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Statistical Analysis on the Training Law of Adolescent Informatics Competition based on Luogu Evaluation Data

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***Abstract*:** Through the statistics of the training data of the NOI winners on luogu.com, this paper analyzes the current situation of the youth informatics competition and the training law. The competition of informatics competition is becoming more fierce, and more difficult to win awards. For an information science competition student, it generally takes about four years of study and training, which not only needs to invest a lot of time, but also improve the training efficiency.

***Keywords*:** NOI; OJ; Luogu

1. NOI introduction

The National Youth Informatics Olympiad series of activities aims to popularize computer science knowledge to those teenagers who study in middle school; Provide impetus and new ideas for the school's information technology education curriculum; Provide opportunities for talented students to communicate and learn from each other; Cultivate and select excellent computer talents through competitions and related activities. NOI series activities include: National Olympiad in Informatics (NOI),National Olympiad in Informatics in Provinces (NOIP), Winter Camp (WC), Asia Pacific Informatics Olympiad (APIO), International Olympiad in Informatics (IOI).

NOI was founded by theChina Computer Federation (CCF) in 1984. Since then, NOI activity has been held every year, attracting more and more teenagers to participate in it. Through the competition, a large number of computer enthusiasts have been trained and found, and many excellent computer reserve talents have been selected. Many players have become computer masters and doctors, some have embarked on computer scientific research posts, and others have succeeded in entrepreneurship.

2. Introduction to online evaluation system

Online judge (OJ) is an online system used to evaluate the participating programs in programming competitions. It can also be used for daily practice. In recent years, there have also been some online evaluation systems for job interviews.

The online evaluation system compiles and executes the program code. The specific process is that users log in to the browser, submit their own program code, and the system background compiles and executes the program. Then the system uses the set input and output to compare and check the correctness of the program. Its technical and theoretical basis is black box test in software engineering. The browser used has no specific requirements, and the program development languages that the system can judge are also diverse.

Users submit their own programs online through the browser. Considering the system security factors, it is necessary to limit the compilation and execution time of program code and the use and occupation of memory. First, the system background compiles the unknown program after receiving the program submitted by the user. The correctness of the compiledprogram must be tested next. The method to test the correctness of the program is black box test. The test data designed according to the program, i.e. test

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cases, are used for input-output comparison, so as to obtain the correctness judgment of the program.

In the evaluation process, accepted (AC) means that the program passes. In addition, "AK" means all the questions in the whole game have been accepted. The test points of some competitions can give "partial points", such as the answer is correct but not good enough, or the contestant does not fully complete the task given by the question.

There are many online evaluation platforms. The well-known OJs include Code forces, At Coder, USACO, Top Coder, Leet code, Now coder, Luogu, AcWing, Botzone and so on.

At present, Luogu is the most commonly used online evaluation website for primary and secondary school students in China for information science competition training. Since its operation in 2013, luogu.com has provided algorithm question bank, community, training tools and online education solutions for the majority of algorithm competition players, program design enthusiasts and colleges and enterprises. So far, it has hundreds of thousands of users. It is not only an online test system, but also has powerful community and online learning functions.

3. Current situation of Informatics competition

In recent ten years, the learning content has been changing, and NOI is also changing in terms of examination methods, learning methods and competition conditions. The Informatics Olympiad is more and more dependent on "massive knowledge reserves and massive modeling reserves". "The sea of exercises tactics" have an important impact on problem solving and have increasingly become a common training mode. Therefore, there are some characteristics and tendencies in the informatics Olympic Games, such as younger players, more difficult test questions, more knowledge points, longer suspension of classes for examination preparation and so on. The training time required for competitors to achieve different levels of goals is about hundreds of hours at USACO level, about 1000 hours at NOIP level, about 4000 hours at NOI level and about 10000 hours at IOI level.

Programming practice is the only way to cultivate computing thinking. The premise of understanding computing thinking is to understand computing and practice computing. Therefore, to talk about cultivating teenagers' computing thinking without computing practice must be passive water and rootless wood. Programming not only provides the necessary perceptual knowledge basis for learning computational thinking, but also the most important and best means to test the learning results of computational thinking.

However, teenagers have to study culture classes. Their time is limited. Excessive and low-quality problem brushing will waste time and kill their interest in computer science.

4. Statistical analysis of Luogu evaluation data

The questions in the Luogu are divided into seven types according to the difficulty, corresponding to seven colors respectively. The three most difficult ones are blue, purple and black, among which the black question is the most difficult, and there is another gray question, which is uncertain and generally difficult. We collected the exercises data of 24 gold medal players, 54 silver medal players and 21 bronze medal players, and counted someimportant parameters, such as pass rate, number of purple and black questions and proportion.

Table 1. Statistics of 99 winners

Player type	Training duration	accepted	Accepted rate	Grey	Blue	Purple	Black	Purple and Black	Rate(Purple&Black)
Gold player	3.7	1155	0.36	64	192	374	145	520	0.49
Silver player	3.2	1077	0.31	20	209	361	99	460	0.43
Bronze player	3	720	0.31	26	152	217	38	255	0.37

As can be seen from table 1, the biggest difference between bronze medal players and gold and silver medal players is that the amount of questions is not enough, especially the amount of purple and black questions. The main difference between silver medal players and gold medal players is that the number of difficult purple and black questions is not enough, the proportion is also slightly lower, and the number of gray questions is also quite different. Overall, the number of years for gold medal players is about 4 years, while that for silver and bronze medal players is about 3 years.

We also made statistics on the award-winning time in 2021 (71 contestants) and before 2021 (28 contestants), as shown in Table 2 and table 3.

Table 2. Statistical data of winners in 2021

Player type	Training duration	accepted	Accepted rate	Grey	Blue	Purple	Black	Purple and Black	Rate(Purple & Black)
Gold player	3.9	1345	0.32	69	224	443	169	612	0.49
Silver player	3.3	1130	0.31	24	220	374	101	475	0.43
Bronze player	3.3	807	0.32	30	170	249	45	295	0.4

Table 3. Statistics of winners before 2021

Player type	Training duration	accepted	Accepted rate	Grey	Blue	Purple	Black	Purple and Black	Rate(Purple & Black)
Gold player	3.3	837	0.43	57	137	260	105	365	0.48
Silver player	2.8	923	0.32	10	177	325	94	419	0.42
Bronze player	2.2	443	0.27	12	95	114	14	128	0.26

We can see from the table that in 2021, both the total number of questions and the number of purple and black questions of the winners have increased significantly. In particular, the gold medal players have an average of 500 and 250 more than the previous winners. It shows that the competition in informatics competition is becoming more and more fierce, and it is more and moredifficult to win the gold medal.

5. Conclusion

According to the statistical data analysis of this paper, if teenagers want to enter the national competition and win the prize in the informatics competition, they generally need about four years of study and training. In the training, they should do as many difficult topics as possible. In other words, they should not only invest more time diligently, but also improve the training efficiency.

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