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MATHEMATICAL LOGIC AND PROGRAMMING

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Abstract. The article presents the history of the emergence of mathematical logic. It is analyzed what is the meaning and application of mathematical logic in programming. The purpose of the article is to determine what is the relationship between mathematical logic and programming. The work is aimed to study how students of information systems evaluate knowledge of mathematical logic and the ability to apply knowledge in programming. It provides how programming knowledge can be applied to solve the tasks of mathematical logic. After analyzing, the opinion of the students of the Panevėžys College/ State Higher Education Institution, information systems study program about the knowledge of mathematics logic and the ability to programming, it was found that students assess their knowledge of mathematical logic and programming 6-7 points. The students of the program of the study of information systems were faced with a situation where knowledge of mathematical logic helped to solve the programming task more effectively. Assessment the difference in scores between mathematical logic and programming self-assessment is small enough for students. Emphasized that mathematical logic is very important in programming, especially when creating complex information systems or computer games. After analyzing how programming can be used to solve the tasks of mathematical logic, it was found that "Matlab" is perfect, which can solve the tasks of logical reasoning by creating a Script file.

Keywords: mathematical logic, programming application, mathematical relationship between logic and programming

INTRODUCTION

Logic is the basis of programming. The link between mathematics and programming begins with mathematical logic.

Computers may also be a way to give mathematical and computer science studies a symbolic form and to allow other algorithms, which operate on symbolic data, to operate on it. (Prudhomme, 2019)

Logic is the study of the principles and techniques of reasoning. It originated with ancient Greeks, led by the philosopher Aristotle, who is often called the father of logic. (Koshy).

The pioneers of mathematical logic: B. Russell, D. Hilbert, K. Gödelis. Until the middle of the 20th century, the main objects of the study of mathematical logic were various logarithmic calculations, the main components of which are the languages of calculations, axioms and rules of derivation. (Norgėla).

Logic plays a central role in the development of mathematics and computer science. Topological methods have been employed in a number of other areas of importance in computing, including digital topology in image processing, software engineering (Hitzier, P., Seda, A)

One of the more important achievements of mathematical logic is the discovery of an algorithm, an effective procedure for solving a task or problem, the discovery of an exact definition (clarification) of the concept. (Norgėla)

Mathematical logic is especially needed in programming, creating a program algorithm.

The relationship between logic programming and argumentation has attracted increased attention in the last years. (Gaggl, S.A., Nieves, J. C., Strass, H., Torroni, P)

Purpose of the research: To study the relationship between mathematical logic and programming.

The objectives of the research are:

1. To research the opinion of students about the knowledge of mathematical logic and to be able to program the relationship with each other.
2. To estimate the relationship between mathematical logic and programming evaluations.
3. To analyze an example of how complex tasks of mathematical logic can be solved with the help of programming.

APPLICATION OF PROGRAMMING TO SOLVE PROBLEMS OF MATHEMATICAL LOGIC

Programming can be successfully used to solve problems of mathematical logic. We will give an example of how we can solve the task of logical reasoning using the Matlab program.

Example: The task of logical reasoning.

If the student learns programming more, then he could write programs better. If he learns more to programing, he would at the same time improve his knowledge of mathematical logic. If he spent more time studying, then he would

find more like-minded friends and better learn to program. If he had more like-minded friends, then his chances of finding a job would increase.

Consequently: *if the student improved his knowledge of mathematical logic, learns to programing and spend more time studying, then* his chances of finding a job would increase.

This assumption needs to be verified.

Hypothesis: If a student improved his knowledge of mathematical logic and learned to programing, then his chances of finding a job would increase.

Let's note the statements:

S1="Student learns more programming"

S2="The student learns better to programing"

S3="Improves knowledge of mathematical logic"

S4="Find more like-minded friends "

S5="It's easy to find a job"

S6= "More time to study"

We write down the assumptions and conclusion:

$S1 \Leftrightarrow S2$

$S1 \Leftrightarrow S3$

$S6 \Rightarrow (S4 \wedge S2)$

$S4 \Rightarrow S5$

Conclusion: $S2 \& S3 \& S6 \Rightarrow S5$

We change the implication using the formula:

$$(p \to q) \leftrightarrow (\neg p \vee q) \quad \textit{(1 formula)}$$

We change the equivalence using the formula:

$$(p \to q) \leftrightarrow (\neg(\neg p \wedge \neg q) \wedge \neg(q \wedge \neg p)) \ \textit{(2 formula)}$$

We rearrange the assumptions using formulas 1 and 2. Reorganized assumptions and conclusion.

$P1 = (\neg(\neg S1 \wedge \neg S2) \wedge \neg(S2 \wedge \neg S1))$

$P2 = (\neg(\neg S1 \wedge \neg S3) \wedge \neg(S3 \wedge \neg S1))$

$P3 = \neg S6 \vee (S4 \wedge S2)$

$P4 = \neg S4 \wedge S5))$

Conclusion: $\neg(S2 \& S3 \& S6) \vee (S5)$

For the realization of this task, a Script file logic1 is created in Matlab (see Figure 1).

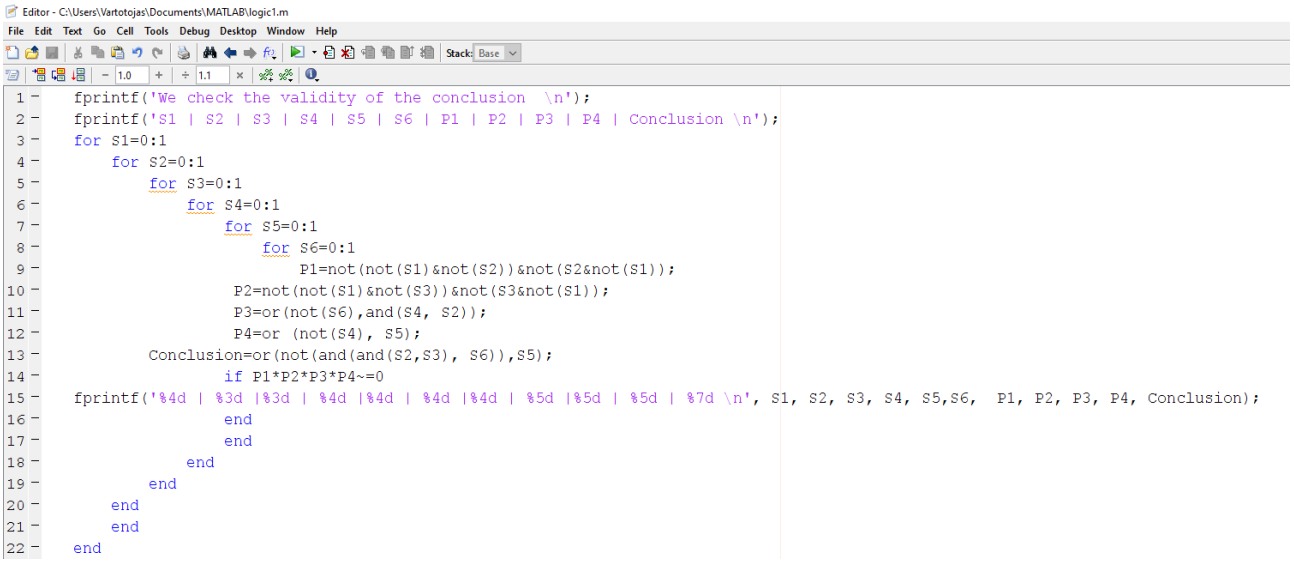

Figure1. **Matlab Script file is for solving the task**

It contains assumptions and a conclusion. In this file, a clause sentence is created, which brings out to the screen only those sentences in which all the assumptions are true.

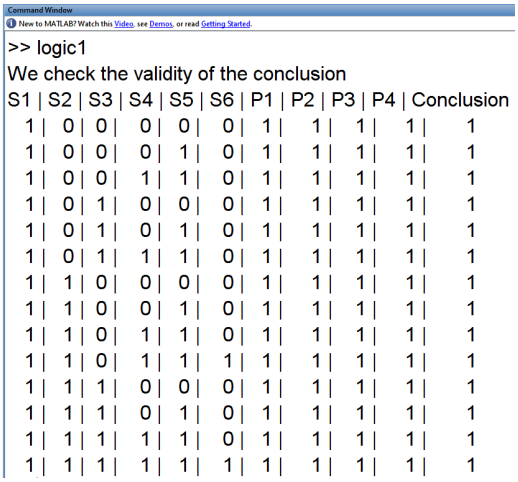

Figure 2. **The Results of the task using the program Matlab**

Analyzing the obtained results, we can say that if all the assumptions are correct, then and the conclusion are correct.

Analyzing the results obtained, we can say that if all the assumptions are correct, then this and the conclusion are correct. Therefore, we can formulate the final conclusion: "If a student improved his knowledge in mathematical logic and learned to programing, then his chances of finding a job would increase."

RESULTS OF THE RESEARCH

We founded out the opinion of 30 students in the information system study program, about the relationship between mathematics logic and programming.

The distribution of survey respondents by study course is shown in Figure 3. The most active participants in the survey were 1st year students (60.0%). 23.3% and 16.7% of the 2nd and 3rd year students who took part in the survey.

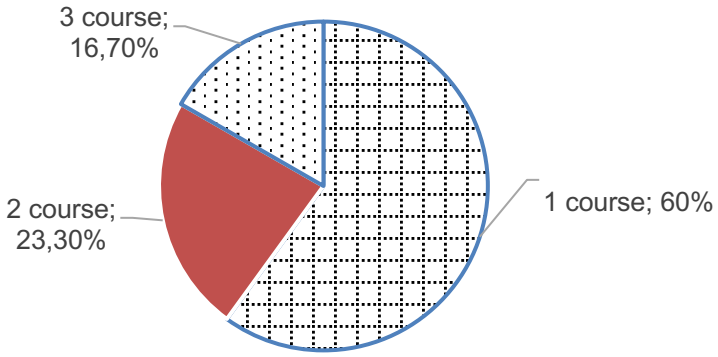

Figure 3. **Distribution of respondents by course**

Respondents evaluated knowledge of mathematical logic on a scale from 1 to 10. Figure 4 shows the results of the research. Most students rate knowledge of mathematical logic at 6 (26.7%) and 7 (23.30%). Knowledge of mathematical logic was negatively evaluated by 16.7% of students. Excellent and very good knowledge was rated by 10% of the respondents each side.

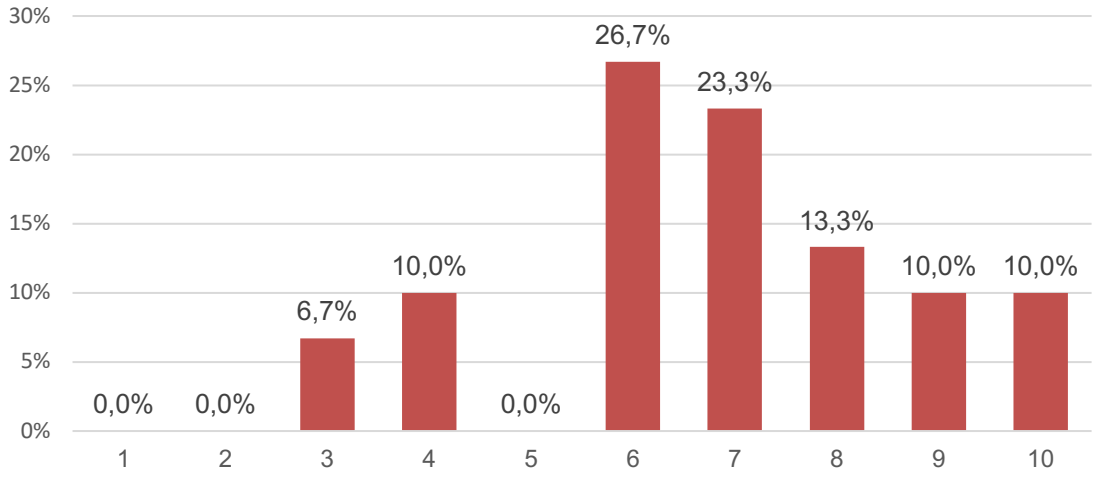

Figure 4. **Assessment of the knowledge of mathematical logic of the respondents on a scale from 1 to 10**

Respondents evaluated knowledge of programing on a scale from 1 to 10. Figure 5 shows the results of the research. Knowledge of programming is better appreciated by students than by knowledge of mathematical logic. Negatively (1-4 points) is rated only 6.6%. With a score of 5-6, they rate their knowledge at 43.4%. Excellent and very good knowledge was rated by 10% of the respondents each.

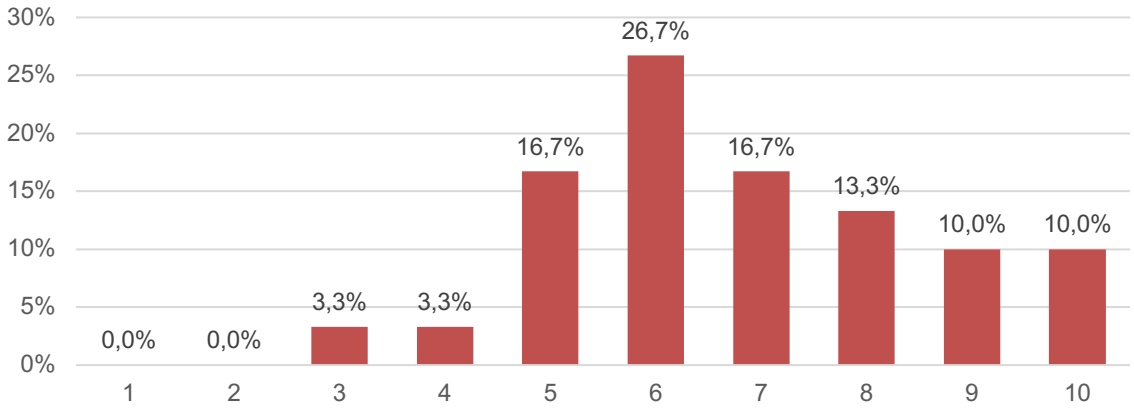

Figure 5. **Assessment of the knowledge of programing of the respondents on a scale from 1 to 10**

To determine how knowledge of mathematical logic and programming differs, we used the Pivot table. Table 1 presents the data obtained.

Table 1. **The difference between mathematical logic and self-assessment of programming knowledge**

Course of study	Difference						
	-5	-3	-2	-1	0	1	2
1 course	6%	6%	11%	6%	33%	17%	22%
2 course	0%	0%	0%	29%	57%	0%	14%
3 course	0%	0%	0%	0%	60%	40%	0%

The biggest difference between the self-assessment of mathematical logic and programming knowledge is -5 points. This difference is fixed only in a survey of students of 1 course. In the 3rd course survey, the difference is 0-1 point. In the 2nd course survey, 2 points. We can say that in higher courses, students rate their knowledge of mathematical logic and programming in the same way. 13 students (43%) assess their knowledge of both mathematical logic and programming with the same score.

The survey sought the opinion of student students on whether mathematical logic is needed in programming. The results of the research are presented in Figure 6.

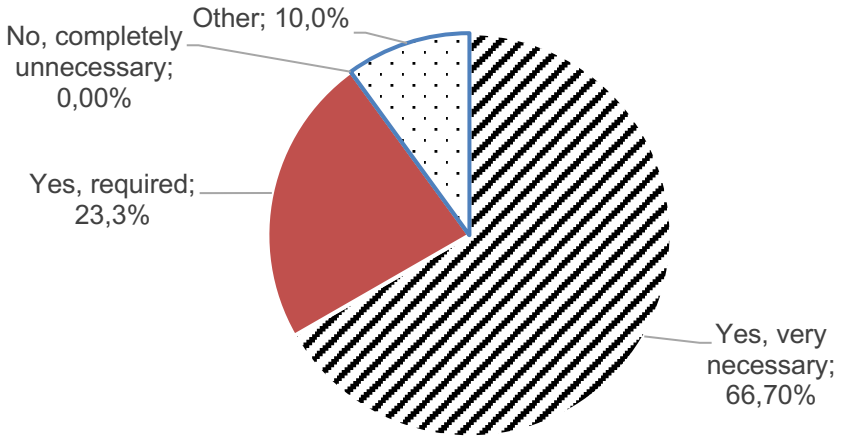

Figure 6. **Respondent's opinion about mathematical logic is needed in programming.**

It was studied whether the students of the program of the study of information systems were faced with a situation where knowledge of mathematical logic helped to solve the programming task more effectively. They indicated that 90% of respondents indicated that they faced such a situation.

There was a survey with the question, the question was: "Have you ever encountered a situation in programming when knowledge of mathematical logic helped to solve a programming task more effectively? " A large percentage of respondents chose the answer to another (59.3%). In response, they emphasized that mathematical logic is very important in programming, especially when creating complex information systems or computer games. Mathematical logic is considered important or very important in programming by 96.7% of respondents.

Analyzing the opinion of students about whether mathematical logic is applied in the development of software, we can say that 86.7% agree that it is applied. 3.3% indicated that it depends on the situation (Figure 7).

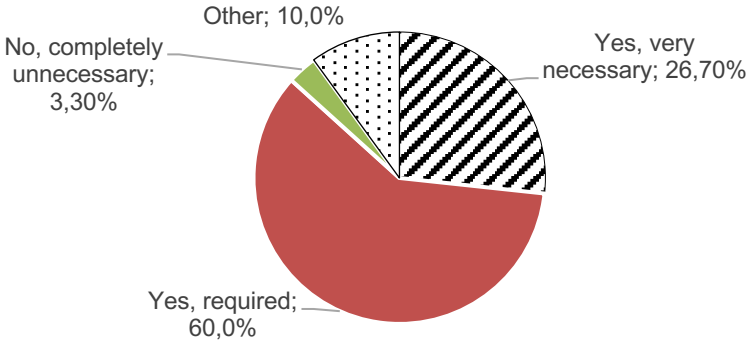

Figure 7. **Respondents' views on whether mathematical logic is used in software development.**

When analyzing the opinion of students (look at Figure 8), whether mathematical logic is applied to the development of the reliability and security of software. 90% indicated that "Yes, required", or "Yes, very necessary".

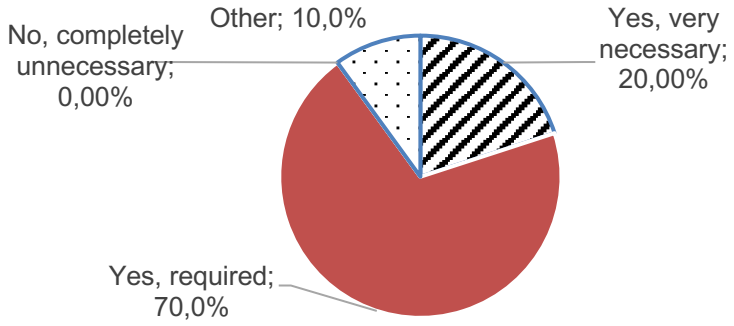

Figure 8. **Respondent's views on whether mathematical logic is used in developing software validation and security.**

There was a survey with the next question, the question was: "Do you think understanding mathematical logic can help you become a better programmer?" Students gave an opinion on whether an understanding of mathematical logic

can help them become a better programmer. 50% choose the answer "Yes, always", 43.3% choose "Yes, but mathematical logic is needed only for those programmers who seek a deeper understanding of the theory of program development".

CONCLUSIONS

1. After analyzing, the opinion of the students of the Panevėžys College/ State Higher Education Institution, information systems study program about the knowledge of mathematics logic and the ability to programming, it was found that students assess their knowledge of mathematical logic and programming 6-7 points. Students of the program of the study of information systems were faced with a situation where knowledge of mathematical logic helped to solve the programming task more effectively.
2. Assessment the difference in scores between mathematical logic and programming self-assessment is small enough for 2-3 course's students. Emphasized that mathematical logic is very important in programming, especially when creating complex information systems or computer games. Mathematical logic is considered very important in programming.
3. After analyzing how programming can be used to solve the tasks of mathematical logic, it was found that the program Matlab is perfect, which can solve the tasks of logical reasoning by creating a Script file.

REFERENCES

Hitzier, P., Seda, A. (2011). Mathematical Aspects of Logic Programming Semantics, Boca Raton, FL : CRC Press. 2011
Koshy, T. (2004). Discrete Mathematics with Applications. San Diego, California, USA
Math for Computer Science: Discrete Math (2022). Internet access: https://masters.cs.uchicago.edu/page/math-computer-science-discrete-math
Norgėla, S. Matematinė logika. Internet access: https://www.vle.lt/straipsnis/matematine-logika/
Prudhomme, G. (2019) Computer Mathematics. Arcler Press
Teiginių logika. Internet access: https://lt.wikipedia.org/wiki/Teigini%C5%B3_logika

