1. Write the correct form of the activation for a bidirectional associative memory (BAM) with threshold vectors $\vec{\theta}_r$ and $\vec{\theta}_l$.

One possible answer:

The update of $\vec{y}$ is given by $\vec{y}_i^{\,T} = sgn\left(\vec{x}_i W - \vec{\theta}_r^T\right)$, or, $y_{ij} = sgn\left(\sum_{m=1}^{n} x_{im} w_{mj} - \theta_{rj}\right)$

and the update of $\vec{x}$ is given by $\vec{x}_i + 1 = sgn\left(W\, \vec{y}_i - \vec{\theta}_l\right)$, or

$x_{i+1\,j} = sgn\left(\sum_{m=1}^{k} y_{im} w_{mj} - \theta_{lj}\right)$.

2. Select an arbitary, nontrivial, ٢×2 weight matrix *W* and find a stable solution to the BAM described by *W*, namely, find vectors $(\vec{x}, \vec{y})$ that minimize the energy function $E(\vec{x}, \vec{y}) = -\frac{1}{2} \vec{x}\, W\, \vec{y}^T$.

One possible answer:

Selecting $W = \begin{bmatrix} ١ & 2 \\ -3 & 4 \end{bmatrix}$ and $\vec{x} = (-1\;1)$ yields $\vec{y}_1^{\,T} = \vec{x}_1 W = sgn\begin{pmatrix} -4 \\ 2 \end{pmatrix} = \begin{pmatrix} -1 \\ 1 \end{pmatrix}$. And in turn, we get $\vec{x}_٢ = W\, \vec{y}_1^{\,T} = sgn(1\,7) = (1\,1)$. Finally, we get $\vec{y}_2^T = \vec{x}_2 W = sgn\begin{pmatrix} -2 \\ 6 \end{pmatrix} = \begin{pmatrix} -1 \\ 1 \end{pmatrix}$ and we see that the vector pair $(\vec{x}, \vec{y}) = ((1\,1), (-1\,1))$ is stable.