INTL/INTL/QMBU472 / CSSM502: Advanced Data Analysis in Python

Introduction

David Carlson

September 28, 2021

Contact Information

Instructor

David Carlson

Office: CASE 140

Email: dcarlson@ku.edu.tr

Office Hours: TU 13.00-14.00, TH 13.00-14.00, or by appointment

Teaching Assistant

Oğuz Bülüt Kök

Email: okok20@ku.edu.tr

Learn Python 3 syntax

- Learn Python 3 syntax
- Understand basic programming concepts

- Learn Python 3 syntax
- Understand basic programming concepts
- Understand advanced data analysis problems and the needed tools to solve them

- Learn Python 3 syntax
- Understand basic programming concepts
- Understand advanced data analysis problems and the needed tools to solve them
- Establish a basic understanding of advanced machine learning concepts and algorithms

- Learn Python 3 syntax
- Understand basic programming concepts
- Understand advanced data analysis problems and the needed tools to solve them
- Establish a basic understanding of advanced machine learning concepts and algorithms
- Improve upon academic and professional writing

- Learn Python 3 syntax
- Understand basic programming concepts
- Understand advanced data analysis problems and the needed tools to solve them
- Establish a basic understanding of advanced machine learning concepts and algorithms
- Improve upon academic and professional writing
- Identify and properly analyze a question in a relevant field

- Learn Python 3 syntax
- Understand basic programming concepts
- Understand advanced data analysis problems and the needed tools to solve them
- Establish a basic understanding of advanced machine learning concepts and algorithms
- Improve upon academic and professional writing
- Identify and properly analyze a question in a relevant field
- Contribute to statistical software development

• Great for beginners and advanced use

- Great for beginners and advanced use
 - Easily readable code

- Great for beginners and advanced use
 - ► Easily readable code
 - ▶ Indentation forces organization

- Great for beginners and advanced use
 - ► Easily readable code
 - ▶ Indentation forces organization
 - Online resources

- Great for beginners and advanced use
 - Easily readable code
 - ▶ Indentation forces organization
 - Online resources
- Widely used, especially in scientific computing

- Great for beginners and advanced use
 - Easily readable code
 - ▶ Indentation forces organization
 - Online resources
- Widely used, especially in scientific computing
- Powerful

- Great for beginners and advanced use
 - ► Easily readable code
 - ► Indentation forces organization
 - Online resources
- Widely used, especially in scientific computing
- Powerful
 - Machine learning modules

- Great for beginners and advanced use
 - Easily readable code
 - Indentation forces organization
 - Online resources
- Widely used, especially in scientific computing
- Powerful
 - Machine learning modules
- Open-source

- Great for beginners and advanced use
 - Easily readable code
 - ▶ Indentation forces organization
 - Online resources
- Widely used, especially in scientific computing
- Powerful
 - Machine learning modules
- Open-source
- In demand

• No programming experience needed

- No programming experience needed
- Understanding of generalized linear models assumed, though we will review

- No programming experience needed
- Understanding of generalized linear models assumed, though we will review
 - Maximum likelihood

- No programming experience needed
- Understanding of generalized linear models assumed, though we will review
 - Maximum likelihood
 - Linear algebra

- No programming experience needed
- Understanding of generalized linear models assumed, though we will review
 - Maximum likelihood
 - Linear algebra
 - Basic probability

- No programming experience needed
- Understanding of generalized linear models assumed, though we will review
 - Maximum likelihood
 - ► Linear algebra
 - Basic probability
 - Linear modeling assumptions

• Familiarize with Python 3 and advanced data analysis techniques

- Familiarize with Python 3 and advanced data analysis techniques
- Should be able to read any book after the course to learn new modeling strategies

- Familiarize with Python 3 and advanced data analysis techniques
- Should be able to read any book after the course to learn new modeling strategies
- Python syntax and programming concepts (data types, functions, loops, recursion, classes, inheritance)

- Familiarize with Python 3 and advanced data analysis techniques
- Should be able to read any book after the course to learn new modeling strategies
- Python syntax and programming concepts (data types, functions, loops, recursion, classes, inheritance)
- Data base management, creation, manipulation, and visualization

- Familiarize with Python 3 and advanced data analysis techniques
- Should be able to read any book after the course to learn new modeling strategies
- Python syntax and programming concepts (data types, functions, loops, recursion, classes, inheritance)
- Data base management, creation, manipulation, and visualization
- Overview of generalized linear models and extensions

- Familiarize with Python 3 and advanced data analysis techniques
- Should be able to read any book after the course to learn new modeling strategies
- Python syntax and programming concepts (data types, functions, loops, recursion, classes, inheritance)
- Data base management, creation, manipulation, and visualization
- Overview of generalized linear models and extensions
- Machine learning models

- Familiarize with Python 3 and advanced data analysis techniques
- Should be able to read any book after the course to learn new modeling strategies
- Python syntax and programming concepts (data types, functions, loops, recursion, classes, inheritance)
- Data base management, creation, manipulation, and visualization
- Overview of generalized linear models and extensions
- Machine learning models
- Projects and presentations

• 2 books; can be read for free online

- 2 books; can be read for free online
- Do not recommend buying them

- 2 books; can be read for free online
- Do not recommend buying them
- Shaw, Zed A. 2017. Learn Python 3 the Hard Way: A Very Simple Introduction to the Terrifyingly Beautiful World of Computers and Code (Zed Shaw's Hard Way Series). 1st Edition. Addison-Wesley. Available at: https://learnpythonthehardway.org/python3/

- 2 books; can be read for free online
- Do not recommend buying them
- Shaw, Zed A. 2017. Learn Python 3 the Hard Way: A Very Simple Introduction to the Terrifyingly Beautiful World of Computers and Code (Zed Shaw's Hard Way Series). 1st Edition. Addison-Wesley. Available at: https://learnpythonthehardway.org/python3/
- VanderPlas, Jake. 2016. Python Data Science Handbook: Essential Tools for Working with Data. OReilly Media. Available at: https://jakevdp.github.io/PythonDataScienceHandbook/

- 2 books; can be read for free online
- Do not recommend buying them
- Shaw, Zed A. 2017. Learn Python 3 the Hard Way: A Very Simple Introduction to the Terrifyingly Beautiful World of Computers and Code (Zed Shaw's Hard Way Series). 1st Edition. Addison-Wesley. Available at: https://learnpythonthehardway.org/python3/
- VanderPlas, Jake. 2016. Python Data Science Handbook: Essential Tools for Working with Data. OReilly Media. Available at: https://jakevdp.github.io/PythonDataScienceHandbook/
- Additional readings listed on the syllabus

Readings

- 2 books; can be read for free online
- Do not recommend buying them
- Shaw, Zed A. 2017. Learn Python 3 the Hard Way: A Very Simple Introduction to the Terrifyingly Beautiful World of Computers and Code (Zed Shaw's Hard Way Series). 1st Edition. Addison-Wesley. Available at: https://learnpythonthehardway.org/python3/
- VanderPlas, Jake. 2016. Python Data Science Handbook: Essential Tools for Working with Data. OReilly Media. Available at: https://jakevdp.github.io/PythonDataScienceHandbook/
- Additional readings listed on the syllabus
- Articles will be posted on Blackboard

• Both graded and ungraded homework

- Both graded and ungraded homework
- All listed in syllabus on GitHub

- Both graded and ungraded homework
- All listed in syllabus on GitHub
- Graded homework should be posted on GitHub

- Both graded and ungraded homework
- All listed in syllabus on GitHub
- Graded homework should be posted on GitHub
- Collaboration is encouraged, but every keystroke must be your own

- Both graded and ungraded homework
- All listed in syllabus on GitHub
- Graded homework should be posted on GitHub
- Collaboration is encouraged, but every keystroke must be your own
- Graded homework: 50%

- Both graded and ungraded homework
- All listed in syllabus on GitHub
- Graded homework should be posted on GitHub
- Collaboration is encouraged, but every keystroke must be your own
- Graded homework: 50%
- All homework, when applicable, needs to be done on git

- Both graded and ungraded homework
- All listed in syllabus on GitHub
- Graded homework should be posted on GitHub
- Collaboration is encouraged, but every keystroke must be your own
- Graded homework: 50%
- All homework, when applicable, needs to be done on git
- Look at other's homework as a last resort, and cite their work

• Can be done in groups (2–4 students) or individually; reflected in grading

- Can be done in groups (2–4 students) or individually; reflected in grading
- Replication code (must be Python!) and report appropriate for your field

- Can be done in groups (2–4 students) or individually; reflected in grading
- Replication code (must be Python!) and report appropriate for your field
- Hypothesis, data report, methods with explanation, findings

- Can be done in groups (2–4 students) or individually; reflected in grading
- Replication code (must be Python!) and report appropriate for your field
- Hypothesis, data report, methods with explanation, findings
- Null results are fine

- Can be done in groups (2–4 students) or individually; reflected in grading
- Replication code (must be Python!) and report appropriate for your field
- Hypothesis, data report, methods with explanation, findings
- Null results are fine
- Exploratory work generally discouraged

- Can be done in groups (2–4 students) or individually; reflected in grading
- Replication code (must be Python!) and report appropriate for your field
- Hypothesis, data report, methods with explanation, findings
- Null results are fine
- Exploratory work generally discouraged
- Benchmarks listed in the syllabus

- Can be done in groups (2–4 students) or individually; reflected in grading
- Replication code (must be Python!) and report appropriate for your field
- Hypothesis, data report, methods with explanation, findings
- Null results are fine
- Exploratory work generally discouraged
- Benchmarks listed in the syllabus
- Presentation (ungraded)

- Can be done in groups (2–4 students) or individually; reflected in grading
- Replication code (must be Python!) and report appropriate for your field
- Hypothesis, data report, methods with explanation, findings
- Null results are fine
- Exploratory work generally discouraged
- Benchmarks listed in the syllabus
- Presentation (ungraded)
- Worth 50% of grade

- Can be done in groups (2–4 students) or individually; reflected in grading
- Replication code (must be Python!) and report appropriate for your field
- Hypothesis, data report, methods with explanation, findings
- Null results are fine
- Exploratory work generally discouraged
- Benchmarks listed in the syllabus
- Presentation (ungraded)
- Worth 50% of grade
- If you do not know LATEX, consider learning the basics

Version control

- Version control
- Open-source development

- Version control
- Open-source development
- Collaboration

- Version control
- Open-source development
- Collaboration
- Let others know your skills

- Version control
- Open-source development
- Collaboration
- Let others know your skills
- Beautiful merging of collaborative work

- Version control
- Open-source development
- Collaboration
- Let others know your skills
- Beautiful merging of collaborative work
- Branches for sub-projects

- Version control
- Open-source development
- Collaboration
- Let others know your skills
- Beautiful merging of collaborative work
- Branches for sub-projects
- Free (unless you want private repos)

 Read https://git-scm.com/docs/user-manual.html up until the section "Exploring Git history"

- Read https://git-scm.com/docs/user-manual.html up until the section "Exploring Git history"
- Shaw, Appendix

- Read https://git-scm.com/docs/user-manual.html up until the section "Exploring Git history"
- Shaw, Appendix
- Shaw, Exercises 0 15

- Read https://git-scm.com/docs/user-manual.html up until the section "Exploring Git history"
- Shaw, Appendix
- Shaw, Exercises 0 − 15
- Install Anaconda

https://docs.anaconda.com/anaconda/install/

- Read https://git-scm.com/docs/user-manual.html up until the section "Exploring Git history"
- Shaw, Appendix
- Shaw, Exercises 0 − 15
- Install Anaconda https://docs.anaconda.com/anaconda/install/
- Sign up for a free GitHub account https://github.com/

- Read https://git-scm.com/docs/user-manual.html up until the section "Exploring Git history"
- Shaw, Appendix
- Shaw, Exercises 0 − 15
- Install Anaconda https://docs.anaconda.com/anaconda/install/
- Sign up for a free GitHub account https://github.com/
- Install git https://git-scm.com/downloads

- Read https://git-scm.com/docs/user-manual.html up until the section "Exploring Git history"
- Shaw, Appendix
- Shaw, Exercises 0 − 15
- Install Anaconda https://docs.anaconda.com/anaconda/install/
- Sign up for a free GitHub account https://github.com/
- Install git https://git-scm.com/downloads
- Create a public repository called PythonCourse, and add me (carlson9) as a collaborator

- Read https://git-scm.com/docs/user-manual.html up until the section "Exploring Git history"
- Shaw, Appendix
- Shaw, Exercises 0 − 15
- Install Anaconda https://docs.anaconda.com/anaconda/install/
- Sign up for a free GitHub account https://github.com/
- Install git https://git-scm.com/downloads
- Create a public repository called PythonCourse, and add me (carlson9) as a collaborator
- Email me your GitHub user name

- Read https://git-scm.com/docs/user-manual.html up until the section "Exploring Git history"
- Shaw, Appendix
- Shaw, Exercises 0 − 15
- Install Anaconda https://docs.anaconda.com/anaconda/install/
- Sign up for a free GitHub account https://github.com/
- Install git https://git-scm.com/downloads
- Create a public repository called PythonCourse, and add me (carlson9) as a collaborator
- Email me your GitHub user name
- Clone the repo at https://github.com/carlson9/KocPythonFall2021 (this is where material for class will be uploaded — sync before class every day)

Other Notes

Twitter

Other Notes

- Twitter
 - ▶ If you do not have an account, get one

Other Notes

- Twitter
 - ▶ If you do not have an account, get one
 - Apply for a developer account ASAP

Other Notes

- Twitter
 - ▶ If you do not have an account, get one
 - Apply for a developer account ASAP
- I do not use an IDE, but feel free to

Other Notes

- Twitter
 - ▶ If you do not have an account, get one
 - ► Apply for a developer account ASAP
- I do not use an IDE, but feel free to
- Bother me and the TA as much as needed

• A programming course

- A programming course
 - ► The goal is data analysis

- A programming course
 - ► The goal is data analysis
 - Python can do much more than data analysis

- A programming course
 - ► The goal is data analysis
 - Python can do much more than data analysis
 - ➤ You will be able to pick up any Python book and understand it after this course if you want to further develop

- A programming course
 - ► The goal is data analysis
 - Python can do much more than data analysis
 - ► You will be able to pick up any Python book and understand it after this course if you want to further develop
- Easy

- A programming course
 - ► The goal is data analysis
 - Python can do much more than data analysis
 - You will be able to pick up any Python book and understand it after this course if you want to further develop
- Easy
 - ▶ But, if you at least try, you will get a decent grade

- A programming course
 - ► The goal is data analysis
 - Python can do much more than data analysis
 - You will be able to pick up any Python book and understand it after this course if you want to further develop
- Easy
 - ▶ But, if you at least try, you will get a decent grade
- Very theoretical

- A programming course
 - ► The goal is data analysis
 - Python can do much more than data analysis
 - You will be able to pick up any Python book and understand it after this course if you want to further develop
- Easy
 - ▶ But, if you at least try, you will get a decent grade
- Very theoretical
 - The emphasis is on application

 Because we will continue covering models until the end of the semester, you should know what you will be able to do as you prepare for the final project

- Because we will continue covering models until the end of the semester, you should know what you will be able to do as you prepare for the final project
 - ► Flexible GLMs for inference on complicated data-generating processes

- Because we will continue covering models until the end of the semester, you should know what you will be able to do as you prepare for the final project
 - ► Flexible GLMs for inference on complicated data-generating processes
 - Measurement tasks (text analysis, image recognition, latent variables, etc.)

- Because we will continue covering models until the end of the semester, you should know what you will be able to do as you prepare for the final project
 - ► Flexible GLMs for inference on complicated data-generating processes
 - Measurement tasks (text analysis, image recognition, latent variables, etc.)
 - Prediction and forecasting models

- Because we will continue covering models until the end of the semester, you should know what you will be able to do as you prepare for the final project
 - ► Flexible GLMs for inference on complicated data-generating processes
 - Measurement tasks (text analysis, image recognition, latent variables, etc.)
 - Prediction and forecasting models
 - Clustering algorithms

- Because we will continue covering models until the end of the semester, you should know what you will be able to do as you prepare for the final project
 - ► Flexible GLMs for inference on complicated data-generating processes
 - Measurement tasks (text analysis, image recognition, latent variables, etc.)
 - Prediction and forecasting models
 - Clustering algorithms
 - Dimensionality reduction

- Because we will continue covering models until the end of the semester, you should know what you will be able to do as you prepare for the final project
 - ► Flexible GLMs for inference on complicated data-generating processes
 - Measurement tasks (text analysis, image recognition, latent variables, etc.)
 - Prediction and forecasting models
 - Clustering algorithms
 - Dimensionality reduction
 - Regression and classification

- Because we will continue covering models until the end of the semester, you should know what you will be able to do as you prepare for the final project
 - ▶ Flexible GLMs for inference on complicated data-generating processes
 - Measurement tasks (text analysis, image recognition, latent variables, etc.)
 - Prediction and forecasting models
 - Clustering algorithms
 - Dimensionality reduction
 - Regression and classification
 - Specifically: Naive Bayes classification, (generalized) linear regression, support vector machines, decision trees and random forests, principal component analysis, manifold learning, k-means clustering, Gaussian mixture models, kernel density estimation, neural networks

- Because we will continue covering models until the end of the semester, you should know what you will be able to do as you prepare for the final project
 - ► Flexible GLMs for inference on complicated data-generating processes
 - Measurement tasks (text analysis, image recognition, latent variables, etc.)
 - Prediction and forecasting models
 - Clustering algorithms
 - Dimensionality reduction
 - Regression and classification
 - Specifically: Naive Bayes classification, (generalized) linear regression, support vector machines, decision trees and random forests, principal component analysis, manifold learning, k-means clustering, Gaussian mixture models, kernel density estimation, neural networks
- If you have an idea, but do not know how to implement it (or if it is possible), talk to me