Exercises week 1, Lisa Tostrams, s4386167

Exercise 1.

1. length x = $\sqrt{1^2+2^2}=\sqrt{5}$ x'y = $1*-1+2*1=1$
2. Zx =

$$1*1+2*2=5$$

$$3*1+4*2=11$$

$$= \begin{pmatrix} 5 \\ 11 \end{pmatrix}$$

3. cos(◌) = $\frac{\langle x, y\rangle}{\|x\|*\|y\|}=\frac{(1)}{\sqrt{5}*\sqrt{2}}=0.3162$ = 71.5651 (rad)

4. $\frac{\partial f(x)}{\partial x_i}=\frac{\partial(x_1^2+\ldots+x_n^2)}{\partial x_i}=2*x_i$

5. $\left(\frac{\partial fx}{\partial x}, \frac{\partial fy}{\partial y}\right)$

$$f(x, y)=g(h(x, y))$$

$$g(x)=-x^2, h(x, y)=\cos(x)^2+\cos(y)^2$$

$$g'(x)=-2\mathrm{x}, h'(x)=-\sin(2\mathrm{x})+-\sin(2\mathrm{y})$$

$$f'(x,y)=g'(h(x,y))*h'(x,y)$$

$$\frac{\partial f}{\partial x}=-2(\cos(x)^2+\cos(y)^2)*-\sin(2x)$$

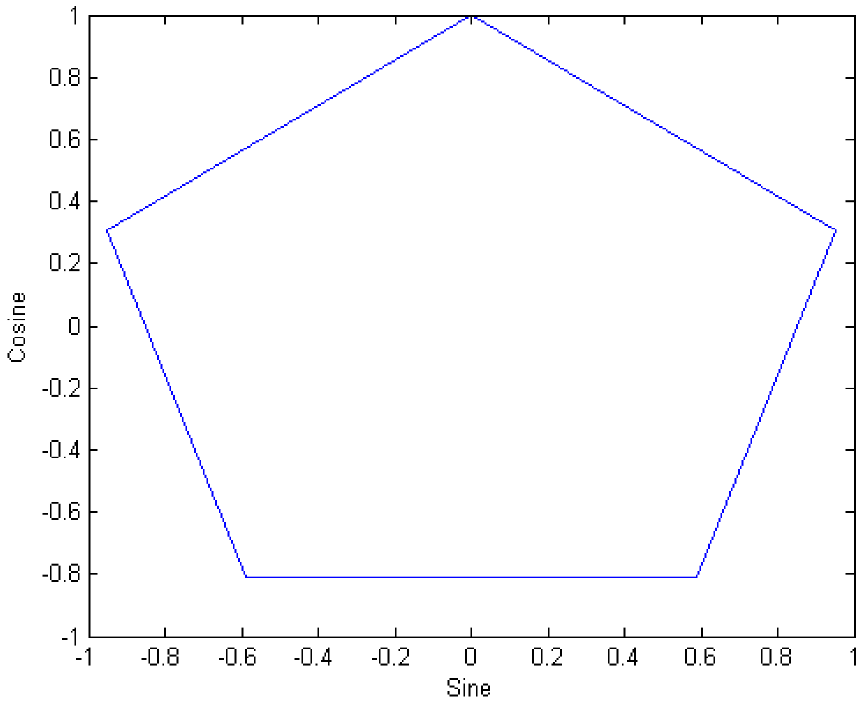
$$\frac{\partial f}{\partial y}=-2(\cos(x)^2+\cos(y)^2)*-\sin(2y)$$

$$\left(\frac{\partial fx}{\partial x},\frac{\partial fy}{\partial y}\right)=\left(-2(\cos(x)^2+\cos(y)^2)*-\sin(2x),-2(\cos(x)^2+\cos(y)^2)*-\sin(2y)\right)$$

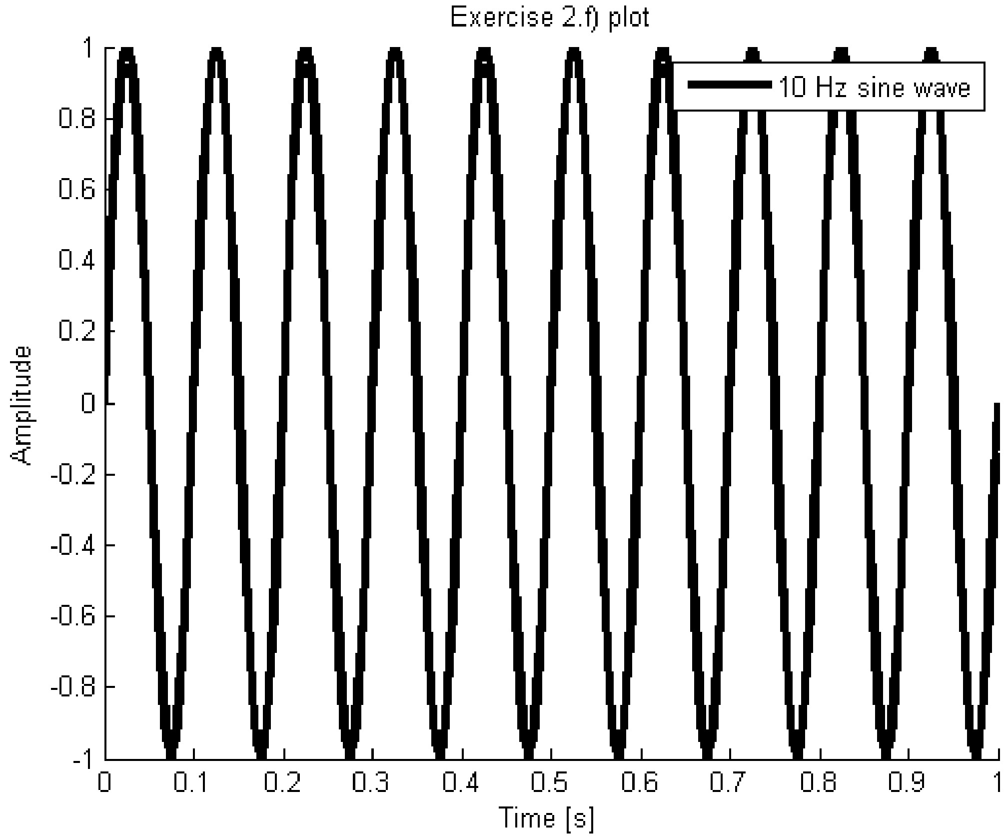
Exercise 2.

Answers in code

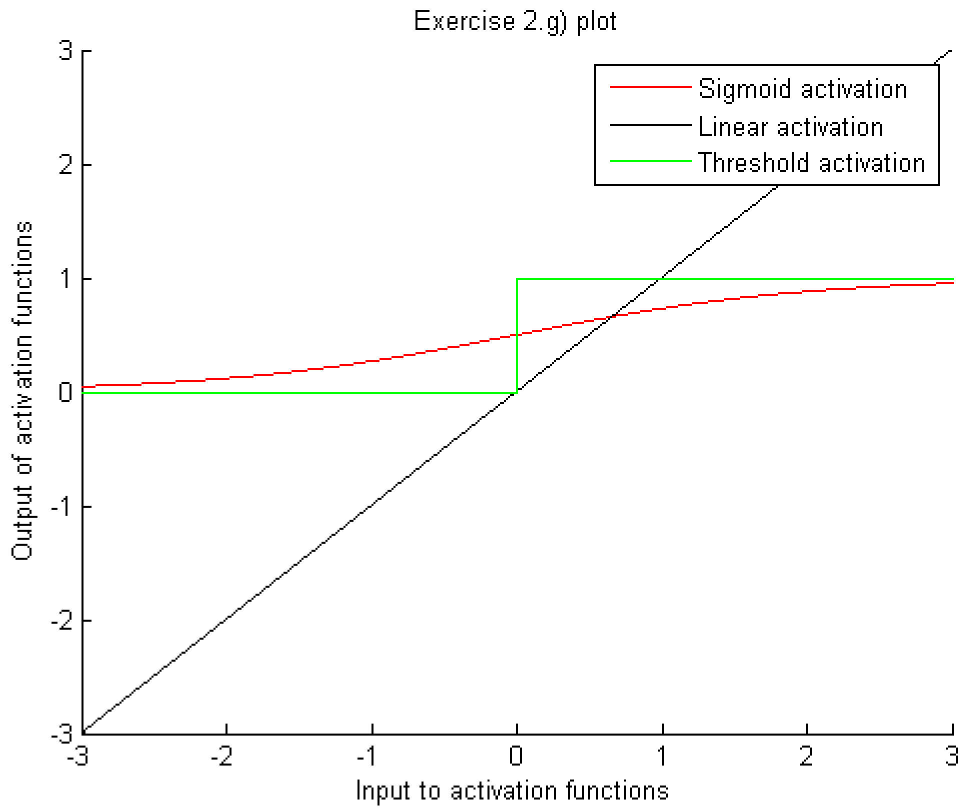
plot 2.e)



plot 2.f)



plot 2.g)



Exercise 3.

Answers in code

Code tutorial.m

```
% tutorial.m Lisa Tostrams s4386167
% Exercise 2

%2.a)
t = 0:5;
t = t * pi;
s = ones(1,6) ./2.5;

%2.b)
output2_b1 = t .* s
%this operation multiplies the elements of t and s pairwise
%the result is a vector containing the products of this multiplication
output2_b2 = t * s'
%this operation multiplies the elements in the column of t pairwise with
%the elements in the row of s' the result is this summation (called a dot
%product in linear algebra). The apostrophe in the second expression
%transposes the vector s. This is necessary because for a dot product, the
%amount of rows in the first vector (or matrix) needs to be equal to the
%amount of columns in the second vector.

%2.c)
x = 0 : pi/2.5 : 2*pi;

%2.d)
X = [x x];
X = [x; x];

%2.e)
figure(1)
plot(sin(X(1,:)), cos( X(2,:)))
xlabel('Sine');
ylabel('Cosine');

%2.f)
figure(2);clf;hold on;
f_sin = 10; %[Hz]
f_nyq = 20; %[Hz]
fs = f_nyq .* 10; %10 times the Nyquist frequency [Hz]
t_2f = 0:1/fs:1; % time array, from 0 to 1 [s].

sig = sin(f_sin.*2.*pi.*t_2f);
plot(t_2f,sig,'k','LineWidth',3);
xlabel('Time [s]');
ylabel('Amplitude');
legend('10 Hz sine wave');
title('Exercise 2.f) plot');

%2.g)
figure(3);clf;hold on;
b = -3: 0.0001 :3;
sigmoid = 1./(1+exp(-b(:))); %activation fucntions
linear = b;
treshold = heaviside(b(:));
plot(b,sigmoid,'r');
```

```
plot(b,linear,'k');
plot(b,treshold,'g');

title('Exercise 2.g) plot');
xlabel('Input to activation functions');
ylabel('Output of activation functions');
legend('Sigmoid activation', 'Linear activation', 'Threshold activation');


%Exercise 3
%3.a)
X = rand(2000);
Y = rand(2000);
U = X.*Y;
V = Y.*X;
%There is no difference between U and V, because the multiplication is
%elementwise. For U, an element at X(i,j) is multiplied with the element at
%Y(i,j). For V, and element at Y(i,j) is multiplied with the element at
%X(i,j). This results in two equal matrices.

tic
comparison(X,Y);
T1 = toc  % T1 = 0.5338
tic
U = X.*Y;
T2 = toc  % T2 = 0.0174

%T1 is more than 30 times as big as T2. I would say the second method is
%the most efficient one.
```

Code comparison.m

```
function [matrix] = comparison(X, Y)

[row, column] = size(X);
matrix = zeros(row,column);

for i = 1:size(X,1)
    for j = 1:size(X,2)
        matrix(i,j) = X(i,j) * Y(i,j);
    end
end

end
```