

**ANALYSIS OF PROGRAMMING LANGUAGES USED IN ARTIFICIAL INTELLIGENCE SYSTEMS**

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**Abstract:** This in the article artificial artificial intelligence (AI) systems in creation wide applicable programming languages, their functional opportunities, advantages, disadvantages and practical application field analysis During the research Python, Java and like C++ languages in SI systems place by comparison studied. Analysis results artificial intellect systems efficiency and programming languages choice between directly dependency existence confirms.

**Key words:** Artificial intelligence, Python, Java, C++, Machine learning Learning, Programming languages, Neuron networks.

**Login.** Last in years artificial intellect technologies various in the fields wide programming as a result of application of languages functional opportunities deep study necessity increasing Modern SI systems big in size information again work, prediction to do, with complex algorithms work and the system to study based functions to do ready to be need. In this chosen programming language efficiency, convenience, libraries availability and performance to the speed according to difference does. Scientific in sources artificial in intellect applicable programming languages often following to groups is separated:

Programming language	Scientific in sources definition	Purpose
Python	The most wide widespread language as is evaluated	Mechanical learning, deep learning
C++	High to efficiency has	Real time systems, robotics
Java	To the platform related not been universality with separates	Corporate SI systems
R	Statistical analysis strong	Data science and scientific accounts
Julia	Fast worker computational language as is described	Scientific modeling, mathematics optimization

Artificial intellect according to international research In 65–75% of cases, Python main language as to be selected shows. R is statistic in modeling to advantage has.

**Scientific research works analysis**

Python artificial intellect in the field wide to use following factors reason will be:

Advantage	Note

Advantage	Note
<b>Simplicity and ease syntax</b>	Code readability easy is complicated mathematician to models attention to focus opportunity gives.
<b>Strong libraries ecosystem</b>	NumPy, TensorFlow, PyTorch such as libraries computing and neural networks to build makes it easier.
<b>Wide community and documentation</b>	Lots to learn courses, forums and technical sources there is.
<b>Flexibility</b>	Like Python Data Science, Machine Learning, Deep Learning, NLP, Computer Vision in directions works.
<b>Cross-platform compatibility</b>	On Windows, Linux, MacOS, Raspberry Pi devices works.

Python's Basics for AI libraries:

### 1. NumPy and Pandas — Data with work

- **NumPy** big in size arrays with optimized for performance.
- **Pandas** and statistic information analysis making and structural table in appearance to work help gives.

These libraries mechanical study before information in preparation wide is used.

### 2. Scikit -Learn — Machine learning study

Scikit -Learn follows algorithms supports:

- Regression ( Linear, Polynomial )
- Classification (KNN, SVM, Random Forest
- Clustering (K- Means, DBSCAN)
- Model evaluation and optimization

This library mechanical of learning classic for the most methods popular is a tool.

### 3. TensorFlow and PyTorch — Deep study

Library	Advantages
<b>TensorFlow ( Google )</b>	Large projects, GPU and TPU support, Keras integration

Library	Advantages
PyTorch ( Meta AI)	Scientific experiments, flexible architectures, NLP and Computer In Vision strong

This tools using convolutional (CNN), recurrent (RNN, LSTM) and transformer models create possible.

#### 4. OpenCV — Computer see

Python using following systems are developed:

- Face determination
- The numbers recognition (OCR)
- Object detection and tracking
- Videos analysis

#### 5. NLTK and SpaCy — Natural the language again performance (NLP)

This through libraries:

- Text tokenization to do
- Language analysis to do
- Chatbots create
- Sentiment analysis
- Machine Translation such as tasks is done.

**C++ 's suitability for AI.** C++ 's artificial in intellect wide to be used following factors reason will be:

Advantage	Note
Quick work	C++ compilation to the language belonging to be, to be fulfilled speed is incredibly important for AI algorithms important.
Memory management capabilities	Developer resources at hand manages, this robotics and IoT in systems necessary.
Many platform	Windows, Linux, macOS, real-time OS (RTOS) systems works.
Wide libraries existence	TensorFlow C API, OpenCV, MLpack, Shark AI libraries like there is.
High-Performance Computing (HPC)	Scientific computing and neural networks networks in optimization is applied.

**C++ in AI fields main libraries:**

**1. OpenCV — Computer see**

OpenCV is based on C++ and includes the following in tasks wide applies to:

- Face and object determination
- Biometric identification
- Videos the flow realistic time analysis
- Autonomous transportation systems

**2. TensorFlow C++ API**

TensorFlow main core exactly in C++ written is, to the following opportunity gives:

- Ready neuron networks fast use
- GPU and TPU optimization
- Real- time model inference to systems integration to do

This technology robotics, medical analytics, self-driving ( autopilots ) and safety in systems is applied.

**3. PyTorch C++ Frontend ( LibTorch )**

LibTorch industry in AI systems at the level is used.

Examples:

- Interpretation algorithms
- Again learnable agents (Reinforcement Learning)
- Game AI and simulators

**4. MLpack and Shark**

Library	Application field
MLpack	Fast working ML models, regression and classification
Shark ML Library	Neuron networks, clustering and optimization

**AI directions of C++ Application:**

**1. Robotics**

C++ with ROS (Robot Operating System). the most many used language. Autonomous robots from sensors arrived information high at speed again works.

**2. Real time systems**

Car industry, drones, IoT on devices delay minimum to be demand Python such in systems slower, so C++ is preferable.

**3. To the game based AI**

Game engines ( Unity, Unreal Engine ) in AI systems user movements prophecy, NPC logic and graphics optimization implemented in C++ is increased.

**Java programming The suitability of the language for AI** is as follows. Java features because of artificial intellect in systems applies to:

Advantage	Note
To the platform related not (JVM)	One times written program all on platforms works.
Safe architecture	Automatic memory management (Garbage Collection) and

Advantage	Note
	safe code to the structure has.
Wide libraries	Weka, Deeplearning4j, Neuroph AI libraries like there is.
Big convenient for systems	Banking systems, corporate AI, servers, Big Data platforms is applied.
Many flowing performance (Multithreading)	Neuron computing and real- time convenient for systems.

**Java -based AI libraries:**

**1. Deeplearning4j (DL4J)**

Deeplearning4j — on the Java platform deep study models to create intended the strongest from libraries is one.

His possibilities:

- CNN, RNN, LSTM, GAN models create
- GPU support
- Hadoop and Spark with integration

DL4J more industry in AI projects at the level is used.

**2. Weka — Machine Learning study**

Weka information Convenient for analysis, classification, regression, clustering, and visualization tool is:

- ML models without using Python or C++ create opportunity gives.
- Training processes, scientific Suitable for research and data mining.

**3. Apache Mahout**

Apache Mahout is big with data (Big Data) worker mechanical study platform is:

- Spark and Hadoop with integrated
- Recommendation systems ( Recommendation System )
- Clustering and classification algorithms uses

**4. Neurology**

Light neuron network framework education processes and prototyping is used.

**Java in AI directions Application:**

**1. Big Data and AI integration**

with Hadoop, Spark and Kafka integrated because of, big information on in working AI systems leader is considered.

Examples:

- Bank risk analysis
- Insurance prediction
- Marketing and recommendation systems

**2. Natural the language again performance (NLP)**

Using Java following systems are developed:

- Chatbots ( Stanford NLP, OpenNLP )
- Text sentiment analysis
- Machine translation

**3. Automated systems and IoT**

Java realistic time systems and IoT AI models on their devices suitable for use.

**Results and discussion**

Research this showed that:

Languages	Learning ease	Speed	Library support	Compatibility for AI
Python	Very high	Medium	Very high	Very suitable
C++	Low	Very high	Medium	Special in the fields suitable
Java	Medium	High	High	Suitable
R	Medium	Medium	Very good for statistics high	Special
Julia	Medium	Very high	Medium	In the field of scientific AI suitable

**Conclusion.** To the results of the study according to, artificial intellect in creation used programming language choice directly of the project purpose, efficiency on demand and processing given information type depends on. Python today's on the day the most suitable universal language as Although recognized, C ++, Java such as languages also his/her own clear in the directions high result gives. Artificial intellect systems development with programming of languages also improvement continue will reach.

**Used literature**

1. Goodfellow I., Bengio Y., Courville A. Deep Learning. MIT Press, 2016.
2. Russell S., Norvig P. Artificial Intelligence: A Modern Approach. 4th Edition, Pearson, 2021.
3. Chollet F. Deep Learning with Python. O'Reilly Media, 2022.
4. Steele J., Patterson J. Python for Data Science. Springer, 2020.
5. Wickham H. R for Data Science. O'Reilly, 2019.
6. Karpathy A. Research Papers & AI Engineering Principles, 2024.