Chapter 3
Codeflex 2.0:
Experience With Competitive Programming in Logical and Functional Paradigms

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ABSTRACT

This work presents the design and implementation of Codeflex, a web-based platform and repository of programming problems, that enables the learning and practice of competitive programming in multiple programming language paradigms. The Codeflex programming platform performs automatic evaluation of submitted solutions for a very diverse set of programming languages, in real time, considering the specificities and requirements of different programming paradigms, being prepared to analyze and detect plagiarism in tournament submissions. The use of Codeflex platform in a real context allowed the test and validation of its functionalities. In particular, several programming tournaments were organized, for Haskell and Prolog programming languages – functional and logic programming tournaments, respectively, within the scope of programming curricular units of computer science undergraduate degree. The findings suggest that Codeflex is a valuable contribution in enhancing programming skills and providing an efficient evaluation system for educational and professional settings.

INTRODUCTION

As the demand for programming skills continues to grow in the tech industry and beyond, educators and coding enthusiasts face the challenge of finding efficient and effective ways to enhance their programming skills. At the education level, traditionally, the evaluation process has been a time-consuming and error-prone task for teachers who manually evaluate code submissions from students, making it difficult to provide timely feedback and detect instances of plagiarism (Luxton-Reilly et al., 2023). To address these issues, we present an extended version of Codeflex (Brito & Gonçalves, 2019), a web-based platform designed to provide a user-friendly, reliable, and efficient resource for competitive programming. The new implementation introduces advanced functionalities such as compilation and evaluation for Haskell and Prolog submissions, from functional and logical programming paradigms, imposing specific requirements on the compilation process. At the same time, it also provides a more manageable system to facilitate the process of inclusion of new programming languages, that might be added in the future, improves the visualization mechanisms of users submissions and adds plagiarism detection tools.

In this chapter we describe the development of the new version of Codeflex, its current features and benefits, and its potential to improve access to competitive programming resources and to facilitate the development of programming skills among students and enthusiasts.

To demonstrate the effectiveness of Codeflex, we conducted competitive programming tournaments at our school in the context of programming courses of the Computer Science undergraduate degree. The platform allowed us to compile and evaluate code submissions in real-time, providing instant feedback to students and enabling instructors to track their progress. Codeflex's plagiarism detection tools also facilitated a thorough analysis of code submissions and automatic identification of any instances of plagiarism, stating the importance of academic integrity in the competitive programming community. The successful implementation of Codeflex will contribute to the improvement of the process of code evaluation, making it easier for students to practice programming problems, benefiting their skill development, enhancing access to competitive programming resources, and provide teachers with an effective way to evaluate student performance.

The chapter is organized as follows. Next section discusses the state of the art, analyzing and comparing existing competitive programming platforms, followed by a section describing the work methodology used in the development of the programming platform. Then we expose the system design, particularly the requirements analysis and the characterization of the desired web-based programming platform and repository of programming problems. Next we will describe the developed programming platform, considering the overall architecture, the submission compilation process, prepared to accept submissions with demands and specificities of different programming paradigms, the plagiarism detection service and the tournament management module. Next section discusses and analyzes the achieved results with the platform operation in real context. Finally, we end the chapter with some conclusions that are drawn from the developed work and mention the work that is intended to be done in the future.

STATE OF THE ART

There is currently a great demand for professionals in the areas of Information Technologies, particularly in Computer Programming, for which there are greater difficulties in satisfying the needs of the market. The study and practice of algorithms, data structures and programming languages is thus essential and

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