FIT2101

SOFTWARE ENGINEERING PROCESS AND MANAGEMENT

ANALYSIS OF ALTERNATIVES PROGRAMMING LANGUAGES

GROUP 2

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1.0 Summary

The Analysis of Alternatives (AoA) is a documented evaluation of the performance, operational effectiveness, operational suitability, and estimated costs of alternative systems. As web application is chosen as the application platform for the project, therefore this document will focus on the selection of programming languages for backend development to write the server side code. The options of the programming language are identified and the criteria to take into account are well-explained. Each option, which is the possible choice of the programming language used for an application, is then compared and evaluated based on the criteria discussed. The last but the least, recommendations will justify and make the most appropriate decision for the programming language based on the evaluation of each option.

2.0 Terms of Reference

There are a total of three programming languages taken into consideration, namely Javascript, Python and Java. In order to justify the architectural decisions on the programming languages to be used in this project, a number of criteria are taken into account for the selection of the choices.

2.1 Performance

Every language ultimately has to be run by executing machine code. A "compiled" language is parsed, decoded, and translated to machine code only once, at compile-time while an "interpreted" language is decoded at runtime, at every step, every time. Each different compiler/interpreter performs different optimizations on the code itself with different use of programming languages. Only so much of performance can be squeezed out of a program and a platform, with the programming language used in the program development affecting performance. Language choice in which the programs can be developed and executed rapidly should be considered. Additionally, the language which requires less memory for the storage of programs for better performance should be selected.

2.2 Security

By design, web applications cannot be protected by firewalls and they must be available to everyone, all the time, unless they are on an intranet, therefore malicious hackers may exploit them easily. Therefore, since web applications are more susceptible to cyber attacks, choice of programming languages for writing the server side code must provide sufficient security for the web application with the use of frameworks. All languages have quirks that can result in unexpected evaluations of untrusted data, compromising the security of web applications which may cause disruption to the web application itself or loss of user data.

2.3 Web App Development Support

Since web applications are chosen as the application platform for the project, there are limitations on the web app development support of the programming languages. Most programming languages come with their own framework to allow designers and developers to focus on building a unique feature for their web based projects rather than re-inventing by coding. Framework that comes with the programming languages for backend development is specially created to help boost the performance and efficiency of the web app development task. So the web app development support needs to be taken into account for deciding the programming language with full support for web application to ease the development stage.

3.0 Body

After identifying the possible criteria, each choice of the programming languages is then compared against each other in terms of the given criteria.

3.1 Alternative 1: JavaScript

3.1.1 Performance

JavaScript tends to be very fast because it is often run immediately within the client's browser. So long as it does not require outside resources, JavaScript would not be slowed down by calls to a backend server. Not only that, major browsers all support just in time compilation for JavaScript, meaning that there's no need to compile the code before running it. Therefore, using just in time compilation requires less memory usage as only the methods that are required at run-time are compiled into machine code by the JIT Compiler.

3.1.2 Security

Since JavaScript code is executed on the client-side, bugs and oversights can sometimes be exploited for malicious purposes. Javascript may be used to view or steal personal data without anyone even realizing that it's happening. Note that most security vulnerabilities in javascript come as a result of end-user interaction. For example, malicious users can input query strings into forms to access or contaminate protected data.

3.1.3 Web App Development Support

Javascript supports web app development and it is a client-side programming language to make dynamic and interactive web pages by implementing custom client-side scripts. Not only that, Javascript is also a server-side programming language with the use of NodeJs framework that is very popular nowadays so there are many online resources for deploying Javascript on backend development. With JavaScript used both server-side and client-side, it is easier to migrate the code if needed besides allowing code sharing and reuse as both frontend and backend web development involves the use of Javascript.

3.2 Alternative 2: Python

3.2.1 Performance

Python is comparatively slower in performance as it processes requests in a single flow whereas Javascript is faster than python. Python is also slower than Java. The slow performance in Python is also caused by it being an interpreted language that is always slower than direct machine code because it takes a lot more instructions in order to implement an interpreted instruction than to implement an actual machine instruction.

3.2.2 Security

Python is quite good for security purposes as it has a Django framework that comes up with built-in security features, which helps in protecting the application from various sorts of security threats. Python is considered the most secure among the other two options according to research as it is less susceptible to cyber attacks.

3.2.3 Web App Development Support

Python can be used to build server-side web applications with the help of frameworks such as Flask and Django. However, most Python developers still have to write their web applications using a combination of Python and JavaScript. Python is executed on the server side while JavaScript is downloaded to the client and run by the web browser. Therefore, the developers need to master both Python and Django if Python is chosen as the backend language.

3.3 Alternative 3: Java

3.3.1 Performance

Java is generally faster and more efficient than Python because it is both a compiled and interpreted language. Java therefore takes less time to execute a code. However, since Python is an interpreted language, it needs to determine the type of data at run time, making it slower comparatively. On the other hand, JavaScript is indeed relatively faster than Java because interpreters execute the source program code themselves.

3.3.2 Security

Java is considered the least secure server-side programming language in web development compared to Python and JavaScript according to the research. For example, Java is vulnerable to log injection attacks, mainly through web browsers. Although Such attacks can be averted through validation or authentication of submitted input, the validation may make the application less user-friendly.

3.3.3 Web App Development Support

Java is a commonly used language for backend web development with the use of frameworks such as Spring. Java web applications are known as the distributed applications that run on the internet. Java is good for developing large web applications because of its ability to communicate with a large number of systems. Services like peer-web services, database connectivity, and back-end services can also be accessed via Java web development.

4.0 Recommendations

The team decides the use of JavaScript as the programming language for the web application in terms of backend development. In terms of performance, JavaScripts tends to be the fastest as JavaScript does not require outside resources and it won't be slowed down by a back-end server. Besides, most of the major browsers support just in time compilation for JavaScript, offering far better performance than interpreters. Another reason that the team decided on JavaScript is that JavaScript allows easy knowledge sharing within a team as both frontend and backend web development uses Javascript. There is therefore the need for the team to master only Javascript for the web development project for delivering the product to the client. With the use of a popular framework known as NodeJs, there are a huge number of free tools available online to ease the development work.

Although JavaScript may be less secure than Python, the team still justified that JavaScript is the most suitable to be used as the programming language for this application. This is because there are many security measures provided by package managers (such as npm) and security solutions, the security vulnerabilities with the use of Javascript as the programming language for the backend web development may be easily fixed.