Text file to create
We need to set red words
The blue part can be omitted

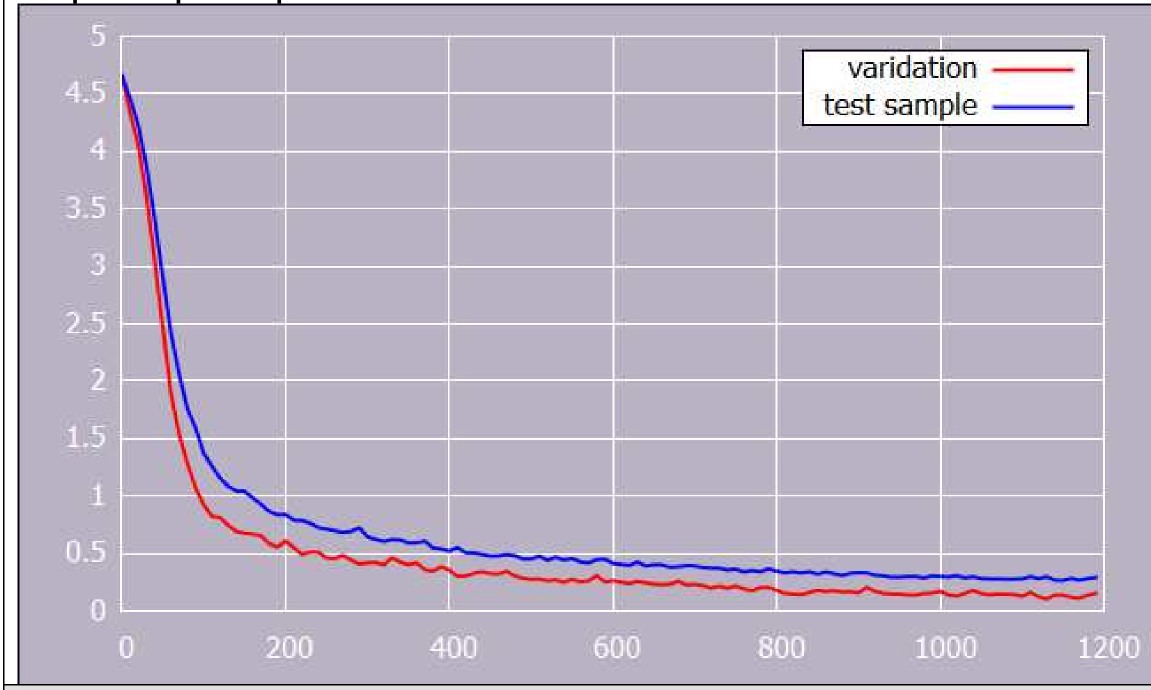
■ Neural network setting「NET.txt」

CrossEntropy BATCH_SIZE **50** EPOCH **10** LAMBDA **0.000000** EPS **0.001000** OPTIMIZER **Adam** VALIDATION_NUM **100** ERROR_PLOT_STEP **10** TEST_SAMPLE **10** ACCURACY_RATE_PLOT **1**	**Square** or **CrossEntropy** Mini batch size Epoch number Load decay (weight decay) Learning rate Optimizer Number of Validation data Graph data output interval(gnuplot format) Number of test data samples Accuracy plotting ※optimizer solver is listed on the final page

~~* Leave the setting of LAMBDA to 0 (there is a problem)~~

ERROR_PLOT_STEP
The loss value is output to ‘**error_loss.dat**’ at the interval specified at the time of learning. **gnuplot** can display graphs in real time.

Gnuplot script example




```
set border lc rgb "white"
set grid lc rgb "white" lt 2
set key opaque box
set object 1 rect behind from screen 0,0 to screen 1,1 fc rgb "#B8B2C3" fillstyle solid

# smooth [unique, csplines, acsplines, bezier, sbezier]

plot 'error_loss.dat' using 1:2    t "varidation"    with lines linewidth 2 linecolor rgbcolor "red"
replot 'error_loss.dat' using 1:3      t "test sample" with lines linewidth 2 linecolor rgbcolor "blue"

#replot 'error_loss.dat' using 1:2 t "varidation"    with lines linewidth 1 linecolor rgbcolor "red"
#replot 'error_loss.dat' using 1:3 t "test sample" with lines linewidth 1 linecolor rgbcolor "blue"

pause 10
reread
```

ACCURACY_RATE_PLOT

Accuracy is output to '**accuracy_rate.dat**' at the interval specified at the time of learning. **gnuplot** can display graphs in real time.

Gnuplot script example


```
set border lc rgb "white"
set grid lc rgb "white" lt 2
set key opaque box
set object 1 rect behind from screen 0,0 to screen 1,1 fc rgb "#B8B2C3" fillstyle solid
set key right bottom

# smooth [unique, csplines, acsplines, bezier, sbezier]

plot 'accuracy_rate.dat' using 1:2  t "varidation accuracy"  with lines linewidth 2 linecolor rgbcolor "red"
replot 'accuracy_rate.dat' using 1:3  t "test sample accuracy" with lines linewidth 2 linecolor rgbcolor "blue"

pause 10
reread
```

■ Layer setting「LAYER.txt」

LAYER **4** **1** [**28**, **28**] *Each layer setting* See layer description END	Number of layers Input feature map from left, input unit width, input unit height ※ Width and height are numbers when input units are regarded as a matrix

■ Describing layers

Fully Connected layer

LAYER_TYPE_FullyConnected**/layerName** **1** [*7, 7*] -> [**1**, **10**] **Softmax**	From the left, input of feature map, output unit width, output unit height, start function ※ The width and height are the numbers when looking at the input device as a matrix ※ Activation function described on final page

Convolutional layer

LAYER_TYPE_Convolutional**/layerName** **20** [*28, 28*]->(**5**, **5**)->[*28, 28*] st **1 ReLU**	From the left, input feature map, convolution width, convolution height, stride, activation function

Convolutional layer

LAYER_TYPE_Convolutional**/layerName** **20** [*28, 28*]->(**5**, **5**)->[*28, 28*] st **1** pd **2 ReLU**	From the left, input feature map, convolution width, convolution height, stride, padding activation function

maxPooling layer

LAYER_TYPE_maxPooling**/layerName** **20** [*28, 28*]->(**4**, **4**)->[*7, 7*] st **4 Identity**	From the left, input feature map, convolution width, convolution height, stride, activation function

maxPooling layer

LAYER_TYPE_maxPooling**/layerName** **20** [*28, 28*]->(**4**, **4**)->[*7, 7*] st **4** pd **0 Identity**	From the left, input feature map, convolution width, convolution height, stride, padding, activation function

AveragePooling layer

LAYER_TYPE_AveragePooling **/layerName** **20** [*28, 28*]->(**4**, **4**)->[*7, 7*] st **4 Identity**	From the left, input feature map, convolution width, convolution height, stride, activation function

maxPooling layer

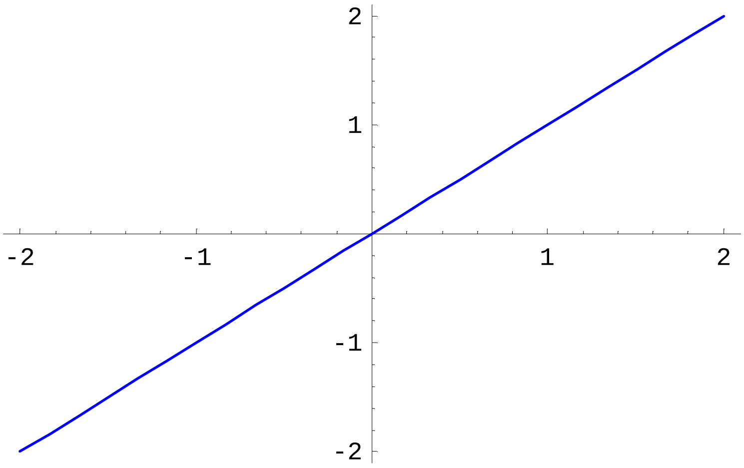
LAYER_TYPE_AveragePooling **/layerName** **20** [*28, 28*]->(**4**, **4**)->[*7, 7*] st **4** pd **0 Identity**	From the left, input feature map, convolution width, convolution height, stride, padding, activation function

Dropout layer

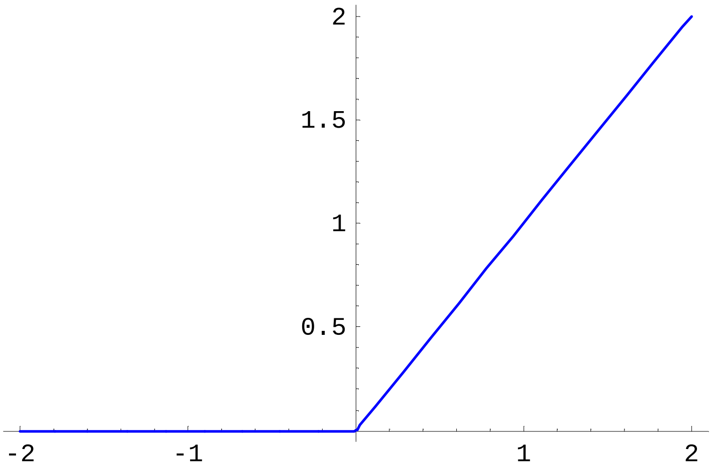
LAYER_TYPE_Dropout**/layerName** **0.5 Identity**	From the left,0.5 is the dropout rate, activation function

■ **Activation function can use**

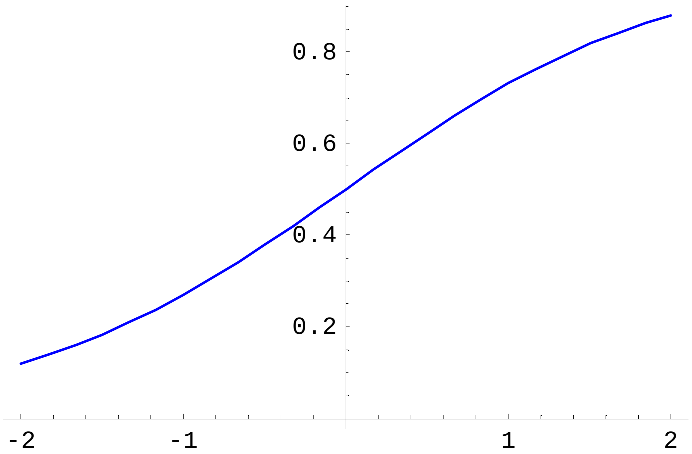
Identity $h(x) = x$



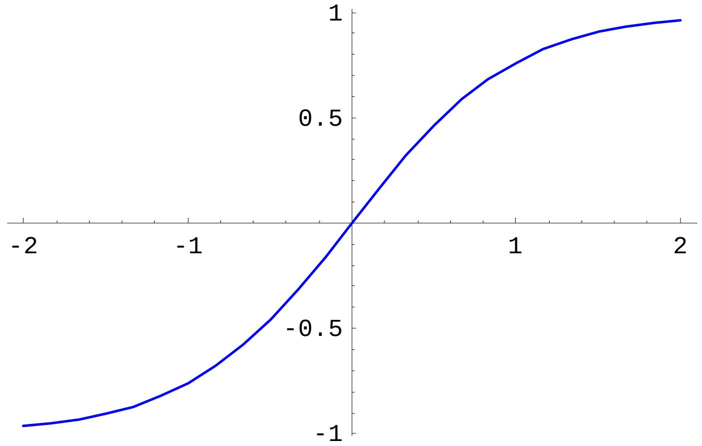
ReLU $h(x) = \max(0, x)$



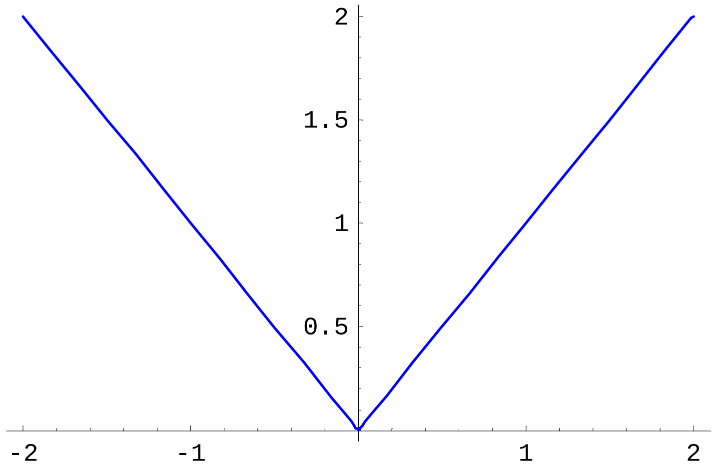
Sigmoid $$h(x) = \frac{1}{1+e^{-x}} = \frac{\tanh(x/2)+1}{2}$$



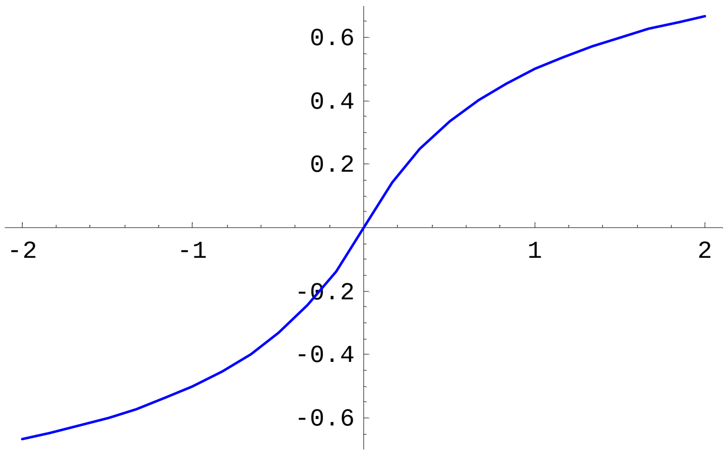
Tanh $h(x)=\tanh(x)$



Abs $h(x)=|x|$

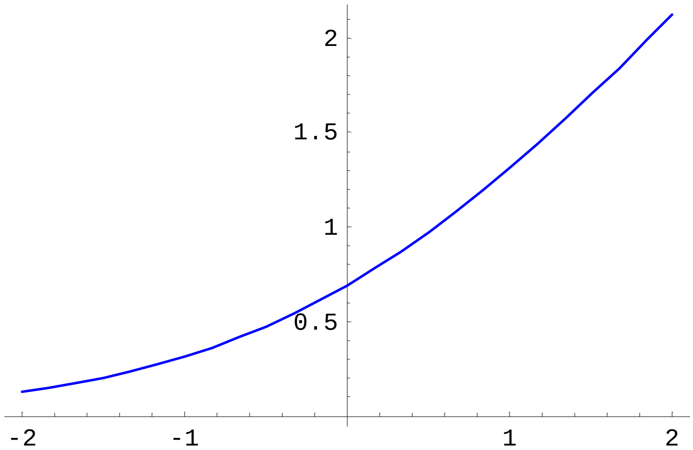


Softsign $h(x)=\dfrac{x}{1+|x|}$



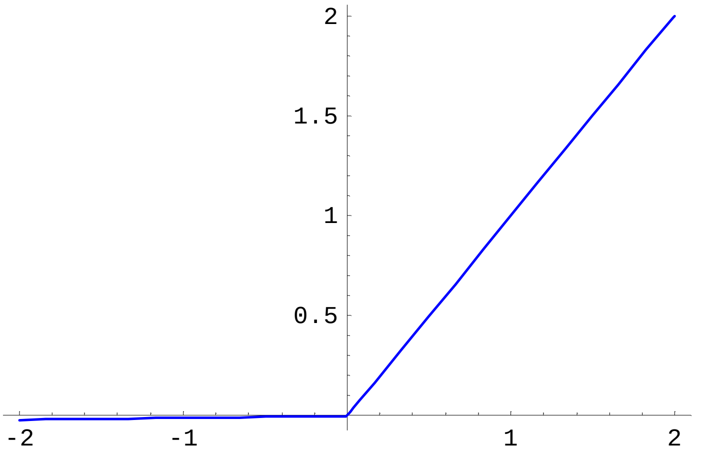
Softplus

$$h(x) = \log(1+e^{x})$$



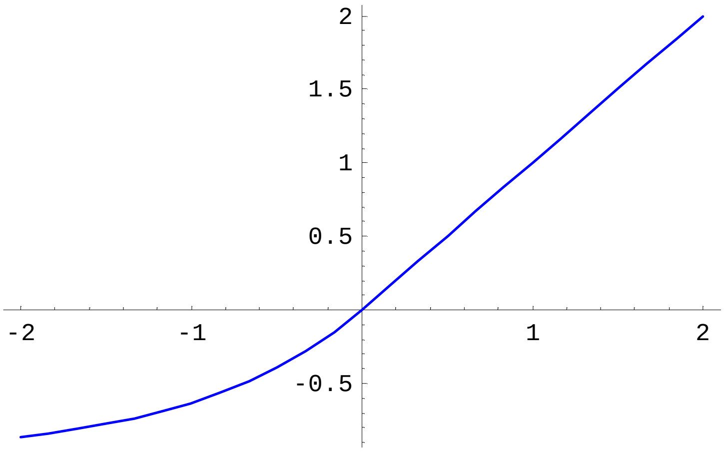
LReLU

$$h(x) = \max(0.01x, x)$$



ELU

$$h(x) = \begin{cases} e^{x} - 1 & x < 0 \\ x & x \geq 0 \end{cases}$$



Softmax

$$h(x) = \frac{\exp(x)}{\sum_{j=1}^{n} \exp(x_j)}$$

Output UNIT

Activation function	**Loss function**	**Differentiation of loss function**
Identity $h(x) = x$	**Square**	$\frac{\partial E}{\partial w} = y - t$
Softmax $h(x) = \frac{\exp(x)}{\sum_{j=1}^{n} \exp(x_j)}$	**CrossEntropy**	$\frac{\partial E}{\partial w} = y - t$

■**Optimizer solver**

Adam

$$m_{t+1} = \beta_1 m_t + (1-\beta_1)\nabla E(\mathbf{w}^t)$$
$$v_{t+1} = \beta_2 v_t + (1-\beta_2)\nabla E(\mathbf{w}^t)^2$$
$$\hat{m} = \frac{m_{t+1}}{1-\beta_1^t}$$
$$\hat{v} = \frac{v_{t+1}}{1-\beta_2^t}$$
$$\mathbf{w}^{t+1} = \mathbf{w}^t - \alpha\frac{\hat{m}}{\sqrt{\hat{v}}+\epsilon}$$

α=0.001,β 1 =0.9,β 2 =0.999,ϵ=10E−8

AdaGrad

$$h_0 = \epsilon$$
$$h_t = h_{t-1} + \nabla E(\mathbf{w}^t)^2$$
$$\eta_t = \frac{\eta_0}{\sqrt{h_t}}$$
$$\mathbf{w}^{t+1} = \mathbf{w}^t - \eta_t \nabla E(\mathbf{w}^t)$$

ϵ=10E−8 ,η 0 =0.001

RMSprop

$$h_t = \alpha h_{t-1} + (1-\alpha)\nabla E(\mathbf{w}^t)^2$$
$$\eta_t = \frac{\eta_0}{\sqrt{h_t}+\epsilon}$$
$$\mathbf{w}^{t+1} = \mathbf{w}^t - \eta_t \nabla E(\mathbf{w}^t)$$

α=0.99,ϵ=10E−8,η0=0.01

AdaDelta

$$h_t = \rho h_{t-1} + (1-\rho)\nabla E(\mathbf{w}^t)^2$$
$$v_t = \frac{\sqrt{s_t+\epsilon}}{\sqrt{h_t+\epsilon}}\nabla E(\mathbf{w}^t)$$
$$s_{t+1} = \rho s_t + (1-\rho)v_t^2$$
$$\mathbf{w}^{t+1} = \mathbf{w}^t - v_t$$

ρ=0.95,ϵ=10E−6

SGD

$$\mathbf{w}^{t+1} \leftarrow \mathbf{w}^t - \eta\frac{\partial E(\mathbf{w}^t)}{\partial \mathbf{w}^t}$$

η=0.01