

An improved XML syntax for the Java programming language

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Abstract—The benefits of using XML to encode programming language's source code have already been identified and XML syntaxes developed for this purpose. However, there is an absence of a systematic identification of the requirements that need to be met in order to fully leverage the potentials of XML and the key concept of the abstract syntax is being misinterpreted. Due to this the syntaxes have various deficiencies, a number of which are common to many of them. This paper clarifies the concepts, identifies these deficiencies, and proposes a new syntax for the Java programming language which avoids them. The superiority of the new syntax is demonstrated by comparing it with two of the most relevant publicly available syntaxes with the same purpose.

I. INTRODUCTION

The benefits of using XML to encode programming languages' source code have already been identified [1], [2] and XML syntaxes developed for this purpose [3], [4], [5]. However, there is a lack of a systematic approach to the identification of more precise goals the syntax should achieve in order to fully leverage the potentials of this approach. Particularly, it appears that the central concept in the application of XML to source code, that of the abstract syntax, is not being interpreted properly.

In order to explore this subject, a research project named *Jezix* was started. The main goal of the project was the development of an XML syntax for the Java programming language that is based on the correct treatment of the concept of the abstract syntax, which allows it to optimally leverage the identified potentials of XML. The results of the research were validated by demonstrating the proposed syntax's superiority over existing syntaxes. This was achieved by solving several code analysis problems for the proposed and two of the most relevant existing syntaxes and then comparing the amount of effort needed and the properties of the resulting query code.

The next section gives an overview of source code and XML. It repeats some well-known results of the formal language theory, but also clarifies important concepts and defines some terms used later. Section III presents the two key benefits of using XML for source code. Section IV reflects on the effects of using XML on the quality of the machine-to-human interface. Section V presents the most sensitive requirements the XML syntax has to meet. Section VI gives a critical overview of other existing syntaxes and identifies the common root of many of their deficiencies. Section VII briefly introduces the proposed syntax and proceeds to the presentation of the

results of its comparison with the two other syntaxes. Finally, the closing section summarizes the achievements and conclusions of the *Jezix* project.

II. OVERVIEW OF SOURCE CODE AND XML

A programming language has two important components:

- 1) A set of basic concepts and a syntax (called the *abstract syntax*) for combining them into a description of the desired behaviour of the program. The description has the form of a tree, called the *abstract syntax tree* (AST).
- 2) An alphabet of characters and a syntax (called the *concrete syntax*) for combining them into a textual encoding of the AST—the source code.

The text of the source code, then, is structured according to the concrete syntax, whose rules are usually separated into two layers for easier formalization, called the *lexical* and *syntactic* grammars. The compiling process begins with the *lexing* of the source code text into a sequence of *tokens* (character strings) according to the lexical grammar. The token sequence is then *parsed* according to the syntactic grammar and the result is a tree, called the *parse tree*, or the *concrete syntax tree* (CST). The syntactic grammar is formally a *context-free grammar* (CFG [6]), usually defined in the *Extended Backus-Naur Form* (EBNF). The rules of the grammar have to be such that each valid token sequence can be parsed into exactly one CST. Otherwise the grammar would be *ambiguous*: it would allow different interpretations of the same source code text.

The AST is produced by processing the information found in the CST and possibly additional information from the broader environment, such as other code modules. The program description it represents can be regarded as the *meaning* of its source code document. The abstract syntax contains additional, higher-level constraints so that only a subset of valid CSTs produce a valid AST. In a typical programming language specification these constraints are only described in plain English, without precise formalization. The abstract syntax also has an important formal property that sets it apart from the concrete syntax: since it is never used for parsing, the idea of ambiguity as defined above—and thus the associated requirement—becomes irrelevant.

Although it can be argued what the essence of XML is, for the purpose of this paper it will be regarded as

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