Hertie School **Master of Data Science for Public Policy**
Fall Semester 2021

Course Syllabus, Version dd.mm.yyyy

GRAD-C9: Data Structures and Algorithms

Hannah Bechara

1. General information

Class time	Mon, 12-14h
Course Format	Online Only
Instructor	Hannah Bechara
Instructor's office	3.14
Instructor's e-mail	bechara@hertie-school.org
Instructor's phone number	
Assistant	Name: TBA Email:TBA Phone: +49 30 259 219TBA Room:TBA
Instructor's Office Hours	TBA

2.

Link to MDS, MPP, MIA Module Handbooks
Link to **Study, Examination and Admission Rules**

Instructor Information:
Hannah is an NLP post-doc who inadvertently found herself hired by Hertie's Data Science lab. In between training neural networks and support vector machines, Hannah occasionally teaches programming classes in Python, the programming language for winners. For reasons yet unclear, the University of Wolverhampton decided to award Hannah a PhD in Computer Science.

2. Course Contents and Learning Objectives

Course contents:
This Python for Data Scientists course leads the students from the basics of writing and running Python scripts to more advanced features such object-oriented programming and data structures.

Main learning objectives:
Master the fundamentals of writing Python scripts

Learn core scripting elements such as variables and flow control structures
Discover how to work with lists and sequence data
Write Python functions to facilitate code reuse
Use Python to read and write files
Learn the fundamentals of object oriented programmed, test-based programming and algorithm analysis.

Target group:
This course is designed for beginners with no previous programming experience who are interested in learning Python for Data Science. It is especially recommended for students who plan to take next semester's Machine Learning or Deep Learning course.

Teaching style:
Classes will be highly interactive, focusing on hands-on experience and allowing students to test out everything they have learned in class. Each 2-hour session is followed by a 1 hour lab and will include a lecture that introduces some core concepts, a classroom activity that allows students to try out what they learned and solve a problem, and a discussion of the solutions to the problem.

Prerequisites:
None

3. Grading and Assignments

The assessment for the course consists of a project, presentation and participation. The research project must be done in teams of 2-4 (individual submissions will not be accepted for the project). The aim of the assessments is three-fold. First, it will provide you with the opportunity to apply the concepts learned in this class creatively, which helps you with understanding material more deeply. Second, designing and working on a unique project in a team which is something that you will encounter, if you haven't already, in the workplace, and the project helps you prepare for that. Third, along with the opportunity to practice and the satisfaction of working creatively, students can use this project to enhance their portfolio or resume.

Note about grading. You will be graded on the quality of your code as well as the efficiency and tidiness. Additionally, you are expected to document your code and to clearly mark any code that is not your own. Smelly code will be penalised.

You must include a link to a GitHub repository containing the code of your project. Your repository must be viewable to the instructor by the submission deadline. If your repository is private, make it accessible to us (GitHub ID hbechara). If your repository is not visible to us, your assignment will not be considered complete, so if you are worried please submit well in advance of the deadline so we can confirm the repository is visible. Furthermore, we will assess individual contribution to the team, should such an issue arise, based on the frequency and quality of GitHub commits in your project repository, so make sure you start the repository as the very first stage of your project.

Composition of Final Grade:

Assignment 1: Group Presentations	Deadline: Starting Week 4	Submit via classroom presentation.	20%
Assignment 2: Project Proposals	Deadline: Week 6	Submit via Moodle	20%
Assignment 3 (if applicable): Final Projects Due	Deadline: Week 12	Submit via Github	40%
Final Presentations	Deadline Week 12	Submit via classroom presentation	10 %
Participation grade			10%

Assignment Details

Assignment 1
Starting Week 4, each team of 2-4 students will give a 20 minute presentation on a package, library or framework of their choice. A list of options will be provided at the start of the semester.

Assignment 2
The main purpose of the project proposal is to receive feedback from the instructor regarding whether your project is feasible and whether it is within the scope of this class. Also, the project proposal offers a chance to receive useful feedback and suggestions on your project.

Assignment 3
You must include a link to a GitHub repository containing full working code of your project, including JUnit tests and full documentation.

Class Presentation
At the end of the semester, teams will produce poster/video presentation of their work to the class and broader Hertie community. Detailed description of the presentation task and marking rubric will be made available on Moodle. Selected projects will be displayed on the lab's website.

Participation grade

The participation grade is based on the assumption that students take part, not as passive consumers of knowledge, but as active participants in the exchange, production, and critique of ideas—their own ideas and the ideas of others. Therefore, students should come to class not only having read and viewed the materials assigned for that day but also prepared to discuss the readings of the day and to contribute thoughtfully to the conversation. Participation is marked by its active nature, its consistency, and its quality.

Late submission of assignments: For each day the assignment is turned in late, the grade will be reduced by 10% (e.g. submission two days after the deadline would result in 20% grade deduction).

Attendance: Students are expected to be present and prepared for every class session. Active participation during lectures and seminar discussions is essential. If unavoidable circumstances arise which prevent attendance or preparation, the instructor should be advised by email with as much advance notice as possible. Please note that students cannot miss more than two out of 12 course sessions. For further information please consult the Examination Rules §10.

Academic Integrity: The Hertie School is committed to the standards of good academic and ethical conduct. Any violation of these standards shall be subject to disciplinary action. Plagiarism, deceitful actions as well as free-riding in group work are not tolerated. See Examination Rules §16 and the Hertie Plagiarism Policy.

Compensation for Disadvantages: If a student furnishes evidence that he or she is not able to take an examination as required in whole or in part due to disability or permanent illness, the Examination Committee may upon written request approve learning accommodation(s). In this respect, the submission of adequate certificates may be required. See Examination Rules §14.

Extenuating circumstances: An extension can be granted due to extenuating circumstances (i.e., for reasons like illness, personal loss or hardship, or caring duties). In such cases, please contact the course instructors and the Examination Office *in advance* of the deadline.

4. General Readings

Required:
Michael Dawson. Python for the Absolute Beginner

Recommended:
Steven Bird, Ewan Klein and Edward Loper. Natural Language Processing with Python
Aditya Y. Bhargava, Grokking Algorithms: An illustrated guide for programmers and other curious people
Roy Osherove, The Art of Unit Testing

5. Session Overview

Session	Session Date	Session Title
1	06.09.2021	Getting Started with Python: Fundamentals
2	13.09..2021	Flow Control
3	20.09.2021	Data Structures
4	27.09.2021	Functions
5	04.10.2021	Working with Files
6	11.10.2021	Unit Tests and Documentation

Mid-term Exam Week: 18 – 22.10.2021 – no class		
7	**25.10.2021**	**Object Oriented Programming**
8	**01.11..2021**	**Inheritance and Composition**
9	**08.11.2021**	**Advanced Data Structures**
10	**15.11.2021**	**Advanced Data Structures II**
11	**22.11.2021**	**Algorithm Analysis and Big-O Notation**
12	**29.11.2021**	**Project Presentations**
Final Exam Week: 13 – 17.12.2021 – no class		

6. Course Sessions and Readings

All readings will be accessible on the Moodle course site before semester start. In the case that there is a change in readings, students will be notified by email.
Required readings are to be read and analysed thoroughly. Optional readings are intended to broaden your knowledge in the respective area and it is highly recommended to at least skim them.

Session 1: Getting Started with Python	
Learning Objective	Learning to use Google Collab and Jupyter Notebooks. Learning about data types, variables, standard input and output with Python. Learning about Integers, Floats and Strings and operators. Learning to open and read files, write to files, and handle exceptions Learn the structure of Python Packages and how to import modules from packages in Python. Writing our first Python program.
Required Readings	Chapter 1 &2: Python Programming for the Absolute Beginner by Michael Dawson
Optional Readings	https://realpython.com/python-introduction/ https://www.programiz.com/python-programming/variables-datatypes

Session 2: Flow Control	
Learning Objective	Learning about conditionals, loops, etc
Required Readings	Chapter 3: Python Programming for the Absolute beginner
Optional Readings	http://www.python-course.eu/python3_conditional_statements.php http://www.python-course.eu/python3_loops.php http://www.python-course.eu/python3_for_loop.php
Session 3: Data Structures	
Learning Objective	Lists, tuples, dictionaries and strings.
Required Readings	Chapter 4: Python Programming for the Absolute Beginner by Michael Dawson
Optional Readings	https://realpython.com/lessons/lists-tuples-python-overview/ https://realpython.com/python-dicts/

Session 4: Functions	
Learning Objective	To understand the use of functions and basic principles like encapsulation and recursion. Learning to reuse functions, global variables.
Required Readings	Chapter 6: Python Programming for the Absolute Beginner by Michael Dawson
Optional Readings	https://en.wikibooks.org/wiki/Non-Programmer's_Tutorial_for_Python_3/Defining_Functions

Session 5: Working with Data	
Learning Objective	Learning to write and read from files, packaging your own modules and working with data.

Required Readings	None
Optional Readings	None

Session 6: Unit Testing and Documentation	
Learning Objective	Learning Unit-testing as part of development. Understanding the importance of writing unit tests
Required Readings	None
Optional Readings	https://docs.python.org/2/library/unittest.html

Mid-term Exam Week: 18 – 22.10.2021 – no class

Session 7: Object Oriented Programming	
Learning Objective	Learning about object oriented programming: classes, objects, attributes and methods
Required Readings	Chapter 8: Python Programming for the Absolute Beginner by Michael Dawson
Optional Readings	http://greenteapress.com/thinkpython2/html/thinkpython2018.html .

Session 8: Inheritance and Composition	
Learning Objective	Digging deeper into OOP concepts with inheritance and composition
Required Readings	Chapter 8: Python Programming for the Absolute Beginner by Michael Dawson
Optional Readings	

Session 9: Advanced Data Structures	
Learning Objective	Learn about more advanced data structures and dynamic programming
Required Readings	None
Optional Readings	None

Session 10: Advanced Data Structures II	
Learning Objective	Learn about advanced data structures and dynamic programming
Required Readings	Please include the required readings for this session.
Optional Readings	Please include the optional readings for this session.

Session 11: Algorithm Analysis and Big-O notation	
Learning Objective	Learning the basics of algorithm analysis, performance and requirements
Required Readings	
Optional Readings	http://greenteapress.com/thinkpython2/html/thinkpython2022.html

Session 12: Project Presentations	
Learning Objective	Students will have a chance to present projects and demos to the class
Required Readings	None
Optional Readings	None

Final Exam Week: 13 – 17.12.2021 – no class