

Training Course Outline

ITU and National Institute of Telecommunications

Title	Key technologies and Governance of Internet of Things, Big Data and Artificial Intelligence
Modality	Online instructor-led
Level	Intermediate
Dates	11 – 18 December 2023
Duration	8 days
Language	English
Region	World or Multi-Regional
Registration type	Application and training fees payment prior to the registration deadline
Registration deadline	10 December 2023
Training fees	150 USD
Description	<p>This course will focus on technical, business and regulatory aspects of Internet of Things (IoT), Big Data and Artificial Intelligence (AI). It will cover Internet technologies for IoT, then IoT standards, architectures and interoperability, as well as IoT policies and regulations, including IoT security and privacy issues. The course will include IoT services in 4G and 5G mobile systems, including massive IoT and critical IoT use cases. The IoT generates large amounts of data that cannot be processed by traditional techniques, and such data is referred to as Big Data. In that manner, the course will include Big Data overview, Big Data ecosystem and reference architecture, Big Data technologies and use cases, as well as business and regulatory challenges for Big Data. Artificial Intelligence (AI) is targeted for processing Big Data in Internet and telecom networks. In that regard the course will cover introduction to AI in ICT/telecom world, and AI applications in Internet and telecom environments, including Machine Learning aspects for 5G mobile networks. The course will further include Big Data and AI challenges, business aspects, as well as policies and regulation. Finally, the course will cover Internet governance with regard to IoT, Big Data, and AI.</p>

<i>Training topics</i>	<i>Artificial intelligence Internet of things Big data and statistics</i>
<i>Certification</i>	<i>Certificate</i>
<i>Code</i>	<i>2301100277MUL-E</i>

1. TARGET POPULATION

This course is targeted at managers, engineers and employees from regulators, government organizations, telecommunication companies and academia, who are interested in understanding, implementation and regulation of Internet of Things (IoT), Big Data and Artificial Intelligence (AI), including technical, business and regulatory aspects. Other institutions and individuals that are dedicated in building their capacity related to IoT, Big Data and AI, including technical, business and regulatory aspects, are also welcome to participate.

2. ENTRY REQUIREMENTS

No prior knowledge or qualification is required to register for this course, considering the given target population.

3. TRAINING OBJECTIVES

At the end of the training, the participant should have gained knowledge about the key aspects of:

- Introduction to Internet technologies and Internet of Things (IoT)
- IoT standards, architectures and interoperability
- IoT in 4G and 5G mobile networks
- IoT data security, privacy and trust
- IoT business aspects, policies and regulations
- Big Data ITU's framework, ecosystem and architectures
- Artificial Intelligence (AI) fundamentals in Internet and telecom worlds
- Big Data and AI technologies and use cases
- AI and ITU's Machine Learning for 5G/IMT-2020 mobile networks
- Governance of IoT, Big Data, and AI

4. METHODOLOGY

This course will be delivered using instructor-led online learning. The course methodology will be as follows:

- Each day from 11 December to 15 December 2023 there will be made available two recorded video lectures, which are recorded in the face-to-face ITU Centre of Excellence workshop organized by

National Institute of Telecommunications in Poland. In total, there are 10 video lectures during the course.

- Course forum, asynchronous, will be organized based on discussion topics raised by the instructor on a daily basis, from Course Day 1 to Course Day 5, which will cover the course material on the given day. Also, participant responses will be asynchronous, keeping in mind the different time zones and daily commitments of participants from different countries around the world.
- General discussion forum, asynchronous, will be provided for participants to ask their own questions which can be answered by the instructor and other participants.
- Final Quiz test will be assigned on the last day of the course, 18 December 2023.
- All announcements for all events (lectures, quiz and forum) will be given in a timely manner (prior to the event) by the course tutor.

5. ASSESSMENT AND GRADING

The evaluation of the participants will be based on 80% from the Final Quiz and 20% from the answers given in the course forum on the raised discussion topics on daily basis by the tutor, thus reflecting both the quantity and the quality of time spent on the course.

The Final Quiz will be open from 00:00 hours on Monday (18th of December 2023) according to the GMT+1 time, and will remain open for 30 hours after opening, so each participant can choose the most convenient time to solve it. However, after the start of the attempt the Quiz should be completed in 90 minutes. The Final Quiz contributes with 80% in the total grade.

The course is completed successfully with a total grade of 70% or higher. The grading will be completed by the course tutor after the course is fully completed.

Each fully registered participant who successfully completes the course with a total grade of 70% or higher will receive an ITU Certificate for this course.

The ITU certificates will be given to participants via the ITU Academy platform after completion of the course reporting and processing within the ITU.

6. TRAINING DETAILS & INSTRUCTIONAL APPROACH

Day	Sessions/Topics covered	Key learning points (detail learning outcomes)	Training activities details
Day 1 Monday	<p>Lecture 1. Introduction to Internet technologies and Internet of Things (IoT)</p> <p>Lecture 2. IoT standards, architectures and interoperability</p>	<p>Outline, discuss, use, analyze, design and evaluate the following topics using technical, business and regulatory aspects:</p> <ul style="list-style-type: none"> - ITU's framework of Internet of Things (IoT) - Telecom vs. Internet Protocol Model - IPv4 vs. IPv6 comparison - TCP, QUIC, and UDP protocols - 6LoWPAN - QoS for IoT - Massive vs. Critical IoT - Web of Things (WoT) and HTTP 3.0 and IoT - IoT over SDN/NFV networks - RFID and Bluetooth - ZigBee and Z-Wave technologies - LoRaWAN - Long Range Wide Area Network - Sigfox - Low Power WAN (LPWAN) - Weightless and EnOcean standards for IoT - WiFi standards for IoT: HaLow, WiFi 6 and WiFi 7 - ITU's architecture of a home network - Industrial Internet networking - The oneM2M standard - Digital identity for IoT - Smart Sustainable City (SSC) architecture - Roles of IoT in addressing the UN SDGs 	<p>Watching and listening to video lectures 1 and 2. Answering on questions asked by the tutor, and possibility to ask questions to him via course forum.</p>
Day 2 Tuesday	<p>Lecture 3. IoT in 4G and 5G mobile networks</p> <p>Lecture 4. IoT data security, privacy and trust</p>	<p>Outline, discuss, use, analyze, design and evaluate the following topics using technical, business and regulatory aspects:</p> <ul style="list-style-type: none"> - Non-3GPP vs. 3GPP standards for IoT 	<p>Watching and listening to video lectures 3 and 4. Answering on questions asked by the tutor, and</p>

		<ul style="list-style-type: none"> - LTE-Advanced-Pro: EC-GSM, LTE-M and Narrow-Band IoT (NB-IoT) - LTE in unlicensed bands - 5G/IMT-2020 use cases and network slicing - NB-IoT and LTE-M for massive MTC in 5G - QoS for IoT over 5G - Industrial 5G - 5G-Advanced IoT - Spectrum for cellular IoT - Vehicle-to-everything (V2X) in 5G/IMT-2020 - IoT with Mobile Edge Computing (MEC) - ITU guidelines for security in Internet of Things (IoT) - Data security threats in heterogeneous IoT devices - Security and privacy risk analysis - Trust in IoT services - End-to-end security and id management for IoT - IoT data ecosystems stakeholders - Securing IoT connections over Internet - Blockchain for IoT security 	possibility to ask questions to him via course forum.
Day 3 Wednesday	<p>Lecture 5. IoT business aspects, policies and regulations</p> <p>Lecture 6. Big Data ITU's framework, ecosystem and architectures</p>	<p>Outline, discuss, use, analyze, design and evaluate the following topics using technical, business and regulatory aspects:</p> <ul style="list-style-type: none"> - Business models for IoT services - Mixed reality offloading in 5G - IoT regulations - GDPR, NIS Directive, EU Cybersecurity Act, NIST (US) - Supply chain reference model for IoT - IoT cybersecurity and privacy laws (UK, US) - Spectrum aspects for IoT services - IoT addressing and numbering - Future IoT with edge clouds and 5G-Advanced - Industrial IoT Law and Regulatory aspects - Future IoT regulations 	Watching and listening to video lectures 5 and 6. Answering on questions asked by the tutor, and possibility to ask questions to him via course forum.

		<ul style="list-style-type: none"> - ITU's Big Data framework - Big Data ecosystem and data types - Big Data reference architecture - Big-Data-Driven Networking (bDDN) - Big Data use by telecom operators - DPI (Deep Packet Inspection) and Big Data - DPI-based IP traffic management - ITU's Cloud Computing ecosystem - Cloud computing based Big Data - Mobile network user behavior Big Data analysis 	
Day 4 Thursday	<p>Lecture 7. Artificial Intelligence (AI) fundamentals in Internet and telecom worlds</p> <p>Lecture 8. Big Data and AI technologies and use cases</p>	<p>Outline, discuss, use, analyze, design and evaluate the following topics using technical, business and regulatory aspects:</p> <ul style="list-style-type: none"> - Introduction to Artificial Intelligence (AI) and Machine Learning (ML) in telecom/ICTs - Machine Learning (ML) model - Classification of ML algorithms and use cases in Internet and telecoms - Naive Bayes ML, K-Means Clustering ML, and Apriori Algorithm - Regression ML algorithms - Deep Learning - High level Machine Learning architecture by ITU - Architecture for ML marketplace - Network intelligence levels by ITU - Applications on Machine Learning in different areas of telecoms/ICTs (QoS management in telecoms) - Intent-driven control in networks - Resource management with AI/ML - Fault management with AI/ML - Future network architecture for telecoms and providers towards 2030 - AI/ML in Big Data-driven networking - Cloud-native and microservices 	<p>Watching and listening to video lectures 7 and 8. Answering on questions asked by the tutor, and possibility to ask questions to him via course forum.</p>

		<ul style="list-style-type: none"> - Machine Learning as a Service (MLaaS) - Zero-touch network - Human-Like networking - AI for IoT, Industry 4.0 and Smart manufacturing - Future Web based on AI and Big Data 	
Day 5 Friday	<p>Lecture 9. AI and ITU's Machine Learning for 5G/IMT-2020 mobile networks</p> <p>Lecture 10. Governance of IoT, Big Data, and AI</p>	<p>Outline, discuss, use, analyze, design and evaluate the following topics using technical, business and regulatory aspects:</p> <ul style="list-style-type: none"> - Artificial Intelligence (AI) and Machine Learning (ML) for 5G - ML-based QoS for the 5G/IMT-2020 - IMT-2020/5G network slicing for V2X - AI/ML assisted network slicing in 5G - BSS (Business Support System) in 5G/IoT era - 5G–Advanced, verticals and automation - Unmanned Aircraft System (UAS) for IoT - AI service exposure for Smart Sustainable Cities (SSC) - AI/ML model transfer in 5G System - Split AI/ML inference, AI/ML model distribution, and Federated Learning over 5G System - The digital regulatory ecosystem - Blockchain regulation - Risk-based approach for AI regulation - Obligations for providers of high-risk AI systems - AI governance system - Enforcement for AI compliance with the regulatory framework - Big Data and AI: ITU guide for national strategies - AI and data strategy: SWOT analysis - Objectives and building-blocks of a National AI and Data strategy - Digital, AI, and data regulatory framework 	<p>Watching and listening to video lectures 9 and 10. Answering on questions asked by the tutor, and possibility to ask questions to him via course forum.</p>

		- Future AI legislation	
Day 6 Saturday	Consolidation of knowledge	Summarizing the knowledge	Possibility to watch all video lecture once again with possibility to ask questions to the tutor.
Day 7 Sunday	Consolidation of knowledge	Summarizing the knowledge	Possibility to watch all video lectures once again with possibility to ask questions to the tutor.
Day 8 Monday	Final Quiz	Final assessment	Solving the Final Quiz.

7. TUTORS/INSTRUCTORS

Name of tutor(s)/instructor(s)	Title	Contact details
Prof. Dr. Toni Janevski	Professor Doctor	tonij@feit.ukim.edu.mk

8. TRAINING COURSE COORDINATION

Course coordinator	ITU coordinator
Name: Dr. Sylwester Laskowski Title: Doctor, Chief Training Specialist Email address: s.laskowski@il-pib.pl	Name: Emil-Eugen Iuga Title: Capacity and Skills Development officer Email address: emil-eugen.iuga@itu.int