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# Data management for a more sustainable and responsible society<sup>1</sup>

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## 1. Résumé

Applying appropriate data engineering and data management practices is essential to achieve sustainability in a society. For example, it is a cornerstone and fundamental building block for AI applications. On the one hand, it is clear that suitable data services can contribute to achieving Sustainable Development Goals (SDGs), which are a political priority. This is related to the idea of green with software. On the other hand, applications and data services should be developed with an awareness of their sustainable impact. Therefore, the data management approaches themselves should be sustainable, according to the idea of green software. While there has been significant progress in terms of research into reducing energy consumption in computing (Green IT), very little work has been done in the design and development of data management proposals where the integration of sustainability is a fundamental characteristic, not only for energy saving but also for other types of sustainability, such as mobility sustainability.

By designing appropriate data management techniques, we can contribute to a better daily life for people and also to foster suitable behaviors in such a way that the existing modern challenges that we face as a society can be tackled. Thus, traditional data management techniques used to develop information services and applications for mobile users can be adapted to be useful, effective, and impactful in the current circumstances that permeate our lives, considering aspects such as the existing environmental risks. Besides, we have to take into account that the previously-existing challenges of Big Data have not been completely solved yet; thus, the existence of large amounts of heterogeneous data, usually coming at high speeds and in large quantities from a variety of data sources (sensors, other users, etc.), makes their collection, retrieval, filtering and processing challenging. Personalization, both as a means to deal with the existing data flood and to offer really customized information adapted to the needs and current context of each specific user, becomes of paramount importance to provide to each citizen the data that he/she really needs at the right moment.

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Within the NEAT-AMBIENCE project, we tackle the design of novel data management techniques for mobile users and for drivers. On the one hand, we develop solutions for mobile Context-Aware Recommender Systems (CARS) which incorporate the consideration of novel factors such as ensuring a suitable physical distance among people (which we call Side-CARS —Social-Distance prEserving CARS—). On the other hand, we tackle challenges of developing information services for drivers, particularly services that provide information about resources on the roads that can be of interest to drivers (mobile resource search), such as parking spaces. Besides, in the context of NEAT-AMBIENCE we also explore specific use cases, related to tourism, resources for drivers, health and agriculture.

In this keynote, we will explore some of our initiatives in NEAT-AMBIENCE. Besides, we will also present some initial ideas about how data management can integrate sustainability as a key ingredient, not only from the perspective of energy efficiency, but also for other types of sustainability, such as organizational sustainability (i.e., more inclusive and egalitarian organizations) and mobility sustainability, focused not only on reducing the carbon footprint of transport systems, but also on enabling the circulation of citizens with a controlled impact, and where the poles of attraction of citizens (e.g., tourist destinations) are able to exploit their places of interest in a sustainable and culturally-attractive way. We should not forget either a third key axis, which is that of well-being sustainability, where data management in basic domains such as health or advances in more efficient food systems must also include the sustainability component. We intend to cover these aspects in detail in a future research project (DAMASCOS), whose main motivation is to progress in the development of data management techniques and services that integrate sustainability for the three aforementioned pillars: organizational, mobility and well-being sustainability. Sustainability plays a double role here: we aim at sustainable data management techniques to improve sustainability. Our intention is to advance the state of the art regarding the design and development of novel solutions for sustainability-oriented decision-making processes in several scenarios.

## 2. Biographie

Sergio Ilarri<sup>2</sup> is a Full Professor (“*Profesor Catedrático de Universidad*”; branch of knowledge: Engineering and Architecture) at the University of Zaragoza (Spain). He belongs to the Department of Computer Science and Systems Engineering and develops his work in the School of Engineering and Architecture of the University of Zaragoza. He is a Computer Science Engineer (University of Zaragoza, 2001) and Doctor in Computer Science (University of Zaragoza, 2006 — Doctoral Program in Systems and Informatics Engineering).

Currently, he is the principal investigator (PI) of the research group COS2MOS (Computer Science for Complex System Modeling, <http://cos2mos.unizar.es>; current reference: T64\_23R), recognized as reference group (“*grupo de referencia*”) by the Government of Aragon for the period 2023-2025 (along with Ramón Hermoso as co-PI); he also played the role of PI of the group during the previous recognition period 2020-2022 (where the group was also recognized as reference group) and during the period 2017-2020 (during which the group had the previous category of group in development / “*grupo en desarrollo*”), thus leading the group to its consolidation. Besides, he is currently leading the national research project NEAT-AMBIENCE “Next-gEnerATion dAta Management to foster suitable Behaviors and the resilience of cItizens against modErN ChallEnges” (<http://webdiis.unizar.es/~silarri/NEAT-AMBIENCE>, PID2020-113037RBI00, funded by MICIU/AEI/10.13039/501100011033 —Spanish State Research Agency—) and has experience also as PI of previous research projects.

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His main research area is digital data management. His research interests include mobile computing, vehicular networks, context-aware recommender systems, data streams, information systems, data semantics, and data-driven decision making. His research on data management within the COSMOS group aligns with the development of data management techniques that allow addressing the challenges of the need to process and exploit large volumes of heterogeneous data in complex systems. Tasks such as the following are considered: development of data management techniques for highly-dynamic mobile computing environments (vehicle networks, mobile users in a city, etc.), and with support for peer-to-peer (P2P) mobile networks; design of strategies for the analysis of large volumes of data for the development of recommendation systems to help users, in particular applied to mobile computing and smart cities; and development of techniques and/or models for the exploitation of information to support decision-making in complex environments with uncertainty, where the information available may be incomplete or imprecise.

He has authored publications in relevant journals (more than 45 regular papers in JCR-indexed journals, with an average ranking position at the top 25%) and conferences and has participated as guest editor of special issues of journals such as Transportation Research Part C, IEEE Internet Computing, IEEE Multimedia, the Journal of Systems and Software, Distributed and Parallel Databases, and Personal and Ubiquitous Computing. For a year, he was a visiting researcher in the Mobile Computing Laboratory at the Department of Computer Science at the University of Illinois in Chicago, and he has also cooperated with other universities (e.g., through research stays with the University of Valenciennes and with IRIT in Toulouse —France—, as well as other short visits and joint actions). He has also participated in numerous program committees as well as in the organization of different events (e.g., Program Co-Chair of the 28th International Database Engineered Applications Symposium Conference —IDEAS 2024—, Program Co-Chair of the 11th International ACM Conference on Management of Digital EcoSystems —MEDES 2019—, Chair and local organizer of the 13th International Workshop on Semantic and Social Media Adaptation and Personalization —SMAP 2018—, Co-Chair of the Third International Workshop on Information Management in Mobile Applications —IMMoA 2013— in conjunction with VLDB 2013, track chair in several events, etc.),

Besides his teaching and research activities, he has served in several academic management positions (as director of university masters / “*Másteres Propios*”, subdirector of the Department of Computer Science and Systems Engineering at the University of Zaragoza from May 2016 to May 2020, and currently as the Coordinator of the Computer Science Degree at the School of Engineering and Architecture of the University of Zaragoza since September 2020), and he usually participates regularly in several academic committees.