

# THE ROLE OF COMPUTER ENGINEERS AND COMPUTER TECHNOLOGIES IN SPACE CENTERS BY USING VARIOUS OPERATING SYSTEMS (OS) AND PROGRAMMING LANGUAGE

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## **Abstract:**

Today, Computer's technology is growing vastly. Here, we are representing the impacts of computer's technology and software in the arena of Space centers. The success for Space researches and critical space missions is totally depends on ability of computer scientists and related computer engineers. The paper represents crucial role & responsibilities of the scientists of technology of computer. This paper also includes several OS (Operating Systems) and Programming Languages that Space centers use for their specific purposes. Day-to-day we see that the new experiments are being happened related to the space. So, gathering of information and controlling the working of space satellites is very critical task for computer scientists and engineers. So, scientists and astronauts need the new technologies like laptops, notebooks, specified operating systems, updated software of languages related to programming. Due to this study, all facts which are discussed here, resolve the curiosity of the mind of learners about the relationship between space and computer technology.

## **KEYWORDS-**

*Space center, Space, The Universe, Computer technology, Computer scientist, Operating systems, Computer Engineers, OS, Linux, Windows, Programming Languages, Role of computer technology in space, ISRO, NASA, ISS, International space stations.*

## **I. INTRODUCTION:**

Now days, there is a curiosity among people of modern generation to know about the space and its unknown facts that can reveal only by the space centers. A space center is an organization where many scientists, researchers, technicians and Computer's Engineers work together in the space organization for searching and exploring unknown facts and hidden informations which are present in Universe. There are multiple space centers that are existing in world, some of them are ISRO-India, NASA-U.S.A., etc which are commonly known. As known by everyone that In

past years, ISRO has made many world records like The Mars mission 2014, the mission Chandrayan2 2019 etc which majorly led the interest of people of the world in the direction of the space and the universe. Especially students of IT sectors get attracted towards knowing that which software and technology is used in the space centers because computer technologies and softwares are the basic needs of a space search.

All type of major operations are possible due to computer technology. The technology of computer performs a crucial job in the achievements of space centers. Here we are going

to tell something about uses of computer in space centers and those OS (Operating Systems) and programming languages which can be used by various space centers for their specific purposes.

**II. ROLES OF COMPUTER TECHNOLOGIES IN SPACE RELATED MISSIONS**



In space centers, computer technologies play the most prominent role in research operations where computer scientists have the main responsibility for whole working.

Every space organization has many data centers. The establishment and maintenance of centers of these data are done by many IT sector graduates. Data centers also have many high range of complex networks. Artificial Intelligence or AI, machine learning and neural network are some of the most favorable areas that space centers are exploring from a long period of time. Hence,

“COMPUTER SCIENTISTS ARE THE ROOT OF THE SPACE RESEARCHES...”

**III. THE WORKING AND THE OPERATIONS OF COMPUTER TECHNOLOGIES INVOLVED IN SPACE CENTERS**

As the Universe is collection of unknown facts. Hence the data which is collected from space is in large amount. The tasks data processing, data ingestion, data archival, data analytics and data security are involved in working of computer scientists in every space organizations.

It is the main challenge that arises in the implementation and communication among different space devices, which is only possible by computer technology and softwares. Computer engineers develop satellite telemetry,

payload commanding, payload interface, monitoring control on equipments, satellites, vehicles, sub systems, etc...

**IV. CONTRIBUTION OF COMPUTER'S SCIENTISTS IN THE SPACE CENTERS-**



There is the main and huge contribution of computer's scientists that are working in space centers for accomplishment of projects. They deal with different varieties of projects. These projects comprised a distinct variety of technologies as coding using VLSI, Enclosed Systems, coding in General Purpose Programming Languages as C Programming, Java language, C++, Web Development and Designing, Python, etc.

It is the major task for software developers to choose that programming languages which works efficiently, impressively and effectively for the achievement of requirements of projects. It completely depends on the types of project.

There is a unique purpose for every programming language. So, the election of languages for programming is accordingly to the goals of project.

In every space center, there is not any hard and fast rule for working by using any one selected programming language. It totally depends upon which center software engineers work for like if their team is working for that centers who launches satellites then their work would be related about to inaugurate vehicles and surrounded operations. Hence they have to select those programming languages which will suit accordingly launching related operations and developments. Space centers have an comprehensive networks of the centers/GROUND-stations. This network is controlled by space scientists.

In space center, every engineer gets a good platform to do operations related research. According to results of their research, they can propose a solution to

improve existing system or can done new inventions and implementations.

Space centers have everything which a passionate developer of softwares needs for his/her research or programming.

#### **V. OPERATING SYSTEMS (OS) USED BY VARIOUS SPACE CENTERS-**

There are the multiple versions of OS (or operating systems) available which are used by many of the Space Centers as per the need and purpose. The International Space Stations (ISS) furnished with about HP ZBook15 and ThinkPad of 100 IBM/Lenovo laptop computers. These laptops have run Windows2000, WindowsXP, Linux & Windows 10 Operating Systems

The ISS previously use Windows-based Operating Systems, but because they infected by virus in 2008. So, it switches from Windows Operating System to Linux Operating System. The migration from MsWindows was held in the year 2013, May. The main cause behind this migration is for improving flexibility, stability and reliability.

After migration, there is not a single computer consigned ISS that runs on Windows Operating System. Linux OS provides them in-house controlling system. So if there is any requirement of adjusting, adapting and patching, is possible to do easily.

Hence, switching from Windows to Linux was essential for protection of International Space Stations against future infections.

The brief description of these operating systems are given as follows-

1. Laptops with a windows OS are use to communicate over internet by taking notes on various experiments.
2. Laptop which has Linux OS can use for communicating with vehicle1553 system used as remote terminals.
3. The European, Japanese modules, Russian section have their laptops with different Operating Systems.

In specific, numbers of laptops are used to change the Debian Linux Distribution. These laptops are also joined to various other systems which relate with International Space Stations (ISS) that are running over many versions of Linux.

Some other Operating System are scientific Linux, RedHat Linu, FCOS (Flight Computers Operating Systems) and GPC Operating Systems. GPC OS (Operating Systems) is System software which controls interfaces among computers and rest DPS. GPC OS is loaded in computers when initialized. It resides in GPC's main memory. The

FCOS monitors key systems parameters, controls processors, allocates resources, updates computer's memory and provides program interrupts orderly.

In the above explained Operating Systems, there are various types of programming languages used, in which some are depend on platforms and some are independent from platforms These languages are used for communicating to the space devices by encoding & decoding information and instructions which are being send/receive to or from the space devices through signals for exploring hidden facts by satellites.

#### **VI. PROGRAMMING LANGUAGES USED BY VARIOUS SPACE CENTERS-**

It is known by all, programs related to the space are highly complex and includes various varieties of operations. In every operation, there are requirements of a different programming language. These languages are given as-

- A. C-LANGUAGE
- B. PYTHON
- C. JAVA
- D. FORTRAN
- E. MATLAB
- F. ANOTHER PROGRAMMING LANGUAGES ACCORDINGLY TO THE NEEDS.

There is short description of program languages used by various space centers as per their necessity.

#### **A. C-LANGUAGE-**



C-language is the originator of all other program languages and is commonly known by the programmers. Every program language is depends upon C language.

C-language is a procedural language which is used in space centers for sped up multi-core analysis and code to run on flight computers.

#### **B. PYTHON-**

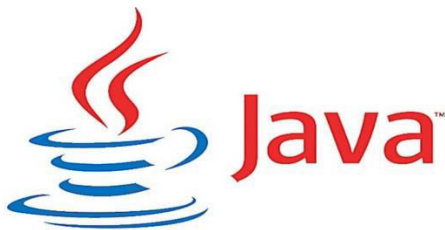


Python is high level, based on objects, interpreted (simplified) programming language which is nearly similar to PERL. Python becomes popular because of simple and clear syntax and for ease of readability. It is portable and easy in learning and understanding.

It is a type of general purpose (or publically available) programming language. In space centers, Python have used in various fields like numerical computation, data analytics, automation, machine learning and so on...

Space centers use Python for processing of gathered data from various space devices and different satellites. It is also used for various research fields like neural network, artificial intelligence and machine learning etc. Hence, the usage of Python is increasing regularly by various space centers.

#### C. JAVA-



Java, a programming language that is high level, based on classes and objects and developed because it performs various new functions and implementations. The main feature of Java is WORA which stands for Write Once and Run Anywhere. So that Java is platform independent language. Java plays a very essential role in various space missions. The space centers use java for a number of interesting applications. An example of these types of applications is **world wind**. It is a development kit of softwares (or SDK) which let them (space scientists) to zoom from space and measuring & exploring locations earth.

Space organizations use Java programming for writing applications related to mathematical operations, scientific calculations and for various complex operations. These

operations are normally considered to be secure, fast, low maintenance and have a high degree of portability.

#### D. FORTRAN-

## FORTRAN Programming

FORTRAN programming language is the commonly used language by various space centers for efficiency, high speed and high performance.

There are various functionalities that can be handled by using FORTRAN language. Softwares of structure design and trajectory design can be written by using FORTRAN.

FORTRAN is used for calculation of mathematical operations. In space centers, some numerical computations that goes around in researches related to space like exploration of space related facts, weather predictions and computing mechanical movements at various steps (phases) of the projects. All types of scientific calculations are possible by using FORTRAN language. It includes some limited element methods which are helpful in processing of data.

It is the more suitable language for multiple numerical and scientific calculations. The speed of computing operations is very high by using FORTRAN languages is the main reason for the selection of FORTRAN language by space centers.

Hence, FORTRAN language is a very fast and matured language.

#### E. MATLAB-



The MATLAB, a platform of programming which is designed particularly for scientists and engineers. MATLAB language is the heart for the platform of MATLAB which is a matrix dependent language provides the most natural expressions of mathematical computations.

MATLAB does many operations in the field of space researches like it analyze data, create models & applications, develop algorithms. The various applications, language, inbuilt mathematics functions enable user to frequently explore multiple goals to come at one result. Users use MATLAB platform for a scalable range of application like machine learning & deep learning, communications and signal processing, measurements and tests, control systems, videos and images processing, finance computation, etc.

MATLAB, used for plotting the analyzed outcomes and graphs. It provides graphical representations of the gathered data from the space. It helps the engineers and space scientists for finding the trending facts of space.

#### F. ANOTHER PROGRAMMING LANGUAGES DEPEND ON NEEDS-

Except above specified programming languages, there are another programming languages available which are not so commonly known by those who has not much knowledge about languages of programming. Out of them some are,

1. Command language (or spacecraft's control language, satellite's control languages & Systems Test & Operation Language (or STOL) or Satellite Test & Operation Language) is a computer command language for giving commands in the spacecraft's mission systems. Although, for commanding remote spacecraft with telecommands by these languages, but they also can be used for development and verification of systems (engineering model, flight hardware & software and prototype) and also of ground systems, before to inaugurate.
2. The Spacecraft's command language is written in the similar format of human languages. The protocols of telecommand are in binary pattern. Few spacecraft's command languages, such of them are PLEXIL or SCL, are implemented on the spacecrafts with an onboard executive.
3. The Systems Test and Operation Language (or STOL) gives the meanings for user interaction with

payloads, application programs and other ground system elements. The language of system's operations that enables to its operator/user for communication from commands to computer systems.

4. One of other programming language is being use, DFG. DFG implies Display FormatGenerator. It was used by astronauts for seeing status and managing computers. In DFG, there were only two different processors K-Load and I-Loads.

#### VII. CONCLUSION-

As the study illustrated above this paper concludes, the curiosity of users related to the space and space center have been covered by giving brief description over OS & some programming languages used by various space center. It also concludes the roles & responsibilities of space scientists for perceiving the goals of space related critical missions.

Hence, facts described above in this will help in resolving the curiosity of new learners about the contribution of computer technologies in the arena of space explorations.

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