**ECE 1111: Engineering Computation I**

**Homework No. 4: Basic Linear Algebra**

**Deposit your work in:**

**/data/courses/ece\_1111/current/homework/hw\_04/<lastname\_firstname>**

**Goal:** Introduce you to basic linear algebra computations in Python. We will also introduce you to visualization techniques and some basic probability theory. You will see more of this in Engineering Analysis (ENGR 2011) and Stochastic Processes (ECE 3522).

**Background:**

A multivariate Gaussian distribution is mathematically, it is defined as:

where is a vector,is a mean vector*,*  is a covariance matrix, is the determinant, and is the inverse of the covariance matrix. To learn more about this function and its computation, go here:

*https://isip.piconepress.com/courses/temple/ece\_1111/resources/tutorials/tips\_gaussian/*

The input to this function is a vector**,** , while the output to this function is a number (a probability). It is very easy to compute and plot this in Python.

**Description:** The tasks for this homework assignment are:

1. Start with a vector of dimension , which we refer to as a scalar. Set the mean to a value of and the covariance matrix to a value of . Generate a plot for the range . Plot the result using matplotlib (Google search how to plot a function in Python using matplotlib).
2. Now set the mean to and the variance to still using a vector of dimension . Plot the new distribution and compare it to the previous plot. How did the shape change?
3. Now consider a vector of dimension . Use a mean vector that is and a covariance matrix of:

.

This is referred to as an identity matrix. Plot the corresponding function using a 3D plot over the range for each component of the vector . Your plot should resemble those shown in the above tutorial.

1. Finally, plot this function for several different covariance matrices:

Explain what you observe. How does the shape of the function change?

**Summary:** You will learn more about the above function in your future engineering courses. In this assignment you are learning the basics of how to generate and visualization multi-dimensional functions in Python. You are also learning how easy it is to do linear algebra in Python.