



What is SEnDIng?

Sector Skills Alliance for the design and delivery of innovative VET programmes to Data Science and Internet of Things professionals (SEnDIng) is a project funded by the EU under the Erasmus + Programme. SEnDIng aims to address the skills' gap of Data Scientists and Internet of Things engineers. For this purpose, it has developed two learning outcome oriented modular VET programmes.

FOR VET PROVIDERS

If you are a VET provider involved in the fields of Data Science and/or IoT and you think you need educational material and/or resources can be upgraded, then you can use the material of the SEnDIng MOOC to enhance the efficiency of the educational-process.

Are you looking for free online courses for Data Science and Internet of Things?

Then go to <http://mooc.sending-project.eu/>

Instruct your students to:

- Register for a free account
- Browse through the available Data Science and IoT online courses and select the ones you are interested in (or all of them)!
- Enroll and Attend the modules you have chosen!
It is completely free of charge!
- Take the online evaluation

If you think your students might benefit from the SEnDIng certification, please contact the SEnDIng consortium:
<http://sending-project.eu/index.php/en/contact>

Contact us!

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The need for Data Scientists and IoT engineers: FACTS

24,697

Open Data Scientist positions on LinkedIn in the United States alone, while the top 3 most common skills requested in LinkedIn DS job postings are Python, R, and SQL

28%

Demand increase for DS professionals in 2020

43%

IT Industry reports lack of DS skills

0.5M

Unfilled DS Positions by 2020

68%

Businesses struggle to hire IoT experts

SEnDIng targets to..

- Address the skills gap of Data Scientists and IoT professionals by targeting the IT sector and other economy's sectors (e.g. banking, energy, and logistics) that have demands for high qualified Data Scientists and IoT professionals.
- Provide Data Scientists and IoT professionals with skills and competences, that meet the needs of employers, are transferable and recognized among European countries SEnDIng has developed and delivered, among others, a Massive Online Open Course (MOOC) including:
 - Internet of Things (IoT) related modules
 - Data Science (DS) related modules
 - Transversal Skills (TS) related modules

To achieve this purpose, the project consortium has:

- Defined the learning outcomes (knowledge, skills and competences) of the training programs for Data Scientists and IoT engineers.
- Designed a common reference scheme of competences, skills, knowledge and proficiency levels needed by Data Scientists and IoT engineers in accordance with European frameworks and standards.
- Designed two modular learning outcomes oriented curricula, one targeting Data Science and another targeting Internet of Things.
- Delivered the vocational trainings to employees of ICT sector and other sectors of economy with increased demands for DS and IoT education and training.

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Impact of SEnDIng on..

ICT professionals and businesses:

- Training in skills and competences tailored to the needs of ICT learners and industry.
- Up skilling of ICT professionals (especially Data Scientists and IoT Engineers) to meet new challenges in the work field.
- Learning opportunities and training methodologies for companies that lack training facilities and departments.
- Reduced training expenses for ICT businesses (due to open training availability).

ICT sector (and sectors where Data Science and IoT have applications):

- Better matching between labour workforce supply and demand in the ICT sector.
- Attractive opportunities for vocational education and training in ICT sector.
- Enhanced productivity, innovation, competitiveness and growth potential in ICT sector.
- Ability of ICT professionals throughout Europe to respond to the needs of different ICT markets and other sectors like banking, insurance and energy.

Who is interested in the results of SEnDIng?

The results of SEnDIng are of interest to:

- Employees/unemployed people that would like to get involved in the field of Data Science and/or Internet of Things
- Companies in the ICT sector or other sectors in need of Data Scientists or IoT engineers that would like to educate their employees in the aforementioned fields.
- VET providers that would like to utilize/incorporate the SEnDIng MOOC and training approach in their VET programs

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What you will be able to do?

The trainee should be able to...

IoT

- Describe the value that IoT delivers in different business domains.
- Explain the business processes related to IoT in specific domains.
- Understand IoT architectures and the related network and communication protocols.
- Recognize different types of sensors, actuators, displays and related embedded electronics
- Design the application level (e.g. use protocols that support different IoT applications) of IoT in the context of big data, cloud technologies and DS.
- Formulate requirements about IoT information security.
- Analyse, argue and describe the business value of a particular IoT system.
- Design an IoT system that includes sensors, controllers, actuators and displays, connected to a cloud platform through Internet connection.
- Develop and deploy workflows and dashboards for an IoT system that includes sensors, controllers, actuators and displays, connected to a cloud platform through Internet connection.
- Develop working code for an IoT system that includes sensors, controllers, actuators and displays, connected to a cloud platform through Internet connection.
- Apply IoT information security concepts.

Data Science

- Describe the key concepts of Data Science.
- Describe ICT methods and tools applicable for the storage and retrieval of data.
- Describe methods and tools applicable for the statistical analysis of data.
- Explain basic concepts and requirements related to information security and privacy.
- Analyse domain specific trends and present them as structured information.
- Create code to statistically analyse data.
- Apply data statistics and data visualization.
- Deploy simple machine learning techniques.
- Deploy data storage and retrieval techniques.
- Implement data models validation techniques.
- Ensure that IPR, security and privacy issues are respected.

Transversal (soft) Skills

- Communicate effectively
- Adapt to change
- Work in teams
- Present in front of colleagues and clients;
- Think outside the box;
- Exercise selfmanagement within the guidelines of work
- study contexts that are usually predictable, but still are a subject to change;
- Supervise the routine work of others, taking some responsibility for the evaluation and improvement of work or study activities

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Training methodology

The training methodology of SEnDIng MOOC is based on:

- **Self-paced online training** which makes participation to the training easy. Self-paced training can improve learning retention, as the learners often retain content better when they have time to absorb concepts between lessons.
- **Asynchronous online training** that promotes learner autonomy. Asynchronous events are time independent, so each learner is able to participate in the online training according to his (or her) program.
- **Learner centred content** provides self reflection opportunities, as you would like to know how information relates to and benefits you directly, enables personalization and responds to your individual needs.
- **Personalization**, to promote effective learning. Self study courses are customizable to reflect your interests and needs. In addition, you will be able to build your own customized learning path.

SEnDIng MOOC design and structure

In order to structure the SEnDIng MOOC we consulted:

- ICT professionals and companies, as well as VET providers, to design the curriculum, the training methodology and the MOOC

The SEnDIng curriculum follows a modular approach to fit to the specific needs of each learner and permit the formation of individual learning paths. It is structured by educational modules, each of which is divided into training units at three levels of proficiency:

- **Introductory (I):** The educational module is introduced and its most important facts are given.
- **Core (C):** All core aspects, principles and methods of the module are covered in sufficient detail as necessary to apply the knowledge and skills on the job. The learner becomes able to discuss matters with other stakeholders and acquire more knowledge when necessary.

Each training unit content includes:

- **Tutorial videos and text**
- **Self assessment tests**
- **Small or larger projects for the trainee to verify the required knowledge and skills**

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Sending MOOC Educational modules for Data Science

The Data Science curriculum includes the following learning modules:

Introduction to Data Science (DS-EM1)

Learners are introduced to Data Science and its application in various disciplines.

Applied machine learning (DS-EM2)

Machine Learning techniques and methods and their application in various domains.

Python for Data Science (DS-EM3)

Python for solving Data Science problems.

Storing and retrieving data (DS-EM4)

The Hadoop ecosystem and its application at storing and processing large volumes of data distributed across commodity servers.

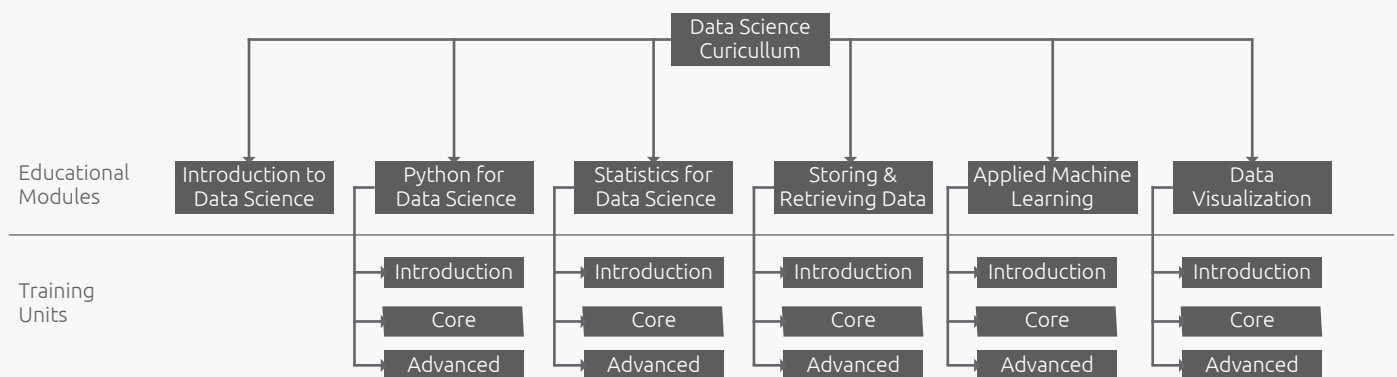
Statistics for Data Science (DS-EM5)

R and its use for solving Data Science problems.

Data Visualization (DS-EM6)

And its application in various disciplines in order to enhance visual communication.

The structure of the curriculum is depicted in the following Figure.



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Sending MOOC Educational modules for IoT

The IoT part of the SEnDIng MOOC includes the following learning modules:

Introduction to IoT (IoT-EM1)

Introduction to the IoT concept and its applications to familiarize learners with the IoT technology and present the different roles involved in an IoT project and the common IoT application development tools and methods.

Architectural Design and Applications in IoT (IoT-EM2)

Introduction to the IoT system architecture (IoT edge devices, gateways) with emphasis on server side infrastructure solutions (cloud computing service models, deployment models and public cloud providers). Here you will become familiar with the software architectural styles in IoT applications (client server, peer-to-peer, publish subscribe, etc.) and how they relate to the predefined IoT application classes.

IoT Communication Technologies (IoT-EM3)

Introduces the plethora of communication protocols and standards that are used for signaling and data exchange in IoT systems.

IoT Security and Privacy (IoT-EM4)

Introduces the risks of using IoT and possible measures to create a more secure environment and aims to create a sense of awareness to the learner of the possible security breaches and how to avoid them by adapting security measures whenever possible.

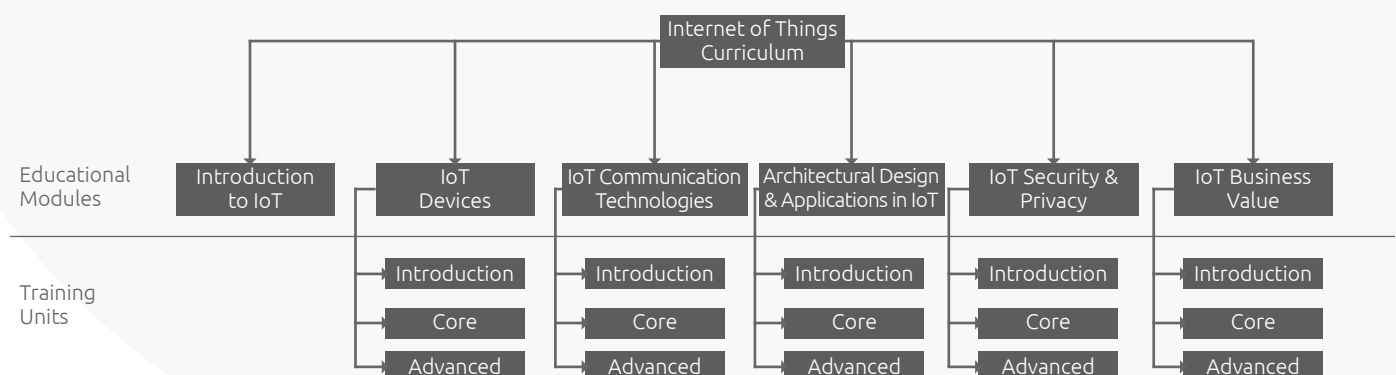
IoT Devices (IoT-EM5)

Introduces the “Things” in the Internet of Things, the different IoT devices (sensors, actuators, peripherals), their electronics and how they can interact with the environment. Here, we focus on how to select and interface common sensors and actuators to support real life IoT applications.

IoT Business Value (IoT-EM6)

An introduction of IoT in the business world clarifying why companies need to understand IoT business. Here, you will see how a company can be transformed with the use of IoT by an overview of the IoT technologies already used in the specific area and study the different IoT business model types, the different challenges that arise in this area of a business and the landscape of IoT Business.

The structure of the curriculum is depicted in the following Figure.



SEnDIng educational modules for Transversal Skill (TS) education

The transversal skills aims to build upon academic and experiential learning and to prepare the ICT professionals for engaging within the business environment in a creative way, communicating effectively with the internal and external environment of a business and acting in a collaborative way. These educational modules introduce a portfolio of skills and competences required for effective communication and presentation, adaptation to changes, teamwork, goal setting and thinking out of the box.

The transversal skills curriculum includes the following educational modules:

Effective communication and presentation (TS-EM1)

Change management (TS-EM2)

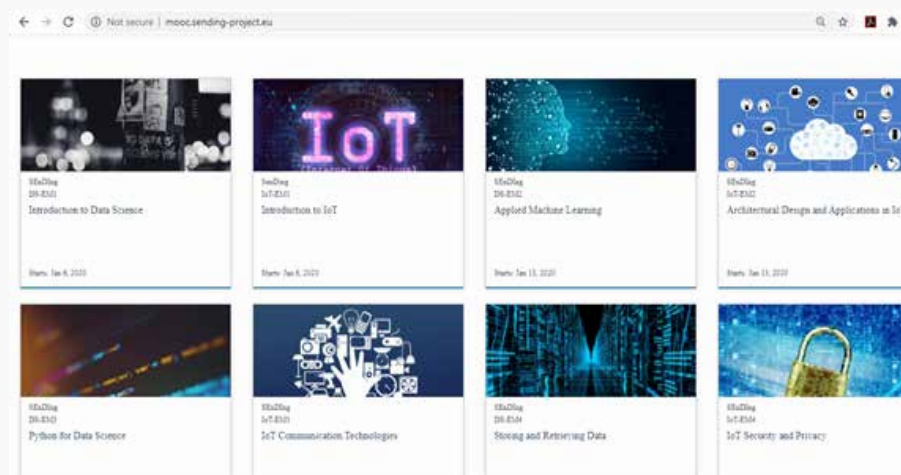
Team working (TS-EM3)

Goal setting (TS-EM4)

Creative thinking (TS-EM)

SEnDIng MOOC screenshot

A sample screenshot of the SEnDIng MOOC (<http://www.mooc.sending-project.eu/>) follows:



The learner can freely register in the platform and enroll in any course in order to attend.

It is completely free of charge!!

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Professional Roles in DS and IoT supported by SEnDIng

There are various professional roles involved in a Data Science project, each characterized by different training needs, e.g.

- Data Analyst
- Data Architect
- Database Administrator
- Machine Learning Engineer
- Data Scientist

The following Table correlates these roles to the different levels of the educational modules of SEnDIng

I: Introductory

C: Core

A: Advanced

	Data Analyst	Data Architect	Database Administrator	Machine Learning Engineer	Data Scientist
Introduction to Data Science	I	I	I	I	A
Python for Data Science	A	C	I	A	A
Statistics for Data Science	C	C	I	A	A
Storing and retrieving data	C	A	A	C	A
Applied machine learning	I	I	I	A	A
Data Visualization	A	I	I	C	A

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The professional roles supported by the SEnDIng material in the IoT domain are:

- IoT Product Manager
- IoT Architect
- IoT Software Developer
- Data Scientist
- IoT Cloud Engineer
- IoT Industrial Engineer

The following Table correlates these roles to the different levels of the educational modules of SEnDIng.

I: Introductory
C: Core
A: Advanced

	IoT Product Manager	IoT Architect	IoT Software Developer	Data Scientist	IoT Cloud Engineer	IoT Industrial Engineer
Introduction to IoT	I	I	I	I	I	I
IoT Devices	C	C	I	C	C	A
IoT Communication Technologies	C	C	C	C	A	C
Architectural Design and Applications in IoT	C	A	A	C	A	C
IoT Security and Privacy	I	C	C	I	A	C
IoT Business Value	A	I	I	I	I	C

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Who can benefit from the results of SEnDIng

The direct beneficiaries of SEnDIng project include:

- ICT professionals and more specific Data Scientists and Internet of Things engineers who work at the ICT sector and other sectors where the Data Science and Internet of Things technologies are applied (e.g. banking, assurance and energy).
- VET providers interested to upgrade their training portfolio with trainings at cutting edge technologies.
- Enterprises that employ ICT professionals who will participate in the provided VET programs, as their employees will be provided with skills and competences that meet their needs together with labor market's needs.

Higher Education Institutes and policy makers are also beneficiaries of the project.

Sending certification scheme

For the certification scheme of SEnDIng we have:

- Defined the individuals' group the certification scheme targets
- Described the knowledge, skills and competences in which the person will be certified
- Described the certification criteria and the specifications of the assessment method as well as the examination system
- Developed the examination questions related to the certification scheme

The certification includes a series of closed form (multiple choice) questions.

Two certification scheme have been delivered, one for the IoT and one for the DS curriculum.

For more info, or if you are interested in taking the SEnDIng certification, please contact the project consortium!

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Open access to the SEnDIng resources!!

- Access to all materials, documents and media produced by the SEnDIng follows the open access policy.
- The training content is provided in the form of Open Educational Resources (OERs), i.e. freely accessible documents and media useful for teaching, learning, and research.
- The educational material produced is freely available under a Creative Commons Public License (CCPL, <http://creativecommons.org>) allowing users to share, reuse and adapt.
- In case that you use the training material provided, please include a reference to the SEnDIng project rights!

After the end of the project:

The e-learning platform & the training material will be maintained and updated.

**It is (and will always be)
free of charge!!**

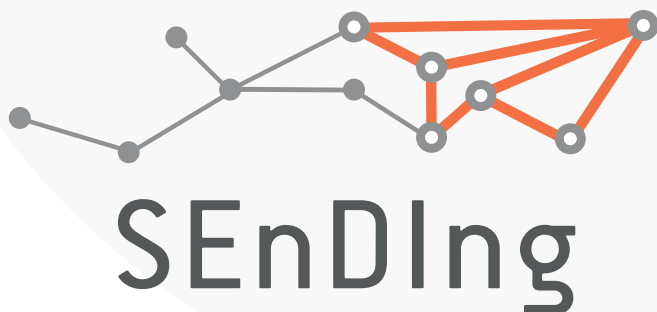
Where to get more info on SEnDIng

<https://www.facebook.com/The-Sending-project-212315929321941/>

<https://www.linkedin.com/groups/13584243>

https://twitter.com/SEnDIng_project

<http://sending-project.eu/>



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