

ECE 512 - Fall 1997
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Test #1

I. Consider the Boolean function $y = \bar{x}_1\bar{x}_2\bar{x}_3 + x_1x_2 + x_2x_3$.

- a. Draw the K-Map for $y(\mathbf{x})$.
- b. Is the mapping defined by $y(\mathbf{x})$ linearly separable? Why?

II. Find a minimal PTG realization for the function $y(\mathbf{x})$ in Problem I employing the method of Section 1.4.

III. Let $y(\mathbf{x}) = a + bx$, where a, b belong to R . Find the parameters a and b which minimize the objective function:

- a. $\int_1^2 [x^3 - y(x)]^2 dx$
- b. $\int_1^2 |x^3 - y(x)| dx$

Plot the two approximations and compare to $g(x) = x^3$. Which is a better approximation?

IV. Employ the perceptron learning rule (given in Equation 3.1.3, p. 60), with $\mathbf{w}^1 = \mathbf{0}$, to synthesize a separating surface for the mapping defined below. Assume that the order of training sample presentation is preserved, as in the table below. Plot the separating surface.

| \underline{x}_1 | \underline{x}_2 | \underline{d} |
|-------------------|-------------------|-----------------|
| 0 | 1 | -1 |
| 1 | 0 | -1 |
| 1 | 1 | 1 |
| .5 | 1 | 1 |

V. Let $y = \mathbf{x}^T \mathbf{w}$, where \mathbf{x} and \mathbf{w} are n -dimensional column vectors. Show that $\nabla_{\mathbf{w}} y = \mathbf{x}$.