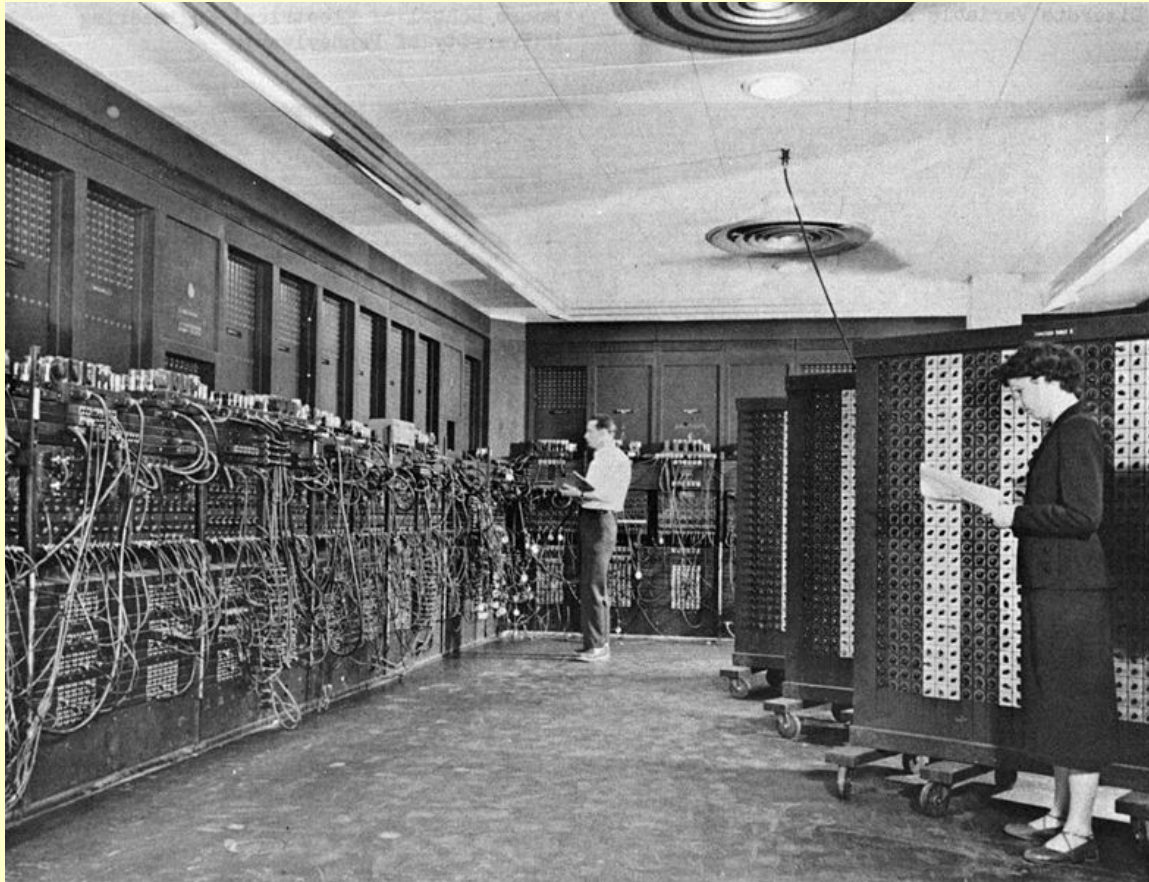


Founders of computer science



Deschutes Hall
University of Oregon, Eugene

ENIAC (1946)



<https://www.wikipedia.org/>

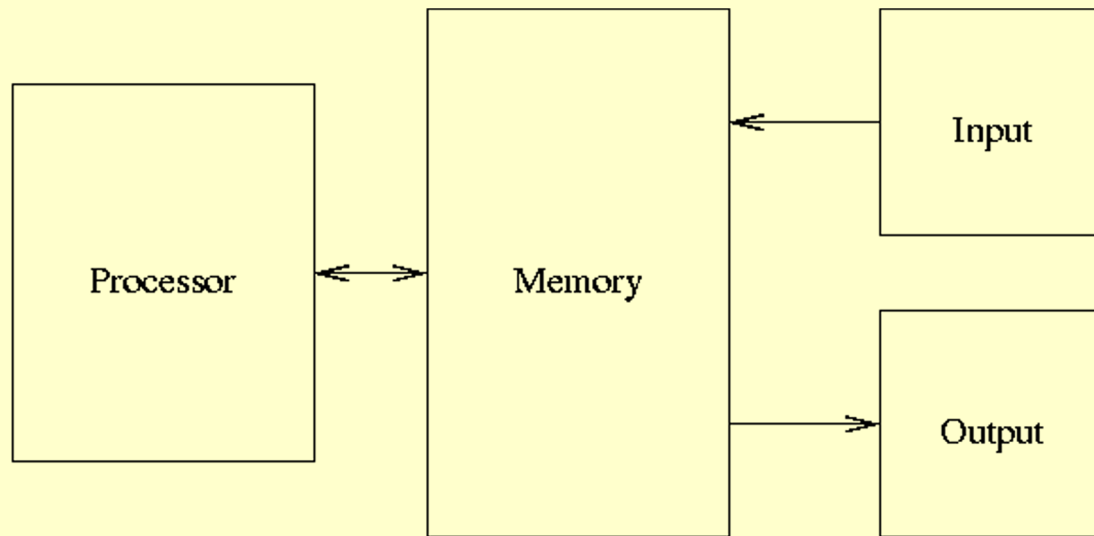
The processor and memory

The processor and memory are the most critical components of a computer. Both are made out of circuits.

- A *processor* executes computer programs (which are basically algorithms written in a computer language).
- *Memory* stores a large amount of information (in bits). Programs as well as data are stored in memory.

von Neumann model

All computers share the following basic design called the *von Neumann* model (named after John von Neumann).



John von Neumann Margittai Neumann János Lajos (1903-1957)



<https://www.wikipedia.org/>

Instruction cycle

Under this model, the processor executes a program by repeating the following cycle.

1. fetch — reads an instruction from the memory
2. decode — decodes the instruction to figure out its meaning.
3. execute — performs the task specified in the instruction.
4. store — stores the result of the above execution in the memory.

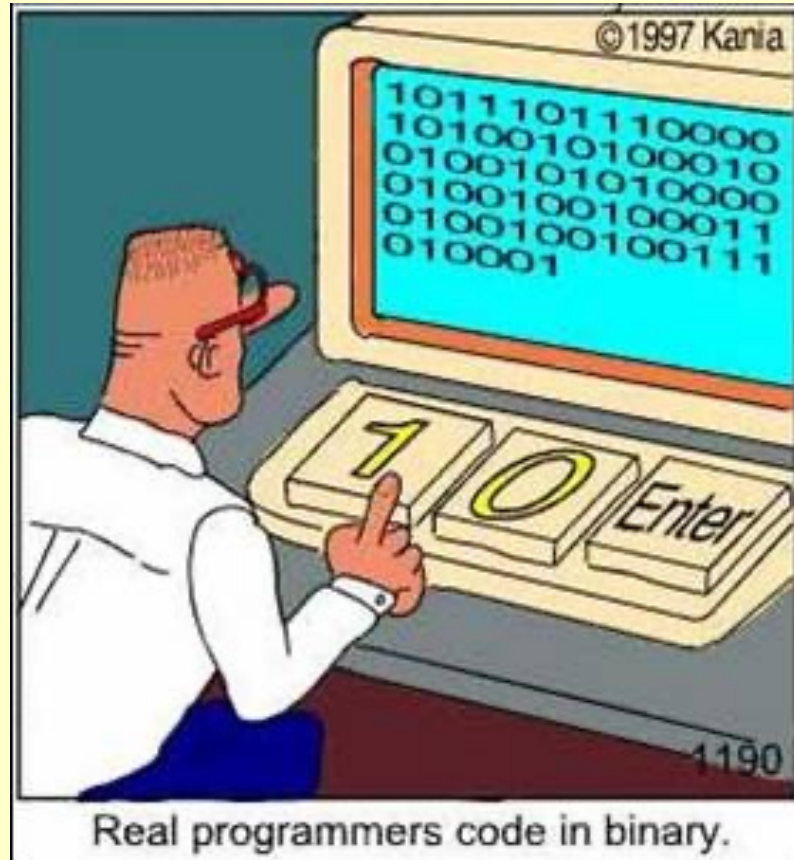
What is programming?

The act of writing a program.

What is a program?

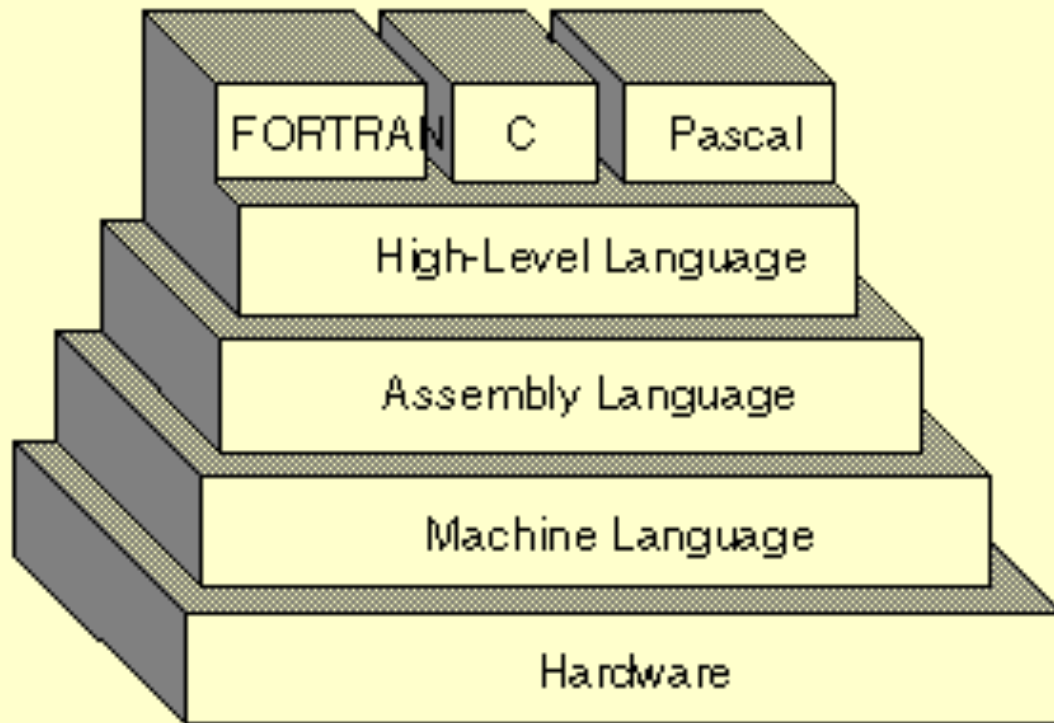
An algorithm written in a language that can be understood by computers.

Real programming?



<https://www.cengizhan.com/>

Hierarchy of languages



<https://www.webopedia.com/>

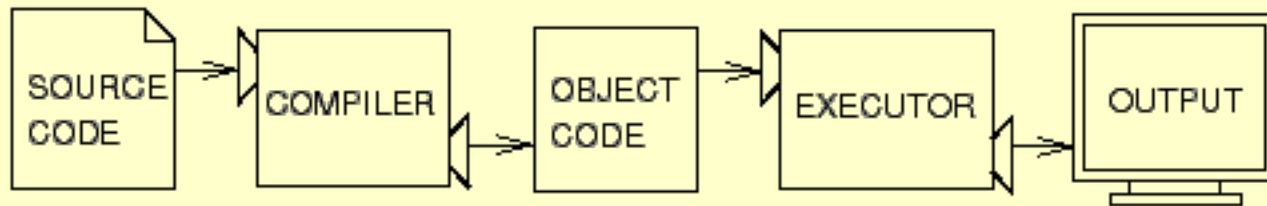
High-level languages

In practice, programs are written in *high-level languages* that can be understood by both human and computers.

Such programs are then translated to binary codes (in a machine language).

A compiler is a software system to perform such translation.

Compiler



- Translates a program into binary/object code completely before execution.
- Program execution is done by running binary/object code.
- The first compiler was invented by

Grace Murray Hopper (1906-1992)



<https://www.wikipedia.org/>

September 16, 2026

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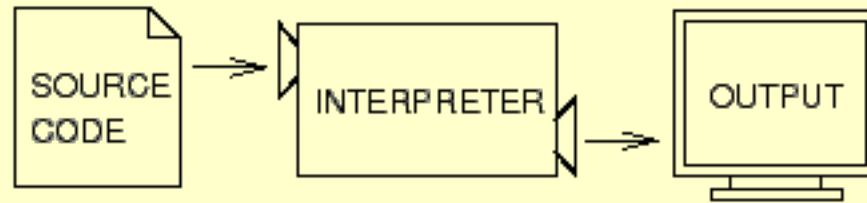
High-level languages

In practice, programs are written in *high-level languages* that can be understood by both human and computers.

Such programs are then translated to binary codes (in a machine language).

An interpreter provides another way to perform such translation.

Interpreter



- Translates and executes a program one line at a time.
- Unlike compilers, programs must be translated every time they are executed.
- Inefficient in general, but convenient!

Modern high-level languages

- Compiled: C/C++, Fortran, Java, Pascal, ...
- Interpreted: JavaScript, PHP, Python, Ruby, Scheme, ...

Java

```
class HelloWorld {  
    static public void main(String args[]) {  
        System.out.print("Hello, World!");  
    }  
}
```

C++

```
#include <iostream.h>

main() {
    cout << "Hello, World!";
    return 0;
}
```

Python

```
print('Hello, World!')
```

Scheme

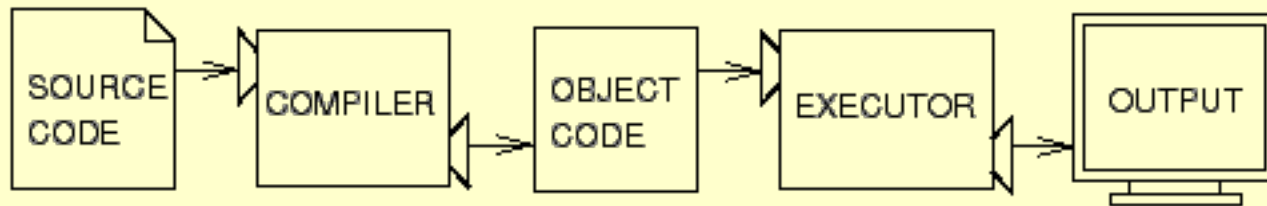
```
(define helloworld  
  (lambda ()  
    (display "Hello, World!")))
```

What is Java?

What is Java?

- A modern, general-purpose, compiler-based language.
- Its root can be traced back to C.
- Designed to work over networks (under the client-server paradigm).
- Designed as an *object-oriented* language.
- Less efficient than C/C++, but far more versatile.

Java compiler



- Translates a program into object code that can be executed on *any* platform.
- Program execution is done by an executor called the Java Virtual Machine (JVM).
- This paradigm allows "Internet computing".

James A. Gosling (1955—)



<https://www.wikipedia.org/>

Program development

Program development

Its foundation is a three-step process consisting of:

1. Formalize the problem.
2. Design an algorithm.
3. Translate the algorithm into program code.

Formalize and design

- Analyze and formalize the problem to be solved. Determine the *Input/Output (I/O) specification* (which in turn determines what the program has to accomplish).
- Formulate the overall structure of the program. Design algorithms that meet the specification. Algorithms are written informally in *pseudocode*.

Then code

- Translate the algorithm into program code.
- More precise your algorithm is, easier it is to translate: One line of pseudocode should correspond to one line of program code.

Program development cycle

For completeness, it is a cycle consisting of:

1. Formalize the problem.
2. Design an algorithm.
3. Translate the algorithm into program code.
4. Correct syntax errors
5. Test the program
6. Correct semantic errors