1918-108-C2-W10-REBC02-HW

Monta Lokmane

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Math formulas

- The sigmoid function (or logistic)

$$\phi(x) = \frac{1}{1 + exp(-x)}.$$

- The hyperbolic tangent function ("tanh")

$$\phi(x) = \frac{exp(x) - exp(-x)}{exp(x) + exp(-x)} = \frac{exp(2x) - 1}{exp(2x) + 1}.$$

- The hard threshold function

$$\phi_\beta(x) = 1_{x \geq \beta}.$$

- The rectified Linear Unit (ReLU) activation function

$$\phi(x) = max(0, x).$$

Five Activation Functions

Matlab kods

x = -10:0.01:10;
y1 = x;
y2 = 1./(1+exp(-x));
y3 = tanh(x); (exp(2.*x)-1)/(exp(2.*x)+1)
y4 = x≥ 1;
y5 = max(0,x);
plot(x,y1,x,y2,x,y3,x,y4,x,y5) grid on legend('Id','Sigmoid','tanh','Threshold','ReLu','Location','northwest')

Grafiks

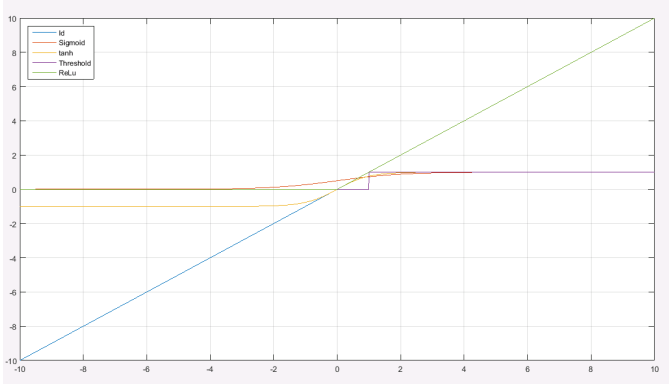
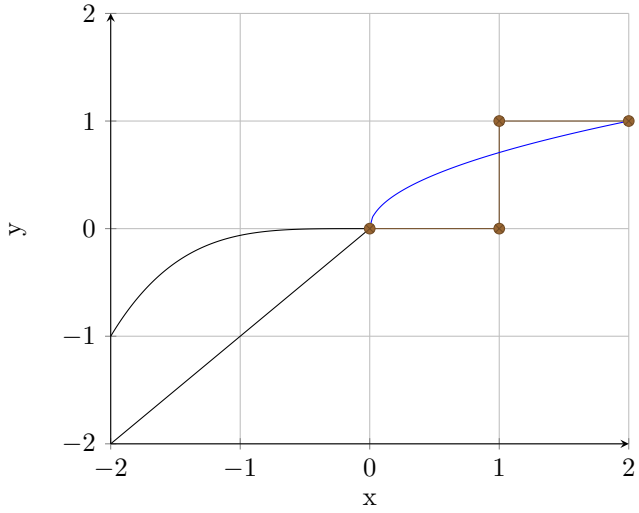


Figure 2: Activation functions

LaTeX




```
    \begin{axis}[axis lines = left, grid=major, xmin=-2, xmax=2, ymin=-2, ymax=2,
     xlabel=x , ylabel=y ,
     xtick = {-2,-1,...,2}, ytick = {-2,-1,...,2},
     scale=1, restrict y to domain=-2:2]
     \addplot[black, samples=100, smooth, domain=-2:0] plot (\x, {\x });
     \addplot[black, samples=100, smooth, domain=-2:0] plot (\x, {(x^4)/(-16)} );
     \addplot coordinates {(0,0) (1,0) (1,1)(2,1)};
     \addplot[blue, samples=100, smooth, domain=0:2] plot (\x, {(sqrt(\x))/sqrt(2)} );

  \end{axis}
\end{tikzpicture}
```

Matplotlib

```
import matplotlib
import matplotlib.pyplot as plt
import numpy as np

x = -10,10;

y1 = x;  #Id

y2 = 1./(1+exp(-x)); # sigmoiida

y3 = tanh(x); # tanh =
(exp(2.*x)-1)/(exp(2.*x)+1)
```

```
y4 = x >= 1; # Threshold

y5 = max(0,x); # ReLu

plot(x,y1,x,y2,x,y3,x,y4,x,y5)
legend('Id','Sigmoid','tanh','Threshold','ReLu','Location','northwest')
```

Grafiks