Using MOOC to Learn the Python Programming Language

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Abstract—The article carries out a quantitative analysis of online courses on learning the Python programming language as of October 2022. Such online platforms as Codecademy, Alison, FutureLearn, Udemy, Edx were considered. The main requirements for software engineers training, as well as features of online courses on learning programming languages were highlighted. The authors analyzed samples of online courses, which were a) generated with an automatic search by the keyword "Python" and b) found manually by relevant thematic sections. The analysis was carried out separately for each sample according to various criteria: a number of courses, an approximate level of student training, the cost of taking an online course, and a possibility of obtaining a certificate/diploma. The largest number of courses on learning Python is presented on Udemy platform. Alison platform offers the fewest number of courses for learning the Python language. All platforms are aimed at different level of student training (beginner, intermediate, advanced). On Alison and Edx platforms, 100% of the courses are free, while on FutureLearn platform, all courses are payable. After completing online courses, students can receive a certificate (all MOOC) and/or a diploma (Alison, Edx). As Python popularity is growing, further research is planned to analyze online courses which are represented on various MOOC and are related to the use of the Python programming language in different areas.

Keywords—programming, skills, Python, MOOC, online course

1 Introduction

The rapid development of the information society has led to an increase in demand for IT specialists who are knowledgeable in modern information technologies and systems [1], who can process information in various digital formats, who can provide computer equipment maintenance, etc. Most information processes are connected with the work of different software. As a result, programming has become one of the career paths in the IT field [2], and the profession of a software engineer is highly paid and prestigious today. In addition, the demand for specialists with advanced programming

skills will only increase in the future [3]. At the same time, in the conditions of a digital society, they are not only software engineers, but also ordinary citizens who should possess programming skills [4], [5].

Since we can observe rapid development of information and communication technologies (ICT), the requirements for IT specialist training, in particular software developers, are also changing. Therefore, specialist training should take into account new software systems and software development tools [6]. Currently, we can see that programming languages for web applications development, back-end functioning, as well as for the analysis of big data, etc. are relevant. Therefore, software engineers turned their attention to the Python programming language, which is designed to develop a wide range of software. Combining simplicity of syntax and powerful features [7], Python is a suitable choice for both a novice programmer and a mature professional [8]. Being quite popular, the course on learning Python is being introduced into vocational [9] and higher education. In addition, the Python language can be used to develop the coding skills of teachers [10], and other non-specialists in the IT field.

Programming skills can be acquired at an educational institution, a center for professional development, or at home. A universal way to improve your experience in programming is to use special online platforms, such as Code.org [3]. Among specialized software, we should mention a virtual learning environments [11], technology of augmented reality [12], and other software solutions.

One of the modern means of learning programming, in particular the Python language, is the massive open online course (MOOC). Learning the Python language is achieved through interactive lessons [13] and examples of program code [14], blended learning approach [15], analysis of learner emotions and behavior while doing online courses [16], etc. At the same time, the number of online courses on learning programming languages is constantly increasing, since modern trends in the IT sphere are taken into account. Therefore, the purpose of this study is a quantitative analysis of online courses on learning the Python programming language, which are presented on well-known online MOOC platforms.

2 Background research

2.1 Features of software engineers training

The level of the software engineer competitiveness depends on a set of professional knowledge and competencies, mental and communicative abilities, universal skills of abstract thinking, critical analysis, sorting and analysis of information. Algorithmic skills that allow software engineers to divide a general task into several subtasks or instructions are important for them. In this case, certain differences can be observed, since the same task can be realized in different ways [17]. Since most software complexes and Internet resources are developed by a team of IT specialists, a programmer must be able to work in a team, to have professional communication skills [6], including in a foreign (English) language [18].

The important factors affecting a software engineer's productivity at an enterprise are knowledge of software [1] and development of software products [11] with a certain

programming language. In addition to knowing the advantages of one or more programming languages and an integrated development environment (IDE), a software engineer must pay a lot of attention to User Interface (UI) development [19].

The optimal choice of a programming language and IDE will allow a software engineer to develop software of any complexity in accordance with the employer requirements. The criteria for choosing a programming language are: functionality, a type of license, difficulty of learning the language, availability of documentation, previous experience, etc. Popularity ratings of programming languages are also an important criterion used to determine the direction of a software engineer's professional development. For example, in the Ukrainian-speaking region, the most popular programming languages are JavaScript, PHP, Java, Python, C# [20]. The work [2] points out the popularity of Java and Python. Considering the chosen programming language, you can decide on the choice of IDE: VisualStudio from Microsoft, free NetBeans and Eclipse, etc.

At the same time, it is impossible to know all programming languages. Therefore, it is typical for programmers to have a certain specialization depending on the knowledge of a specific language/programming environment. It can be desktop, mobile, web-developer, etc. To develop desktop applications, you need to know C#, Delphi, etc. In turn, the free and open-source Python programming language is used for web application development, scripting, machine learning, pattern recognition, and big data analysis. Researchers emphasize its space, portability, power and speed [8]. One of the strong features of Python is its multi-paradigm support, as it supports procedural, structural, imperative, functional programming, etc.

Innovations in the field of education related to the ICT integration in the educational process make it more flexible, open and active. Students' involvement in learning programming, including the Python language, takes place through a variety of methodological approaches, including experimental learning [21], flipped classroom [9], ADDIE model [10], technology of augmented reality [12], and the analysis of motivation to study programming [7]. In order to learn Python more effectively, it is suggested to constantly monitor students' learning achievements [15]. Learning materials can be found on online courses which are taught on MOOC platforms, on distance learning systems or other educational resources. Each student can choose the optimal online course for himself, study the theoretical material, and later implement the acquired knowledge in practice.

2.2 Learning programming with online courses

MOOC is considered a good option for mass learning of programming languages [22]; it is designed for different level of students' training [11]. The target audience of the MOOC is:

- Students who study additional material within a specific discipline.
- Working people who want to improve their qualifications in their spare time.
- Users who wish to change their own direction of professional activity, etc.

Researchers pay attention to such advantages of MOOC as their mass character, lifelong education [23], their being fully or partially free of charge, a possibility to get access to educational material a lot of times, a free schedule for taking online courses [13], internationalization of education [24], independence from social status, a possibility to get a certificate [10], etc. MOOC is a means of branding for higher educational institutions [25], organizations and institutions of various levels whose employees participate in the development of online courses [26]. Most of the possibilities provided by MOOC are achieved through Web 2.0 technology. First, it concerns the multi-user mode of operation, active content exchange between users, possibility to choose cooperation between them using convenient tools.

With MOOC, you can learn Java [17], [27], VBA [25], Python [28] and other programming languages. Both beginner and expert programmers can freely use MOOC if they want to master a new tool or improve their knowledge of programming. According to research [22], as of July 2021, there were 6,979 online courses in 21 programming languages, including Python, on the well-known online platforms.

It should be noted that online programming courses have their own features. Many researchers pay attention to the low percentage of online courses completion. This is partly due to the accumulation of difficulties and problems while doing the course [16], misunderstanding of certain software structures or program code presented in the form of an example, uninteresting or boring theoretical information, etc.

In order to raise interest in online programming courses and increase the percentage of their completion, researchers recommend paying attention to the following issues: a) Practical orientation of online courses. b) Availability of software code verification tools. c) Avoiding negative attitudes and increasing motivation. d) Organization of feedback.

In our opinion, the main condition for qualitative learning of a programming language is the accumulation of experience in software design and the practical orientation of a software engineer's activities. The process of learning programming is based more on abilities than knowledge [14], [15]. While learning a programming language, students should accumulate practical experience [13]. All the tasks should be thought out and practically-oriented so that they could be used in real conditions. Online courses, which are rich in practical exercises and tasks, will allow you to practice more and understand the programming language better [24]. The tasks for which a sample solution is provided with an explanation of the program code [14] turned out to be effective.

It is desirable that the program code, which students write, should be checked for errors. Mass verification of assignments is a serious challenge for an online course developer. Therefore, researchers [15], [21] advise using external subsystems that are integrated into MOOC. They allow you to automatically check the correctness of the program code entered by users and generate appropriate marks.

In order to avoid boredom and motivation decrease in completing an online course, the educational content should be well thought out without causing negative emotions. It should contain positive confusions [5] that will encourage thinking and solving practical problems.

Providing feedback in case of independent completion of an online course is achieved through forums, bulletin boards and other means. However, this training format implies greater independence and motivation, as well as developed skills for self-study [24].

A better situation is observed if the online course is used during a blended form of education. In this case, the study of programming is carried out simultaneously at an educational institution and with the help of MOOC. To provide feedback, communication with the teacher [16], support service, forum and e-mail [10], [28], instant messaging, etc. are used.

3 Methodology

The purpose of our study was to analyze quantitative indicators of online courses on the Python programming language presented on popular MOOC platforms as of September 2022. Five online platforms were selected for quantitative analysis: Codecademy, Alison, FutureLearn, Udemy, Edx. Our choice was influenced by similar studies regarding the analysis of MOOC for learning programming, as well as our own practical experience.

The selection of online courses on the Python programming language was based on the search for courses through the rubric search and automatic search bar. Thematic catalogues related to IT technologies, software development, and certain programming languages were used for the manual search. When searching for online courses with the search bar, the keyword "Python" was used.

The selection of online courses presented on Codecademy platform (www.codecademy.com) was based on the thematic section "Catalog" – "Language" – "Python". A total of 56 online courses on the Python programming language were found using the rubric search. The sample of online courses, formed by the results of an automatic keyword search, was 73 courses.

The search for online courses on Alison platform (https://alison.com) was carried out in the thematic block "IT" – "Programming". Of the 200 online courses available in this section, 69 courses deal with learning different programming languages. Among them there are 21 online courses which are developed for learning the Python programming language. With the help of an automatic search by the query "Python", we managed to find 63 online courses.

For the quantitative analysis of online courses on FutureLearn platform (www.futurelearn.com), a sample of 58 courses was formed; the courses are presented in the section "Subjects" – "IT & Computer Science" – "Coding & Programming" – "Python". We found 100 courses with an automatic search by the keyword "Python". Since the function of the automatic search is quite limited on the platform, this method was not taken into account in the research.

The selection of online courses on learning the Python programming language on Udemy online platform (https://www.udemy.com) was formed by searching in the sections "Development" – "Programming languages" – "Python" and "IT & Software" – "Other IT & Software" – "Python". In this way, 2,781 online courses were found. An automatic keyword search found 8,433 online courses related to learning or using the Python language.

The selection of online courses on Edx online platform (https://www.edx.org) was formed with an automatic search by the keyword "Python". In this way, 334 courses that have various levels of complexity and duration were found. At the same time,

a sample of the necessary online courses with a manual search was not carried out due to the significant time costs and complexity of this procedure.

4 Result

There are 193 courses on various programming languages on Codecademy online platform. There are 56 online courses on the Python language on the platform, which is 29% of the total number of online programming courses presented in the section "Catalog" – "Language". Quantitative information about online courses is presented in Table 1.

Table 1. Number of online courses on the Python programming language

Level of Training	Free			Pro			
	Count	Lection	Time (Hours)	Count	Lection	Time (Hours)	Final Projects
beginner	7	1–20	2–25	13	1–28	–	4
intermediate	3	4–8	4–9	30	1–43	–	7
advanced	1	2	2	2	5–8	–	0
Total	11			45			

Table 1 shows that 11 online courses (20%) are free. On the platform, there are 45 courses (80%) that are offered with the "Pro" mark, that is, they require subscription to a paid account. A feature of some "Pro" online courses is the availability of final projects, which must be done to complete the course. In addition, the content of 9 free courses includes paid content (informational, lessons, projects, quiz or article), which becomes available for the "Pro" status. It should be noted that you have a possibility to view the approximate number of hours spent for the course only for free online courses.

The advantage of this MOOC is the availability of online courses on Python, focused on beginner (36%, 20 courses), intermediate (59%, 33 courses) and advanced (5%, 3 courses) levels. This distribution of online courses by levels allows beginners to choose courses that will teach them the basics of programming in the Python language, they will help to form basic concepts and demonstrate the program code samples. Most of online courses are designed for more experienced users who are improving their qualifications in certain topics or areas. Fewer courses are intended for advanced users, which is quite logical, since they concern narrow practical problems.

The search for online courses on learning the Python programming language on Codecademy platform can be performed automatically. In this way, you can find 73 online courses. Of these, 18 courses (25%) are free, and 55 online courses (75%) are marked "Pro". It should be noted that in this way it is possible to choose online courses that contain a keyword either in the title or content of the course. Unfortunately, the automatic search service does not have additional options to filter the found online courses.

On Alison online platform in "IT" – "Programming" section there are 21 online courses for learning the Python programming language. After successful completion

of 15 (71%) online courses, you can get a certificate, and based on the results of 6 (29%) online courses, a diploma is issued. All the online courses presented on the Alison platform are free and have a quality certificate from the Continuing Professional Development organization.

The sample, formed with an automatic search by the keyword "Python", consists of 63 online courses. All the found online courses are placed in four sections: IT, Business, Teaching & Academics, Engineering & Construction. Upon completion of 14 (22%) courses, a diploma can be obtained, and in other cases (49 courses, 78%) you can get only a certificate. Among the 49 online courses that allow obtaining a certificate, we observe the following distribution by sections: IT – 35 courses (72%), Business – 10 courses (20%), Teaching & Academics – 2 courses (4%), Engineering & Construction – 2 courses (4%). The 14 online courses on the Python programming language that allow you to get a diploma are presented in only three sections: IT – 8 courses (57%), Business – 5 courses (36%), Engineering & Construction – 1 course (7%). The Teaching & Academics section does not contain any online courses that provide an opportunity to obtain a diploma. All online courses on learning the Python programming language involve familiarization with the educational material through the video content. Its volume depends on the number and complexity of educational modules of a certain online course (Figure 1).

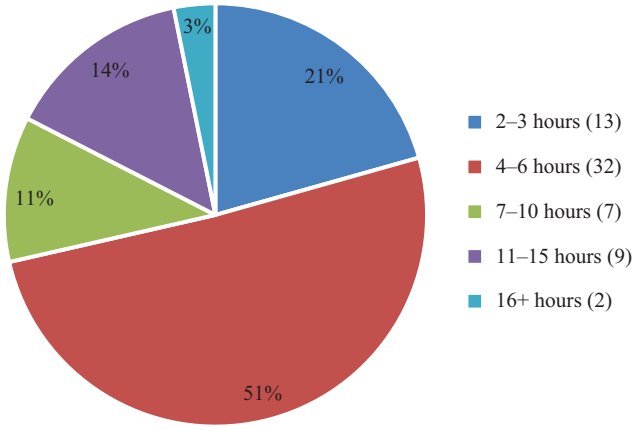

Fig. 1. Number of online courses by the volume of the video content on Alison platform

According to Figure 2, most of the courses have the volume of the video content from 4 to 5 hours (32 courses, 51%). However, there are only 2 courses (3%) with the maximum video content (more than 16 hours).

Similar to the MOOC on Codecademy, online courses on Alison platform are designed for different levels of learners. Thus, users are offered 25 (40%) courses at the beginner level, 9 (14%) courses at the intermediate level, and 29 (46%) courses are designed for advanced users.

When working with FutureLearn online platform, you can search for Python online courses in two ways: with an automatic mode and manual selection of courses in the relevant sections. In the case of manual search for online courses, you can find 58 online

courses on learning the Python programming language. They differ in the following characteristics: the number of academic weeks, the number of hours per week, the availability of accreditation, the possibility of obtaining a digital certificate, the level of training.

To study online courses on the Python programming language students have from 2 to 6 weeks. Out of 58 courses which were found, 3 courses (5%) provide training for 2 and 6 weeks respectively, 5 (9%) online courses are designed for 5 weeks, 11 (19%) courses are designed for 3 weeks. The largest number of courses (36 courses, 62%) is designed for 4 weeks. We can observe a different situation regarding the number of hours given to learn the Python programming language (Figure 2).

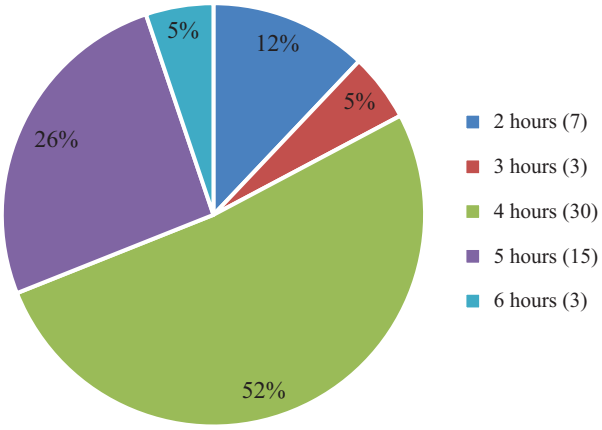

Fig. 2. Number of online courses by the volume of the video content on FutureLearn platform

The smallest number of courses (3 courses, 5%) is designed for 3 and 6 hours respectively. The largest number of online courses (30 courses) involves a 4-hour workload, which is 52% of the total number of courses presented on the platform. 15 (26%) courses are designed for 5 academic hours. We can conclude that the optimal amount of workload is 4–5 academic hours for doing most of the courses.

Among the analyzed online courses on FutureLearn platform, 8 (14%) courses are intended for the beginner level, 19 (33%) courses are for the intermediate level of users, 1 (2%) course is for the advanced level. Among the total sample of courses, the learners' level is not indicated for 30 courses (51%).

Online platform Udemy offers users a significant number of courses, including learning the Python programming language. To search for a course with the rubric search, the student has to get acquainted with the thematic sections and choose the most optimal one from his/her point of view. The online platform has two sections that contain online Python programming courses. With the help of the section "Development" – "Programming languages" – "Python", the user is offered 2,781 online courses. Of them, 1,397 (50%) courses are intended for the beginner level, 320 (11%) courses are for the intermediate level of users, 45 (2%) courses are designed for the advanced level. Among the total sample, 1,019 (37%) courses do not depend on the level of training.

The majority of online courses (2,447 courses, 88%) require payment, while 334 (22%) online courses are free to study.

Most of the educational material that is available on the online courses is presented in the form of video lectures. The amount of the video content depends on the number of lectures included in the content of a certain online course (Figure 3).

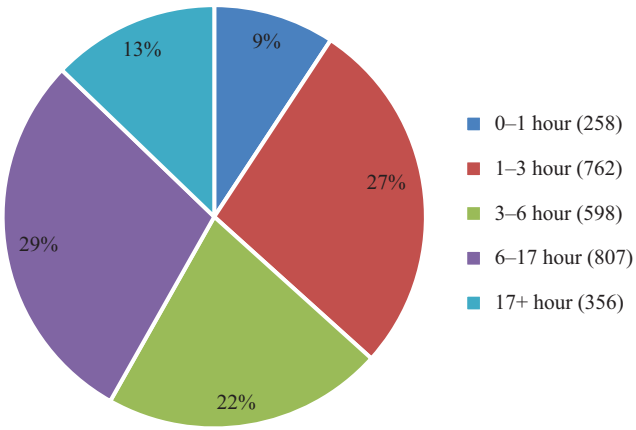

Fig. 3. Number of online courses by the volume of the video content on Udemy platform

According to Figure 3, in most of the courses the amount of the video content varies from 6 to 17 hours (807 courses, 29%) and from 1 to 3 hours (762 courses, 27%). However, the courses with the minimal video content (up to 1 hour) were the least of all (258 courses, 9%).

The number of courses found with the keyword search "Python" has increased significantly. It is due to the fact that online courses related to Python were included in the sample. Most of these courses concern learning the programming languages such as Java (920 courses), Excel (765 courses), Machine learning (672 courses), Math (612 courses), etc. If we add up the number of online courses, which are offered in various sections and related to Python, we get 8,433 courses.

Among the total number of courses found, 4,329 (51%) are intended for intermediate users, 694 (8%) courses are designed for advanced users. Other online courses (3,410 courses, 41%) do not depend on the level of training or require the student's beginner level. Among the total sample, 6,592 (78%) online courses are free to study, the rest require payment. A significant percentage of free online courses can be explained by the fact that the sample included online courses of general purpose, which are most often free.

334 courses on learning the Python programming language are available on Edx online platform; they are divided into different thematic areas: Python courses (127 courses, 38%), Python executive education courses (7 courses, 2%), Python programs (192 courses, 57%), Python degree programs (8 courses, 3%). The automatic search allows you to filter the sample by various criteria, including Level, Language, Availability. Generalized indicators according to these criteria are presented in Table 2.

Table 2. Number of online Python courses on Edx platform

Courses	Level of Training			Language	
	Beginner	Intermediate	Advanced	Eng.	Span.
Python courses	71	37	19	100	27
Python executive education courses	7	0	0	7	0
Python programs	148	112	37	165	27
Python degree programs	–	–	–	8	8

The online courses included in the "Python courses" section are designed for different levels of training: Beginner (71 courses, 56%), Intermediate (37 courses, 29%), Advanced (19 courses, 15%). In this section, courses are taught in two languages: English (100 courses, 79%) and Spanish (27 courses, 21%). In this section, 107 (84.3%) courses can be completed independently, and for 20 courses (15.7%) you can use the instructor service.

In the section "Python executive education courses" there are only 7 courses on learning the Python programming language. All of them are intended for Beginners, they are taught in English and are available at any time, all of them are taught under the instructor's guidance. In most cases, it is a 5–8 week course (7–10 hours per week). All courses of this category provide the deadline for registration and the date when learning begins.

In the "Python programs" section, 192 courses for learning the Python programming language are divided into 43 training programs, which contain from 2 to 11 courses. All of the online courses are taught in English (165 courses, 86%) and Spanish (27 courses, 14%). The online courses of this section are designed for different levels of student training: Introductory (33 programs, 148 courses, 77%), Intermediate (25 programs, 112 courses, 58%), Advanced (8 programs, 37 courses, 19 %). A larger number of programs (67 instead of 43 programs) is explained by the duplication of individual programs for different levels of student training.

Out of 43 programs, 4 (9%) programs can be completed under the instructor's guidance. These are quite large courses lasting from 5 months to 1 year 2 months. Accordingly, these programs are payable. The programming language can be learned independently with the help of 39 programs, which is 91% of the total number.

The "Python degree programs" section contains 8 online courses on learning the Python programming language. All courses are designed for different levels of student training. The course content is in English and Spanish. The programs in this section are designed for a certain period, which ranges from 15 to 24 months of online education. Upon successful completion of the course, the student receives a master's degree in the field of applied sciences. Training takes place only online in Self-paced mode.

Generalized data on the online courses found with the rubric search are presented in Table 3.

Table 3. Quantitative indicators of online courses displayed in thematic sections

Indicators	MOOC				
	Codecademy	**Alison**	**FutureLearn**	**Udemy**	**Edx**
total	56	21	58	2781	–
Level of training					
beginner	20	–	8	1397	–
intermediate	33	–	19	320	–
advanced	3	–	1	45	–
no level	–	–	30	1019	–
Cost of training					
free	11	21	0	334	–
payable	45	0	58	2447	–
Certification					
certificate	56	15	58	2781	–
diploma	0	6	0	0	–

The analysis of Table 3 showed that most of the Python programming language courses are located on Udemy online platform (2,781 courses). The smallest number of online Python courses (21 courses) is presented on Alison online platform. Considering the features of various online platforms, we can single out some common characteristics in them: the level of training, the cost of training, the possibility of obtaining a certificate or diploma. The specified features cannot be displayed on Edx online platform, so Table 3 does not contain information about this online platform.

If we consider the level of students for whom the online courses are developed, then the maximum number of Beginner level courses is presented on Udemy platform (1,397 courses). The maximum number of Intermediate level courses is presented on Udemy platform (320 courses) and Codecademy (30 courses). It should be noted that the least number of courses on all platforms are intended for the Advanced level: Udemy (45 courses), Codecademy (3 courses), FutureLearn (1 course). We cannot provide information about the levels of training on Alison platform in Table 3 since there is no access to such information in payable courses.

If we analyze the number of free and payable online courses, we have the following quantitative indicators: 100% of free courses (21 courses) are presented on Alison online platform. Codecademy platform ranks second since it contains 19.6% (11 courses) of free courses. Udemy platform ranks third in the number of free courses (12%, 334 courses). On FutureLearn platform, 0% of courses are free, that is, all courses are payable.

After completing the online course, students can receive a certificate or diploma. By default, all the analyzed platforms provide a certificate after completing the course. The largest number of such online courses is on Udemy platform (2,781 courses), the smallest number is on Alison platform (15 courses).

The generalized data on the online courses found with automatic search are presented in Table 4.

Table 4. Quantitative indicators of the online courses found automatically

Indicators	MOOC				
	Codecademy	**Alison**	**FutureLearn**	**Udemy**	**Edx**
total	73	63	–	8433	334
Level of training					
beginner	–	25	–	3410	–
intermediate	–	9	–	4329	–
advanced	–	29	–	694	–
no level	–	–	–	–	–
Cost of training					
free	18	63	–	6592	334
payable	55	0	–	1841	0
Certification					
certificate	73	49	–	8433	326
diploma	0	14	–	0	8

When using an automatic keyword search, the following quantitative indicators were obtained: Alison (63 courses), Codecademy (73 courses), Edx (334 courses), Udemy (8,433 courses). We failed to carry out an automatic search for online courses on FutureLearn platform, so there is no information about this online platform in Table 4.

Analyzing the possibility of free access to online courses, we see that there are no payable courses on two platforms (Alison and Edx). The number of payable courses on Udemy and Codecademy is 78.1% (6592 courses) and 75.5% (55 courses), respectively. The possibility of obtaining a certificate is available on all the online platforms. You can get a diploma after completing your studies on such online platforms as Alison (14 courses) and Edx (8 courses).

5 Discussions

Online courses on information technology and programming are in high demand among students [21], [24] due to their accessibility, convenience and mass character [25]. In our opinion, before starting to learn a programming language in an online format, you should study the features of a specific MOOC and conduct a proper search for an online course. For this, various criteria should be taken into account, such as the number of weeks, the number of lectures, the availability of practical tasks, the level of training, etc. In this case, such online platforms as Alison, Udemy, edX have powerful tools for an automatic search for online courses in the Python programming language.

In addition, the content of the online course is also important, i.e. the list of topics offered for study. In this case, Alison online platform is preferable since each online course on the platform provides the syllabus, which contains a list of topics to study.

An important criterion when choosing an online course is cost. Many researchers emphasize the fact that online courses presented on MOOC are free. Here we want to draw attention to the differences in providing access to online courses on different platforms. On Alison and Edx platform, 100% of the courses are free, whereas on FutureLearn platform, all courses are payable. Different payment options are presented on Codecademy and Udemy platforms, which contain up to 25% of free courses from the total number of courses on these platforms.

Different people have different ability of coding, which affects the speed of mastering a specific programming language. In this aspect, such online platforms as Codecademy, Alison, FutureLearn, Edx offer users online courses developed for different levels of training (beginner, intermediate, advanced). Therefore, in this case, the content of the course will suit the student's level, so educational motivation will not decrease.

When studying programming at a higher educational institution, including with MOOC, considerable attention should be paid to the formation of sustainable motivation [7] and positive emotions [5]. In the case of self-taught online programming courses, users should be convinced of the MOOC benefits [24]. The same applies to adults who want to improve their own qualifications and focus on their own job duties [10]. At the same time, we consider the abilities for self-study and self-development to be one of the main competencies of an IT specialist. If a programmer fails to self-improve, he might quickly lose his qualifications and his job.

A problematic issue in learning programming with the help of MOOC is insufficient feedback [15], [21] and the limited possibility to check the software code entered by users when solving practical tasks. Consolidation of acquired knowledge in practice occurs through virtual learning environments where students learn and simultaneously supplement educational content [11], through modules embedded in MOOC [17], and interactive practical tasks [13]. The problem of lack of support from teachers can be solved through blended learning [9], advanced interactive features of the online learning platform [16], embedded software tools [27]. On the other hand, applied software (proprietary mobile applications, educational environments, etc.) often require programmers' team work, as well as a lot of development time.

6 Conclusion

Thus, a software engineer who is familiar with a popular programming language becomes more in demand on the labor market and more financially independent. Among the popular programming languages, researchers and IT specialists single out Java, JavaScript, PHP, Python, and C#. The main advantages of the Python programming language are the simplicity of the syntax, open code, and a variety of applications.

The search for online courses on learning the Python programming language was carried out on well-known MOOC such as Codecademy, Alison, FutureLearn, Udemy, Edx. If we analyze the sample of online courses that was formed with the help of sections, then the maximum number of courses on the Python programming language was found on Udemy platform (2,781 courses). The minimum number of courses was found on Alison online platform (21 courses). Each analyzed MOOC has online courses developed for different levels of students' training. Udemy platform has the biggest

number of Python courses for beginners (1,397 courses, 50.2%). The majority of online courses on Codecademy platform are developed for students with an intermediate level of training (33 courses, 58.9%). On FutureLearn platform, most courses (30 courses, 51.7%) are developed for any user, without reference to the level of training. If we analyze the number of free and payable online courses, then 100% of free courses are available on Alison online platform. Codecademy platform contains 19.6% of free courses, while Udemy platform offers users 12% of free courses. On FutureLearn platform, 0% of courses are free, that is, all courses are payable. All online platforms allow you to receive a certificate upon completion of the course. At the same time, Alison platform provides a diploma after completing any of 6 courses.

If you analyze the online courses that were found with an automatic search by a keyword, the maximum number of courses is presented on Udemy platform (8,433 courses). On Alison (63 courses) and Edx (334 courses) platforms, 100% of the courses are free. The number of payable courses on Udemy and Codecademy is 78.1% (6,592 courses) and 75.5% (55 courses), respectively.

In our opinion, MOOC have all the possibilities for learning different programming languages, including Python. Since the Python language continues to take the first places in the popularity ratings, we consider promising to carry out the analysis of online courses related to the use of the Python programming language.

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