1918-108-C1-W10-REBC01-HW

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April 2019

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

Grafiks:

MATLAB code:
x = -10:0.01:10;
y1 = x; y2 = 1./(1+exp(-x)); y3 = tanh(x); (exp(2x)-1)/(exp(2x)+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")

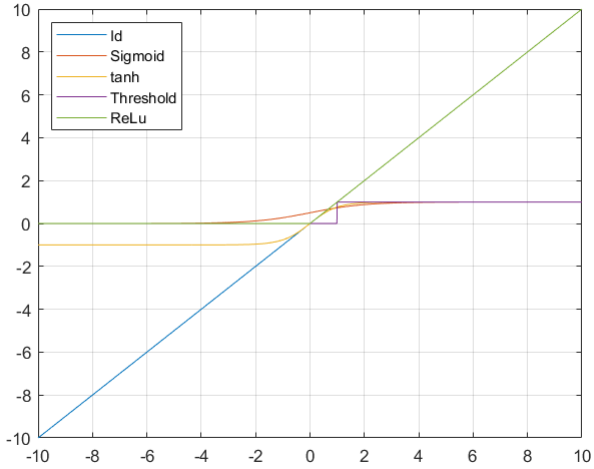
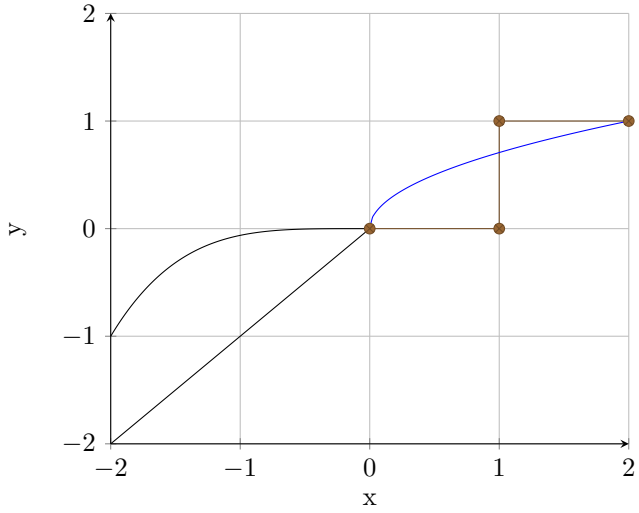


Figure 2: Activation functions

LaTeX

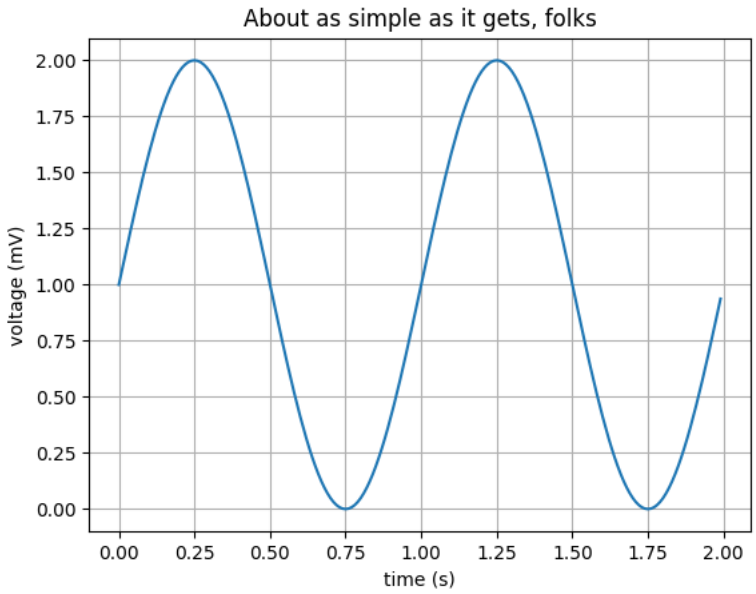



```
    \begin{axis}[axis lines = left, grid=major, xmin=-2, xmax=2, ymin=-2, ymax=2,
     xlabel=x , ylabel=y ,
     xtick = {-2,-1,...,2}, ytick = {-2,-1,...,2},
     scale=1, restrict y to domain=-2:2]
     \addplot[black, samples=100, smooth, domain=-2:0] plot (\x, {\x });
     \addplot[black, samples=100,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

# Data for plotting
t = np.arange(0.0, 2.0, 0.01)
s = 1 + np.sin(2 * np.pi * t)

fig, ax = plt.subplots()
ax.plot(t, s)

ax.set(xlabel='time (s)', ylabel='voltage (mV)',
       title='About as simple as it gets, folks')
```

```
ax.grid()

fig.savefig("test.png")
plt.show()
```



LaTeX code

```
 \documentclass{report}
\usepackage[utf8]{inputenc}
\usepackage{graphicx}

\title{1918-108-C1-W10-REBC01-HW}
\author{Anna Bogachova }
\date{April 2019}

\begin{document}

\maketitle

\begin{Large}
  \textbf{Math formulas}
\end{Large}

\begin{itemize}
    \item The sigmoid function (or logistic)
```

```
    $$\phi (x) = \frac{1}{1+exp(-x)}.$$
    \item The hyperbolic tangent function ("tanh")
    $$\phi (x) = \frac{exp(x) - exp(-x)}{exp(x) + exp(-x)} =
    \frac{exp(2x) -1}{exp(2x) +1}.$$
    \item The hard threshold function
    $$\phi_\beta (x) = 1_{x\geq\beta}.$$
    \item The rectified Linear Unit (ReLU) activation function
    $$\phi (x) = max(0,x).$$
\end{itemize}

\hfill

\begin{Large}
  \textbf{Five Activation Functions}
\end{Large}

\begin{minipage}[c]{0.5\linewidth}

MATLAB code:


   x = -10:0.01:10;

y1 = x; % Id
y2 = 1./(1+exp(-x)); % sigmoiida
y3 = tanh(x); % tanh =
(exp(2x)-1)/(exp(2x)+1)
y4 = x >= 1; % Threshold
y5 = max(0,x); % ReLu

plot(x,y1,x,y2,x,y3,x,y4,x,y5)
grid on
legend("Id","Sigmoid","tanh",
"Threshold","ReLu","Location",
"northwest")


\end{minipage}
\begin{minipage}[c]{0.6\linewidth}

Grafiks:

   \includegraphics[scale=0.5]{new.png}
\end{minipage}
\end{document}
```