

**Figure 1)** Torus geometrical shape

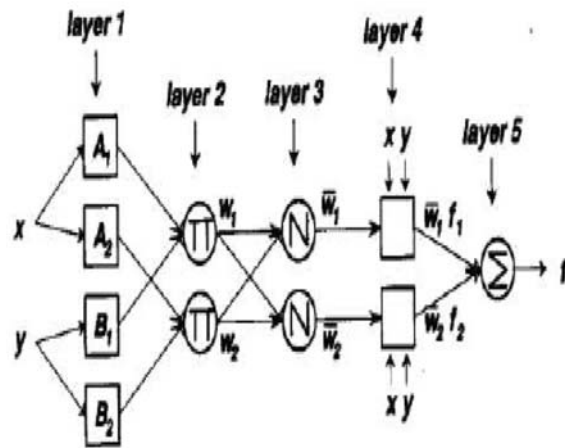


Figure 2) View of the Sugeno Fuzzy System

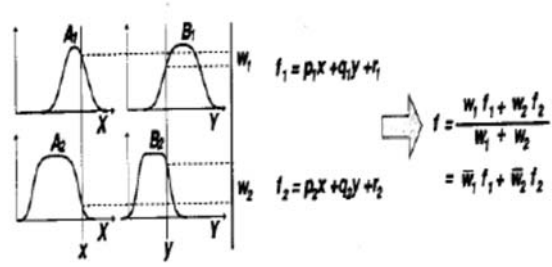


Figure 3) Fuzzy system output

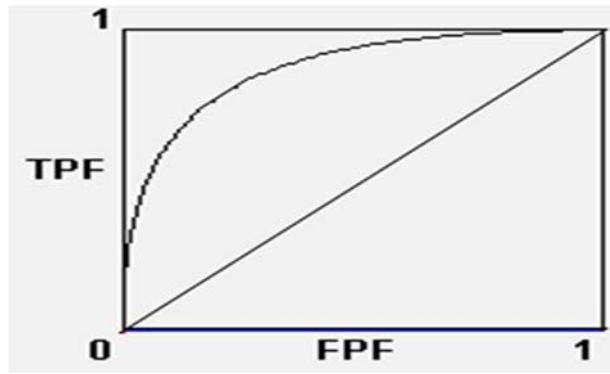
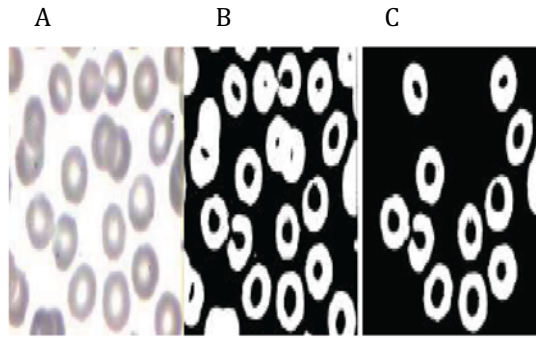
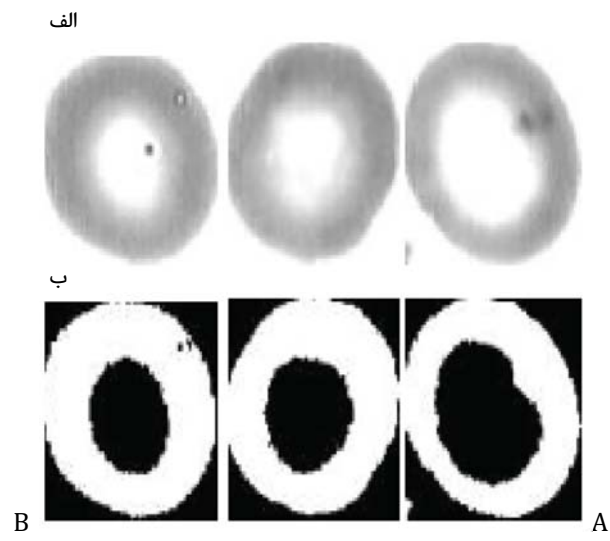


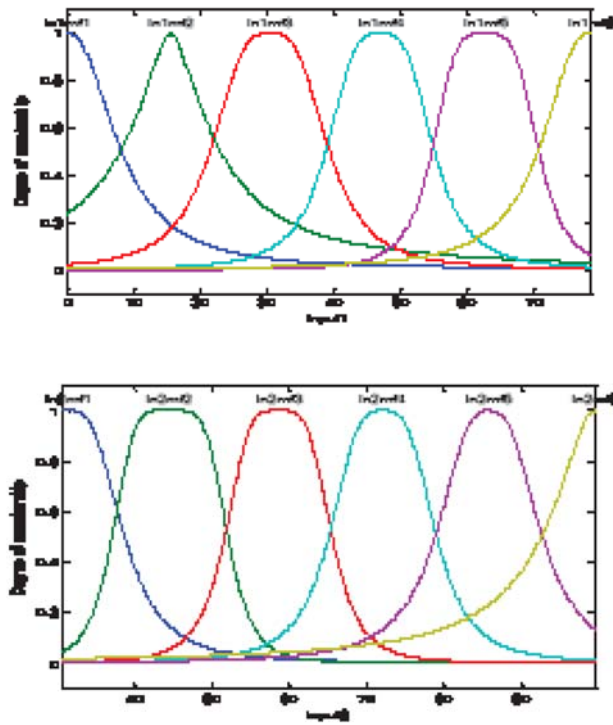
Figure 4) ROC curve



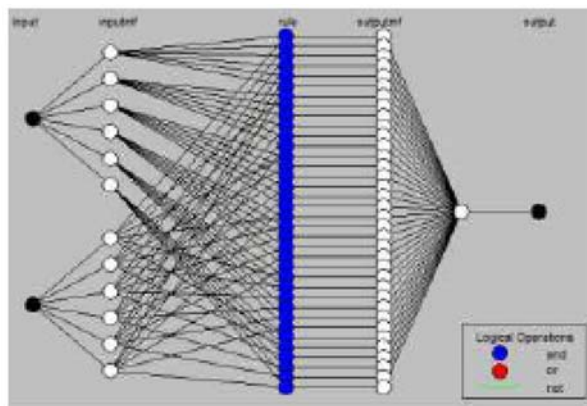
**Figure 5)** The main image; b) The binary image of the otsu threshold; c) The processed image



**Figure 6)** a: beneath the binary image with gray levels; b) the binary image of the adaptive local threshold

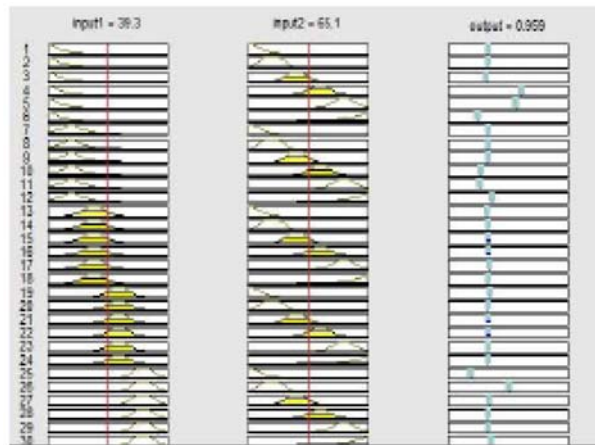


**Figure 7)** Form of membership functions of the two input variables after the network training

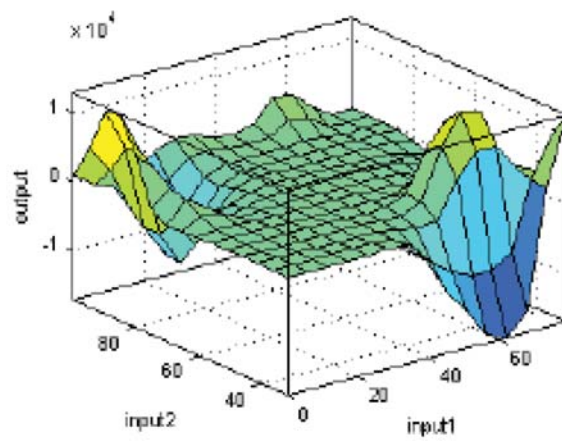


**Figure 8)** ANFIS network structure

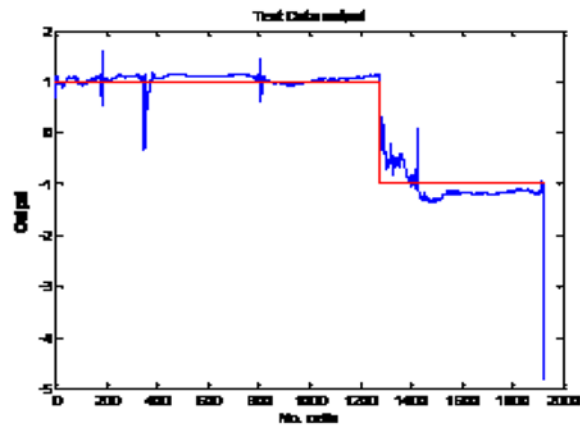




**Figure 9)** ANFIS rules base and how it works when applying one data sample



**Figure 10)** Process of input and output of ANFIS network



**Figure 11)** Desired output (dots) and actual network output based on test data belonging to a 6-batch

**Table 1) ANFIS Network Results Table**

<b>Parameters</b>	<b>Value</b>
Number of ANFIS network membership functions	6
Normal class variance	0.1123
Non-normal class variance	0.1361
Average network training error	0.005
Average network test error	0.0307
System accuracy	96.6%
Area below the ROC curve	0.9950