# UNIVERSITA' DEGLI STUDI DI GENOVA- Dip. DICAT

*Planning and restoring of small hydropower stations for small basins : actual conditions and potential developments.*

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# Multilayer Perceptron scheme

- $Y_i$ outputs;
- $\varsigma_i$ targets;
- $V_j$ nodes of hidden layers;
- $X_k$ nodes of input layer;
- $W_{j,k}$ weights of hidden layers;
- $W_{i,j}$ weights between hidden and output layer;
- g hidden layer activation function;
- $g_1$ output layer activation function;
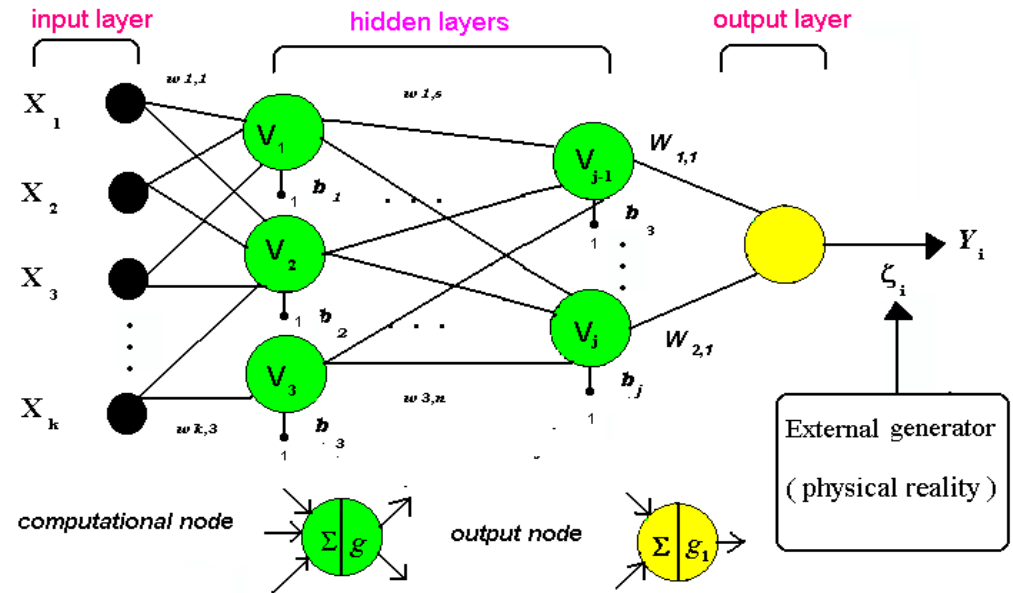


The *j-th* neuron receives

$$h_j^\mu = \sum_k w_{j,k} \cdot x_k^\mu$$

And produces output:

$$V_j^\mu = g\left(h_j^\mu\right) = g\left(\sum_k w_{j,k} \cdot x_k^\mu\right)$$

The output nodes receives

$$h_i^\mu = \sum_j W_{i,j} \cdot V_j^\mu = \sum_j W_{i,j} g\left(\sum_k w_{j,k} \cdot x_k^\mu\right)$$

And produces output

$$Y_i^\mu = g_1\left(h_i^\mu\right) = g_1\left(\sum_j W_{i,j} \cdot V_j^\mu\right) = g_1\left(\sum_j W_{i,j} \cdot g\left(\sum_k w_{j,k} \cdot x_k^\mu\right)\right)$$

Error cost function is:

$$E[w] = \frac{1}{2} \sum_{\mu i} \left[\varsigma_i^\mu - Y_i^\mu\right]^2$$

Weights updating:

$$\Delta w_{i,j}^{new} = -\eta \frac{\partial E}{\partial w_{i,j}} + \alpha \cdot \Delta w_{i,j}^{old}$$

ANN streamflow recosntruction

The ANN have demonstrated to give an acceptable value of discrepancy between the modelled and measured streamflow despite the very few measures available and a total modelling based only on rainfall data.