4.3 NN

**Exercise 1**
Describe the topology for a multilayer network solving the problem of parity check with three coordinate vectors (3-3-1 Network).
Output $z=1$ (odd number of +1 in x)
Output $z=-1$ (odd number of +1)
Give the number of weights and propose some laws based on the hard limiting function: $\text{sign}(x)$ to build the complete function.

**Exercise 2**
Show that the $\Delta w[n]$ weight adaptation increment in the Levenberg-Marquadt algorithm is equivalent to $\Delta w[n]$ that minimises the error function:

$$J[n+1] = J[n] + \nabla J_w \Delta w[n] + \frac{1}{2} \Delta w[n]^T H \Delta w[n] + \lambda \left( \| \Delta w[n] \| - K \right)$$
where $\lambda$ is a positive Lagrange Multiplier and $K$ is a constant to control the trust-region where the approximation for $J[n+1]$ is valid.

**Exercise 3 (Optativo)**
En el diseño de redes neuronales basadas en funciones base radiales, demuestre que al minimizar la función de error $\frac{1}{2} Trace\left((\Phi^T(x)W^T - T^T)(W\Phi(x) - T)\right)$ respecto a la matriz $W \in \mathbb{R}^{Ca}$, la solución obtenida es:

$$W^r = (\Phi(x)\Phi^r(x))^{-1}\Phi(x)T^r$$

Nota: Recuerde que

$$\nabla_R \left( Trace(ARB) \right) = A^T B^T$$

with $A \in \mathbb{R}^{abc}, R \in \mathbb{R}^{hac}, B \in \mathbb{R}^{cx}$,

$$\nabla_R \left( Trace(AR^T RB) \right) = 2A^T B^T R^T$$

with $A \in \mathbb{R}^{abc}, R \in \mathbb{R}^{cab}, B \in \mathbb{R}^{hca}$.