

## **Programming in Python for Industrial and System Engineers**

**Summer 2022, 3 credit hours**

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(ONLINE)

**Summer 10WK: 05/18/2022 – 07/29/2022**

## **Course Outline**

### **Course Objective:**

The objective of this course is to build on your knowledge of computing and data analysis by focusing on programming using the Python language. In particular, you will learn more about the Python and its ecosystem of libraries, conduct File I/O operations, and perform numerical and scientific computing within Python. This course is designed for senior undergraduate and graduate students to learn the essentials of the Python language and write programs to perform scientific computing with Python with two of its most popular packages in use for heavy data intensive analysis – Numpy and SciPy. Several engineering examples from physics, industrial engineering core courses and general engineering will be used to contextualize the programming examples.

### **Student Learning Objectives:**

- Demonstrate the differences among the various semantics of the Python Programming Language.
- Demonstrate usage of Variables, Functions and File I/O in Python Based Programming.
- Demonstrate usage of fundamental data structures available in Python for use in computing.
- Write Python based scripts using the NumPy package.
- Demonstrate ability to leverage Python's extensive libraries for handling, cleaning, analyzing and visualizing data.
- Writing programs to solve scientific computing tasks using the SciPy package.

### **Pre-requisites**

- Graduate Standing in any engineering degree program.
- All students must have some familiarity with one of the following programming languages: FORTRAN, C, Matlab or Visual Basic. Part 1 of the course will assume that you have had some programming language experience prior to coming into the course. This course does NOT fulfill a GEP requirement.

### **Student Expenses**

None. There is no textbook for this course. The instructor has prepared self-paced learning videos to complement the course available via Moodle. In addition, there are many free books available online.

### **Course Grading Components**

Homework (35%)

Take Home Tests (Timed Test 1=15%, Timed Test 2=20%) (Total 35%)

Final Semester Project (30%)

**ONLINE Delivery (PLEASE READ)**

- All learning material through self-paced tutorial style videos will be posted to Moodle. Students can watch these videos at your own pace but must be completed during the assigned week. Students are free to learn ahead.
- Online Forum Discussions will be opened up to allow students to ask questions regarding assignments and homework. These discussions can allow other students in the class to respond to queries. Helping out another student improves your own understanding of the concept.
- **HELP SESSIONS:** There will be online Zoom sessions held every week on the following schedule below. These sessions will be led by the instructor and intended to help students with questions regarding learning material, class assignments, homework questions and general questions regarding the use of Python. It is intended to aid in programming with Python and to help brush up on basics and intermediate concepts.
- Dr. Binil Starly's Personal Zoom Meeting Room
  - **SATURDAY: 10.30AM – 11.30AM (US EASTERN)**
  - <https://ncsu.zoom.us/j/2429591888>
- Mr. Akshay G. Bharadwaj Personal Zoom Meeting Room
  - **WEDNESDAY: 6.00PM – 7.30PM (US EASTERN)**
  - <https://ncsu.zoom.us/j/4138568375>
  - **Meeting ID: 413 856 8375**

## ISE 535: Python Programming for Industrial Engineers

“Note: this syllabus is not a contract and can be altered at any point with advanced notice to accommodate the educational goals of the Course.”

**PLEASE BE PREPARED TO WATCH VIDEOS DURING ASSIGNED WEEK**

### Essentials I

Python Scripting and Anaconda Python Packages, Python Basics	Week One – May 18 <sup>th</sup> Section 1: Chapter 1 HW1 Assigned
Advanced Data Types and Structures (Lists, Tuples, Sets, Dictionaries)	Week Two – May 25 <sup>th</sup> Section 1: Essentials 1: Chapter 2,3 HW2 Assigned
Logic and Control Flow (If, While, For-Loops)	Week Three – June 1 <sup>st</sup> Section 1: Chapter 4 HW3 Assigned
Functions, Dates and Time	Week Four – June 8 <sup>th</sup> Section 1: Chapters 5,6,7
<b>TIMED TEST – 1</b> <b>(Content: Part 1: Chapters 1 – 5)</b>	<b>TAKE-HOME TIMED TEST</b> <b>(Between JUNE 9<sup>th</sup> – 12<sup>th</sup> 2022)</b>
File and Directory Handling Operations	Week Five – June 15 <sup>th</sup> Section 1: Chapter 8 HW4 Assigned
Solve Problems with Python Scripts	Week Six – June 22 <sup>nd</sup> Section 1: REVIEW CATCHUP HW5 Assigned
<b>TIMED TEST – 2</b> <b>(Content: Section 1: Chapters 1-8)</b>	<b>TAKE-HOME TIMED TEST</b> <b>(Between June 30<sup>th</sup> – July 3<sup>rd</sup>, 2022)</b>

### Computing for Data Analysis with NumPy and SciPy Package

NumPy (1D, 2D, Boolean Indexing, Broadcasting)	Week Seven – June 29 <sup>th</sup> Section 2: Numpy: Chapter 1,2 HW6 Assigned
Pandas - I (Clean, Transform, Merge)	Week Eight – July 6 <sup>th</sup> Section 2: Pandas: Chapter 3
Pandas – II (Data Munging, Plotting and Visualizing Data using Matplotlib, Seaborn)	Week Nine – July 13 <sup>th</sup> Section 2: Pandas: Chapter 4 HW7 Assigned

<p>Pandas – III (More Practice Problems)</p> <p>Scikit-learn-I (Basic Machine Learning with Python)</p>	<p>Week Nine – July 20<sup>th</sup> Section 2: Pandas: Chapter 4 Section 2: Scikit-learn</p>
<p>SciPy Package (Differential Equations, Integration, Root Finding Interpolation and Curve Fitting, Fourier Transforms, Optimization)</p> <p>Scikit-learn-II (Basic Machine Learning with Python)</p>	<p>Week Ten– July 27<sup>th</sup> Section 2: Scipy Section 2: Scikit-learn</p>

**FINAL PROJECT DELIVERABLES: August 1<sup>st</sup> 2022, 11.59pm**

#### Notes on Homework Assignments and Timed Tests

- You are allowed to seek help from classmates with regards to solving homework assignments.
- All tests are open book, open notes, and you are allowed to freely browse the web.
- Online students will activate the test at their own convenient time (between set time windows) and are required to complete and load solutions within the given timeframe.
- If time conflicts arise, please notify the instructor at least 1 week prior to the test date.

**Grades and Grade Point Average:** <https://policies.ncsu.edu/regulation/reg-02-50-03>

This Course uses Standard NCSU Letter Grading:

$97 \leq \mathbf{A+} \leq 100$   
 $93 \leq \mathbf{A} < 97$   
 $90 \leq \mathbf{A-} < 93$   
 $87 \leq \mathbf{B+} < 90$   
 $83 \leq \mathbf{B} < 87$   
 $80 \leq \mathbf{B-} < 83$   
 $77 \leq \mathbf{C+} < 80$   
 $73 \leq \mathbf{C} < 77$   
 $70 \leq \mathbf{C-} < 73$   
 $67 \leq \mathbf{D+} < 70$   
 $63 \leq \mathbf{D} < 67$   
 $60 \leq \mathbf{D-} < 63$   
 $0 \leq \mathbf{F} < 60$

**An A+ will only be awarded if the student has clearly demonstrated mastery over the subject as demonstrated through assignments, exams and projects.**

#### **Accommodations for Disabilities**

Any student in this course, who has a disability which may prevent him/her from fully participating in class activities, should contact the instructor personally. Reasonable accommodations will be made for students with verifiable disabilities. In order to take advantage of available accommodations, students

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must register with the Disability Resource Office at Holmes Hall, Suite 304, 2751 Cates Avenue, Campus Box 7509, 919-515-7653. For more information on NC State's policy on working with students with

disabilities, please see the Academic Accommodations for Students with Disabilities Regulation (REG02.20.01). <https://policies.ncsu.edu/regulation/reg-02-20-01>

### **Non-Discrimination Policy**

NC State University provides equality of opportunity in education and employment for all students and employees. Accordingly, NC State affirms its commitment to maintain a work environment for all employees and an academic environment for all students that is free from all forms of discrimination. Discrimination based on race, color, religion, creed, sex, national origin, age, disability, veteran status, or sexual orientation is a violation of state and federal law and/or NC State University policy and will not be tolerated. Harassment of any person (either in the form of quid pro quo or creation of a hostile environment) based on race, color, religion, creed, sex, national origin, age, disability, veteran status, or sexual orientation also is a violation of state and federal law and/or NC State University policy and will not be tolerated. Retaliation against any person who complains about discrimination is also prohibited. NC State's policies and regulations covering discrimination, harassment, and retaliation may be accessed at <http://policies.ncsu.edu/policy/pol-04-25-05> or <https://oied.ncsu.edu/equity/policies/>. Any person who feels that he or she has been the subject of prohibited discrimination, harassment, or retaliation should contact the Office for Institutional Equity and Diversity at 919-515-3148.

### **Students in Stress/Distress**

As members of the NC State Wolfpack community, we each share a personal responsibility to express concern for one another and to ensure that this classroom and the campus as a whole remains a safe environment for learning. Occasionally, you may come across a fellow classmate whose personal behavior concerns or worries you. When this is the case, I would encourage you to report this behavior to the NC State Students of Concern website: <http://studentsofconcern.ncsu.edu/>. Although you can report anonymously, it is preferred that you share your contact information so they can follow-up with you personally.

### **Requirements for Credit-Only (S/U) Grading**

In order to receive a grade of S, students are required to take all exams and quizzes, complete all assignments, and earn a grade of C- or better. Conversion from letter grading to credit only (S/U) grading is subject to university deadlines. Refer to the Registration and Records calendar for deadlines related to grading. For more details, refer to <http://policies.ncsu.edu/regulation/reg-02-20-15>. Please note that courses at 500 level and above cannot be taken for credit only.

### **Requirements for Auditors (AU)**

Information about and requirements for auditing a course can be found at <http://policies.ncsu.edu/regulation/reg-02-20-04>.

### **Policies on Incomplete Grades**

If an extended deadline is not authorized by the instructor or department, an unfinished incomplete grade will automatically change to an F after either (a) the end of the next regular semester in which the student is enrolled (not including summer sessions), or (b) the end of 12 months if the student is not enrolled, whichever is shorter. Incompletes that change to F will count as an attempted course on transcripts. The burden of fulfilling an incomplete grade is the responsibility of the student. The university policy on incomplete grades is located at <http://policies.ncsu.edu/regulation/reg-02-50-3>.

### **Academic Integrity**

Students are required to comply with the university policy on academic integrity found in the Code of Student Conduct found at <http://policies.ncsu.edu/policy/pol-11-35-01>. See Page 5 for Department of Industrial and Systems Engineering policies.

### **Academic Honesty**

See <http://policies.ncsu.edu/policy/pol-11-35-01> for a detailed explanation of academic honesty.

### **Honor Pledge**

Your signature on any test or assignment indicates "I have neither given nor received unauthorized aid on this test or assignment."

### **Attendance Policy**

Excuses for anticipated absences must be cleared with the instructor before the absence. Students will be allowed a minimum of two excused absences per academic year for religious observances as verified by the Division of Academic and Student Affairs (DASA). Assignments due in conjunction with an excused absence is due prior to the deadline unless negotiated in advance with the instructor. Unanticipated Absences. Excuses for unanticipated absences must be reported to the instructor as soon as possible, but not more than one week after the return to class. Assignments due in conjunction with an unanticipated absence is due within 24 hours after returning to class. After the third unexcused absence the student's final grade is lowered by 5% for each additional absence. <http://policies.ncsu.edu/regulation/reg-02-20-03>.

### **Electronically Hosted Course Components**

Students may be required to disclose personally identifiable information to other students in the course, via electronic tools like email or web-postings, where relevant to the course. Examples include online discussions of class topics, and posting of student coursework. All students are expected to respect the privacy of each other by not sharing/using information outside the course.

### **Class Evaluations**

Online class evaluations will be available for students to complete during the last two weeks of class. Students will receive an email message directing them to a website where they can login using their Unity ID and complete evaluations. All evaluations are confidential; instructors will never know how any one student responded to any question, and students will never know the ratings for any particular instructors. Evaluation website: <https://classeval.ncsu.edu> • Student help desk: [classeval@ncsu.edu](mailto:classeval@ncsu.edu) • More information about ClassEval: <http://www2.acs.ncsu.edu/UPA/classeval/index.htm>

### **N.C. State University Policies, Regulations, and Rules (PRR):**

"Students are responsible for reviewing the PRRs which pertain to their course rights and responsibilities. These include: <http://policies.ncsu.edu/policy/pol-04-25-05> (Equal Opportunity and Non-Discrimination Policy Statement), <http://oied.ncsu.edu/oied/policies.php> (Office for Institutional Equity and Diversity), <http://policies.ncsu.edu/policy/pol-11-35-01> (Code of Student Conduct), and <http://policies.ncsu.edu/regulation/reg-02-50-03> (Grades and Grade Point Average)."

**Edward P. Fitts Department of Industrial and Systems Engineering  
North Carolina State University**

The Department strives to provide an environment conducive to learning and believes strongly in the Code of Student Conduct (POL 11.35.01). The portion below, extracted from POL 11.35.01, is specific to academic misconduct:

## **8 ACADEMIC MISCONDUCT**

All members of the University community, students, faculty and other employees, have the responsibility to report academic misconduct to the appropriate authority.

Faculty members must undertake a threshold responsibility for such traditional safeguards as examination security and proctoring and should clearly communicate their academic expectations in the course syllabus. The use of the Pack Pledge, "I have neither given nor received unauthorized aid on this test or assignment," on all syllabi, assignments, examinations, or other academic evaluations is encouraged. Similarly, faculty members should familiarize themselves with the procedures for addressing academic misconduct. The procedures for reporting academic misconduct can be found in **NCSU REG11.35.02 - Student Discipline Procedures**.

Definitions regarding academic misconduct are set forth in writing in order to give students general notice of prohibited conduct. They should be read broadly and are not designed to define academic misconduct in exhaustive terms. If a student is in doubt regarding any matter relating to the standards of academic integrity in a given course or on a given assignment, that student must consult with the faculty member responsible for the course before presenting the work.

### 8.1 Aiding and Abetting

Aiding and abetting others to cheat or plagiarize is as detrimental to the scholarly community as engaging in the acts themselves. Aiding and abetting others to cheat or plagiarize includes, but is not limited to, the following:

- (a) Giving unauthorized assistance to another or others during a test or evaluation;
- (b) Posing as another student in order to meet a course or graduation requirement;
- (c) Providing specific information about a recently given test, examination, or assignment to a student who thereby gains an unfair advantage in an academic evaluation;
- (d) Providing aid to another person, knowing such aid is expressly prohibited by the faculty member, in the research, preparation, creation, writing, performing, or publication of work to be submitted for academic evaluation;
- (e) Permitting one's academic work to be represented as the work of another; or
- (f) Sharing or distributing academic materials, including class notes, in violation of the **UNC Policy Manual 500.2 – Patent and Copyright Policies** or **NCSU REG01.25.02 – Copyright Infringement – Policy Statement**.

### 8.2 Cheating

Cheating is the giving, taking, or presenting of information or material by a student that unethically or fraudulently aids oneself or another person on any work which is to be considered in the determination of a grade or the completion of academic requirements or the enhancement of that student's record or academic career. Cheating includes, but is not limited, to the following actions:

- (a) Copying from someone else's assignment, examination, or other academic exercise;
- (b) Possessing, buying, selling, removing, receiving, or using, at any time or in any manner not prescribed by the faculty member, any information related to an instrument of academic evaluation;



- (c) Using materials, equipment, or assistance in connection with an assignment, examination, or other academic exercise which have not been authorized by the faculty member, including but not limited to, notes, calculator, or other technology;
- (d) Obtaining or attempting to obtain, in a dishonest manner, any material relating to a student's academic work;
- (e) Working with another or others in completing an assignment, examination, or other academic exercise when the faculty member has required independent and unaided action;
- (f) Attempting to influence or change an academic evaluation, grade, or record by unfair means;
- (g) Permitting another individual to substitute for one's self in an academic evaluation;
- (h) Marking or submitting an examination or evaluation material in a manner designed to deceive the grading system;
- (i) Failing to comply with a specific condition of academic integrity which has been clearly announced in a particular course;
- (j) Submitting, without prior permission of the faculty member, any work by a student which has at any time been submitted in identical or similar form by that student in fulfillment of any other academic requirement at any institution;
- (k) Submitting of material in whole or part for academic evaluation that has been prepared by another individual(s);
- (l) Submitting data which have been altered or contrived in such a way as to be deliberately misleading; or
- (m) Providing false information to the University in any manner to achieve an unfair advantage, enhance one's record, or complete a requirement.

### 8.3 Destruction or Removal of Academic Materials

The destruction or removal of academic materials denies access to, and prevents the ability to develop the full potential of, scholarly resources. Prohibited acts under this section include, but are not limited to, the following:

- (a) Removing or attempting to remove, destroy, steal, or make inaccessible library or other academic material without authorization; or
- (b) Willfully damaging the academic work or efforts of another.

### 8.4 Plagiarism

Plagiarism is the use or close imitation of the language and thoughts of another and the representation of the other's work as their own. The act of submitting work for evaluation or to meet a requirement is regarded as assurance that the work is the result of the student's own thought and study, produced without assistance, and stated in that student's own words, except as quotation marks, references, or footnotes acknowledge the use of other sources. Any ideas or materials taken from another source for either written or oral use must be fully and correctly acknowledged. Submission of work used previously must first be approved by the faculty member. Plagiarism includes, but is not limited, to the following actions:

- (a) Representing the work of others as his or her own; or
- (b) Submitting written materials without proper attribution or acknowledgment of the source.

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I have read, understand, and agree to abide by the Code of Student Conduct.

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Name (Printed)

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Signature

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Date