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Abstract Syntax Tree Metamodel for SW Visualization

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Abstract In the previous approaches, for syntax analysis of a program code such as *C, C++*, or *Java*, it needs to use a particular parser. The parser generates *Abstract Syntax Tree* (AST) during compiling the program code. At that time, it analyzes the statements & expressions of functions and classes, and also the definition and declaration of variables through static analysis of the program code with the AST. But the existing ASTs are not compatible with other AST due on the specific parser. For this reason, most of industry companies defines OMG's standard named *Abstract Syntax Tree Metamodel* (ASTM). This means to define metamodel of the AST within any compiler, which can represent diverse programing languages with just an ASTM. This paper shows the specification of ASTM based on OMG standard, and a case study about the ASTM. Then we suggest a whole procedure for SW visualization with the ASTM.

Keywords: *Abstract Syntax Tree (AST), Metamodel, Visualization, Reverse Engineering*

1. Introduction

Most companies and ventures develop the software code without any design due on time and cost. They just release SW product quickly, but may spend more cost at the maintenance stage. This approach may be the low quality of SW product. Therefore, the companies need to show inside of the developing code for the SW visualization. The visualization is able to reverse the architecture from a program code through reverse engineering [1]. For the SW visualization, diverse tools are required such as *Source Navigator* [2], *Graphviz* [3], and a parser. The parser generates *Abstract Syntax Tree* (AST) during compiling the program code. But the existing ASTs are not compatible with other AST due on the specific parser.

Industry companies defines OMG's standard named *Abstract Syntax Tree Metamodel (ASTM)* [4], which is metamodel of abstract syntax tree with the existing compiler. The main purpose of the ASTM easily exchanges the metadata repository between the software in such as software modernization, platforms, and distributed heterogeneous environment. The ASTM consists of the defined elements to represent the AST from the existing programming languages such as *C, C++, C#, Java, Ada, VB/.Net, COBOL, FORTRAN, Jovial,* and so on.

But OMG's ASTM has defined and complicated with 193 elements of metamodel, but just specifications without any implementation. This paper shows the specification of ASTM based on OMG standard, and a case study about the ASTM.

2. A Procedure of SW Visualization

In order to develop SW visualization tools, it is required that 1) the parser generates the abstract syntax tree and 2) the visualizer needs to generate a graph. The figure 1 shows a whole structure for SW visualization. The parser generates ASTM from a program code such as *C, C++*, or *Java*. The visualizer generates the graph from the ASTM. Through this process, we can reverse the architecture from the program code.

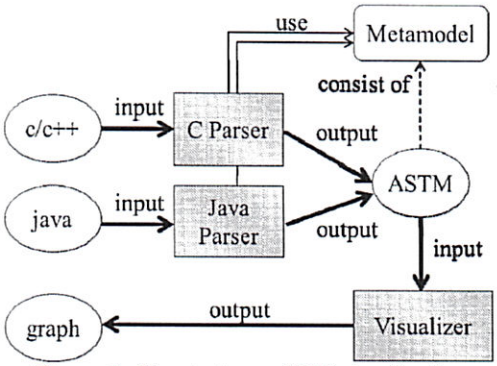

Figure 1. The strategy of SW visualization

It is very useful for reuse the existing parser better than to develop a new parser. Therefore, we will use the existing parsers as *C/C++*

Development Tooling (CDT) [5] and *Java Development Tools* (JDT) [6]. The CDT is a tool in *Eclipse platform* to develop *C/C++* application. It supports to create the project, to build the program, to edit the *C/C++* code, to analyze the static code, and to debug & refactor functions. The JDT is a tool to develop Java application. It supports the same function like the CDT.

In the future, we will apply the existing parser such as CDT and JDT. Using them, we will develop new tools for SW visualization.

3. A Case Study

To show the metamodel elements of ASTM, we use the program code like figure 2. For example, the code is as *C++* which consists of a class, one member variable, and three functions.

```
class Figure {
private :
        int x;
public :
        Figure();
        virtual ~Figure();
        virtual int getArea();
};
```

Figure 2. The example of a code on C++

This code shows the ASTM in figure 3.

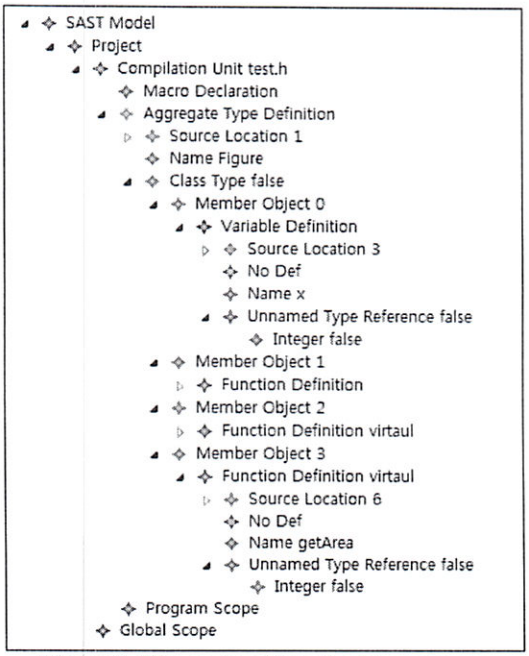

Figure 3. The analyzed result of the program code in figure 2

In the figure 3, a *SAST Model* in a top line is a root that has one more *Project*. The *Project* has on more *Compilation*. The internal *Compilation* includes actual program statements. The *Compilation* also consists of the definition and declaration of functions and classes. In these elements of the *Compilation*, the class 'Figure' in the figure 2 is translated as an *Aggregate Type Definition*. The *Aggregate Type Definition* has one more *Member Object*. In the *Member Object*, the statements within *C++* are translated as the elements such that a variable is *Variable Definition*, and a function is *Function Definition*.

4. Conclusions

The *Abstract Syntax Tree Metamodel* (ASTM) is useful to convert from the diverse program codes to *Abstract Syntax Tree* (AST), which is good for interoperability but has a complex structure of 193 elements with just specifications. This paper shows the specification of ASTM based on OMG standard, and a case study about the ASTM. Then we suggest a whole procedure for SW visualization with the ASTM.

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