Assignment 1

Reactive-Ion-Etching (RIE) machines are used in some company for removal of thin layers in the production of magnetic heads. The task of a RIE machine is to etch a specified surface of some μm depth into sliders. The etch depths of sliders are regarded as indicators for process stability. It would be easy to control the process if the etch depth could be monitored online. Unfortunately such a depth can only be measured at the end of the etching process.

In order to enhance process stability and reliability, attempts have been made to analyse data from process observations and to detect correlation between sensor data and process result, i.e. etch depth. At present, however, there is no explicit mathematical model to calculate etch depth from process parameters. As alternative artificial neural network may be constructed to predict etch depth based on sensor information**.**

The 21 features extracted from sensor signals are illustrated in the table below. But not all of them are relevant for the underlying problem. A pre-step of feature selection has been performed to select the most critical features as inputs. The results of feature selection recommend that features 2, 19, and 20 be selected for etch process modelling (selected features are marked with red text in the table).

Number	Features extracted	Original signals
1	Run time	
2	**HF energy (integral of HF power)**	**HF power delivered**
3	Start time	HF power delivered
4	Peak to peak value	HF power delivered
5	Integral	DC voltage
6	Start time	DC voltage
7	Integral	Gas flow 1
8	Mean value	Gas flow 1
9	Standard deviation	Gas flow 1
10	Integral	Gas flow 2
11	Mean value	Gas flow 2
12	Standard deviation	Gas flow 2
13	Integral	Gas flow 3
14	Mean value	Gas flow 3
15	Standard deviation	Gas flow 3
16	Integral	Chamber pressure
17	Mean value	Chamber pressure
18	Peak to peak value	Chamber pressure

19	**Integral**	**Throttle position**
20	**Mean value**	**Throttle position**
21	Peak to peak value	Throttle position

Two data sets are available to be downloaded from **Data_Training** and **Data_Test** in the same folder. Data_Training contains the examples that are available for learning, while Data_Test includes test examples that represent unseen examples and are not involved in the learning procedure. Every case in both data sets consists of 21 features listed in the above table and the associated etch depth as output. The first 21 columns in the files represent the 21 features and the last column represents the output.

Your task now is to develop a competent neural network to predict etch depth based on Data_Training. Then you should examine the performance of the learned neural network on Data_Test. Only the three features selected need to be used as inputs to the neural network (you just use the results of feature selection here). As learning algorithm you can use GA or BP as your free choice.

You report has to summarize the following information: the structure of neural network selected, the learning algorithm used, the evolving of performance (errors with iterations), performance on training data, performance on test data.