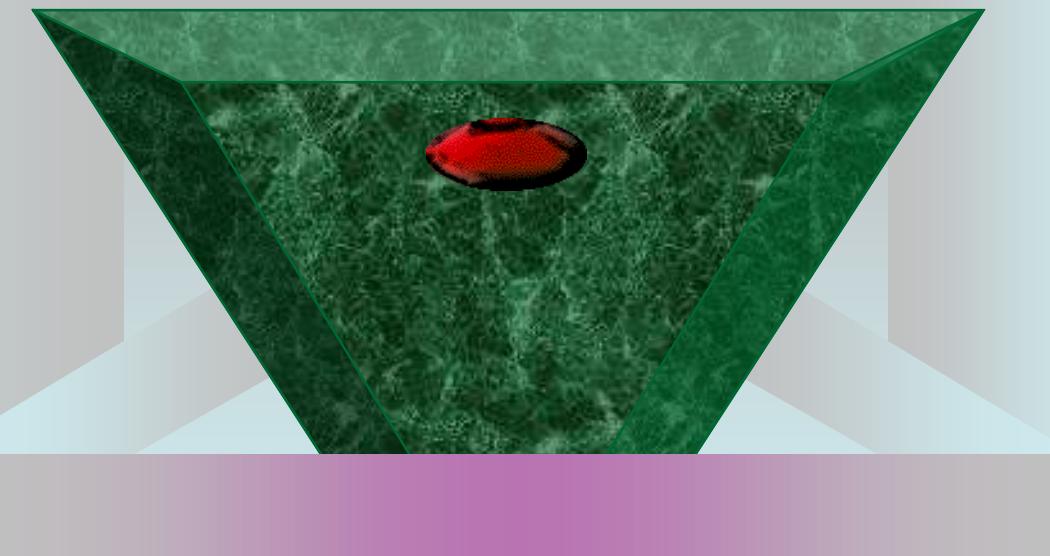


The 13th International Conference on Informatics in Economy  
IE'2014  
Bucharest, Romania  
May 15-18, 2014



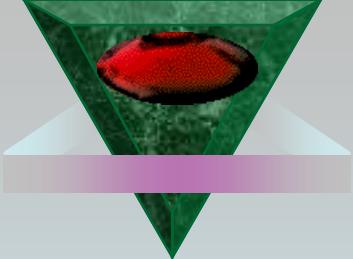
# A FORMALIZATION WAY FOR COMPUTATIONAL FORMULAS WITHIN BUSINESS RULES DEFINED IN SIK REPOSITORIES

SIK website: <http://siknet.org>

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## **1 The Problem Space**

**The meaning of business rules content incorporated in support software products is not accessible to humans and is hidden to both users and computers (it is represented as a string of bits, a large finite number of 0's and 1's in its executable form)**  
**– Figure 1.**

**A lot of valuable knowledge remains hidden to all the actors that manipulate and interact with the support software, in the same way the implicit knowledge belonging to the minds of employees remains hidden to others if that is not made explicit knowledge.**

**Software applications -> always accompanied and delivered with many user guide manuals specialized to user's roles, such as “User's guide, Administrator's guide” etc.**  
**In this context one can argue that the knowledge is explicit, in that way, to the involved actors [2].**





## **1 The Problem Space**

**The knowledge embedded in software is mobile, similarly to the tacit knowledge of employees:**

**the withdrawal of a software product or non-usage of all his incorporated knowledge in current activities (as unused branches or options) always leads to losing it, similarly to the way a company loses the tacit knowledge of a person who leaves it.**

**The difference is that the unused options can be reconsidered and reintegrated in the company operation.**



## 1 The Problem Space

**Operating System -> critical updates [4].**

The market statistics in [6] shows that, in January 2014, 82.1% of the Internet uses a Microsoft Windows version and the desktop OS share in May 2013 was 91.67% for Windows [7].

The updates of the software do not makes changes in the user guide manuals (it means in the knowledge delivered) they provided you when the software was sold. In that way a lot of knowledge corresponding to those updates remains completely hidden to the user or can be hardly accessible. Another problem of software applications -> the gap between how information is presented in the textbook and how the software delivers it effectively [2].

*Note! When people use software only by providing the required inputs and without any knowledge about how information is processed in order to obtain the output, they use that software as a black-box. A black-box induces in time the so called 'black-box syndrome': each mistake or bad past experience is amplified, and fear appears every time one operates the software [4].*



# 1 The Problem Space

## Source Code (PHP)

```

function aggregate_values($grade_values,$items) {
    switch ($this->aggregation) {
        case GRADE_AGGREGATE_MIN:
            $agg_grade = reset($grade_values);
            break;
    ...
    case GRADE_AGGREGATE_WEIGHTED_MEAN
        // Weighted average of all existing final grades, weight specified in coef
        $weightsum = 0;
        $sum = 0;
        foreach($grade_values as $itemid=>$grade_value) {
            if ($items[$itemid]->aggregationcoef <= 0) { continue; }
            $weightsum += $items[$itemid]->aggregationcoef;
            $sum += $items[$itemid]->aggregationcoef * $grade_value;
        }
        if ($weightsum == 0) { $agg_grade = null; }
        else
            {$agg_grade = $sum / $weightsum; }
        break;
    ...
}
return $agg_grade;
}

```

Executable as required and understood by microprocessor

The classic software architecture keeps business rules hidden to both machine and end user (teacher, learner)

## How Moodle SIK interpreted by a simple RDF Parser (Redland Raptor RDF Parser )

Redland Raptor RDF Parser Demonstration - Mozilla Firefox

File Edit View History Bookmarks Yahoo! Tools Help

<http://librdf.org>

File Edit View Insert Tools Window Help

rdf parser - Google Search

```
<?xml version="1.0" encoding="iso-8859-1"?>
```

```
<xdif:DDE xml:base="http://avrami.ro/sik/SIKPro
```

/1.1/\* ~~dc:title~~:dcTerms="http://purl.org/dc/terms

~~xmlns:label="http://www.w3.org/2004/12/q/conte~~

/sik/moodle/moodle10#> xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#>

`xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"`

`<rdf:Description rdf:about="SIRI repository for SIRI creator resource" rdf:resource="http://www.AVRM`

<dcterms:issued>2009-10-18</dcterms:issued>

ANSWER

**Run Parser**

RDF/XML is defined in the [RDF/XML \(Revised\) W3C Rec](#)

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#### Reviewing Wrong Results

Subject	Predicate	Object
<a href="#">http://avrams.ro/sik/SIKProducts.rdf#compute_mean</a>	<a href="#">http://www.w3.org/1999/02/22-rdf-schema#comment</a>	Weighted Mean is computed by formula: WeightedMean=Sum(AggregationCoefficient <sub>i</sub> *GradeValue <sub>i</sub> )/Sum(AggregationCoefficient <sub>i</sub> ), where i ranges from 1 to NumberOfValidGrades
<a href="#">http://avrams.ro/sik/SIKProducts.rdf#compute_mean</a>	<a href="#">http://www.w3.org/2000/01/rdf-schema#Class</a>	Teaching and Learning Domain Business Rules Incorporated in Moodle
<a href="#">http://avrams.ro/sik/SIKProducts.rdf#compute_mean</a>	<a href="#">http://www.w3.org/2000/01/rdf-schema#comment</a>	Simple Mean is computed by formula: SimpleMean=Sum(GradeValue <sub>i</sub> )/NumberOfValidGrades, where i ranges from 1 to NumberOfValidGrades
<a href="#">http://avrams.ro/sik/SIKProducts.rdf#compute_mean</a>	<a href="#">http://www.w3.org/2000/01/rdf-schema#Class</a>	Weighted Mean is computed by formula: WeightedMean=Sum(AggregationCoefficient <sub>i</sub> *GradeValue <sub>i</sub> )/Sum(AggregationCoefficient <sub>i</sub> ), where i ranges from 1 to NumberOfValidGrades
<a href="#">http://avrams.ro/sik/SIKProducts.rdf#compute_mean</a>	<a href="#">http://www.w3.org/2000/01/rdf-schema#comment</a>	SimpleMean
<a href="#">http://avrams.ro/sik/SIKProducts.rdf#compute_mean</a>	<a href="#">http://www.w3.org/2000/01/rdf-schema#Class</a>	WeightedMean

With a SIK compliant architecture the business rules revealed to both machine and end user (teacher, learner)

**Figure 1: Traditional software application (A, B labels - Moodle excerpts) vs. the compliant SIK architecture (label C – SIK content; label D the revealed rules)**



## 2 The SIK Concept

SIK concept was introduced first in [1] and is built on the basis of a loose connected software architectural component, materialized in the form of one or multiple knowledge repositories [2] with an architecture having the components shown in Figure 2, left.

It is used for systematically acquire, structure, store and maintain knowledge, formalized as business rules for all domain business rules that are incorporated in the software product itself. The knowledge refers mainly to the domain knowledge of the business domain modelled by the application software together with the knowledge about the operation of the current application.

The formalization of the business rules is realized through RDF/XML (Resource Description Framework/Extended Mark-up Language) serialized triples. A triple is defined by <subject, predicate, object> as specified by RDF standard which was defined with the scope to represent and manipulate knowledge in web space.



## 2 The SIK Concept

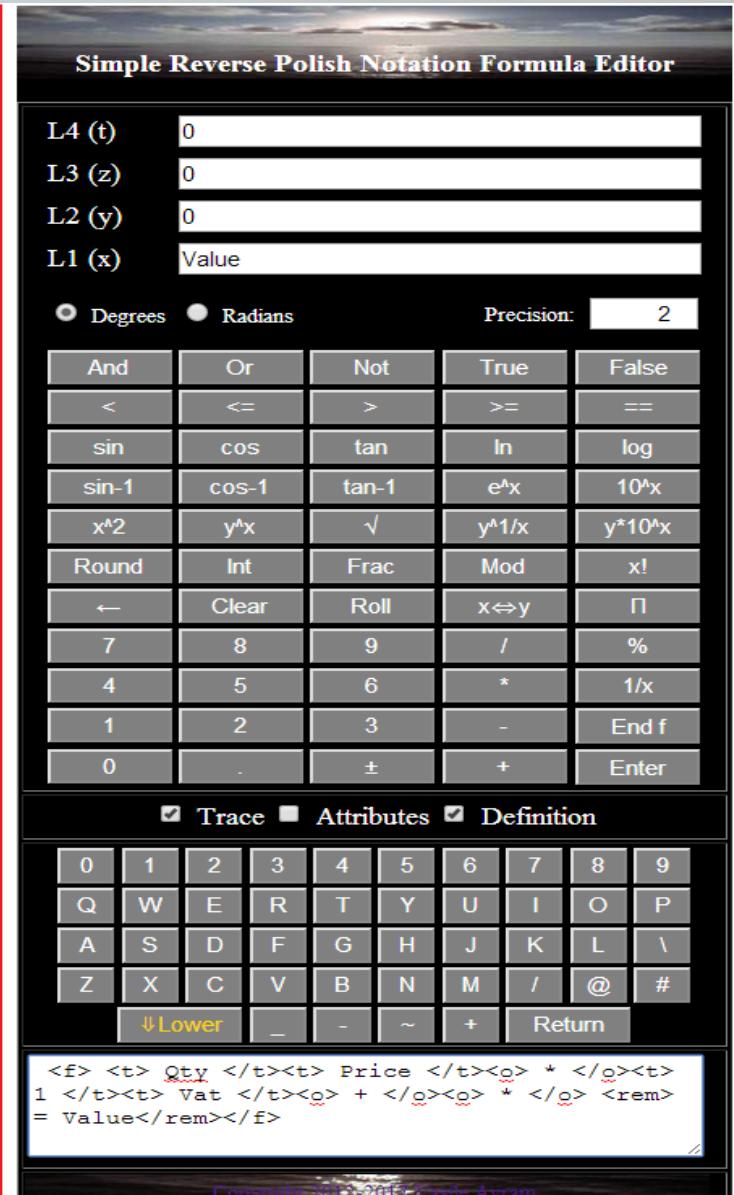
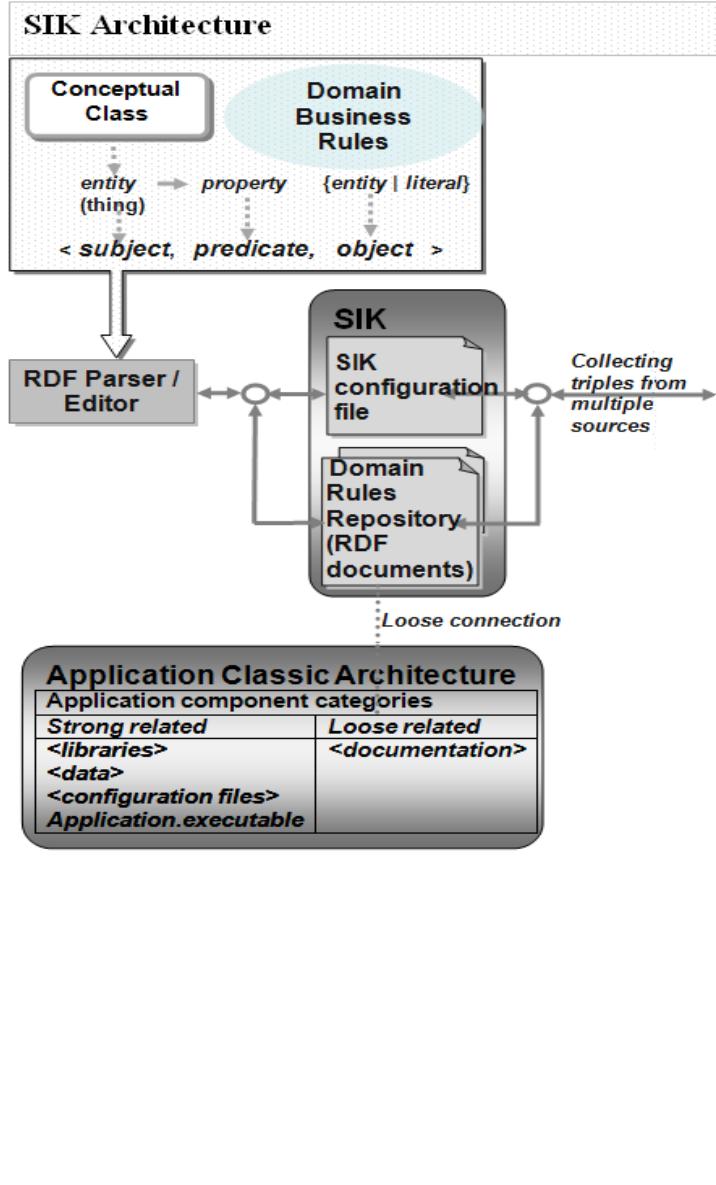
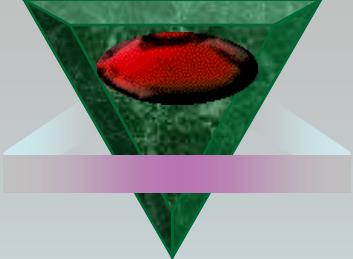


Figure 2: The SIK Architecture (left part excerpt from [2])



## 2 The SIK Concept

We consider here the business rules categories as defined by the Universal Meta Model for Business Rules (which organize and represent them as nodes in a tree):

- 1) Business Rules Expression** – that connect a business rule with an expression node that can be represented as a calculation, comparison, or direct move;
  - 2) Business Rule Term** – a definition of a word or phrase used by the company;
  - 3) Miscellaneous Business Rule** – as a textual representation/ description of the business rule which cannot be represented as expression or business term.
- 



### 3 Description of Computational Formulas

Formula in SIK -> using Reverse Polish Notation adapted for RDF-XML representations (Figure 2 , right a Simple Reverse Polish Notation Formula Editor):

Active elements have the general syntax:

```
<elementname [id="""] [sq="""] [type="""] [title="""]  
[prompt=""""]>content</elementname>
```

where *elementname* can be f (formula), t (term), o (operand), or rem (description/ remarks) and the attributes means:

- **id=""",** defines a unique identifier of formula;
- **sq=""",** is a sequence number allowing preservation of the order in which formula and elements inside must be interpreted and acted element;
- **type=""",** defines the associated data-types as specified by XSD;
- **title=""",** defines the title of the element, used as description in code and as tips in execution;
- **prompt=""""**, the name that must be used when the formula used for generating a user form dialog to input values for generic terms described as names.



### 3 Description of Computational Formulas

The specification uses the following simple elements:

- Formula -  $<f>$ , defined as a complex element type grouping together, as an atom, the description of terms/ operands ( $<t>$ ) and operators ( $<o>$ ), and the eventually comments ( $<\text{rem}>$ );
  - Term / Operand -  $<t>$ , used to define an operand of formula represented by a literal, a variable, or in general an expression;
  - Operator -  $<o>$ , an arithmetic, conditional, or logic operator that appears in formula;
  - Remarks/ Descriptions -  $<\text{rem}>$ , used to define the explanations within the generated form (for business rule itself we use the category **Miscellaneous Business Rule** to realize the descriptions of the rules, as an intra-formula description) or subtotals/ partly evaluations for valued case.
- 



### 3 Description of Computational Formulas

The computational formula  $\left(3 + \frac{27-5}{7}\right)^3$  is described in RPN as: 3 27 5 – 7 / + 3 ^ and produces the result 231.80.

In a simple XML elements description (without attributes, in order to simplify understanding) this formula shows as:

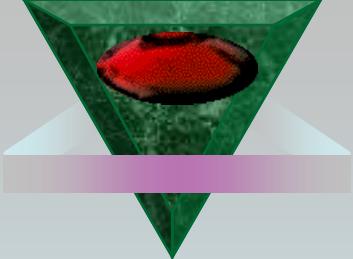
```
<f> <t> 3 </t><t> 27 </t><t> 5 </t><o> - </o><t> 7 </t><o> / </o><o> + </o><t> 3 </t><o> ^ </o> <rem> = 231.79883381924193</rem></f>
```

In Figure 2, right is illustrated a generalized formula description to compute the value with VAT of a product quantity:

Qty\*Price\*(1+Vat)

linearized as:

```
<f> <t> Qty </t><t> Price </t><o> * </o><t> 1 </t><t> Vat </t><o> + </o><o> * </o> <rem> = Value</rem></f>.
```



## 4 Conclusions

**SIK concept is not directed to replace any of the technologies and languages created to represent knowledge.**

**RPN formula representation -> simple representation way obeying to principle “readable and understandable by both humans and machines”.**

**A non-negligible aspect of using RPN is represented by that the parenthesis are not necessary to enforce another order of evaluation than the natural order of evaluation of the operators: all formulas are linearized from left-to-right, avoiding the parenthesis, and evaluated too from left-to-right taking in accounting the type of operand (unary or binary) and the preceding elements and obtaining in that way a high degree of simplicity of both processes of representation/description and evaluation/ execution**



## 4 Conclusions

**SIK is more a challenge for software vendors: to make available to all the domain knowledge they consider to incorporate inside and to redirect the competition in what they are - software designers and manufacturers.**

### Future developments

The next effort in arguing this RPN solution as suitable to describe computational formulas is to:

- Find a way to translate its description into a **SVG (Scalable Vector Graphic)** description which allows visualizing the formula in a graphical representation;
  - Enrich the functionality of the editor to allow both definition and interpretation not only in singular cases but also when formulas chained into the steps of a procedure containing all types of business rules categories (and nodes).
- 



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