Introduction to Software Design I

computers and **programming**

are tools for

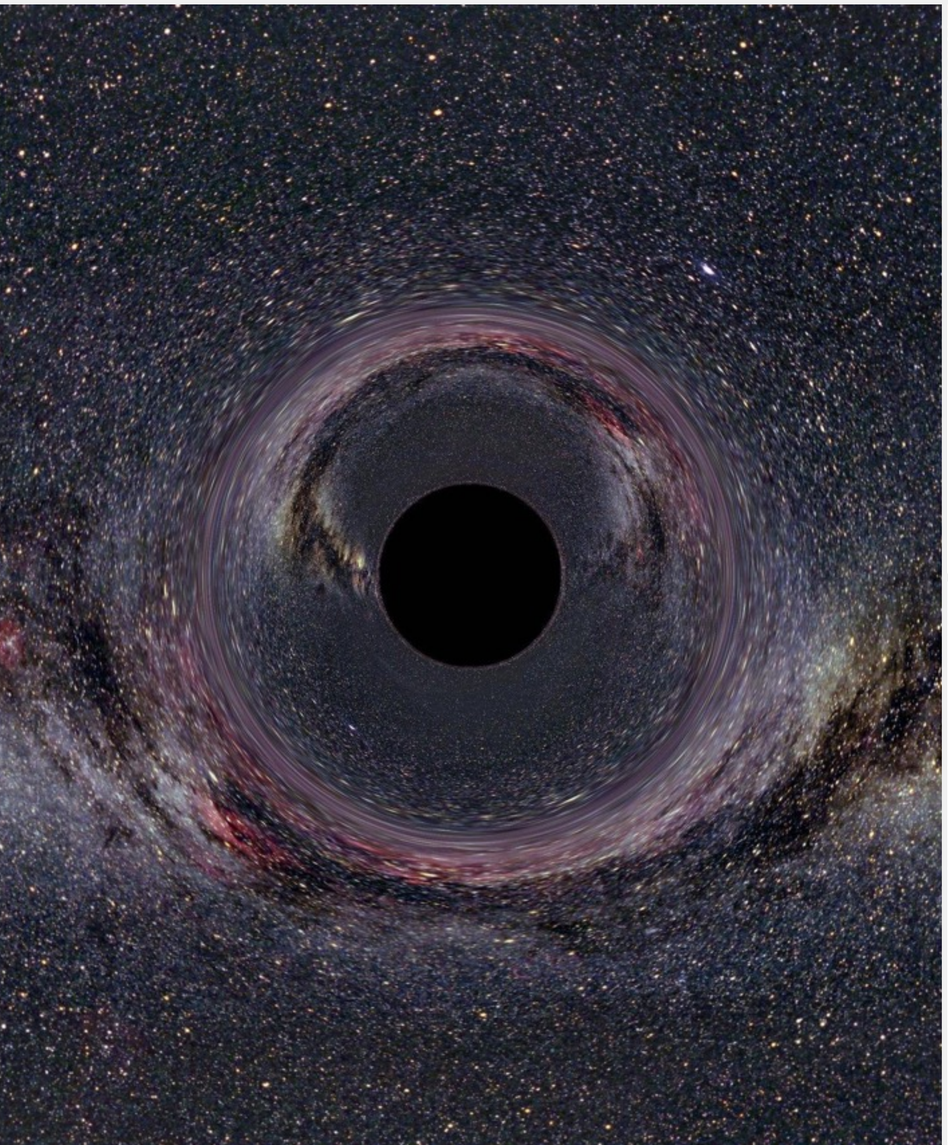
empowering people

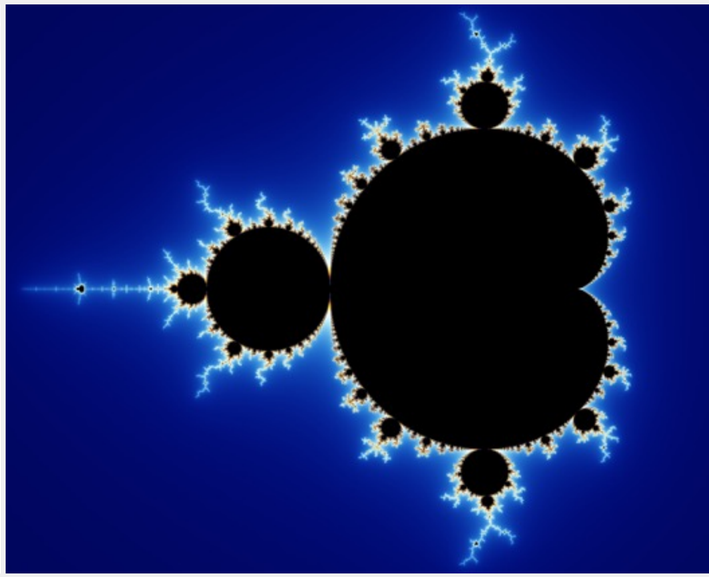
through the art of

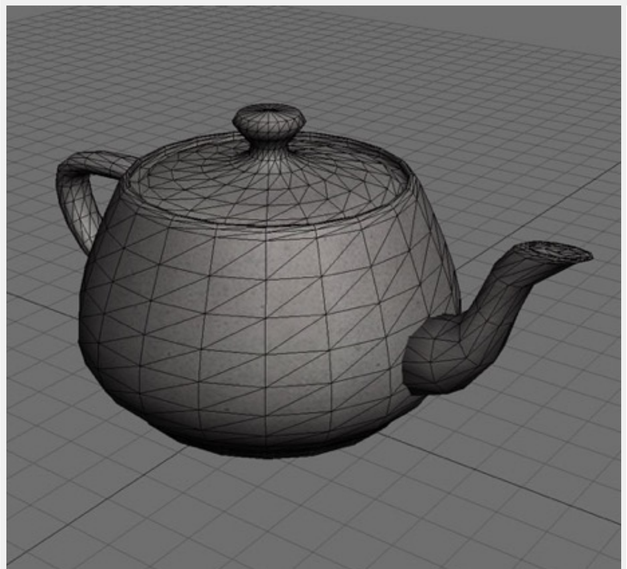
problem solving

Empowering People

Programming in Scientific Work







computers are becoming

increasingly dominant

in our jobs and lives

The Power of Computers

Three distinct advantages

1. can remember/process a large amount of information
2. can process information quickly
3. can repeat a well-defined task forever

Take advantage of this through programming

programming is a tool

necessary to make computers

work for us

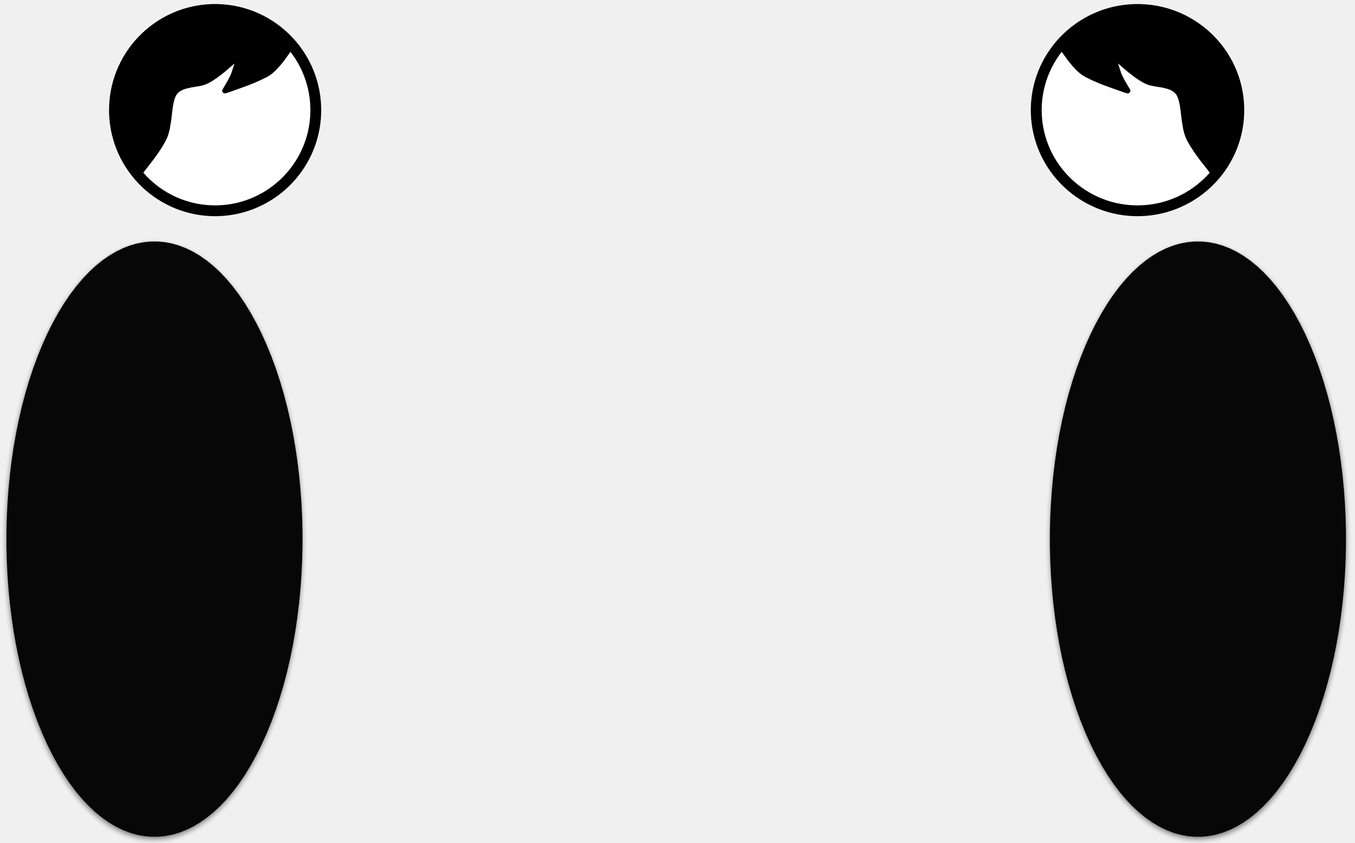
programming is a tool

necessary to make computers

work for us

goal: work smarter, not harder

Giving Instructions



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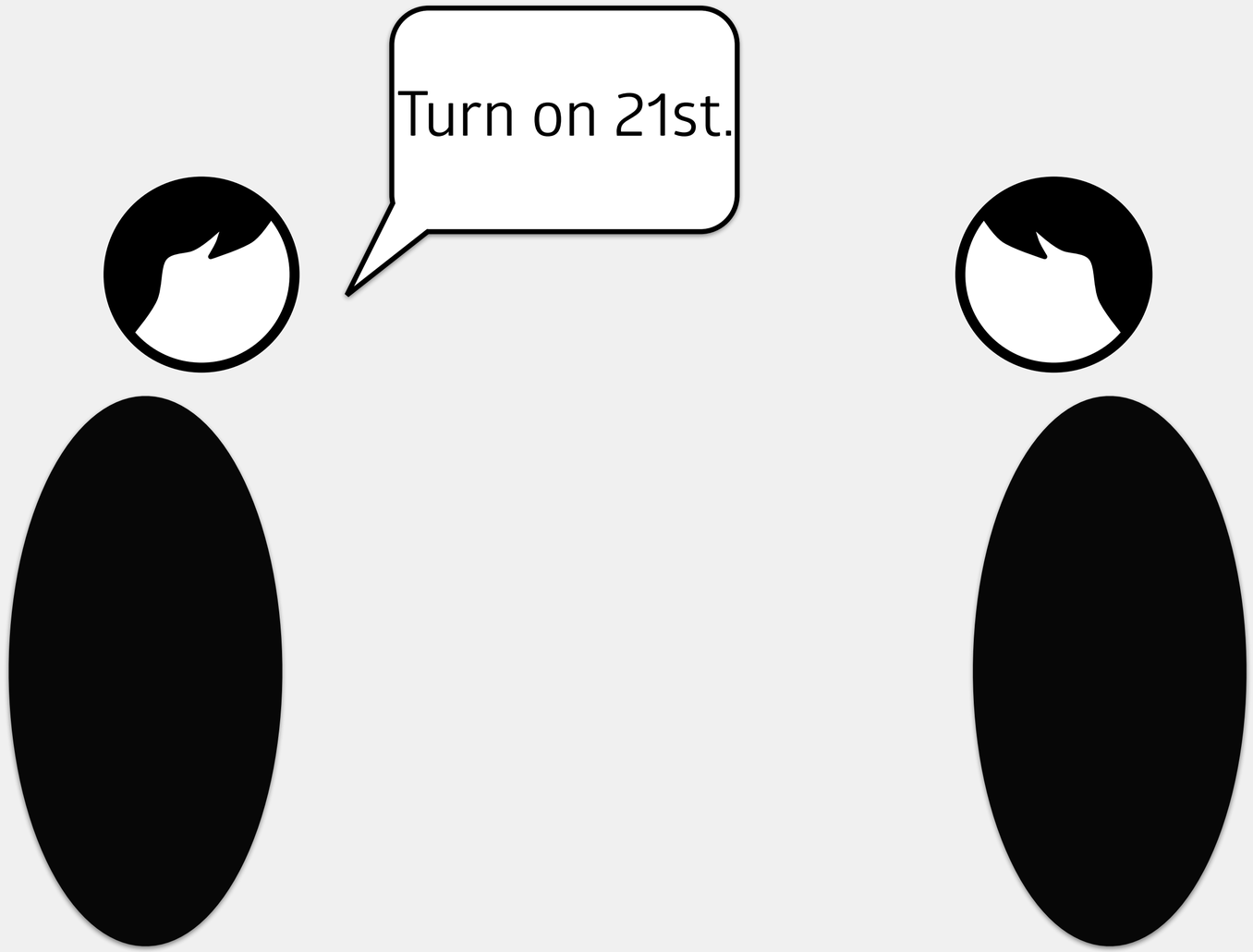

Giving Instructions

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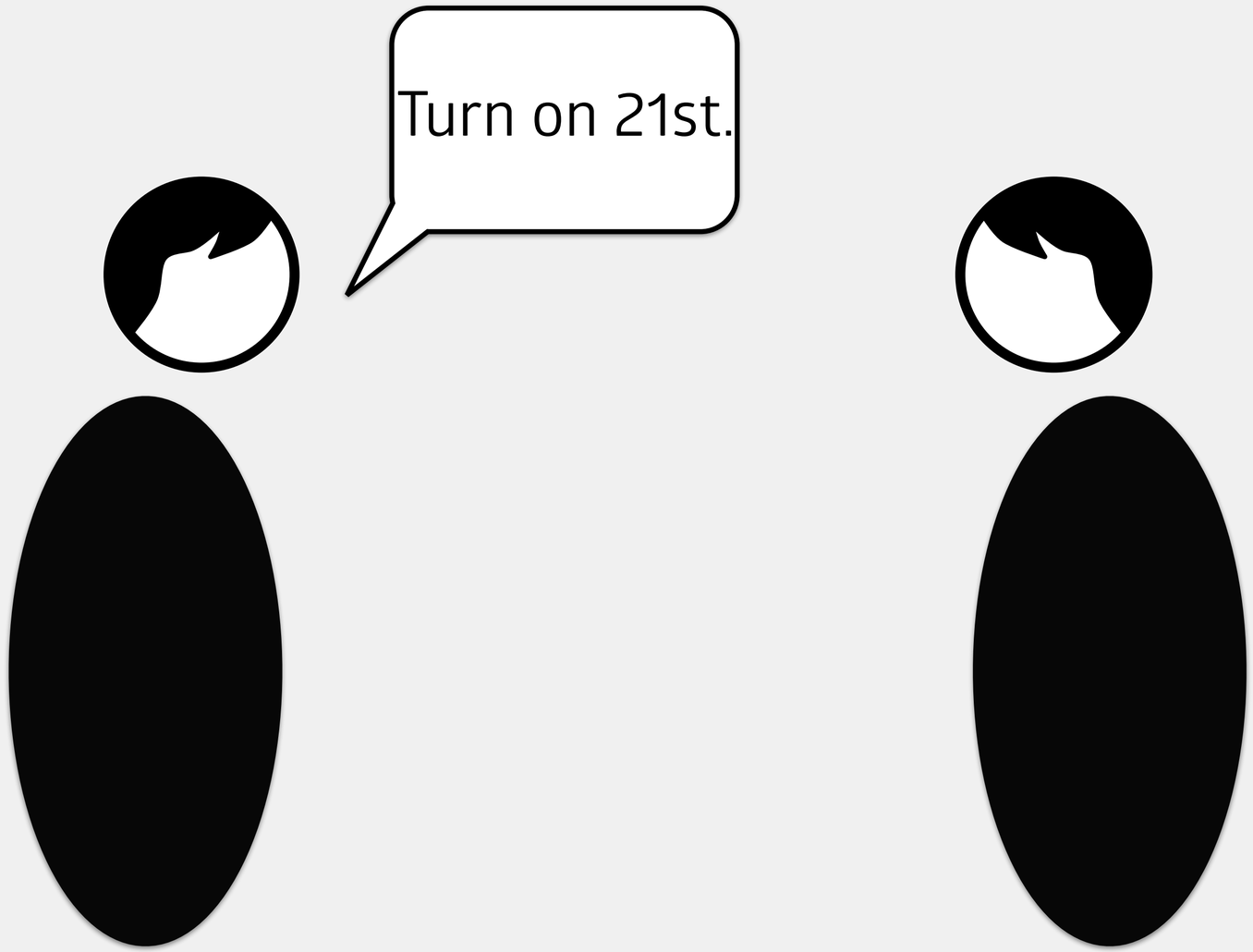

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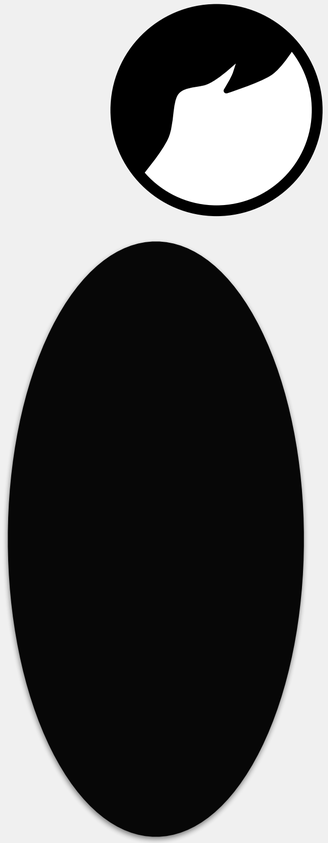
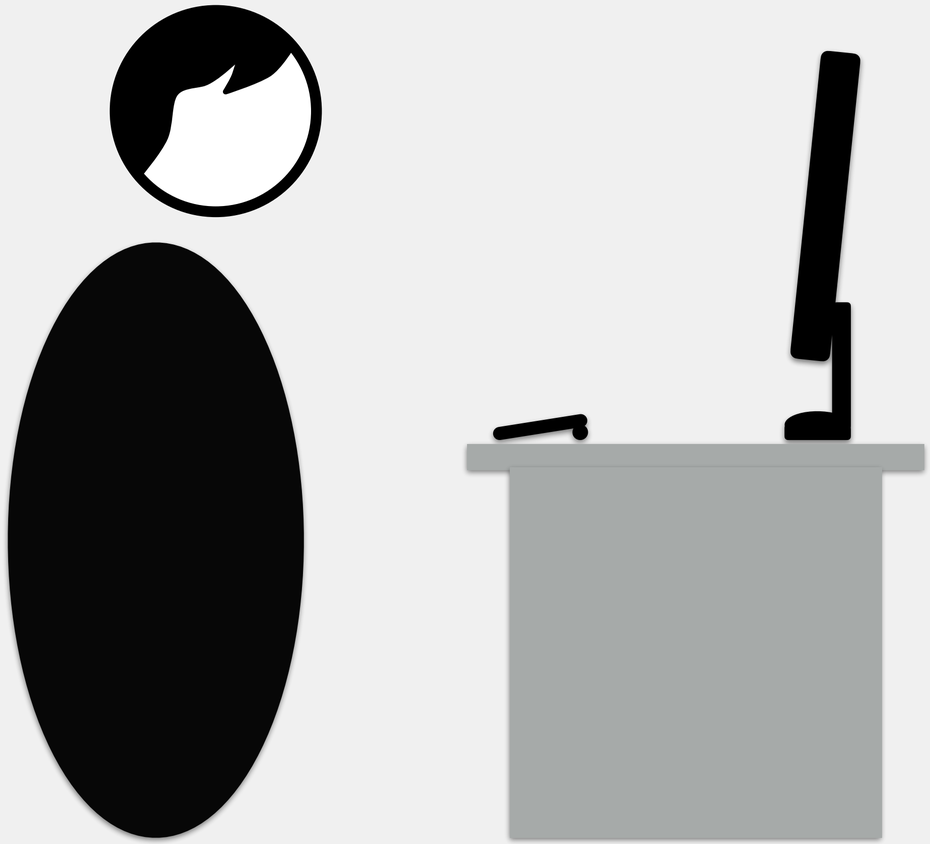
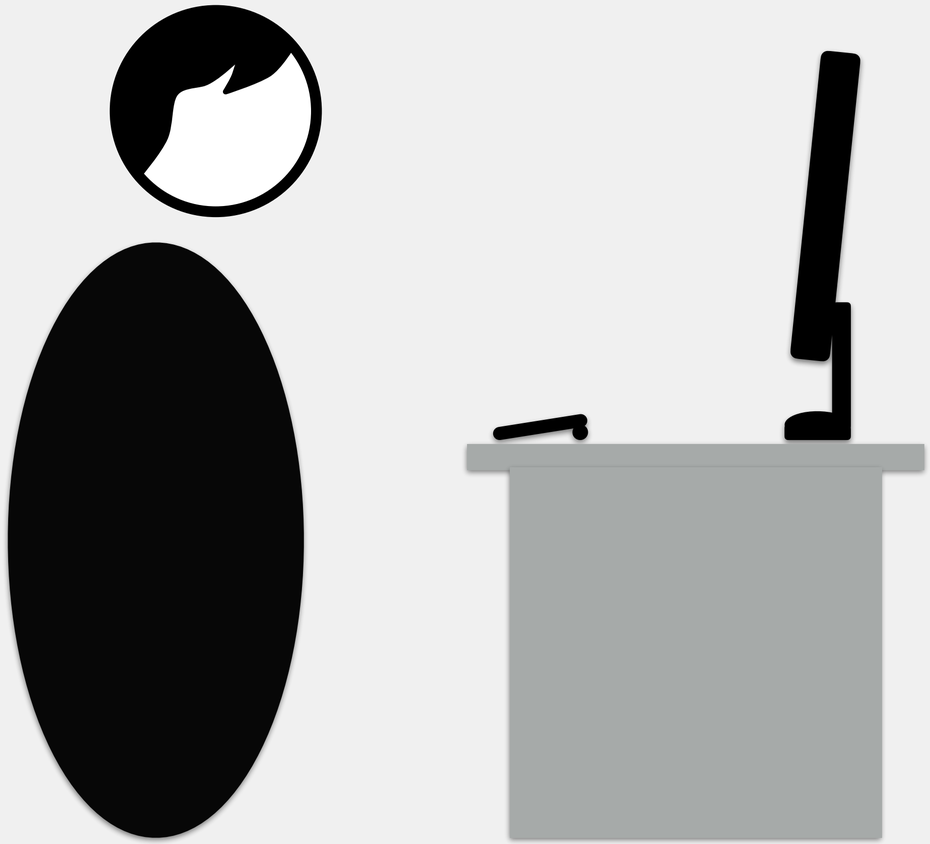


Programming as a Language



Programming as a Language

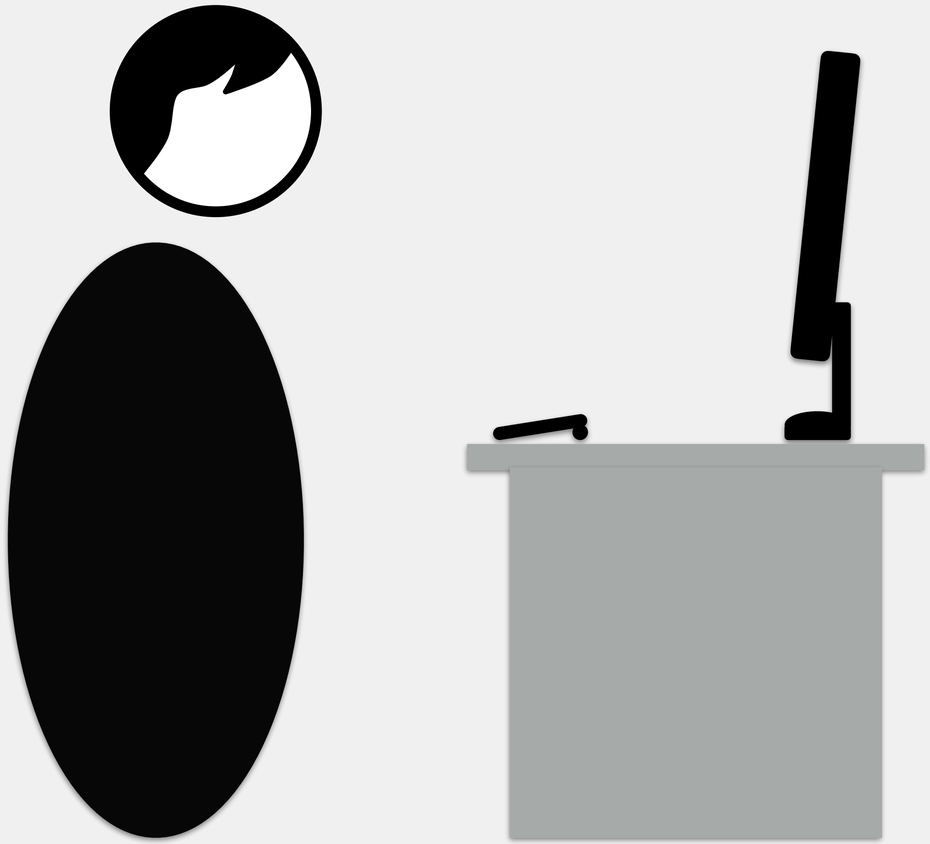
Two main differences:



Programming as a Language

Two main differences:

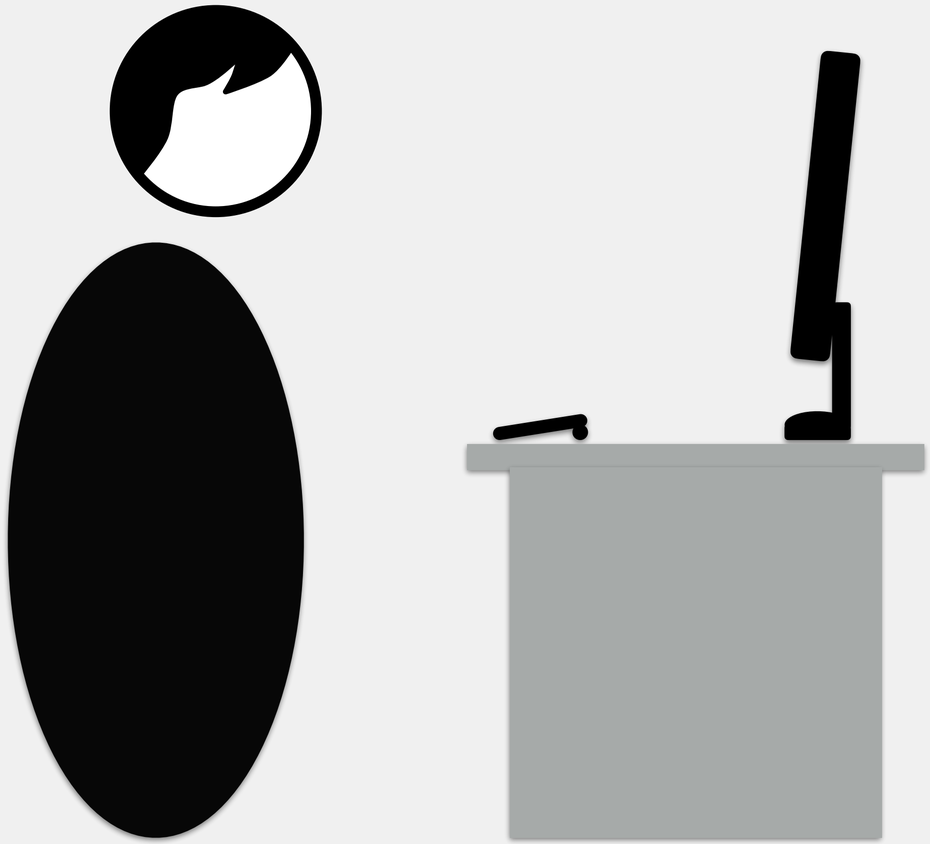
1. A programming language speaks on a computer's terms



Programming as a Language

Two main differences:

1. A programming language speaks on a computer's terms
2. A computer is not smart and adaptable like a human



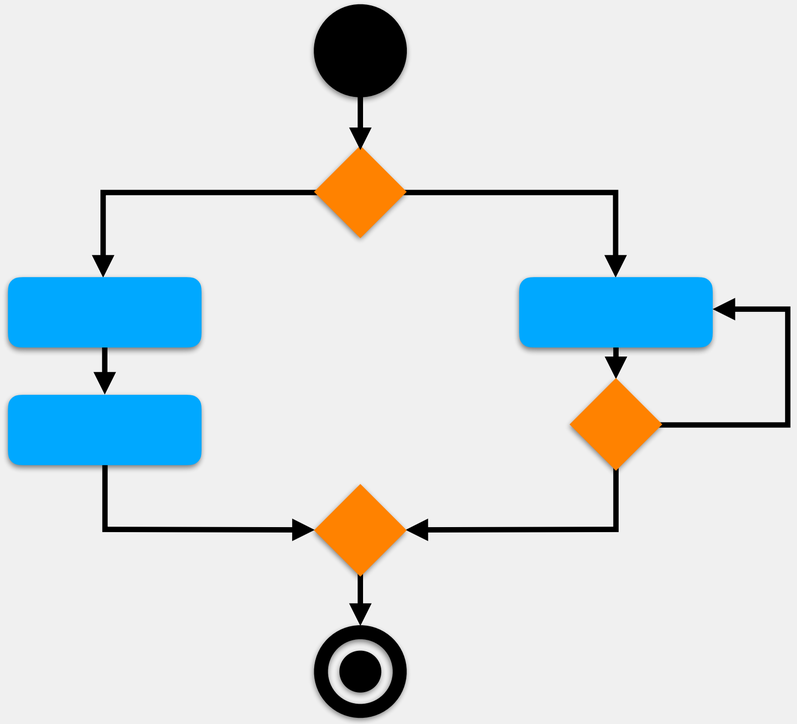
Two Main Aims of this Course

```
int i = 0;

while (i < arr.length) {
    if (arr[i] % 2 == 0) {
        arr[i] = i * 2;
    } else {
        arr[i] = i / 2;
    }

    ++i;
}
```

Fundamental
Programming Concepts



Computational Thinking
& Problem Solving

Two Main Aims of this Course

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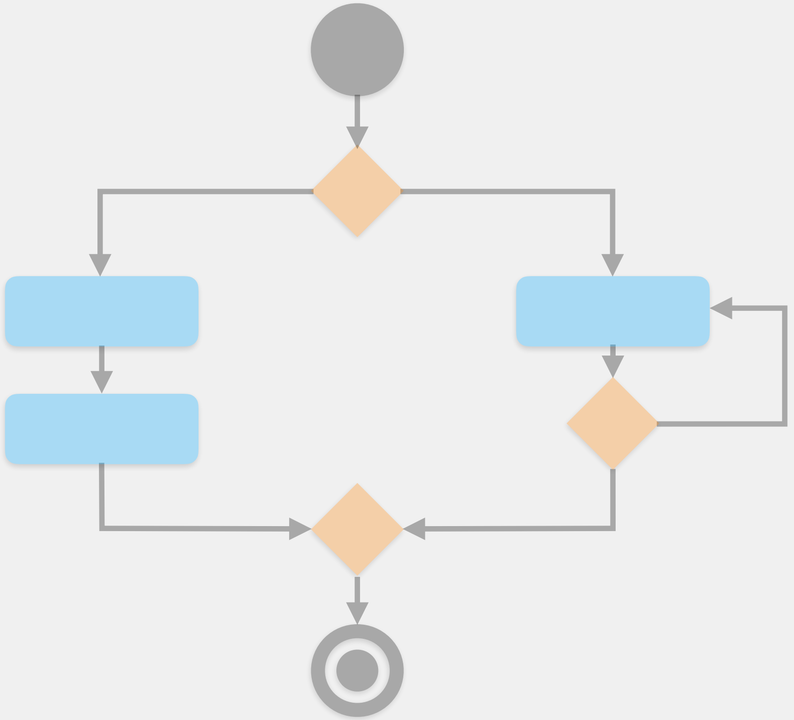
Fundamental
Programming Concepts



Computational Thinking
& Problem Solving

Fundamental Programming Concepts

Learning the fundamentals of a programming language

- in our case, Java

Enables us to communicate instructions to the computer

Serves as a tool for problem solving

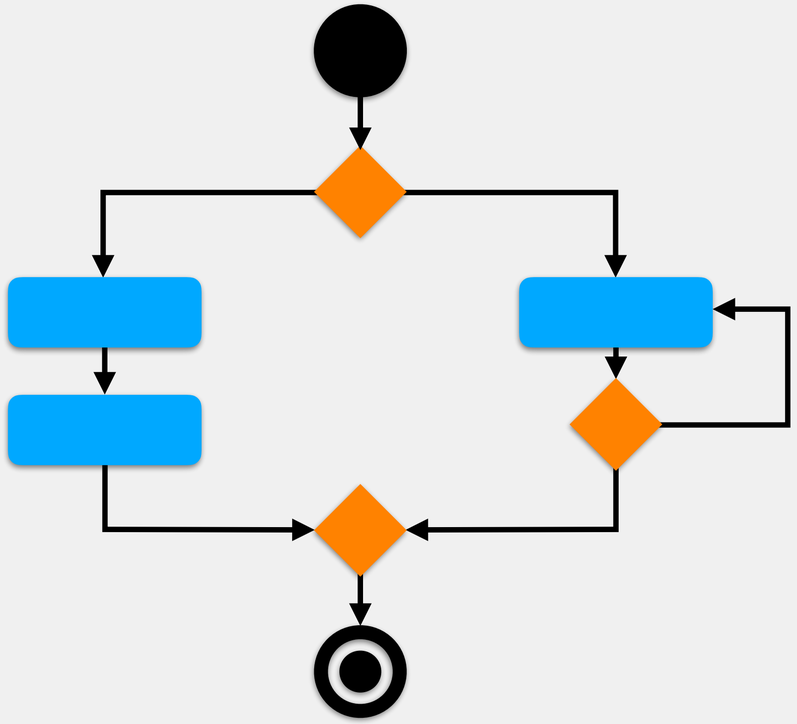
Two Main Aims of this Course

```
int

while

}
```

Fundamental
Programming Concepts



Computational Thinking
& Problem Solving

Computational Thinking & Problem Solving

How we approach problems and form our solutions to them

Computers are not very smart

- limited set of instructions to communicate with
- not able to adapt/interpret what we meant if we do not clearly communicate

Two steps:

1. recognizing how we might solve a problem as humans
2. translating that problem solving approach such that a computer will understand it

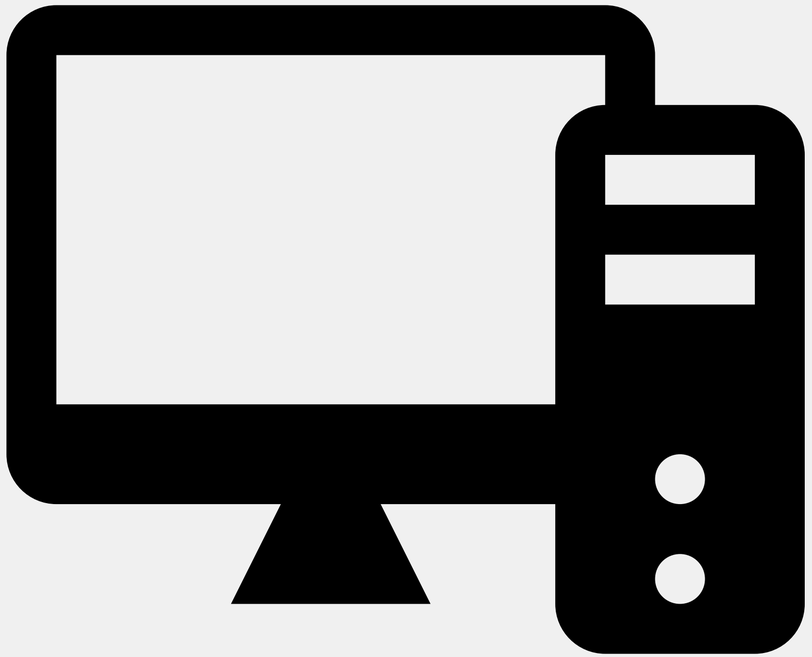
How can I **solve** a given **problem**

with the **tools** I have?

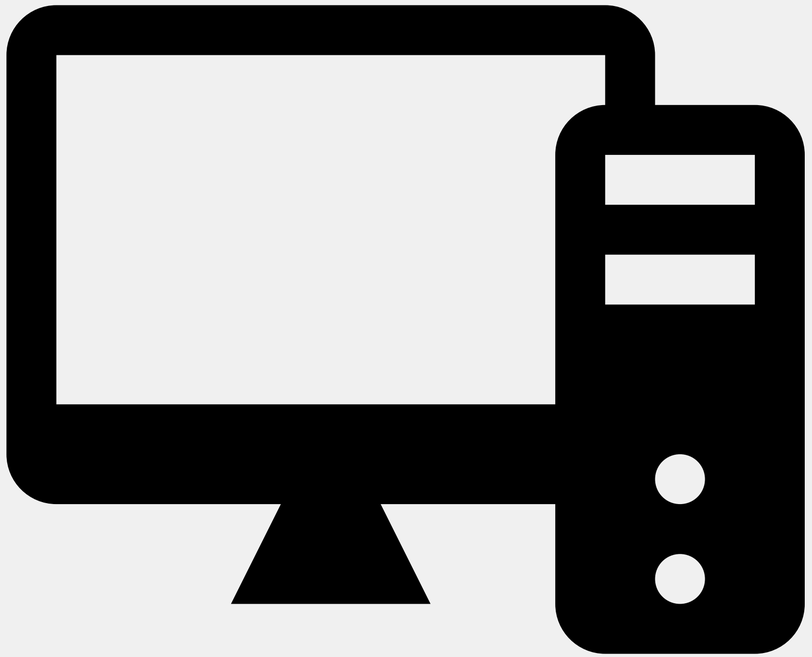
https://www.youtube.com/watch?v=nKlu9yen5nc&index=13&list=PLzdnOPI1iJNfpD8i4Sx7U0y2MccnrNZuP

https://www.youtube.com/watch?v=nKlu9yen5nc&index=13&list=PLzdnOPI1iJNfpD8i4Sx7U0y2MccnrNZuP

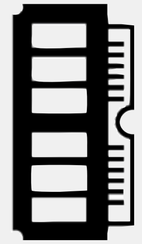
Computer Science Ecosystem

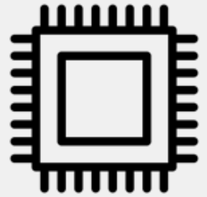


Computer Science Ecosystem

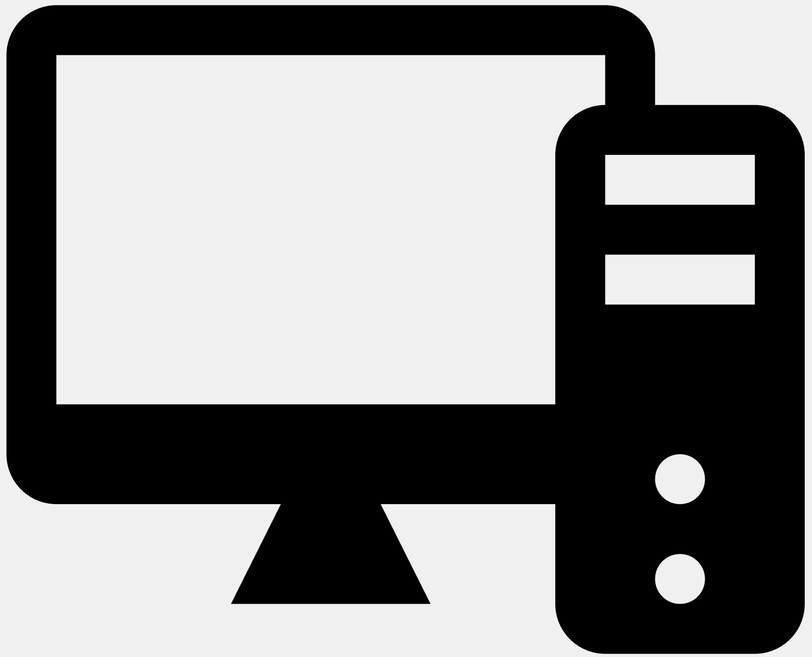


computer
hardware





Computer Science Ecosystem



computer architecture

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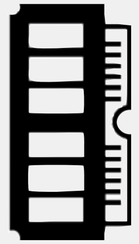
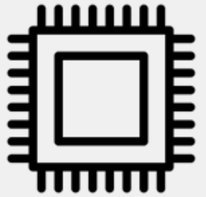
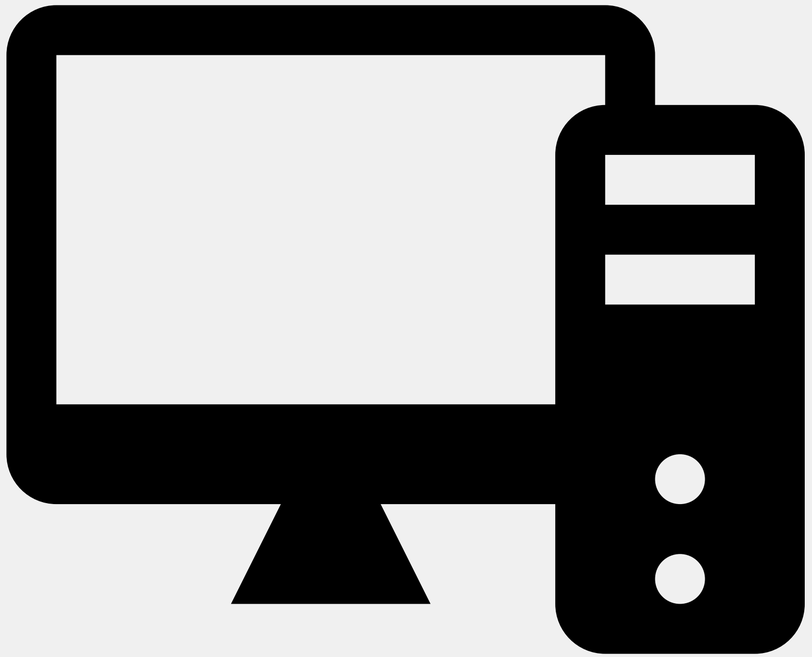
computer hardware

Computer Science Ecosystem



operating system

computer architecture

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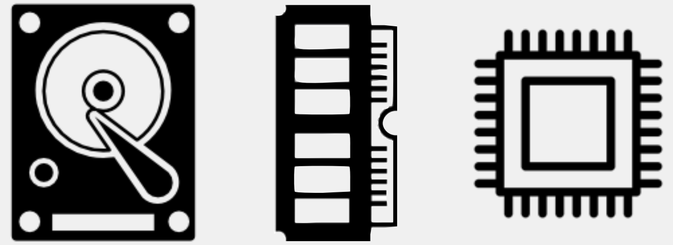
computer hardware



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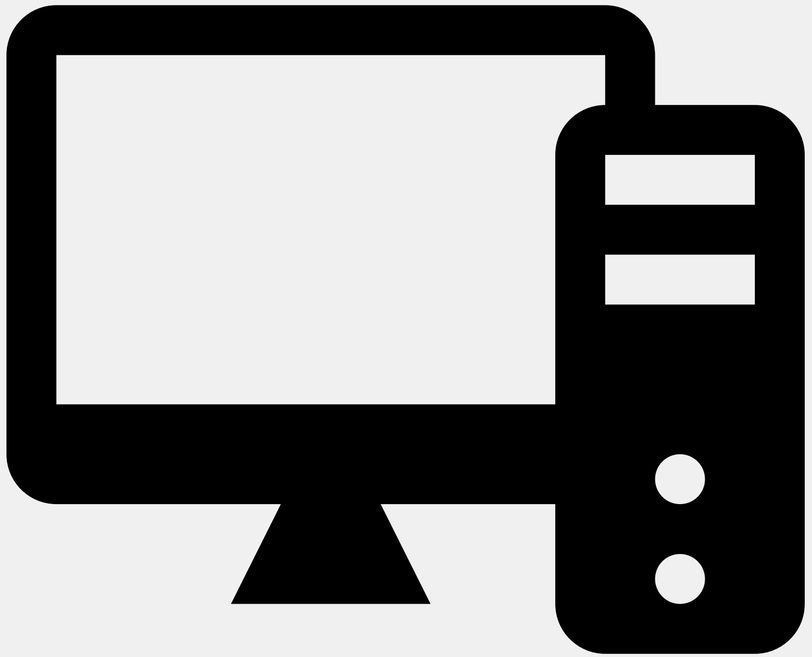

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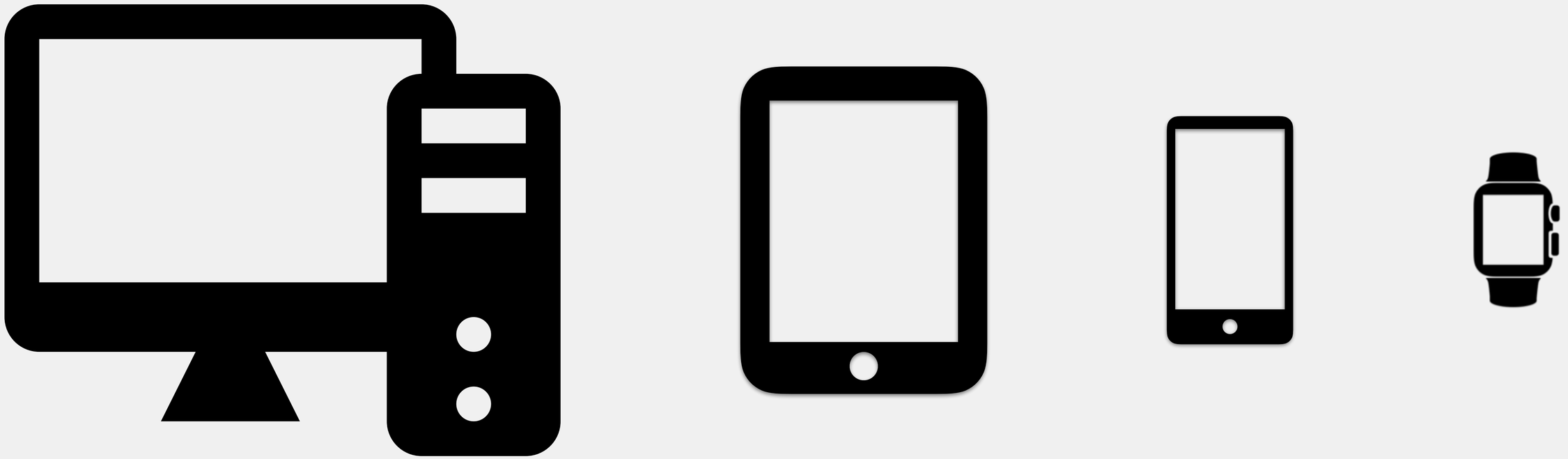

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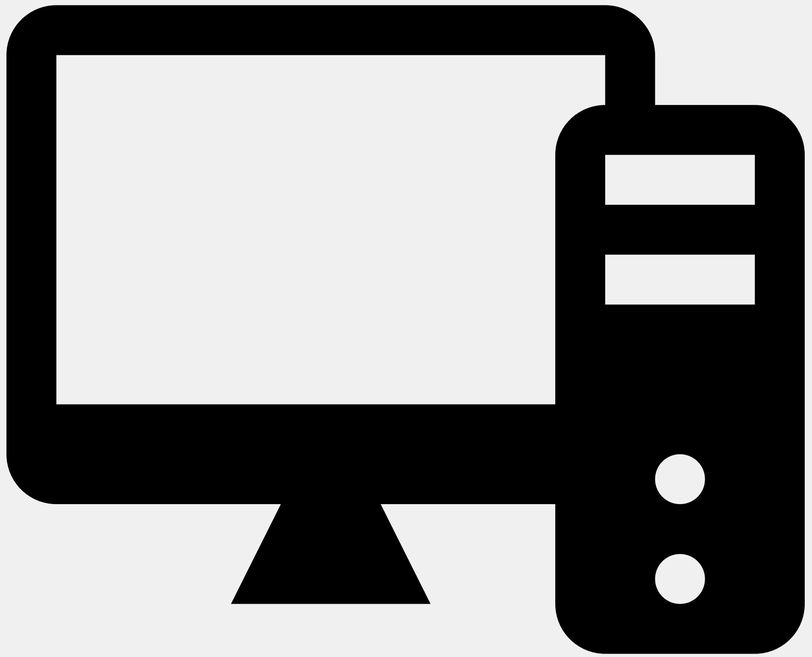

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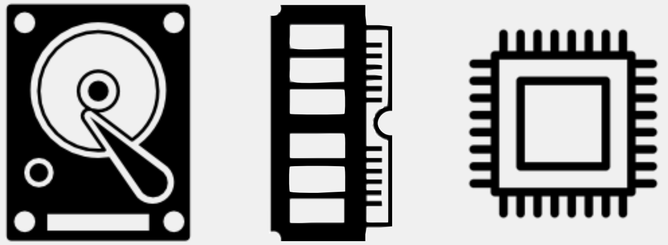

Computer Hardware

hardware: the physical components of the computer

Computer Hardware

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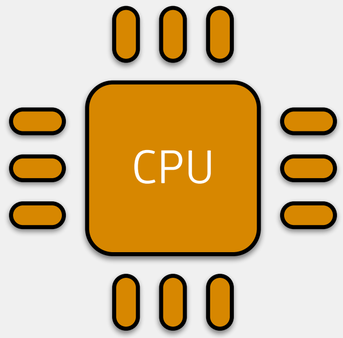

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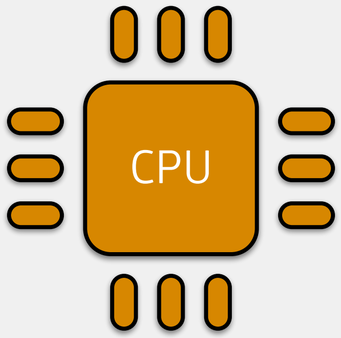


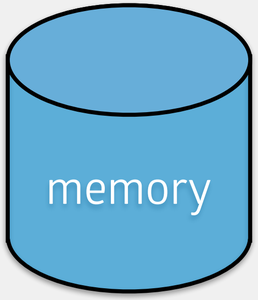
central processing unit (CPU)

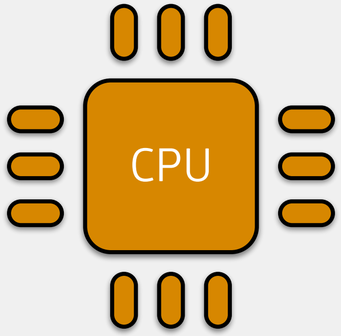
processes input

“brains” of the computer

Computer Hardware

hardware: the physical components of the computer





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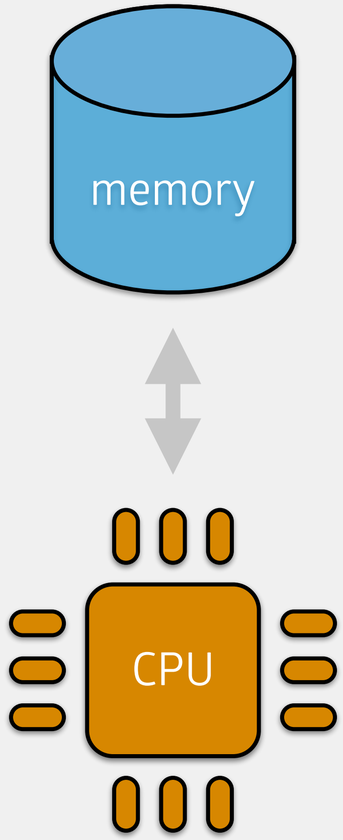
Computer Hardware

hardware: the physical components of the computer

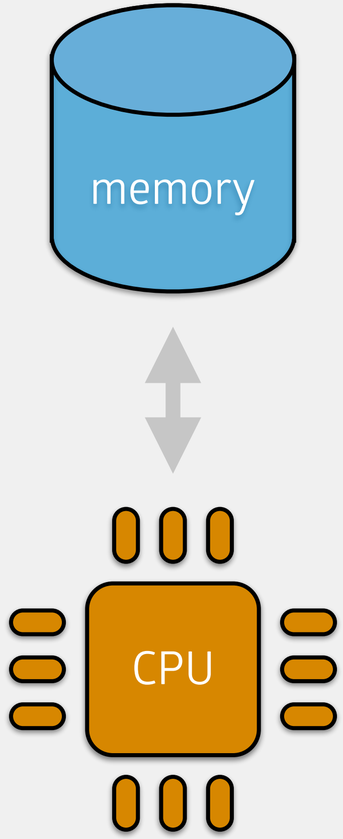


saves/stores data, instructions
e.g., hard drive, RAM, flash drive

central processing unit (CPU)
processes input
“brains” of the computer

Computer Hardware

hardware: the physical components of the computer



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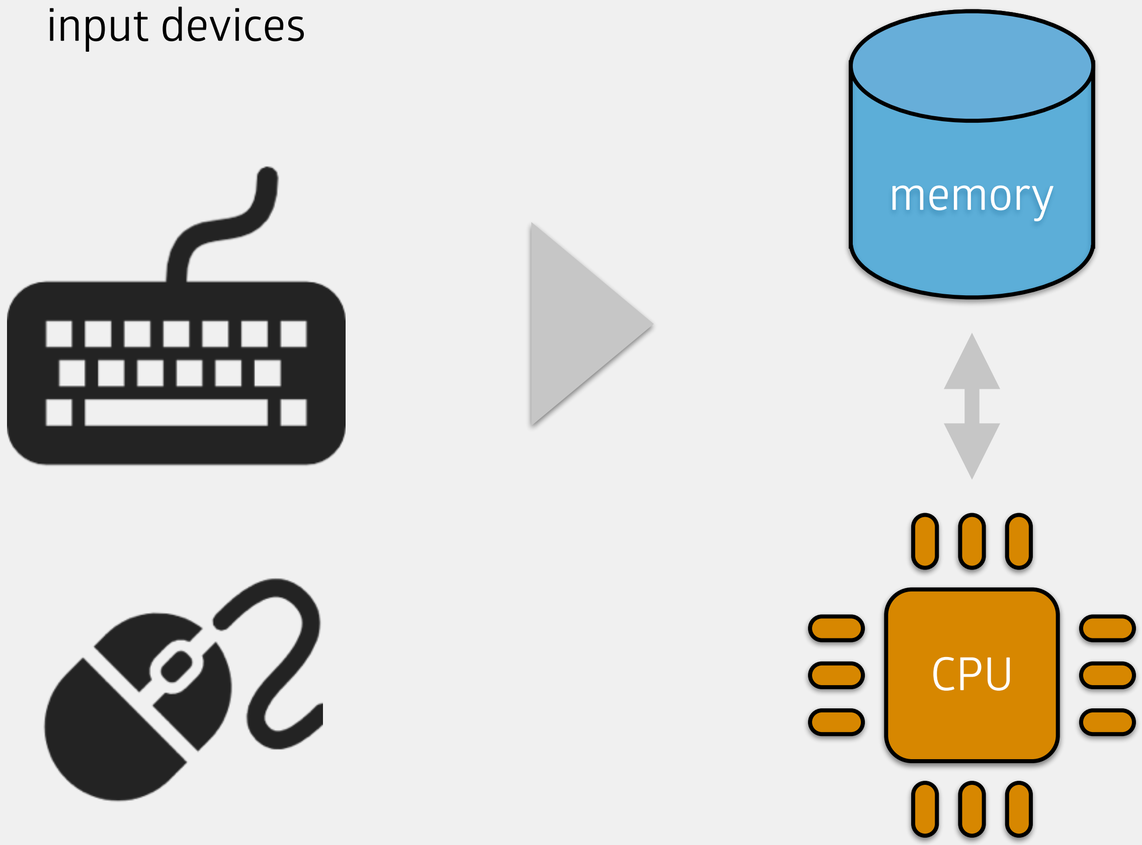
hardware: the physical components of the computer



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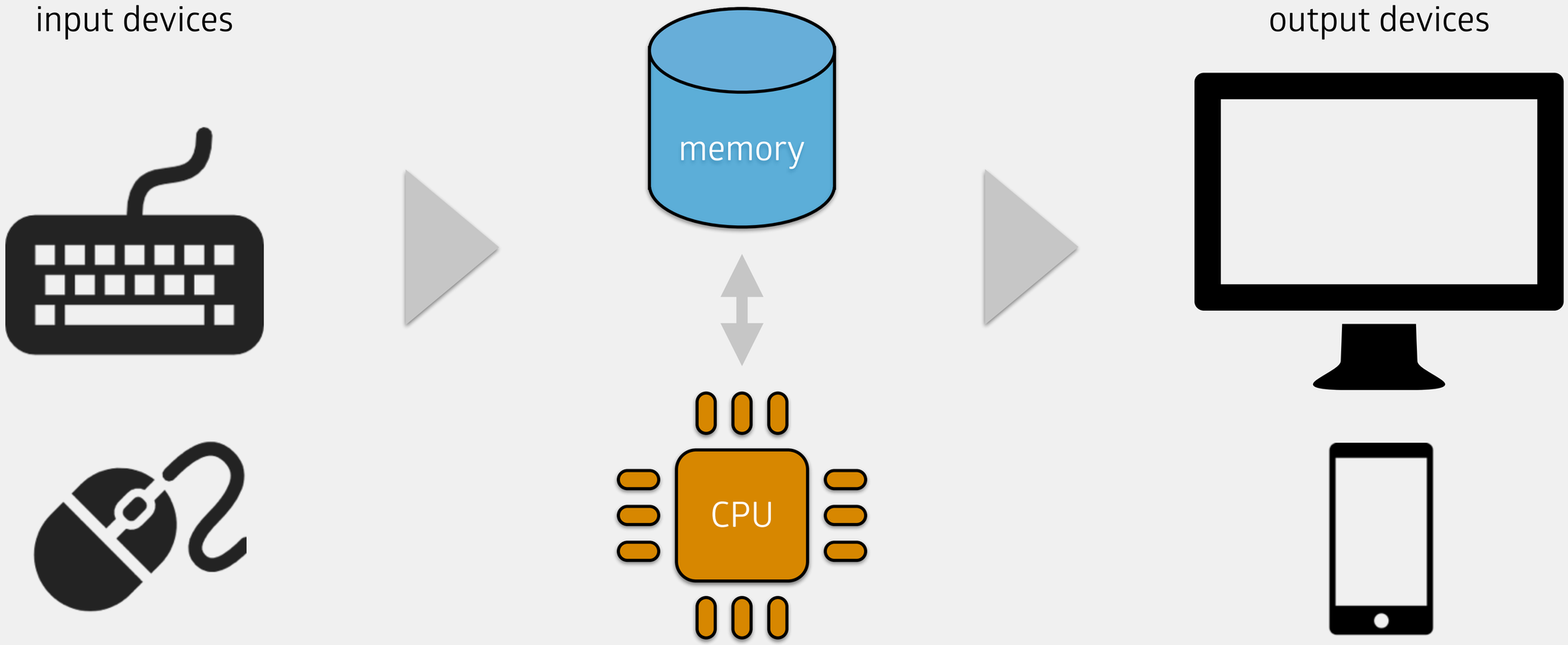
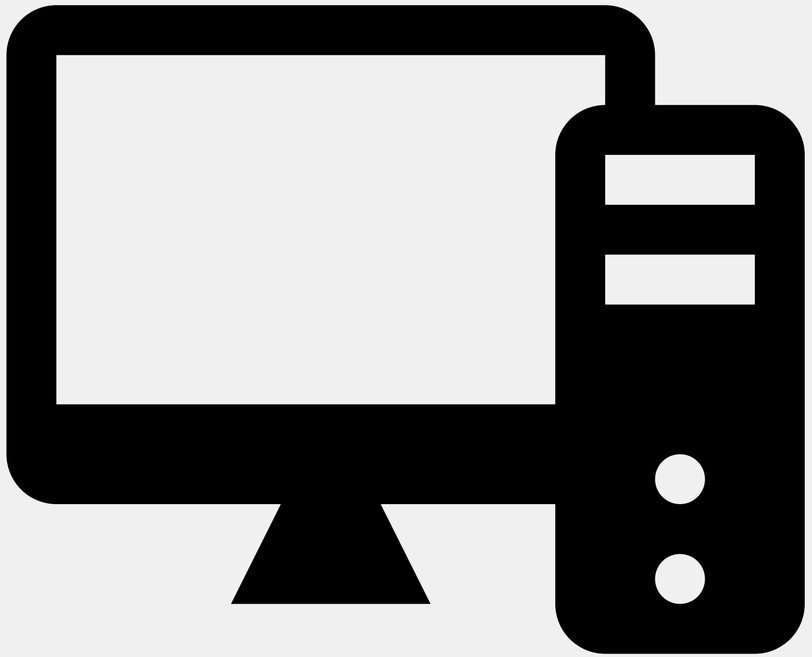


Computer Science Ecosystem



operating system

computer architecture

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computer hardware

Operating System

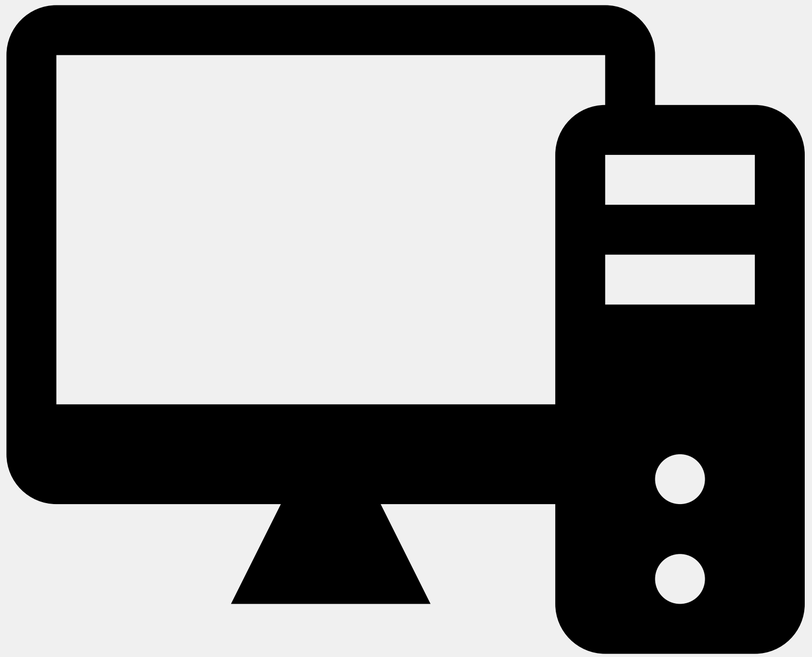
Allows people to easily interact with a computer

Manages computer resources (e.g., hardware, software)

applications: programs written for a computer for a specific task

- document creation, music/video playback, web interfaces

Computer Science Ecosystem



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computer hardware

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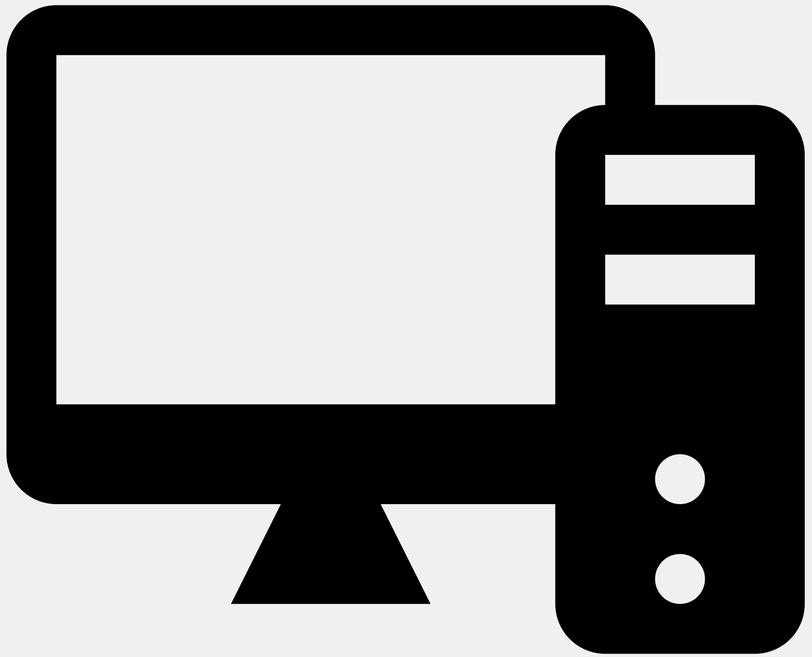

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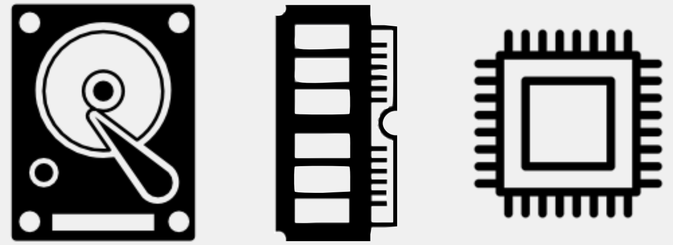

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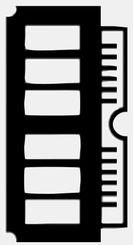
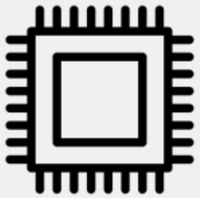

Computer Science Ecosystem

operating system

computer architecture

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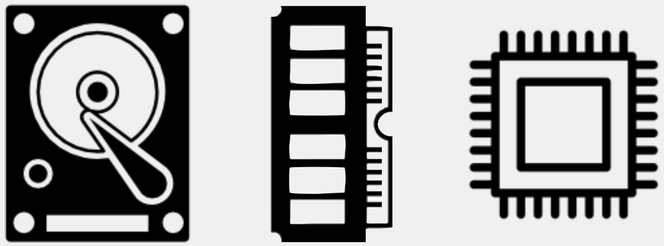
allows the hardware to communicate with the architecture in a basic programming language (*low level programming language*)

computer hardware



Computer Science Ecosystem

operating system

allows the OS to communicate with the architecture in a more English-like programming language (*high level programming language*)

computer architecture

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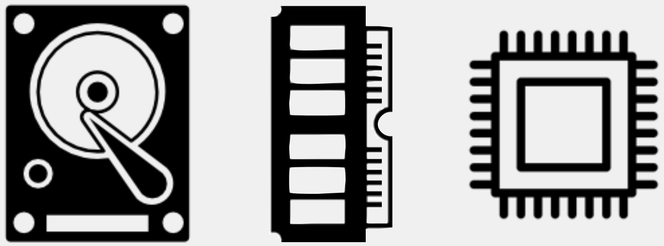
computer hardware



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Computer Science Ecosystem

operating system



computer architecture

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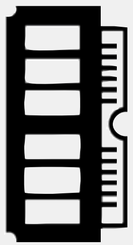
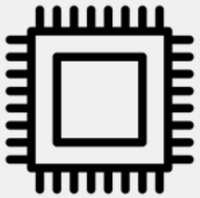

Computer Science Ecosystem

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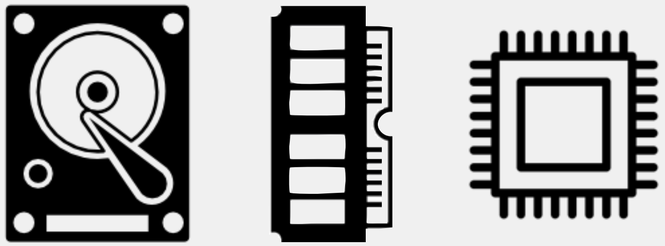

Applications run on the OS

People need to program these too!

Computer Science Ecosystem

operating system



computer architecture

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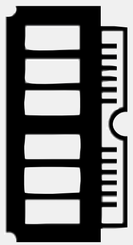
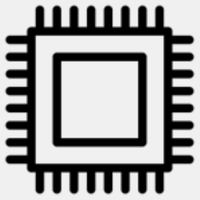
computer hardware

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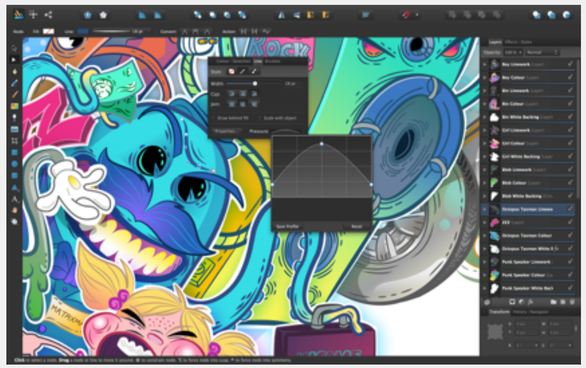

Programming

A tool to give instructions to a computer

Consists of a set of fundamental *programming constructs*

These constructs are then implemented in a programming language

- each language implements these constructs in slightly different ways
- but, the concepts are universal across languages

Knowing one language makes it easier to learn others

Programming: Printing a Message

Displaying “Hello world!” to the user:

Java: **`System.out.print(“Hello world!”);`**

Python: **`print “Hello world!”`**

Lisp: **`(write-line “Hello world!”);`**

C: **`printf(“Hello world!”);`**

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C: **`printf(“Hello world!”);`**

basic syntax: **`<printing instruction> <what to print>`**

Programming Languages

Hundreds of languages

- each has unique features, uses

Can be classified into a variety of paradigms

programming language paradigm: a fundamental style of programming

- multiple paradigms
- each language implements one or more paradigms

In this class, we're learning a language called Java

The Java Programming Language

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Free for everyone to use

Primarily an object-oriented programming (OOP) language

Language is OS-agnostic

- identical code can be run on any machine with the same results

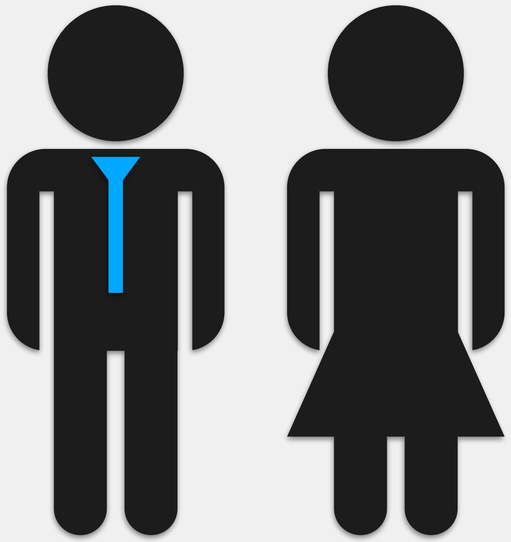
Object-Oriented Programming

OOP: based on the premise that programming is typically about representing real-world concepts in a way that a computer can understand/use them

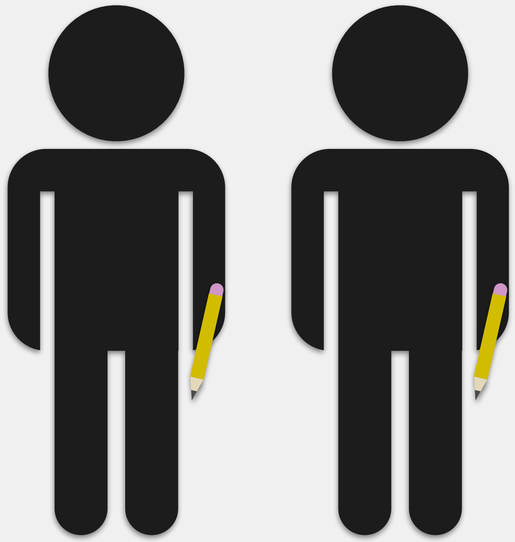
- overview today; will discuss this in more detail later in the semester
- other OOP languages: Python, C#, Ruby, C++, Objective-C

Describes how we organize our instructions

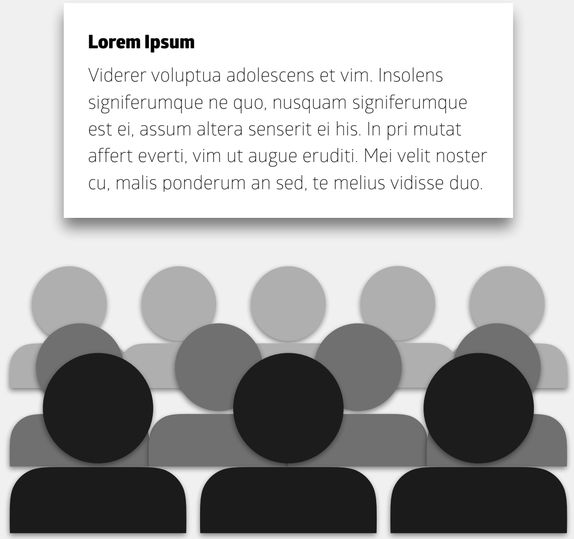
UWL as Data



professors

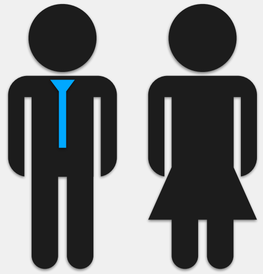


students



classes

UWL as Data



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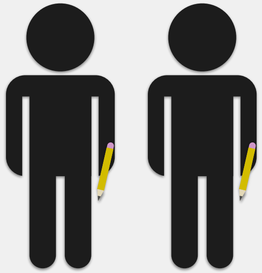

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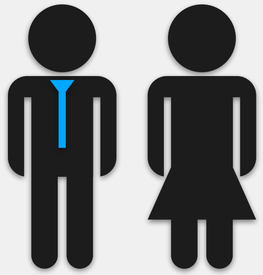

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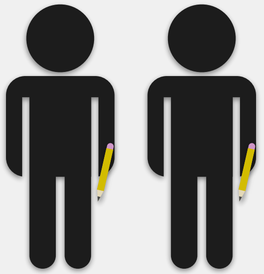
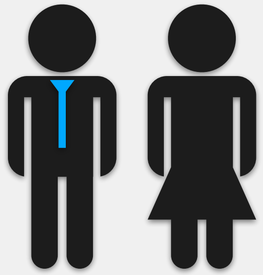


students

classes

- first name
- last name
- department

UWL as Data



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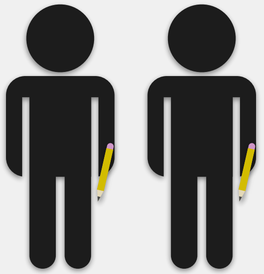

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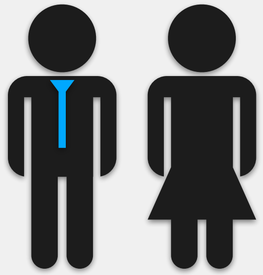

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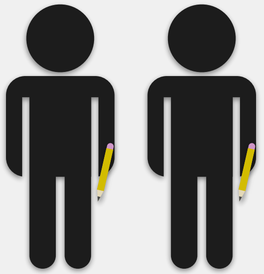

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classes

- department (e.g., CS)
- number (e.g., 120)
- section (e.g., 1)

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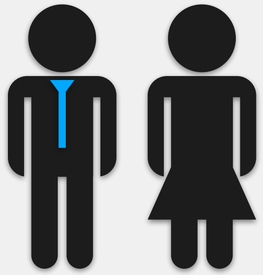

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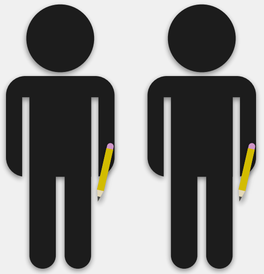

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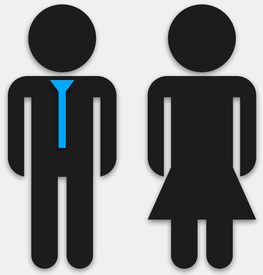

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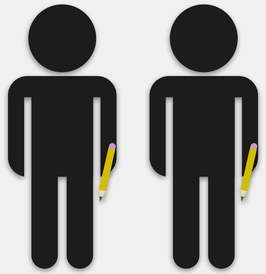

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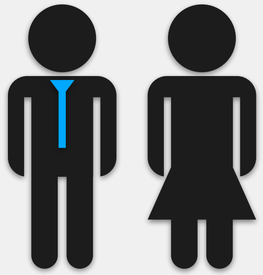

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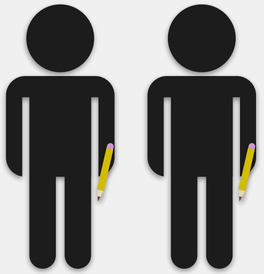

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classes

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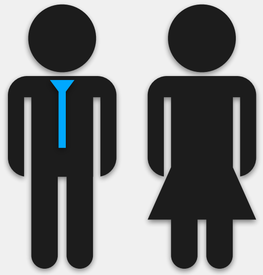

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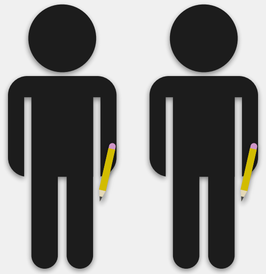

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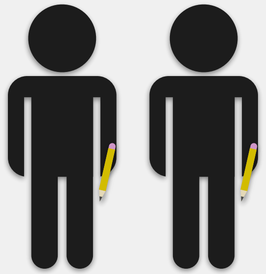

students

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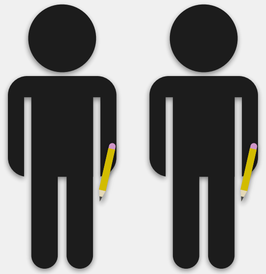

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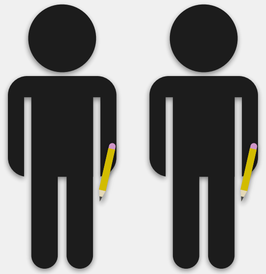

students

- birthday: **Feb. 23, 1994**
    - year: **1994**
    - month: **2**
    - day: **23**

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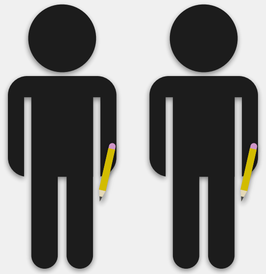

students

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Calculating a student's age: Write out instructions to calculate a student's age, given their birthday (i.e., year, month, day) and a value for today's date. Avoid using words like "before" or "after"; instead, use words for numerical comparison (e.g., "greater than", "less than or equal to"). Test your instructions with the following possibilities for today's date:

March 26, 2016

January 26, 2016

February 22, 2016

February 24, 2016

February 23, 2016