A COMPARATIVE ANALYSIS OF THE BENEFITS OF PYTHON AND JAVA FOR BEGINNERS

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Abstract: *Programming has developed so much that it is present in all areas of human life, and even greater presence is expected in the near future. The main criterion for training new developers is the choice of programming language. This criterion is usually chosen by experienced programmers based on the need and applicability of a particular programming language. For beginners, such a task is more difficult given that they have little or no initial knowledge. The beginning of learning poses a large number of challenges to the user, each of which can affect the continuation of learning and achieving the ultimate goal, ie. mastering a programming language. The choice of language at the beginning additionally burdens beginners, because due to the wrong choice, it is easily possible for them to lose interest in further learning. There are a number of programming languages on the market, and some of them can be very complicated for beginners. All this sufficiently emphasizes the importance of choosing the appropriate programming language for beginners. In this paper, two very popular programming languages, Java and Python, are analyzed. Their main characteristics, the most common ways of application, as well as the author's recommendations are discussed.*
Keywords: *Analysis, Comparison, Programming Language, Python, Java, Education.*

INTRODUCTION

The myth that people are born destined for the profession of programmer is something that we will certainly not discuss, because there are ubiquitous examples of how much can be achieved through work, and that is how we will look at this topic. Programming is learned like any other science or craft. It is necessary to start gradually with easy tasks that are adapted to beginners, and in which they can easily recognize the real-life application. The basic task in learning programming is developing logic and the programming way of thinking needed to solve problems effectively. It can often be heard that it is necessary to

choose one programming language and use it to learn the basic principles of programming (Khoirom et al., 2020). This statement should be taken as the view that a programming language is still only a technology used in communication between computers and humans. From a craftsman point of view, and in the way it is most often done in informal trainings, it makes sense to learn everything using one language. On the other hand, if we are thinking long-term or dealing with formal education, it is very important to learn from the very beginning how to approach problems well, and thus how to achieve their efficient solution by applying one of many available technologies.

Coding is a narrower term that denotes the ability to write code. Programming is the ability to transcribe a good idea into a solution to a given problem, and includes analysis, understanding of data structure, coding, etc. Today, developers have a number of programming languages available (Avouris et al., 2017). Each of them has its advantages and disadvantages, but each can be used to solve various tasks. The choice of programming language usually depends on the need, but also on the preferences of the user.

It is normal for beginners to think differently from experienced professionals, so it is very important right at the beginning of the decision to choose a programming language for learning to guide them on a path that will, in the simplest and most accessible way, allow them to master the material. When choosing a language, several factors must be taken into account, and the basic questions are what it will be used for, what are the previous occupations of the user, and whether documentation is available and to what extent. (Khoirom et al., 2020) All three factors are very important, but documentation has proven to be crucial in many cases. So often among professionals it can be heard that they have learned programming through the official documentation of a particular programming language.

Two very popular programming languages are considered in this paper. Each of them has certain advantages, but also disadvantages. When choosing which of them would be the better choice for the first programming language, one should consider as many of their features as possible and, based on that, decide on one. (Khoirom et al., 2020) Of course, it is desirable to know several programming languages, but one must be chosen to begin with.

Java is definitely one of the most popular programming languages with a wide range of usability. On the other hand, Python is an older programming language than Java, and in recent years it has gained increasing popularity (Lakshminarayanan and Prabhakaran, 2020; Girma et al., 2020) among beginners due to its simple syntax. This simplicity is highly appreciated by more experienced users who use it to solve serious tasks.

OVERVIEW

From the multitude of programming languages available today, we chose these two because they have proven to be a common choice suitable for training beginners, and at the same time have a value for later development. A large number of schools, starting from primary, to secondary, all the way to universities, use some of these two programming languages in their teaching. (Kohn, 2017; Moumoutzis et al., 2018) In addition, they are leaders in all rankings of popularity among programming languages used in real work, so it is no wonder that they are also used in education. Additionally, because of the popularity they have gained and because of the opportunities they provide, there is a great demand for staff who use them. From the multitude of programming languages available today, we chose these two because they have proven to be a common choice suitable for training beginners, and at the same time have a use value for later development. A large number of schools, starting from primary, secondary, all the way to the faculty, use some of these two programming languages in their teaching. (Kohn, 2017; Moumoutzis et al., 2018) In addition, they are leaders in all rankings of popularity among programming languages used in real work, so it is no wonder that they are also used in education. Additionally, because of the popularity they have gained and because of the opportunities they provide, there is a great demand for employees who use them.

JAVA PROGRAMMING LANGUAGE

The Java programming language was created in 1991, and was officially introduced in 1995 (Michael Mutongwa and Abeka, 2019). Its main advantage is that it is platform-independent, ie. has the slogan WORA (Write Once, Run Anywhere), or WORE (Write Once, Run Everywhere). (Khoirom et al., 2020) It is a compiler language and compared to Python it is much faster, but again slower compared to C ++, for example (Gamua, 2020). Some of the most well-known companies that use it in their work are Uber, Pinterest, Airbnb and LinkedIn. In addition to the above, a large number of other technology companies use Java in their daily work.

Some of the features of Java are:

- It is a completely object-oriented language (OOP) (Michael Mutongwa and Abeka, 2019)
- It is independent of the platform on which it will be executed - during compilation, a platform-independent program is obtained, and for its

execution only the appropriate Java virtual machine (JVM) is needed. It is this ability that makes Java a frequent choice when a software solution is needed that will run in different environments (Mahmood and Mahmoud, 2018).

- High level of security - since Java uses its own runtime environment (JVM), full control over data types and execution times is enabled (Gamua, 2020).
- Exceptional robustness - Java has implemented capabilities for powerful memory management with automatic release of unused objects (Docampo et al., 2013).
- Multithreading - Java has all the features of multithreaded programming languages, which helps to create highly interactive applications that efficiently perform multiple tasks at the same time (Penha et al., 2005).

These capabilities of the Java programming language lead to its wide application, and some of the most common are:

- Android applications - Java is one of the popular languages for developing Android applications. It is currently competing with the Kotlin programming language, but before its creation, Java was almost the only language for this purpose (Gamua, 2020).
- Desktop applications - Java is used to develop desktop applications with a fully developed graphical user interface (GUI), which allows easy use by the end user. (Michael Mutongwa and Abeka, 2019)
- Web applications - Java is also used to create web applications. Such applications are characterized by the fact that they are easy to encode, and they also bring high security, so they are used in areas such as e.g. health, education, banking and insurance.
- Cloud Computing Applications - which provide savings on IT infrastructure. It is also used to develop modern software such as SaaS (Software-as-a-Services), IaaS (Infrastructure-as-a-Service) and PaaS (Platform-as-a-Services) (Khoirom et al., 2020).
- Big Data Applications - due to its speed, reliability and robustness, Java is also used for data mining. Java, with its powerful memory management, is a great choice for this purpose. (Akbar and Kak, 2020)

PYTHON PROGRAMMING LANGUAGE

The Python programming language originated in the late 1980s. Its author is Guido van Rossum (Shi, and Chen, 2020) from the Netherlands. Python is a dynamic programming language, which means that the

programmer does not have to define variables' data type and there is no need to compile. It is also characterized by a very simple syntax (Šandrih, 2018), so for many developers it is often the first choice because of that, but also because of the coding speed (Avouris et al., 2017). Its popularity is growing rapidly, especially today as it is increasingly used in science (Shi and Chen, 2020). Companies that use it include Google, Instagram, IBM, NASA, Amazon, YouTube, Reddit, Facebook, and Spotify (Lakshminarayanan and Prabhakaran, 2020; Girma et al., 2020).

Some of the Python's stand-out features are:

- Ease of use - due to its simplicity, it is easy to learn and use, but that does not prevent it from performing very complex requirements (Avouris et al., 2017).
- It's free and Open Source (Karnalim and Aldiansyah, 2017) - it is available to everyone, and a large community of developers participates in its development, constantly improving it by improving performance and eliminating observed errors. Its source code can be freely downloaded, modified, used or distributed.
- High-level language - Python is a high-level language, but that doesn't prevent it from managing a computer's architecture and memory very efficiently.
- Portability - the same Python program can be executed on various platforms such as Unix, Linux, Windows (Brand et al., 2018).
- Interpreted language - this means that a program written in Python does not need to be compiled, and that it is executed in the order in which it was written. This property allows errors to be easily detected and eliminated, but it is therefore slower than programming languages that are compiled, such as Java and C ++.
- Object Oriented (OOP) (Karnalim and Aldiansyah, 2017) - this provides code reusability and programs are written with fewer lines of code, which indirectly has a positive effect on the speed of their execution.
- Extensibile and embedded - code written in Python can be used within programs in other languages such as C or C ++. The same code can later be used in Python. (Colliau, 2017)
- There are a large number of extensive standard libraries - this allows the availability of a wide range of modules and functions, which simplifies coding and significantly speeds it up, because it is possible to use them directly immediately after importing to the program (Khoirom et al., 2020).

Python is widely used, and some of the most common usages are (Lakshminarayanan and Prabhakaran, 2020):

- Artificial intelligence and machine learning - these two areas are in great expansion today, so the popularity of Python as a programming language is increasing. Its characteristics of being stable, secure and flexible make it a very common first choice for such projects.
- Data Science and Data Visualization - Python is the preferred language for data analysis and visualization by most professionals (Girma et al., 2020; Shi and Chen, 2020).
- Game development - a large number of available libraries greatly facilitates the creation of games.
- - Web development - tools such as Django, Flask and Pyramid, which have Python as a basis, provide a fast, easy and reliable way to develop web applications that are adorned with security, scalability and flexibility, but unfortunately not speed.
- Desktop applications - Python allows the development of great desktop applications, and with tools such as Tkinter it is possible to create a very likable and user-friendly user interface. (Hussain and Khan, 2018)
- Web scraping applications - Python does an excellent job of collecting data from the Internet that can later be used for various analyzes or other business uses. (Khoirom et al., 2020)

RESEARCH ON IT STUDENTS

As part of the writing of this paper, a small-scale research was done with final year IT students. The research was conducted using an online questionnaire, and included 76 students. All students have had contact with both programming languages during their schooling so far. The results of the research confirmed the previously mentioned empirical assumptions and helped to draw conclusions.

- The main question was “which programming language was easier to learn?” The answers showed that 89% of respondents said that Python is easier to learn and easier to use.
- The second question required the respondents to state what are the opportunities in their future careers that they consider important with these programming languages. In this case, the majority (93%) knew what can be done with the Java programming language, and a significantly smaller number (37%) what could be done with Python. It is interesting that almost all students mentioned Android programming and connected it with the Java programming language.

DISCUSSION

Considering that only two programming languages are used in this analysis, we must explain why this is so. Both languages have their own history and very great use value in practice, especially when it is known that both are transferable to different platforms. Both languages are also preferred by the large community of developers who support them. The large community plays an important role for both languages, as it helps beginners to overcome the obstacles they encounter in learning.

The task set is to compare the two programming languages, which is very difficult, because each of them has its advantages and disadvantages in different areas of application. Java has a more complex structure than Python (Michael Mutongwa and Abeka, 2019), and Python is simple and easy to learn and code (Olsen, 2018). In Python, line indentation is mandatory, which makes the code clearer and easier to read (Fagan and Payne, 2017), while in Java it is not mandatory to indent, and the entire program can be written in one line. Java requires the use of semicolons (;) as end-of-line tags, which is often a problem for beginners because they omit it, so the program reports an error.

The final judgment certainly depends on the task of a particular project in which some of the offered programming languages will be used. For example. both languages are often encountered in schools, but Python is still given a slight preference precisely because of its simple syntax and ease of use. This by no means means that it is less valuable and that it must and can be used only in education, because the fact that it is so represented in schooling gives it additional weight in later use. Of course, in some future work, it would be good to compare these two languages with some of the other more commonly used general-purpose languages or those that are intended for specific tasks.

CONCLUSION

In this paper, the possibilities of two programming languages are considered, and it is very difficult to determine which is better to start learning. According to the students who learned both programming languages during their education, it is Python, but at the same time they have little knowledge of what they can do with the knowledge of that language later. Both languages are portable and allow learning on a variety of platforms. Both are very powerful for developing various tools.

The programming language that will be used should be chosen depending on the desired purpose, but our question is which one should be chosen to start learning programming from scratch. In practice, it would be good to choose one language and one language only it until it is learned, ie. mastered to a satisfactory extent. This way, student satisfaction is achieved, and the goal of learning is achieved. In our opinion, the best choice for mastering programming is Python, which has a less steep learning curve, and at the same time provides solid application later in employment. This does not mean that Java is a bad option, but only that it is more convenient as a second language, that is subsequently learned if the need arises.

When a student masters a programming language to a sufficient extent, and through it learns the main principles in coding and, more importantly, the correct way of thinking, he can easily master some more complex programming languages later. Earlier, Pascal was taught as a first language in schools, which fulfilled the goal of learning the basics of programming well, but its later use value became lower and lower over time. As Python and Java are used in modern education, we can freely say that from that point of view, the educational process has progressed towards a greater use value of the acquired knowledge. This should be the main goal of programmer education.

References

Akbar, Shayan A., and Kak, Avinash C. *A Large-Scale ComparativeEvaluation of IR-Based Tools for Bug Localization*. In 17th InternationalConference on Mining Software Repositories (MSR ’20), October 5–6, 2020, Seoul, Republic of Korea.ACM, New York, NY, USA, 11 pages, 2020. https://doi.org/10.1145/3379597.3387474

Avouris, Nikolaos, Sgarbas, Kyriakos, Paliouras, Vassilis, and Koukias, Michalis. *Work in progress: An introduction to computing course using a Python-based experiential approach*. IEEE Global Engineering Education Conference (EDUCON), 2017.

Brand, Isaiah, Roy, Josh, Ray, Aaron, Oberlin, John, and Tellex, Stefanie. *PiDrone: An Autonomous Educational Drone using Raspberry Pi and Python*. IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2018.

Colliau, Taylor, Rogers, Grace, Hughes, Z., and Ozgur, Ceyhun. *MatLab vs. Python vs. R*. Business Faculty Publications. 51, 2017. https://scholar.valpo.edu/cba_fac_pub/51

Docampo, Jorge, Ramos, Sabela, Taboada, Guillermo L., Exposito, Roberto R., Tourino, Juan, and Doallo, Ramon. *Evaluation of Java for General Purpose GPU Computing*. 27th International Conference on Advanced Information Networking and Applications Workshops, 2013.

Fagan, Bryan J., and Payne, Bryson R. *Learn to Program in Python - by Teaching It!*. Proceedings of the Interdisciplinary STEM Teaching and Learning Conference, Volume 1, Article 9, 2017.

Gamua, Elvis. *Multi-language APP Development - Java and C++*. Centria University of Applied Sciences, Thesis, 2020.

Girma, Dawit, Yett, Bernard, Hutchins, Nicole, and Biswas, Gautam. *Development of a Python-based Platform for Teaching Computer Science*. Young Scientist, A Hight School Research Journal, 2020.

Hussain, Zahid, and Khan, Muhammad Siyab. *Introducing Python Programming for Engineering Scholars*. IJCSNS International Journal of Computer Science and Network Security, VOL.18 No.12, 2018.

Karnalim, Oscar, and Aldiansyah, Aldi. *Python Source Code Plagiarism Attacks in Object-Oriented Environment*. Computer Engineering and Applications Vol. 6, No. 3, 2017.

Khoirom, Selina, Sonia, Moirangthem, Laikhuram, Borishphia, Laishram, Jaeson, and Singh, Tekcham Davidson. *Comparative Analysis of Python and Java for Beginners*. International Research Journal of Engineering and Technology (IRJET), Volume: 07 Issue: 08, 2020.

Kohn, Tobias. *Teaching Python Programming to Novices: Addressing Misconceptions and Creating a Development Environment*. ETH Zurich Research Collection, Doctoral Thesis, 2017.

Lakshminarayanan, D., and Prabhakaran, S. *A Study on Python Programming Language*. Dogo Rangsang Research Journal, Vol-10, Issue-07, No. 12, 2020.

Mahmood, R., and Mahmoud, Q. *Evaluation of Static Analysis Tools for Finding Vulnerabilities in Java and C/C++ Source Code*. ArXiv, abs/1805.09040, 2018.

Michael Mutongwa, Sanja, and Abeka, Silvance. *A Comparative Study of C, C++, C# and Java Programming Languages: Underpinning Structure Equation Modeling, Data Structures and Algorithm*. Journal of Scientific and Engineering Research, 2019, 6(12):162-171, 2019.

Moumoutzis, Nektarios, Boukeas, George, Vassilakis, Vassilis, Pappas, Nikos, Xanthaki, Chara, Maragkoudakis, Ioannis, Deligiannakis, Antonios, and Christodoulakis, Stavros. *Design, Implementation and Evaluation of a Computer Science Teacher Training Programme for Learning and Teaching of Python Inside and Outside School*. In Auer M., Tsiatsos T. (eds) Interactive Mobile Communication Technologies and Learning. IMCL 2017. Advances in Intelligent Systems and Computing, vol 725. Springer, Cham, 2018. https://doi.org/10.1007/978-3-319-75175-7_56

Olsen, Jan-Fredrik. *How to (and why) use Python to teach introductory Calculus*. LTHs 10:e Pedagogiska Inspirationskonferens, 2018.

Penha, Dulcinéia, Corrêa, João, Ramos, Luiz, Pousa, Christiane, and Martins, Carlos. *Performance evaluation of programming paradigms and languages using multithreading on digital image processing*. 2005.

Šandrih, Branislava. *Informatics for Library and Information Science students with special focus on Python*. Infotheca Vol. 18, No. 1, pp. 61-74, 2018.

Shi, Xiangrong, and Chen, Yuangao. *New Teaching Method of Python Programming for Liberal Arts Students*. International Journal of Innovation and Research in Educational Sciences, Volume 7, Issue 3, 2020.

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