The Modern Methods In Teaching And The Examination Of C Language

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Abstract

Creating a web-based testing system 'eXam' to support teaching and examination of C/C++ language. System allows proving the correctness problems submitting by students. The correctness of problems is proving by comparing results of submitting program and the right results. The using of the system is good motivation to make correct source codes for students.

1. Introduction

The education of any programming language has specific position, because there are many factors in lecturing. Before we starting to teach any programming language, is necessary to explain the basics of logic and algorithmization. There are several observations in teaching of programming language:

- Unlike others subject of education, students have to understand the programming. Is not good choice to remember all problems by memory for students.
- In teaching, it is necessary to have methodical tools. Is very good when is presented some problem with more examples in explaining of specific problem.
- A good support system for education of programming language is some LMS (learning management system). We use the moodle system in our university. There is possibility to make the lessons, tests, survey, assignments and so on. Also the feedback from students is very important. The next support tool (described in this paper) is testing system eXam, which automatically checking the correctness of source code write in C language.
- In classes, when the teacher gives the problems to solve, these problems have to be unambiguously defined. There is the unusualness. The students have a problem to understand text of the problem, when is presented in print form (on web page or on sheet of paper).
- In education process is good, when students have some motivation to learning specific problem. The motivation can be positive or negative. The presented system eXam presents a positive motivation for students.

There are two ways how to make the examinations:

Examination of theory: When students know the theory they needn't to know to program. Therefore, this isn't a good way to examining.

The examination by writing the code. There are several possibilities:

- Writing the code on the paper. Teacher has to check all of programs by himself (human compiler). There is not effective way of checking.
- Checking of compiled programs. This way is better as first one, but teacher still have to check all of program by himself.
- Automatic check. There have to be some supporting system, which make checking automatically. One example of this system is presented system eXam. Teacher needn't check any program.

2. System eXam

The eXam system is interactive web application, which makes automatic checking of posted source codes programmed in C language. This system is divided into two parts. There is part for students and part for teachers (administrator part).

The part for students (Figure 1) includes these subparts:

- List of problems to solve (assignments). These problems are marked by letter of alphabet.
- The 'test' page (Figure 1). Students can to post their source code to check. After choosing a solved problem and posting the code, system in real time respond about success of posted source code. The respond of eXam can be "OK", program is good or "WRONG" program.
- The score page. There is information of student's success / failure for all posted assignments.

Figure 1. The eXam system

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- The score page. There is information of student's success / failure for all posted assignments.
also students can see the score of his (or others) class.

- The statistics (Figure 2). There is percentage successfulness of all posted assignments by pie chart.

**Figure 2. Statistics of solved assignments**

Every student has to log in before posting any assignment. Therefore, the teacher has information of all activity for the any student.

The administration part (Figure 3) includes these parts: (will be described only important parts)

- 'Student' includes all information of students, with all posted source codes (Figure 3)
- The mode of system. The system differentiates three modes: 'semester', 'credit' and 'examination'. These three modes differ only in set of assignments.
- Add / manage assignments. Teacher can add new or modify existing assignments.
- Administration of databases. There is possibility make a backup of system and restore system from the backup.
- Statistic. There are detailed statistics about successfulness of posted assignments. This statistics will be presented in next text.

**Figure 3. The administration part**

3. The modern methods of checking the source codes.

In previous part of this paper was mentioned the automatic checking of the source code. As was showed, the eXam system is such system. With using this system, I present several observations:

- Students have to learn to read the assignments. There is big problem, because in the beginning of the semester, students read the text, but don’t understood what is the goal of this assignment. They have learned to red assignments gradually.
- Students have to learn to make programs very precisely. The have to adhere the instructions in assignment exactly, because the eXam system compares the results of posted source code and prepared right results.
- The social aspect. When a student posts the source code, he sees the result immediately. Also, he sees the results of all members of his class. This is some kind of positive motivation to make all of assignments (on the other side, this motivation is work only for those students, which have interest of programming).
- In eXam system can be prepared number of assignments. Teacher can choose different assignment for every student in class. The second possibility is to allow to students to pick the assignment by their choose.
- Similar system of testing the skills of programming is common in programming contests.

Some advantages and disadvantages of this system:

**Advantages**

- When you use the system a longer time, there is saving of teacher's time for preparing the assignments.
- You needn't no manually check any of submit source codes. There is automatic check of correctness.
- The statistics of correctness of posted source codes is prepared immediately.

**Disadvantages**

- When you use system eXam first time, you have to spend a little more time with preparing the assignments.

4. The results of eXam system

EXam system was used from winter semester 2004 in Faculty of mechatronics. Now we have some results from 2 semesters of using eXam system. Exam system was using in three modes: 'semester' (the posted the codes wasn’t rated), 'credit' (there was a credit tests) and finally 'examination' (the examination in end of semester). In these two semesters, the same students posted the codes (because the subject ‘the programming' last for two semesters).
The Figure 4 and Figure 5 shows extended statistics for all attempts of posting the source code\(^1\). There are several statuses in the graph. The green part is part, which imagines percentage representation of all successfully posts. The red one is case, when the posted code gives wrong results. The blue one is when in the source code is the syntactic error. And black one is for case, when the posted code doesn't terminate in allowed time. This charts shows that in second semester were the assignments more difficult as in first semester for students. In first semester was 54.5% attempts successfully; in second semester was only 37.6% of all posts.

The next two of charts (Figure 6 and Figure 7) showed the basic statistic of all posted source codes. When student post first time the wrong source code, and second time success source code (of the same problem); in this graph for this student count the last attempt (thus, the source code was market as correct). As you see the successfullness of all solved problems is approximately the same – 75%. That means, the most of the students have corrected the posted assignment, when eXam says, that the last attempt was not successful.

5. Present and future work
In present time the eXam system partially co-operate with moodle system. This co-operation is about sharing the users (eXam use moodle's database of students). The future work is to make closer co-operation between these systems. The idea is that results of eXam system will be accessible in moodle environment.

6. References

\(^1\) There in no 'syntax error' part in graph, because the extended statistics was added after end of summer semester 2005