# Assignment #1

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Course: *49275 Neural Networks & Fuzzy Logic* – Professor: *Dr. Steve Ling*
Due date: *December 23rd, 2020*

### Question 1

Two perceptron classifiers are trained to recognise the following classification of five patterns x with known class membership d.

$$x_1 = \begin{bmatrix} 0.4 \\ 0.8 \\ 0.2 \\ 0.3 \\ 0.2 \end{bmatrix}, \; x_2 = \begin{bmatrix} 1.0 \\ 0.2 \\ 0.5 \\ 0.7 \\ 0.5 \end{bmatrix}, \; x_3 = \begin{bmatrix} -0.1 \\ 0.7 \\ 0.3 \\ 0.3 \\ 0.9 \end{bmatrix}, \; x_4 = \begin{bmatrix} 0.2 \\ 0.7 \\ -0.8 \\ 0.9 \\ 0.3 \end{bmatrix}, \; x_5 = \begin{bmatrix} 0.1 \\ 0.3 \\ 1.5 \\ 0.9 \\ 1.2 \end{bmatrix}$$
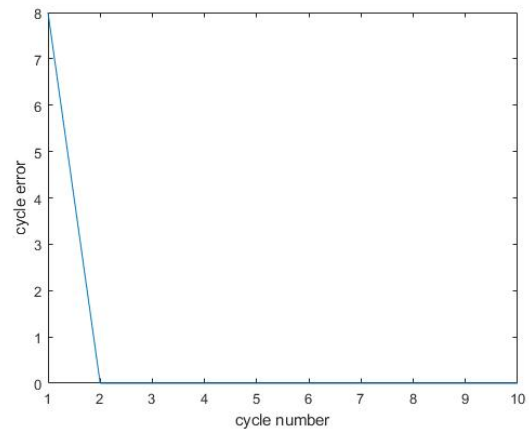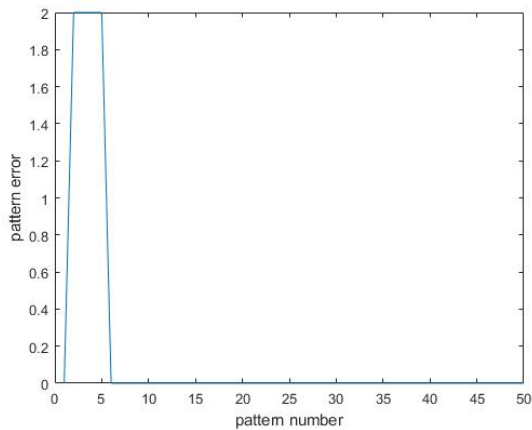
$$d_1 = [1], \; d_2 = [-1], \; d_3 = [1], \; d_4 = [-1], \; d_5 = [1]$$

**Q1.1 [Discrete Perceptron Training].**

```
%% Question 1 MATLAB CODE
clc
clear
x = [0.4 0.8 0.2 0.3 0.2 1;
     1 0.2 0.5 0.7 -0.5 1;
     -0.1 0.7 0.3 0.3 0.9 1;
     0.2 0.7 -0.8 0.9 0.3 1;
     0.1 0.3 1.5 0.9 1.2 1];

d = [1 -1 1 -1 1];
c = 2;
w = [0.3350 0.1723 -0.2102 0.2528 -0.1133 0.5012]';
numCycles = 10;
numPatterns = 5;
pr = [];
cr = [];

for i = 1:numCycles
    e = 0;
    for j = 1:numPatterns
        v = w'*x(j,:)';
        z = sign(v);
        r = d(j) - z;
        delta_w = c * r * x(j,:);
        w = w + delta_w';
        p = 0.5*(d(j)-z)^2;
        e = e+0.5*(d(j)-z)^2;
        pr = [pr p];
    end
    cr = [cr e];
end
```

$$
FinalWeightVector = \begin{bmatrix} -4.4650 \\ 0.5723 \\ 8.1898 \\ -1.3472 \\ 9.0867 \\ 0.5012 \end{bmatrix}
$$

While this question leaves out the crucial element of the geographic origin of the swallow, according to Jonathan Corum, an unladen European swallow maintains a cruising airspeed velocity of **11 metres per second**, or **24 miles an hour**. The velocity of the corresponding African swallows requires further research as kinematic data is severely lacking for these species.

**Q1.2 [Continuous Perceptron Training].**

### Question 2

How much wood would a woodchuck chuck if a woodchuck could chuck wood?

(*a*) Suppose "chuck" implies throwing.

(*b*) Suppose "chuck" implies vomiting.

**Answer.**

(*a*) According to the Associated Press (1988), a New York Fish and Wildlife technician named Richard Thomas calculated the volume of dirt in a typical 25–30 foot (7.6–9.1 m) long woodchuck burrow and had determined that if the woodchuck had moved an equivalent volume of wood, it could move "about **700 pounds (320 kg)** on a good day, with the wind at his back".

(*b*) A woodchuck can ingest 361.92 cm$^3$ (22.09 cu in) of wood per day. Assuming immediate expulsion on ingestion with a 5% retainment rate, a woodchuck could chuck **343.82 cm$^3$** of wood per day.

## Question 3

Identify the author of Equation 1 below and briefly describe it in Latin.

$$P(A|B) = \frac{P(B|A)P(A)}{P(B)} \tag{1}$$

**Answer.** Lorem ipsum dolor sit amet, consectetur adipiscing elit. Praesent porttitor arcu luctus, imperdiet urna iaculis, mattis eros. Pellentesque iaculis odio vel nisl ullamcorper, nec faucibus ipsum molestie. Sed dictum nisl non aliquet porttitor. Etiam vulputate arcu dignissim, finibus sem et, viverra nisl. Aenean luctus congue massa, ut laoreet metus ornare in. Nunc fermentum nisi imperdiet lectus tincidunt vestibulum at ac elit. Nulla mattis nisl eu malesuada suscipit.

## Question 4 (bonus marks)

The table below shows the nutritional consistencies of two sausage types. Explain their relative differences given what you know about daily adult nutritional recommendations.

| *Per 50g* | Pork | Soy |
|---|---|---|
| Energy | 760kJ | 538kJ |
| Protein | 7.0g | 9.3g |
| Carbohydrate | 0.0g | 4.9g |
| Fat | 16.8g | 9.1g |
| Sodium | 0.4g | 0.4g |
| Fibre | 0.0g | 1.4g |

**Answer.** Lorem ipsum dolor sit amet, consectetur adipiscing elit. Praesent porttitor arcu luctus, imperdiet urna iaculis, mattis eros. Pellentesque iaculis odio vel nisl ullamcorper, nec faucibus ipsum molestie. Sed dictum nisl non aliquet porttitor. Etiam vulputate arcu dignissim, finibus sem et, viverra nisl. Aenean luctus congue massa, ut laoreet metus ornare in. Nunc fermentum nisi imperdiet lectus tincidunt vestibulum at ac elit. Nulla mattis nisl eu malesuada suscipit.

## Question 5 (bonus marks)

Listing 1: Luftballons Perl Script

```perl
#!/usr/bin/perl

use strict;
use warnings;

for (1..99) { print $_." Luftballons\n"; }

# This is a commented line

my $string = "Hello World!";

print $string."\n\n";

$string =~ s/Hello/Goodbye Cruel/;

print $string."\n\n";

finale();

exit;

sub finale { print "Fin.\n"; }
```

1. How many luftballons will be output by the Listing 1 above?

2. Identify the regular expression in Listing 1 and explain how it relates to the anti-war sentiments found in the rest of the script.

**Answer.**

1. 99 luftballons.

2. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Praesent porttitor arcu luctus, imperdiet urna iaculis, mattis eros. Pellentesque iaculis odio vel nisl ullamcorper, nec faucibus ipsum molestie. Sed dictum nisl non aliquet porttitor. Etiam vulputate arcu dignissim, finibus sem et, viverra nisl. Aenean luctus congue massa, ut laoreet metus ornare in. Nunc fermentum nisi imperdiet lectus tincidunt vestibulum at ac elit. Nulla mattis nisl eu malesuada suscipit.