INTRODUCTION TO COMPUTER SCIENCE

Dr. Ihsan Hussein

Introduction to Computer Science

- What is computer science?

- What computer scientists do?

- What tools do they use?

- *This course introduces computing and how to look at the world from a computer science perspective.*

- *This Course also an introduction to programming by Python*

Computer System

Computer System Consists from :

1. Hardware: consists of physical components.

2. Software: all the nonphysical components of the computer.
   a) Operating system: Windows, Linux, Android ….etc
   b) Applications: Word, Excel ….etc

- *A computer system* is a combination of hardware and software that work together to execute application programs.
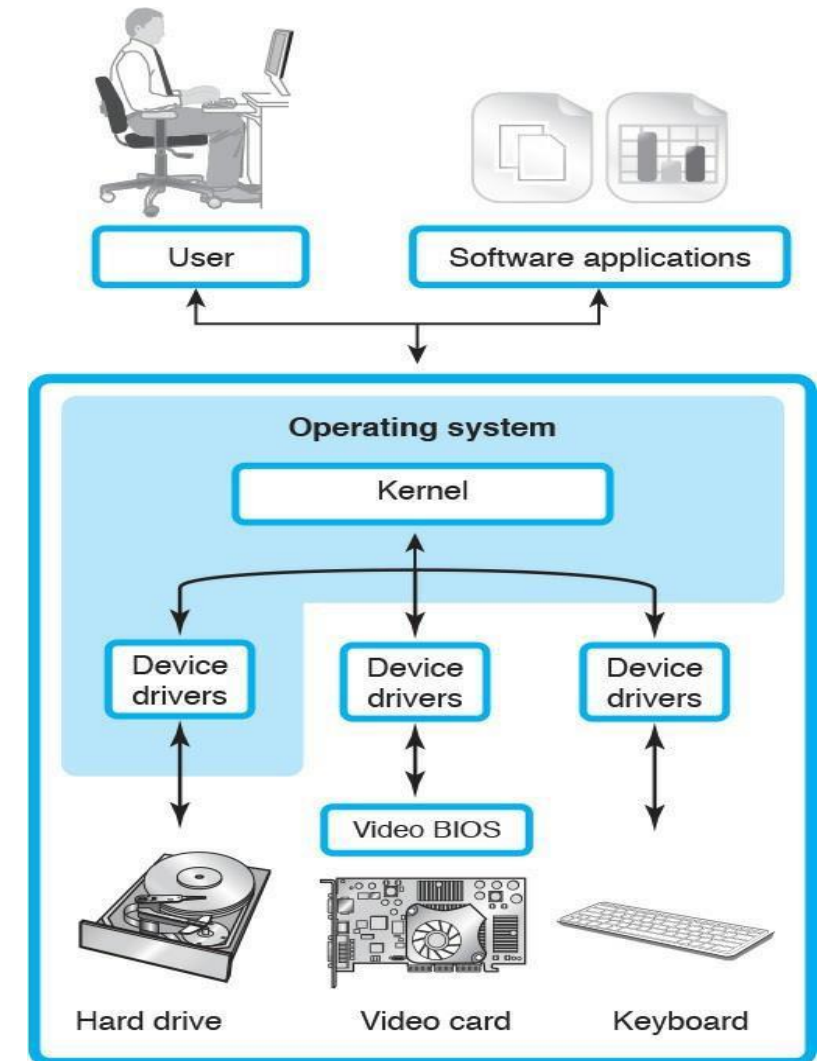
Computer System

- **Hardware:**
  - A Collection Of Electrical And Mechanical Parts Referred To As Hardware. Hardware Are The Pieces You Can See And Touch; Hardware Performs The Physical Work Of The Computer.

- **Software:**
  - Software Programs (Including Operating Systems and application Programs) Control The Hardware And Make It Useful.
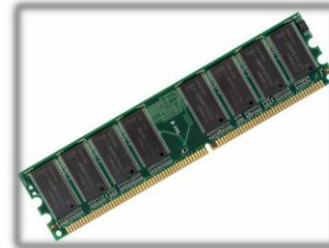
Computer System

- *Central Processing Unit* (CPU)

- *Memory*: ROM , RAM

- *Storage Device* : HDD, SSD

Hardware:

- *Input Devices*

- *Output Devices*

About the Numbers

- **1s and 0s (Binary bits)**
    - Computers are digital devices. That means they understand 1s and 0s. One 1 or one 0 is known as A bit. In actuality, A "1" is simply A voltage level to the computer. So, when we type characters into A word processing application, for example, those letters get translated by the keyboard into voltage levels. Figure shows this concept. Notice that each letter is represented by A combination of eight 1s and 0s. Each 1 will be A voltage level sent to the motherboard (and components on it). Each 0 is simply the absence of A voltage level.

		D	E	A	R	[space]	M	O	M
What we see	👁👁	01000100	01000101	01000001	01010010	00100000	01001101	01010010	01001101
What a computer sees	🖥	⚡ ⚡	⚡ ⚡⚡	⚡ ⚡	⚡⚡ ⚡	⚡	⚡ ⚡⚡⚡	⚡ ⚡ ⚡	⚡ ⚡⚡⚡

About the Numbers

- **Measuring Capacity**

Measurement	Abbreviation	Equal to …
Bit		A single binary digit
Byte	B	Eight bits
Kilobyte	KB	1,024 bytes (a thousand bytes)
Megabyte	MB	1,024 KB (a million bytes)
Gigabyte	GB	1,024 MB (a billion bytes)
Terabyte	TB	1,024 GB (a trillion bytes)
Petabyte	PB	1,024 GB (a quadrillion bytes)

Bit Bit Bit Bit Bit Bit Bit Bit

8 Bits = 1 Byte
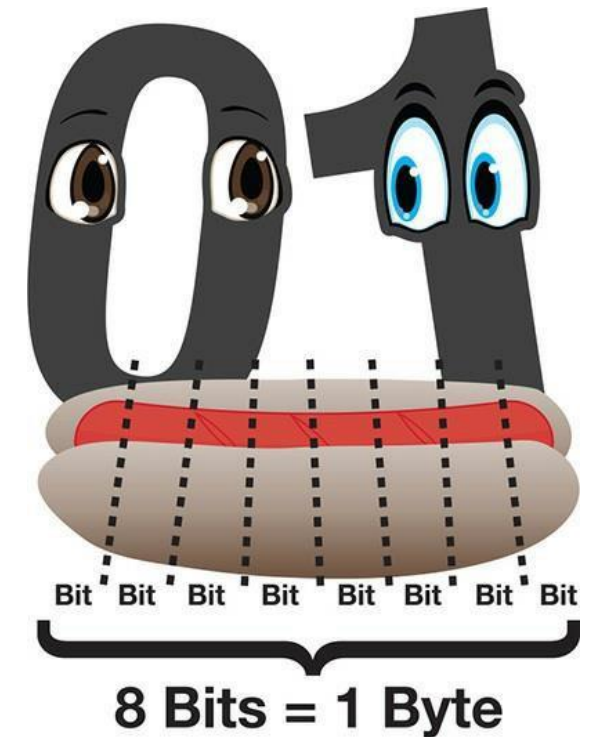
About the Numbers

- **Measuring Frequency**

Measurement	Abbreviation	Multiplies by	Equal to …
Hertz	Hz		1 cycle per second
Kilohertz	KHz	One thousand	1,000 cycles per second
Megahertz	MHz	One million	1,000,000 cycles per second
Gigahertz	GHz	One billion	1,000,000,000 cycle per second
Terahertz	THz	One trillion	1,000000,000,000 cycles per second

About the Numbers

- **Measuring Bandwidth**

| Measurement	Equal to …
bps	Bits per second
Kbps	Thousand bits per second
Mbps	Million bits per second
Gbps	Billion bits per second

Software

What is an Operating System?

- The Operating System (Or OS) Is A Computer Program

- A Program Is A Sequence Of Instructions That Guides The Computer Through The Performance Of A Specific Task Or Sequence Of Tasks

- The Individual Lines Of Instruction Are Referred To As Code

- The Term Software Refers To Any Program That Makes A Computer Run, Including Operating Systems And Application Programs.

- Every Computer Requires An Operating System In Order To Function. Think Of An Operating System As The Central Manager Of Communication, Coordination, And Control.

What is an Operating System?

- Users And **Application** Programs Interact With The OS

- Applications Create Documents Or Complete Specific Tasks. They Use The OS To Control The Hardware Functions Of The Computer.

Operating System

Application Program
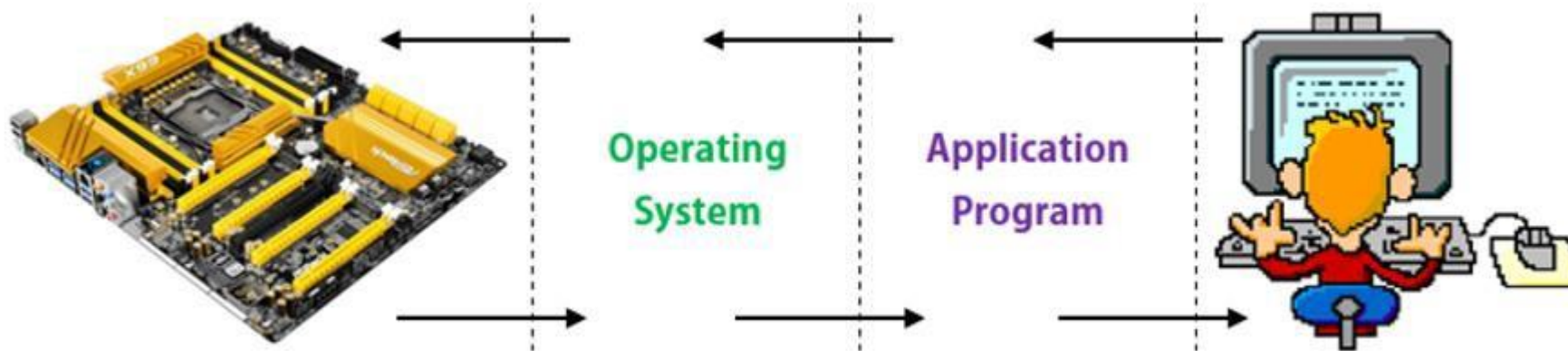
Desktop Operating Systems

- **Windows**
  - ✓Microsoft Windows 10
  - ✓Microsoft Windows 8
  - ✓Microsoft Windows 7

- **Mac OS X**
  - ✓Version 10.11 – El Capitan
  - ✓Version 10.10 – Yosemite
  - ✓Version 10.9 – Maverick
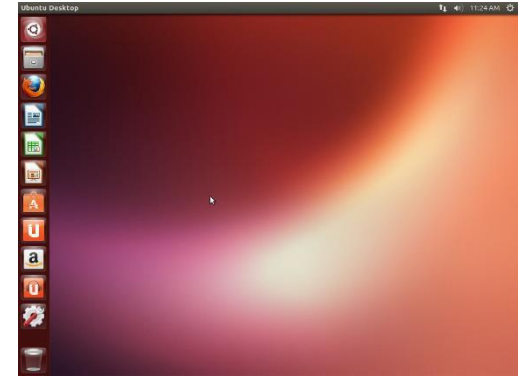
Desktop Operating Systems

- **Linux**
  - **Versions Called Distributions**
    - ✓ Red Hat
    - ✓ Ubuntu
    - ✓ Kali

- **UNIX**
    - ✓ Includes a separate GUI

Applications

- Desktop Application

- Mobile Application

- Web Application

Computer System

- Computing Professionals writes programs.
    - Computing professionals are often called computer application developers or simply developers.
    - Some developers even work on applications, like computer games , web applications… etc

- Some computing professionals support their clients with newly installed software and others keep the software up to date.

- Many computing professionals administer networks, web servers, or database servers.

- Some like to teach computing, and others offer information technology (IT) consulting services.

- A few computing professionals have become entrepreneurs and started new software businesses.

Computer System

- Regardless of the ultimate role they play in the world of computing, all computing professionals understand the basic principles of computing, how computer applications are developed, and how they work.

- Therefore, the training of a computing professional always starts with the mastery of a *programming language* and the *software development process*

Problem Solving

- Computer science is the study of problems, problem-solving, and the solutions that come out of the problem-solving process.

- Solving problems is the core of computer science.
  - Programmers must first understand how a human solves a problem
  - Then understand how to translate this into something a computer can do
  - Finally how to write the specific syntax (required by a computer) to get the job done.
  - It is sometimes the case that a machine will solve a problem in a completely different way than a human.

Models, Algorithms, and Programs

- To create a computer application that addresses a need in some area of human activity :
  - Developers invent a model that represents the "real-world" environment in which the activity occurs.
    - The model is an abstract (imaginary) representation of the environment and is described using the language of logic and mathematics.
  - Developers also invent algorithms that operate in the model and that create, transform, and/or present information.
    - An algorithm is a sequence of instructions. Each instruction manipulates information in a very specific and well-defined way, and the execution of the algorithm instructions achieves a desired goal.

Models, Algorithms, and Program

- After inventing a model and an algorithm, developers implement the algorithm as a computer program that can be executed on a computer system.

- An algorithm and a program are both descriptions of step-by-step instructions of how to achieve a result.
  - An *algorithm* is described using a *language* that we understand but that cannot be executed by a computer system
  - *Program* is described using a ***language*** that we understand and that can be executed on a computer system.

pseudocode and Flowchart

Find the sum of 5 numbers

Algorithm in simple English
1. Initialize sum = 0 and count = 0 (PROCESS)
2. Enter n (I/O)
3. Find sum + n and assign it to sum and then increment count by 1 (PROCESS)
4. Is count < 5 (DECISION)
   if YES go to step 2
   else
   Print sum (I/O)
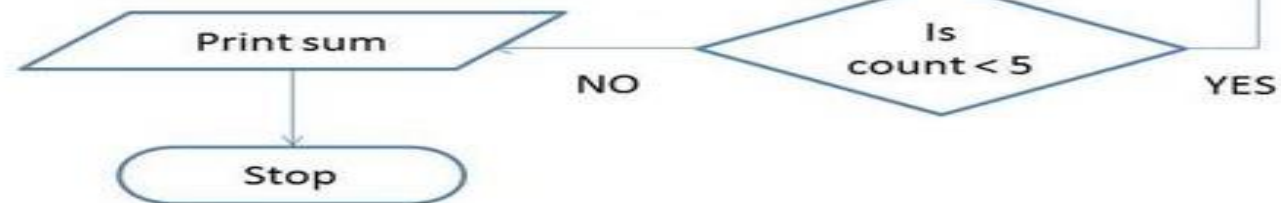
Flowchart

Programming Languages

- What distinguishes computers from other machines is that computers can be programmed

- Computers do exactly what they are told

- The instructions that are actually executed are machine language instructions
  - They are represented using binary notation (i.e., a sequence of os and 1s)

- Because machine language instructions are extremely hard to work with, computer scientists have developed _programming languages_ and _language translators_ that enable developers to write instructions in a human readable language and then translate them into machine language.
  - Language translators are referred to as _assemblers_, _compilers_, or _interpreters_, depending on the programming language.

Programming Languages

Computer Languages

Low Level Language (Machine Language)	Middle Level Language (Assembly Language)	High Level Language
Use 1's & 0's to create instructions	Use mnemonics to create instructions	Similar to human langugae

Language Translators

High Level Languages
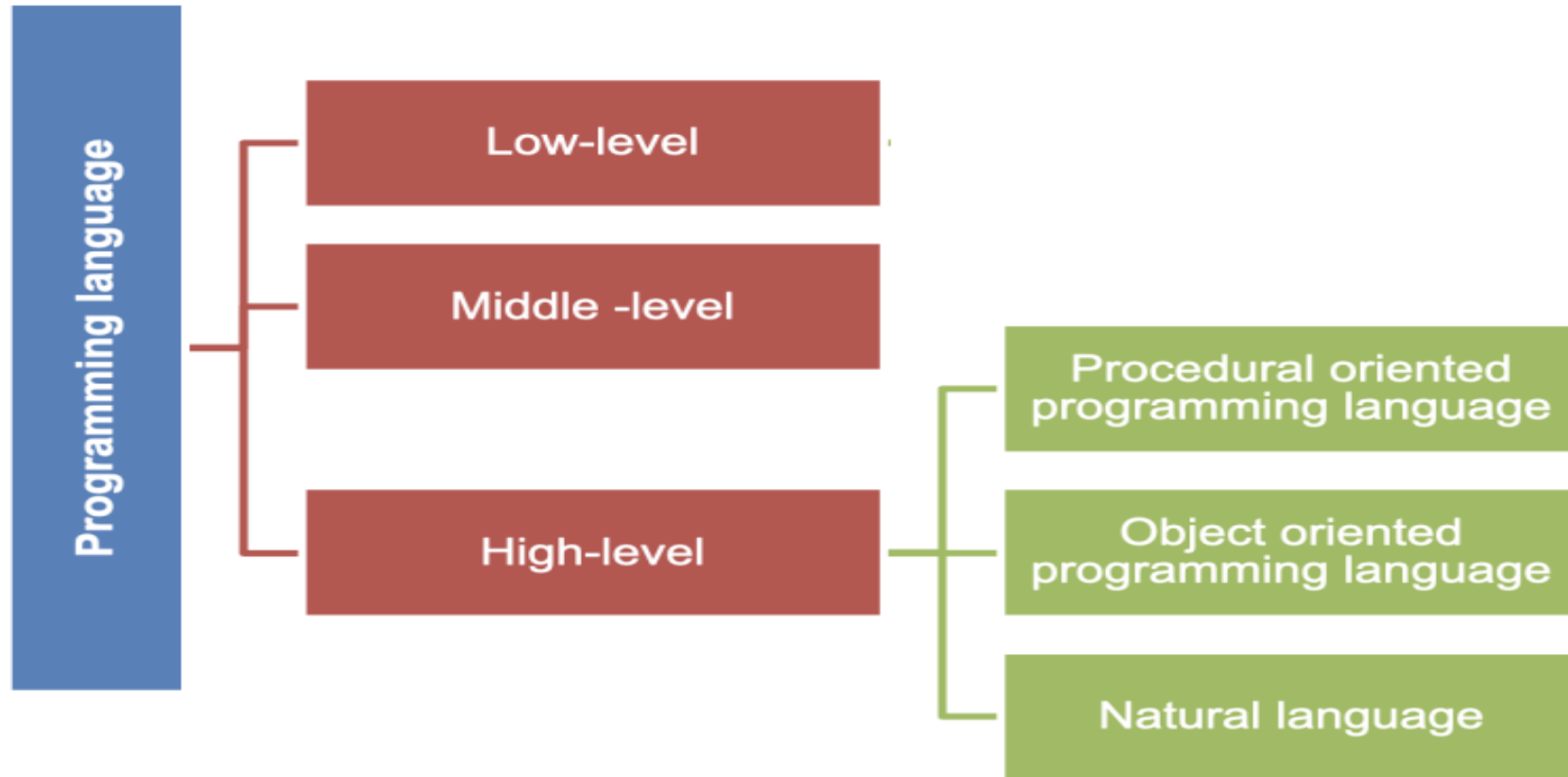
High Level Languages

The Most Popular Programming Languages
Share of the most popular programming languages in the world*
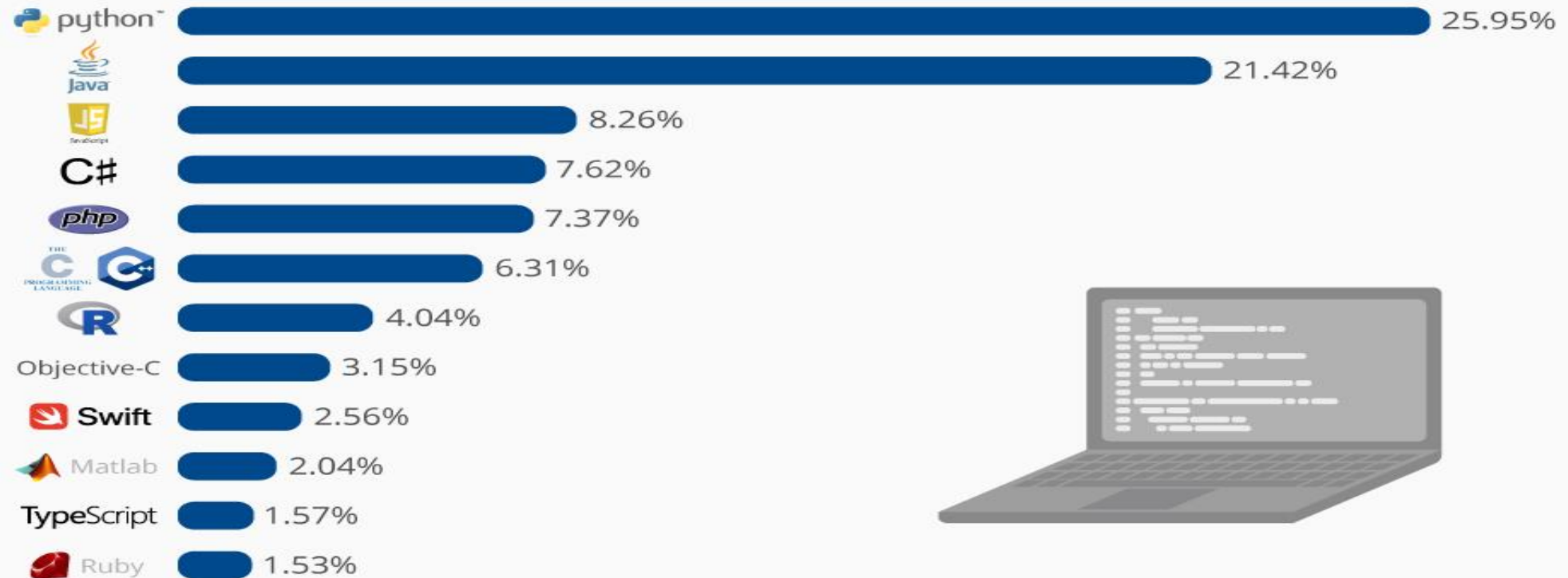
Language	Share
python	25.95%
Java	21.42%
JavaScript	8.26%
C#	7.62%
php	7.37%
C / C++	6.31%
R	4.04%
Objective-C	3.15%
Swift	2.56%
Matlab	2.04%
TypeScript	1.57%
Ruby	1.53%

* Based on the PYPL-Index, an analysis of Google search trends for programming language tutorials.

@StatistaCharts   Source: PYPL

statista

High Level Languages

Source: DistantJobs

Emerging programming languages by popularity

1. Python
2. Java
3. JavaScript
4. C#
5. C/C++
6. PHP
7. Swift
8. Objective - C
9. Kotlin

High Level Languages

- Developers use Integrated Development Environments (IDEs) that provide a wide array of services that support software development.
  - They include an editor to write and edit code, a language translator, automated tools for creating binary executables, and a debugger.

- When a program behaves in a way that was not intended, such as crashing, freezing the computer, or simply producing erroneous output, we say that the program has a *bug*.
  - The process of removing the error and correcting the program is called *debugging*.
  - *A debugger* is a tool that helps the developer find the instructions that cause the error.

Home Work

- Install python at home .

- Submit a report " 1 page " about installation process

- Take screen shot from python IDE and put it on the report

Thank You