Principles of Software Programming: Introduction

WU WIRTSCHAFTS UNIVERSITÄT WIEN VIENNA UNIVERSITY OF ECONOMICS AND BUSINESS

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SS 2018

MARCH 2018.

EFMD EQUIS ACCREDITED · AACSB ACCREDITED · ASSOCIATION AMBA ACCREDITED

Preview

- Programming
- Algorithm

- First application **demo**!

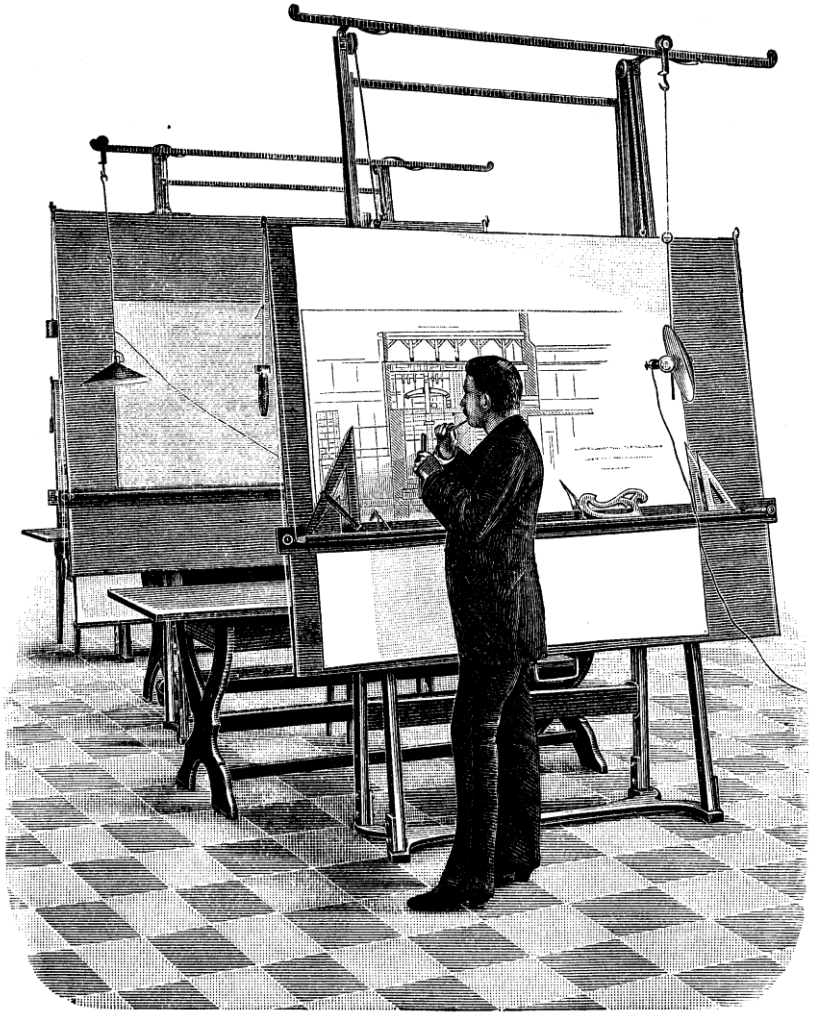
- How hardware works
- How software works

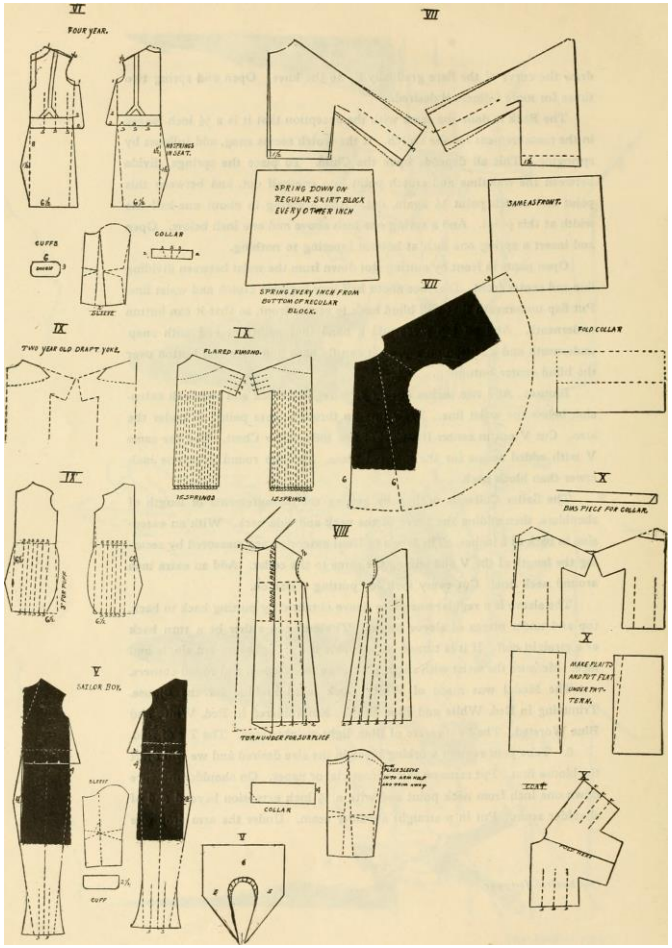
- End.

What is Programming?

https://pixabay.com/en/photos/computer%20science/
slide borrowed from Svitlana Vakulenko WS 2017 lecture slides

What is Programming?





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https://commons.wikimedia.org/wiki/File:Art_in_dress_(1922)_(14781442712).jpg
slide borrowed from Svitlana Vakulenko WS 2017 lecture slides

What is Programming?

Idea: describe a solution to the **problem** in a precise manner, so that computer can follow the **commands**

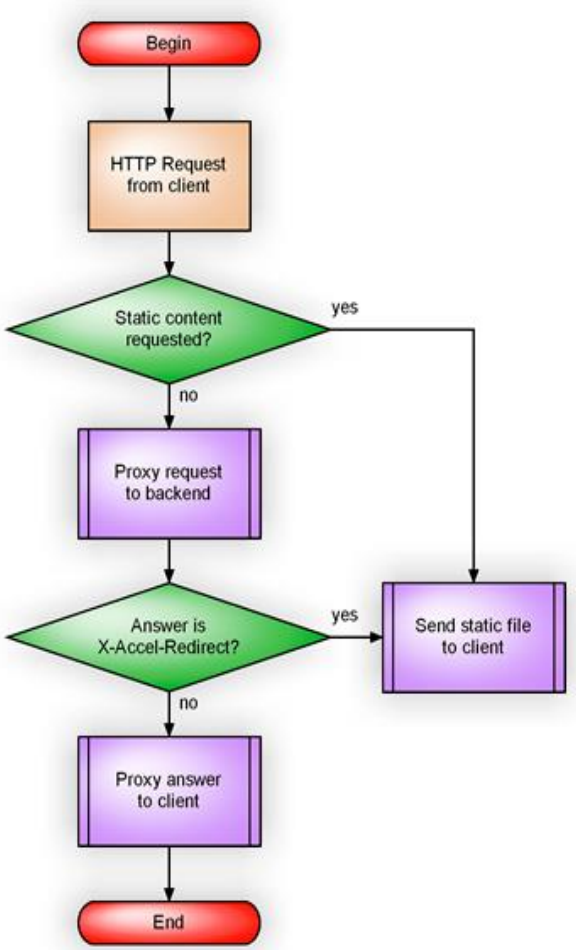
- Problem
- **Creative** solution

Data Inputs + **Program**(Commands) => Results

slide borrowed from Svitlana Vakulenko WS 2017 lecture slides

Algorithm

Sequence of commands (computation steps)



slide borrowed from Svitlana Vakulenko WS 2017 lecture slides

Examples of Algorithms

- Recipe for coffee, is an algorithm

http://2.bp.blogspot.com/-bPE0E6zEHkg/T4bGyQaMSlI/AAAAAAAAoA0/cPDOpjpt9AY/s1600/20120402_Demel-Coffee-Einsp%25C3%25A4nner-Copyright-Merisi-Vienna_0218.jpg
https://www.epicurious.com/recipes/food/views/einspanner-200826

Examples of Algorithms

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EINSPANNER

Coffee:

- 60 ml (2 shots) espresso
- cocoa powder to top
- brown sugar as preferred

Whipped cream:

- 100 to 120 ml heavy/whipping cream (aka 35% cream)
- 1.5 tsp powdered sugar
- 1/2 tsp vanilla extract (optional)

Instructions:

Whip the heavy cream until stiff with peaks by hand or using a mixer with the whisk attachment. Add freshly brewed espresso into a cup and top with whipped cream. The ratio of cream to espresso for an Einspanner is 1:1 so not all the cream will be used up—although I certainly won't discourage you from adding all the of the whipped cream into the drink! To finish, sift on cocoa powder and add brown sugar to your liking.

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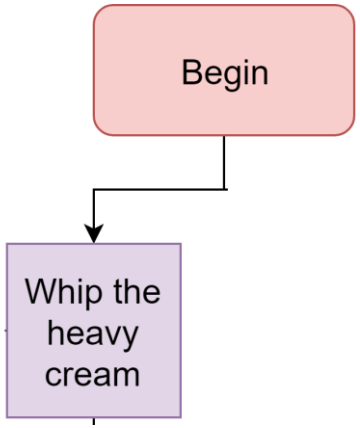
Examples of Algorithms



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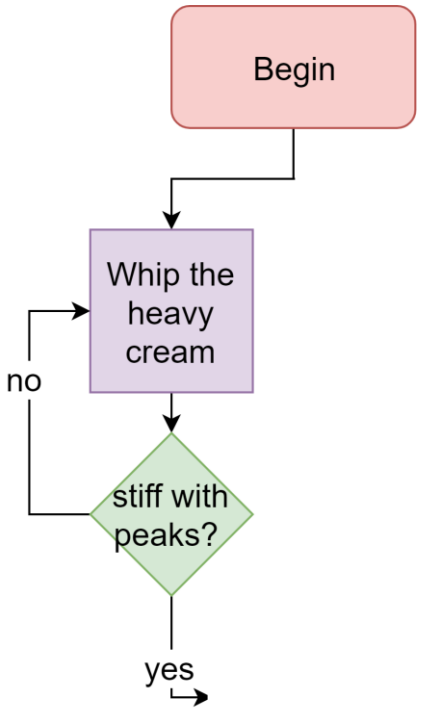

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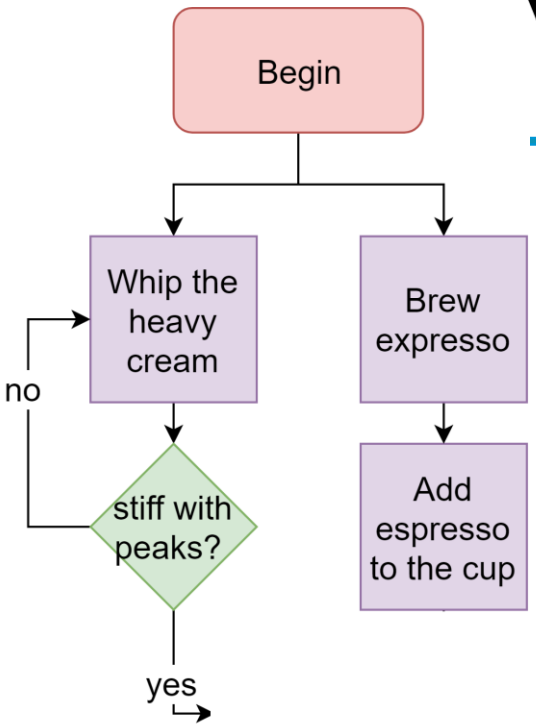

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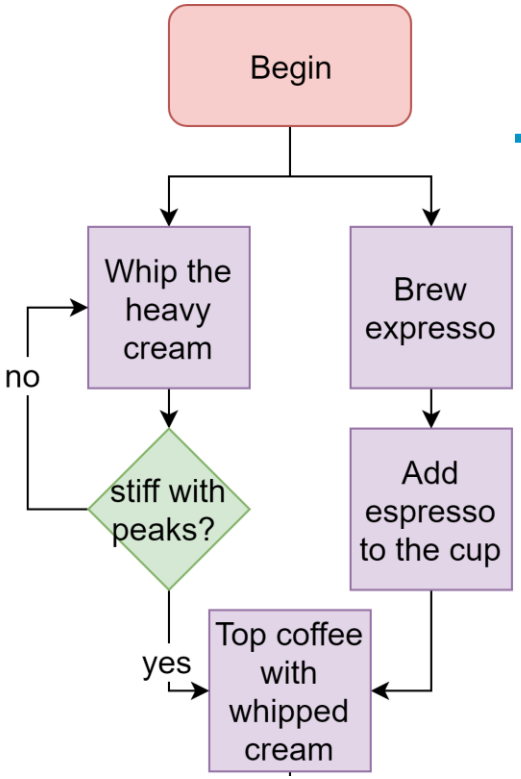

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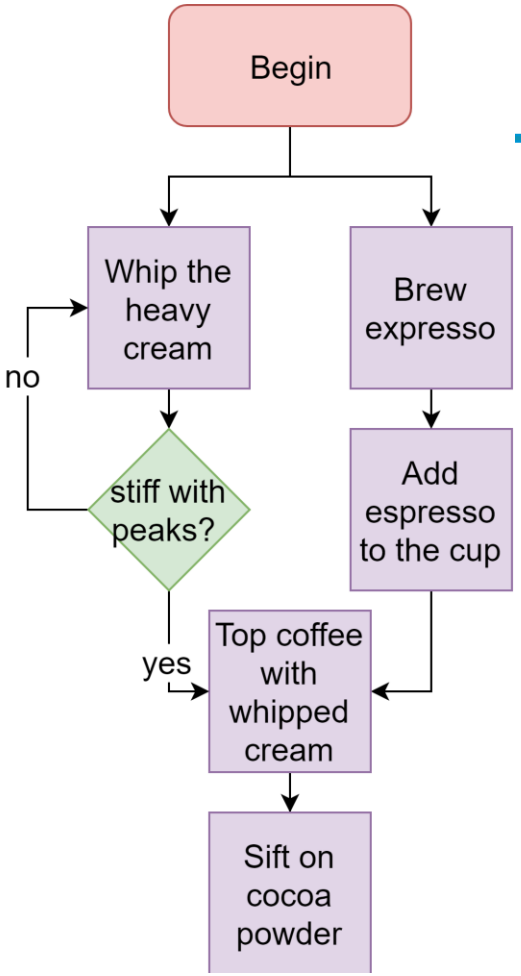

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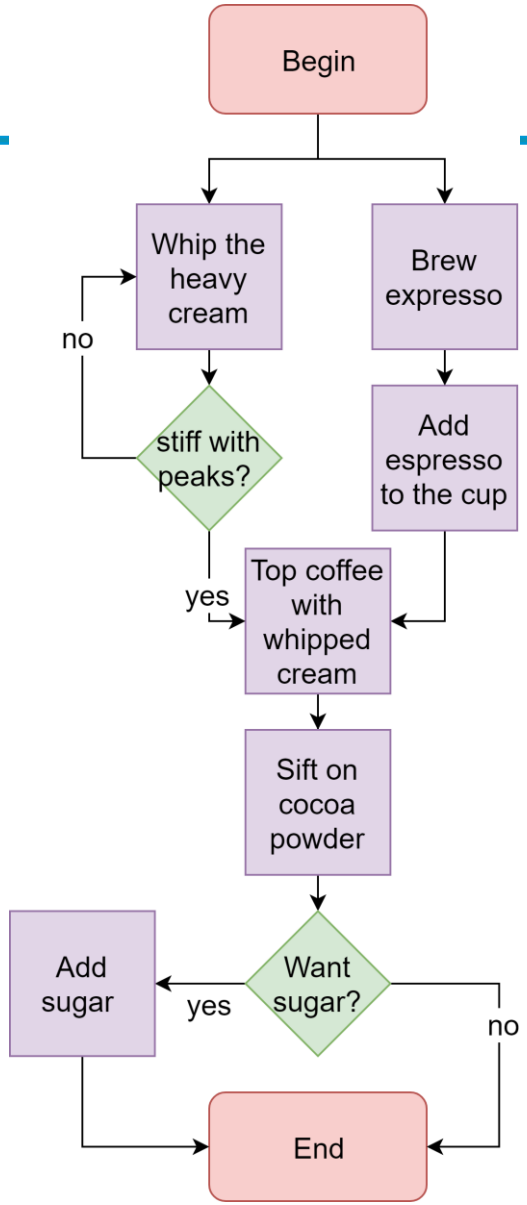

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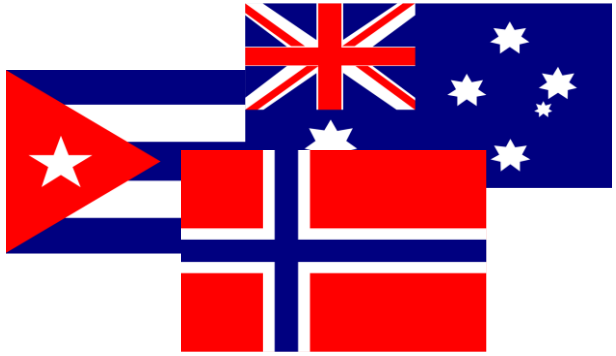
Languages

- Natural language is complex and ambiguous



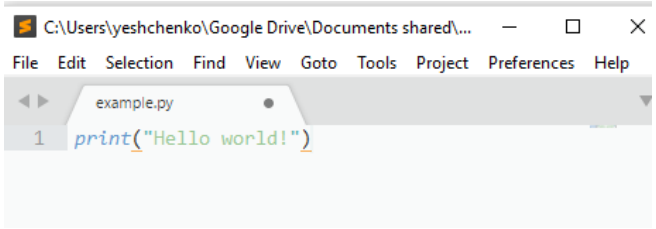
- Programming language is simple and straight-forward

http://noeticforce.com/most-popular-programming-languages-best-for-developers

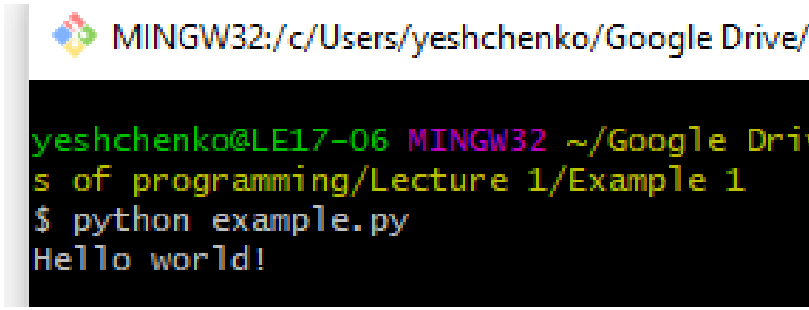
First Demo!

HTTP://CANACOPEGDL.COM/IMAGES/DEMO/DEMO-10.JPG

What's under the hood? (Long story)



Program executed (run)



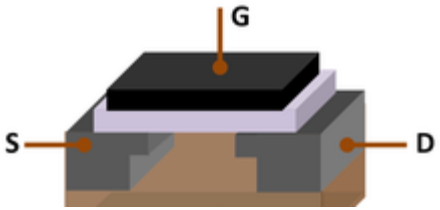
What's under the hood?

Software

Hardware

(1)The Physical Level

transistor



it's an electronic switch, essentially

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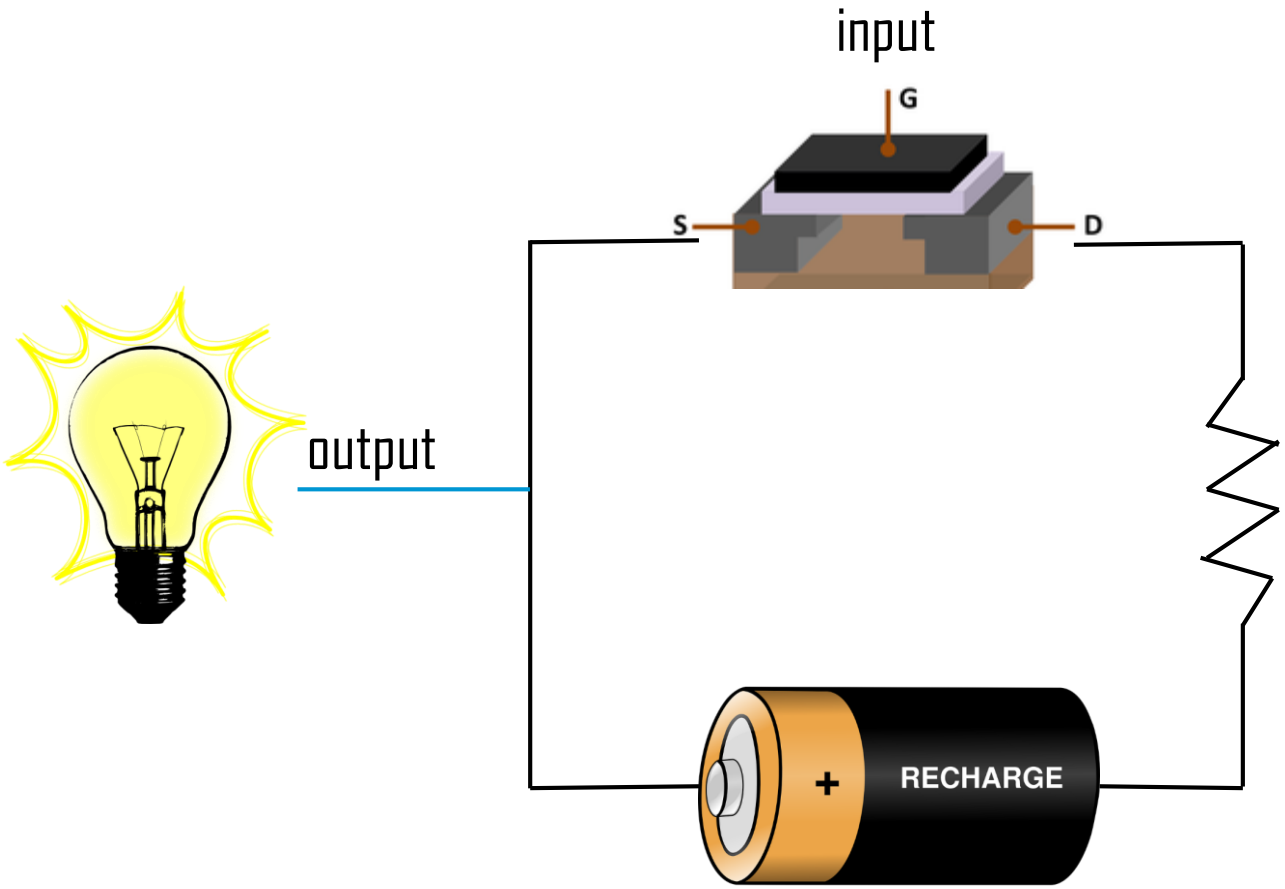
(1)Logical NOT



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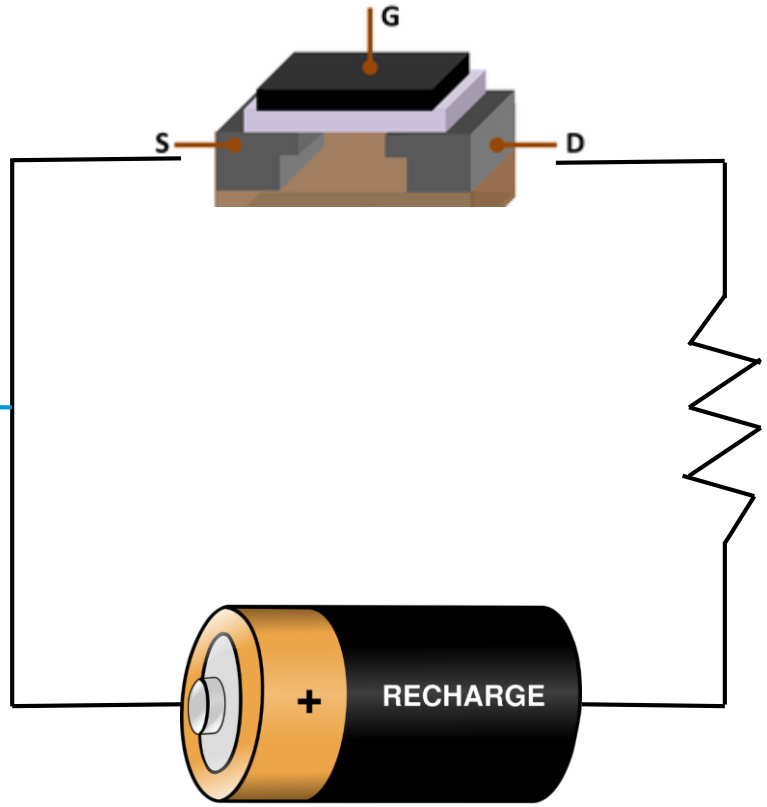
HTTP://WWW.CLKER.COM/CLIPARTS/1/0/F/G/2/4/BULB-LAMP-HI.PNG

(1)Numbers

- High voltage -> Number **1**
- Low voltage -> Number **0**

(1)Logical NOT

input **0**



output **1**

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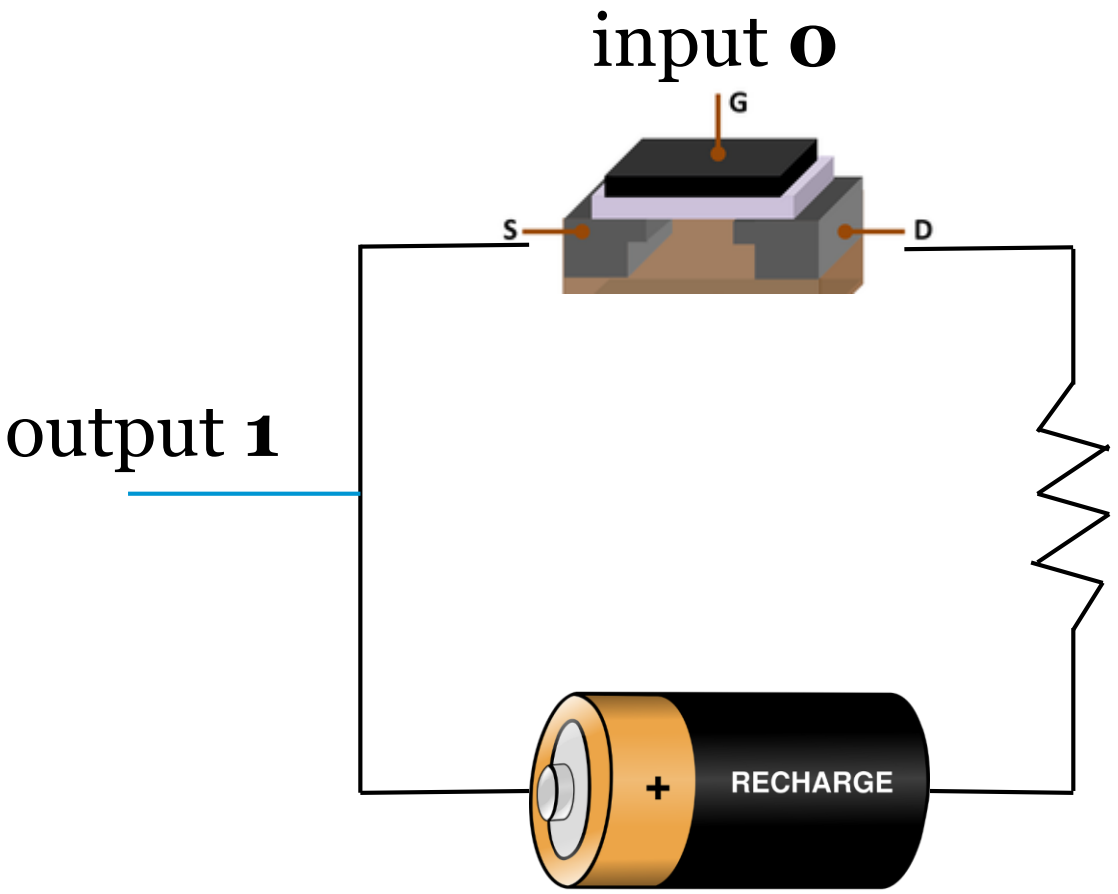
(1)Logical NOT



Input	Output
1	0
0	1

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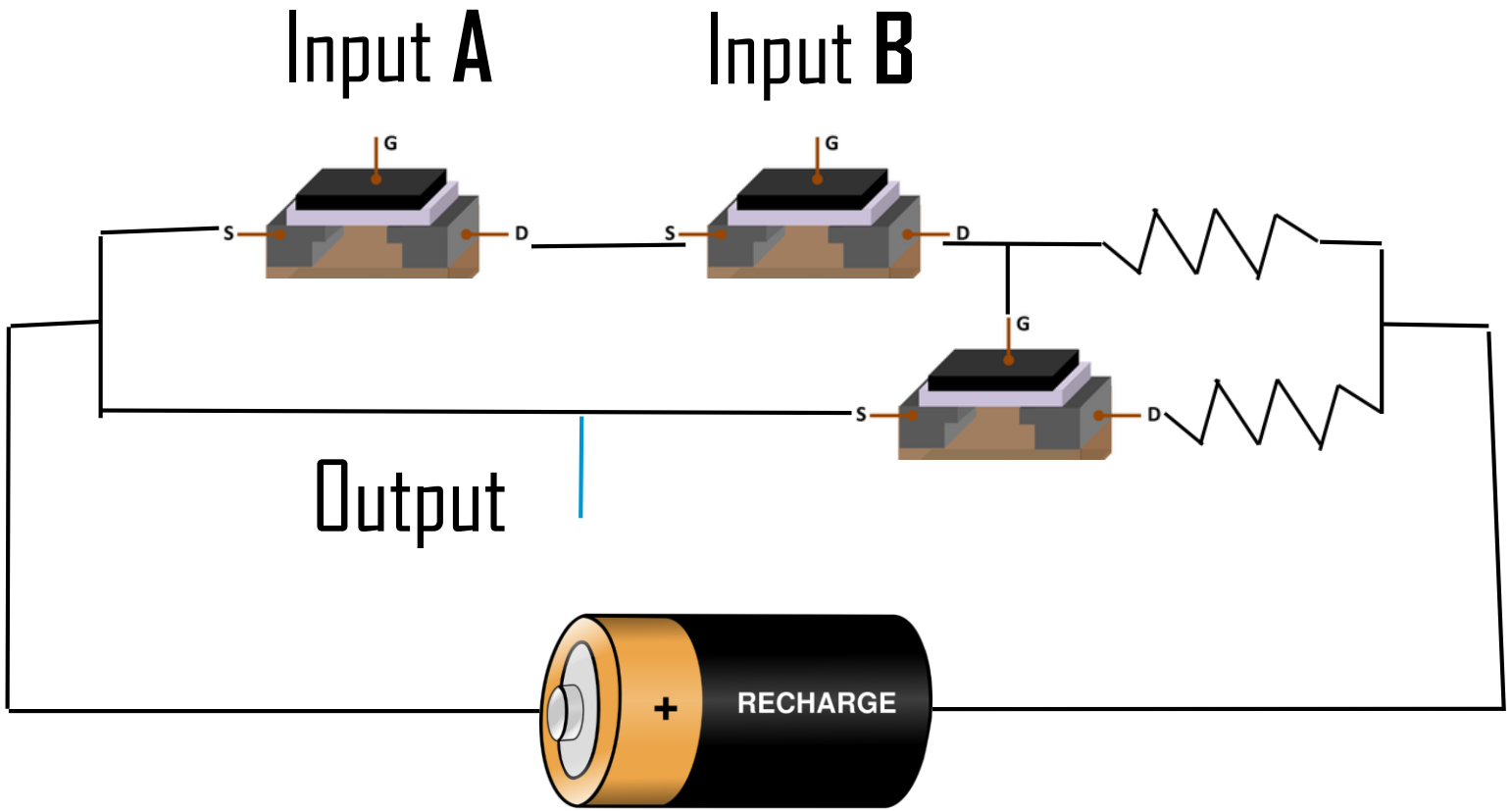
(1)Logical AND



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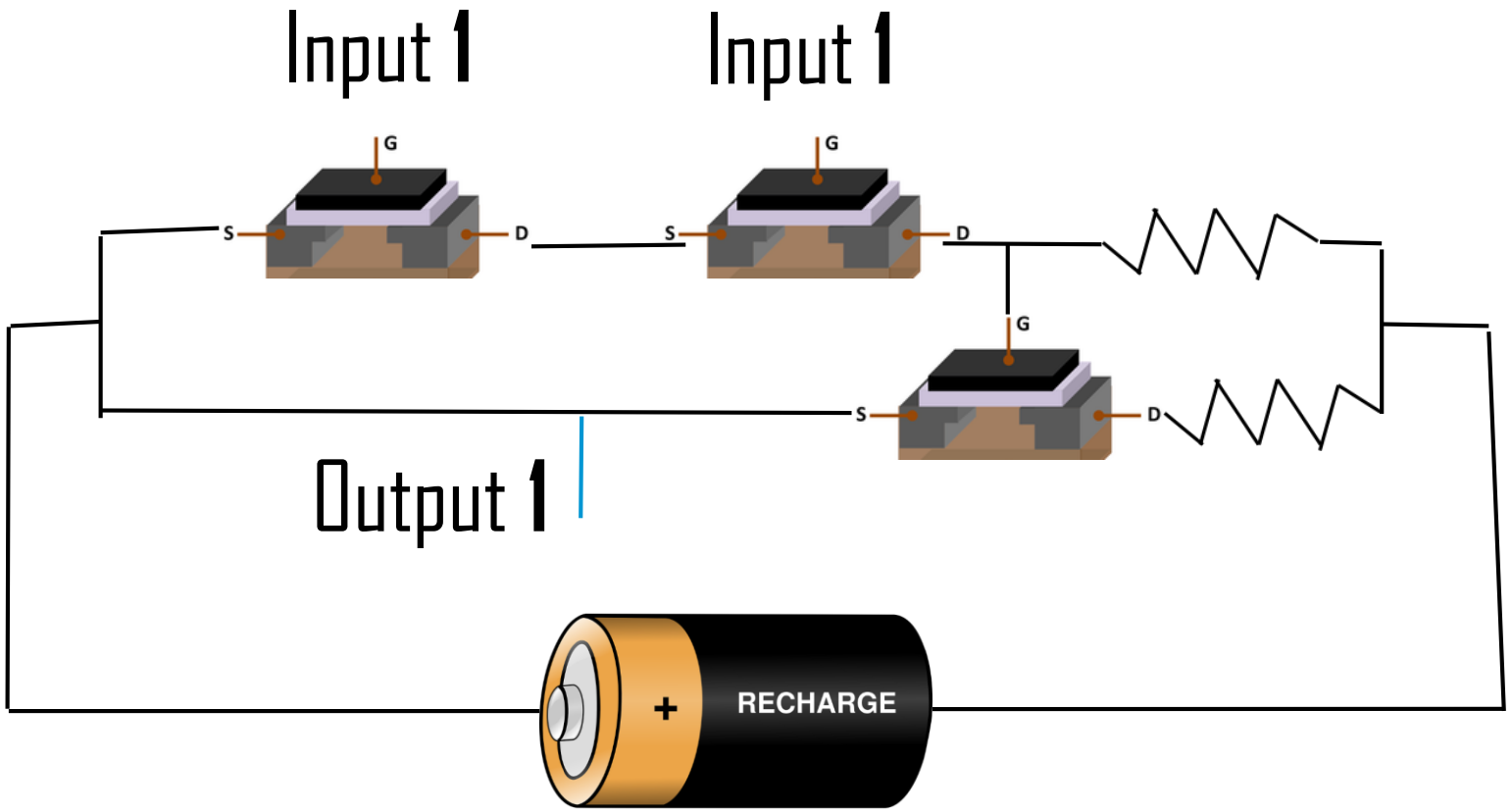
(1)Logical AND



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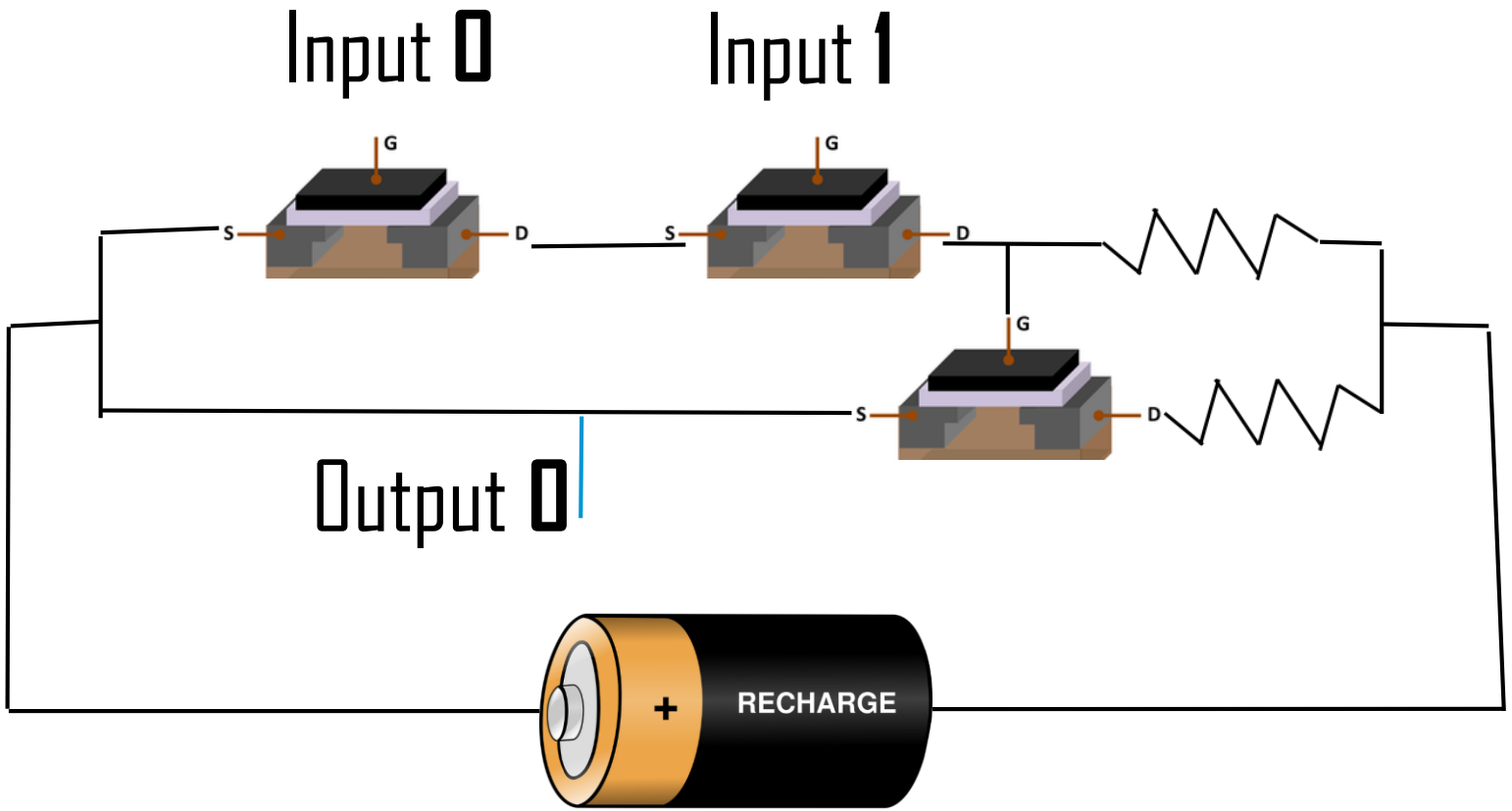
(1)Logical AND



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(1)Logical AND

Input A	Input B	Output
1	1	1
1	0	0
0	1	0
0	0	0

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(1)The Logical Level

- Logical **AND**
- Logical **NOT**
- **Logical OR**

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(1)Binary number representation

Gottfried Leibniz. 1679

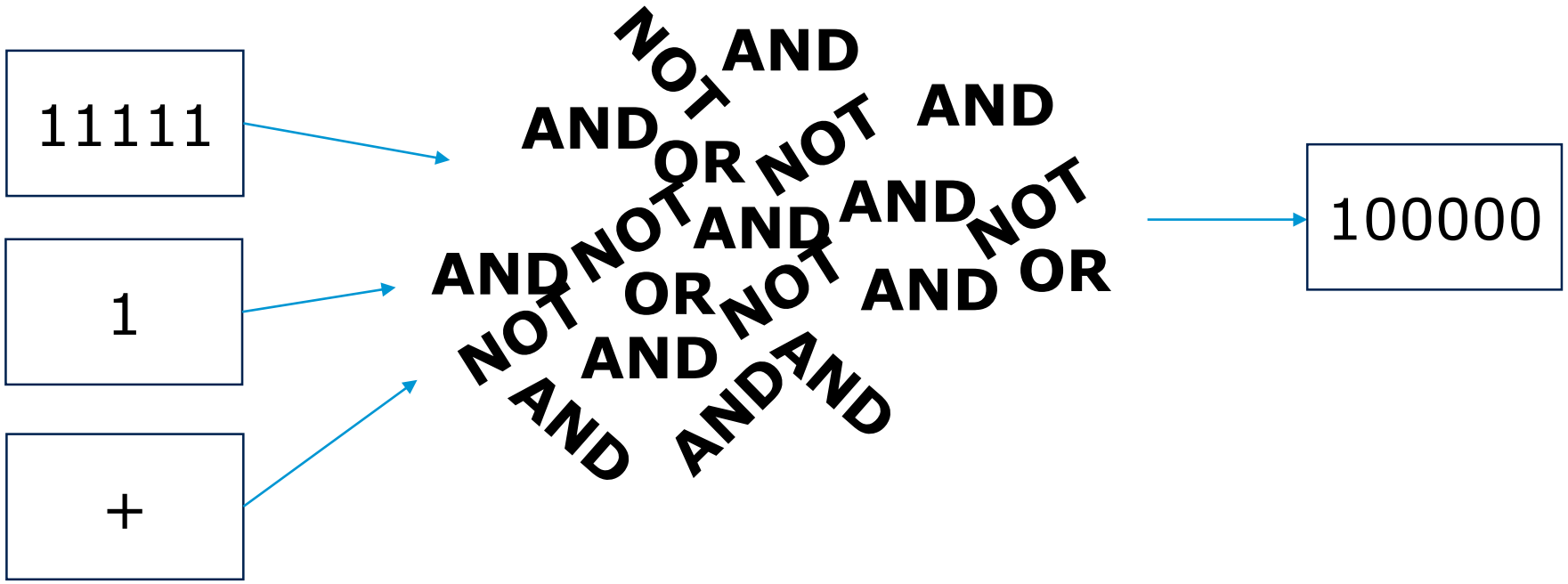
Decimal pattern	Binary number
0	0
1	1
2	10
3	11
4	100
5	101
6	110
7	111
8	1000
9	1001
10	1010
11	1011
12	1100

addition

```
    Binary
    1 1 1 1 1
+           1
  ------------
  1 0 0 0 0 0
```

HTTPS://EN.WIKIPEDIA.ORG/WIKI/BINARY_NUMBER

(1)Arithmetic logic unit (ALU)



(1)Arithmetic logic unit (ALU)

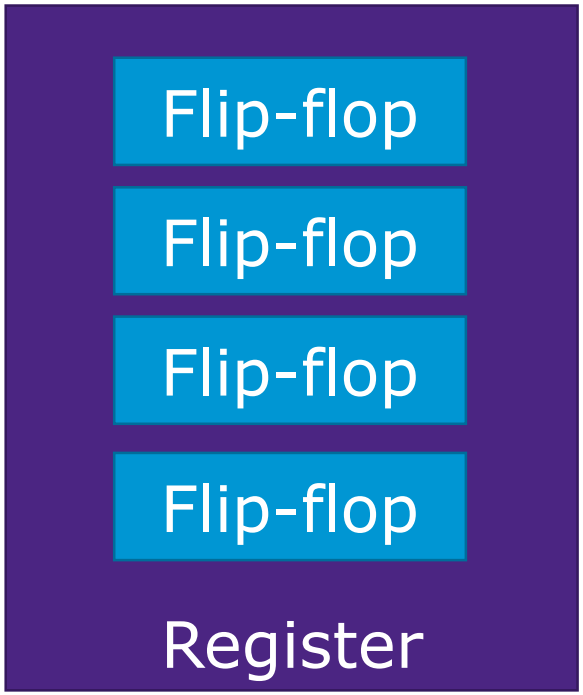
(1)The Logical Level. Boolean arithmetic

Arithmetic Logic Unit

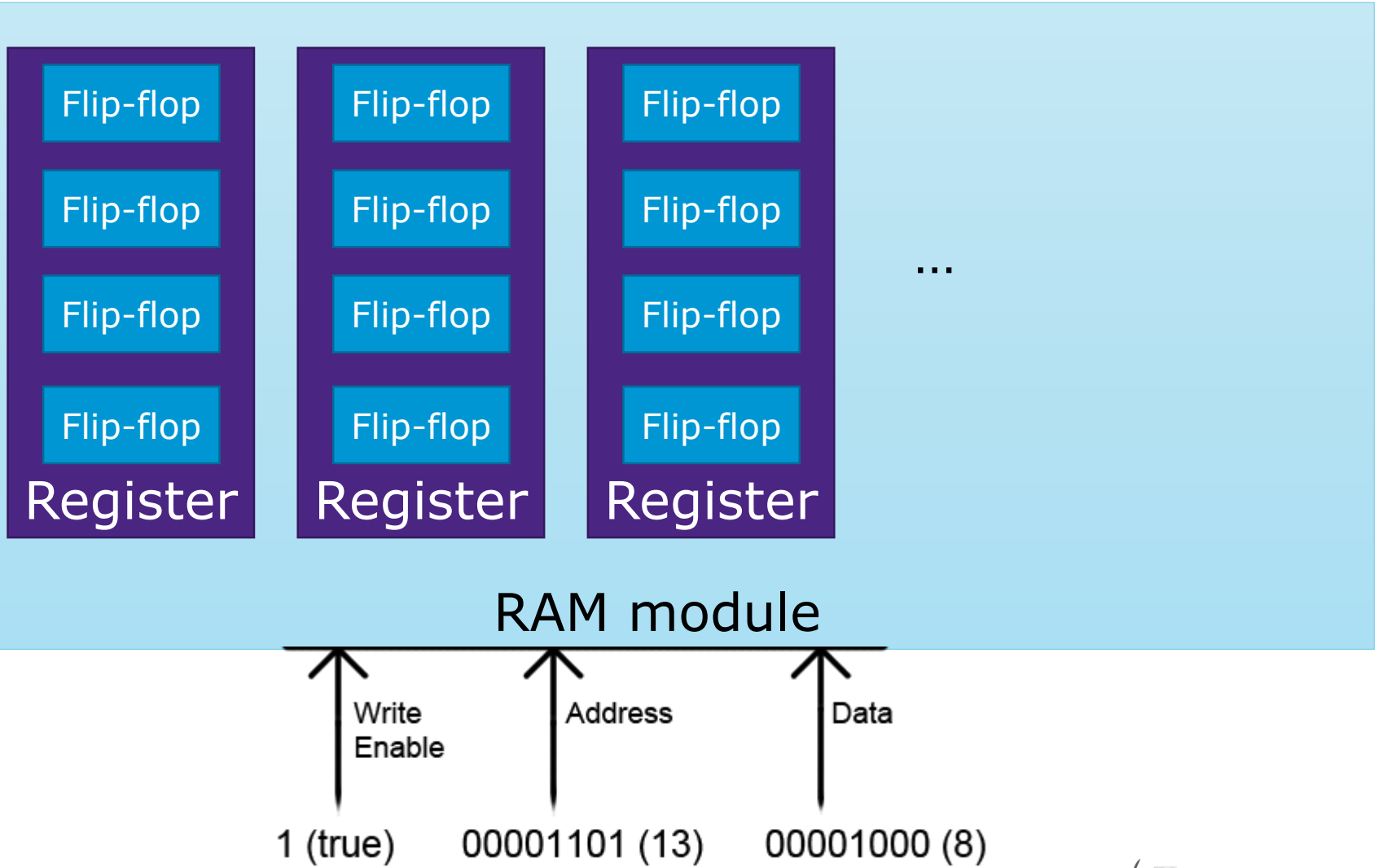
(2) Some memory

flip-flop or **latch**
is a circuit
that "remembers" its
last input (**0** or **1**)

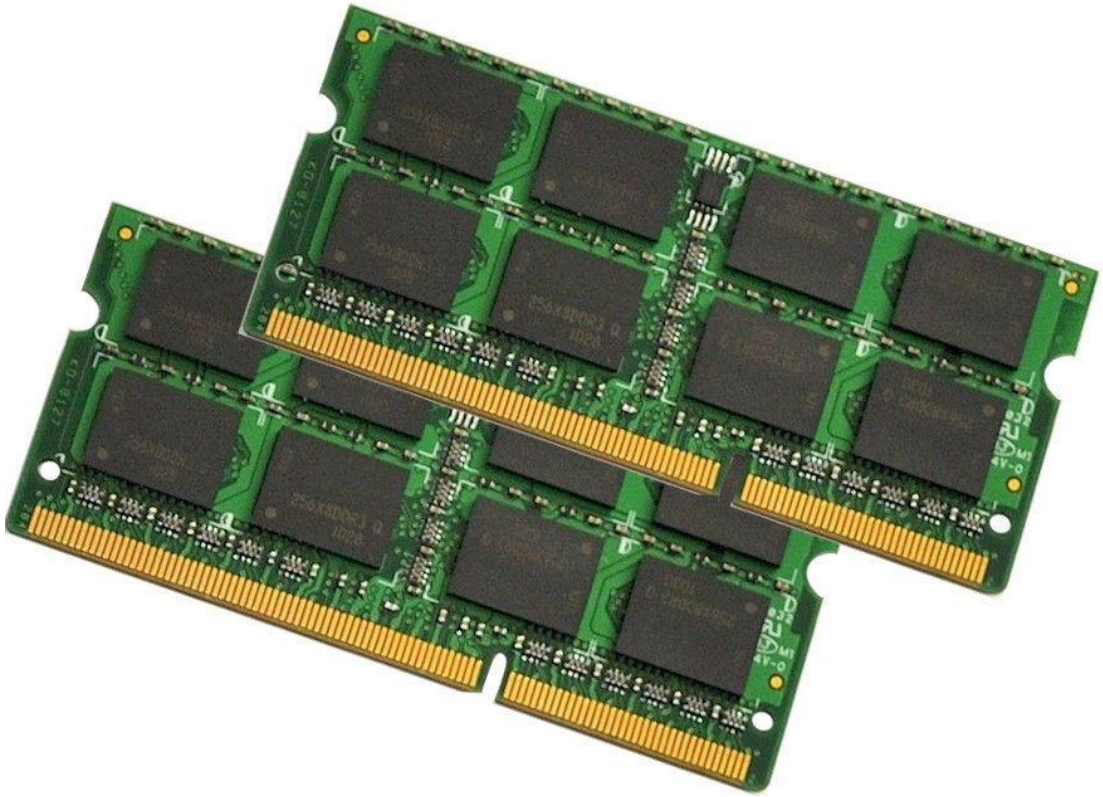
(2) More memory



(2) Even more memory



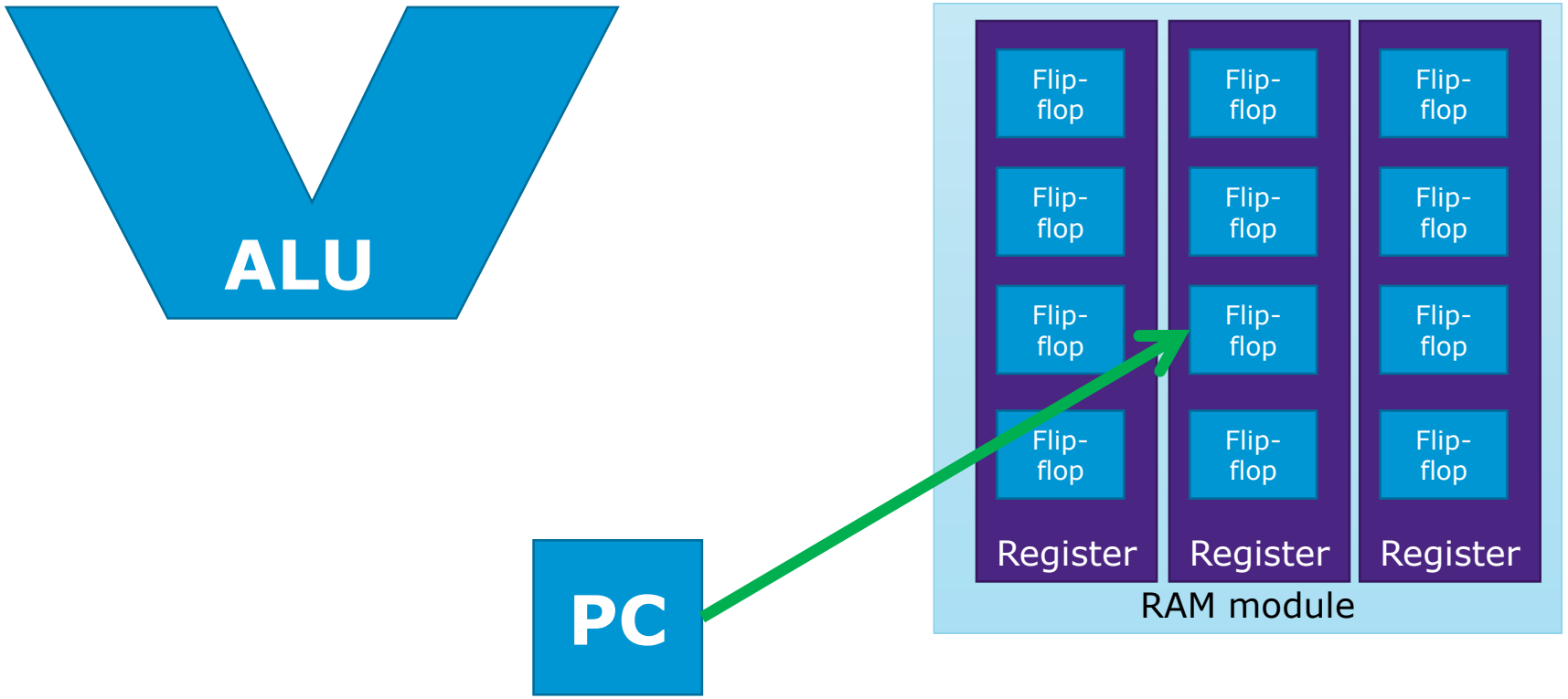
(2) RAM



HTTPS://WWW.EBAY.COM/ITM/8GB-2X-4GB-DDR3-1333-MHZ-PC3-10600-SODIMM-LAPTOP-RAM-MEMORY-MACBOOK-PRO-APPLE-/331028176930

(3) Program counter (PC)

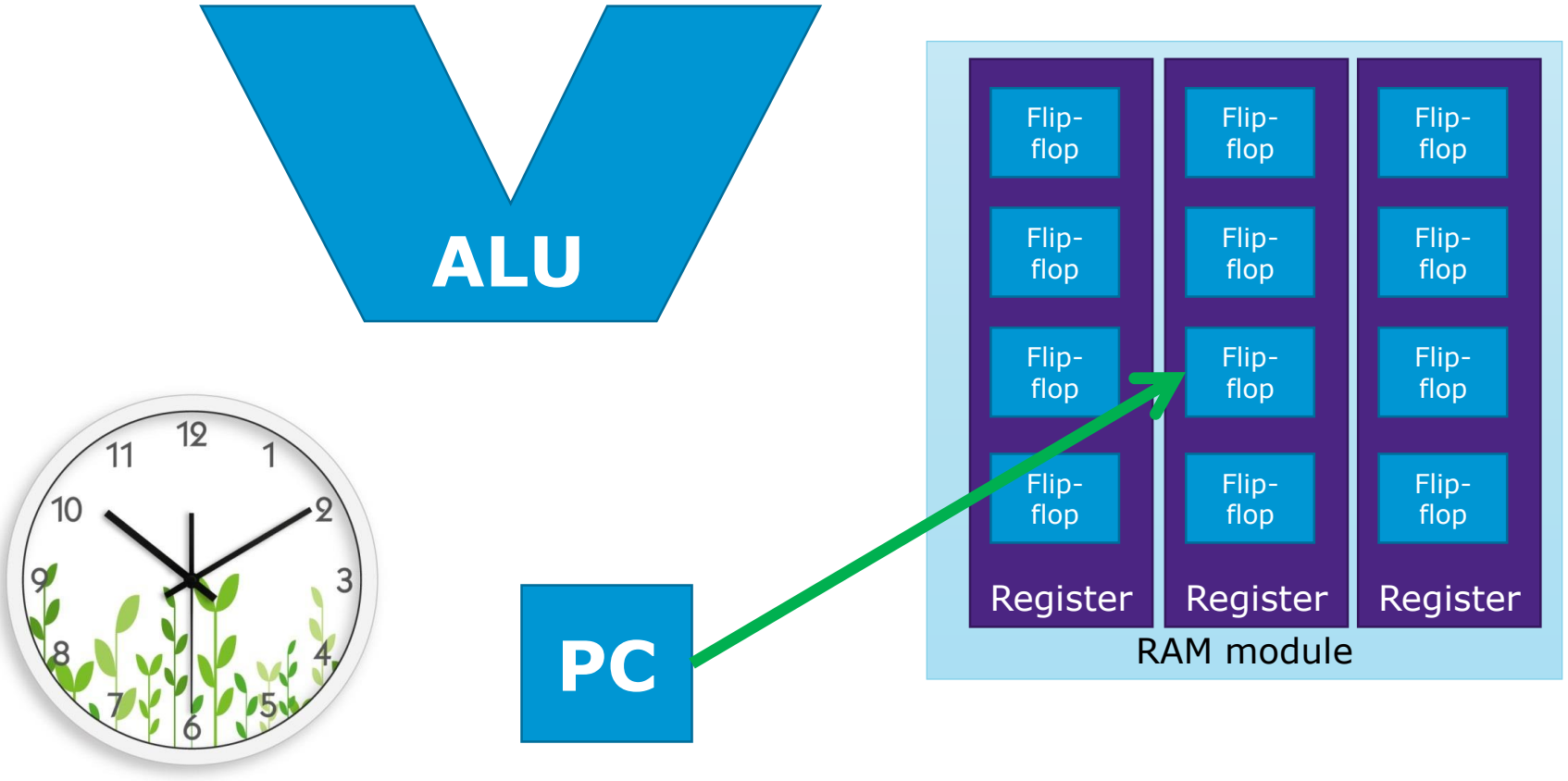
- The role of the **PC** is to store the address of the current instruction in RAM that we want to execute

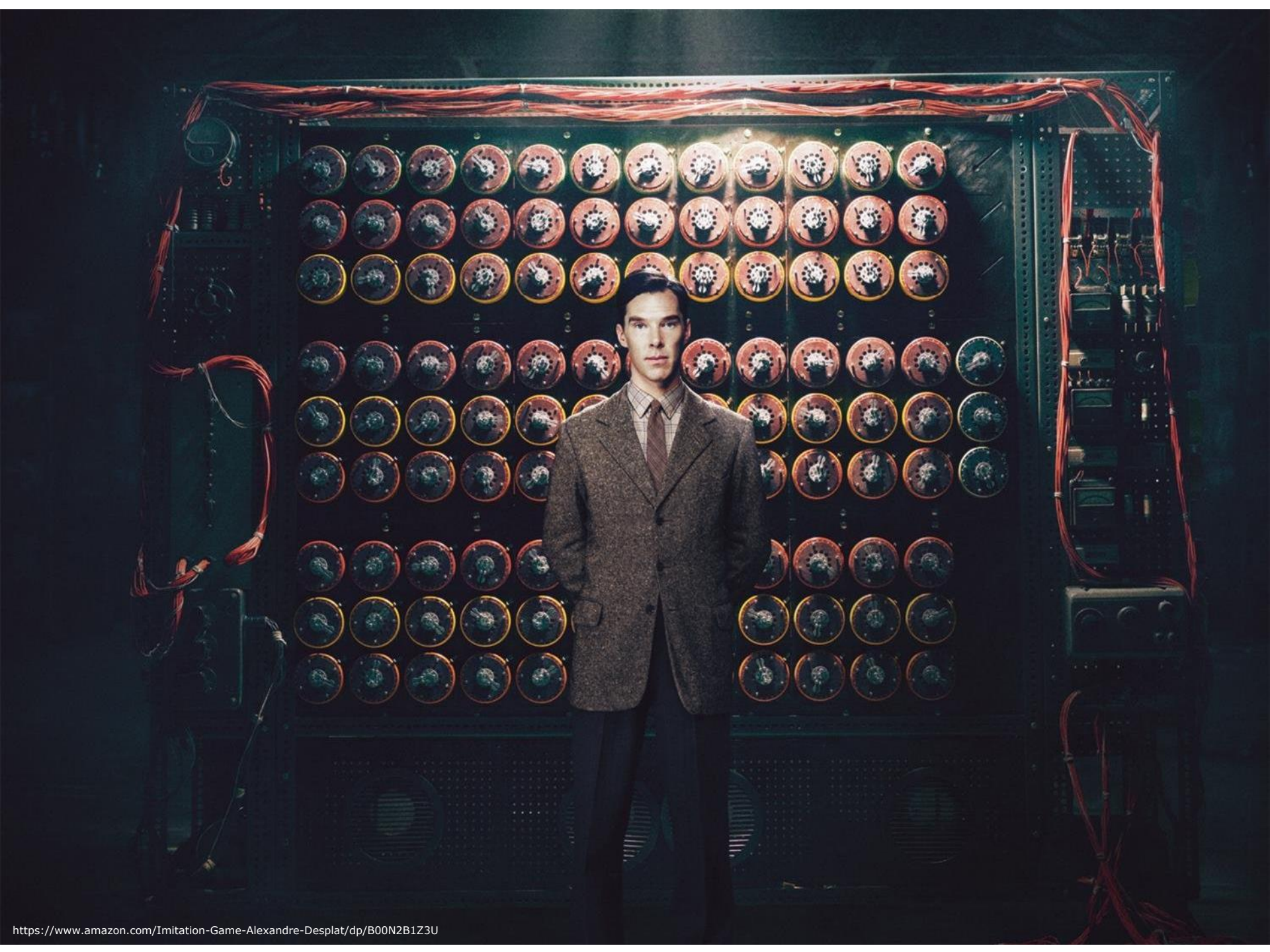


(4)Write and read from memory in sync

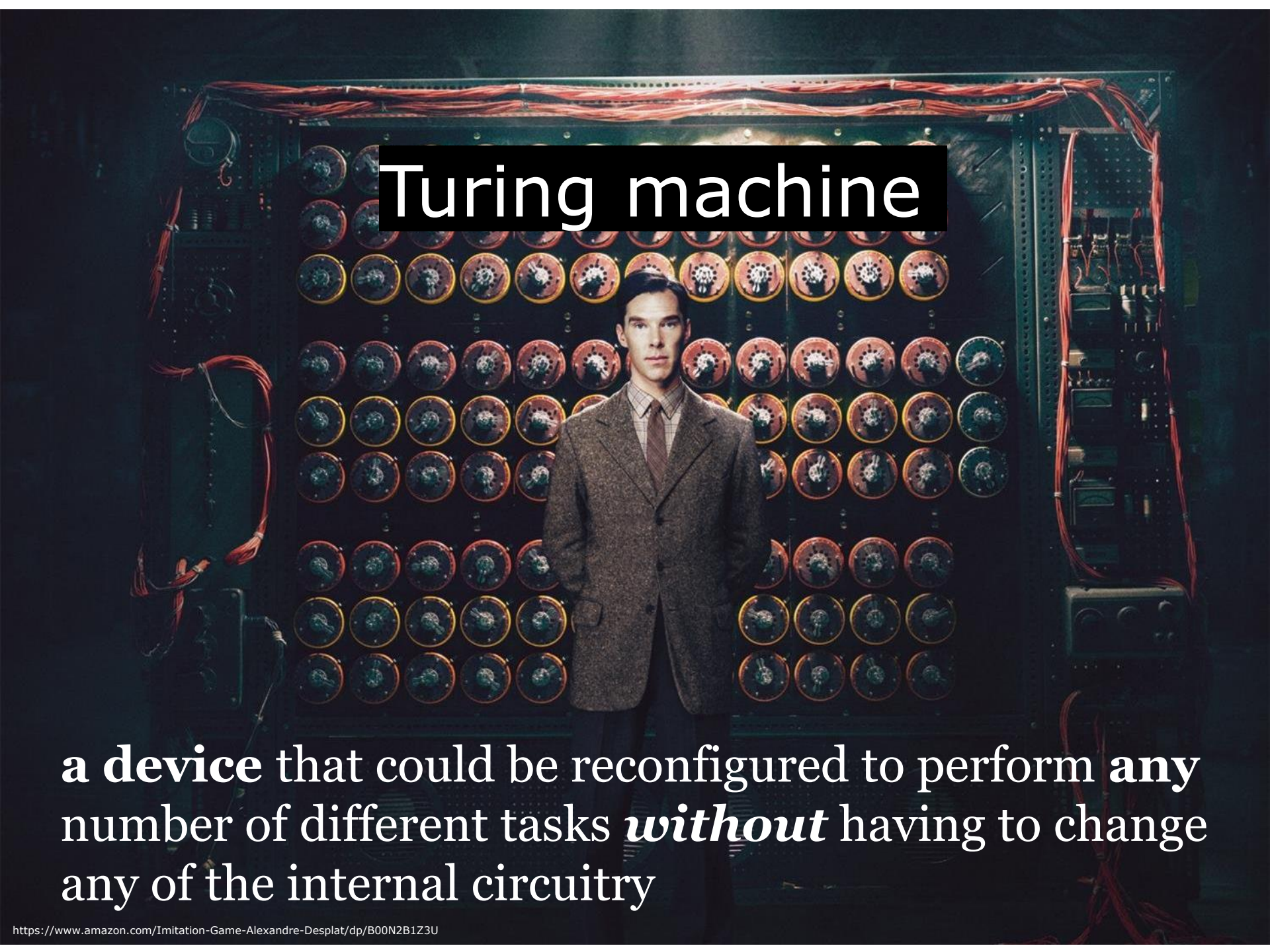
HTTPS://WWW.QUORA.COM/WHAT-IS-THE-BEST-WAY-TO-TEACH-CHILDREN-TO-READ-A-CLOCK

HARDWARE ready





https://www.amazon.com/Imitation-Game-Alexandre-Desplat/dp/B00N2B1Z3U



a device that could be reconfigured to perform **any** number of different tasks ***without*** having to change any of the internal circuitry

https://www.amazon.com/Imitation-Game-Alexandre-Desplat/dp/B00N2B1Z3U

Quiz 1!

Assembler!

```
SET Register 1's value to 100
SET Register 2's value to 23
ADD Register 1 and Register 2, and store the result in Register 3
MULTIPLY R1 and R2, and store the result in R4
STORE R3's contents in RAM address 42
STORE R4's contents in RAM address 9001
```

Low level languages

Assembler

```
1  SET R1's value to 6
2  SET R2's value to 9
3  ADD R1 and R2, and store the result in R3
4  STORE R3's contents in RAM address [some_address_goes_here]
```

Compiler

- C++
- C

```
1  int main() {
2      int x = 6;
3      int y = 9;
4      return x + y;
5  }
```

High Level languages!

- **Python**
- Ruby
- PHP
- Perl
- BASIC
- Java
- ..

Assembler

```
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2 SET R2's value to 9
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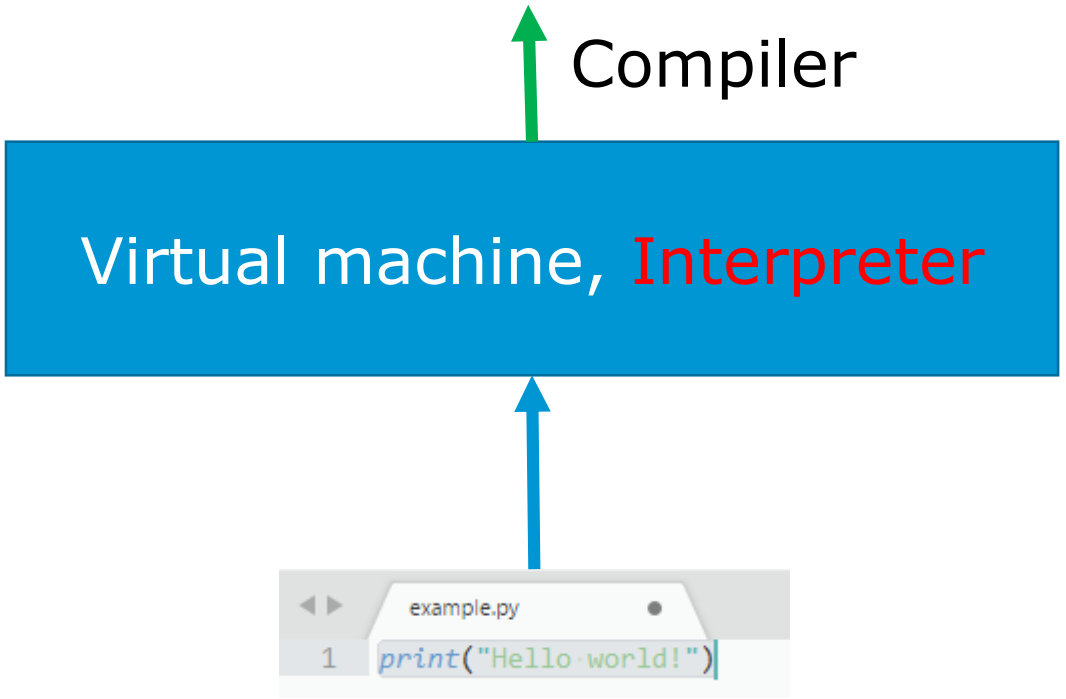

Quiz 2!

Jupiter notebook! Let's put our hands to actually do something here

- Integrated Development Environment (**IDE**)
- **web** application
- **easy**-to-use, interactive
- show **results** in the same document with code
- **presentation**: add description, plots, images & videos

Login to your own battlefield!

https://programming.ai.wu.ac.at/6088/notebooks/$STUDENTID

The only exercise

Make a program write
“Hello, —your_name—”

HTTPS://PXHERE.COM/EN/PHOTO/720036

Thanks for coming. Homework:

- Describe some problem that you can possibly have/encounter that might be solved by programming.
  - Examples:
    - Trading bot for bitcoin (I want to get a hell a lot of money)
    - Alternative to google maps that only shows the map and the places with Kebab
    - A program that will *automatically* like all my friends Instagram posts, because I am lazy but want them remember of my existence.

How to submit?

- **Deadline, 14 of March 10pm (*Tomorrow*)**

- Algorithm to submit the homework:

1. Login to the course page https://learn.wu.ac.at/dotlrn/classes/pool/6088.18s
2. Find homework's page
3. Write text
4. Click submit button

See you next time. 15 March

- **Programming:** algorithms, syntax and semantics, programming, compiler, interpreter
- **Basics and types:** variables, operations, primitive data types, Strings, static vs dynamic typing, explicit vs implicit type casting
- **Control flow and functions:** if-else branches, loops, functions (parameters, return values)
- **Lists:** Arrays (lists), create and fill Arrays, multidimensional Arrays
- **Classes:** Class vs Instance of class, objects, create objects, instance variable, constructor, method overloading
- **Inheritance:** inherit classes, method overriding, problems and solutions for multiple inheritance
- **Information hiding:** variable access, access modifier (Java) and naming conventions, get- and set-methods
- **Object oriented programming:** why OOP, inheritance ("is-a"- and "is-part-of"-relations), information hiding/encapsulation, abstract classes, Super-constructor, polymorphism

Additional topics if you plan to take the exam as "Wahlfach" course (5 ECTS):

Wahlfach:

- **Exceptions**
- **Dynamic data structures:** Stacks, Queues, Maps (Dictionaries), Trees