NEW COURSE: Introduction to Python for Rapid Engineering Solutions
EEE498/591

To Be Offered in Spring 2018 on campus and hopefully later online – David R. Allee

Engineers in industry frequently need to solve quickly problems that may be new to them. This goal of this course is for students to learn how to achieve rapid engineering solutions using Python libraries and functions readily available on the internet. The Python libraries include NumPy, SciPy, matplotlib, pandas, and scikit-learn for example. The focus is on rapid solutions on wall-clock time, not necessarily CPU time. At the end of this course, the student will have been exposed to wide variety of computational problems from engineering and physics and have become acquainted with a typical approach to their solution using Python. When confronted with similar problems in the future, the student will know how to attack the problem and where to look for more detailed knowledge.

The course will use the open data science platform Anaconda (https://www.continuum.io/downloads) powered by Python.

Required Texts:
Computational Physics, Newman ~$36 at Amazon.com
Python for Machine Learning, Raschka ~$40 at Amazon.com
Online Reference: http://www.scipy-lectures.org/

You will need to have a laptop computer and bring it to class.

Prerequisites: CSE100, EEE203, PHY131, MAT342/343 Co-requisite: EEE350
Topics (tentative and not in order):

1. **Python Grammar:**
2. **Predictive Modeling / Machine Learning:** The students will learn how to automatically extract predictive algorithms, regression analysis, and clustering analysis from large databases. In addition, we will apply learning algorithms to predict writer sentiment from text.
3. **Linear Algebra:** The students will solve systems of linear equations and find associated eigenvalues and eigenvectors. One such example is the analysis of vibrating strings or atoms, and there are even applications in machine learning such as principal component analysis.
4. **Scripting for interface to CAD tools:** The students will write a python script to a) parse the output of CAD tool, b) analyze the results, c) create a new input file and d) launch the CAD tool again in a Linux environment.
5. **Generating a simple Graphical User Interface (GUI)**
6. **Data Acquisition and Instrumentation Control**: using a Raspberry Pi / Arduino and python code
7. **Optimization:** The students will learn how to find local and global minimum of nonlinear single and multi-variable functions. This will include stochastic techniques to reduce the chance of getting stuck in a local minimum.
8. **Integration:** We will learn how to use existing algorithms to rapidly evaluate complicated integrals that arise in engineering and physics problems.
9. **Discrete Fourier and Cosine Transforms:** We will look at removing noise from signals and images.
10. **Ordinary Differential Equations:** The students will solve the 3-body problem applied to planetary motion and study how non-linearity can lead to chaotic motion with a moon of Saturn, Hyperion, as an example.
11. **Partial Differential Equations:** The students will use finite difference equations and methods such as Gauss-Seidel to solve the Laplace, heat and wave equations.