Goal and Scenario Modeling, Analysis, and Transformation with jUCMNav

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Abstract

jUCMNav is an open-source Eclipse plug-in that supports the definition, analysis, transformation, and management of requirements engineering models expressed with the User Requirements Notation (URN). In November 2008, URN was approved as a standard by the International Telecommunication Union (ITU-T). URN is the first standard that combines modeling concepts and notations for goals and intentions (mainly for non-functional requirements, quality attributes, and reasoning about alternatives) and scenarios (mainly for operational requirements, functional requirements, and reasoning about scenario interactions, performance, and high-level architecture). jUCMNav has been instrumental in validating key concepts for the current standard as well as prototyping new concepts.

1. Introduction

jUCMNav [3] is the most comprehensive tool available to date that supports the User Requirements Notation (URN) standard [2]. jUCMNav is an open-source Eclipse plug-in that can handle URN’s two complementary sublanguages – GRL (the Goal-oriented Requirement Language) for modeling goal-oriented and intentional concepts and UCM (Use Case Maps) for modeling scenario concepts.

URN supports the elicitation, analysis, specification, and validation of requirements. URN is the first standard to address explicitly, in a graphical way and in one unified language, goals and scenarios, and the links between them. URN models do not intend to provide detailed specifications of “how” functionalities are to be supported but are primarily concerned with exposing “why” certain choices for behavior and/or structure were introduced, combined with an abstract view of “what” capabilities and architecture are required. Modeling goals and scenarios is complementary and may aid in identifying additional or spurious goals and scenarios, thus contributing to the completeness and accuracy of requirements.

URN has concepts for the specification of stakeholders, goals, non-functional requirements, rationales, behavior, structure, and scenarios. URN is suitable for describing most types of service-oriented, concurrent, distributed, reactive, and information systems, covering abstractions from business goals and requirements description to high-level design. For more details, the reader is referred to the (210+) publications and theses available at the URN Virtual Library [8].

2. Features of jUCMNav

jUCMNav’s features can be broadly grouped into basic URN model definition, analysis, transformation, and advanced research. The basic model definition features are based on the URN standard and ensure that syntactically correct URN models are created and that definitions of URN model elements can be shared among multiple interlinked GRL and UCM diagrams.

Fig. 1. URN modeling with jUCMNav

The two key URN analysis features supported by jUCMNav are GRL model evaluation with strategies and UCM model interpretation with scenario definitions and the path traversal mechanism. jUCMNav has
an extensible architecture that allows customized GRL
and UCM analysis techniques to be added to the tool
with little effort. Currently, the three sample GRL
evaluation mechanisms in the URN standard are sup-
ported (quantitative, qualitative, as well as a mixed
analysis), plus a fourth one proposed in [7]. jUCMNav
gives immediate visual feedback for global tradeoffs
among conflicting stakeholder goals (see Fig 1).

jUCMNav’s path traversal mechanism conforms
to the requirements defined in the URN standard and
traverses a UCM model based on a scenario definition
provided by the modeler. A scenario definition speci-
sifies scenario start points, preconditions, expected sce-
nario end points, postconditions, and initializations of
global variables. The actual path to be traversed is
determined by the initial, user-defined values of these
global path variables and the changes to their values
during the traversal. The URN data model contains a
simple action language that supports variable assign-
ments, expressions, and conditional statements and is
fully supported by the jUCMNav tool. Various errors
and warnings are reported if the traversal cannot pro-
cceed, when non-deterministic choices are encountered,
or when preconditions, postconditions, or expected
cenario end points are violated. This enables the (re-
gression) testing and validation of the UCM model, as
well as the detection of undesired scenario interactions.

jUCMNav also uses scenario definitions to high-
light, in red, the paths traversed while running the sce-
nario on a UCM model. In addition, strategies and sce-
nario definitions can be combined for an integrated
analysis of a URN model and their results can influ-
ence each other [4]. jUCMNav automatically creates
UCM integer variables for each GRL graph element.
The current satisfaction levels of such elements can
hence be used to influence the selection of UCM paths.
Also, new values can be assigned to these variables
during the traversal, hence influencing the propagation
of satisfaction levels in a GRL graph.

Recently, jUCMNav has been extended with the concept of Key Performance Indicators (KPIs) [6].
KPIs represent real metrics of a system that can be retrieved from external sources of information (e.g.
data warehouses or performance management tools)
and are used in URN as input for the GRL evaluation
mechanism. Therefore, KPIs may change the satisfac-
tion level of high-level goals which in turn may cause
changes to the parts of the UCM model that are linked
to the goal model. A feedback-based framework
for online monitoring of system metrics and runtime adap-
tation of scenario models is therefore established.

The transformation features of the jUCMNav
tool support advanced functionalities such as scenario
export of performance models based on UCM per-
formance annotations, and integration with the
IBM/Telelogic DOORS requirements management
system [6] (for requirements and model evolution, and
for compliance). The tool can also generate reports and
export diagrams in various formats.

3. Conclusion

jUCMNav is the most popular and feature-rich
modeling tool for the User Requirements Notation, a
goal and scenario modeling standard recently approved
by ITU-T. jUCMNav has been and continues to be
very useful in validating new ideas and concepts for
URN and to demonstrate the usefulness of the nota-
tion. jUCMNav is currently used at a dozen universi-
ties and in several companies around the world for
education, research, and industrial modeling purposes.
We ourselves have been using it successfully for 4
years in our undergraduate Software Requirements
Analysis and graduate Software Engineering courses.

Future versions of jUCMNav will focus on better
supporting new URN constructs recently standardized
as well as concepts and capabilities from advanced
research in the areas of business process monitoring /
runtime adaptation [6], composition of aspect-oriented
models [5], OCL-based semantic model verifica-
tion [1], and advanced workflow patterns.

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