



IJRASET

International Journal For Research in
Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 11 **Issue:** XI **Month of publication:** November 2023

DOI: <https://doi.org/10.22214/ijraset.2023.56446>

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C vs Python: A cursory Look with Industry Opinion

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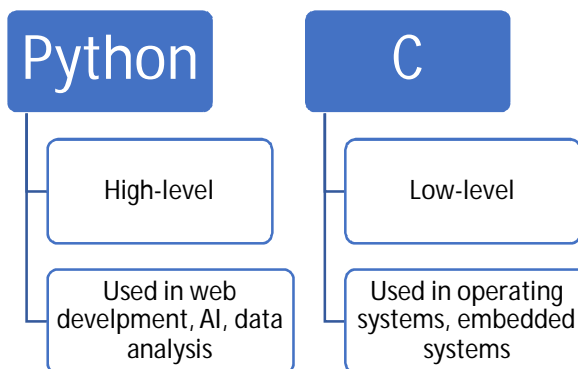
Abstract: In this paper, the author explores the characteristics and applications of C & Python programming languages across various industries, drawing insights from interviews with professionals. The study includes a comparative analysis of C and Python based on execution time, code readability, and length. C, favored for its speed and applicability in game development and embedded systems, has complexities such as large code size and lack of cross-platform support. In contrast, Python excels in artificial intelligence, machine learning, and web scraping due to its simplicity and extensive libraries. The article emphasizes the influence of programming communities on language popularity, noting Python's widespread adoption due to its concise syntax and strong community support. Industry experts concur on C's complexity and time-intensive nature but acknowledge its effectiveness. Python's ease of learning has made it the world's most widely used language, prompting non-coding sectors to encourage Python education.

Keywords: C, Python, IT Industry, Data Structures, Arrays

I. INTRODUCTION

Computers only understand binary language i.e., 0's and 1's. For a computer to understand human written language, it must first be translated into a computer-understandable language first. There is a medium that translates human thoughts or language into machine/computer understandable language which is called a programming language. A programming language can be classified into mainly two types- (a) High-level language and (b) Low-level language.

In this paper, author will focus on C which comes under low-level language but is also considered the “mother” of many modern programming languages due to its influence on their development; and Python which is a high-level programming language. Python is very easy to understand, has a shorter syntax, dynamically typed i.e., one should not have to declare data types. Python is best suitable for a big feed data or a very complex data, it is very easy for Python to interpret complex code.



A. C: [1][2][3]

C is a general-purpose programming language created by Dennis Ritchie at the Bell Laboratories in 1972. It was mainly developed as a system programming language to write the UNIX operating system. It is a very popular language, despite being old. Most beginner programmers ask the question, “Why should we learn this old (C language) programming language?”. The answer to the question is rather very simple, i.e. as it is one of the oldest programming languages many later languages have borrowed the syntax/features directly or indirectly from C. So, if a person learns C programming first, it will help them to learn any modern programming language as well. Learning C helps to understand a lot of the underlying architecture of the operating system.

Applications of C

The development of system software and desktop applications is mostly accomplished via the use of C programming. Some of the examples of C programming languages are as follows.

- 1) *Operating Systems*: A high-level programming language built in the C programming language was used to construct the first operating system, which was UNIX.
- 2) *Graphical User Interface (GUI)*: As everyone must have heard of Adobe photoshop. It was created with the help of C. It was also used for developing Adobe Illustrator and Adobe Premiere.
- 3) *Gaming and Animation*: C programming language is based on a compiler and is thus far quicker than Python. Some of the most basic games, such as the Dino game, Tic-Tac-Toe, and the Snake game, are written in C programming languages.
- 4) *Design of a Compiler*: You can widely use the C programming language to develop compilers, one of its most popular applications. Many other languages' compilers were created with the connection between C and low-level languages in mind, making it easier for the machine to grasp what was being written. Many prominent compilers, such as Clang C, Bloodshed Dev-C, Apple C, and MINGW, were developed with the C programming language.
- 5) *Numerical Analysis*: As C is faster than Python, numerical analysis, simulations, and scientific computing is much easier and faster.
- 6) *Aerospace and Defence*: C is used for developing safety-critical software in aerospace and defence applications like radar systems.

B. Python [4][5][6][7]

Python is a popular programming language that was created by Guido van Rossum, and released in 1991. It is a dynamic, interpreted (bytecode-compiled) language. There are no type declarations of variables, parameters, functions, or methods in the source code. This makes the code short and flexible, and you lose the compile-time type checking of the source code. Python works on different platforms like Windows, Mac, Linux, Raspberry Pi, etc.

Applications of Python [7]

- 1) *Web Development*: Python comes up with a wide range of frameworks like Django, Flask, and a lot more that provide ease to developers. It also has inbuilt libraries and tools which make development effortless.
- 2) *Machine Learning and AI*: AI & ML are the hottest topics in the world. Python offers simple, readable and concise codes. Some of the examples of the inbuilt libraries in python are:
 - Numpy (for data analysis)
 - Keras (for machine learning)
 - Seaborn (for data visualization)
- 3) *Data Science*: Data science involves data collection, data sorting, data analysis, and data visualization. Some of the popular libraries for data analysis in python are TensorFlow, Pandas, and Socket learning.
- 4) *Web Scraping*: Web scraping is an automated process used to extract information from websites in an easier and faster way. The information is used by researchers, organizations, and analysts for a wide variety of tasks. Python has a wide range of features that make it suitable for web scraping some of them are:
 - Concise syntax that enhances the readability and saves time.
 - Wide range of libraries.
 - Easy to understand.
- 5) Some of the other applications for Python are as follows:
 - Robotics and Automation by the use of inbuilt libraries and tools like PyDy, Dart and PyRobot.
 - Image processing by the use of popular libraries like OpenCV, Blender, Houdini, and PIL.

C. Summarily the applications of C and Python programming language are as follows [1][4][7] :

| Application | C Programming Language | Python Programming Language |
|--------------------------|--|--|
| System Software | Operating Systems, Compilers, Embedded Systems | Not typically used for system software development, except in specialized areas like operating system components. Python is often used for scripting within operating systems. |
| Game Development | Game Engines, High-performance Games | Game Development Frameworks like Pygame, Game Engines (Unity, Godot) |
| Web Development | Limited use for server-side applications, CGI scripts | Web Frameworks (Django, Flask), Server-side scripting, Web scraping |
| Desktop Applications | Resource-intensive applications, Software for Windows, Linux | GUI Applications, Desktop Software, Image Processing Applications |
| Scientific Computing | Numerical simulations, Computational Chemistry | Scientific Libraries (NumPy, SciPy, pandas), Data Analysis |
| Data Science | Limited due to performance constraints | Data Analysis, Machine Learning, Data Visualization (pandas, matplotlib) |
| Artificial Intelligence | Limited use for performance-critical AI algorithms | Machine Learning (TensorFlow, PyTorch), Natural Language Processing |
| Network Programming | Network protocols, Packet Sniffers | Network Libraries (socket), Web APIs, HTTP Requests |
| Scripting and Automation | Limited, often used for system-level scripts | Automation, Scripting, Task Automation (automation scripts, web scraping) |
| Cybersecurity | Tools development, Ethical Hacking | Security Tools, Penetration Testing (Scapy, PyCrypto) |

II. STAGES IN SOFTWARE DEVELOPMENT

The stages are :

- Stage 1: Input/Output,
- Stage 2: Data Structures and Algorithms
- Stage 3: Error Handling
- Stage 4: Functions and Modularization
- Stage 5: Data Validation and Sanitization
- Stage 6: Logging and Debugging
- Stage 7: Testing
- Stage 8: Version Control
- Stage 9: Documentation
- Stage 10: Deployment and Packaging

Out of the above stages only first three ie Input/Output, Data structures & Error Handling are discussed:

1) Stage 1: Input/Output [8]

In this stage, you deal with reading input from users or files and writing output to the console or files. It's a fundamental part of programming to interact with data.

| Task | C Code | Python Code |
|--------------------|---|--|
| Reading from stdin | <code>c printf("Enter a number: "); scanf("%d", &num);</code> | <code>python num = int(input("Enter a number: "))</code> |
| Writing to stdout | <code>c printf("Result: %d\n", result);</code> | <code>python print("Result:", result)</code> |

2) Stage 2: Data Structures and Algorithms [9] [10]

This stage involves understanding and implementing fundamental data structures (like arrays, linked lists, trees) and algorithms (sorting, searching) that are essential for solving complex problems efficiently.

| Task | C Code | Python Code |
|---------------------------|--|--|
| Array Manipulation | <code>c int array[5] = {1, 2, 3, 4, 5};</code> | <code>python array = [1, 2, 3, 4, 5]</code> |
| Sorting (Bubble Sort) | <code>c for (int i = 0; i < n - 1; i++) for (int j = 0; j < n - i - 1; j++) if (arr[j] > arr[j + 1]) swap(&arr[j], &arr[j + 1]);</code> | <code>python for i in range(len(arr)): for j in range(0, len(arr) - i - 1): if arr[j] > arr[j + 1]: arr[j], arr[j + 1] = arr[j + 1], arr[j]</code> |
| Searching (Binary Search) | <code>c int binary_search(int arr[], int size, int target) { int left = 0, right = size - 1; while (left <= right) { int mid = left + (right - left) / 2; if (arr[mid] == target) return mid; if (arr[mid] < target) left = mid + 1; else right = mid - 1; } return -1; }</code> | <code>python def binary_search(arr, target): left, right = 0, len(arr) - 1 while left <= right: mid = left + (right - left) // 2 if arr[mid] == target: return mid if arr[mid] < target: left = mid + 1 else: right = mid - 1 return -1</code> |

3) Stage 3: Error Handling [8]

This stage involves understanding and implementing fundamental data structures (like arrays, linked lists, trees) and algorithms (sorting, searching) that are essential for solving complex problems efficiently.

| Task | C Code | Python Code |
|-------------------------------|--|--|
| Error Handling (Return Codes) | <code>c int result = do_something(); if (result == -1) { printf("An error occurred\n"); return 1; }</code> | <code>python result = do_something() if result == -1: print("An error occurred") return 1</code> |
| Error Handling (Exceptions) | <code>c if (divisor == 0) { fprintf(stderr, "Division by zero\n"); exit(1); }</code> | <code>python try: result = dividend / divisor except ZeroDivisionError: print("Division by zero") sys.exit(1)</code> |

III. EXPERIMENT & DISCUSSION

In this paper the author is going to compare the two programming languages by the following: -

1) Parameters[11]

- Speed
- Readability
- Code length

| Task | C program | Python program | Speed | Readability | Code Length |
|--------------------------------|---|--|---|---|--|
| Addition of two numbers | <code>#include<stdio.h> #include<math.h> Int main(){ Int a,b,add; Printf("Enter two numbers:"); Scanf("%d%d",&a,&b); add = a+b; Printf("Addition of two numbers is %d",add); Return 0;}</code> | <code>num1 = int(input("Enter a number : ")) num2=int(input("Enter a number : ")) add=num1+num2 print(add)</code> | Executing speed of C program is much faster than of Python. | As you can see the Python code has less number of variables and syntax it is much easier to read compared to the C program. | It is evident that the Python program has fewer lines compared to C program. They both are giving the same output. |
| Making a diamond with stars(*) | <code>#include<stdio.h> void main(){ int n,i,j,k,l; printf("Enter te number of rows"); scanf("%d",&n); For(i=-n;i<=n;i++){ if (i<0) k=-i; else k=i; for (l=0;l<k;l++) printf(" * "); for (j=0;j<2*(n-k)+1;j++) printf(" * "); printf("\n"); return 0;}</code> | <code>Row=int(input("Enter the number of rows")) For I in range (row): Print(" *(row-i)+ " *(i+1)) For j in range (row-i) Print(" *(range(j+2)+ " *(i-1-j))</code> | | | |

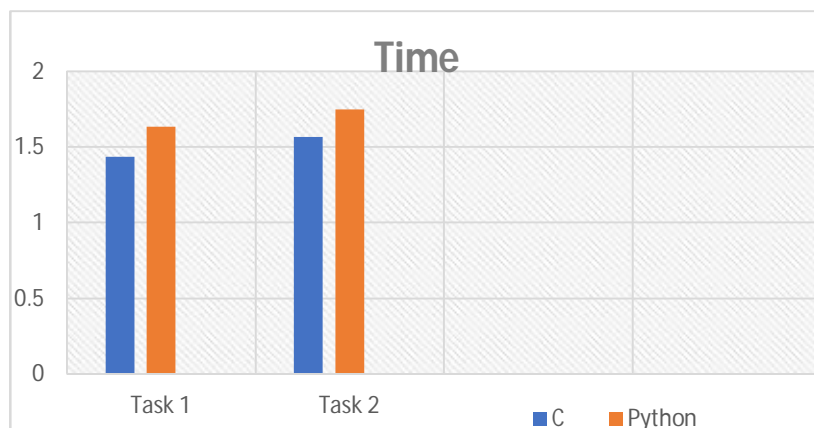
2) *Error Handling*

- How do various types of errors are handled by C and Python?

3) *Data structures:*

- Arrays
- Searchin
- Sorting

A. *Parameters*



| Parameter | C Program | Python |
|-------------|-----------|--------|
| Speed | ● | |
| Readability | | ● |
| Code length | | ● |

C is a faster language compared to Python as it is compiled.

Python programs are usually slower than C programs as they are interpreted. This amplifies the number of actual CPU instructions required in order to perform a given statement.

B. *Data Structures*

Unlike in C, defining and manipulating arrays in Python is much easier. For example, if we have to search and delete an element in an array there are already keywords for it like [index(x)], where (x) is an element in the array to be searched, and [remove(x)], where (x) is the element in the array to be deleted.

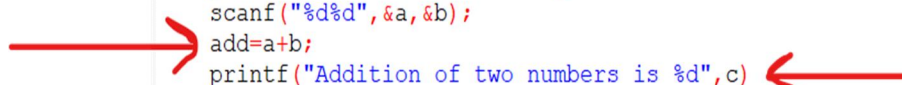
| | C Program | Python |
|---------------------------|--|---|
| Arrays | <code>int array[5] = {1, 2, 3, 4, 5};</code> | <code>array = [1, 2, 3, 4, 5]</code> |
| Searching (Binary search) | <code>int binary_search(int arr[], int size, int target) { int left = 0, right = size - 1; while (left <= right) { int mid = left + (right-left) / 2; if (arr[mid] == target) return mid; if (arr[mid] < target) left = mid + 1; else right = mid - 1; } return -1; }</code> | <code>def binary_search(arr, target): left, right = 0, len(arr)-1 while left <= right: mid = left + (right - left) // 2 if arr[mid] == target: return mid if arr[mid] < target: left = mid + 1 else: right = mid - 1 return -1</code> |
| Sorting (Bubble sorting) | <code>for (int i = 0; i < n - 1; i++) for (int j = 0; j < n - i - 1; j++) if (arr[j] > arr[j + 1]) swap(&arr[j], &arr[j + 1]);</code> | <code>for i in range(len(arr)): for j in range(0, len(arr) - i - 1): if arr[j] > arr[j + 1]: arr[j], arr[j + 1] = arr[j + 1], arr[j]</code> |

C. Error Handling

1) C program

In the following program, there are two errors. One is of undeclared variable (add) and the other is a syntax error.

```
#include<stdio.h>
int main()
{
    int a,b,c;
    printf("Enter the numbers");
    scanf("%d%d",&a,&b);
    add=a+b;
    printf("Addition of two numbers is %d",c)
    return 0;
}
```



Now let us see how the compiler of the c program tells us about the errors.

```
7 error: 'add' undeclared (first use in this function)
7 note: each undeclared identifier is reported only once for ...
8 error: expected ';' before 'return'
=== Build failed: 2 error(s), 0 warning(s) (0 minute(s), 0 ...
```

Result: It gives out on which line the error occurred and which variable was undeclared and what was missing.

2) Python Program

In this program, there is one error, i.e. an undeclared variable (a).

```
num1 = int(input("Enter number 1:"))
num2 = int(input("Enter number 2:"))
add = num1 + a
print(add)
```



The red highlighted is the output till the program asks the user for the input. However, it cannot run the program ahead because of the undeclared variable. It gave us the line on which the error occurred.

```
Enter number 1:2
Enter number 2:3
```

```
-----
NameError                                Traceback (most recent call last)
Cell In[9], line 3
      1 num1 = int(input("Enter number 1:"))
      2 num2 = int(input("Enter number 2:"))
----> 3 add = num1 + a
      4 print(add)

NameError: name 'a' is not defined
```

Result: The Python program runs till it does not find any error in the code, and when it finds the error it stops running. Unlike in C, it does not execute the program if there is an error.

D. Industry Opinion

1) Developer Communities [12]

a) What are Programming/Coding Communities?

The coding community is a dedicated space for coders worldwide to collaborate on the same platform, discuss their problems and solutions, and announce the latest programming language and tool trends. Simply put, it is not compulsory but necessary for programmers of any level to join a coding community to enhance their level of programming as well as gain uplifting connections. There are not hundreds not thousands but millions of coding communities in the world. There are over a million communities dedicated to each programming language, such as Java, Python, C, C++, etc.

b) Why a Coder Should join a Coding Community?

Each developer community consists of thousands of programmers of various levels who post any issues and solutions for solving such problems.

So if you have any trouble with any errors or doubts regarding concepts you can reach out to these communities for help. Coding communities are the best place to connect with like-minded people and also express any doubts you might have regarding programming.

Beginner programmers frequently encounter many challenges and difficulties early in their programming careers. Even if Google is the most extensive resource for developers, becoming active in a coding community gives you more room to discuss your problems and makes finding relevant information to dispel your concerns easier.

Every coding community is filled with programmers of different levels. Therefore, your chances of finding mentors to help you on your software development path are good.

Additionally, you can interact with other developers in the community and work together on a project. Another compelling argument for why you should join a developer community is the networking opportunities that might develop simply through participating in them and interacting with people travelling similar paths.

2) Python Communities [13]

There are over 15 million developers in the Python community. Some of most prominent one are: -

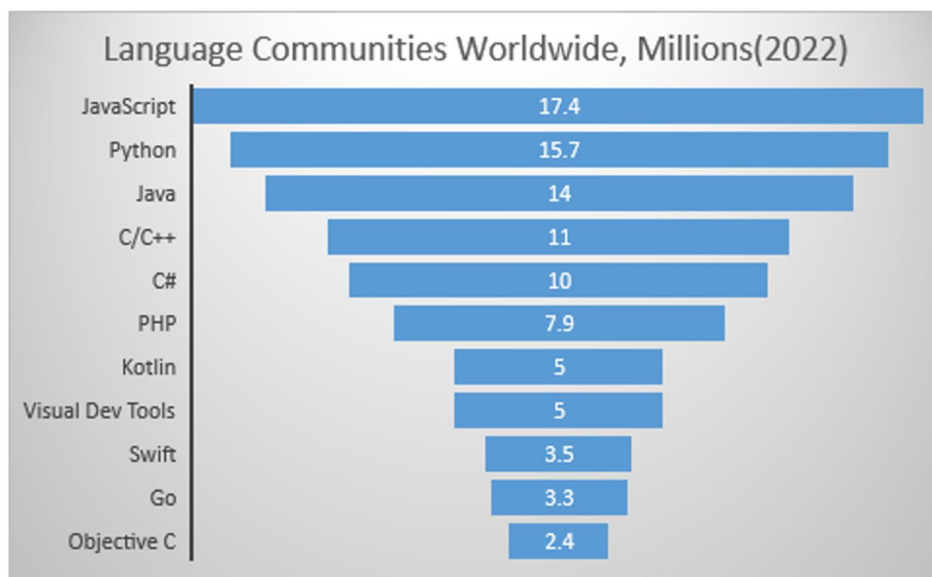
- Python.org – It is the one of the biggest community on the internet as it is made by the developers of Python.
- PySlackers - This community has a range of resources from the main presence on Slack to community projects.
- Real Python - The Real Python Member's Slack is an English-speaking Python community with members located all over the world.
- Full Stack Python - Full Stack Python is a non-profit with the mission to “promote, protect, and advance the Python programming language, and to support and facilitate the growth of a diverse and international community of Python programmers.”
- HackerEarth - The HackerEarth platform uses artificial intelligence to give users access to more than 2,500 questions used by Fortune 50 companies in several coding challenges and programming interviews.

3) C communities:

C and C++ have a wide range of communities like:

- Stack Overflow
- HackerRank (for improving coding skills)
- GitHub
- C Board (C programming forums)

According to the survey [14], the size of the JavaScript programming language community is roughly 17.4 million software developers as of 2022, making it the most popular programming language in the world. Python is also a popular community for programmers, with 15.7 million developers.



Above are the number of communities for respective coding languages.

E. Discussion with Industry Experts [15]

The author has discussion with some industry experts primarily on following questions:

- Is there really a difference using C & Python? If yes/no, why
- What is industry preference?
- What is future of C and Python?
- How does developer communities help industry?

1) Prashant Bopardikar, Partner - Lead Client Partner, IBM Consulting - Riyadh, Saudi Arabia

Mr. Prashant gave a brief insight into how Python and C programming languages are used in the industry. He commented on how the uses of Python and C change on the requirements of current projects.

Mr. Prashant said that as the world is going towards sustainability, and as Python uses more energy than its counterpart C, the use of C should be more if we have to conserve energy.

Industries use Python and Java, Python for its efficient libraries and readable codes, and Java for its outstanding use in web development. Python is highly preferred and used in Artificial Industry and Machine Learning products. The future of Python is in AI&ML, Data science, and in Quantum.

C on the other hand is mainly used in embedded software, Database drivers, and in the defence line of work. C is still a preferred language for students because of its complexity and logic-building ability. “So that’s why many institutions teach C programming as it builds logic of the student and does not teach Python as it is easy to use and handle.”

Mr. Prashant also quoted, “As the world is going toward LOW CODE – NO CODE it is very important to understand that the industry will try to prefer Python over C/C++ wherever possible.”

2) Dr. Preetam Tiwari, Cofounder and Director at IncubXperts, Consulting CTO at BFAC, Pune, India

Dr. Preetam Tiwari stated that the use of Python and C programming language depends on the current project the company is working on. For example, Dr. Preetam’s company prefers using C/C++ for web development. But as C also has limitations like C only works on Windows, they use Python on various occasions. Dr. Preetam also said “As Python has large community support and more options (it works on cross platforms) and as it also has more libraries compared to C, the industry adoption of Python gets easier.

3) *Ashwani Kumar Rathod, CEO, IndoAI Technologies P Ltd, NOIDA, India*

Mr. Ashwani Rathod had the following views on C and Python programming:

- C is considered a middle-level language because the compilers of many modern-day programming languages are made by C as its basis.
- C is without a doubt a very complex and difficult language but on the other hand it is also very efficient. It is faster than most modern-day languages and is very efficient.
- As for Python, it is very easy to understand and write programs. There are many applications in an industry where Python is always preferred over C like in the internet industry, in Data Analytics where data has to be manipulated there are inbuilt libraries that help them reorganize the data and work more efficiently.
- C is used where there is a specific need for an application like in Space Programs for safety and security, in defence line of work, etc. It needs to be carefully monitored and specific changes have to be made which is not efficiently possible in Python.

4) *Neeraj Shetty, Consulting system Engineer, Juniper Networks, US*

Mr. Neeraj Shetty expressed his following views on C and Python programming languages:

- As C is compiled it is faster and its performance is better than Python which is interpreted. On the other hand, Python is much easier to learn.
- As C is a low-level programming language many of the libraries of Python and other programming languages are made and compiled in C/C++. Python libraries like NumPy and Panda are compiled in C and are widely used in Python.
- C is used in device programming, embedded systems, etc. Python is used in Data Science, AI&ML, Automation, etc. It also depends upon the skill set of a person and the usage of the programming language required for the current project.
- Python which is easier to learn and implement is being used in industries where till now coding/programming skills were not required. For example, in the healthcare industry requirement for coding was not needed. But as the data increases the organization of that is very much essential. So, now healthcare industries are trying to encourage their employees to learn Python language as it is easy to learn and data manipulation is much easier in it.
- The future for both programming languages is unpredictable. But Python has a strong future ahead of it. Most applications are made in C after the data is processed in it Python is used to organize it and after that mainly Python is only used.
- For the current future “Python is the front runner” in the industry.

IV. CONCLUSION

In this paper the author discussed what is C and Python programming languages and what are their applications in different industries as author talked to different professionals and what are their views on use of Python and C in the future. The author also did a comparative analysis of C and Python on the parameters; which are the time taken to execute a program, easy to read and understand the code, and lastly the length of the codes. C which is fast and static, and also preferable in game development and embedded systems has some disadvantages to it. It has complex syntax and structure, its code length is quite large and it does not support cross-platform.

While Python is more efficient when used in artificial intelligence, machine learning, web scraping, etc. Python is the most popular programming language as it has one of the largest communities and has the most libraries. It has been seen that the programming languages which has the largest communities are the ones that are most popular and are widely used in the era. Python is popular these days due to its short syntax, and code length, and it's easy to understand.

The author also observed how programming communities are important in boosting the popularity of the programming language. And how useful the developer community is. It is seen that Python has a much larger developer community compared to C, which helps in its popularity and usage.

The industry professionals gave many similar views on the use of Python and C in the IT industries. There were some conflicting points in the opinion but if there were none there would have been no reason for comparing C and Python in the first place. The people from the industry agreed to the fact that C is a much more complex and time-consuming programming language, but it also gives satisfactory results. On the other hand, Python is much easier to learn and less time-consuming. It is currently the most widely used programming language in the world. Many non-coding industries are trying to recruit professionals from the IT sector or are trying to encourage their employees to learn Python. But we never know what the future holds for the next technology.

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