UNIVERSITÄT SIEGEN

Co-funded by the
Erasmus+ Programme
of the European Union

Erasmus+ SkoPS

< D0.5: Python programming for IoT and Data Science Course Outline and Description>

Project Title	Empowering the European Workforce Development through Online/Virtual Skills Training for Digital Transformation towards Mitigating the Impact of Pandemic Situations (SkoPS)		
Project Acronym	SkoPS	**Project Number**	2020-1-DE01-KA226-HE-005772
Date	2021-11-03	**Deliverable No.**	D0.5
Contact Person		**Organisation**	Petanux (PTX)
Phone	-	**E-Mail**	mahnaz.mirhaj@petanux.com
Version	2	**Confidentiality level**	Public

UNIVERSITÄT SIEGEN   **Petanux** From Knowledge to Market   **Universitat d'Alacant**   European Institute for Local Development

Version History

Version No.	Date	Change	Editor(s)
1	13.12.2021	Initial draft	Mahnaz Mirhaj
2	14.12.2021	Second draft	Mahnaz Mirhaj

Contributors

Name	Organization
Mahdi Bohlouli	PTX
Mahnaz Mirhaj	PTX

Disclaimer

Table of Contents

1   Introduction

In the modern and intelligent world, high volumes of data are generated at a rapid pace via IoT devices. To employ and utilize this amount of data Data Science techniques and approaches can be a great asset. Besides, Python is a popular programming language that has powerful libraries for implementing Data Science strategies. Therefore, Python programming for IoT and Data Science is an emerging technology, and learning it is a must for everyone.

1.1   Abstract

The Python programming for IoT and Data Science course is arranged in 4 chapters aiming to help students enhance their knowledge and skills in the most updated and popular Python libraries, Data Science methods, and IoT datasets. The course covers the technical and practical parts of Python programming for IoT and Data Science. This course offers different types of activities and media to assist students to understand Python Programming and employ it to large extent.

1.2   Purpose of the document

The purpose of this document is to have an outline for the Python programming for IoT and Data Science course. In this file, the general structure of the course is described and determined. This file includes description, materials, activities, objective, contents, prerequisites, references, assessment methods of the course.

1.3   Relation to other deliverables

The Python programming for IoT and data science course is in relation to Fundamental Machine Learning, Smart Cities and IoT, Wireless sensor networks, and Big Data Management course.

2   Template

<table>
<tr><td colspan="4" align="center">Course Plan Template</td></tr>
<tr><td>Course ID and Title:</td><td colspan="3">Python programming for IoT and Data Science</td></tr>
<tr><td>Course Duration:</td><td>6 Weeks</td><td>Course ECTS:</td><td></td></tr>
<tr><td>Leading Organization:</td><td colspan="3">Petanux</td></tr>
<tr><td>Course Media:</td><td colspan="3">Video, Jupyter Notebooks, Text File</td></tr>
<tr><td>Laboratory (Yes/No)</td><td colspan="3">Yes</td></tr>
<tr><td colspan="4">Course Description:</td></tr>
<tr><td colspan="4">

Internet of Things (IoT) and Data Science are two emerging technologies that empower businesses to have better intuitions and enhance their decision-making process by bringing access to massive amounts of data and analyzing them. IoT technology enables interconnection between devices varying from a household tool to advanced industrial ones which are gathering tones of Data every second. With the help of Data Science, you can utilize and put these enormous and even streaming data in use.

During this course, you will learn how to collect, clean, analyze, and store IoT data by executing effective Python programming, using Data Science approaches. Python is one of the most popular programming languages for Data Science. It is used widely for applying Data Science methods and running experiments over a large amount of Data. Also, it is equipped with powerful libraries to facilitate coding. This course will guide you to build Data Science models to detect patterns or anomalies over IoT data with the help of these libraries.

In addition, to educate you practically we have designed many virtual laboratories and hands-on projects that concentrate on applications of Data Science on IoT datasets. Real-world problems are presented with given IoT datasets and you are asked to design a model for learning by applying Data Science techniques. Finally, you should analyze its results and evaluate your model.

This course is planned for students of Computer Science, Mathematics, and any other related fields in bachelor or master degree or those who want to learn Python programming for IoT and Data Science on a self-learning basis. While to use this material you do not need to have any background knowledge, for implementing the hands-on project you need to have access to the Anaconda environment or Google Colaboratory.

Students and participants of this course are expected to learn the basics of Python Programming, fundamentals of Data Science algorithms, how to collect and store IoT data, and get familiar with popular Python libraries (for e.g Pandas, Matplotlib, Numpy, Tensorflow, Sklearn). This leads them to be able to use Python Programming to work with data and manipulate it. Also, empowers them to build and initiate Data Science Models on IoT datasets using Python on their own after finishing the course.

To reach the course objectives and ensure the proper learning, the course engages diverse activities including, watching videos, reading the materials, participating in self-assessment, and completing the hands-on project.

</td></tr>
<tr><td colspan="4">Course Materials and Equipment (Prerequisite)</td></tr>
</table>

You are not required to have any background knowledge of Data Science or IoT. But you should have access to the Anaconda environment or Google Colaboratory.

Teaching and Learning Activities:

Teaching Activities for this course consist of :

1-Video Lectures: Presenting basics of the Data Science Algorithms, IoT datasets, and Python

2-Virtual labs and hands-on Projects:

2.1-Problem representation: representation of a (real-world) problem.

2.2- Present an IoT dataset

2.3-Hands-on experience: executing Data Science Algorithms on the problem, using

Python Libraries

3-Teaching Programming (With Jupyter Notebooks (sample codes))

Course activities:

The activities for this course include:

1- Watching video lectures students are expected to watch all the video lectures to better understand the content.
2- Programming and completing the laboratories: students should apply their acquired knowledge to build models using Python libraries.
3- Take part in self-assessments (A problem is presented and a data set is given. Students are asked to drive and initiate ideas to use the best methods and libraries, solving the problem with programming. Also, some hints and advice are given in Jupyter notebooks.)

Course Objectives:

This course main objectives are listed below:

1- Data Collection using IoT Devices
2- Data Cleaning, Data Analysis, and Data Visualization with Python using Data Science Algorithms and IoT datasets
3- Building IoT Data Science Projects with Python

Course Summary:

There are four main chapters of this course that guide students through updated techniques and approaches of IoT Data Science, important Python libraries, and programming and executing IoT Data Science projects with Python.

Through this course students broaden their knowledge and skills in the following areas:

1) Basics of IoT Data Science and fundamentals of Programming with Python
2) IoT data collection and storage
3) Data cleaning, analysis, and visualizing by using Python libraries (Pandas, Numpy, Matplotlib)
4) Implementing Data Science approaches (Pattern/Anamoly detection) with Python libraries (Sklearn, Tensorflow)

Table of Contents:

Laboratory Description and Equipment:

You need the Jupyter Notebook to execute and run Python codes for this course. For this purpose, you can use Google Colab or Anaconda environment.
The purpose of virtual labs is to gain practical experience executing Data Science techniques on IoT datasets using Python.

Course References:

Hastie, Trevor, Robert, Tibshirani and J. H. Friedman, The Elements of Statistical Learning: Data Mining, Inference, and Prediction. New York: Springer, 2009.
Wes McKinney. Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython 2nd Edition. O'Reilly Media, 2017.
https://www.tensorflow.org/

Evaluation and Assessment Methods:

To successfully complete the course, students must implement all hands-on projects properly.

The tasks lead to the production of the intellectual output and the applied methodology.

There are four main steps, leading to the production of the intellectual output and the applied methodology:

1-Tasks
The Python programming for IoT and Data Science course tasks are listed below:
1- Studying all the course references by the organization in charge (PTX).
2- Extracting information from the References based on the arranged content of the course.
3- Organizing and preparing reading materials.
4- Developing video lectures.
5- Designing virtual laboratories (choosing appropriate Datasets and conducting codes with Jupyter Notebooks)
6- Designing self-assessments

2-Review and Feedback
All partners will be asked to review the course materials and give feedback. This leads to enhancing the functionality of the course, improving its outcomes.

3-Fine-tunning
The responsible partner (PTX) should take the feedback into account and ameliorate the course materials.

4-Publishing
After the approval of the course by all partners, it will be published and is available for everyone online.

3   Course Contents