CSCE 496/896: Machine Learning	**Fall Semester, 1999**

Prerequisite Test

August 23, 1999	*Due Date: September 3*

No collaboration is allowed, but you may use any resources you wish, so long as you cite them. Show all work and state all assumptions.

1. (10 pts) Give the equation for a hyperplane that separates the set of points $A = \{(0,0,0),(1,1,0),(0,2,1)\}$ from $B = \{(0,0,4),(3,3,1),(4,2,0),(1,6,0)\}$. Describe how you derived the equation and verify that your hyperplane actually does separate the two sets of points.

2. (5 pts) Given the set of numbers $A = \{2, 3, 4, 5, 7, 9\}$, what is its mean? What is its variance?

3. (5 pts) What is the power set of the set $A = \{a, b, c\}$? In general, if a set has n elements, what is the size of its power set?

4. (10 pts) Let $\vec{a} = [a_1, \ldots, a_n]$ be a vector and

$$B = \left\{\vec{b}_1, \ldots \vec{b}_m\right\} = \{[b_{11}, b_{21}, \ldots, b_{n1}], [b_{12}, \ldots, b_{n2}], \ldots, [b_{1m}, \ldots, b_{nm}]\}$$

be a set of vectors. Solve

$$\frac{\partial}{\partial a_i} \sum_{\vec{b}_j \in B} \left(c - \vec{a} \cdot \vec{b}_j\right)^2,$$

where c is a constant and $\vec{a} \cdot \vec{b}_j$ is the dot product of $\vec{a}$ and $\vec{b}_j$. Carefully explain each step of your derivation.

5. (20 pts) Write a brief (2–3 pages) essay on any advanced computer science-related topic that you are familiar with, e.g. virtual memory, Ethernet, NP-completeness or any other topic covered in a 4XX/8XX computer science or applied math class. Assume that the reader of this essay has a basic computer science and math background, but is unfamiliar with the topic that you are writing about. Thus you want to convey the fundamental ideas and applications of this topic, *but do not overwhelm the reader with enormous amounts of detail!* Use some document preparation system (e.g. LaTeX) for this, and submit a laser-printed version to me. Cite all references you use in a style such as that found in any ACM or IEEE journal. Do *not* simply copy the material from these sources, but instead *write this in your own words.* I will only grade your presentation and writing style, so have someone proofread this for you before handing it in.