Introduction to the CONTEXT-21 Special Issue

Review Modeling and Using Context

Patrick Brézillon[1] & Roy M. Turner[2]

[1] LIP6 – Sorbonne Université, France
[2] University of Maine, USA

The CONTEXT conference series has brought together researchers and practitioners from a wide range of disciplines and industries to present their work related to issues of context, contextual reasoning, and context-awareness to discuss commonalities and diversities in the different disciplinary approaches. It is unique in focusing on context as a subject of study in its own right, and it has become one of the top venues for context-related research.

Context affects virtually all aspects of behavior in animals, humans, and computer systems. It affects how we understand the world, communicate with others, and plan and carry out our actions. It affects how computer systems behave so that they act appropriately for their situation and users. Contextual effects have been studied in many different disciplines over the years, but usually without too much interaction between the researchers in the different fields. This began to change in the mid-1990s, beginning in a small way with a 1993 International Joint Conference on AI workshop on modeling context in knowledge representation and reasoning, which sought to bring together some of the various threads of context-related research. The interdisciplinary focus on context as a subject of research truly began in 1997, when the First International and Interdisciplinary Conference on Modeling and Using Context, CONTEXT 1997, was held in Rio de Janeiro.

CONTEXT conferences over the years have showcased papers from some of the leading thinkers on the subject as well as newcomers from fields as diverse as artificial intelligence, philosophy, linguistics, neuroscience, management, and computer applications, and have included world-renowned invited speakers. This conference was first held at a time when other fields had begun to recognize context as a subject of study in its own right, but the CONTEXT series still remains the premier venue for bringing together researchers from many different fields to share ideas and discuss commonalities.

This special issue of the MUC Review contains ten papers submitted to the CONTEXT-21conference, which was planned to be held jointly with IE-21 in Dubai in June 2012; however, it was cancelled due to the COVID-19 virus. This CONTEXT-21 issue aims to illustrate specific aspects of context modeling and use at different granularities.

Brézillon and Turner argue for the centrality of a pragmatic approach to modeling and using context as a means of unifying research along all axes of context-related research: formal, cognitive, and pragmatic. After briefly discussing the evolution of the research on context in the past 25+ years, we describe the case for a focus on pragmatic research (e.g., applications) going forward. We then give three illustrative examples of pragmatic approaches leading to implementations.

Jagarlamudi et al. concretize the potential benefits of the context-driven intelligence delivered by Context Management Platforms (CMP), by proposing efficient and effective metrics for measuring Quality and Cost of Context (QoC and CoC) that can hinder them from uptake and commercialization. Furthermore, the CMPs might have limited abilities to incorporate efficient QoC drivers and a suboptimal selection of QoC-aware context providers. The authors introduce a

conceptual architecture to achieve the QoC and CoC awareness in CMPs, aiming to improve their efficiency and the context consumer's experience.

Augusto and Dickins present their thoughts on connecting contexts as they are handled in natural systems and in computer science. Based on some natural contexts, the authors analyze them as an inspiration to highlight possible improvements on how contexts are designed and used in computer science. They point out beneficial lessons and inspirations which have the potential to bring practical benefits as a result of this process.

Brézillon describes the evolution of AI systems from expert systems, knowledge-based systems, joint cognitive systems, intelligent systems, intelligent assistant systems (IASs) and the coming generation of Context-based IASs (CIASs). CIASs require a deep focus on context and its relations with the users, the task at hand, the situation and the environment in which the task is accomplished by the user; the observation of users through their action and behaviors and not a profile library; a robust conceptual framework for modeling and managing context; and a computational tool for representing in a uniform way pieces of knowledge, of reasoning and of contexts.

Anjou et al. describe the advances in the TEEC project (for Educational Technologies for Teaching in Context in French). This multidisciplinary project aims to develop and experiment with a context effects-based pedagogical model involving learners and teachers from multiple geographical contexts, collaborating on common subjects with local specificities. Some tools already exist, such as the "Clash model", a pedagogical model based on context effects, and Mazcalc (Context gap calculator), a numeric tool for modeling learning objects in two distinct geographical contexts and calculating gaps between them. The first paper presents research relying on the Design Based Research methodology (DBR) that allows the articulation of the project between all those disciplines and stakeholders. The second paper gives a description of the CEM (Context Effect Manager) that will provide recommendations about the relevance of setting up of a pedagogical context-sensitive collaborative experiment between the two contexts.

Also on the subject of education, Macchia and Brézillon show that the teacher establishes a task model that the learner must realize according to a given frame of knowledge, methods and tools. The unique feedback from learners comes from their evaluation. For including the learner in the training-design loop, the authors propose to replace the task model by an activity model of the learner realizing the task. Making the learning context explicit facilitates knowledge acquisition. Three frames of reference are proposed: for learner modeling, for training specifications and for learning activities. Each frame of reference is described by contextual elements that are instantiable with specific values for each learner and each step in the training session. This "learner-driven" training is more relevant than the usual "profile-driven" training.

Turner et al. argue that explicitly representing an agent's context has many benefits, which should also apply to machine learning. In this paper, the authors describe an approach to do this called context-dependent deep learning (CDDL), which is based on earlier work in context-mediated behavior (CMB) that uses contextual schemas (c-schemas) to represent classes of situations along with knowledge useful in them. These are then recalled and guide reasoning in the corresponding contexts. CDDL stores knowledge about deep neural network structure and weights in c-schemas, which allows context-specific learning. This work is being developed in the domain of seabird detection in aerial images of islands for use by biologists.

Marpaung and Gonzalez describe a study involving human test subjects that sought to gauge how well they could identify the emotion being expressed by a speaker using only paralinguistic signals (i.e., speech without understanding the spoken words), with and without knowing the speaker's context. The first part of the study entailed asking the test subjects to identify the emotion expressed by a speaker who utters unintelligible sounds in a context-free basis. The test subjects were provided with knowledge about the context in which the speaker(s) uttered the same sounds heard before on a

context-free basis. The results indicate that knowing the context under which the speakers uttered the expressions indeed improved the ability of the test subjects to infer the correct emotion being expressed by the speakers.

Hegarty and Maubrey defend a vision of management as good when it is rational (i.e. intentional), pragmatic (i.e. focus on results), and responsible (i.e. ensure appropriateness). This vision grounds an approach to knowing, doing, and being that is used in teaching management to students. The paper presents a method for practicing good management together with its theoretical justification. Attention is drawn to the importance of modeling and using context in management. The method is applied in studying a real-world business case, a major company merger in France.