



Impact of Python, Java and R on Data Science

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Abstract— The comparison of programming languages can be a common difficulty of communication amongst software program developers. Every year, programming languages are invented, specified, and carried out in an effort to hold up with the existing programming languages used for Data science. To put such disputes on strong ground, we ought to first recognize how distinct language factors are different from one another. This paper is a comparative study of python, java and R. The impact of these languages on data science is analyzed to understand the scope of these languages.

INTRODUCTION

Data science uses science and technology, procedures, algorithms, and systems to extract information and insights from noisy structured and unstructured data, bringing that knowledge and practical insights to a variety of application areas. According to Turing Award-winning Jim Gray, Due to the effect of information technology, data science is the fourth paradigm of science (empirical, theoretical, computational, and now data-driven). Everything in the course of research is evolving.^[1]

R for Data Science is a programming language that may be used for statistical analysis and other tasks^[2]. As a programming language, R provides objects, operators, and functions that allow users to explore, model, and visualize data. Data analysis and statistical modeling are also possible applications^[3]. Java is an object-oriented, versatile, unique language that offers a myriad of features. Compiling object-oriented, platform-independent Java compiles into platform-independent bytecode rather than a platform-specific engine and lastly, the Python language structure and

object-oriented approach are intended to allow programmers to write clear and logical code for small and large projects. Python provides great capabilities for processing math, statistics, and scientific functions.

I. IDE'S USED FOR PYTHON, JAVA, AND R LANGUAGE

An integrated development environment (IDE) is software for developing applications that combines the common developer tools right into a single graphical user interface (GUI).^[16] A source code editor, build automation tools, and a debugger are all standard components of an IDE. One of the objectives of the IDE is to lessen the measure of setup required to put together various development utilities by providing the same set of features as a single coherent unit. Reduced setup time can boost developer productivity, especially when learning to use the IDE takes less time than manually integrating and learning all of the different tools.^{[4][5]}

A. IDE's For R Language

1. RStudio:

RStudio was developed by RStudio Inc., which was founded by JJ Allaire. There are two types of RStudio: RStudio Desktop, which runs locally as a desktop program, and RStudio Server, which provides access to RStudio through a web browser while running remotely on a Linux server.

2. R Tools for visual studio:

As a sophisticated IDE for programming, Visual Studio has provided R programmers with a great experience. Recently released, RTVS is

Microsoft-provided software under the free open source MIT license that allows you to take advantage of IDE features when writing R scripts.

3. Rattle:

Rattle is a well-known graphical user interface for data mining written in the R programming language. You can model and manipulate data from supervised and unsupervised machine learning models, and view visual data summaries and statistical statistics.

Rattle's main feature of recording GUI interactions in R scripts that can be run independently in R is its elegance.

you can use it to master R skills and fine-tune your model with Rattle to R for more advanced data modeling capabilities.

4. statET for R:

StatET is an Eclipse-based R programming IDE. It provides an unparalleled collection of tools for R code creation and package development. The integrated R console, object browser, and R help are also some features, as are support for multiple local and remote installations. Because StatET is an Eclipse IDE plug-in, it can be combined with a variety of other tools built on the Eclipse platform. StatET is open-source software that runs on most operating systems.

5. ESS:

Emacs peaks Statistics (ESS) is a GNU Emacs add-on package. The ESS is designed to simplify scripting and interface with statistical analysis software such as R, SPlus, SAS, Stata, and OpenBUGS JAGS. ESS is useful for specialists looking at text-based scripts on a variety of operating systems. It has a more advanced graphical user interface than the.

In addition to supporting multiple statistics programs, ESS supports keyboard shortcuts, abbreviations, code formats, syntax highlighting, comments, script submission, and result display.^[6]

B. IDE's For Python Language

1. IDLE:

When we install Python, IDLE is set up by default. This makes it simple to get started in Python. It consist of the Python shell window(interactive interpreter), auto-completion, syntax highlighting, smart indentation, and a simple built-in debugger are one of the main features.^[7] IDLE is a great

However, it is not ideal for large tasks.

2. Sublime text3:

Sublime Text is a popular code editor that supports a variety of programming languages, including Python. Fast, highly customizable and has a large user base. The installation comes with minimal Python support. You can install packages for debugging, autocomplete, code linting, and more. Django, Flask, and other scientific development programs are also available. Basically, you can configure Sublime Text to create a full-featured Python workspace based on your needs. Sublime Text can be downloaded and evaluated for a long time.

3. Atom:

Atom on Github is an open-source code editor that you can use for Python programming. Autocompletepython, linterflake8, pythondebugger, and other widely used Atom Python development tools include autocompletepython, pythondebugger, and more.

From a Python development perspective, I prefer Atom to Sublime Text.

4. Thonny:

Thonny is a Python-specific IDE that includes Python 3. After installing, you can start writing Python code. The user interface is kept simple so beginners can get started quickly. Although the

Thonny is designed for beginners, it has many useful features that make it a great IDE for serious Python development.

You can take advantage of syntax error highlighting, debugger, code completion, step-by-step expression evaluation, and other features.

5. Pycharm:

JetBrains, known for creating great software development tools, invented it. PyCharm has two flavors. The community is a lightweight, free open-source version suitable for Python and scientific development. Professional is a full-featured premium version of the IDE that also supports web development. PyCharm has all the important features you need for a proper IDE, including code completion, code inspection, error highlighting and correction, debugging, version control systems, and code refactoring. Personally, PyCharm is my favorite Python programming IDE. The only big criticism I've heard about PyCharm is that it consumes a lot of resources. If you are using a computer with limited RAM, you may experience delays.^[7]

C. IDE's For Java Language

1. Eclipse

Eclipse is one of the most widely used Java development environments (IDEs) on the market. The Eclipse

IDE is available in both desktop and cloud versions. In the cloud version, developers can program from a web browser.

Eclipse is the top choice for its development tools. Eclipse provides an Eclipse marketplace with a large number of downloadable plug-ins and a plug-in development environment that allows developers to create their own functionality. Eclipse provides support for over 100 programming languages, including JavaScript, Groovy, and Scala, as well as a comprehensive set of modeling, diagramming, and testing tools.

2. NetBeans:

As the official Java 8 IDE, Apache NetBeans is the leading Java IDE for developing desktop, mobile, and web applications. NetBeans is an open-source tool for developing desktop, web, mobile, HTML5, and C apps. NetBeans makes it easy to customize your software program by highlighting Java code syntactically and semantically.

NetBeans' robust refactoring and debugging capabilities help improve accuracy and efficiency.

3. IntelliJIDEA:

IntelliJ is the best IDE for Java programming. This includes a set of programming tools such as smart completion, cross-language refactoring, data flow analysis, and language injection. IntelliJ comes in two formats: the community version licensed by Apache2 and the proprietary Ultimate Edition. The community version is open source and free, with a focus on Android and Java virtual machine development. Premium edition focused on online and business development is paid.

4. BlueJ:

BlueJ is a great Java IDE for beginners, but many Java veterans prefer BlueJ for its interactive and clean interface. BlueJ supports simple object interactions and has a powerful editor that allows developers to visually analyze their code to create dynamic objects. BlueJ is a state-of-the-art Java IDE with features not found in many other features. B. Scope coloring, chords pad, object bank. The BlueJ is portable and works with a variety of operating systems.

5. Oracle J Developer:

Provides capability for growing programs in Java, PHP, SQL, XML, HTML, and JavaScript Works with the Oracle Application Development Framework to simplify development. JDeveloper has a visual and declarative editor that allows developers to modify their applications directly from the programming environment. JDeveloper has drag-and-drop capabilities that simplify application development.^[8]

II. FEATURES OF PYTHON, JAVA, AND R

R: HIGHLY-VALUED BY DATA SCIENTISTS

R is a famous programming language amongst information scientists. R is one of the most famous languages for information analysis. It was created via the means of statisticians as an open-supply opportunity to costly statistical software program applications like SAS and MATLAB. R is a procedural language, this means that it executes programming responsibilities the use of a succession of step-by way of means-of-step sub-workouts in preference to object-oriented programming languages like Java or Python. Procedural programming has the advantage of offering a clean perception of complex movements with several dependencies, that's beneficial for plenty of information-processing jobs. Java: Scalable Speed Java is a strong, portable, and scalable era that is right for growing enterprise-scale packages and assisting fast expansion.

PYTHON: BUILT FOR FLEXIBILITY

Python's different important distinctive feature is its big library of functions. This lets it perform a huge variety of jobs. The applications NumPy and matplotlib, in particular, permit Python to execute lots of MATLAB's analytical and charting functions. In a nutshell, Python is a pass among R and Java, combining the former's intricacy with the latter's velocity and scalability.

JAVA: SPEED AT SCALE

These tools, while used together, make Java coding less difficult and help improve in any respect levels, offering builders all they want to create Java internet structures and apps. Because of its speed, Java may also outperform different languages and frameworks, which is one of the motives it's so nicely proper for large-scale applications. The advantage of Java is that, it is as near to 100 percent object-oriented as we can go. All of the benefits of object-oriented programming are included, which include simplicity of improvement, modular software, flexibility, and extensibility.^[9]

IV. Comparison Between Python, Java, And R

R excels in statistical evaluation. R changed into created through statisticians for statisticians, so it's no marvel that it is well-applicable to in-intensity statistical evaluation, whether or not you are operating with sensor information from an IoT tool or complicated monetary models. Furthermore, the information network backs it up with the CRAN library, which actually gives loads of programs that assist you to execute extra complicated evaluation and visualization jobs. In those cases, information scientists might often prototype in R earlier than shifting directly to an extra bendy language together with Java or Python for product development.

On large-scale systems, it plays fantastically well. Java's velocity makes it best for building large-scale systems. While Python is appreciably faster than R, Java outperforms Python in terms of velocity. Because of its speed and scalability, Java is the backbone of record engineering efforts at Twitter, LinkedIn, and Facebook.

Development Time is Reduced. The Java Virtual Machine (JVM) is an exceptional platform for difficulty imposing bespoke tools. Visualization and statistical modeling. Java is certainly the least suitable for the severe exams of the 3 languages. Although there are programs that offer a number of those functions, they aren't as state-of-the-art or broadly supported as the ones for Python and R.

Integration of labor processes. Python is a famous preference amongst builders who want to apply statistical strategies or information evaluation of their work, in addition to information scientists whose responsibilities should be incorporated with internet websites or manufacturing settings. Python has a tremendous opportunity if you're trying to find a single device to manipulate your whole information-associated activity.

Python is ideally fitted to growing state-of-the-art fashions and prediction engines that plug at once into the manufacturing machine due to its mixture of professional devices studying libraries (like scikit-learn, PyBrain, and TensorFlow) and fashionable motive flexibility.

Data jobs that want an excessive degree of expertise. Despite the truth that the Python network is catching up, there are nonetheless loads of R applications without Python counterparts. You will be higher off the use of R if you're in search of especially unique features.^[9]

V. Frameworks Used For Python, Java, And R

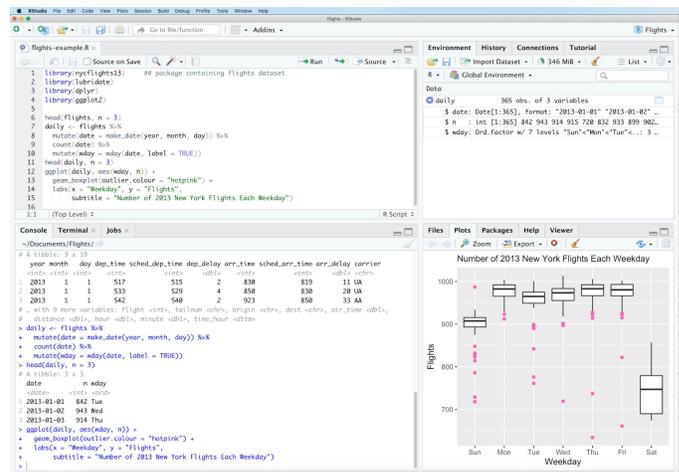
FRAMEWORKS FOR R

1. Beakr:

beakr is a little package and basic web framework for constructing simple and reliable online services rapidly. It is simple and stable to set up, with a very concise syntax.

2. Plumber:

Plumber is a tool that allows you to construct a web API by using specific decorator comments in your current R code. It only takes a decorative comment to reveal endpoints and is supported by RStudio provides assistance.



R framework : plumber^[22]

3. Ambiorix:

Ambiorix is an unprejudiced web framework package for R that is intended to be versatile and expandable.

Features:

Extensions (Generators template extensions, CLI support)

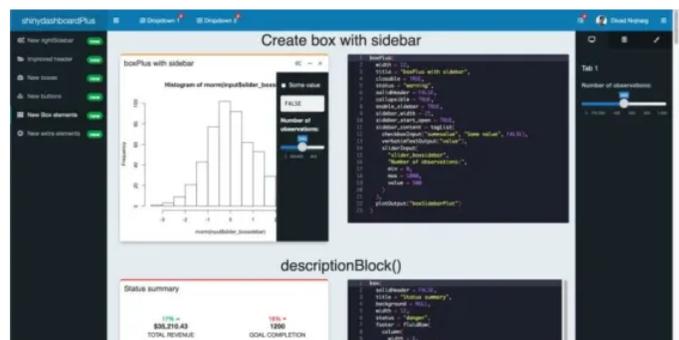
Websocket support

4. Fiery:

Fiery is a lightweight and adaptable framework for constructing web servers in R with precise control. It has complete control over server life-cycle events and is compatible with Design which is modular.

5. Shiny:

Shiny is a full-suite package that makes it simple to create interactive web apps directly from R. This bootstrap GUI API is included and is a common alternative supported by RStudio.^[10]

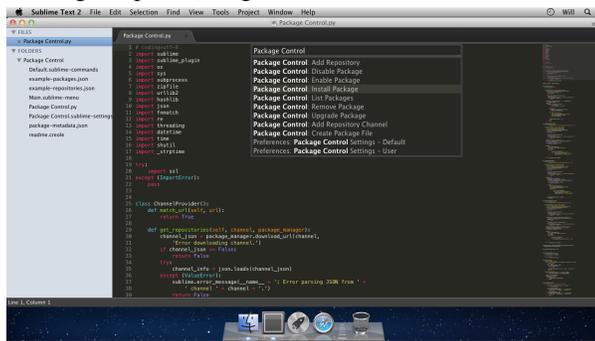


R framework : shiny^[23]

FRAMEWORKS FOR PYTHON

1. Django:

Django is a free and open-source full-stack Python framework that comes with all of the essential capabilities by default. The following are some examples of django web framework Features: Authentication, Routing of URLs, Engine for creating templates, Migrations of ORM Database Schemas

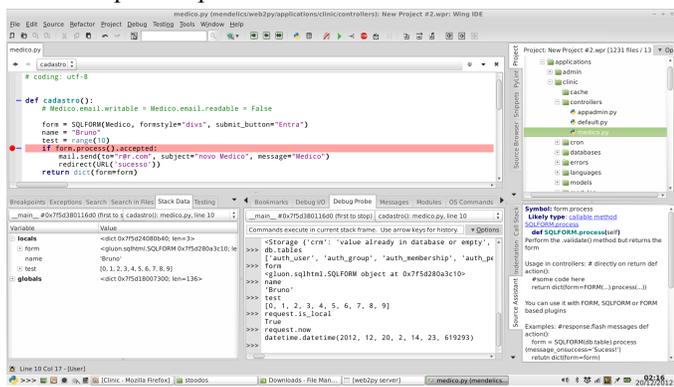


python framework:Django^[24]

2. Web2Py:

Web2Py is a full-stack framework that is open source and scalable. It does not support Python 3 and has its own web-based IDE with a separate code editor, debugger, and one-click deployment.

Web2Py framework features: It has no requirements for installation or configuration. It is capable of running on a variety of systems. As an example, consider the operating systems Windows, Mac, and Linux. It has the capacity to read numerous protocols. Web2Py protects data from vulnerabilities such as cross-site scripting, SQL injection, and other malicious attacks. It has a tool for recording errors via an error logging and ticketing system. There is also a role-based access restriction. Backward compatibility provides user-oriented innovation without the need to sever relationships with previous versions.

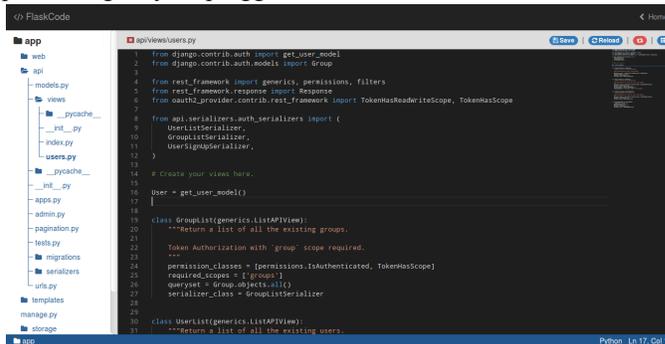


python framework:Web2py^[25]

3. Flask:

Flask is a small framework. It is lightweight, and its modular architecture allows it to be quickly adapted to the demands of developers. It comes with the following features out of the

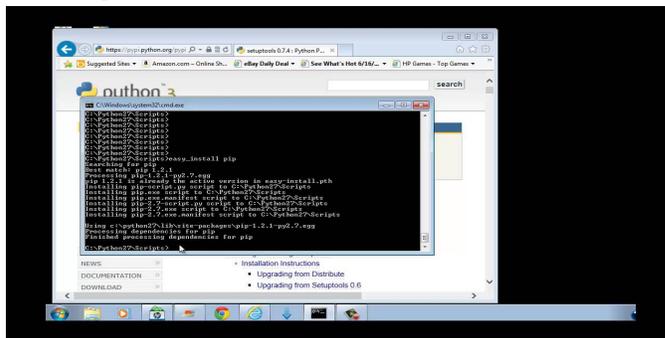
box: Integrated development server, A quick debugger, Support for unit testing is built-in. Request dispatching with RESTful API, Jinja2 template creation, Support for secure cookies, WSGI compliance based on Unicode Any ORM HTTP request processing may be plugged in.



python framework : Flask^[27]

4. Bottle

Bottle is a micro-framework that was designed to construct APIs. It implements everything in a single source file. Apart from the Python standard library, it has no dependencies. The following are the standard features: Templating Routing, Form data, file uploads, cookies, headers, and so on are all accessible. Overlay abstraction layer on top of the WSGI standard. A development server that works with any other WSGI-capable HTTP server.



python framework: Bottle^[26]

5. CherryPy

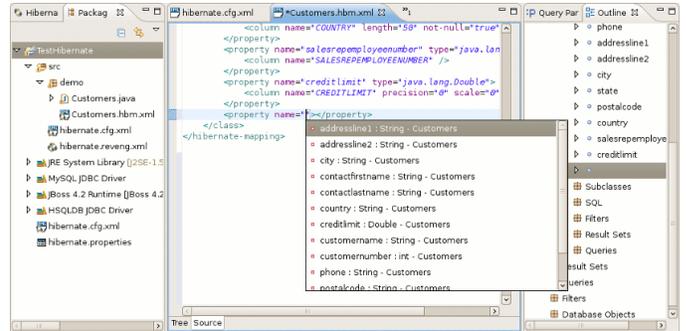
CherryPy is a free and open-source Python framework. It takes a minimalist approach to develop web apps. It is akin to constructing an object-oriented programme while creating web apps. CherryPy enables us to leverage any sort of technology to create templates and access data. It can still manage sessions, cookies, statics, file uploads, and anything else that a web framework can. The following are some of CherryPy's important features: A thread pooling web server that is HTTP WSGI compatible. It offers the advantage of being able to run many HTTP servers at the same time. A versatile plugin system Caching \ Encoding \ Authentication Profiling, coverage, and testing are all built-in. Capability to run on a variety of platforms.^[11]

productivity and

mobility. Hibernate is free and open source. Giving it a shot on your next project won't break the bank.

3. JSF (JavaServer Faces)

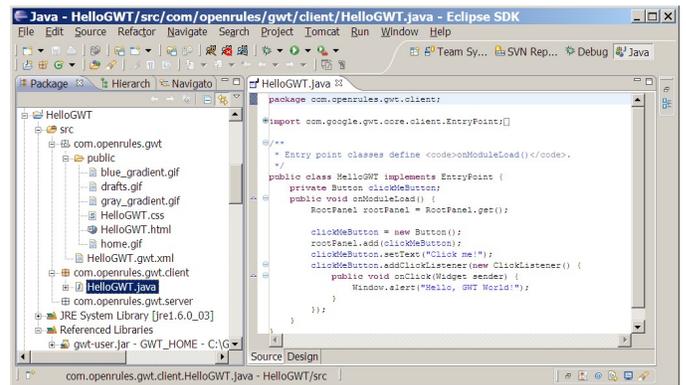
Back-end developers frequently face enormous challenges when it comes to getting the front end of complicated programmes properly. JSF comes in handy in this situation. Typical benefits of adopting JSF include, but are not limited to: JSF is a significant component of Java 2E. It's here to stay and has a lot of backing. Back-end developers have a plethora of front-end technologies at their disposal that do not need any code.



java frameworks:JSF^[30]

4. GWT (Google Web Toolkit)

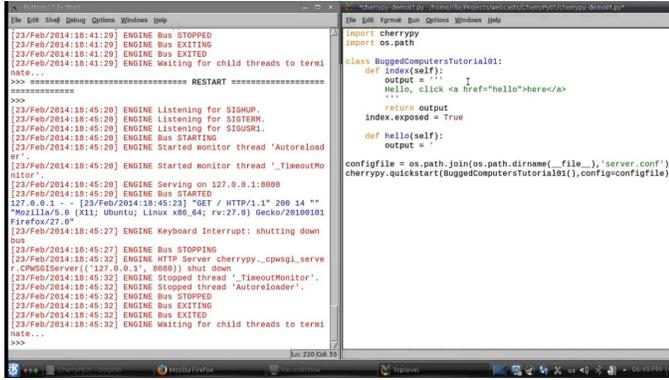
GWT is open source, as one would expect from a Google product. The fact that it is simple to create stunning UIs with no experience in front-end scripting languages is why many developers begin their work with GWT. It essentially converts Java code to browser-friendly packages. Here are some of the benefits of utilizing GWT: It serves as a link between back-end and front-end development. When deploying apps online, cross-browser interoperability comes in useful. Google APIs are easier to implement with GWT, and there are a lot of them.



java framework:GWT^[31]

5. Struts

Struts is an enterprise-level framework that runs on Apache and is ideal for web developers. It has a lot of features and comes in two versions: Struts 1 and Struts 2. The most popular

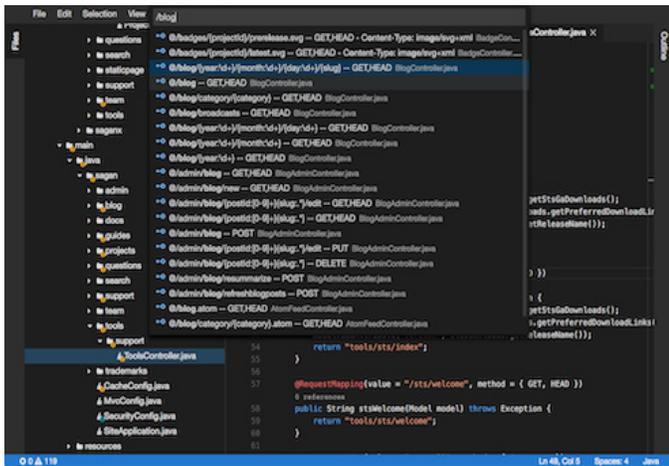


python framework:CherryPy^[28]

FRAMEWORKS FOR JAVA

1. Spring

Spring is a relatively lightweight Java framework implementation that may be used for almost any form of Java project. It's a modular framework that may be used to any level or layer of a project. What distinguishes it is that you may utilize it to work on not just one layer of a project, but the full span. The following are some of the benefits of adopting the Spring Java framework: It's lightweight and doesn't require anything other than the default container as a web server. It allows for backward compatibility. It supports an annotation-style setup.

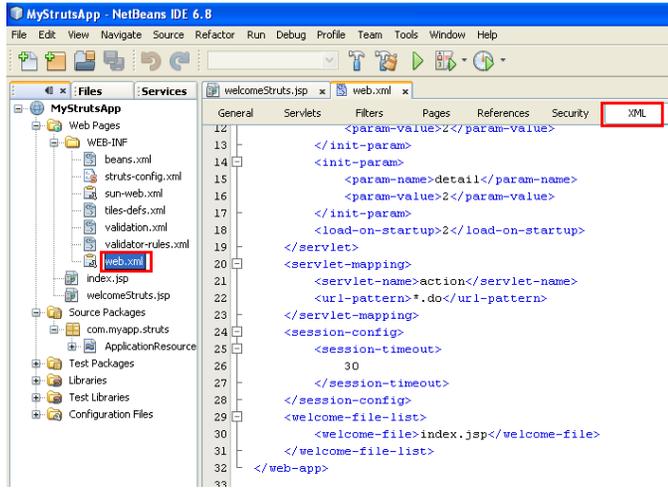


java frameworks:spring^[29]

2. Hibernate

Hibernate is an object-relational mapping (ORM) framework that eliminates frequent data handling mismatch scenarios. If you often work with relational databases, the Hibernate ORM framework might quickly become your go-to. The following are some of the benefits of utilizing Hibernate: There is the capacity to manipulate large amounts of data with little code. It's ideal for OOP applications that demand both great

is Struts 2, which effectively expands the earlier version with all of the OpenSymphony web framework features. The following are some interesting benefits of utilizing the Struts Java framework: Struts integrates smoothly with other frameworks. You may bring what you're already working with and increase Struts' capabilities. You'll notice a significant reduction in development work and time, allowing you to create more apps more quickly.^[12]



java framework:struts^[12]

root cause of these failures. Local building datasets can also be examined in relation to these research concerns. Build Corruption Prediction attempts to determine if a particular build will fail as soon as possible. This minimizes wasted time for developers and avoids potential timeouts.

Local build log datasets can help improve similar techniques. Data 2020, 5, 86 10 of 11 Overall, improving the quality of build systems is relevant, from decompiler studies that require compiled bytecode [25] to empirical studies of program comprehension. It may lead to progress in the research field. Compilable projects use objects as research. object. Our dataset is relatively simple and contains both structured and unstructured data, so it can be used in data science education as a sample software engineering dataset. This can lead to a symbiotic relationship between data science and software engineering education.

The source code for the dataset is available so you can reuse and update your research on the set of projects it contains, the file patterns used to discover the technology, the execution environment, and the analytical process. The features of Python are: Python is simple and beautiful. This is a very high-standard language with multiple learning resources. Python has a variety of third-party tools that make it easier to use and allow users to continue using Python.

As a program written in other languages such as C ++, Java, C #, Python programs are much easier to read and write. Python applications can be run from one platform to another without changing them. It works perfectly on almost all platforms such as Windows, Mac OS X, and Linux.^{[13][14]}

VI. APPLICATIONS:

Python is used to implement cryptographic functions that include various techniques for building secure applications (Vidya, S., 2016). Python is widely used in science and numerical computing, including SciPy for mathematics, science, and engineering, Pandas for data analysis and modeling, and IPython for convenient editing and recording of work sessions. Enables ing. Education The current education system requires numerous tools for learning, education, and management. These tools can be developed using the Python programming language (Arvind, K., 2017). Other platform-specific toolkits are available that support Linux, Windows, and macOS running Python 3.5 and above and PyPy3. Python is used to create controlled and managed software that uses SCons, Buildbot, Apache Gump for automated continuous compilation and testing, and Roundup or Trac for problem tracking and project management. increase.

In Business applications, Python is also used to build ERP and e-commerce applications. Tryton is a high-level, three-tier, general-purpose application platform, and Odoo is an all-in-one enterprise management application management software. Since the 2020 version has a high rate of build failures, it is important to research direction to identify the

VII. ADVANTAGES AND DISADVANTAGES

R

ADVANTAGES:

R is a computer language and software environment for statistical computation and graphics that is free and open source. A data handling and storage facility that is efficient. A set of operators for doing calculations on arrays, specifically matrices. A vast, cohesive, and integrated set of intermediate data analysis tools. Graphical tools for data analysis and presentation, either on-screen or in hardcopy. A well-developed, simple and effective programming language with conditions, loops, user-defined recursive functions, and I / O functions.

DISADVANTAGES:

R is associated with the much older "S" programming language. This indicates that the base package does not support dynamic or 3D graphics. R programs such as Ggplot2 and Plotly can be used to create dynamic 3D and animation visualizations. This feature is required by most programming languages, including Python. This can easily be addressed

with data management products and Hadoop integration. R packages and R programming languages are significantly slower than languages such as MATLAB and Python. The R algorithm is divided into many packages. Building an algorithm can be difficult for programmers who do not understand the package in advance.^[20]

PYTHON

ADVANTAGES:

Python's ease of use and simple syntax make it easy for people with no technical experience to adopt. This is one of the main reasons why Python is so widely used in academia and research. This program is open source, so anyone can use or modify it without any restrictions. Supports object-oriented programming to help develop reusable components. These objects are associated with properties and methods. It also allows inheritance. This allows one class to inherit all the attributes and methods of another class. Supports object-oriented programming that supports reusable components in developing reusable components. These objects are connected to properties and methods. They also enable inheritance and classes of all attributes and methods of all other heirs. Because it uses an interpreter compiled to assemble into a machine code, it has a very fast execution speed. As a result, it is not delayed in the execution of the software. Python is platform-independent.

DISADVANTAGES:

Python does not support traditional design patterns such as MVCs. This may feel uncomfortable to some developers. However, you can detect your own design pattern by protecting best practices. Python has no database management system. You can always install MySQL DB modules to link requests to the database. If you want to create a LargeScale web app, you may encounter memory social problems. Python also has an insufficient native thread function, so you need to rely on the multiprocessor library. Safety is a recent great concern with the latest Wannacry attack. Python's security features are not enough to prevent attacks such as SQL injection. Python exists on many desktop and server platforms but is considered an unsuitable choice for mobile computing. For this reason, only a few mobile applications like Carbonnelle are integrated. 'Diehard Pythonites' is so familiar with its features and rich libraries that it is difficult to master or master other programming languages. Python runs using an interpreter rather than a compiler, which slows down Python because it requires compilation and execution to work properly. As a result, it runs slower than the compiled language because it uses bytecode instead of machine instructions.^[19]

JAVA

ADVANTAGES:

Java is simpler to use, develop, build, debug, and comprehend than other programming languages. Java is an object-orientated programming language that helps you write standard programs and reusable code.^[21] Java is platform-independent. This means that the JVM must be on your computer, but the code can run on any system without any additional software installed. Java applications are cheap to design and maintain because they rely on a specific hardware infrastructure to function. Java offers users a very powerful advantage by providing the platform with an agnostic feature called Write Once Run Anywhere (WORA). Java compiled or bytecode is platform-independent and can be run on any machine regardless of the operating system. Java is a high-level programming language in a human-readable format.

DISADVANTAGES:

Java consumes a lot of memory and is much slower than native languages such as C and C. Java is primarily related to storage and does not prioritize backing up data. Java requires a significant amount or a significant amount of memory. Memory efficiency and system performance can be adversely affected while the trash collection is running. Java code is verbose. In short, Java code contains many words that are difficult to read and understand, as well as long, complex statements.^{[17][18]}

VIII. CONCLUSION:

For large-scale systems, the Java programming language is ideal. When **those 3** languages are **in comparison** for large-scale systems, Java comes out on top. When statistical techniques or facts evaluation strategies are required, python may be used to combine those skills with the manufacturing surroundings or internet apps. When managing precise facts, though, you could desire to keep away from the usage of Python. If you need to do a closer statistical study, R is the manner to go. If you're coping with IoT gadgets or another complete economic model, the CRAN repository has a wealth of applications that can help you in undertaking through visualization and analytical activities. If you are in search of first-rate performance, large-scale data, and learnability, R is not an excellent choice. As you can see, every programming language has its very own set of blessings and disadvantages. You should first recognize your necessities to be able to select what is good for your requirements.

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