \hline \end{array} \longrightarrow \begin{array}{|c|c|c|c|c|}\hline \; & \; & \; & \; & \; \\ \hline & & & & \\ \hline & & & & \\ \hline & & & & \\ \hline & & & & \\ \hline \end{array} \longrightarrow \begin{array}{|c|c|c|c|c|}\hline \; & \; & \; & \; & \; \\ \hline & & & & \\ \hline & & & & \\ \hline & & & & \\ \hline & & & & \\ \hline \end{array} \longrightarrow \cdots$$

(1) Uruchomić sieć Hopfielda dla poniżej podanych parametrów w_{ij}.
$\square = 0.0$, $\blacksquare = 1.0$

$$z = (z_i)_{i=1}^{25} = (z_1, \ldots, z_{25}) = \begin{array}{|c|c|c|c|c|}\hline \; & \; & \; & \; & \; \\ \hline & \blacksquare & \blacksquare & & \\ \hline & & \blacksquare & & \\ \hline & & \blacksquare & & \\ \hline & & \blacksquare & & \\ \hline \end{array} \in \mathbb{R}^{25}$$

$1 \leq i, j \leq 25$

$$c_{ij} = \begin{cases} (z_i - \frac{1}{2})(z_j - \frac{1}{2}) & \text{gdy } i \neq j \\ 0 & \text{gdy } i = j \end{cases}$$

$$w_{ij} = 2c_{ij}, \qquad \theta_i = \sum_{j=1}^{25} c_{ij}$$

(2) Uruchomić sieć Hopfielda dla poniżej podanych parametrów w_{ij}.
$\square = 0.0$, $\blacksquare = 1.0$

$$z = (z_i)_{i=1}^{25} = (z_1, \ldots, z_{25}) = \begin{array}{|c|c|c|c|c|}\hline \; & \; & \; & \; & \; \\ \hline & \blacksquare & \blacksquare & & \\ \hline & & \blacksquare & & \\ \hline & & \blacksquare & & \\ \hline & & \blacksquare & & \\ \hline \end{array} \in \mathbb{R}^{25}$$

$1 \le i, j \le 25$

$$c_{ij} = \begin{cases} (z_i - \frac{1}{2})(z_j - \frac{1}{2}) & \text{gdy } i \neq j \\ 0 & \text{gdy } i = j \end{cases}$$

$$z' = (z'_i)_{i=1}^{25} = (z'_1, \ldots, z'_{25}) = \left| \begin{array}{|c|c|c|c|c|} \hline & \blacksquare & \blacksquare & \blacksquare & \\ \hline & \blacksquare & & \blacksquare & \\ \hline & \blacksquare & & \blacksquare & \\ \hline & \blacksquare & & \blacksquare & \\ \hline & \blacksquare & \blacksquare & \blacksquare & \\ \hline \end{array} \right| \in \mathbb{R}^{25}$$

$1 \le i, j \le 25$

$$d_{ij} = \begin{cases} (z'_i - \frac{1}{2})(z'_j - \frac{1}{2}) & \text{gdy } i \neq j \\ 0 & \text{gdy } i = j \end{cases}$$

$$w_{ij} = 2(c_{ij} + d_{ij}), \qquad \theta_i = \sum_{j=1}^{25} (c_{ij} + d_{ij})$$

Notacja. (Propozycja)
$x_i(t) \rightsquigarrow x[i],\ u_i(t) \rightsquigarrow u[i]$ (Nie prowadzić kroków t!)
$z_i \rightsquigarrow z[i],\ z'_i \rightsquigarrow z'[i]$
$c_{ij} \rightsquigarrow c[i][j],\ d_{ij} \rightsquigarrow d[i][j]$
$w_{ij} \rightsquigarrow w[i][j],\ \theta_i \rightsquigarrow theta[i]$