COURSE OUTLINE: This is an upper division undergraduate course on the mathematical theory underlying Applied Linear Algebra. Said briefly, linear algebra is the study of matrices. Since data is usually stored in matrices, this is fundamental to the theory of data analysis. Thus in applications, matrices can be 1000x1000 and larger, up to as large as you can handle. So the big problem of linear algebra is: how to decompose a matrix so as to display the information salient to your application, but so as also to best avoid dealing with the vast information displayed by the matrices that has no bearing on your particular application. This is a profoundly important problem, with many unresolved issues. But there are many interesting and surprising solutions as well. Topics in this class include: Gaussian elimination of $n \times n$ matrices with application to solving large systems; abstract theory of vector spaces; least squares approximation; Gramm-Schmidt orthogonalization; eigenvalues, eigenvectors, similarity transformations and applications to linear differential and difference equations; singular value decomposition with applications. Fast Fourier Transform and positive definite matrices if time permits.