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Internationalization of Medical Logic Modules and Extended Time Operations in Arden Syntax Version 2.6

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Abstract and objective

Using Arden Syntax based systems in an international environment poses new requirements in terms of localization of knowledge. To support translatable, multi-lingual rules that can be maintained centrally, extensions to Arden Syntax have been defined and approved by HL7. Further extensions of this version deal with extended time operations. First international projects prove the usability of these extensions.

Keywords:

Clinical Decision Support, Arden Syntax

Introduction

Many factors affect the reusability of Arden Syntax 'Medical Logic Modules' (MLMs). While recent studies mainly focused on the curly braces problem [1], another important but neglected factor is the language of the message text of an MLM. Rules in multilingual countries or rules that are used in more than one country should always create messages in the language of the message recipient. Recent extensions to Arden Syntax defined a structured message format with natural language parts but did not address localized messages [2]. During the rollout of Orbis, a widely used hospital information system in Europe, this kind of localization of an MLM became an important issue in terms of reusability and maintainability. The natural text parts of an Arden Syntax rule that represent the result message have to be translatable, while the rest of the rule usually has to be centrally maintainable. Therefore, separation of an MLM's message part from the logical section should be possible. These requirements finally led to a set of extensions to the Arden Syntax in its latest version 2.6 [3].

This version includes further extensions dealing with temporal conditions to facilitate the readability of MLMs. Since the first version, Arden Syntax has placed emphasis on supporting rule authors to express temporal conditions and other temporal expressions in an easily readable way. For example, the blood glucose values from a list 'bg_values' that have been measured within the past three months can be selected by

```
bg_values where they occurred within past 3
months
```

Each information in an Arden Syntax MLM that has been read from the data base or from similar sources has an implicit attribute 'primary time' which defines the medically relevant timestamp associated with the information. This attribute is automatically used by temporal operators, as shown in the previous example. In a similar way, operations on other time ranges can be defined.

However, as these operators always refer to a timestamp that consists both of a date and a time, some expressions such as "this examination can be ordered only from 10 pm to 8 am" are hard to express. To support temporal expressions that do not refer to a specific date, a new data type "time of day" has been introduced.

Methods

Internationalization of Medical Logic Modules

Arden Syntax MLMs have been designed to serve as knowledge exchange format. One requirement was therefore that MLMs should always include all required information for making a decision. Whenever an MLM is transferred from one system to another, all required information is loaded into a text file in Arden Syntax format. To support MLMs with multiple languages for the result messages "resource bundles" have been added to MLMs that contain the required translations of all text fragments of the MLM that need to be available in more than one language. As an MLM is defined to consist of one file, all language resources of a localized rule have to be part of the individual MLM text file.

Up to Arden Syntax version 2.5, one Medical Logic Module is structured into the three categories "maintenance", "library", and "knowledge". These categories contain various unstructured and structured information ("slots") which describe administrative facts, such as author or version, background information, such as an explanation, and the decision logic. The logic is modeled as an algorithm within the knowledge category that contains the structured slots "data", "logic" and "action". For internationalization, in addition to these existing, mandatory categories of an MLM, a fourth category "resources" has been specified. This category contains all relevant text used in the logic or

action slots of the MLM. Entries in the resources slot are structured by sections that define translations for individual languages. Each language is identified either by a 2-character language code or by a combination of a language code and a 2-character geographical code, such as 'en', 'en_us' or 'de'.

Within such a section, all resources are identified by a unique textual key and the corresponding text, for example[1]

```
language: en
   'msg': "Caution, the patient has the following
           allergy to penicillin documented: ";
   'creat': "The patient's calculated creatinine
             clearance is %f ml/min."
;;
language: de
  'msg': "Vorsicht, zu diesem Patienten wurde die
     folgende Penicillinallergie dokumentiert: ";
 'creat': "Die berechnete Kreatinin-Clearance des
     Patienten beträgt %f ml/min."
;;
```

Like in the previous examples, translatable resources usually are message parts or format patterns. A new operator "localized" has been introduced that returns the translation of a text for the current language setting. It returns the localized resource whose key corresponds to the argument of the operator. For example, in an English setting the expression

```
creat formatted with localized 'creat'
```

returns[2]

```
"The patient's calculated creatinine clearance is
                  0.33 ml/min."
```

while in a German setting the same expression returns

```
"Die berechnete Kreatinin-Clearance des Patienten
             beträgt 0,33 ml/min.".
```

This use of the operator implies that the implementing system is able to retrieve an implicit "language setting". In a multi-lingual system where the destination language cannot be implicitly detected, the localized operator can be used with an additional argument that defines the language or combined language-locale code.

Extended temporal operators

As described in the introduction, Arden Syntax provides a timestamp data type termed "Time" and various operators that deal with temporal aspects. In addition to this data type, a new data type "time of day" has been introduced. This data type is used to define temporal conditions such as "lab order was placed after 10 pm and before 6 am" in an easily readable and comprehensive way, for example

```
order_time was within 10:00 to 18:00
```

This expression returns true, if the order was placed within the defined time range without considering the date fraction of the 'order_time' variable. Special attention was paid to cases where the defined time range spans midnight. If a rule has to check whether an order is to be placed during night hours, the condition may be expressed by

```
now is within 22:00 to 03:00
```

Here, the operator checks whether the time of day is after 10 pm or before 3 am. The new data type has been applied for most temporal operators and conditional expressions and can be combined with normal "Time" values, for example

```
  irregualar_measurements := measurements where
measurements.time not occurred within 1 hour sur-
                  rounding 14:00;
```

The last example selects those entries of a list of measurements that have not been measured within a time range of 13:00 to 15:00 and that may therefore not conform to a guideline.

Accordingly, another set of new operators and constants can be used to refer to a day of week to express conditions, such as "lab order was not placed on Sunday".

Results

The internationalization of MLMs allows commercial and academic suppliers to address an international range of users with rules that can be centrally maintained. This extension was limited to the textual parts of the structured algorithms that represent message sections. Other parts of the rule which also consist of free text, such as the explanation and description of the rule, have not been extended. The focus of has been set on those parts where localization in terms of communication to the users is crucial. However, as the rationale of other textual slots of an MLM was to increase transparency of the rules and to support user acceptance, also these resources may have to be localizable one day. While former versions of Arden Syntax were based on a 7-bit ASCII file format, for many international users UTF-8 encoded rules may be required.

The time of day data type allows an easy and intuitive definition of temporal conditions and harmonizes with existing elements of the Arden Syntax. The option to express temporal conditions independently from a specific date and the option to directly support week days was found useful by the members of the HL7 Arden Syntax Special Interest Group.

1 All examples have been cited from [3].

2 This example presumes that the variable ‚creat' represents a numeric variable with a value of 0.33.

Both extensions may be another step towards a broader use of Arden Syntax. They have been balloted as Arden Syntax version 2.7 by HL7 and have also been successfully implemented in Orbis.

References

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