CS559 Homework 1 Due: September 9, 2003, 2:30 pm name:

CS login: _____

Linear Algebra Refresher

Please either answer in the space provided, or attach additional sheets. Be sure to write your name AND CS login on EVERY page, and to attach multiple pages together with a staple. Remember, your course survey is also due at the same time (but don't staple it to your homework)

*x*1 *x*2 *x*3

1. Prove that the determinant of the matrix y_1 y_2 y_3 can be used to tell if the 1 1 1

three 2D points ((x1,y1), (x2,y2), (x3,y3)) are co-linear. Show what value this determinant has when the points are co-linear and that it must have this value for any set of co-linear points.

- 2. Suppose we have n k by k matrices (A, B, C, ...) and m k-vectors (a, b, c, ...) and that we want to compute the product of all of these matrices times each vector (e.g. ABCa, ABCb, ABCc, ...). Clearly, for each of these products it is faster (in terms of the number of arithmetic operations) to do the multiplies from right to left (doing a sequence of vector/matrix multiplies) than left to right. However, for a large enough number of vectors (m), it will be faster to compute the product of the matrices and to multiply this matrix by each vector. Write a condition that determines which is faster (it should be an "if" statement involving n, m, and k.
- 3. Consider the plane (in 3 space) 2x + 2y + z = 2. What point on this plane is closest to the origin? Does the unit sphere intersect this plane?
- 4. Given 2 vectors in 3D (a,b,c) and (d,e,f), write an equation describing the set of points that includes the origin and is perpendicular to these vectors as:
 - a. A parametric (explicit) equation (e.g. $f(s) \rightarrow (x,y,z)$)
 - b. An implicit equation (e.g. f(x,y,z) = s).
- 5. Do problems 5 and 10 in Chapter 2 of Shirley.