DESTINI

HORIZON 2020

Research Outcomes

DESTINI

Smart Data Processing and Systems of Deep Insight

eTwinning

European Commission

Sapienza Università di Roma

Cyprus University of Technology

Tilburg University

SEiIS

JADS Jheronimus Academy of Data Science

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BPM in Healthcare

Business process mining is a must-have set of techniques for top management to better organize and automate operational processes. Process management enables business owners to turn processes into visual flows and flows into automations. This is also the way to keep operations aligned with goals and strategies, track performance, and detect gaps or process bottlenecks to fix. This thesis aims to apply BPM models, specifically process discovery, conformance checking and process optimization, to Healthcare data. The thesis utilizes data from health services in Cyprus (e.g., Ambulance).

BPM on Data Lakes

Process mining is a family of techniques combining data science and process management to support the analysis of operational processes based on event logs. Process mining aims to turn event data into insights and actions. Process mining techniques use event data to show what people, machines, and organizations are really doing. Process mining provides novel insights that can be used to identify the execution path taken by operational processes and address their performance and compliance problems. This thesis's goal is to apply Business Process Mining (BPM) by processing not only event logs (structured data) but also semi-structured and unstructured data stored in their raw/natural format in Data Lakes system repositories. The thesis experimented with data that are expressed as RDBMS tuples, images, videos, tweets etc. The data are first transformed into a standardized format (e.g. metadata) and then BPM techniques are applied to this format.

Blockchain - Data Lakes Blueprint - Metaverse – NFTs

The Metaverse is an online, three-dimensional universe that combines multiple virtual spaces. It can be compared to a future version of the internet. With Metaverse, users can collaborate, meet, play games, and socialize in these 3D spaces. NFTs are digital items that can be bought and sold using this blockchain technology. Users can have complete control over their digital assets in the Metaverse, thanks to NFTs. Blockchain technology provides immutable confirmation of ownership that underpins these virtual worlds. This thesis aims to use Blockchain and NFTs' technologies to make Data Lakes Blueprint (an existing work) available to the Metaverse.

Methodology for assessing the accuracy of logs in Process Mining

This thesis investigates the challenge of the accuracy of logs used in the area of Process Ming to perform process discovery. Data accuracy is paramount for producing a reliable process model and then experimenting with it to improve tasks and steps within the discovered process. If accuracy is low, then any decision made to modify and optimize a process or any information retrieved from the analysis of the data projects on this model is biased and flawed. Therefore, the thesis surveys the literature to find appropriate metrics and techniques that could enable the assessment of the accuracy level of logs and proposes possible ways to improve it.

Real-time processing and visualization of heterogeneous data streams

The purpose of this thesis is a methodological approach to gather data streams and discover data values. All this information is taken and represented with Digital Twin. Digital Twin monitors the structure of streaming data to interact with gathering data to customize and finally visualizes the data with graphical techniques.

Graphical techniques to show how people and tasks are integrated into reality

The purpose of this thesis is to collect all the information of task flow that people execute a business process from event data and process logs. This is achived with the Digital Twin to define and collect the flow of tasks and metrics (total time of execution, number of steps, time for each step, etc). Finally, all this information is shown in a graphical dashboard that studies business flows.

Interactive Dashboard for business flow changes using Blockchain

This thesis aims to interact with the business flow to reduce time, cost and human resources. This interaction must record all the flow and parameter changes in Blockchain. Moreover, the Blockchain gives the resources and analytical changes to users. When a business flow succeeds in reducing cost, for example, updating all the users using Blockchain technology.

3D Training platform

This thesis aims to create a 3D training platform to train and increase employees' skills for resolving real problems in production line machines. The 3D environment is being designed in the virtual world (Metaverse) with if-scenarios and interactions. All steps and processes of training are stored on Blockchain to certify the training.

Business Process Mining with Visual Querying

This master thesis uses Digital Twin to mainly use a graphical technique to investigate the relations between the data. Users can use standard steps to obtain the desired result without programming skills. This thesis converts process mining into an interactive procedure that utilizes Digital Twins to visualize data of historical data and processes that were retrieved from logs or data warehouses.

Metaverse in Healthcare

This thesis aims to create a virtual environment that visualizes patients' files. Users can read and interact with humans in the virtual environment to see the patient's problem and suggest treatment. The idea of this interaction patient is to propose a treatment and see the progress of treatment in real-time.

Survey on Industry4.0 - Smart Data Processing and Systems of Deep Insight Current Research and Future Challenges

This survey is conducted in the context of a DESTINI project which aims to identify and quote the most significant research findings, challenges and open problems on Smart Data Processing and Systems of Deep Insight approaches in the area of Industry 4.0 and Smart manufacturing that are reported in the relevant literature. The survey is organized as follows: First, the survey presents the research questions that motivate this study and describes the methodology followed to identify relevant studies published in various venues. Secondly, it outlines the most important aspects of these studies organized in specific scientific areas accompanied by their literature review, introducing the problem dealt with, the methodology followed, and the results produced. The scientific areas included are: Infrastructures, frameworks and technologies supporting SDP (Data Lakes, Data Meshes, CPS) and Tools and Techniques supporting SDI (Predictive Maintenance and predictive analytics, BPM, Blockchain, Optimization, Decision Support and Prediction) in the area of Smart Manufacturing. Finally, the survey summarizes the research challenges and open problems identified in the corresponding studies reviewed.

Survey on Graphical methods and models that contribute to the area of Smart Data to identify the most significant challenges and open problems

The new scientific trends nowadays worldwide are the Internet of things (IoT), big data, cloud computing, artificial intelligence (AI) and other new generation information technologies. All these generate a large volume of data that may be structured, semi-structured and unstructured. Big data analysis models and algorithms can run to organize, analyze and mine these raw data to obtain valuable knowledge. These data, when visualized you, can provide different information with the use of some filters. Data visualization represents data in some systematic form, including attributes and variables for the unit of information. Visualization data allows users and businesses to mash data sources to create custom analytical views.

In manufacturing, we see that big data involve a large volume of structured, semi-structured and unstructured data generated from the product lifecycle. Internet of Things (IoT) devices collect these manufacturing data in real time and sometimes automatically. Manufacturers aim to find a way to increase efficiency, manage the storage of all these data and visualize them to improve and increase productivity and quality of manufacturing. Nowadays, industries are being transformed with the rise of IoT, autonomous robots, cyber-physical systems, cloud computing and cognitive computing. This transformation is called Industry 4.0 or Smart Industry. Industry 4.0 aims to construct an open, smart manufacturing platform for industrial information applications based on various technologies.

KnowGo: An Adaptive Learning-Based Multi-model Framework for Dynamic Automotive Risk Assessment (https://doi.org/10.1007/978-3-031-11510-3_18)

In autonomous driving systems, the level of monitoring and control expected from the vehicle and the driver change in accordance with the level of automation, creating a dynamic risk environment where risks change according to the level of automation. Moreover, the input data and their essential features for a given risk model can also be inconsistent, heterogeneous, and volatile. Therefore, risk assessment systems must adapt to changes in the automation level and input data content to ensure that both the risk criteria and weighting reflect the actual system state, which can change at any time. This paper introduces KnowGo, a learning-based dynamic risk assessment framework that provides a risk prediction architecture that can be dynamically reconfigured in terms of risk criterion, risk model selection, and weighting in response to dynamic changes in the operational environment. We validated the KnowGo framework with five types of risk scoring models implemented using data-driven and rule-based methods.

Exploring Forensic DNA analysis and profiling with intelligent techniques.

This research is tightly connected with the study of relevant and critical aspects like Smart Healthcare Intelligence, Crime Security & Safety, Nature & AgriFood, and Sustainability. These domains align with the actual objectives and issues to improve the quality of life and reduce manual and time-consuming approaches.

So far, in the context of Forensics investigations, new approaches and implementations to support traditional manual methods in identifying genetic profiles have been explored, such as convolutional neural networks to improve electropherogram classification performance. The results interpretation appears to be a highly complex problem due to abnormalities in the laboratory steps. This obstacle inevitably leads to possible wrong identification of matching between DNA profiles and consequently mistakes about the people involved in the crime scene. These problems highlight the challenge that arises since more of the applied approaches fall short of performing on an acceptable level. An investigation of applying more techniques coming from the computational intelligence area will be conducted, followed by the introduction of the relevant results.

Usage of FCM for evaluating a Maturity Model

Industry 4.0 has introduced many technologies requiring absolute knowledge to be implemented correctly. Because of the multitude of solutions and techniques, it is not easy for a company to schedule and plan the roadmap and the investments required to shift towards Industry 4.0. Moreover, it is not straightforward for a company to understand its readiness as an Industry 4.0 player. The presence of a maturity model to assess the maturity and readiness of a company as an Industry 4.0 actor, according to the complexity and the type of software and hardware installed and their usage, can bring significant advantages. Companies can use it to evaluate and analyze their strengths and weaknesses, but, more importantly, they can use it to define a roadmap of investments to reach a higher "maturity level." This work aims to provide a maturity model based on Multi-Layer Fuzzy Cognitive Map approach.

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