Graphical Reactive Platform for Programming Learning

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***Abstract*—Nowadays programming learning for beginners is mainly focused on solving abstract problems, most of them of mathematical nature (i.e, "implement an algorithm that prints the Fibonacci sequence"). As a result, students not only need to understand the programming concepts that are being transmitted, but also the complex abstraction behind them.**

To combat that, CodeSpell intends to create a reactive graphical platform that allows students to visually identify and explore the effects of several programming mechanisms based on their code (i.e, for/while loops, branching, if and switch statements, etc.). If the code developed by the student compiles and corresponds to the goal of the suggested problem, the platform is capable of interpreting it and its graphical environment interacts with the user, showing some awesome animations. If the code doesn't compile or has syntax mistakes the platform comes with the ability to show errors in a more user-friendly way than a conventional terminal so that students can easily figure out where everything went wrong in their solution.

Documentation, tips, and possible solutions for the problems are also at the core of CodeSpell's awareness, regarding its importance in the teaching of programming.

Alongside this didactic strand, CodeSpell also wants to explore a game-like perspective, focusing on a fun and competitive user experience divided by levels (i.e, each level deals with a different programming topic). Achievements, scoreboards, and community solutions have been implemented so that users feel motivated to improve their programming skills. Users will also be able to consolidate their knowledge and learn different approaches by exploring other users' solutions.

Through its features and learning nature, CodeSpell is also meant for teachers giving them an easier way to reach out to students that are having difficulties solving conventional programming problems and giving them a platform to better learn core concepts surrounding not only coding but also its building blocks. This platform through its competitiveness is also a powerful tool to create a whole new classroom dynamic by engaging students.

To make this implementation possible, several architectural modules have been considered so that the different system requirements could be satisfied:

- **The backend strand consists of a SpringBoot-based REST API**
- **The frontend and graphics aspects, were developed in ReactJS and Three.js.**
- **The data layer, using MongoDB and Redis.**
- **The analysis, execution, and launching of the code developed by the user, are carried out in SpringBoot and Docker containers.**
- **The WebSockets module to update the frontend regarding the user actions, was also developed in Spring Boot.**

CodeSpell is not only a mighty classroom software but also a fun and illustrative game for new programming enthusiasts and a very needed, user-friendly spin on the way to teaching programming.

***Index Terms*—codespell, code, programming, learning, teaching, java, documentation**