ENEE 434 Spring 2002
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Homework # 4 (due 05/02/02)

1.

a. Assume a polynomial function with inputs in the range [-1, 1]. We will try to fit this function using a Radial Basis Network.
For example suppose y = -(x+0.8)*(x+0.4)*(x-0.1)*(x-0.9)
You are welcome to use any other type of function you may like to work with.
Define your inputs P=-1:0.1:1 and set the target values to represent the function you have chosen to fit. Plot the input and target values, which represent your function to fit with RBN. (10 pt.)

b. Define the network to approximate the function. Set sum squared error eg = 0.02. You should also initialize spread constant. Explain idea of spread constant and how it affects the performance of the network. (10 pt.)

c. Set the spread constant to a small value, run and observe the performance of your network. How well it approximates your target function? And also try a large spread constant and observe the change in the performance of your system. Comment on the results, is this what you expect to see when the spread constant is increased? (15 pt.)

d. What can be an optimum value for the spread constant of any RBN? Can you propose any system that sets the spread constant according to the input-target values so your RBN performs well in most of the cases? (15 pt.)

2.

a. Refer to the circuit in Figure 1 below. Simulate this circuit using PSpice and explain how this MOSFET Differential Amplifier circuit works. (There is no need to solve the circuit with exact values. Just explain how current flows, how MOSFETs turn on/off and what is the expected output of the circuit and compare it with the Spice output). Can we use this circuit to implement unit step function as an activation function? (25 pt.)

b. Design a differential amplifier using an op-amp and several resistors. The circuit will have two input voltages, V_1 and V_2 and we want to find the difference and amplify it. So the output response of the circuit will be $V_0 = A * [V1 - V2]$ where A is the gain term. Comment on any implementation of your circuit as activation function. Compare this amplifier with the one in 2a. Can you use this type of circuit as an analog device to implement any part of a neural network? If so how? (25 pt.)

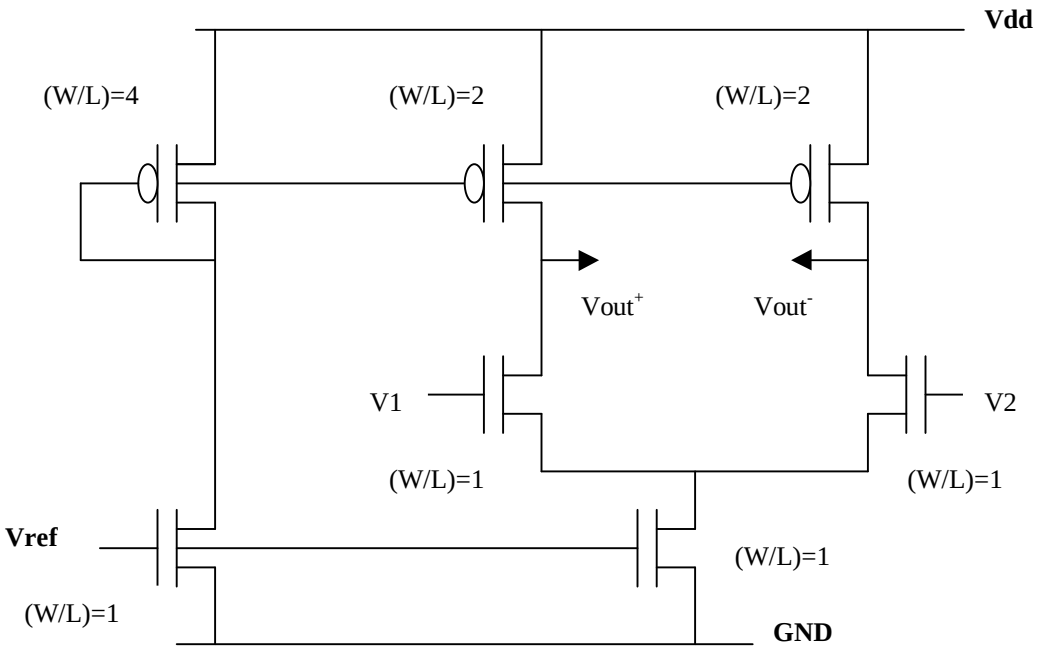

Figure 1: A MOSFET based differential amplifier. All nFETs and pFETs (W/L) ratios are as shown. Assume Vref sets a bias current of 2mA to the nFET current source transistors when biased in saturation. Additional information is as follows:

$K_n = 32mA/V^2$, $K_p = 10mA/V^2$, $V_T = 1V$, $I_{th} = 0.25mA$, $V_A = 25$ V