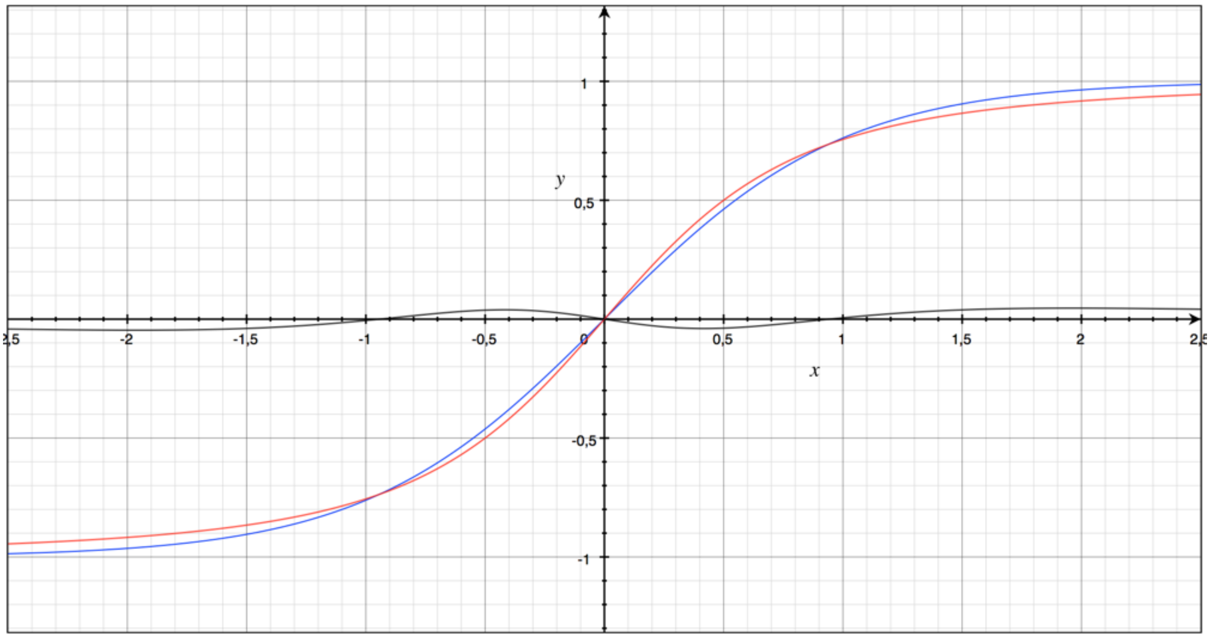
Assignment 19.

Besides the hyperbolic tangent function, sigmoid functions also include algebraic functions like $\frac{z}{\sqrt{1+z^2}}$.

Since the function is not exactly same as hyperbolic tangent function, by adjusting constant 1 we can get g(z) which shape is almost like the hyperbolic tanh(z) with maximal deviation below 0.05.

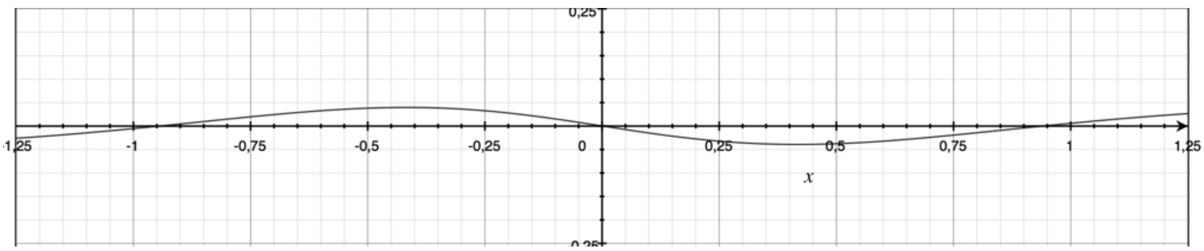
$$g(z) = \frac{z}{\sqrt{0.75 + z^2}}$$

- Graph



- blue curve : $tanh(z)$
- red curve : $g(z) = \frac{z}{\sqrt{0.75 + z^2}}$
- black curve : $tanh(z) - g(z)$

max deviation between tanh(z) and g(z) does not exceed 0.05.



Assignment 20

Given an array of patterns `P` with `n` elements and a function called `random` useful to calculate integer random number between a range it is possible to shuffle the original array using the next algorithm:

Randomize elements in an array

for $i = 0$ `such that` $i < n$ **do**
    $i \leftarrow i + 1$
    $swap \leftarrow random(0, n)$
    $temp \leftarrow P[swap]$
    $P[swap] \leftarrow P[i]$
    $P[i] \leftarrow temp$
end for

Assignment 21

Backpropagation of errors (BP). After the computation of the output values, we calculate the difference between our teacher value ${}^{p}\hat{y}_m$ and each output unit ${}^{p}y_m$. We obtain the sum of all these differences and apply to it an error function:

$${}^{p}E = \frac{1}{2}\sum_{m=1}^{M}({}^{p}\hat{y}_m - {}^{p}y_m)^2$$

Now, with a derivation of the error function (ommited here) is possible to get a new formula to calculate δ *values*. This calculation is different for the neurons located in the output layer:

$$\delta_m = (\hat{y}_m - y_m) \cdot f'(net_m)$$

and the neurons located in the hidden layers:

$$\delta_h = (\sum_{k=1}^{k} \delta_k w_{hk}) \cdot f'(net_h)$$

We must be warned that δ_k and w_{hk} are referring to values in the next layer. Now, using the δ *value*, the output $\widetilde{out}_g$, and a learning rate η we can calculate the weight changes is using this formula:

$$\Delta w_{ij} = \eta \cdot \delta w_{ij} \cdot \widetilde{out}_g$$

We iterate in this process until we reach the input layer. Finally, we update the current weights w_{ij} adding to them the changed weights Δw_{ij}:

$$w_{ij} = w_{ij} + \Delta w_{ij}$$