

The status of MATLAB in the Software Development Market

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Abstract. With the continuous development of technology, it is necessary to analyze the applicability of MATLAB in the field of software development according to the mainstream trend of the market. This article aims to outline the design purpose of MATLAB and its applicable user groups, and emphasizes the advantages of MATLAB in scientific computing and engineering applications. By comparing it with other programming languages such as Python, this article further highlights the unique advantages of MATLAB in computing performance and functions, thereby clarifying its importance and application value in related fields. This article concludes that as a programming language specializing in computing, MATLAB is not only loved by professionals in engineering, finance, physics, and other fields but also has a high status in education. Through the experiment of developing small games and comparing the rich functions of Python in software development, it points out the immaturity of MATLAB in UI design, code optimization, data transmission, and other aspects. The subsequent research provides some improvements that MATLAB can make in code performance optimization and loop performance. The significance of this study is to let people who are new to software development choose a more suitable programming language.

1 Introduction

With the continuous advancement of science and technology, especially in the context of the big data era, the demand for information technology and computer science has increased dramatically. The more intuitive feeling is that more students are applying for IT-related majors such as computer science and data science, and the demand for programming professionals in the market is increasing. These phenomena show that the trend and focus of the current market is information technology and software development, and with the continuous update of data and the continuous maintenance of software, the development speed of the market will become faster and faster in the future. This also means that there will be more vacancies in information technology and software development technical positions in the market in the future. Therefore, mastering appropriate programming technology is helpful for most people, especially students, for future development and employment.

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In a market characterized by ongoing technological advancement, establishing a competitive presence in this field requires not only robust programming skills but also a well-defined area of specialization that is currently in demand. Presently, a significant number of technology companies are focused on the research and development of software solutions. Although there are already sufficient software systems on the market, and people's lives are very conveniently served by these mature systems, there are still some areas that need to be improved and are waiting for professionals to develop and fill. Therefore, people who have made achievements in software development are more likely to get first place in future job hunting or scientific research.

Some newcomers may choose MATLAB as a programming language when trying to practice software development and other related skills. Due to MATLAB's excellent computing and data processing capabilities, many people choose MATLAB as a daily auxiliary tool. After they realize the built-in software design functions of MATLAB, they may choose MATLAB as a base to design software.

Most of the research on MATLAB focuses on its functions in mathematical computing, data analysis, and algorithms. As a multiparadigm programming environment, MATLAB itself is widely praised in the fields of mathematics, physics, and finance for its powerful computing capabilities. Its function and data plotting meet the needs of researchers and engineers for numerical visualization. At the same time, as Waleed K. Ahmed gave an example, he observed that students used MATLAB in class to help calculate functions and matrices. At the same time, the data visualization function also allows students to have a clearer understanding of their results [1]. Its convenient computing capabilities for high-level mathematics are also beneficial to many college students. From this feature, it can be concluded that MATLAB's user group includes people from all professions.

This study aims to explore the current status of MATLAB in the field of software development. This article will introduce the role of MATLAB, related fields, and applicable populations, and analyze the advantages and disadvantages of MATLAB in some functions to discuss whether MATLAB is suitable for software development. At the same time, popular programming languages on the market will be cited for comparison. This paper is organized as follows: Section II discusses the core features and advantages of MATLAB; Section III analyzes its limitations in software development; Section IV demonstrates its practical applications through case studies; and Section V explores improvement suggestions and future development directions for MATLAB.

2 MATLAB's features and advantages

Programming languages were invented as early as the last century. Initially, people used short symbols and instructions to represent machine language instructions, making it easier to interact with and program computers. With the subsequent advancement of technology, programming languages have evolved from simple machine-level programming to more abstract and easier to use. To this day, many well-structured programming languages, such as C and C+, are widely used, mainly in software development, graphics rendering, system programming, and other fields. These programming languages are in demand by many technology companies today. This article will discuss one of the more mainstream programming languages, which appeared earlier, called MATLAB.

MATLAB is a highly versatile and full-featured programming language with a powerful environment suitable for various fields. The first is its computing power. Marko Kalevo has stated that because MATLAB is very good at processing and analyzing data, it supports users in performing professional data visualization [2]. MATLAB was originally designed to serve matrix and linear algebra calculations, and its main service group is scientists. It appears from time to time in major mathematics and computer competitions. MATLAB's high-efficiency

numerical computing capabilities make it one of the first choices for people to deal with a series of problems such as differential equations. In addition, MATLAB's built-in rich database can also help users perform tasks in fields such as physics and finance. In addition to its excellent algorithmic capabilities, MATLAB is also used in fields such as system design, image processing, and model optimization, all thanks to MATLAB's built-in toolbox. MATLAB is equipped with essential functions that meet a wide range of needs. Additionally, its built-in toolboxes significantly enhance its capabilities. The Statistics and Machine Learning Toolbox, along with the Deep Learning Toolbox, enables users to perform classification and clustering tasks, which are crucial for machine learning and artificial intelligence applications. The Image Processing Toolbox and Signal Processing Toolbox facilitate operations like Fourier transforms, allowing for efficient processing and enhancement of images and signals. Furthermore, the Financial Toolbox and Control System Toolbox assist users in modeling interest rates, analyzing risks, and designing control systems. Not only does MATLAB serve professionals, but its beneficiaries include people from all walks of life. The MATLAB official website mentioned that 'People who do not work in engineering or science are often surprised to learn how widespread MATLAB is adopted, including Millions of users in colleges and universities, Thousands of startups, Thousands of people at every major company and organization where engineers and scientists work [3]. MATLAB has been put into the daily learning of college students almost all over the world, and most science and engineering students need to learn some MATLAB knowledge. Due to MATLAB's high-performance computing power, this makes MATLAB a highly practical programming language. Students can use MATLAB to perform calculations or tasks in class and get feedback in a short time. This allows some mathematics students to flexibly deal with some function and matrix-related problems in class. Coursera once praised MATLAB as ideal for mathematical modeling and linear algebra, offering a clear and concise representation of mathematical concepts [4]. Compared with the current mainstream programming languages that most students will come into contact with, such as Python, MATLAB's computing power is more flexible and easier to use, which is attributed to MATLAB's constantly updated and optimized ecological libraries and toolboxes. In addition, MATLAB's toolbox also makes students more comfortable in cross-disciplinary learning. MATLAB's Simulink tool provides powerful visual modeling capabilities in the design of automated control systems, allowing developers to quickly build and optimize complex dynamical system models.

However, such a convenient and versatile programming language is not in the first tier of programming languages needed by the current software development market. The following will analyze it step by step.

3 Limitations of MATLAB in Software Development

As a programming language that tends to be computational, MATLAB is mainly used by people in engineering, information statistics, data analysis, and other fields. Its excellent computing power and graphics processing capabilities are widely recognized. However, in terms of software development, MATLAB is not complex enough for network programming, database management, and other functions. Compared with other mainstream programming languages, such as Python, C++, Java, etc., MATLAB's library support in software development is obviously insufficient. Craig S. Lent mentioned that 'Several language features make the MATLAB language easier for beginners than many alternatives: it is interpreted rather than compiled; variable types and array sizes need not be declared in advance; it is not strongly typed [5]. This directly leads to the disadvantage of using MATLAB as the base for compilation in front-end development and graphics processing. At the same time, MATLAB's integrated development environment has obvious deficiencies in code editing, testing, and version control functions compared with other mainstream

development environments. These deficiencies will seriously affect the efficiency of subsequent large-scale software development. Although MATLAB is indeed very efficient in computing, its overall execution speed is relatively slow. That is to say, in real-time processing, model training, and other links, MATLAB will perform poorly in the execution of logic and loops due to its insufficient performance.

MATLAB's portability is also one of the reasons why it has not become a mainstream programming language for software development. MATLAB usually relies on MATLAB Runtime when generating executable files. MATLAB Runtime is an independent shared library that is used to execute on systems without MATLAB and uses the components generated by the MATLAB compiler. Since the deployment of MATLAB requires additional running links, it is not efficient in terms of deployment and portability; specifically, it is reflected in running efficiency, cross-platform compatibility, and file size.

4 Case study

4.1 Design of multiplayer games based on MATLAB

This paper attempts to create a small game that supports multiplayer online connection based on MATLAB. In terms of the data storage and transmission platform, this study chose ThingSpeak. After completing the compilation of the basic code of the game, the researchers gradually tested the integrity and online feasibility of the software. During the test, the time it took for MATLAB to upload data was not satisfactory. Specifically, when the tester clicked the interactive button, the background platform data was not updated immediately. It took about 3-5 seconds for the platform data and icons to receive user information and change. However, the screen of another user participating in the test did not immediately display the other party's data. After another 2-3 seconds, the data of the two testers was synchronized. Through these tests, MATLAB exposed the problem of data transmission efficiency. When the game software was initially completed, it did not compile too much code and did not fill in too much information. However, MATLAB's response time still affected the test efficiency. Later, when packaging the software files and testing whether they could be downloaded, although there was no error, another tester was required to download the MATLAB Runtime that matched the compilation version to run the program. In addition, some online tutorials on MATLAB's built-in tools also have inconsistent versions and devices and need to be synchronized. Eklas Hossain mentioned, "GUIDE is an old version of app builder. App Designer was built in 2016 to replace GUIDE completely. Hence, it is recommended by MathWorks to migrate from GUIDE to App Designer. For the current guide users, it is very important to learn how to migrate from GUIDE to App Designer [6]. Compared with C++, C++-compiled programs are usually independent binary executable files. Since all necessary functions and libraries are directly packaged in the file, the file does not require additional environment support. From this, it can be seen that compared with the mainstream compilation environment, MATLAB is slightly insufficient in terms of execution and startup time, data transmission, and portability.



Fig.1. UI Design (Picture credit: Original)

During the design of the software, it was also found that the graphic designer provided by MATLAB only supports the creation of simple user interfaces, which lack aesthetics. The UI design interface is shown in Fig.1. This is not only reflected in the small number of color options provided by MATLAB but also in the lack of built-in art graphics. And because MATLAB's interface components are too simple and the dynamic interaction function has not been improved, it is difficult to make innovative designs for MATLAB's interface interaction, and most of them are slightly simple. At the same time, MATLAB's resource interaction function is not satisfactory. In terms of adding text, MATLAB can enrich the visual effects of text in a variety of forms. But in terms of pictures and background music, it seems a bit stiff and cumbersome, and there is a sense of violation. Compared with Python, Python has a complete set of front-end development library ecosystems, such as Tkinter, PyQt, etc. These development libraries allow users to use Python to effortlessly design highly interactive and visually attractive interfaces. This feature gives Python greater flexibility and innovation space in front-end development.

4.2 Comparison of MATLAB and other programming languages

According to the investigation, MATLAB's image processing library does not have an integrated interface with popular computer vision frameworks, which is not conducive to creating relatively complex visual effects when developing software with MATLAB. Unlike MATLAB, sci-kit-image in Python's library ecosystem contains rich image-processing functions and is well integrated with mainstream plug-ins such as Numpy and Pandas. This greatly facilitates users in the process of developing software, not only in image processing but also in data analysis and other aspects.

Of course, the most critical thing is that MATLAB, as commercial software, has a very high licensing fee. The cost that cannot be ignored is also one of the important factors that make it not a mainstream programming language for software development. Compared with MATLAB, Python and Java are all free. At the same time, Python, Java, etc. also have more active and diverse developer communities. This phenomenon allows users to get faster community response speed, more cutting-edge innovative technologies, and more extensive support. At the same time, more frequent updates and iterations will also promote the gradual improvement of the system. P.M.Lu and S.S.Yau et al. mentioned that each software update will undergo a major iteration, and these iterations are accompanied by the secondary design

of the software system [7]. Software systems that keep pace with the times will have more fresh blood and trigger more valuable academic discussions. However, since most of its members are engineers or researchers, the discussion topics are concentrated in the fields of calculation, analysis, modeling, etc. The topics are not varied enough, the references are not enough, and the update frequency is difficult to meet the needs of many people. As a data computing and model-building software, MATLAB is very valuable for scientific research. To this day, it is still the first choice of scientists. Asawari Nilkantha Dixit once used MATLAB's App Designer to design a performance analyzer. This performance analyzer can calculate technical parameters such as system loss and performance ratio [8]. At the same time, in many academic competitions, MATLAB is required to be used instead of other programming languages such as Python and C. At the same time, MATLAB also occupies a very important position in academic research and teaching. However, due to its insufficient library support and developer community, as well as its weak integrated environment and portability, it lacks competitiveness in the field of software development.

5 Future Improvements

It must be acknowledged that MATLAB is a relatively easy-to-use programming language for beginners. Beginners do not need to spend too much time understanding the logic of the code. This is necessary. Yu-Chang Hsu and Yui-Hui Ching said that designing mobile programs is difficult for inexperienced newcomers. Spending extra time learning programming languages and writing code will greatly increase the time spent by developers [9]. Easy-to-understand and easy-to-use operations not only save beginners a lot of time but also give them the confidence and motivation to continue trying. However, in order to better support the needs of software development, MATLAB still needs to focus on code performance optimization. In research, MATLAB's relatively slow execution speed makes it difficult to satisfy experimenters. Therefore, MATLAB should improve loop performance and optimize the compiler. In this way, when facing massive iterations and code generation, MATLAB can take into account loop performance while taking into account high-performance computing, greatly improving software efficiency. Parallel to code performance optimization is MATLAB's cross-platform compatibility. Although MATLAB's built-in tools such as Embedded Coder can generate embedded code, MATLAB is still difficult to expand across devices, especially mobile devices such as iOS and Android. Therefore, MATLAB needs to continue to update and optimize cross-platform compatible tools, and if necessary, special cases need special treatment. As Hemant K. Bhargava et al. mentioned, 'Due to the complexity - expertise, effort, and cost - of developing decision technologies, many of them exist only as broadly applicable general solutions, needing further customization before they can be used to solve real-world problems [10]. In addition, in terms of UI design functions, MATLAB can look to the library ecosystem of Python and C++, the mainstream programming languages currently used in software design. The built-in functions of these programming language environments have already met the needs of most designers and developers. MATLAB can appropriately draw on its optimization of third-party resource insertion, as well as 2D and 3D plug-ins to improve the expressiveness of front-end module design and development.

6 Conclusion

This paper aims to explore whether MATLAB meets the market demand for software development. In the study, this paper introduces MATLAB's advantages are calculation and model building. It covers many fields such as physics, mathematics, finance, etc. It is not

only suitable for professionals from all walks of life but also loved by most students of related majors. This paper briefly introduces the development trend of the information technology market and software development and compares the built-in toolbox of MATLAB to explore that MATLAB's built-in software design functions do not support users to perform complex page design and code compilation. This study also conducted an experiment on game compilation. From the steps of background code compilation, front-end UI design, and subsequent data uploading, MATLAB's immaturity in UI dynamic design, interface interaction, slow data transmission speed, etc. is revealed. At the same time, the follow-up study will also compare MATLAB with other popular programming environments, such as Python, etc., once again exposing the reason why MALLAB is not the first choice in software development. The significance of this study is to explore whether MATLAB performs as well in the field of software development as it does in computing, data visualization, and other fields compared to other programming environments and to discuss why. This will help some newcomers in computer science and software development industries choose a more suitable programming language. This study can also explore from the perspective of outstanding software development results, by analyzing its advantages for comparison and finding features that MATLAB can optimize.

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