



DESTINI
*Smart Data Processing and Systems
of Deep Insight*



JANUARY 24-28, 2022

Overview

Second School
*Smart Data Processing and
Systems of Deep Insight*



DESTINI



HORIZON 2020

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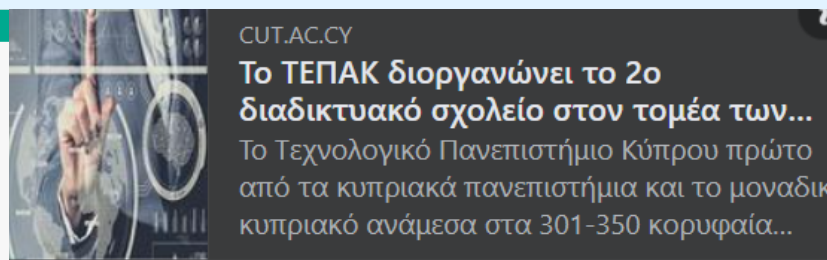
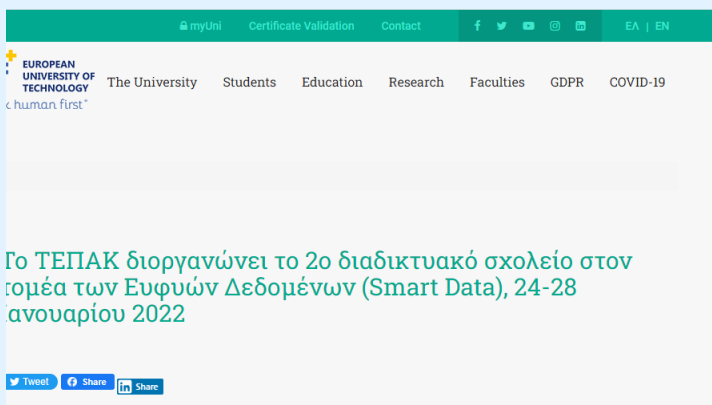


DESTINI
Smart Data Processing and Systems
of Deep Insight

About School

This event is the second part of a series of schools and workshops organized by DESTINI on Smart Data and it is aligned with the project's dissemination and communication strategy. The latter has been organized and structured to present different scientific topics within the project's Joint Research Activities (JRAs) and demonstrate their benefits to real cases. This school aims to share knowledge developed in the project and to facilitate discussions, as well as exchange of expertise, between researchers, industrial and business stakeholders, governmental and decision-making bodies and the general public.

The duration of the school is five days. It comprises various talks and presentations that mainly target industrial and market stakeholders. During its sessions, the school covers a variety of topics and scientific areas which offer solutions to real-world problems and challenges, and demonstrate how applied research can benefit businesses, researchers, project stakeholders and the general public. The talks are delivered by DESTINI's partners and other project collaborators.





About DESTINI

TWINNING PROJECT - HORIZON2020

Smart Data ProcESSing and SysTems of Deep INsight (DESTINI) is a H2020 Twinning Project that proposes a series of coordination and support actions for promoting research in the area of Smart Data. The Cyprus University of Technology (CUT) joins forces with two internationally recognized scientific groups from the Netherlands (Tilburg University and Jheronimus Academy of Data Science) and Italy (Sapienza Università di Roma), aiming to strengthen its research and scientific profile in the relevant area. Specifically, DESTINI's activities revolve around exchanging scientific knowledge and transferring best research practices amongst its partners in the field of Smart Data Processing and Systems of Deep Insight.



SAPIENZA
UNIVERSITÀ DI ROMA



Cyprus
University of
Technology

TILBURG



UNIVERSITY



JADS

Jheronimus
Academy
of Data Science

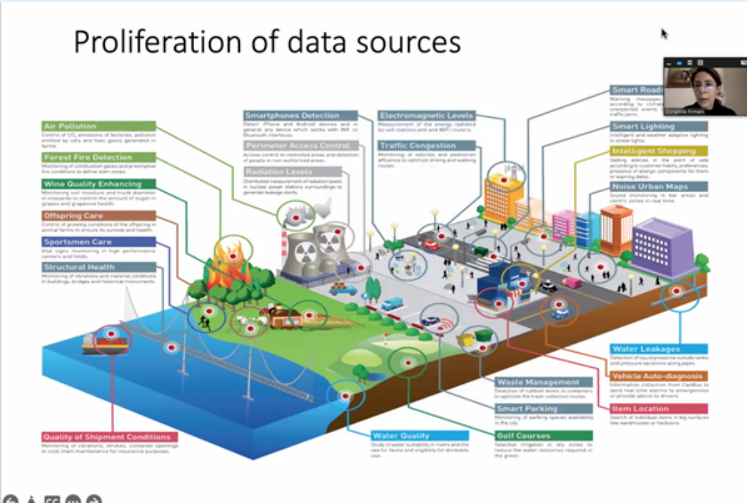


DESTINI

24, January, 2022

Day 1

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Professor Donatella Firmani from Sapienza University of Rome presented **Big Data: Methods and Technologies**. Prof. Firmani illustrated methods and technologies for the management of big data. The presentation included the challenges and solutions of the aforesaid methods, through examples and discussion with the audience.

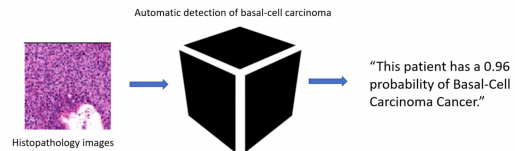
Mrs Nicoletta Prentzas, PhD candidate from the University of Cyprus presented the topic: **Argumentation-based framework for Explainable Machine Learning (ARGEML)**. ARGEML is a framework built to support and offer a novel approach towards the XAI (Explainable AI), by combining the interpretability of symbolic AI with the high efficiency and accuracy of the Machine Learning models.

Explainable AI – Definitions, challenges

- **XAI** refers to methods and techniques to make AI/ML systems transparent and produce results that can be understood by humans.
- **XAI Goal**: to support the utilization of AI predictions in the next task/step of a process (e.g., disease diagnosis), for better or more informed decision making.
- **Challenges**:
 - accuracy vs interpretability
 - quality of explanations, e.g.:
 - understandable, true to the model, answer why-questions
 - human-in-the-loop

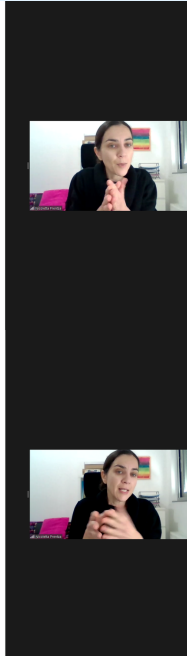
ARGEML, DESTINI workshop, 24/1/2022

Explainable machine learning (ML) - example



[1] A. Cruz-Uribe et al., "A deep learning architecture for image representation, visual interpretability and automated basal-cell carcinoma cancer detection," in *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, 2013, vol. 8150 LNCS, no. PART 2, pp. 403-410.

ARGEML, DESTINI workshop, 24/1/2022





24, January, 2022

Day 1

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Background

Brain-computer interface (BCI)

Virtual Reality (VR)

Results

Subject No.	Training set accuracy (%)	Cross-Validation test set accuracy (%)
1.	91.20	88.28
2.	82.54	78.93
3.	74.67	63.65
4.	64.76	57.08
5.	60.13	46.20
AVG	74.66	66.82

Mr Marios Hadjaros, PhD candidate from the University of Cyprus and researcher at CYENS, has given a talk on **Preliminary Findings on the Virtual Reality Cognitive Gaming Based on Brain Computer interfacing**. The presentation discusses a way of integrating Brain Computer Interfacing with Virtual Reality, in order to develop interactive applications for cognitive tasks.

Professor Claudio Di Ciccio from Sapienza Università di Roma presented the topic: **Blockchain Applications**. Throughout the presentation, Prof. Di Ciccio explained the foundations of blockchain, such as how the transactions are happening and how the security is accomplished. Furthermore, the evolution of the web from web 1 to web 3 was discussed, as well as some research-oriented directions of blockchain, with the most relevant topics.

What is the Blockchain?

Blockchain is an open, distributed ledger that can record transactions between two parties efficiently* and in a verifiable and permanent* way.

Transactions are immutable**
 A copy of the blockchain is accessible to every node in the network
 It offers access to the history of all previous states
 Consensus is achieved through dedicated algorithms
 Economic disincentive to history rewriting
 Offers the possibility of executing user-defined scripts (smart contracts)
 Smart contracts are unstoppable from the outside

* Asterisks mark words/sentences that are valid in most of the cases, but have exceptions



25, January, 2022

Day 2

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Professor Lauren Ferro and Dr. Francesco Sapiaio from Sapienza University of Rome presented a talk on **Virtual Reality and Gamification**. The purpose of the presentation was to introduce the concept of gamification, and how it can be used to solve real world problems, followed by case studies and examples.

Mrs Andria Nicolaou, a PhD candidate from the University of Cyprus, presented a part of her recent research on **Rule Extraction in the Assessment of Brain MRI Lesions in Multiple Sclerosis: Preliminary Findings**. Mrs Nicolaou began her presentation by explaining what multiple sclerosis is, followed by some preliminary conclusions from her research about how rule extraction can help identify brain lesions related to multiple sclerosis, from MRI images.

OBJECTIVE

Extraction of explainable information in the form of rules for the assessment of brain MRI lesions and their interrelation to disability in Multiple Sclerosis (MS) subjects based on texture features



RULE EXTRACTION IN THE ASSESSMENT OF BRAIN MRI LESIONS IN MULTIPLE SCLEROSIS: PRELIMINARY FINDINGS

- A chronic neurological disease affecting the central nervous system, brain and spinal cord
- It is characterized by autoimmune inflammation, demyelination, and axonal damage
- Pathological hallmark of MS: appearance of white matter (WM) lesions, also called plaques, that are caused by the immune system attacking the myelin sheath around axons
- Lesions are visualized using magnetic resonance imaging (MRI) and evaluated by expert neurologists following the McDonald criteria

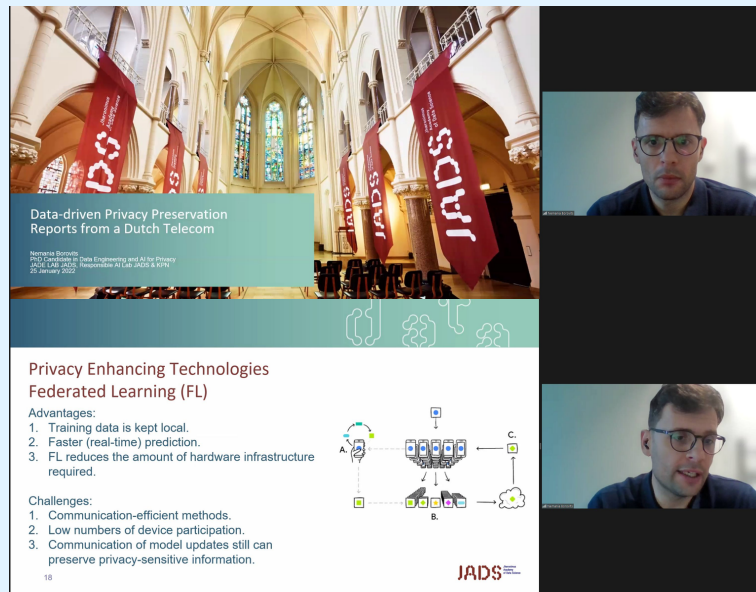


RULE EXTRACTION IN THE ASSESSMENT OF BRAIN MRI LESIONS IN MULTIPLE SCLEROSIS: PRELIMINARY FINDINGS

25, January, 2022

Day 2

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Data-driven Privacy Preservation Reports from a Dutch Telecom

Heracles Borovits
PhD candidate in Data Engineering and AI for Privacy
JADS LAB 14005
25 January 2022

Privacy Enhancing Technologies Federated Learning (FL)

Advantages:

1. Training data is kept local.
2. Faster (real-time) prediction.
3. FL reduces the amount of hardware infrastructure required.

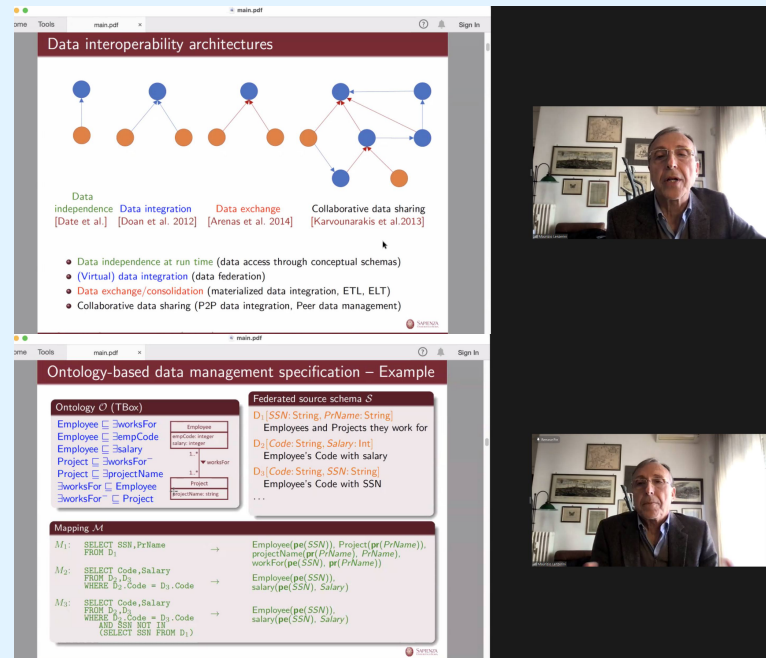
Challenges:

1. Communication-efficient methods.
2. Low numbers of device participation.
3. Communication of model updates still can preserve privacy-sensitive information.

JADS

Mr Nemanja Borovits, PhD candidate from Tilburg University presented a talk on **Privacy preservation - Reports from a Dutch Telecom**. As part of the presentation, some principles about privacy by design were presented, followed by methodologies to enhance privacy, such as Federated Learning (FL). Moreover, advantages and challenges of the methodologies were discussed.

Professor Maurizio Lenzerini from Sapienza Università di Roma presented the topic **Query answering and query abstraction through ontologies**. During the presentation, Prof. Lenzerini explained what ontologies are, and how they can contribute to the interoperability of the data, through mapping the data into an ontology.



Data interoperability architectures

- Data independence [Date et al.]
- Data integration [Doan et al. 2012]
- Data exchange [Arenas et al. 2014]
- Collaborative data sharing [Karvounarakis et al. 2013]

- Data independence at run time (data access through conceptual schemas)
- (Virtual) data integration (data federation)
- Data exchange/consolidation (materialized data integration, ETL, ELT)
- Collaborative data sharing (P2P data integration, Peer data management)

Ontology-based data management specification - Example

Ontology \mathcal{O} (TBox)

- Employee \sqsubseteq worksFor
- Employee \sqsubseteq empCode
- Employee \sqsubseteq salary
- Project \sqsubseteq worksFor
- Project \sqsubseteq projectName
- worksFor \sqsubseteq Employee
- worksFor \sqsubseteq Project

Federated source schema \mathcal{S}

- D_1 (SSN: String, PName: String)
- Employees and Projects they work for
- D_2 (Code: String, Salary: Int)
- Employee's Code with salary
- D_3 (Code: String, SSN: String)
- Employee's Code with SSN
- ...

Mapping \mathcal{M}

- M_1 : `SELECT SSN, PName FROM D1` → `Employee(pe(SSN)), Project(pr(PName)), projectName(pr(PName)), workFor(pe(SSN), pr(PName))`
- M_2 : `SELECT Code, Salary FROM D2 WHERE D2.Code = D1.Code` → `Employee(pe(SSN)), salary(pe(SSN), Salary)`
- M_3 : `SELECT Code, Salary FROM D3 WHERE D3.Code = D1.Code AND SSN NOT IN (SELECT SSN FROM D1)` → `Employee(pe(SSN)), salary(pe(SSN), Salary)`



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Day 3

Second School of DESTINI

Professor George Spyrou, Head of the Bioinformatics department of Cyprus Institute of Neurology and Genetics (CING), presented **Complex Patterns of Biological Information Decoded with Network-based Bioinformatics**. A key focus of the presentation was Precision Medicine, which can be accomplished by combining data science with healthcare, by decoding and analyzing the information to produce more accurate and precise medicines.

Mr Sheraz Aslam, PhD candidate and researcher at CUT provided a talk on his recent research work on **Enhanced Berth Allocation Using the Cuckoo Search Algorithm**. During the talk, an algorithm was showcased (Cuckoo) which can schedule dynamically the vessel's arrival in order to avoid conflicts. The algorithm was based on the well-known berth allocation problem which was included in the presentation. Lastly, the algorithm is a part of the EU project STEAM (Sea Traffic Management in the Eastern Mediterranean), which is undertaken by CUT.

Introduction

- Maritime container terminals are important nodes in maritime industry
- Containerized trade is increasing
 - 8.4 billion in 2018
 - 11.1 billion in 2019

Berth Allocation Problem – Variations

- Berthing layout**
 - Discrete
 - Continuous
 - Hybrid
- Vessel arrival**
 - Static
 - Dynamic
- This work presents a solution to BAP using **continuous** berthing layout and **dynamic** vessels arrival

STEAM Project



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Day 3

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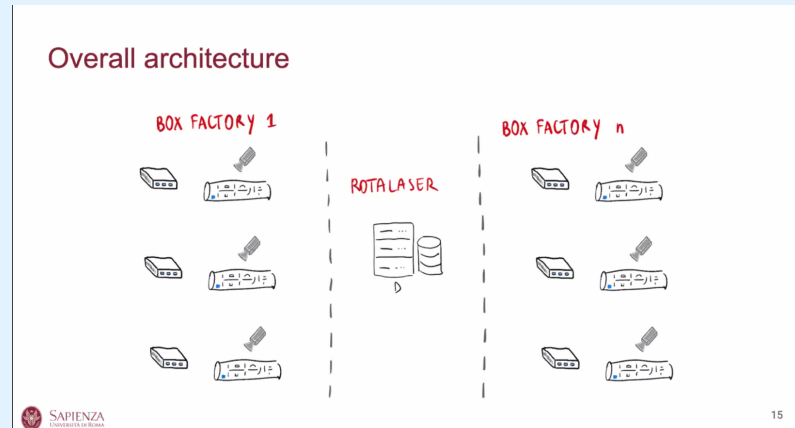
What is skillsChain?

- A fully deployed Ethereum dApp that exploits the capabilities of Blockchain technology.
- It provides means to educational robotics for securely recording students' skills during the educational process.
- Aim: is to provide an approach for securely exchanging students' records starting from their early years in education and beyond.

skillsChain Architecture

Professor Panayiotis Christodoulou from Neapolis University of Pafos / researcher at SEIIS lab of CUT, provided an overview of the scientific article **skillsChain: A Decentralized Application that Uses Educational Robotics and Blockchain to Disrupt the Educational Process**. SkillsChain is a case study for a decentralized application published in an academic journal, about combining educational robotics and blockchain, aiming on providing a way to secure the exchange of students' records.

Mr Jerin George Mathew and Mrs Flavia Monti from Sapienza Università di Roma presented **Transformation in Traditional Industry: Die Cutter 4.0**. The presenters explained the evolution of the industry, concluding on industry 4.0. Then, a case study followed, on the application of a Smart Die Cutter which contains sensors that are controlled by a mini-PC. The worker interacts through a dashboard, where he monitors and manages the production.



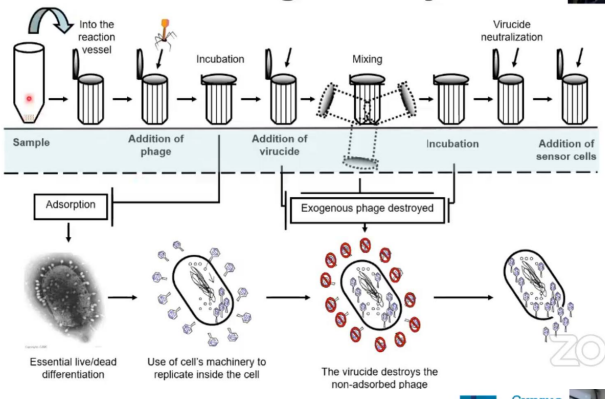
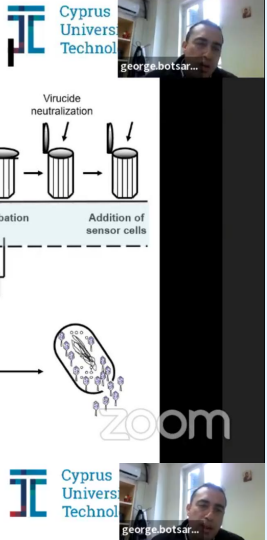


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Day 3

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The Phage Assay



Cut-off value

- The *FASTplaque*TM assay for TB in human sputum gives a cutoff for positive samples at 20 plaques

Phage-PCR	Number of pfu/50ml						Number of pfu/50ml					
	<=20 pfu		21+ pfu		Totals		<=40 pfu		41+ pfu		Totals	
	No	%	No	%	No	%	No	%	No	%	No	%
Positive	1	2.0	49	98.0	50	100	4	8.0	46	92.0	50	100
Negative	111	63.4	64	36.6	175	100	157	89.7	18	10.3	175	100
Totals	112	49.8	113	50.2	225	100	144	64.0	81	36.0	225	100

Professor George Botsaris from the department of Agricultural services, biotechnology, and food science of CUT presented the topic: **Data Driven Detection and Biological Control of Food Borne Pathogens: The Case of Mycobacterium Avium Subspecies Paratuberculosis**. Prof. Botsaris introduces a way of detecting food borne pathogens, using a data driven methodology. In the context of the presentation, the case study of Mycobacterium Avium Subspecies Paratuberculosis was examined.



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Day 4

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Application – Motion Capture (B2) 25

► Learn to Dance: (Folk Dancing - Greek/Cypriot):



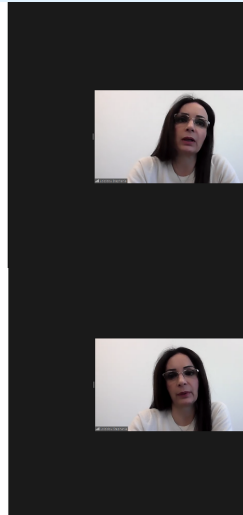
Realistic simulation of Humans 22

- PHOTOREALISTIC HUMAN CHARACTERS
- UNDERGOING PHYSICALLY-CORRECT MOTION (FACIAL ANIMATION, WITH CLOTHES, HAIR, INTERACTION WITH OTHER HUMAN CHARACTERS)

THAT IS,

- NO DIFFERENCE FROM REAL ACTORS
- NO DIFFERENCE FROM THE REAL WORLD

THE POSSIBILITIES ARE ENDLESS!!!




Professor Stephania Loizidou from the Frederick University of Cyprus provided a talk on **Computer Graphics - Animation**. Prof. Loizidou, introduced to the audience the concepts of computer graphics and animations, followed by some innovational topics and examples, such as Virtual Reality, motion capture, and simulations.

Mrs Elia Kouzari (Assistant Manager at KPMG) presented **The Art of Process Mining**. A detailed introduction on Business Process Mining was established, including the four main phases of a business process mining lifecycle (Collection, Discovery, Enhancement, Monitoring). Furthermore, the benefits of BPM, reason of existence as well as some tools, were described.

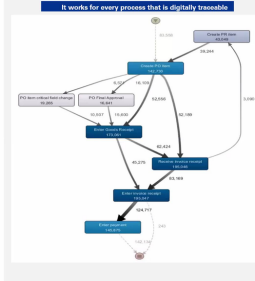
What is process mining?

Process Mining helps to address questions like:

- How do you know what really happens in your processes?
- How do you learn about harmful bottlenecks, inefficiencies and compliance issues?
- How fast can you get insight into your processes?
- How do you find out where to improve your processes?



It works for every process that is digitally traceable.



Process Mining is helping enterprises optimize each and every operational element for better outcomes, extraordinary experiences and world-class performance.

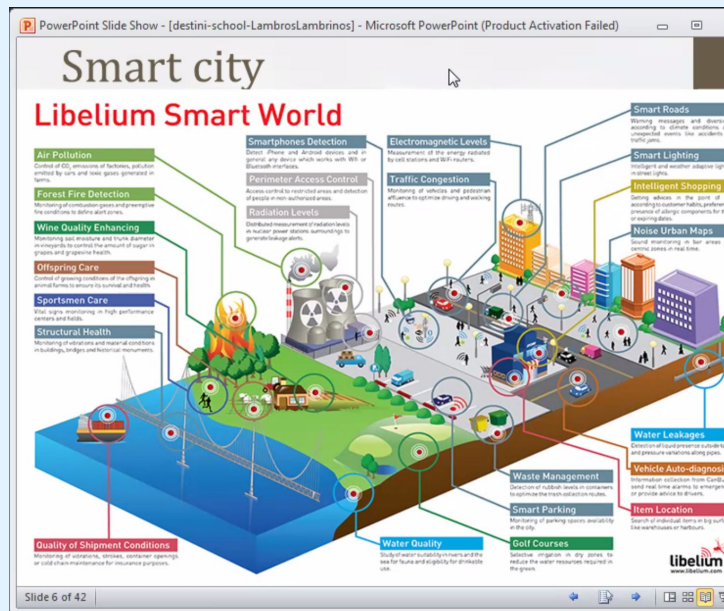
- Step-by-step methodology to discover, enhance and monitor core business processes at the deepest levels.
- Prescriptive analytics solution to find (and resolve) the true root causes of friction invisibly embedded in the systems and operations.
- Holistic, bottom-up approach to process excellence built on the principles of continuous improvement while advancing the technologies used to drive it.



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Day 4

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Professor Lambros Lambrinos from the Cyprus University of Technology provided a talk on **Integrating the Internet of Things in Real-life Scenarios**. During the talk, the concept of Internet of Things (IoT) was explained, followed by some real world applications such as smart cities, and smart parking.

Professors Massimo Mecella & Francesco Leotta from Sapienza Università di Roma presented the topic: **Business Process Management and Process Mining**. The presentation focused on the context of business process mining and the larger area of business process management. The concepts of business process and process model were clarified, showcasing some of the multiple different ways of creating a process model. Furthermore, the speakers explained the main goals of BPM, concluding with some examples.

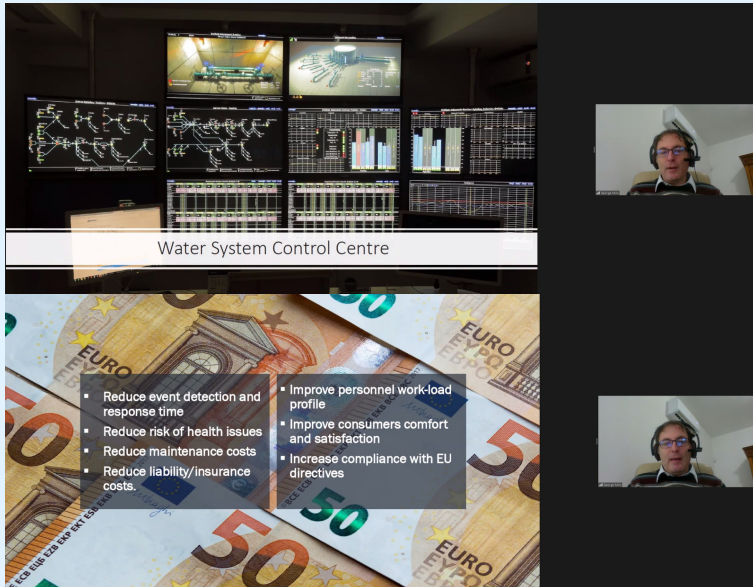
The slide, titled "Where does process modelling fit in BPM?", shows a circular diagram of the BPM lifecycle: Process identification, Process architecture, Process discovery, Process analysis, Process redesign, Process implementation, and Process monitoring and controlling. A second slide, titled "Generation of Event Logs", shows a process model being executed by a PMS to produce an event log. A text box explains: "Any execution of a process model produces a new execution trace (i.e., a process instance) recorded in an event log." Two video feeds of speakers are visible on the right side of the slide.



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Mr George Milis (Director and Innovations Manager at PHOEBE Research & Innovation) presented the topic **The Water Analytics Digital Twin**. The main focus was on the technology of Digital Twins, including the benefits, and how it can contribute to improve the quality of life of the general public. Furthermore, a case study of a Digital Twin replicating an intelligent Water System was presented.

Mr Demetrianos Gavriel (Data Analytics Expert at PHOEBE) presented the topic **PandoraSEAL: An AI-based Decision Support Tool for the Selection of Non-Pharmaceutical Interventions During Pandemics**. PandoraSEAL, is a Neural Network tool that aims to assist decision makers to select and implement the most efficient responses regarding the pandemics. Aside from the tool, a case study was also showcased, for the methodology followed in order to build the tool, including predictions, historical results, and what-if scenarios.

Models for predicting COVID-19

Several models have been proposed and developed in the literature, that predict how the COVID-19 pandemic spreads.

1. Compartmental models
2. Network models
3. Agent-based models

Our focus is on simulating effects of **non-pharmaceutical interventions (NPIs)**
→ support decision making about response policies.

Case study

Predictions

1. Choose dates and countries.
2. Set NPIs :

Build your own custom intervention plan, by choosing a set of NPIs and their respective strictness level or by choosing one of the predefined intervention plans.

Predefined Intervention Plans :

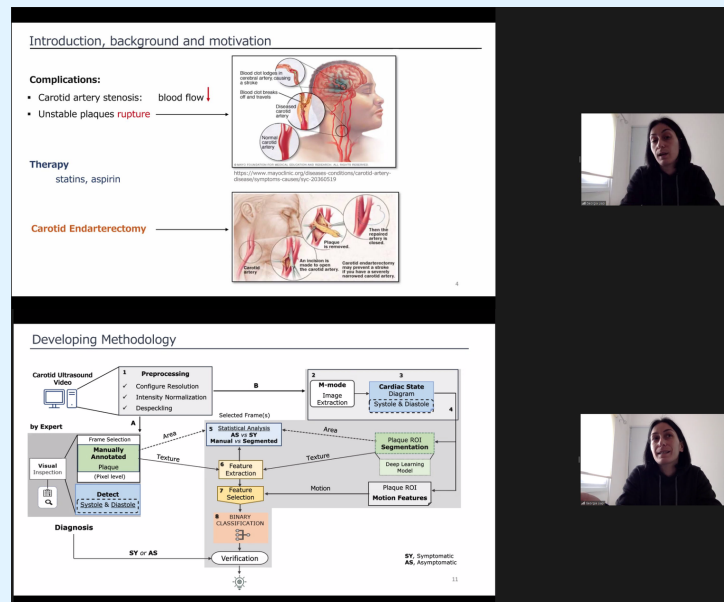
Four pre-defined intervention plans, as follows:

- **'Minimum'**: The level of strictness of NPIs is set to 0, i.e., no NPIs are applied;
- **'Maximum'**: The level of strictness of NPIs is set to the highest level of each NPI;
- **'Freeze'**: The level of strictness of the last available NPIs, i.e., for predictions beyond the last known date;
- **'Historical'**: The historical level of strictness of a specific period in the past is applied.

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Day 5

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Introduction, background and motivation

Complications:

- Carotid artery stenosis: blood flow ↓
- Unstable plaques rupture

Therapy
statins, aspirin

Carotid Endarterectomy

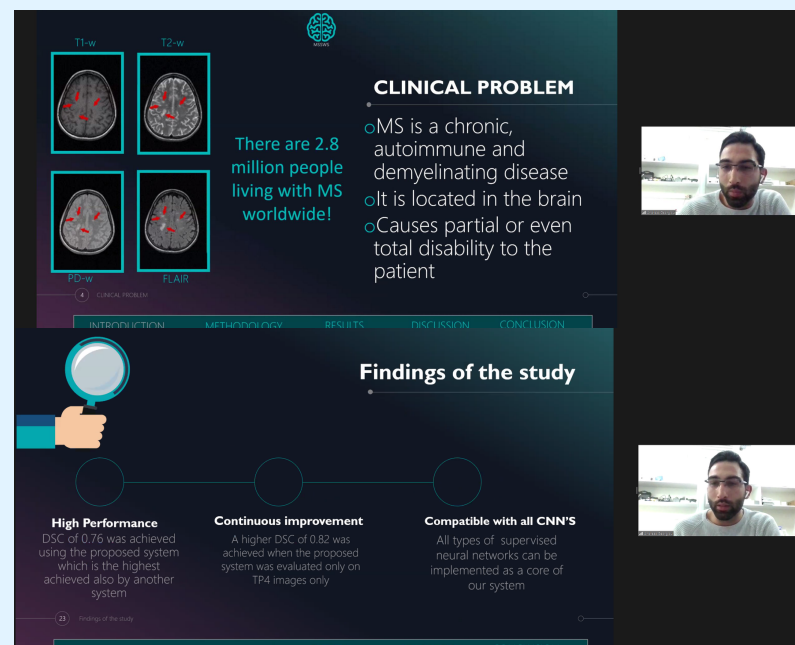
Developing Methodology

Flowchart showing the methodology for Carotid Ultrasound Video analysis, including steps like Preprocessing, M-mode Image Extraction, Cardiac State Diagnosis, Plaque ROI Segmentation, Feature Extraction, and Verification.

Mrs Georgia Liapi (PhD candidate at Cyprus University of Technology) presented the topic: **Ultrasound Carotid Plaque Video Data Analysis for the Estimation of the Risk of Stroke**. During the presentation, a methodology was presented for the estimation of the risk of stroke, using Ultrasound Carotid Plaque Video analysis.

Mr Andreas Georgiou (MSc student at Cyprus University of Technology) provided a talk on **An Adaptive Semi-Automated Integrated System for Multiple Sclerosis Lesion Segmentation in Longitudinal MRI Scans Based on a Convolutional Neural Network**.

The presenter proposes a simple solution that comes provides lesion segmentation to MRI scans of Multiple Sclerosis, where the user has the opportunity to correct errors from the model, so the model can be constantly improved.



CLINICAL PROBLEM

- MS is a chronic, autoimmune and demyelinating disease
- It is located in the brain
- Causes partial or even total disability to the patient

There are 2.8 million people living with MS worldwide!

Findings of the study

- High Performance**: DSC of 0.76 was achieved using the proposed system which is the highest achieved also by another system
- Continuous improvement**: A higher DSC of 0.82 was achieved when the proposed system was evaluated only on T1w images only
- Compatible with all CNN'S**: All types of supervised neural networks can be implemented as a core of our system




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Day 5

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Overview of this talk

1. Short history of distributed data
2. Data Meshes
3. GaiaX as the backbone for Data Products
4. Data Marketplaces: types and approaches
5. Future work



What is a data market?

- A version of a *digital market* such as eBay that specialises in *monetising data*?
- No need for payment and solely *exchanging data products* in a way that is convenient for the actors involved and respects their needs?
- A *platform* where *new data utilisation- and value creation methods* are "created through the process of interaction between" different actors?



JADS

Professor Willem-Jan van den Heuvel & Geert Monsieur from the Jheronimus Academy of Data Science & Tilburg University provided a talk on **The Service Paradigm Rebound: Data Products, Meshes & Markets**. The speakers initiated with a brief history of distributed data, followed with the mentioning of the latest technologies of handling big data, such as data meshes & data products.


Professor Klitos Christodoulou from University of Nicosia presented the topic: **Demystifying Non-Fungible Tokens (NFTs)**. The speaker introduced the ideology behind the production and trend of NFTs, their relation with blockchain and the idea of tokenization in blockchain technology. Moreover, the presentation also mentioned the involvement of NFTs in the upcoming virtual technological ecosystem "metaverse".

Main Entities in Matrix ≈ Blockchain Metaverse

The Architect World Creator	The Merovingian Data Governance Data Trafficking	The Oracle Predictions Data Feeds	Deus Ex Machina Central Interface Eliminate Threads
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↓

Blockchain Operations	Community World Creator Administration	Consensus Alternative Governance Models Decentralization	Oracles Data Feeds
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Demystifying Non-Fungible Tokens (NFTs)



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Day 5

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The image shows two screenshots from a presentation. The top screenshot is a conceptual diagram of the SMARTControl system. It features a landscape with a river, Mediterranean Sea, and agricultural fields. A cycle of seven steps is shown: 1. Capture Zone, 2. Pre-treatment, 3. Recovery, 4. Post-treatment, 5. End Use, 6. (unlabeled), 7. (unlabeled). The diagram is divided into four quadrants: **BENEFITS** (Improvements of health, environmental, technical benefits), **DATA** (Observations, real-time sensors, remote sensing), **DECISIONS** (Improved management, process optimisation), and **KNOWLEDGE** (Better system understanding). **MODELS** (Web-based, collaborative simulations) are also mentioned. The SMARTControl logo and website (www.smart-control.inowas.com) are at the bottom.

The bottom screenshot shows the **Numerical groundwater modelling tool (INOWAS_T03)** interface. It has four main sections: **1. Setup** (Discretization, Soil layers, Boundaries, Head observations, Solute transport, Variable density flow), **2. Calculation** (MODFLOW, MT3DMS, SEAWAT), **3. Results** (Flow, Budget, Concentrations, Calculation logs), and **4. Calibration** (Statistics, Simulated vs. observed, Weighted residuals vs. simulated heads, Banked residuals vs. normal probability). A graph on the right shows 'Observed vs. Simulated Values' with a red regression line and data points.

Dr. Constantinos Panagiotou from Excelsior – Eratosthenis CoE presented the topic **Web-based Real-time Monitoring and Modeling of Managed Aquifer Recharge Applications**. In the context of the presentation, a Smart Real Time Monitoring Web Application was presented, which gathers data from different locations of the world about groundwater systems. These data are utilized in order to make some assessments, such as the states of the groundwater systems.



DESTINI

Smart Data ProcESSing and SysTems of Deep INsight

Conlusion

TWINNING PROJECT - HORIZON2020

The **Second School of the DESTINI project** was successfully held on January 24-28, with participation from universities, researchers, students, businesses, offering their knowledge and expertise to the audience. The topics of the presentations covered a wide variety of topics and scientific areas, and it was demonstrated how applied research can the project's stakeholders and the general public.

The **consortium of DESTINI** would like to thank all the presenters and participants of the event, for their courtesy to be a part of this and honor us with their presence.

Contact us



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