The program complex for cross-compiling of models of virtual laboratories in physics to Android platform

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Abstract

The goal of the work is developing software of virtual laboratories in physics which are used in Online Contest in Physics. Online Contest provides a unique opportunity for assessment of the practical application of student knowledge. It is achieved by means of models of virtual laboratories in Physics, simulating a real physical experiment. The project so far has not been cross-platform and has not worked on some popular platforms (Android, iOS). We develop the program complex for the cross-platform compilation of source code of virtual laboratories to Java source codes and Dalvik codes for the Android platform.

Keywords: virtual laboratory in physics; learning management system; cross compiler

1. Introduction

Physics faculty of St. Petersburg State University annually organizes The Online Contest (Internet Olympiad) in Physics since 2005 [1]. The Contest gives an opportunity to take part in it a large number of students from different regions of Russia and other countries. It provides a unique opportunity to test the practical application of student's knowledge. This is achieved by means of models of virtual laboratories in Physics, which simulate a real physical experiment.

An important goal of the development of software is to ensure the working capacity of models of BARSIC [2] virtual laboratories on a number of popular operating systems.

Our research group is working on the transfer modules of the virtual laboratories to various platforms. Java programming language was used as intermediate language to solve this problem. Java programs are written not for a specific platform, but for a virtual machine running on all major platforms. This approach makes it possible to guarantee the correct operation of the models of virtual laboratories compiled for different target platforms.

2. Module structure of the cross compiler

The project consists of several modules [3] (Fig.1). Each module performs certain functions. The structure allows expanding and adding new modules. It is worth noting that the structure of the project is logically understandable. That makes it easier to get acquainted with the program and understand it.
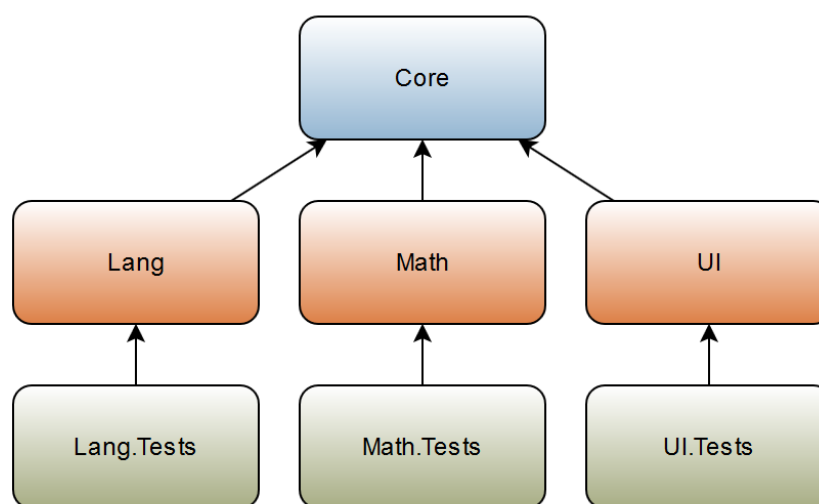

Fig.1. The modular structure of the project.

Description of the modules:

- Core module provides the basic infrastructure and a set of interfaces of the BARSIC package.
- Lang module implements the logic associated with BARSIC language syntax. Main elements: lexer, parser, code generator.
- Math module keeps the basic math functions.
- UI module is specific for each platform. It contains basic GUI components and components of scientific graphics.

Project architecture has many advantages:

- Low coupling between modules. For this purpose, the Inversion of Control is used. Any module can be replaced with another one with the similar implementation, or the module can have several implementations at once - each for own platform.
- Testability. Each element of the module interfaces refers only to its dependencies. These interfaces can be easily implemented to take tests.

3. Description of the scheme of work with the ANTLR parser-generator

ANTLR [4] was selected as the parser generator.
The project has two grammars:

- Barsic.g is a combined lexer-parser grammar.
- BarsicTreeWalker.g - grammar to bypass the abstract syntax tree.

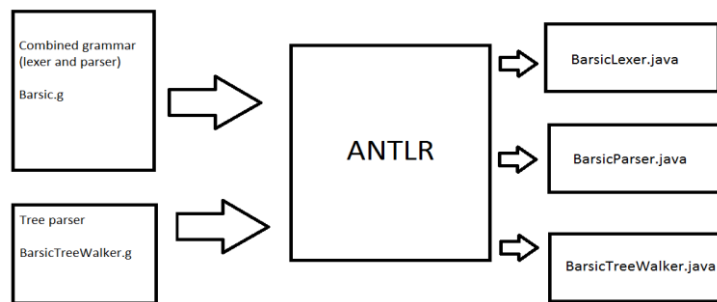ANTLRWorks software was used to describe the grammar.

Fig.2. Scheme of work of ANTLR parser generator in JBARSIC project.

4. Implementing the code generator

Currently, two code generators have been developed in the Java source code and in the JVM bytecode. Work is underway to create a code generator for the Android platform.

Jasmin [5] is used for generate class files. It is the assembler of the Java virtual machine (JVM).

5. Conclusion

The main part of the grammar parser for the translator was developed. The basis for the creation of cross-platform the BARSIC applications supporting the work on the operating systems Windows, Linux, Mac OS, Android was made. That makes possible to develop fully portable applications with a graphical user interface, which is important for creating cross-platform virtual laboratories of the Online Contest in Physics.

References

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