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Research and Practice on Algorithm Analysis and Design CourseBased on Online Judge

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Abstract— *The algorithms analysis and design course that uses ACM-ICPC programming competition problems as the foundation for lectures, homework, and exams is described in this paper. Programming challenge has specific idealness, receptiveness and objectivity of assessment. Students can enhance their problem-solving and programming abilities by participating in programming competitions. The strategies for solving a variety of specific problems (such as sorting problems, search problems, path problems, combinatorial problems, and so on) are presented in the course of algorithm analysisand design. so that students can master algorithm analysis and design strategies. We plan numerous issues for each issue in the internet based judgment framework (OJS). We use OJS to complete all tests and experiments within the allotted time frames. Students submit the code to OJS via browser after solving a problem. The student codes can be exported to the background management system for further analysis. Students can learn the course material on an open, independent platform provided by the online judge system. Students can submit their code whenever andwherever they want with OJS.*

Keywords- *Course in algorithm design and analysis; openeducating stage; system for online judges (OJS); programming rivalry*

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I. INTRODUCTION

As of now, instructive propensities are focused on the understudy's perspective instead of the educator's. The new approaches ought to pique the interest of the students, provideappealing content, a fair assessment, and pertinent feedback [1].

As PC and Web innovation created, PC helped schooling andorganize training have caused a significant transformation in the mode and the thought of schooling. Teachers' workloads are reduced and education methods are expanded thanks to computer technology. Internet education is becoming more and more accessible to more students [2, 3].

The foundation of collegiate programming competition is the Online Judge System (OJS). OJS's best feature is that it can test source codes online automatically. The system now supports the following programming languages: Pascal, C++,and C. In the OJS, students can write programs in any language to solve a problem and then submit the source codesto the system. The submitted source code is saved in a document, and a relating compiler is chosen to gather the source code into an executable program. Several pre-preparedinput/output data pairs will be used to execute the executable multiple times. At each run of the program, one information is taken care of to the program and the program's result are contrasted and the comparing pre-arranged yield information. The program is accepted for the input/output pairif the two outputs are identical and the time limit and memory limit are not violated. The system will accept the program if it can be demonstrated that it works with all pairs of input and output. The program will be rejected as "Wrong Answer," "Time Limit Exceed," "Memory Limit Exceed," "Runtime Error," and "Compile Error" in accordance with the severity ofthe error [4].

An innovative experience with the web-based automatic OJS in the course "Algorithm analysis and design" is presented in this paper. The objective of the review is to dissect the impact of this clever showing technique on the advancement of understudy programming abilities. The proposal's viability andhigh capacity to inspire students' enthusiasm are demonstratedby our findings.

II. CHARACTERISTIC OF THE ALGORITHM ANALYSIS AND DESIGN COURSE

The understudies major in software engineering and innovation strength, who need to be developers with solid programming capacities, need to dominate the information onsignificant level programming language, information structures, calculation plan techniques and configuration designs, programming design and improvement strategy.

The fundamental programming course, algorithm analysis anddesign, primarily introduces common strategies and algorithmcomplexity analysis. The course teaches the students how to better analyze and solve problems, as well as how to program for large-scale software systems [5].

The course is hands-on, comprehensive, methodical, and all- encompassing. Analyzing algorithm efficiency, the divide andconquer method, the greedy method, dynamic programming, the branch and bound method, the backtracking method, approximation and probabilistic algorithms, and some programming techniques like sorting, searching, graph theory,geometry, composition, and numerical calculation problems are all included in its contents. In order to teach students how to use computers to solve problems in a creative way and to improve their ability to independently analyze and solve problems, the course places an emphasis on the concepts and design of algorithms. On the other hand, we need to focus more on how the algorithms are applied.

The traditional, teacher-centered teaching method has continued to be the method of instruction for the course in many universities. The classical algorithms, which are typically based on classical data structures and mathematicalmodels, are typically explained to students by teachers [6]. The exercises in the course focus on verification algorithms but ignore their efficacy, test data size, and actual scenarios. Students' learning focuses primarily on algorithm comprehension and memory, not on flexible algorithm application. It is difficult to achieve the training effect and effectively improve student practical ability during the practicesession because the students are heavily conditioned to copy the problem codes.

III. PEDAGOGICAL PRINCIPLES IN THE COURSE

To change conventional showing designs, we need to take on another learning worldview. In accordance with some recommendations made by other authors [7], the following arethe four pedagogical principles that support this novel paradigm:

1) Motivation. With acceptable dropout rates, it is evidentlyessential to increase student motivation. We mean the desireto learn and apply new ideas and techniques when we talk about motivation.

2) Learning by doing. The students must be aware of and involved in their own learning. To achieve real and lasting learning, an active method in which students are not merelyspectators is required.

3) Independent work Programming is, in our opinion, the mosteffective method for learning computer programming. A straightforward retention of ideas is almost futile. The students must independently consider algorithmic problems and develop their programs.

4) Students' perspectives on the learning process as feedback.The strategy ought to give understudies a constant assessmenton how well they are doing.

All of these tenets call for more activities that involve students, both in and outside of the classroom. It is in these circumstances where e-Learning devices can deliver an extraordinary advantage, not by subbing the educators, butrather by assisting them with controlling and assess the exercises.

IV. THE METHODOLOGY BASED ON OJS

By maintaining the educational standards proposed above, wehave planned four distinct approaches to involving the OJS inthe course [7]1) Independent issues. In the OJS, multiple hundred issues are proposed to the understudies. There are four volumes. Every volume has 100 issues aside from last one. The case of certain issues is displayed in Table I. The issues are autonomous of one another, and with various degrees of trouble. The understudies are supposed to choose and address some of them, not really all. Issues can be gathered by class, so that every classification shows a programming method examined in class.2) Dependent issues. This case is ideal when the target of a movement is to foster a more drawn out and more perplexing programming project. The venture is separated into more modest and back to back sub issues; every one of them is portrayed as an issue in the adjudicator. The understudies need to take care of the multitude of issues in the provided request. In the schedule,various programming methods can be outlined. This sort ofexercises can typically require a while.

TABLE I. THE Case OF Certain Issues

ID	Title	Ratio(AC/submit)	Difficulty
	……		
1339	Arctic Organization	56%(5/9)	44%
1340	Addition Chains	25%(1/4)	75%

1341	Binomial Confrontation	20%(4/20)	80%
1342	Tree Recuperation	100%(3/3)	0%
1343	Do the Untwist	44%(68/155)	56%
1344	Parencodings	58%(69/118)	42%
1345	Number Game	54%(54/100)	46%
1346	The Worm Turns	73%(52/71)	27%
1347	Undercut	60%(50/84)	40%
1348	Currency Trade	59%(53/90)	41%
1349	Round and RoundWe Go	61%(54/88)	40%
	……		

3) Contest style. As opposed to different cases, where exercises are completed on the web, here the presence of the understudies is required. A bunch of all things considered 4-9issues is given to the members. They need to attempt to take care of whatever number issues as could reasonably be expected, and as quick as possible. The challenge can requiresomewhere in the range of 2 and 4 hours.

4) Designing issues. This is the most innovative kind of exercises. The understudies need to make an issue with theconfiguration of the appointed authority: issue depiction, source code to tackle it, input cases, and anticipated yields.The capacity of the understudies to deliver unique and applicable issues is assessed.

Every sort of movement is exceptionally centered around a specific mental level. For instance, the primary sort is fixatedon application capacities; the subsequent kind attempts to further develop blend abilities; the third kind targets creatinginformation and assessment; and the keep going sort centers around cognizance and investigation [8, 9].

V. THE FRAMEWORK OF THE OJS

In the course on algorithm analysis and design, the function ofOJS is extremely helpful. The students can quickly receive their results by submitting their source codes at any time. The educator jobs in checking the source codes can be ease up fundamentally and they have additional opportunity to speak with their understudies and answer their inquiries. In thecourse, the OJS is a useful smart tool.

Foreground web pages and background management systemsmake up the OJS. Teachers can manage the content of a website through the browser with the help of the backgroundmanagement platform.

A. Foreground User Interface Fig. depicts the framework ofthe foreground user interface. one, with seven columns.

1) Issues and Codes to Submit Students can search some problems by key words in the titles or browse all of the problems by volume. A user can submit the code via browserif they select a problem and prepare the replacement code.

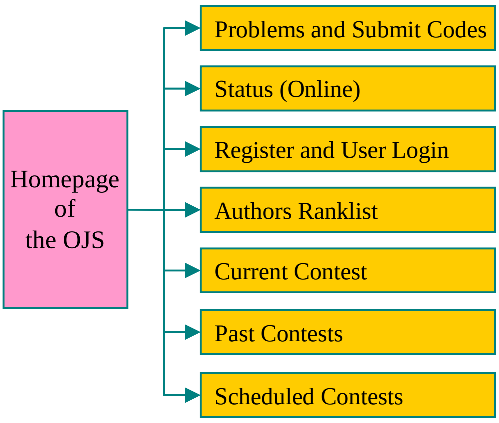

Figure 1. The framework of foreground user interface

2) Condition (Online). When understudy presented the code,he/she can see the status that code run. Six levels of status exist:

- *Acknowledged*

Understudy program should peruse information from standard contribution as per the detail of the challenge question. OJS will test it with foundation secret information. The program will be deemed correct if its output is consistent with the judgeoutput.

- Wrong Answer (WA): If its output differs from what the judges anticipate, it will be notified of its wrong answer. By and large, wrong response happens in light of the fact that understudies either have misjudged the issue, missed a stunt inthe inquiry, unrestrained the outrageous circumstances or are just not experienced to the point of taking care of the issue. If you don't read the problem statement very carefully, you mightmiss tricks in the problems. Show Mistake (PE)

This mistake happens when understudy program produces right result for the appointed authority restricted informationhowever doesn't deliver it in the right configuration.

- Runtime error (RE): When run on judge input, this error indicates that the student program performed an illegal operation. Invalid memory references, such as accessing outside an array boundary, are examples of illegal operations. Additionally, there are a number of prevalent mathematical errors like the divide by zero error, overflow error, and domainerror.
- Time Limit Exceeded (TLE): In a contest, each problem hasa time limit set by the judge. This error occurs when the student program does not end within the allotted amount of time. Students may be using an inefficient algorithm, such as recursively searching for the factorial of a large number, or there may have been a bug in the student program that causedan infinite loop. Another normal mistake is for understudy program to utilize improper information design.
- Exceeded Maximum (MLE) The OJS's maximum memory, which includes memory for global variables, the heap, and thestack, is 32767 MB. In the event that understudy program attempted to utilize more memory than the appointed authoritydefault settings this blunder happens.

3) Sign up and log in as a user. A student must register and login before submitting a code for a particular problem. 4) Creators Ranklist. Table II displays the number of problems solved by each user in descending order by number. It inspiresstudents to work together to solve more problems.

TABLE II. AUTHORS RANKLIST IN THE OJS

No.	User ID	Solved Problems	Submit numbers	Ratio (AC/submit)
1	bearfly	239	1012	23%
2	fish1210	221	264	83%
3	d518	202	536	37%
4	sunny	196	795	24%
5	wswyb001	194	225	86%
6	yes	177	499	35%
7	yeyoulong	167	266	62%
	……			

- *5) The Present Contest The contest's webpage currently has four menu options: Issues, Standing, Statusand*
- *Measurements.* Problems

An illustration of the issues list is displayed in Table III.

TABLE III. THE PROBLEMS IN A CONTEST

Problem Id	Title
1344 Problem A	Do the Untwist
1345 Problem B	Parencodings
1346 Problem C	Number Game
1347 Problem D	The Worm Turns
1348 Problem E	Undercut
1349 Problem F	Currency Exchange
1350 Problem G	Round and Round We Go

- Standing

The total number of problems that have been solved by eachuser in the contest, listed in descending order by the number.An instance of standing is displayed in Table IV.

TABLE IV. THE STANDING IN A CONTEST

Rank	Nick Name	Accepts	Penalty	A	B	……	G
1	d522	7	2:15:23	0:06:12	0:12:35		0:21:21
2	d303	7	3:00:14	0:07:12	0:12:32		0:29:01
3	d621	7	4:04:55	0:09:41	0:15:52		0:46:40
4	d624	6	7:24:16	0:46:17	0:41:54		
5	d626	6	8:24:16	0:53:18	0:55:07		
6	d222	6	9:17:55		0:59:05		1:16:28
7	d502	5	3:48:43	0:16:00	0:24:25		0:59:21
	……						

- Statistics

As shown in Table V, we create a statistic for each problembased on the number of accepted (AC), presentation error (PE), wrong answer (WA), and time limit exceeded (TLE) responses.

VI. EVALUATION OF THE OJS

Figure depicts a histogram of the problem numbers that eachstudent solved. 3 [7].

TABLE V. THE STATISTICS IN A CONTEST

	AC	PE	WA	TLE	……	CE	Total	G++	GCC
A	67		37			35	154	143	11
B	68	7	24			12	117	107	10
C	53	12	23	2		7	99	90	9
D	51	2	12	2		3	70	68	2
E	49	7	19			7	83	82	1
F	52		18			15	89	87	2
G	49	6	13			6	81	70	11
Total	389	34	146	4		85	693	647	46

6) Current and upcoming contests. The contests have alreadytaken place or are currently scheduled to. Students are unableto view contest details for scheduled contests.

B. Background Management The framework for the background management system that teachers use to managethe OJS is depicted in Figure. 2, with four menus included.

1) Include a Issue. The teacher must enter the problem's title,time limit, memory limit, description, input and output specifications, sample input and output data, and hint when adding a problem.

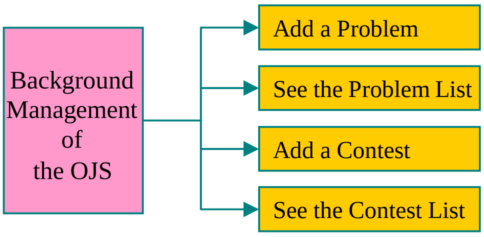

Figure 2. The framework of background management system

1) Look at the list of problems. List of all problems. Theteacher has the option to edit or remove each problem.

2) Add a competition. The teacher must enter the contest's title, description, start and end times when adding a contest before selecting contest problems.

3) Check out the Contests. The list of scheduled contests,which teachers can view in detail from and use to add, remove, or update problems.

Problem numbers solved by each student

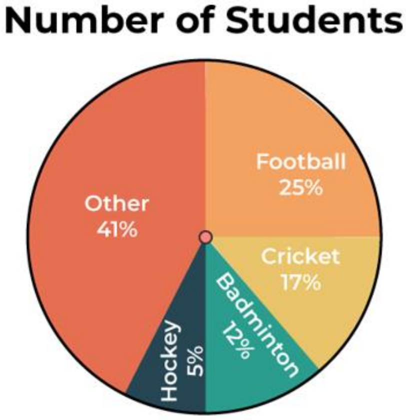

Figure 3. Problem numbers by each student, cumulative values

The outcomes got after the use of the judge based procedure are exceptionally encouraging. "The Authors Rank list is a crucial factor in encouraging students to solvemore problems more quickly and effectively. They want to climb the rankings. Students do not have to be frustrated when they receive a "wrong answer" because submissions are public. They are able to see that their classmates are experiencing the same difficulties and that it is an aspect oflearning. Students take the lead in their own learning when they solve the suggested problems.

VII. CONCLUSIONS

The novel experience we've described in the algorithm analysis and design course is excellent. The primary objectiveof the proposed strategy, which was to improve student programming skills, has been accomplished with the OJS. Theresult was a rise in the pass rate. With the new method, students' final grades are higher on average; However, overcoming the high failure rate will remain a challenge in thefuture.

Students are encouraged to work independently and develop skills for self-assessment through this method. Understudies are more engaged with their picking up, addingto areas of strength for a for the understudy's long lasting learning. We think that the proposed method can be easily used in other classes, especially those that have programmingassignments like C/C++ programming and data structure.

There are two main areas that need to be improved in the future: the OJS's feedback and the detection of plagiarism. We are designing and developing the plagiarism detection system, as well as working on OJS extensions that will provide in- depth feedback in the event of "Wrong Answer" and "RuntimeError."

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REFERENCES

[1]. Xu Qingxiang, Feng, Zhiling, and Zhao Duanyang. The study and implementation of individualistic education at independent colleges forcomputer science majors," Proc. Pages from the second international workshop on education technology and computer science, IEEE Press, March 2010, v1. 789-792.

[2]. Wuheng Zuo, Duanyang Zhao, and Qingxiang Xu. The curriculumsystem for the research and practice of software engineering majors," Proc. The second international workshop on education technology andcomputer science is ETCS 2010, v1, pages. 417-420.

[3]. Wuheng Zuo, Qingxiang Xu, and Duanyang Zhao The investigation andimplementation of computer instruction for students at independent colleges of varying levels," Proc. ICIE 2009, v1, pages, 2009 WASE worldwide gathering on data designing 20-23.

[4]. Zhengyi Zhang, Xiaolin Wang, and Yingwei Luo. Framework for programming: a web-based judge-based PC supported school system forprogramming courses," Proc. SCE '08 was the first acm culmination on registering schooling to occur in China.

[5]. Niannian Chen and Chunming Yang. In Chinese, it is referred to as "the showing investigation and practice of calculation examination and configuration based on programming challenge." Computer instruction.Tsinghua University Beijing, 2009, 20 page 146-149.

[6]. Sixth, Qun Dai. Teaching research in Chinese for the degreecourse in algorithm design and analysis. PC education. Tsinghua University pp. 2009, Beijing(18). 70-72.

[7]. Ginés Gárcia-Mateos, José Luis Fernández-Alemán. A web-basedseminar on calculations and information structures," Proc. the 14th annual ACM SIGCSE conference on innovation and technology in computer science education, ITiCSE '09

[8]. John Paxton, number eight, [2] The article "Programming competition problems as a basis for an algorithm and data structures course" was published in the Journal of Computing Sciences in Colleges. Bozeman,2007, p. 23

[9]. John Paxton and Brendan Mumey, number 9 Instruction in advanced problem-solving: suggestions for the Software engineering educationalprogram," Proc. of the fourteenth annual consortium on Small CollegesSoutheast conference, the CCSC '00 conference.