Distributed Systems Development using Info Cases

(Extended Abstract)

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***Abstract*–Info cases consist in a functional requirements specification technique, based on the elicitation of information flows between a system and its external actors, which aims to reconcile use case models and domain models. Empirical studies suggest that they guide requirements elicitation activities to happen in a more systematic way, while reducing inconsistencies between derived domain models. Although info cases were proposed to be a generic technique, it is equally possible to focus their application in specific software system domains, such as distributed systems. These are harder to develop than software in other domains, not only due to the hostile environments in which they normally appear, but also due to their additional functional requirements, such as location dependency, concurrency and non-determinism. Despite their complexity, distributed system behaviors depend on rich patterns of information flow, suggesting that info cases are perfectly fitted. In this interactive tutorial, we illustrate how distributed software systems can be developed from their first principles using info cases.**

***Index Terms*–Info Cases, Distributed Systems, Requirements Engineering, Software Engineering.**

I. Introduction: Motivation and Objectives

Info cases consist in a functional requirements specification technique, based on the elicitation of information flows between a system and its external actors, which aims to reconcile use case models and domain models [1]. They can be regarded as a specialization of use cases from which domain models can be derived using a structured method based on semi-formal rules. Empirical studies suggest that they guide requirements elicitation activities to happen in a more systematic way (yielding domain models with higher granularity), while reducing inconsistencies between derived domain models (produce domain models with greater uniformity). When first proposed, info cases were conceived to be part of a specific software development methodology called Informational Requirements Modeling [2].

In fact, info cases are a generic textual specification technique that can be used in an integrated way with general purpose diagrammatic software development techniques, such as Use Case Diagrams and Information Flow Diagrams [3]. As it can be noticed, the integrated usage of such techniques and derivation methods can be regarded as a specific (and rather innovative) information-based approach to drive software development processes.

Info cases have been used in the development of software systems of different domains, such as information systems in general and business processing systems in particular [4]. Given that they were proposed to be a generic technique, one could wonder if they would also be suitable to deal with the subtleties of complex domains, such as distributed systems.

In particular, distributed software systems are harder to develop than software in other domains, not only due to the hostile environments in which they normally appear [5,6], but also due to the existence of additional functional requirements in this domain, such as location dependency, concurrency and non-determinism, not to mention non-functional requirements. In spite of this additional complexity, standard software development methods and techniques have been shown to be effective in the development of distributed software systems. Since distributed system behaviors depend on rich patterns of information flow, info cases appear to be perfectly fitted.

The authors have been applying info cases in the development of distributed software systems and believe that such application should be popularized, the reason for proposing the present tutorial. It is expected that the development process of distributed systems could be made clearer, on one hand, and that info cases become more popular, on the other.

In addition to applying info cases in the development of real distributed systems, the authors have taught undergraduate courses on the subject and have developed software development tools (Michel developed, with his students, an info case specification tool, and Carlos has developed a UML profile using the Papyrus tool that runs under the Eclipse software development environment), which are reasons to believe that this subject has reached sufficient maturity to be shared with a wider audience.

II. Format and Services

This half-day tutorial consists in the presentation of a sequence of connected conceptual definitions and practical examples. The authors have also prepared exercises and a list of annotated bibliographic references, suggesting further studies and topics for personal investigation. A complete set of slides, specifications, source code, exercises and bibliography will be made available online, after the tutorial.

The tutorial is organized according to the following timetable:

Begins	Ends	#	Subject
14:00	14:15	1	Presentation: (a) Authors and Attendees; (b) Tutorial Goals
14:15	15:30	2	Introduction to: (a) Distributed System Notions; (b) Info Cases
15:30	16:00	3	Coffee Break
16:00	17:15	4	Examples from a Large Scale Distributed System Development
17:15	17:30	5	Final Considerations: Comments, On-Line Material, Evaluation

The initial tutorial session is devoted to making the attendees comfortable, to presenting authors and attendees to one another and to making tutorial goals and methods clear to the audience.

The sub-session Introduction to Distributed System Notions provides the basic notions related to the development of distributed systems, such as their generic and particular requirements, as well as the notions of object, interaction, model, architecture and refinement.

The sub-session Introduction to Info Cases comprises the explanation of the key concepts about info cases (including their relationship with uses cases) and the presentation of simple examples of how to apply info cases and to derive a domain model from them.

The session Examples from a Large Scale Distributed System Development details, using an information-based approach centered on info cases, the development process of a complete software system to automate retail networks. These are regarded as inherently distributed systems, since their physical facilities are geographically distributed. In order to integrate the operation of such facilities, proper product transportation, data processing and communication infrastructures must be in place. Moreover, apart from the face-to-face sales methods, modern retail networks provide distance sales channels, such as virtual online stores in which product selection, ordering and payment are performed entirely in an electronic manner. Such distribution aspects and the entire development process of software systems automating retail networks are discussed with the attendees.

During the second and fourth tutorial sessions (#2 and #4), small individual written exercises are handled to the attendees, in order to further motivate their participation, ensure an alternative way to capture tutorial contents and provide immediate feedback to the presenters, so that they can adjust their exposition and/or emphasize certain topics, aiming to guarantee the expected dissemination outcomes of the tutorial.

The final tutorial session is devoted to hearing from the attendees questions or comments that they might have, to providing pointers to online material and post-tutorial procedures, as well as to distributing an evaluation form that should help the authors to improve future issues of the tutorial.

III. Target Audience

The tutorial is addressed to undergraduate and graduate students, as well as researchers and industry practitioners. The attendees should have some maturity in Software Engineering, in particular some knowledge on software systems development. Specifically, the attendees should have some practical experience in systems modeling using use cases and class structure diagrams, as well as in programming with object-oriented languages.

IV. Tutorial History

The contents of this are offered as such for the first time during RE´2015. However, Michel has already taught courses on info cases as part of a mandatory discipline for obtaining a BSc undergraduate degree at UFJF. In the last occasion, in the six months ending in December of 2014, there were a hundred computing and business administration students enrolled in his courses. In that occasion, for the first time, the students were asked to apply, as their term project, info cases to specify the requirements of a distributed information system, something that was performed without difficulties.

V. Biographies of the Authors

Carlos Henrique Cabral Duarte is a Member of Technical Staff at the National Bank of Social and Economic Development (BNDES, 1992-), Rio de Janeiro, Brazil, where he is currently responsible for the accreditation of machines and equipment, particularly of the healthcare sector (2012-). Previously, he was an operations manager and deputy head of department (2002-12), having financed more than 60 ICT companies, two of which now listed in the Bovespa Stock Market as a direct result of his work. He was the BNDES representative in the National IT Committee and deputy board member of the National Society for the Advancement of Software Quality (2003-12). In 2007, his biography was included in the publication Marquis Who is Who in the World due to his contributions to the Brazilian software industry. Carlos Henrique has also had an academic career. He worked as a Lecturer in some Brazilian Universities (1999-2009) and has written and reviewed papers for scientific journals and conferences, recently becoming also a panelist (in the issues of the RST series, held during RE´2013 and ICSE´2014), workshop organizer (CESI´2015, held in conjunction with ICSE´2015) and an industry committee member (RE´2014-5). Carlos holds PhD (Imperial College, London, 1999), MSc (PUC-Rio, 1994) and BMath (UFJF, 1992) degrees in computing. He is a senior member of the IEEE, Computer Society.

Michel Heluey Fortuna is an Associate Professor at the Computer Science Department of the Federal University of Juiz de Fora, Brazil (1984-). He was a key person leading the creation of the BSc course on computing in that university (2000). Since then, he wrote a book about systems modeling and has taught, conducted research projects and supervised students therein, as well as occupied management positions in university and course administration. Previously, Michel was a System Analyst at Rede Ferroviária Federal S.A. (1983-1996). He holds PhD (COPPE/UFRJ, 2008) and MSc (IME, 1982) degrees in computing and a BEng (UFJF, 1979) degree. He has been a member of ACM and IEEE, Computer Society.

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