ENEE434 Spring 2004 In Class Portion of the Final Exam

100 points; 60 minutes, open book, open notes; if stuck go on to the next; good luck!

1class. [50 points, 30 minutes]

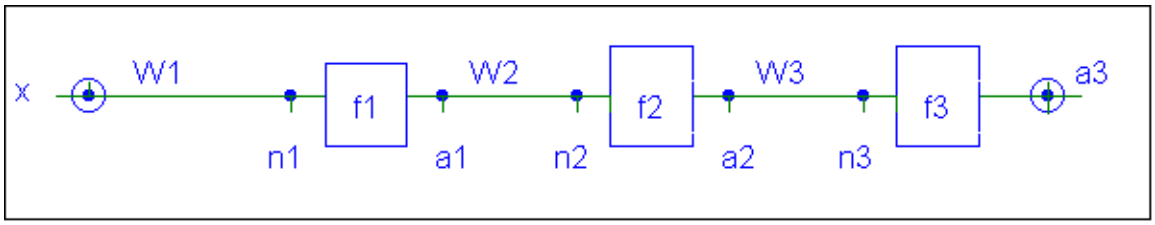
It is desired to generalize real neural networks to complex valued ones, as in the paper "MEMS Resonators and Mechanical Neurocomputing." Using $s=\sigma+ j\omega$ it is proposed to generalize the logsig activation to $f(s)=1/[1+\exp(-s)]$.

a) Explain why this seems to be a logical generalization for the activation function.

b) Discuss though that there are difficulties by observing the behavior for purely imaginary s. Note that $\exp(jx)=\cos(x)+j\sin(x)$.

c) A single layer complex valued network with two real inputs, x1 & x2, is to have a single real output. The two inputs feed a single output neuron with this activation function, $f(s)=1/[1+\exp(-s)]$, and complex weights. Give the real and imaginary parts of the output and determine weights so that the imaginary part of the output is zero for all real inputs if possible and if not possible give the reason..

2class. [50 points, 30 minutes]



For the above network

a) write a3 directly as a function of the weights, activation functions, and x.

b) It is desired to approximate $y(x)=x^4$, the fourth power of x, over the interval [1, 2] by using

$$f1(z)=f3(z)=\text{purelin}(z)$$

$$f2(z)=\exp(-\frac{[z-a]^2}{b})$$

for which it is assumed that a and b are real positive constants.

b1) what is the maximum number of points for which it should be possible to achieve $a3(x)=y(x)$ exactly.

b2) Assuming that the weights are required to be unity, $w1=w2=w3=1$, determine a and b such that the RMS error E is minimized,

$E^2=[y(1)-a3(1)]^2+[y(2)-a3(2)]^2$

and give the value of this minimum E.