Electrónica digital para todos con FPGAs Libres

UNIVERSIDAD DE CANTABRIA

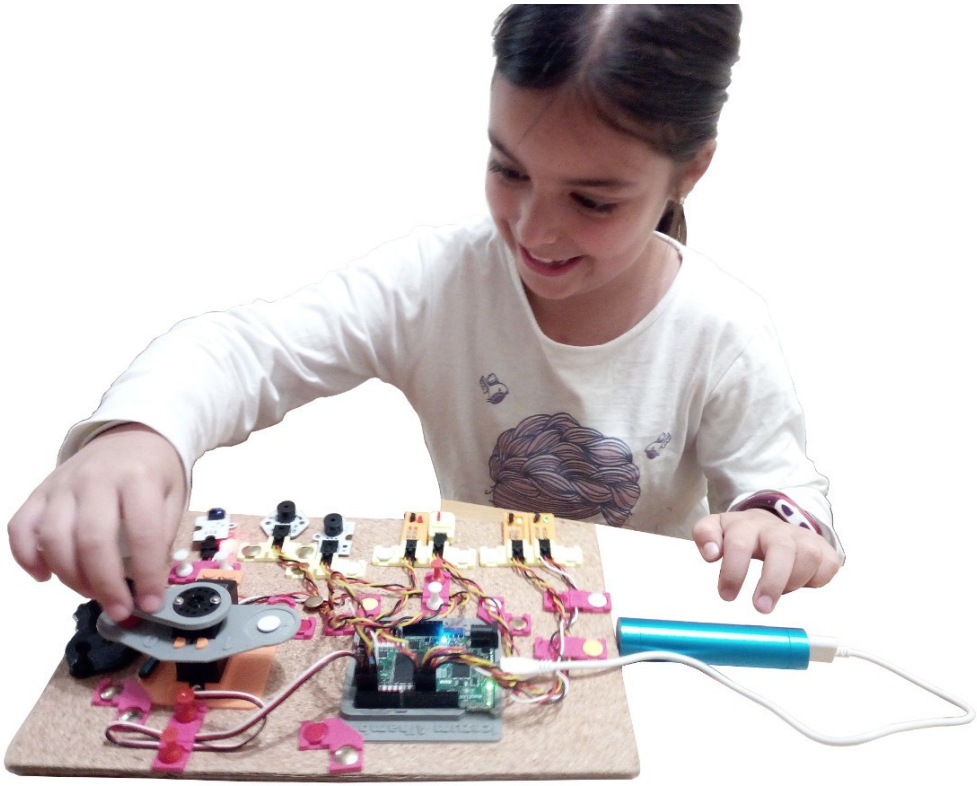
CURSOS DE VERANO

VICERRECTORADO DE CULTURA Y PARTICIPACIÓN SOCIAL

AYUNTAMIENTO DE CAMARGO

IBEROBOTICS

ROBOTS PERSONALES Y DE SERVICIOS



Juan González Gómez (Obijuan)

https://github.com/Obijuan

Curso de Verano UC: Robótica, Arduino y Hardware Libre
Centro Municipal de Empresas. Pol. Industrial de Trascueto, s/n. Revilla de Camargo

https://github.com/Obijuan/myslides/wiki/2017_07_06:-UC:-Electrónica-digital-para-todos-con-FPGAs-libres

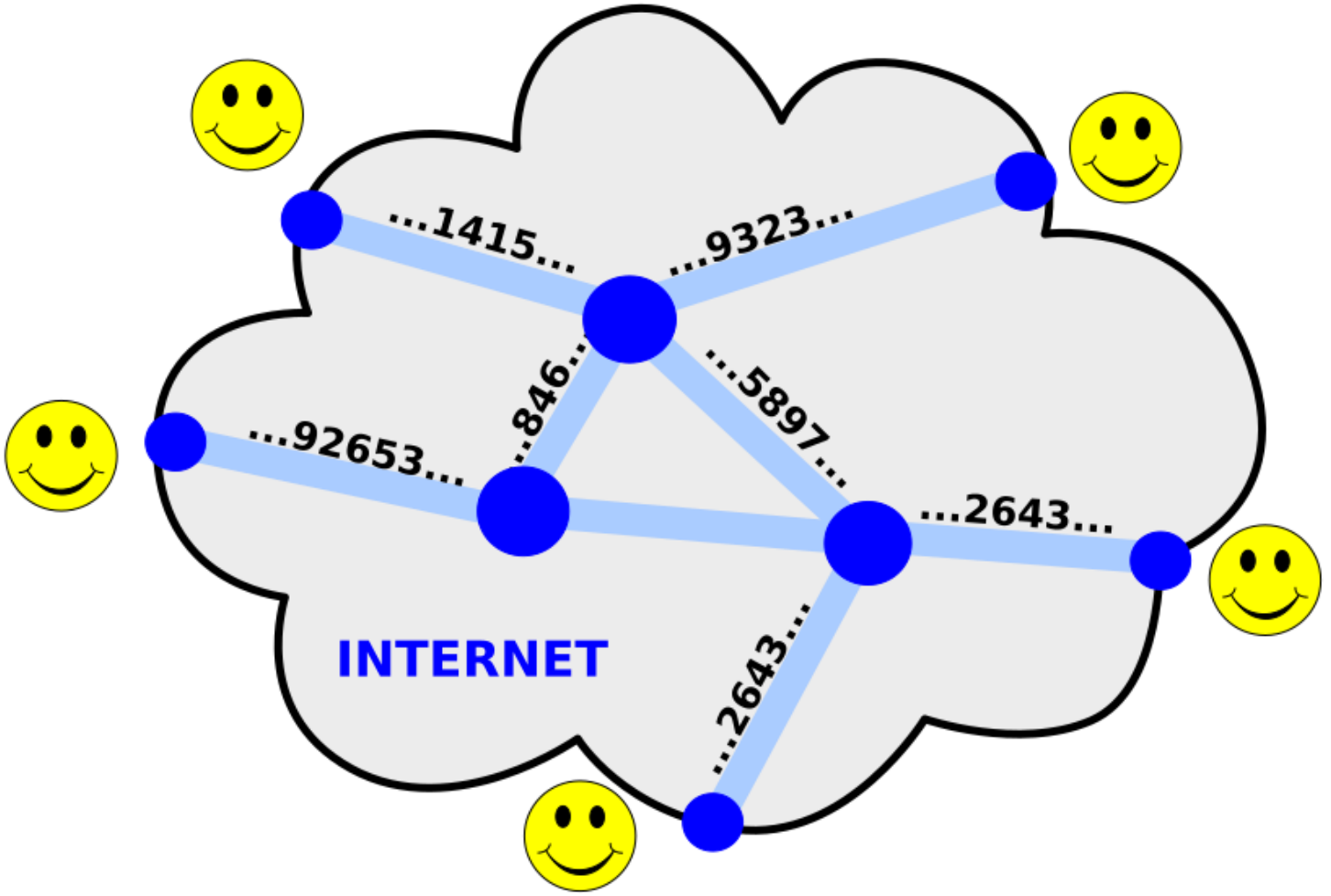
La era digital: Todo es número

Mundo digital

1415926535 8979323846 2643383279
5028841971 6939937510 5820974944
5923078164 0628620899 8628034825
3421170679 8214808651 3282306647
7245870066 0631558817 4881520920
9628292540 9171536436 7892590360
0113305305 4882046652 1384146951
9415116094 3305727036 5759591953
0921861173 8193261179 3105118548
0744623799 6274956735 1885752724
8912279381 8301194912 9833673362
4406566430 8602139494 6395224737
1907021798 6094370277 0539217176
2931767523 8467481846 7669405132

TODO SON NÚMEROS

Internet



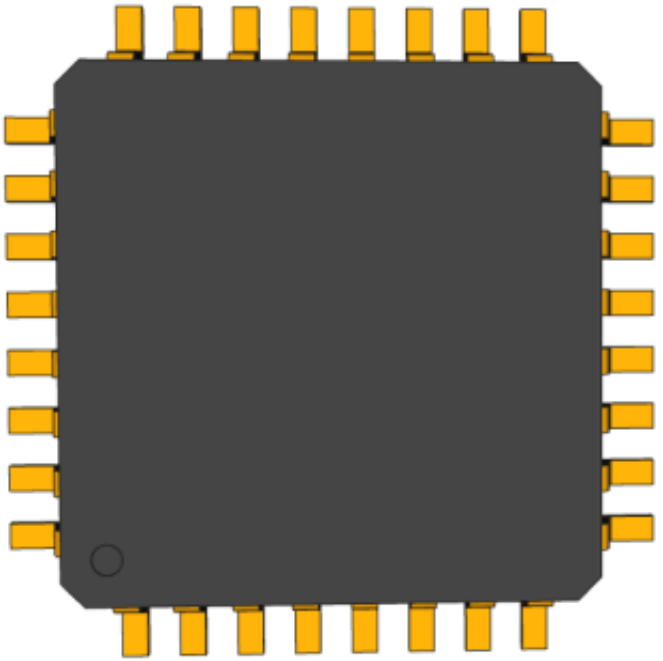
Transporte, almacenamiento y manipulación de NÚMEROS

Los pitagóricos estarían orgullosos

Electrónica digital (I)

ENTRADA

14 159 265 35 89
79 32 384 6 2643
38327 9 50 288
4197 1 693 9937
510 58 209 ...



SALIDA

34 211 70 67 9 82
14 808 65 1 328
230 6 647 7 2458
70 06 6 063 155
88 17 48 ...

Circuitos electrónicos que manipulan, transportan y almacenan NÚMEROS

Bits

14159265358979323846264
33832795028841971693993
75105820974944592307816

Números en decimal

0001 0100 0001 0101 1001 0010 0110 0101 0011
0101 1000 1001 0111 1001 0101 0000 0010 1000
1000 0100 0001 0001 1001 0111 0001 0110 0111

Digitos Binarios

TODO se reduce a 1s y 0s

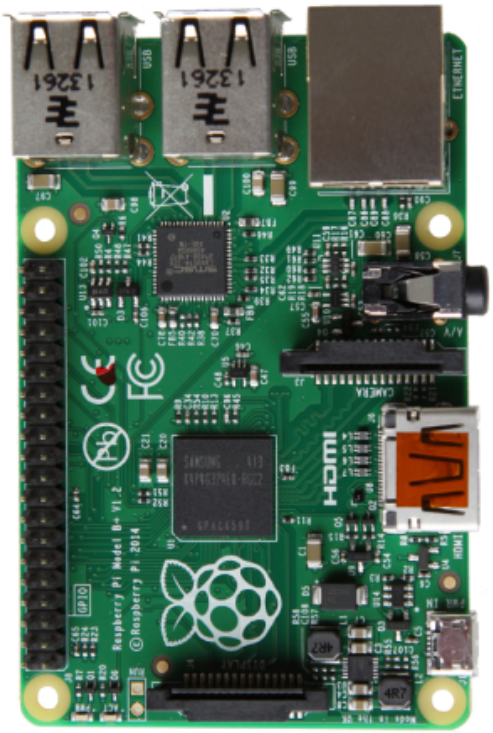
0 1

Ser o no ser
Par o impar
Verdadero o falso
Todo o nada
Yin y Yang
Culo o codo...

En el interior de los microchips

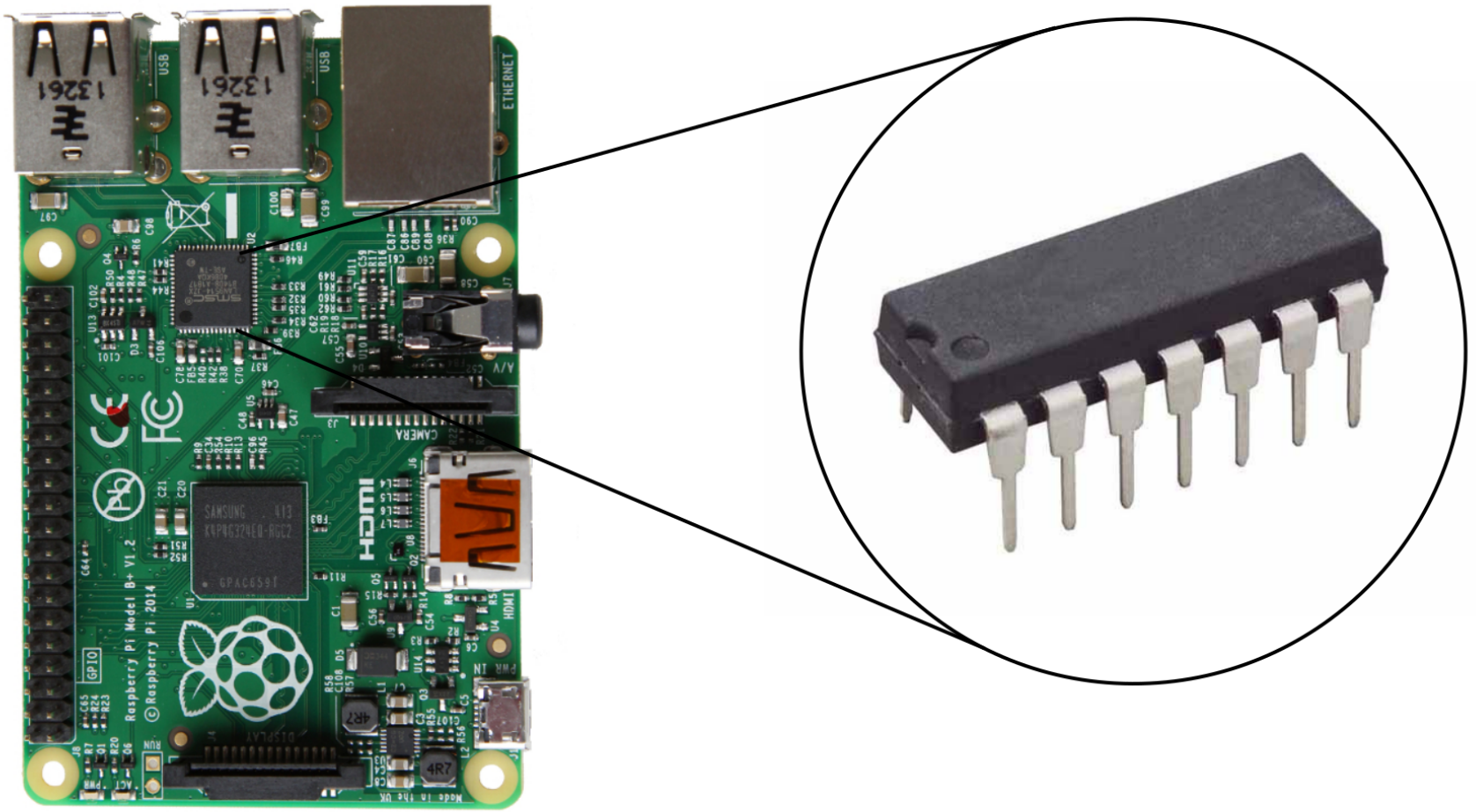
Productos electrónicos y circuitos

Producto Electrónico



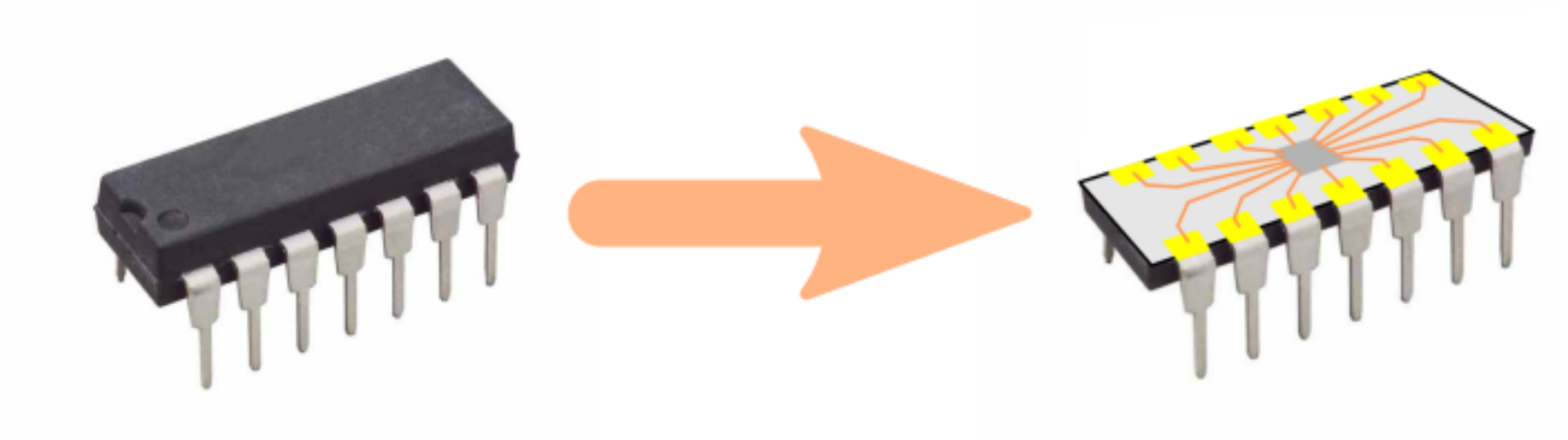
Circuito electrónico

PCBs y Circuitos integrados



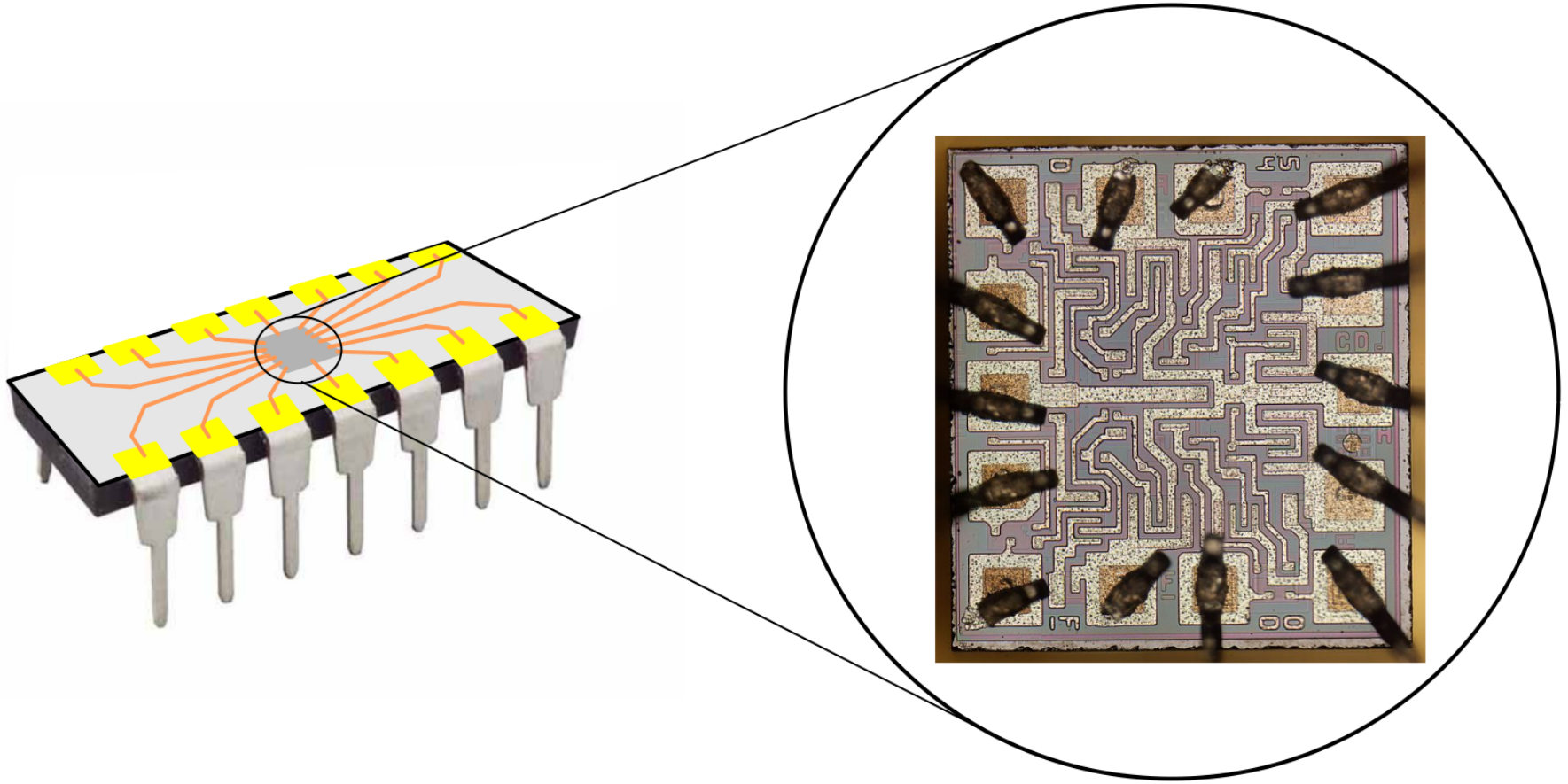
Encapsulado y dado

Demo: Mostrar chips Dip y eeprom



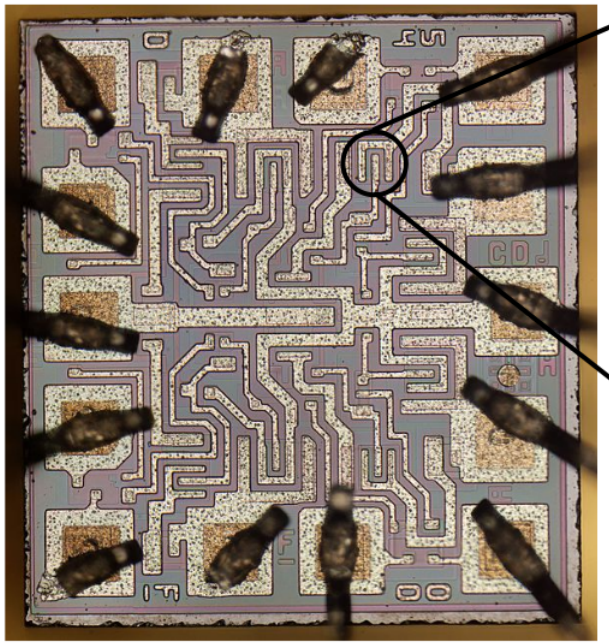
Dado de silicio

Demo:
Proyecto 54/74

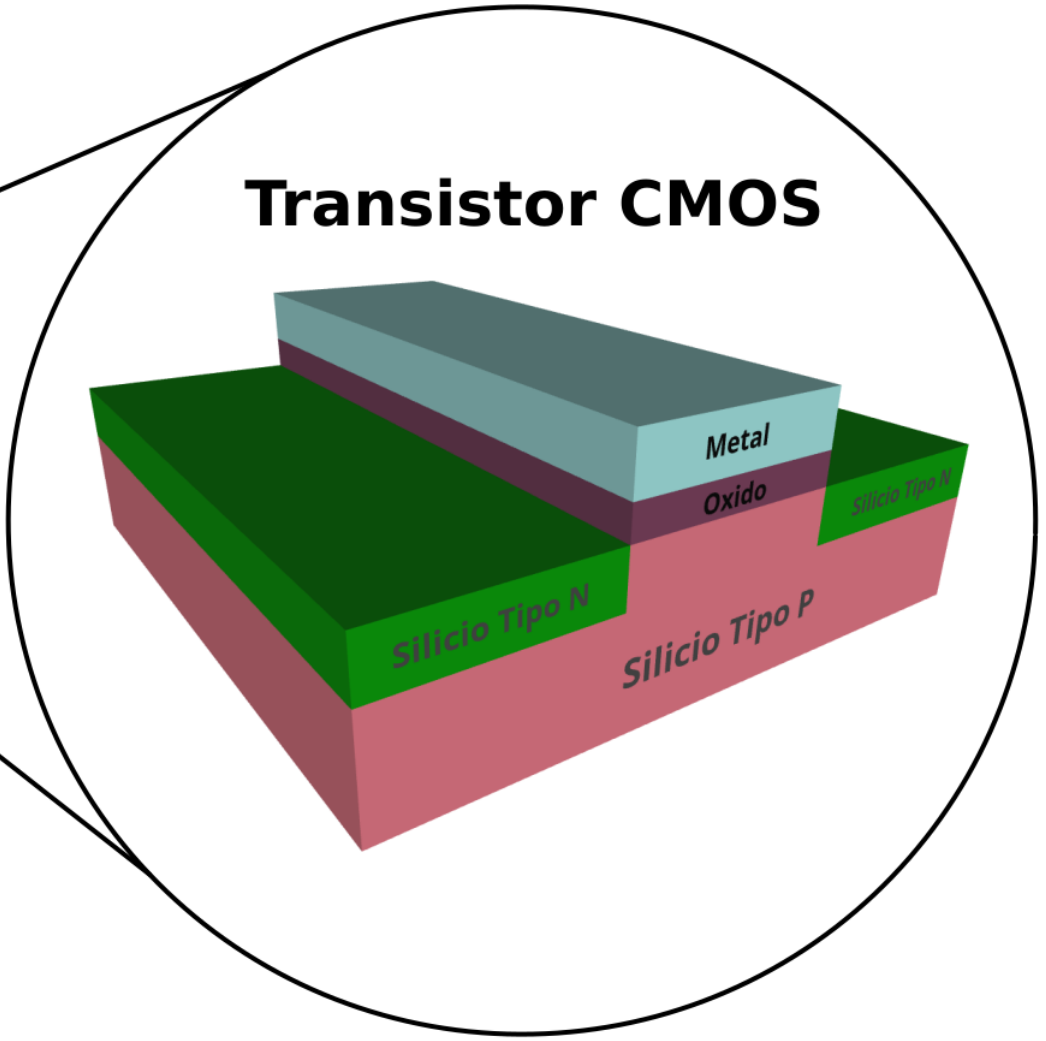


Semiconductores

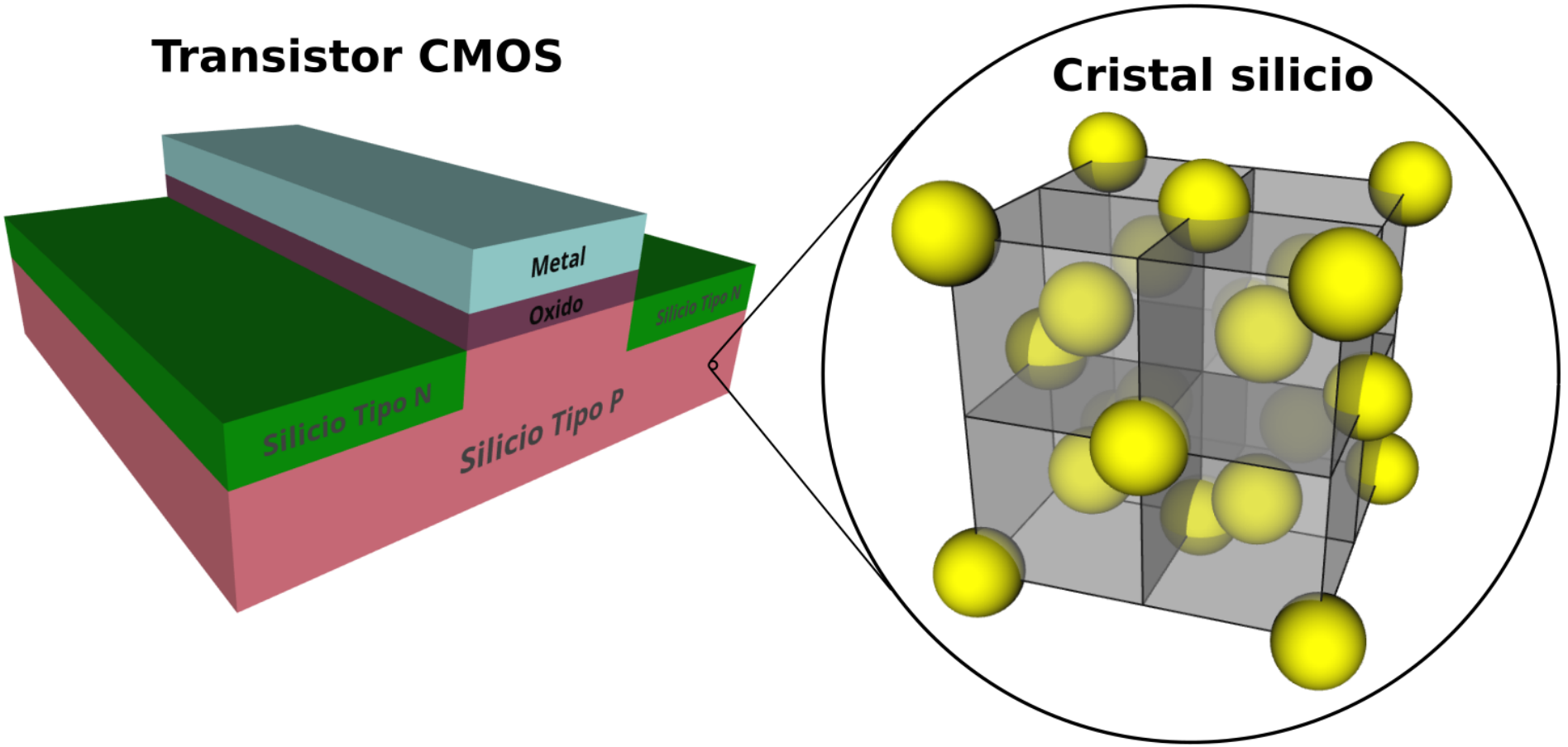
Dado



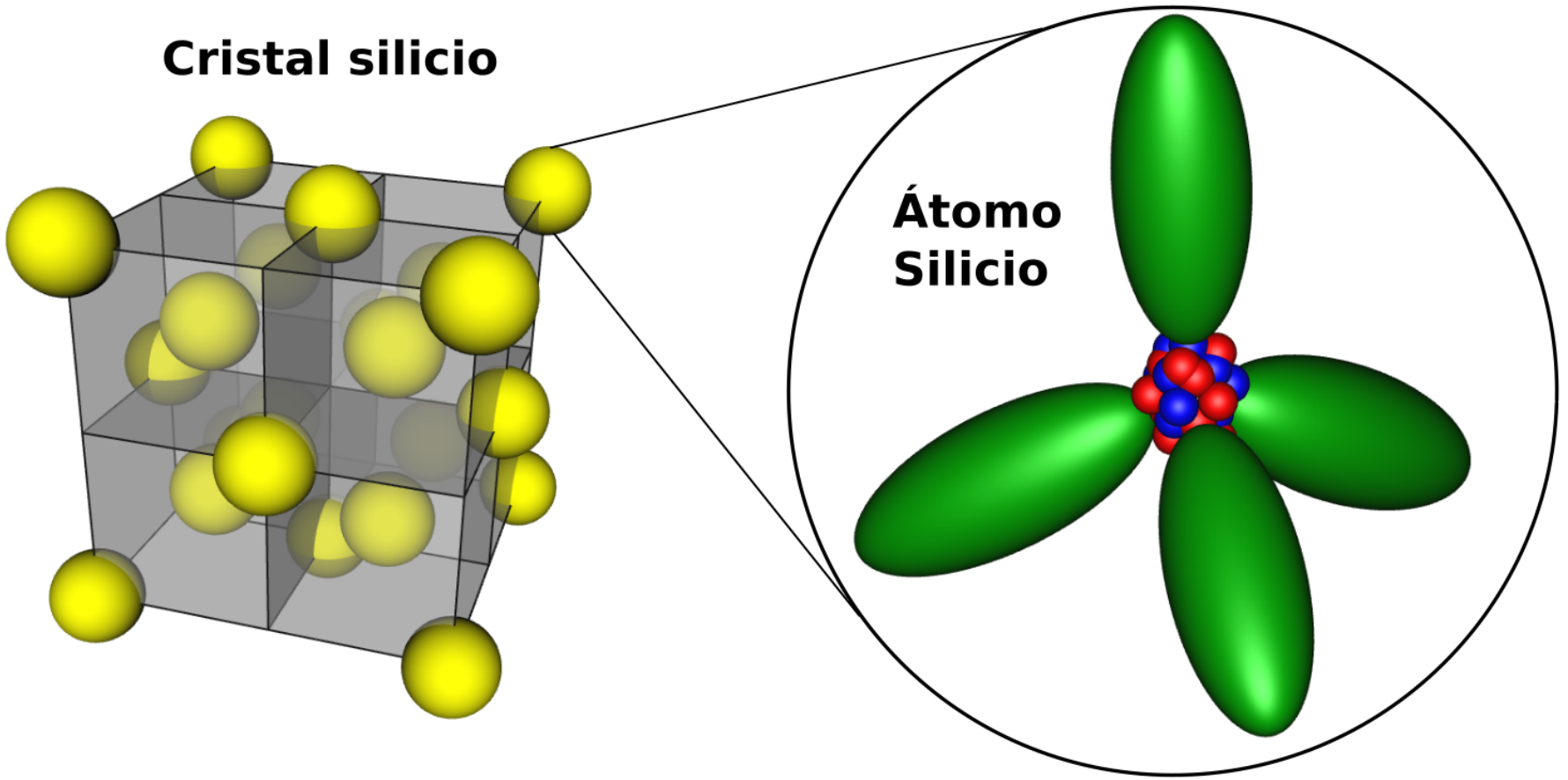
Transistor CMOS



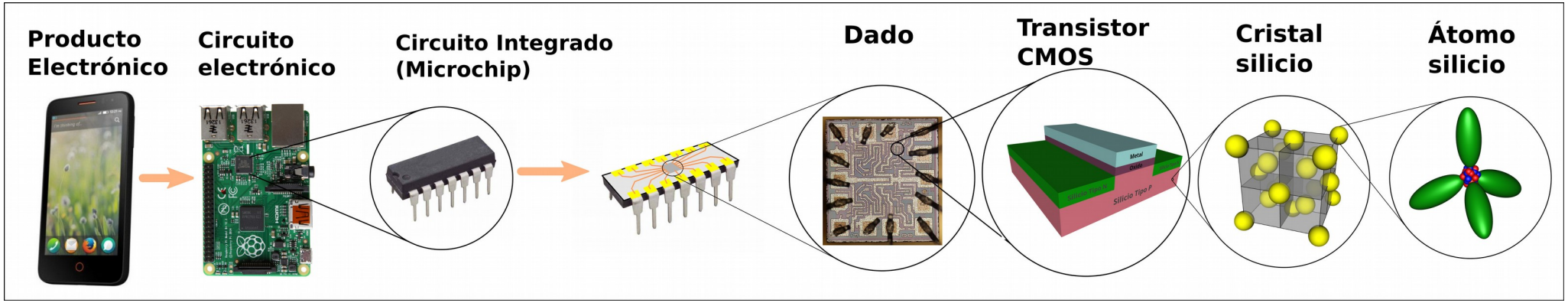
Cristal de silicio



Átomos :-)

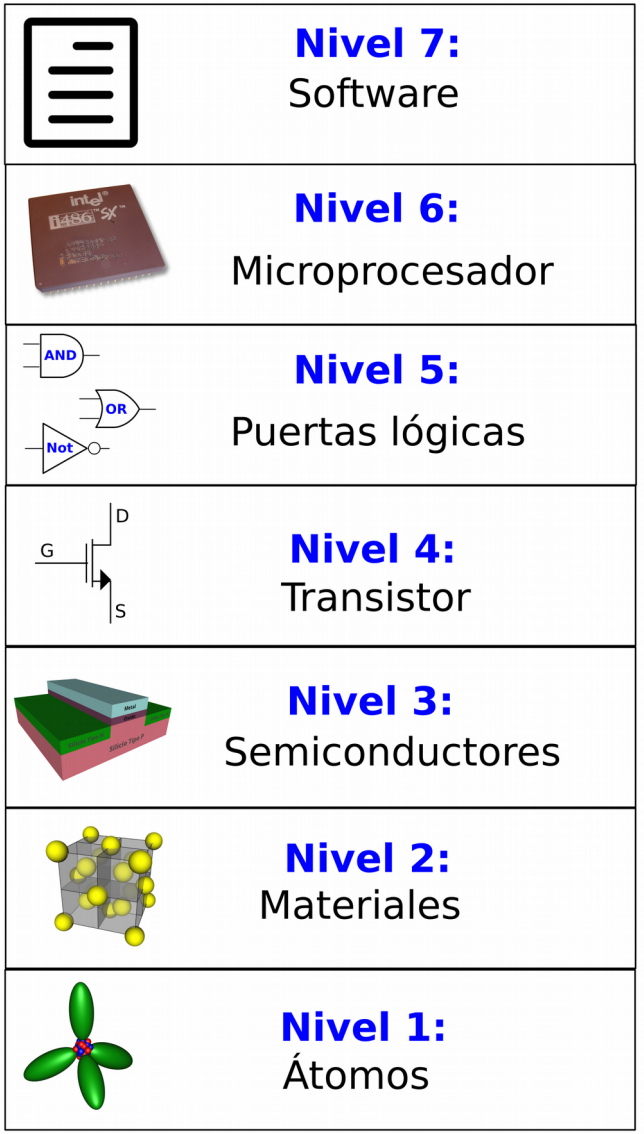


Del producto al átomo

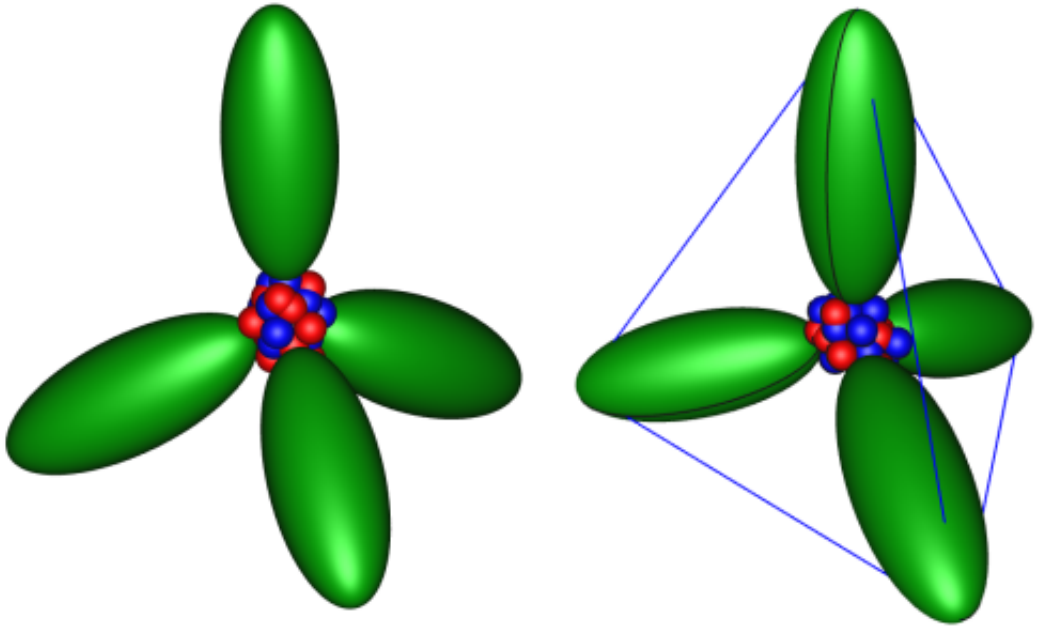


Niveles de descripción

Agrupación en niveles



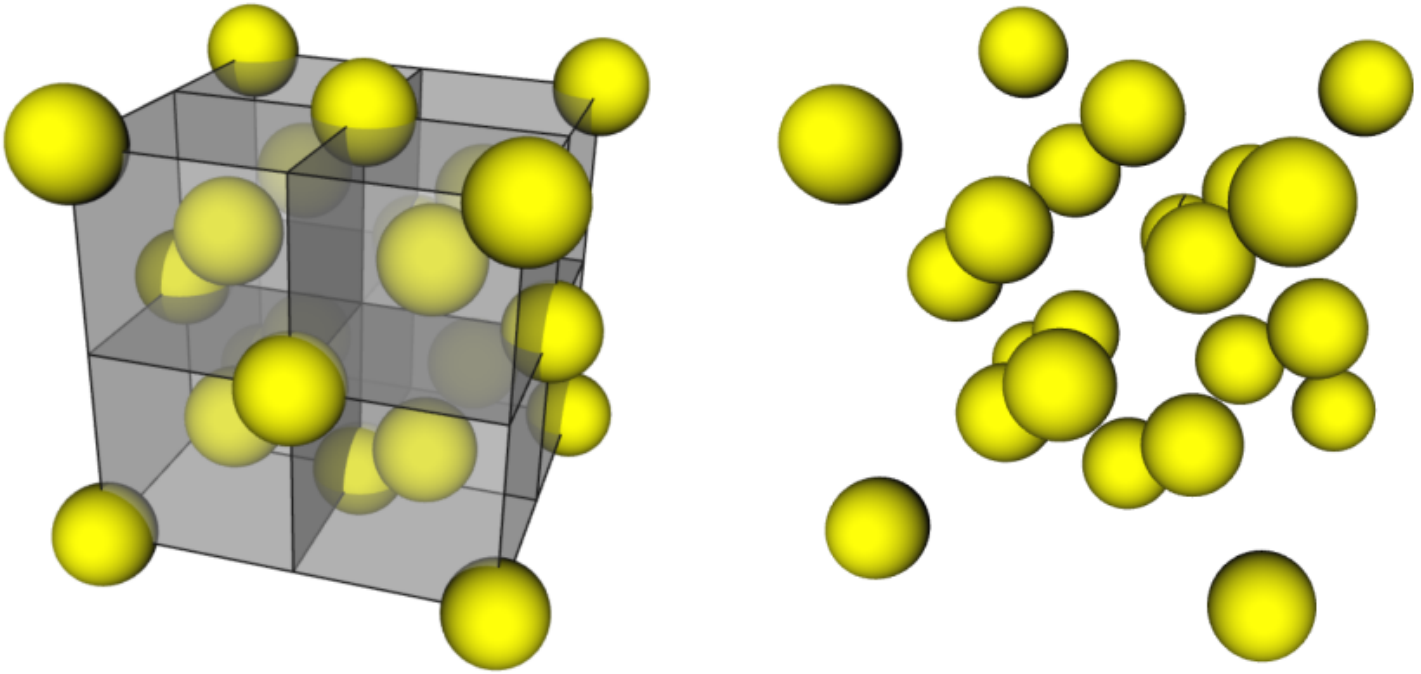
Nivel 1: Átomos



Átomo de silicio

Física, Química

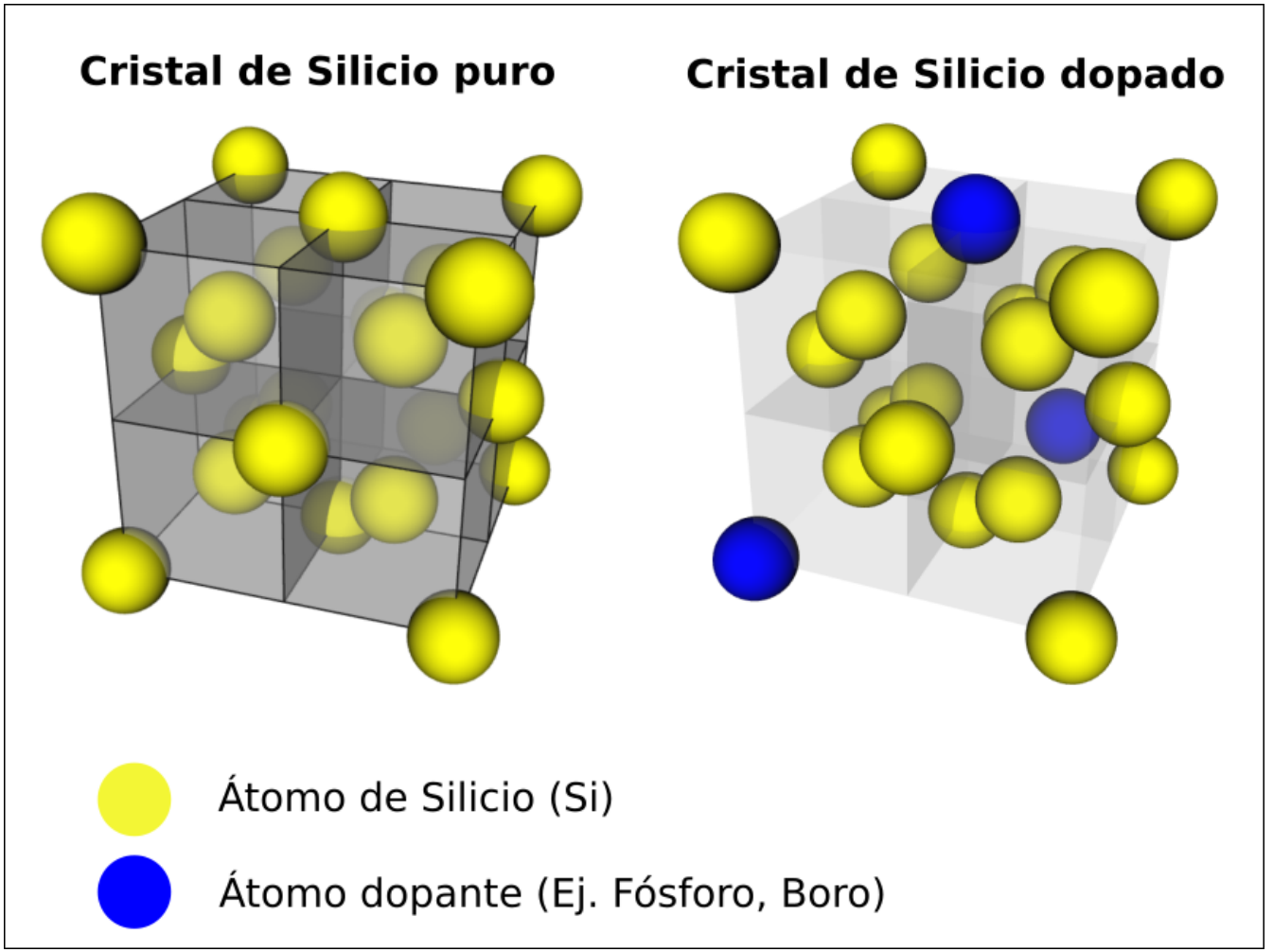
Nivel 2: Materiales



Cristal de silicio

Física del estado sólido

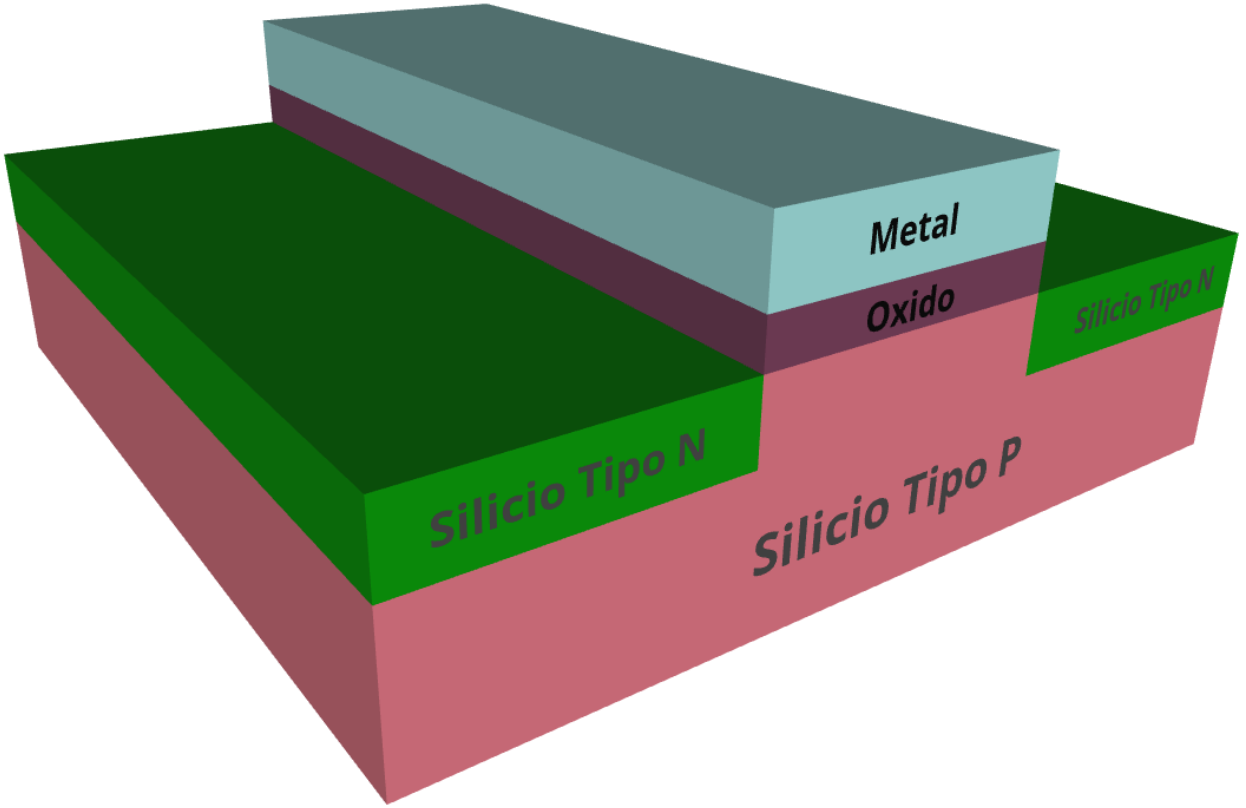
Nivel 3: Semiconductores



Uniones PN

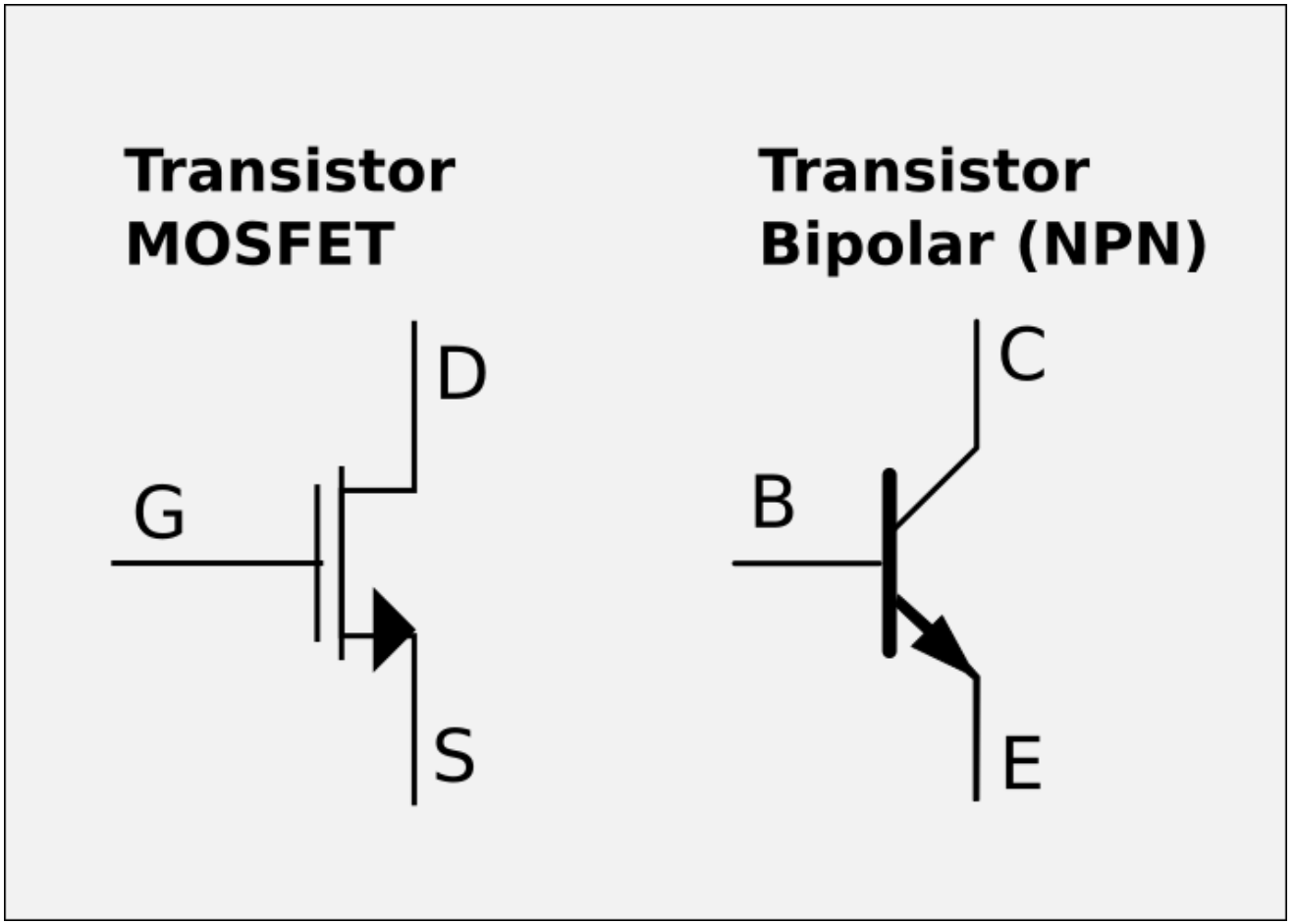
Electrónica de dispositivos

Nivel 3: Semiconductores



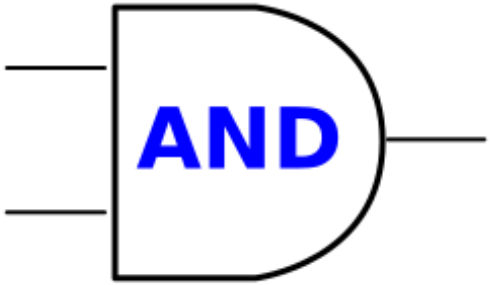
Transistor MOSFET

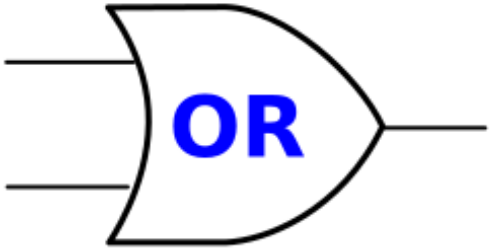
Nivel 4: Transistor

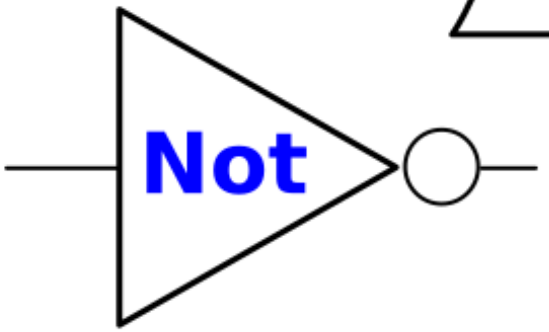


Transistor
Microelectrónica

Nivel 5: Puertas lógicas







Puertas Lógicas

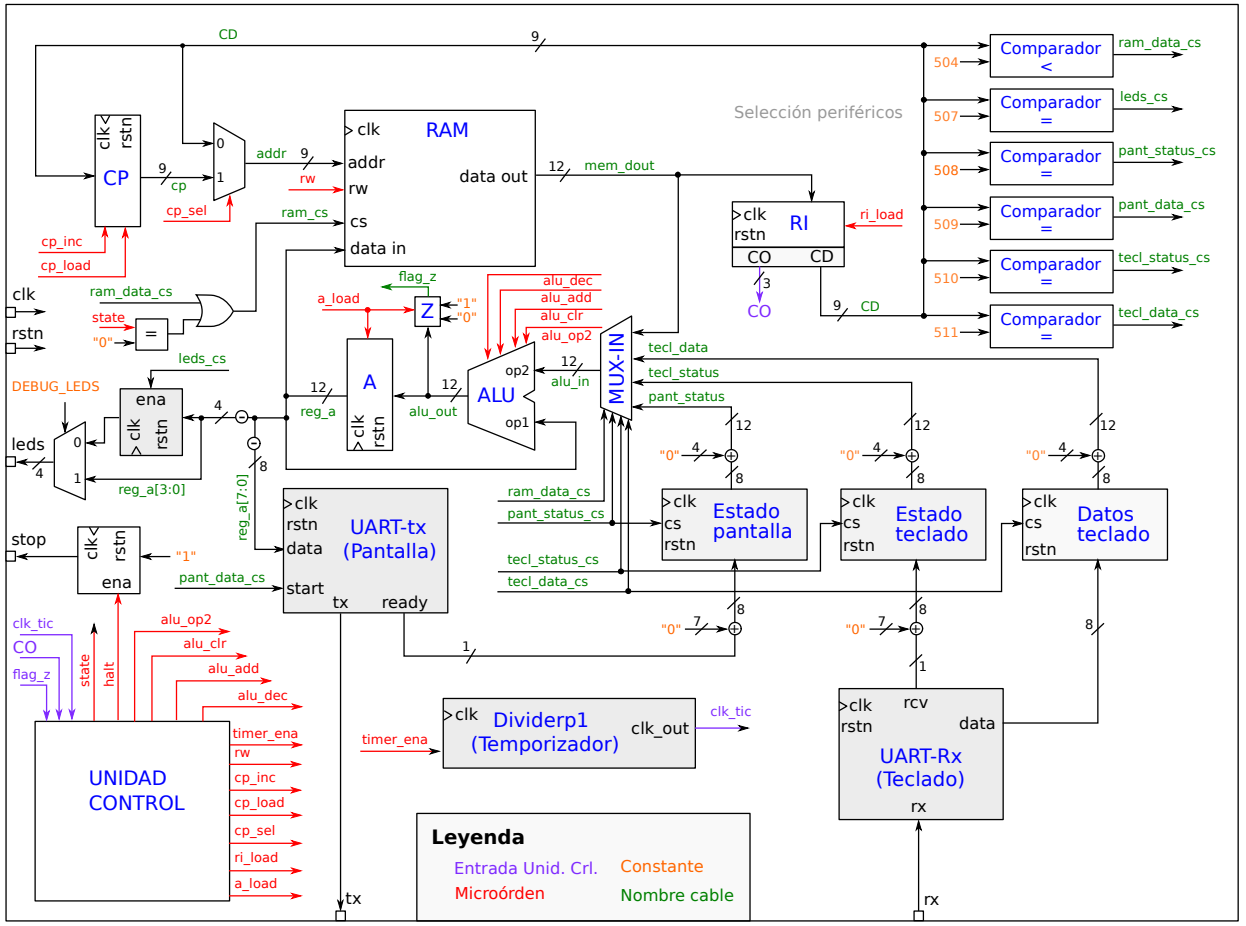
Electrónica Digital

¡Aparecen los bits!

0 *= 0 voltios*

1 *= 5 voltios*

Nivel 6: Microprocesador



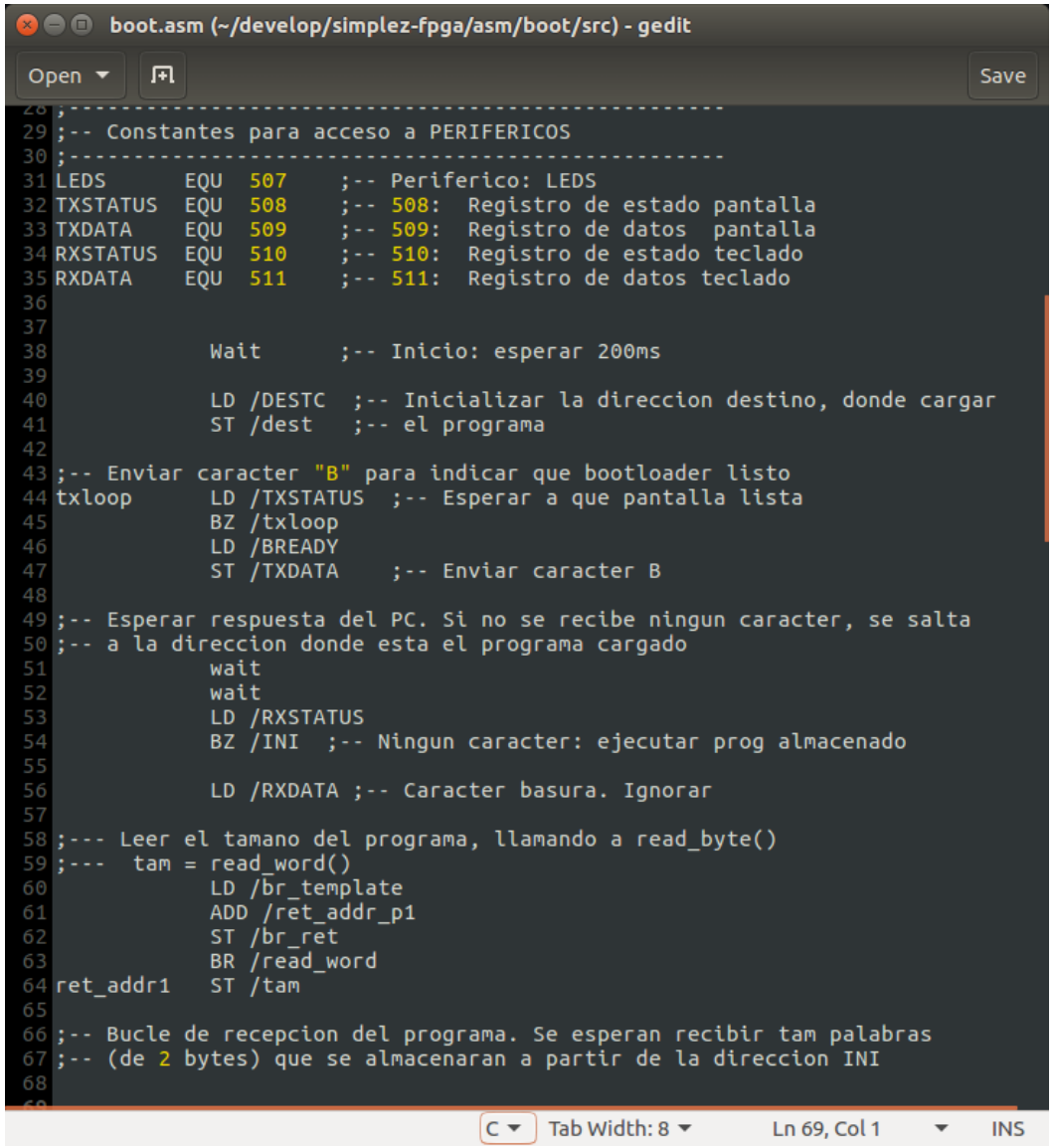
Microprocesador

Arquitectura de Ordenadores

¡Máquina universal!

Máquina reprogramable

Nivel 7: Software

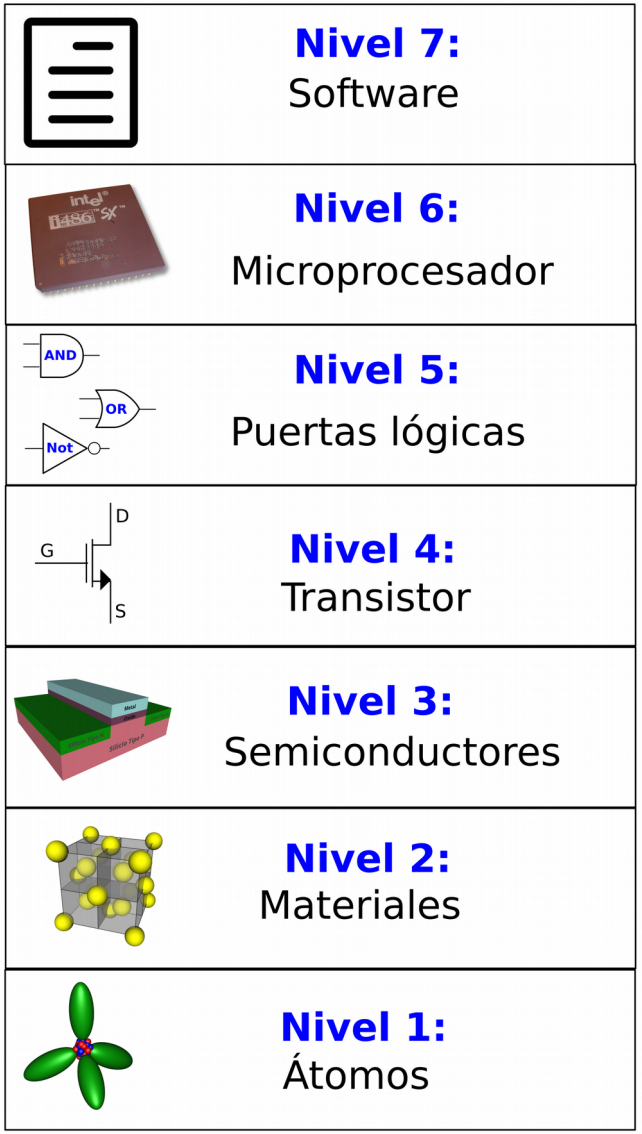


Software
Programación

Código
Algoritmos

Muchos niveles de software

Arduino y Electrónica digital

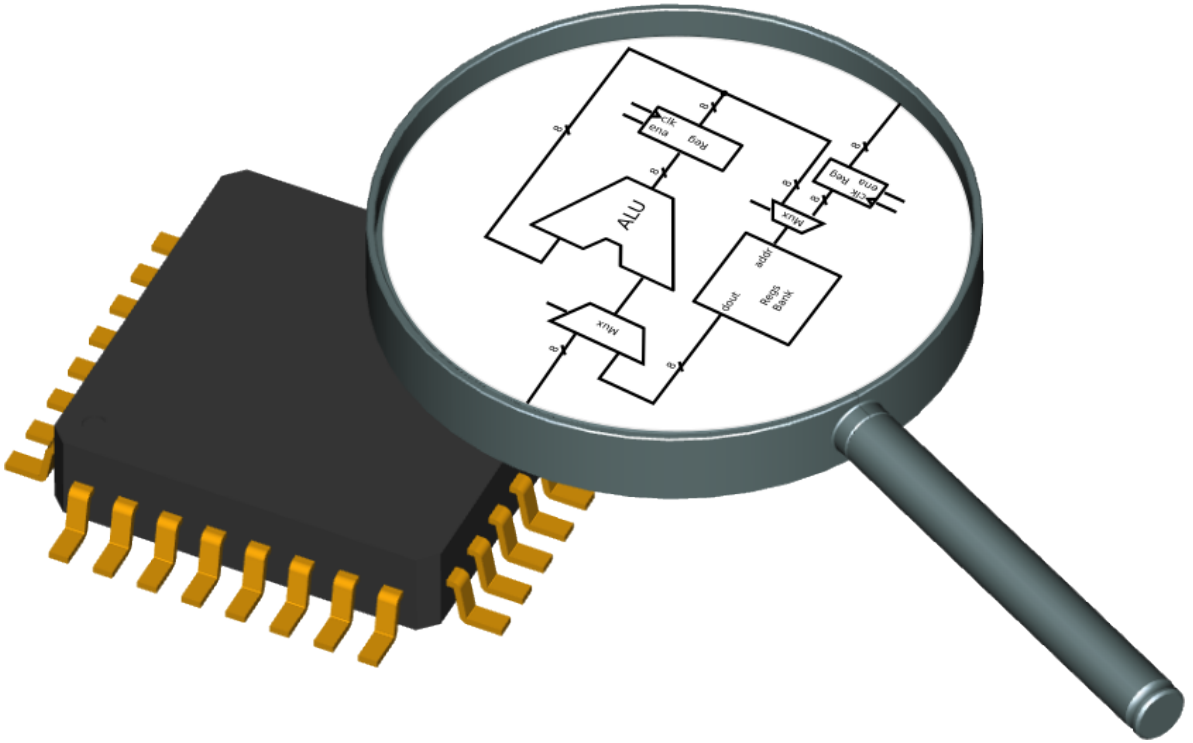


ARDUINO

Electrónica digital

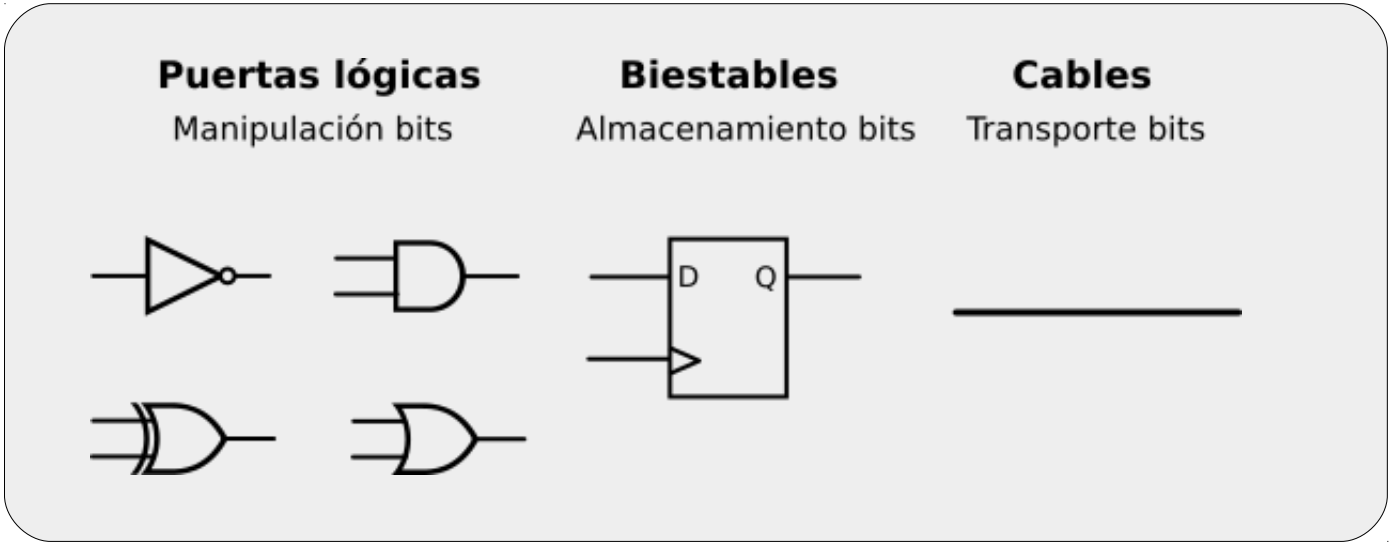
Electrónica Digital y FPGAs

Diseño de microchips



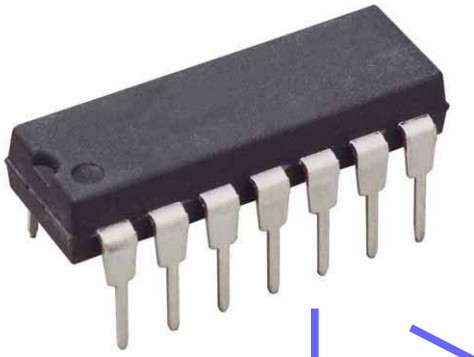
- Nivel de electrónica digital
- Información: Sólo 1s y 0s (Bits)
- Función: **Manipular**, **almacenar** y **transportar** bits

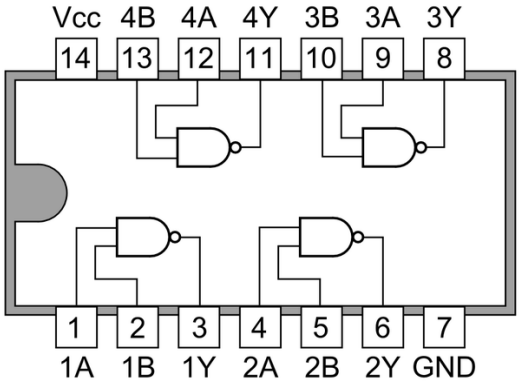
Elementos en circuitos digitales

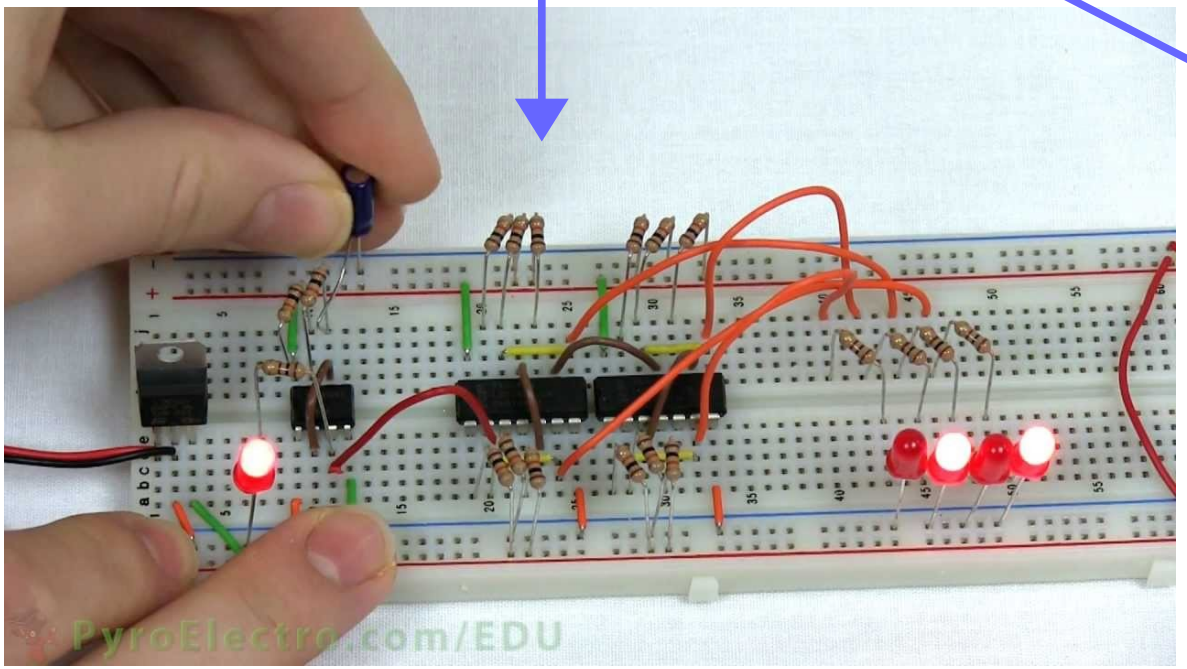


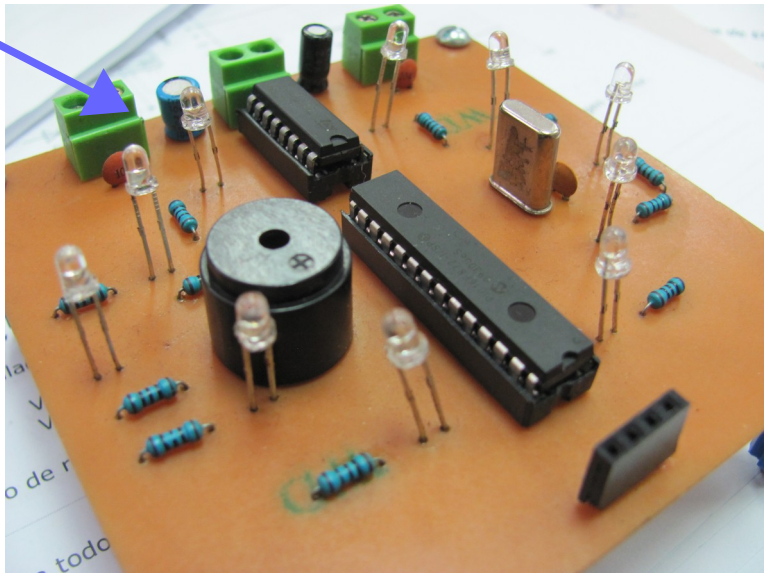
Cualquier circuito digital, por muy complejo que sea, se descompone en estos 3 tipos de **componentes elementales**

¿Cómo se hacen los circuitos digitales?

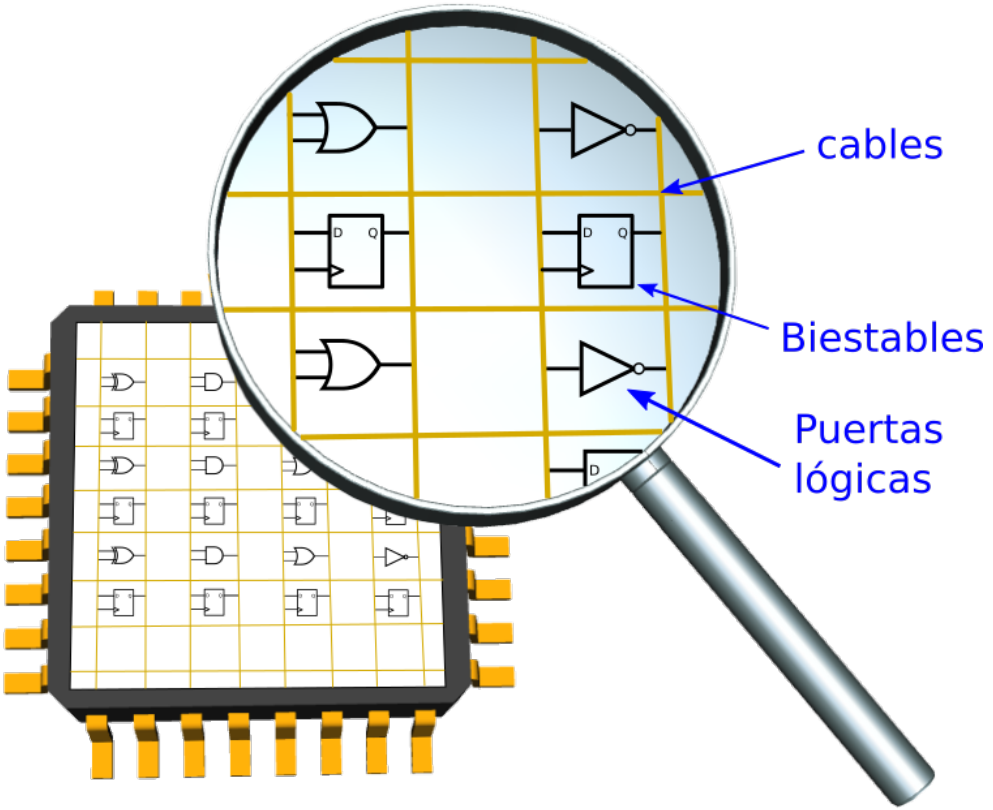






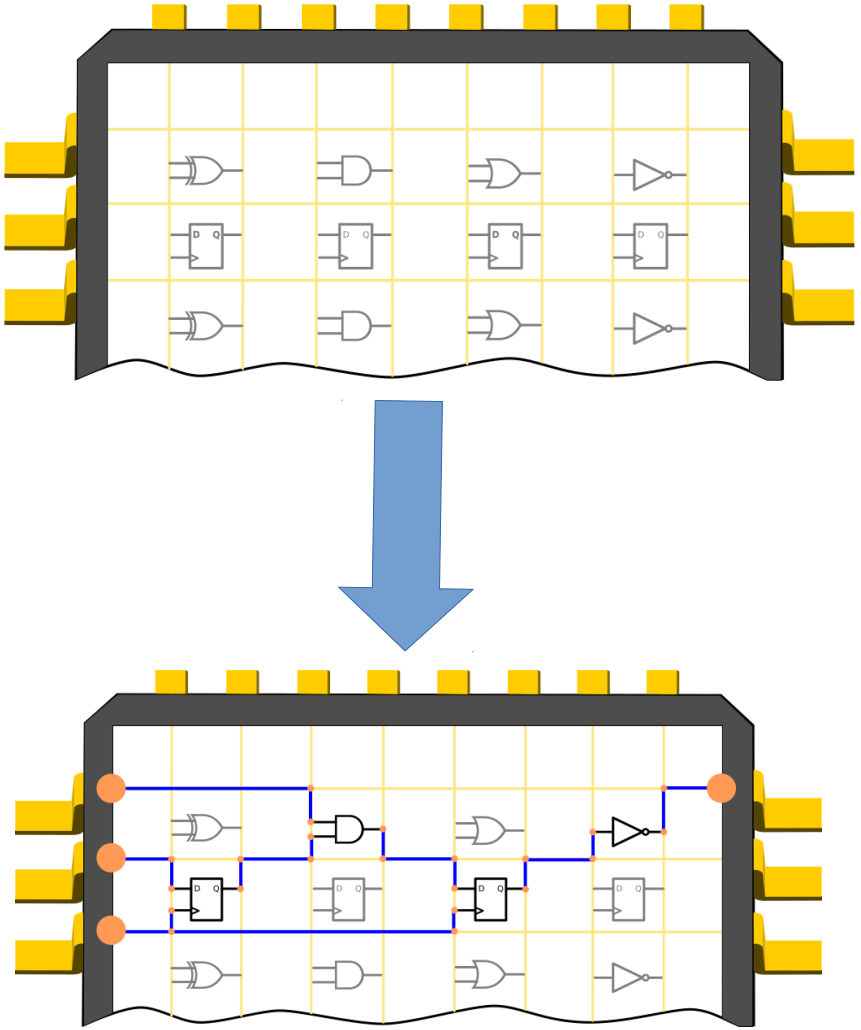


Tecnología FPGA



FPGA: Chip “en blanco” que contiene una matriz con los 3 componentes básicos: puertas lógicas, biestables y cables

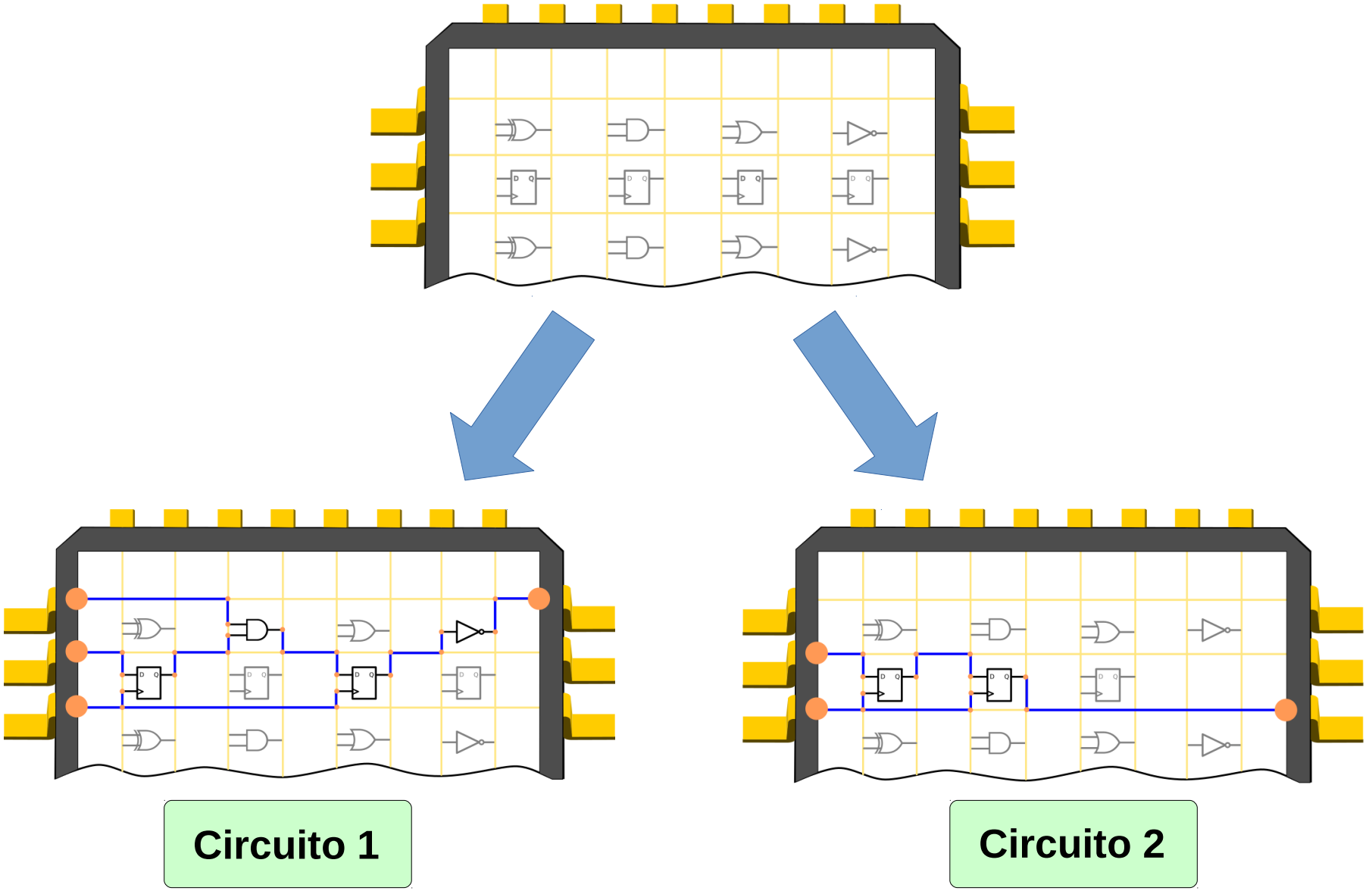
Electrónica digital con FPGAs



FPGA **en Blanco**

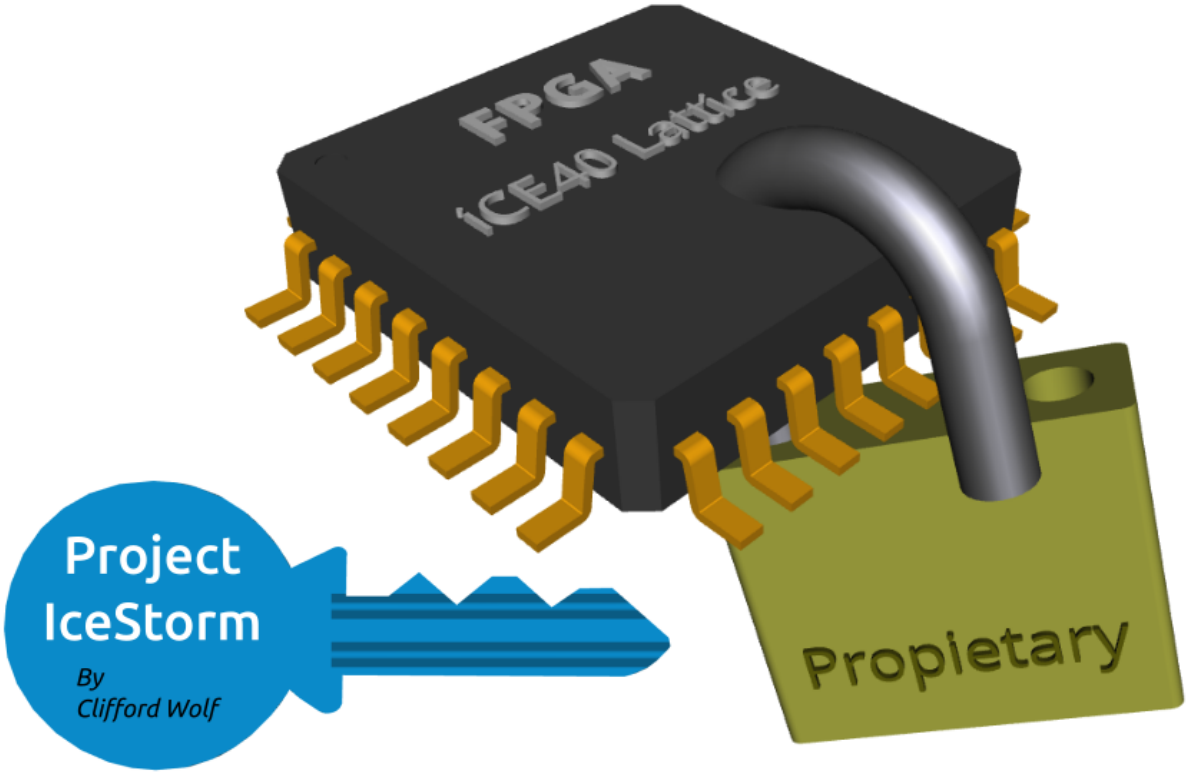
FPGA **configurada**

Circuito creado configurando las uniones entre los elementos básicos de la FPGA


Circuito 1
Circuito 2

¡FPGAs = Impresoras 3D de circuitos digitales!

FPGAs libres: El renacimiento



- Proyecto Icestorm (Mayo, 2015)
- La primera *toolchain* que permiten pasar de Verilog al bitstream usando sólo Herramientas libres

Comunidad FPGAwars

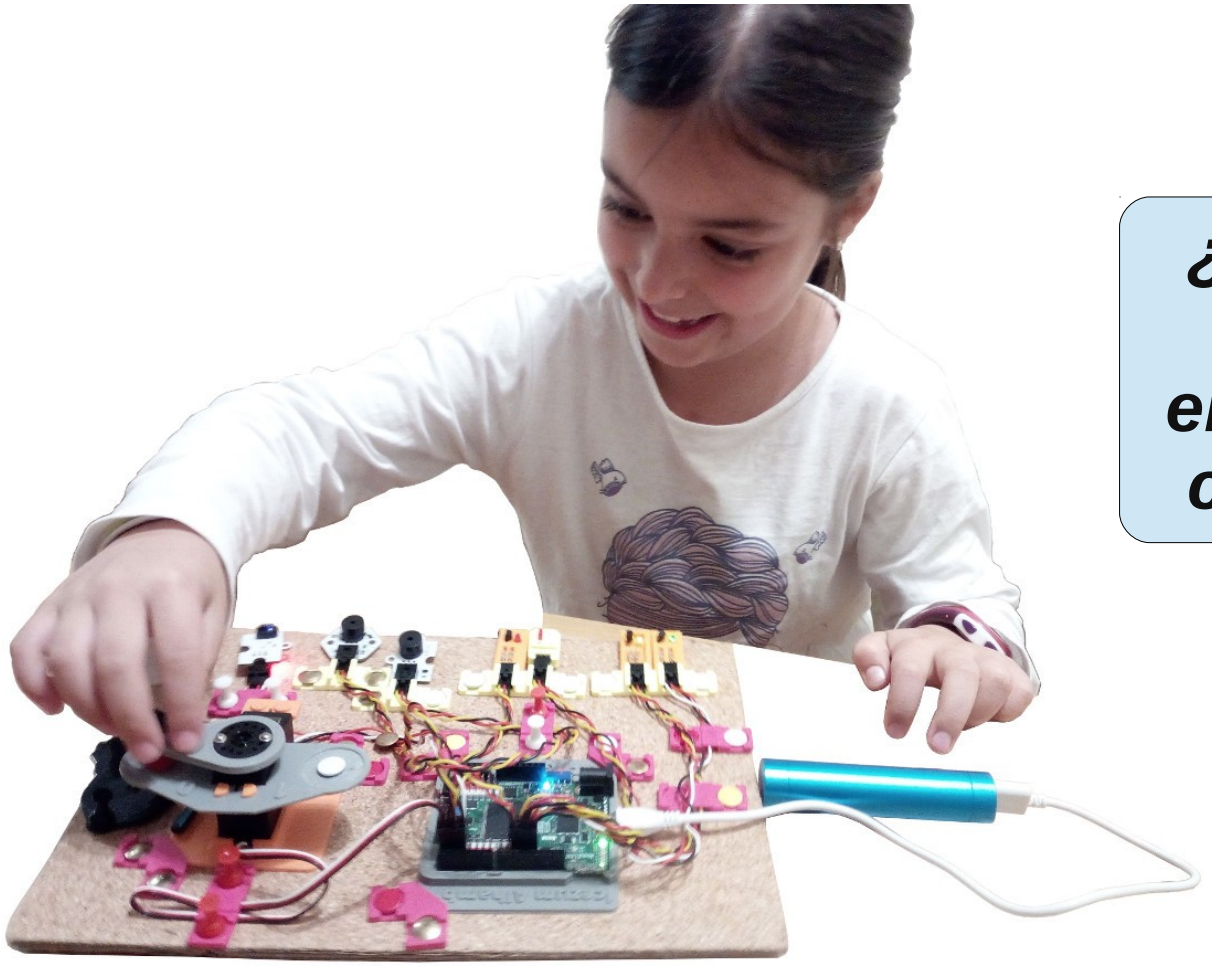
- Comunidad para **compartir conocimiento** relacionado con **FPGAs libres**
- Es el **clonewars** de las FPGAs, pero en modesto :-)
- Idioma: Castellano
- 424 miembros
- Cualquier pregunta / comentario / sugerencia → Correo a la lista :-)

http://fpgawars.github.io/

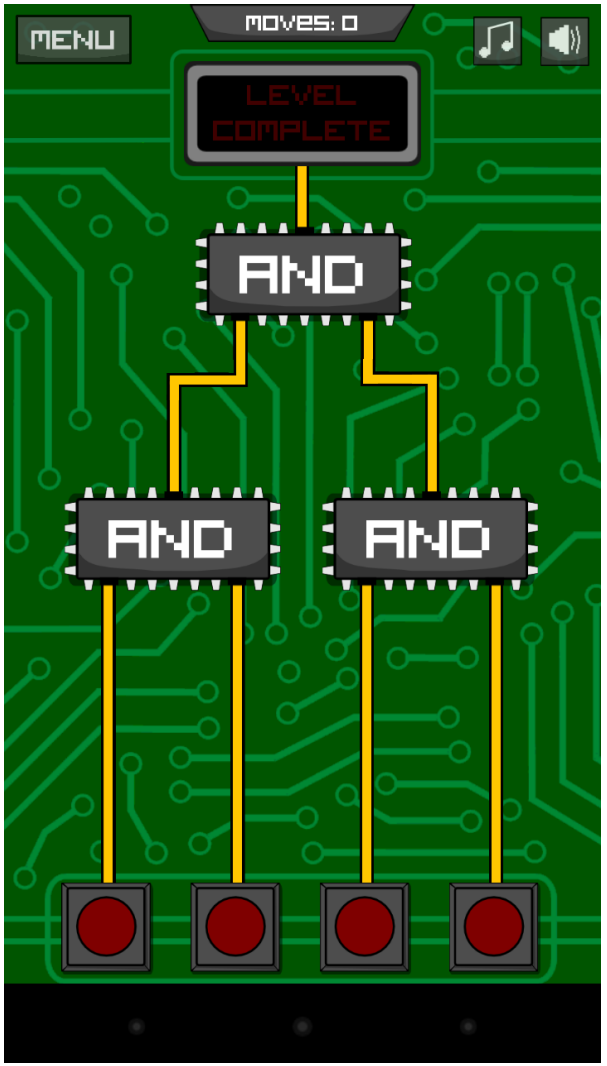
Electrónica Digital fácil, intutitiva y divertida

Motivación

Electrónica digital accesible

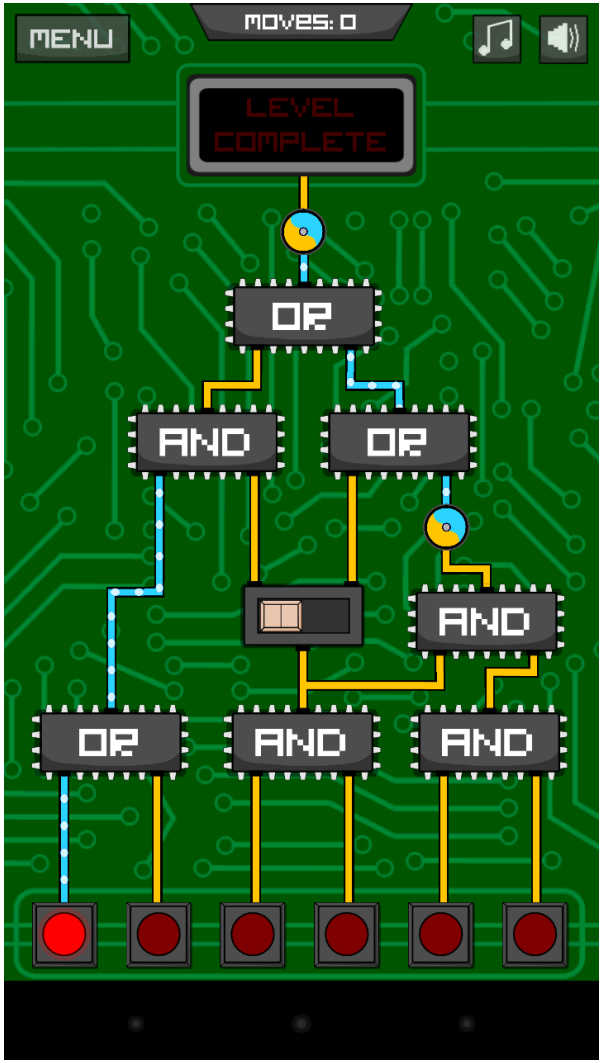


¿Cómo podrían los niños y los no electrónicos diseñar circuitos digitales?



APP:
Circuit Scramble

Demo

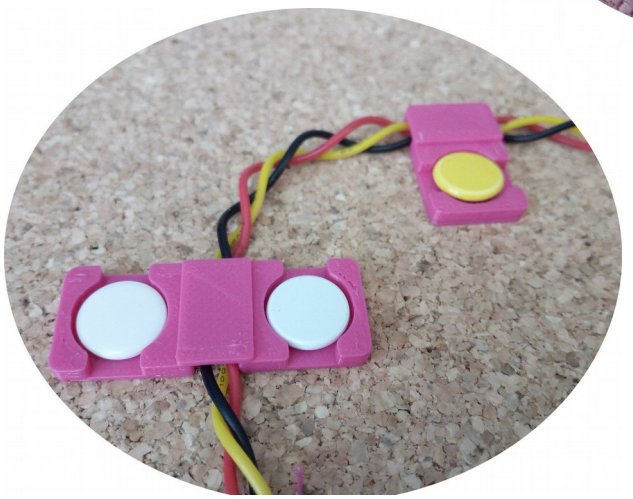


La electrónica digital es intuitiva y…
¡Divertida!

Elementos

Panel de corcho (28x19cm)

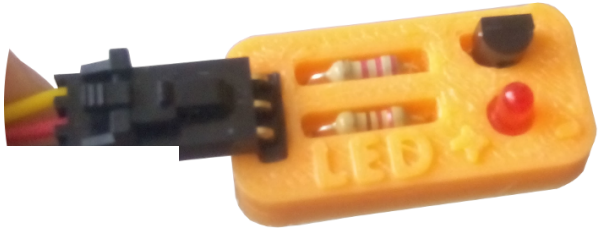
Piezas Impresas en 3D para fijar elementos al corcho

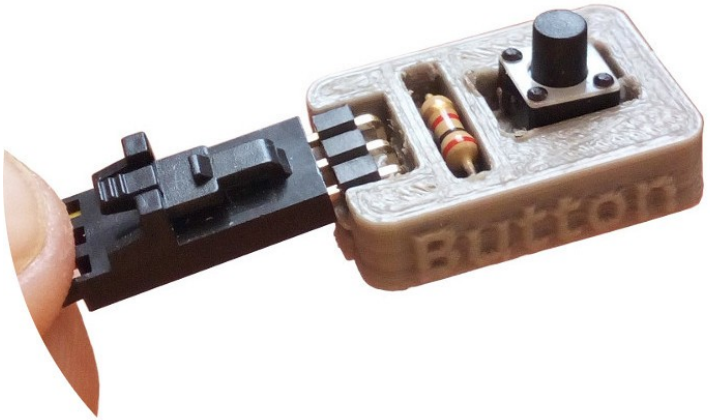


https://github.com/Obijuan/3D-parts/wiki

Periféricos

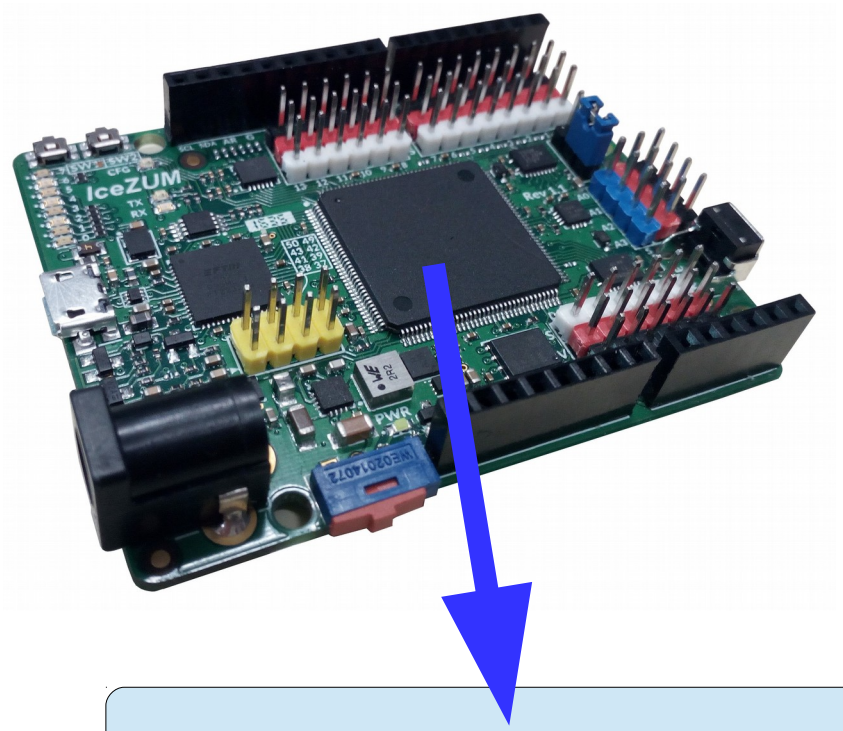
PCBprints: Mini-circuitos impresos en 3D





Icezum Alhambra v1.1

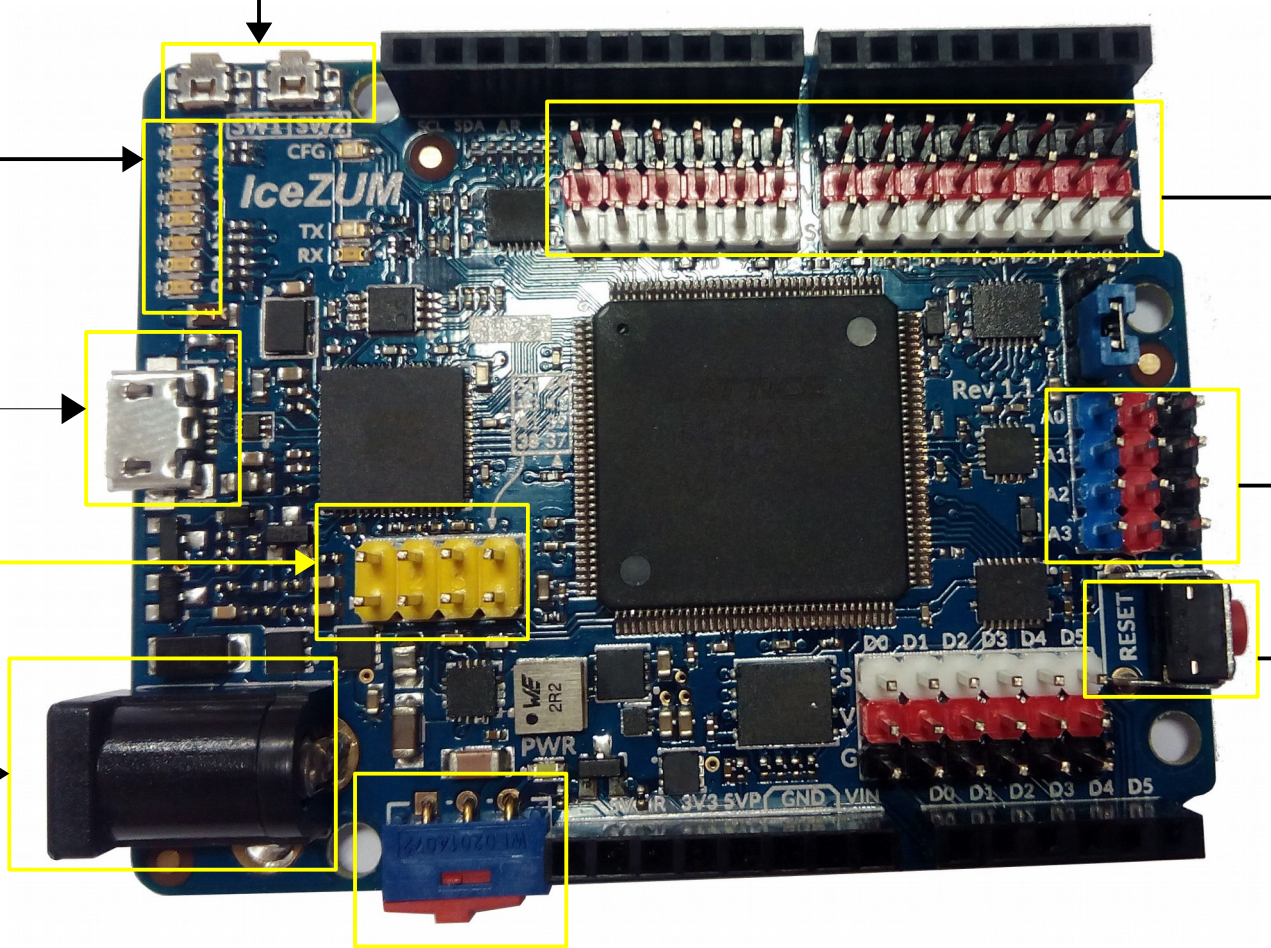
https://github.com/FPGAwars/icezum/wiki



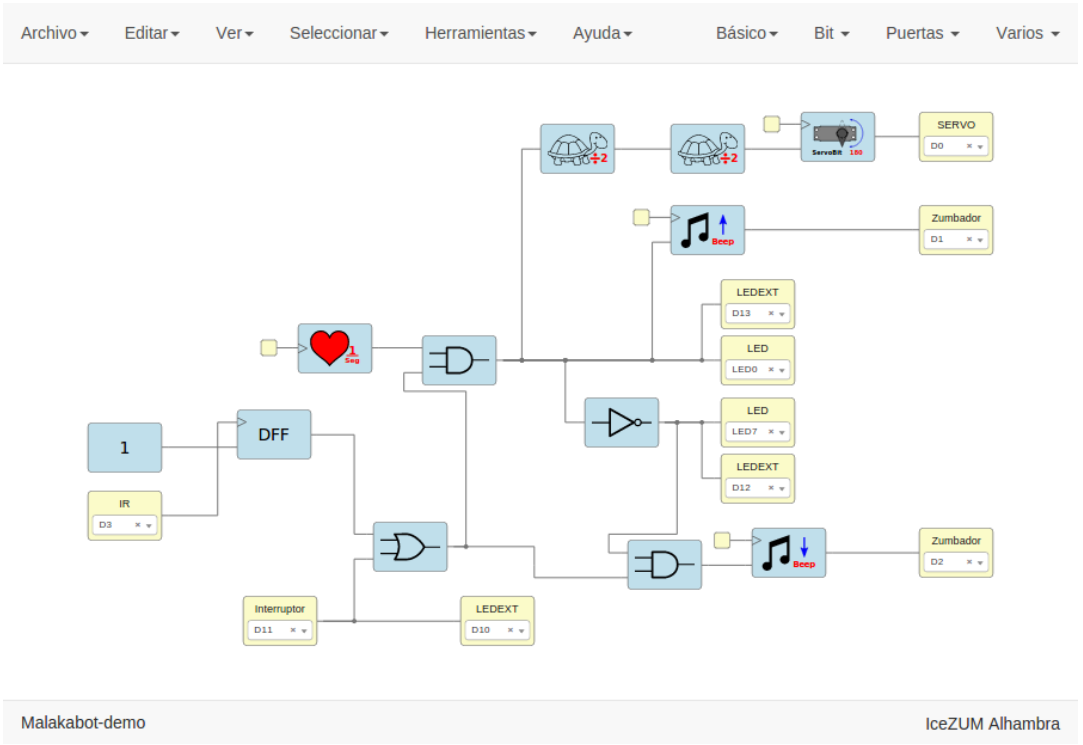
FPGA Libre

- Autor: **Eladio Delgado**
- Diseñada en Pinos del Valle (Granada)
- Arduino de las **FPGAs**
- Compatible Arduino
- Fácil conexión de circuitos externos/sensores/servos
- Reutilización de los shields de arduino
- 20 entradas/salidas de 5v
- 3A corriente de entrada
- Perfecta para hacer robots

Icezum Alhambra v1.1



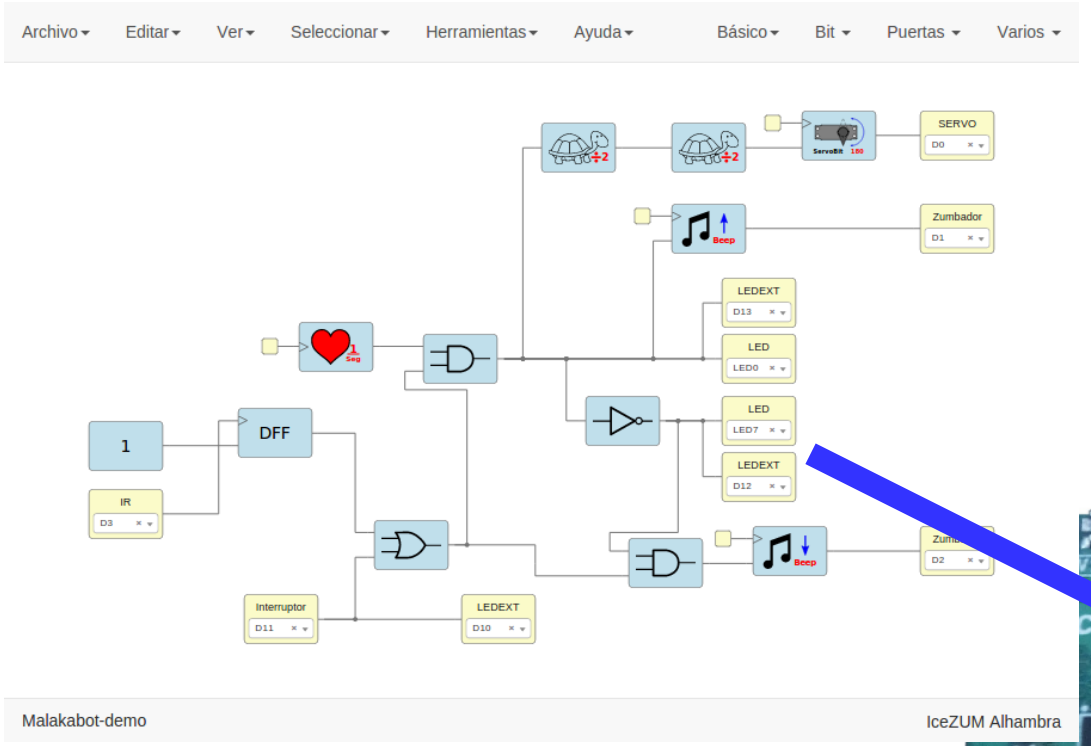
icestudio

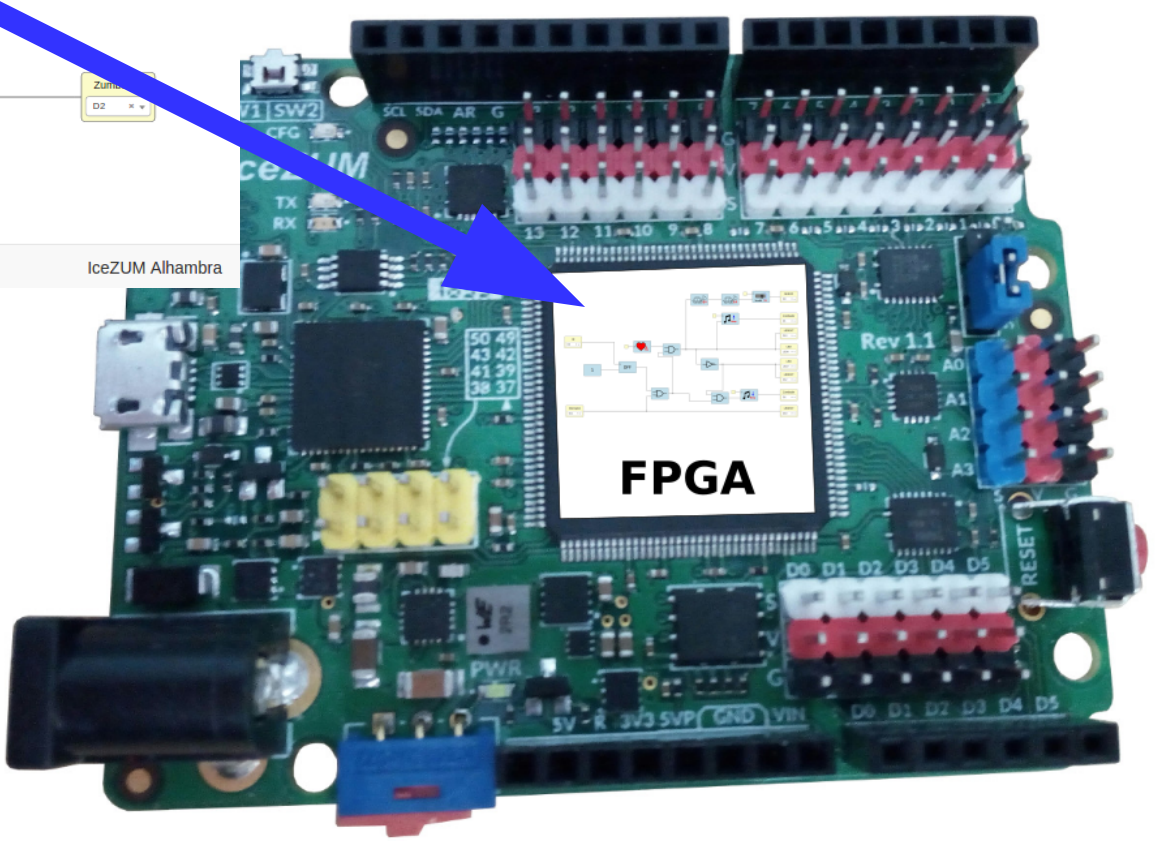


https://github.com/FPGAwars/icestudio

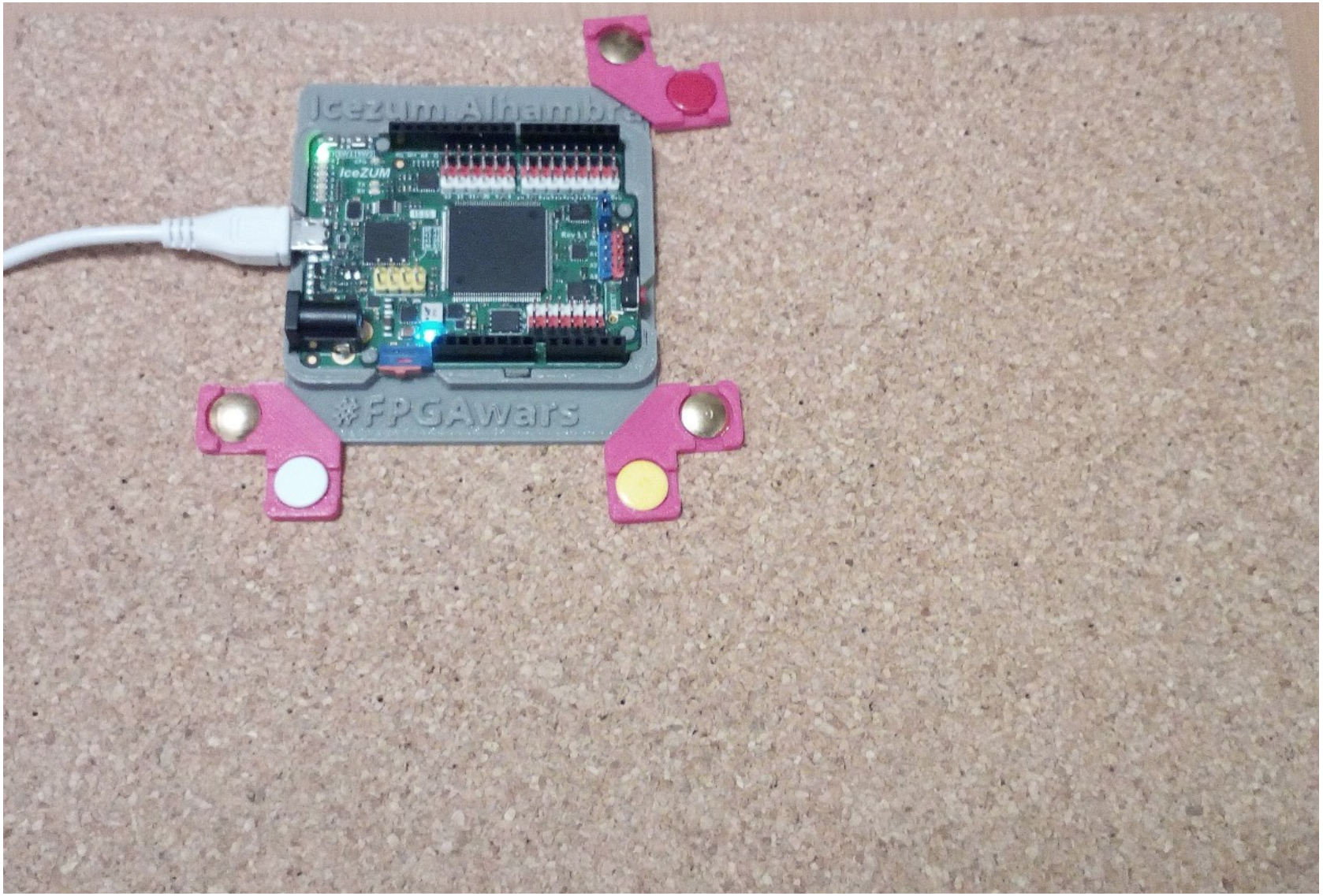
- Autor: **Jesús Arroyo**
- Electrónica digital para todos
- Herramienta visual
- Traduce a verilog

La magia de las FPGAs



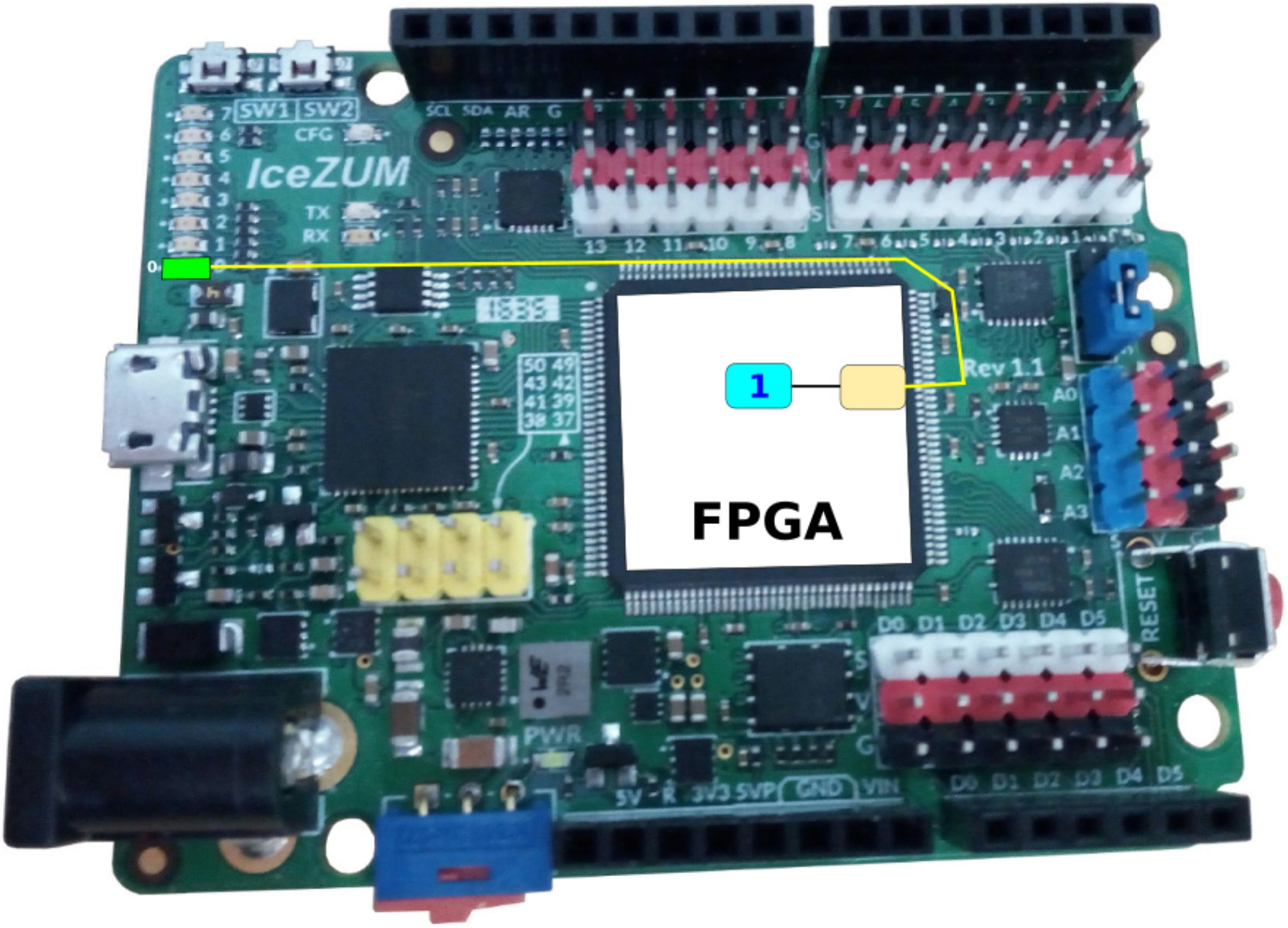


¡Empezamos!

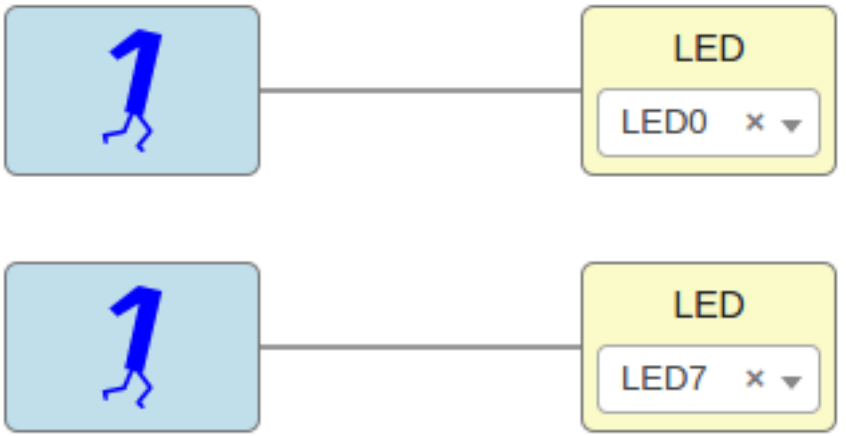


Ejemplo 1: Hola Mundo

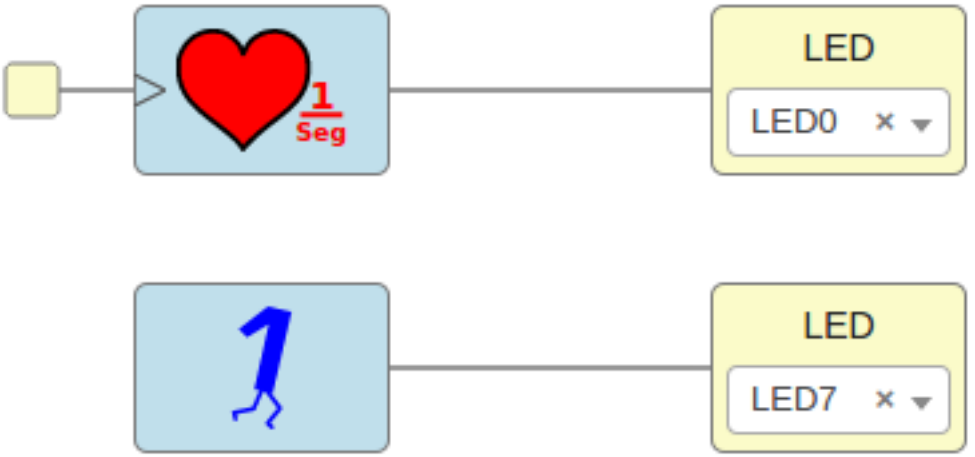
Hola mundo: Implementación física



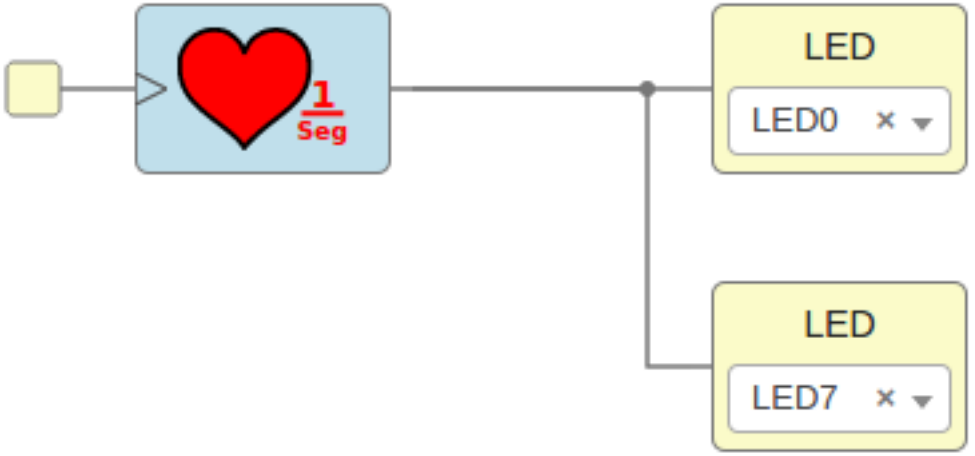
Ejemplo 2: Dos leds en paralelo



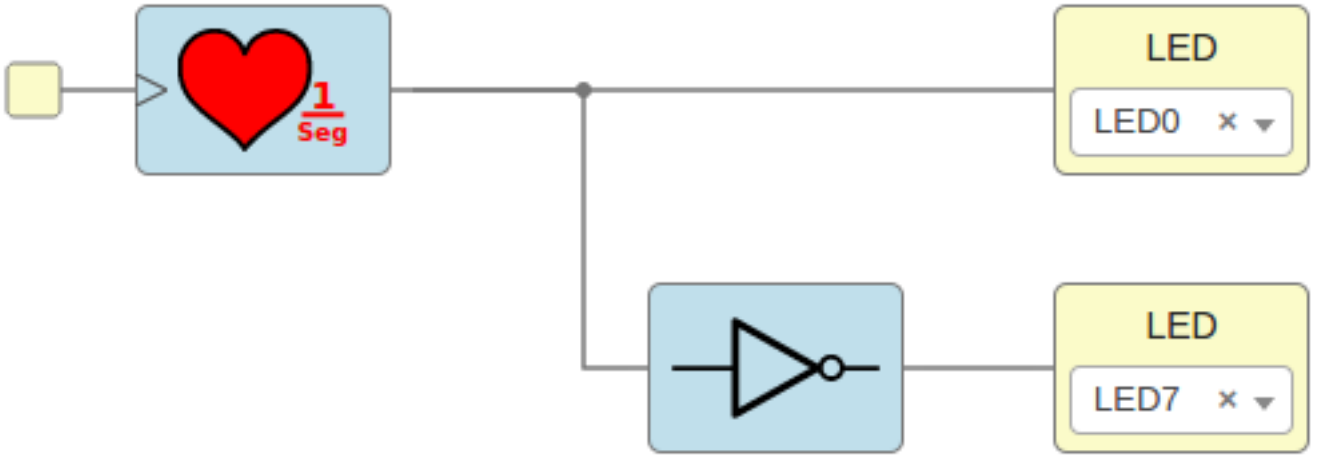
Ejemplo 3: Led pulsante



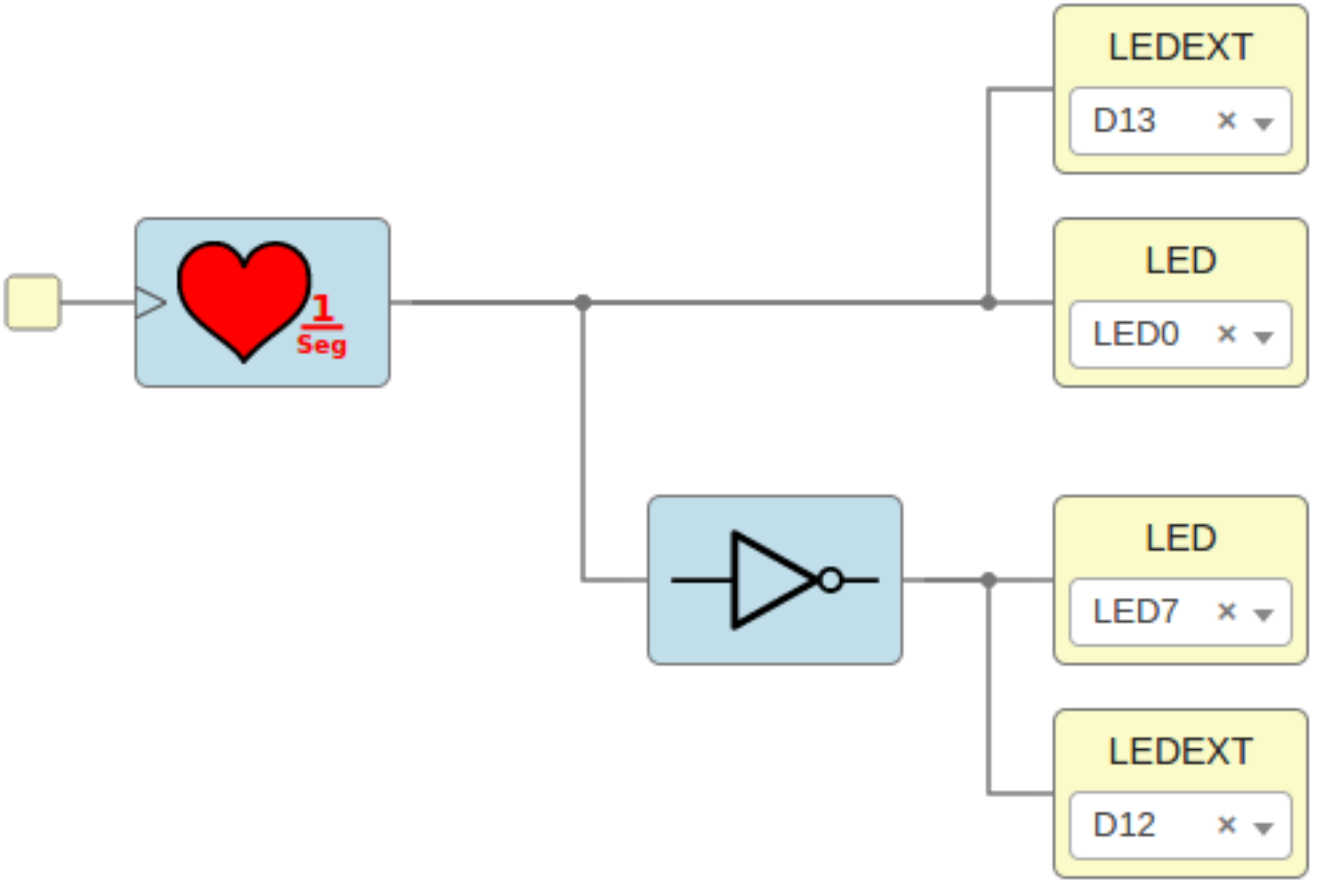
Ejemplo 4: Leds pulsantes Mismo ritmo



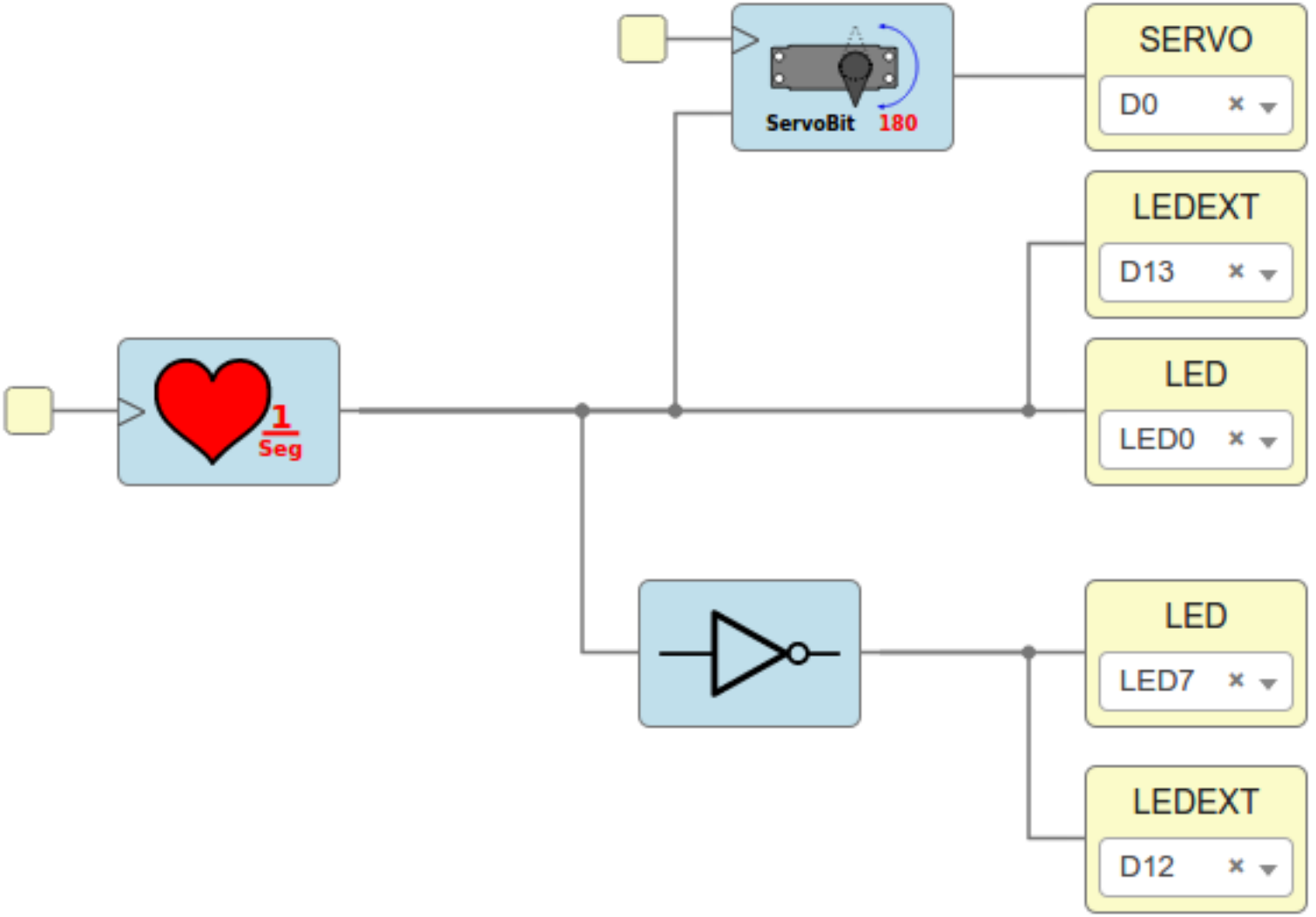
Ejemplo 5: Leds alternativos



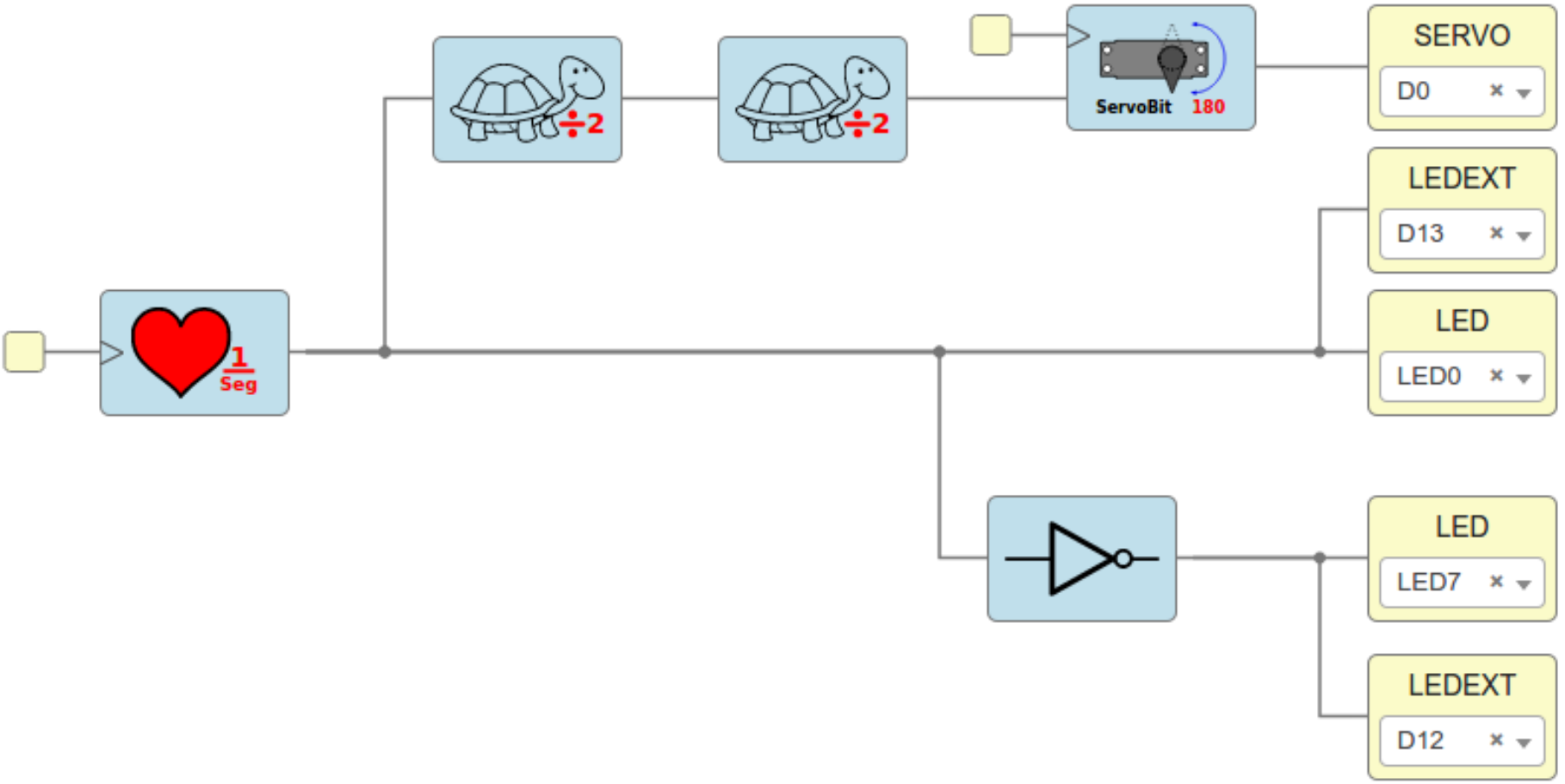
Ejemplo 6: Leds externos



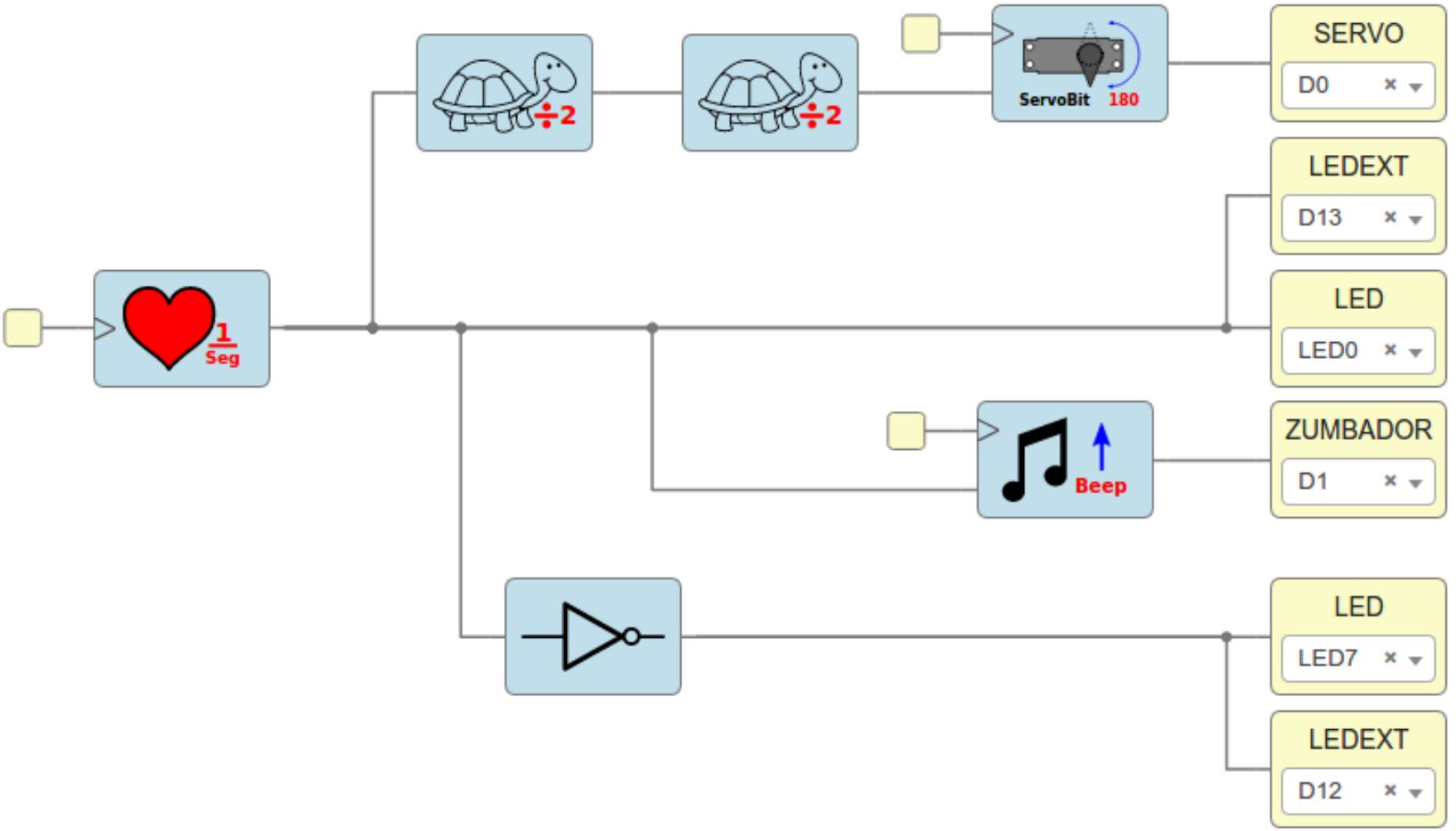
Ejemplo 7: Servo binario



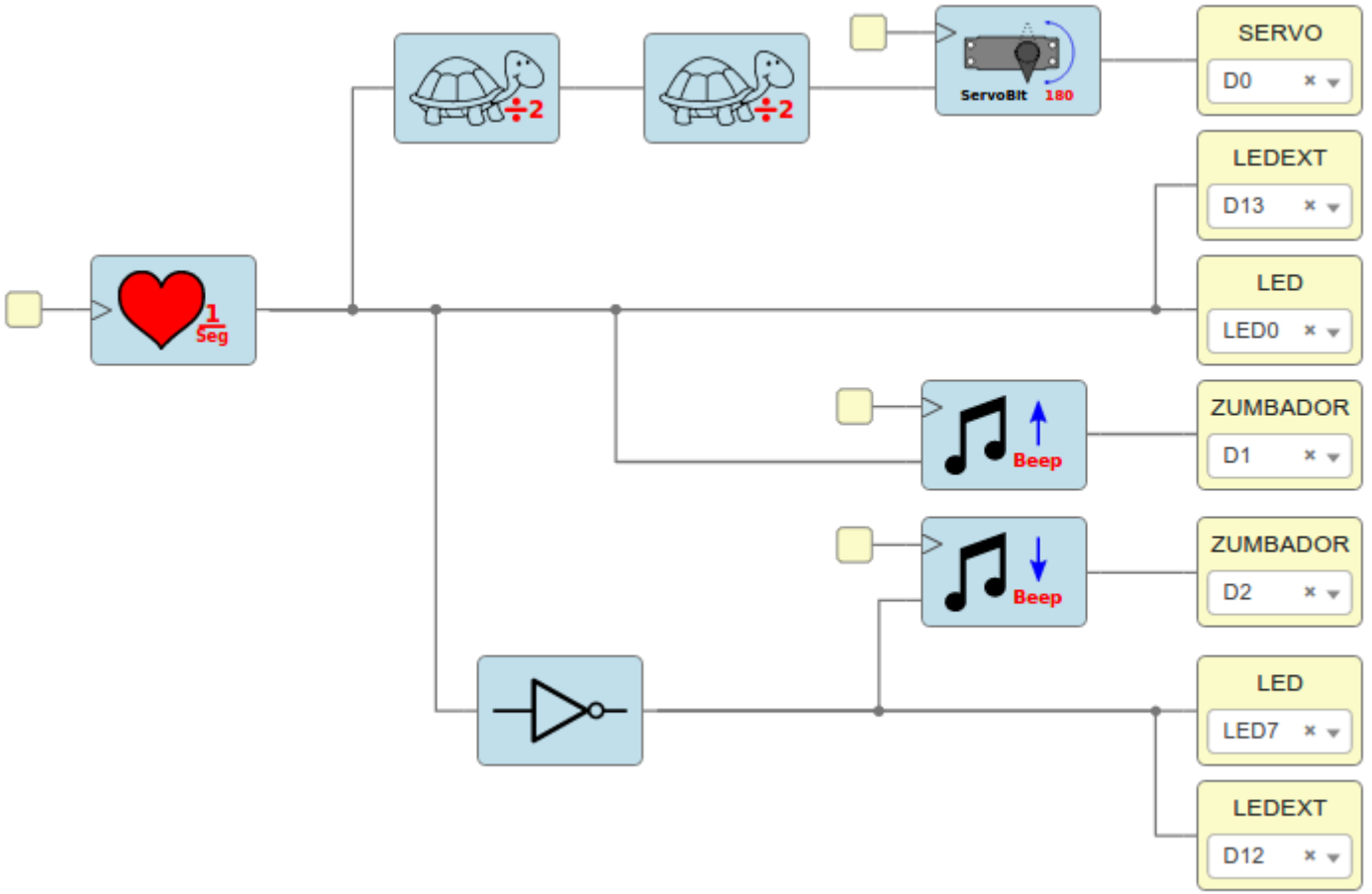
Ejemplo 8: Bajando el ritmo



Ejemplo 9: Zumbador

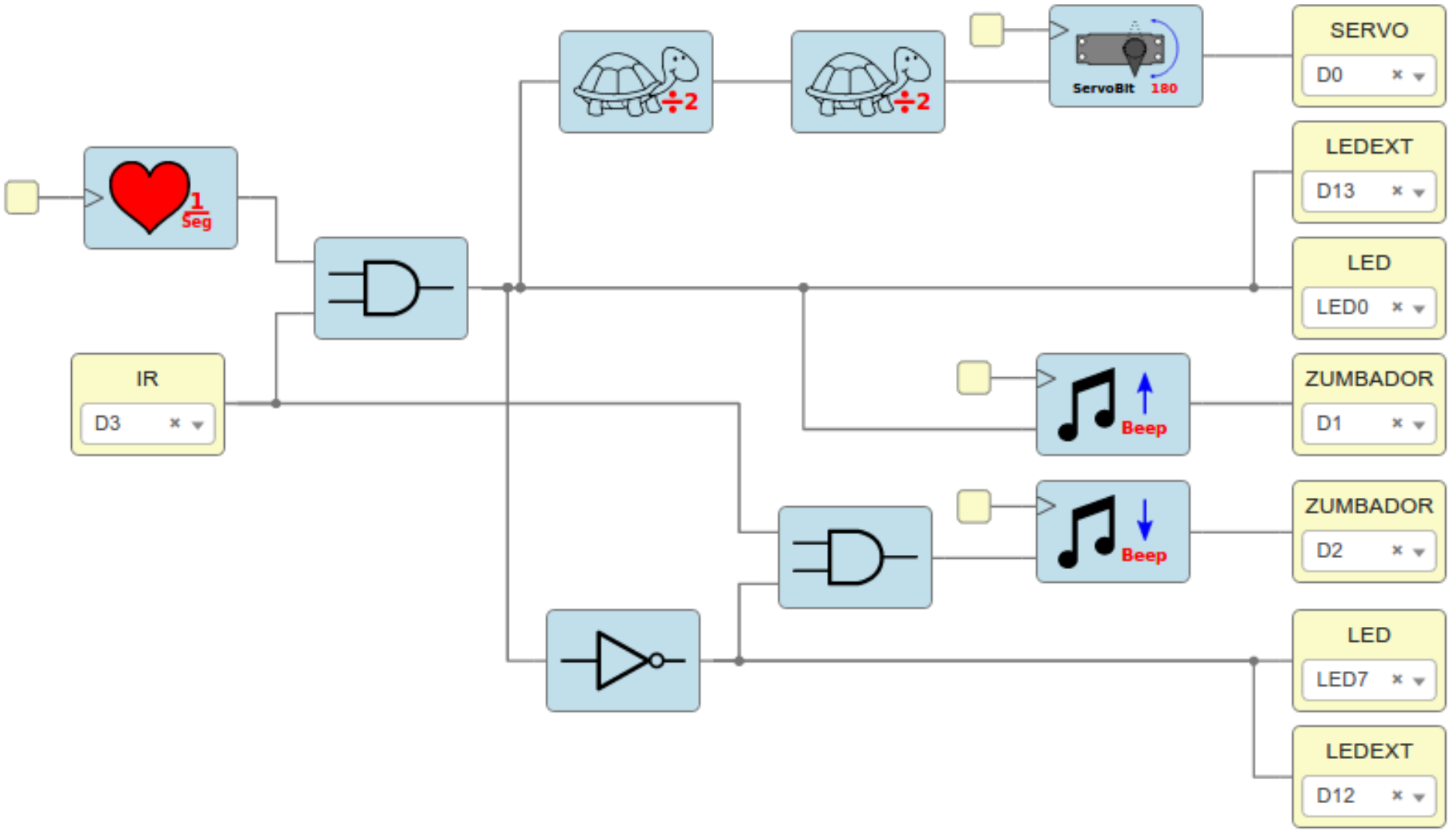


Ejemplo 10: Sirena

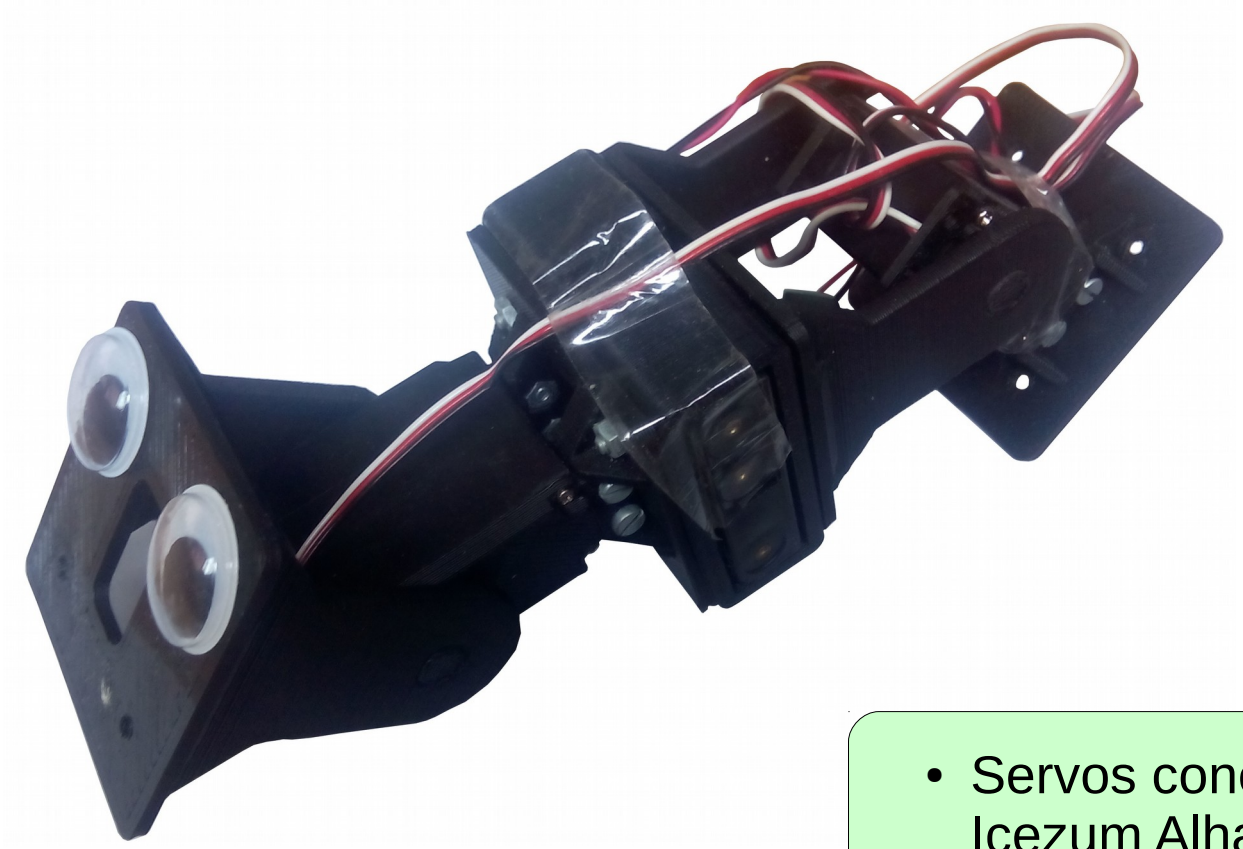


Ejemplo 11: Test IR

Ejemplo 12: Alarma v1.0



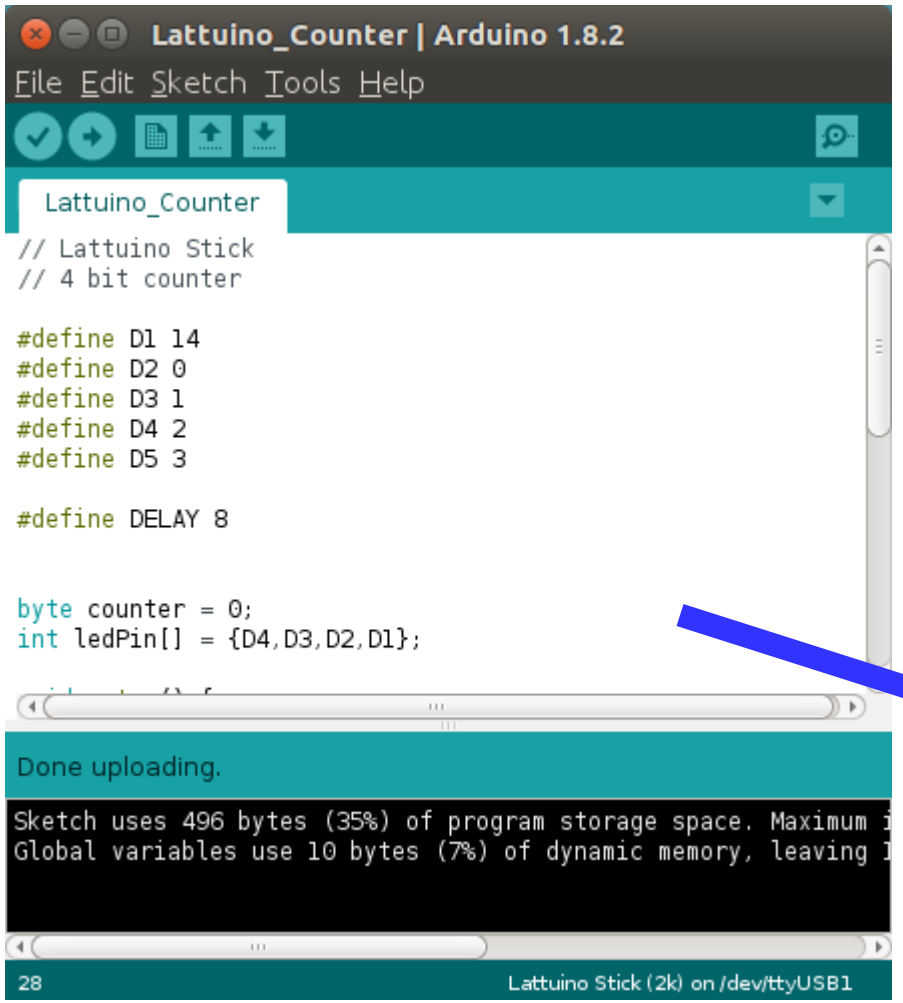
Larby: Robot modular



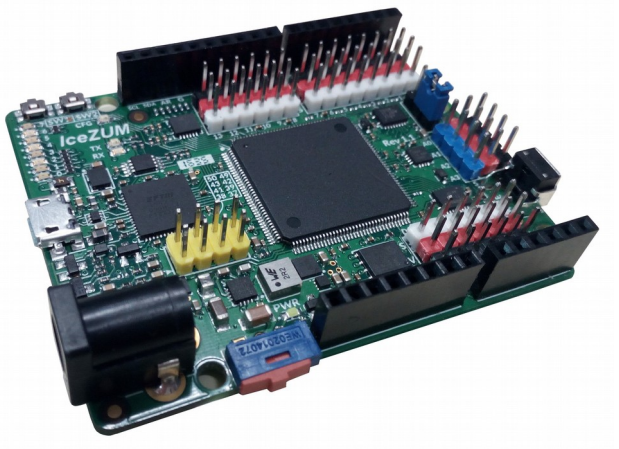
- Servos conectados directamente a Icezum Alhambra
- Configuración mínima pitch-pitch
- Módulo impresos en 3D

Lattuino

https://github.com/INTI-CMNB/Lattuino_IP_Core



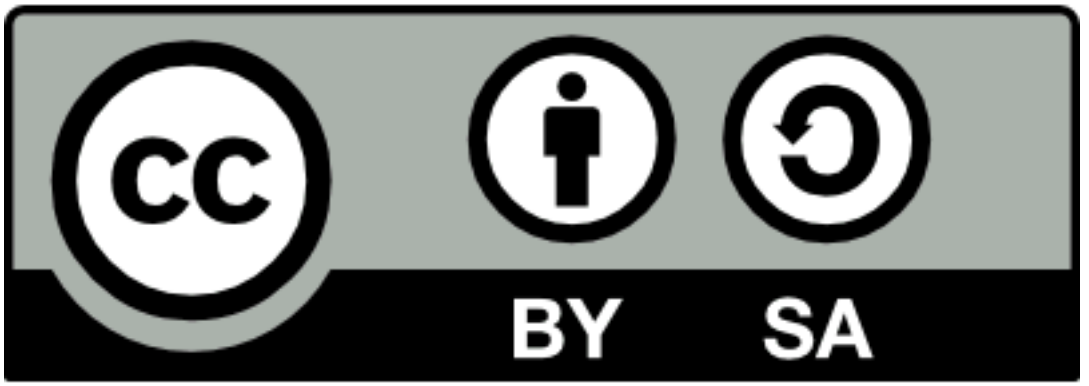
- Autor: **Salvador Tropea**
- Core de Arduino para FPGA
- Lattice Ice40 (1k, 4k, 8k)
- **VHDL**
- Herramientas privativas
- Migrando a **herramientas libres**



Lattuino (II)


Nivel 7: Software
Nivel 6: Microprocesador
AND
OR
Not
Nivel 5: Puertas Lógicas
D
G
S
Nivel 4: Transistor
Lattuino
FPGAs

¡Comparte con la comunidad!



¡Que las FPGAs libres os acompañen!

Electrónica digital para todos con FPGAs Libres

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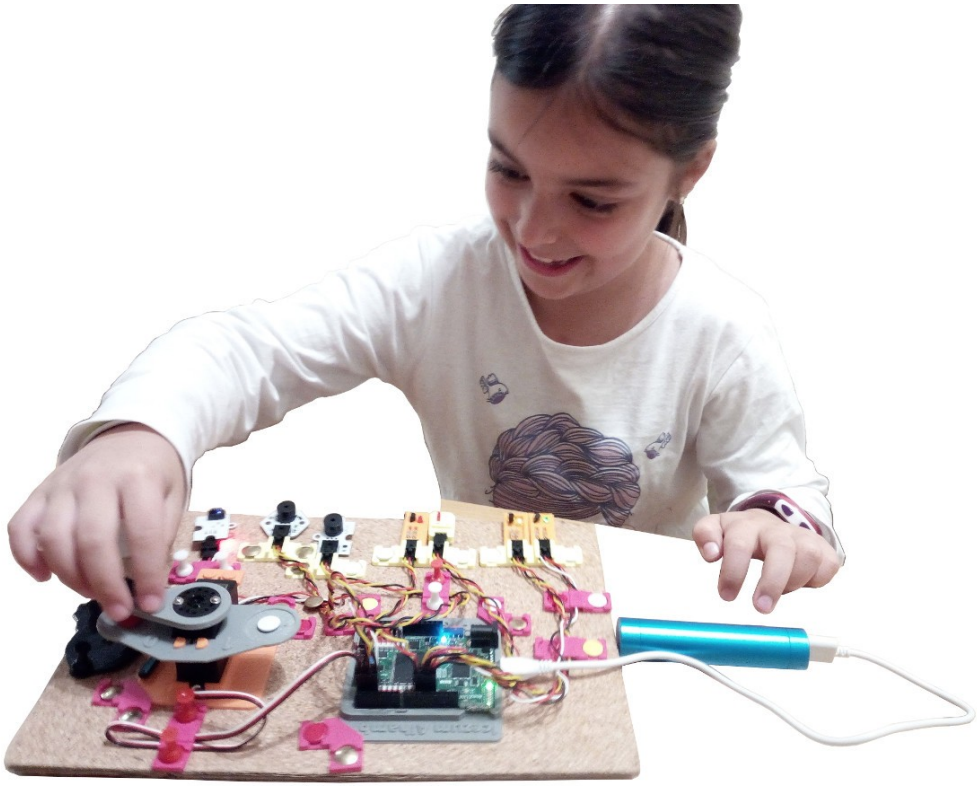

Juan González Gómez (Obijuan)

https://github.com/Obijuan

Curso de Verano UC: Robótica, Arduino y Hardware Libre
Centro Municipal de Empresas. Pol. Industrial de Trascueto, s/n. Revilla de Camargo

https://github.com/Obijuan/myslides/wiki/2017_07_06:-UC:-Electrónica-digital-para-todos-con-FPGAs-libres