

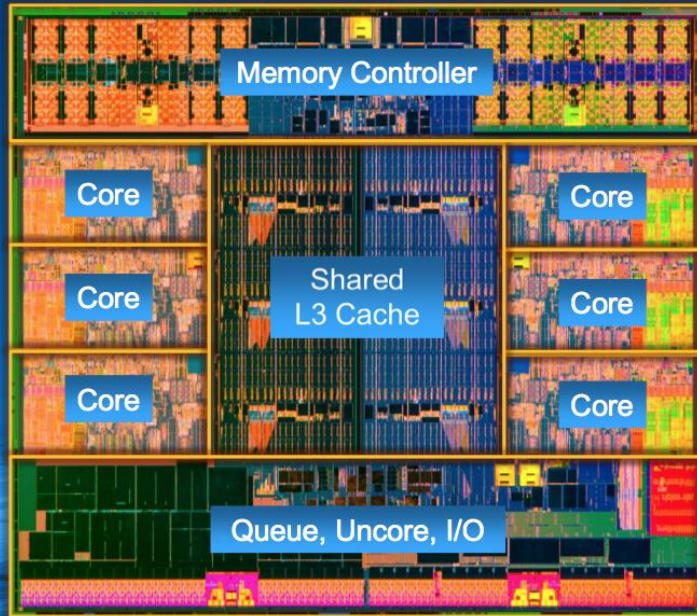
Intro to Arduino architecture

Session 3.0

PH435

CPU Architecture can be very complex

Intel® Core™ i7-4960X Processor Die Detail



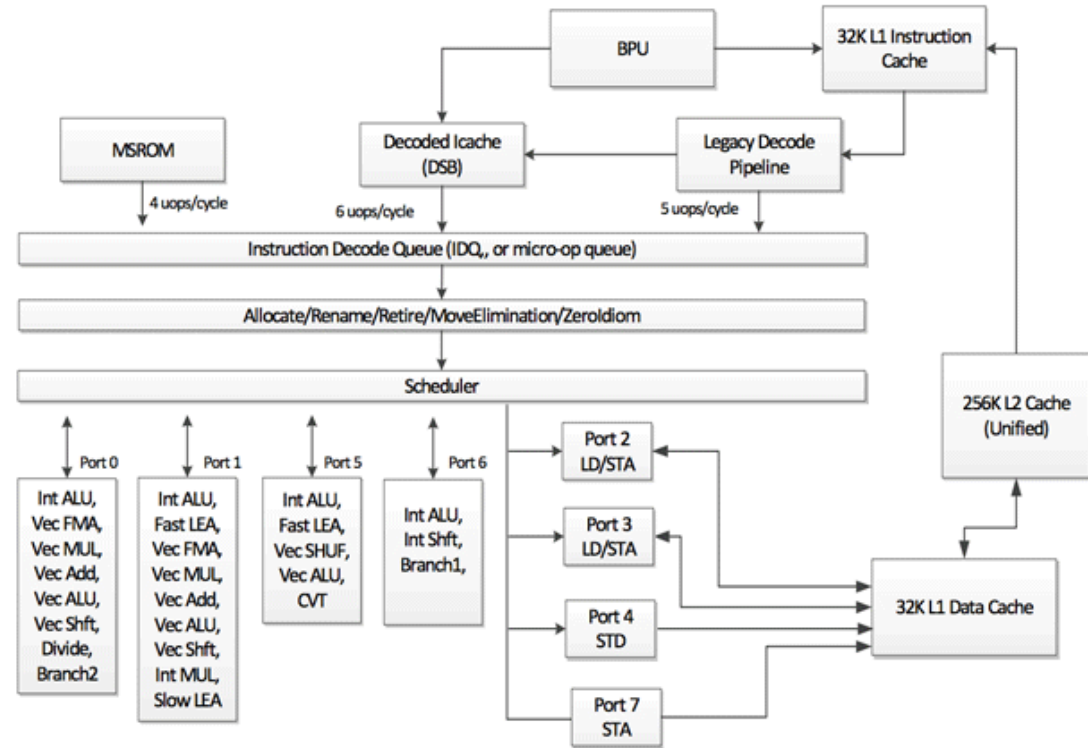
Total number of transistors 1.86B

Die size dimensions 15.0 mm x 17.1 mm [257 mm²]

** 15MB of cache is shared across all 6 cores

*Other names and brands may be claimed as the property of others.

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Latest AVX-512 instruction set extensions to Intel i10 (2021). 512 bit opcodes
Optimized for data centers – coming to a laptop near you soon!

<https://techreport.com/review/32111/intels-core-i9-7900x-cpu-reviewed-part-one/>

<https://hardware.slashdot.org/story/20/08/22/0550242/intel-defends-avx-512-against-critics-who-hope-it-dies-a-painful-death>

Proud that Intel's Chief Architect: Raja Koduri is from Andhra (IIT Kharagpur alum)?

This course deals with

Microprocessors

For

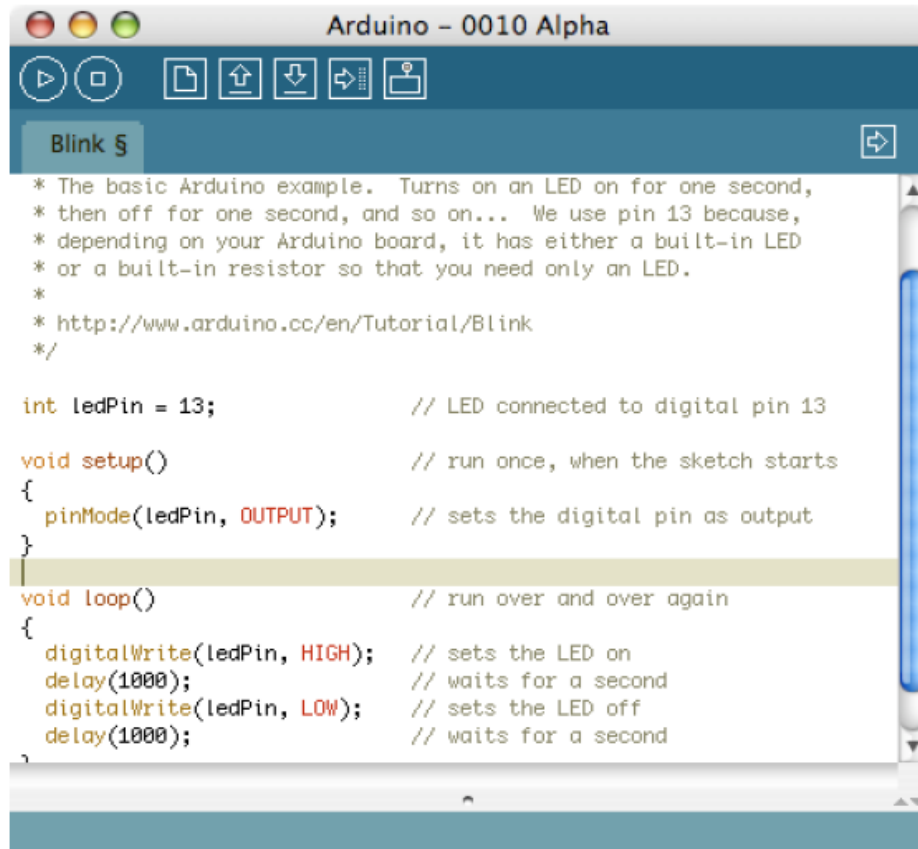
Arduino

Physicists

Raspberry Pi is also an option – but more like a ‘mini-computer’ – lots of software overhead.

What is the Arduino?

Program written, compiled into opcodes on host PC/laptop



The screenshot shows the Arduino IDE window titled "Arduino - 0010 Alpha". The code editor displays the "Blink" sketch, which is a basic example that turns an LED on and off. The code is as follows:

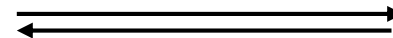
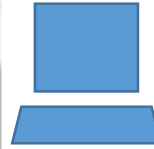
```
* The basic Arduino example. Turns on an LED on for one second,
* then off for one second, and so on... We use pin 13 because,
* depending on your Arduino board, it has either a built-in LED
* or a built-in resistor so that you need only an LED.
*
* http://www.arduino.cc/en/Tutorial/Blink
*/

int ledPin = 13;           // LED connected to digital pin 13

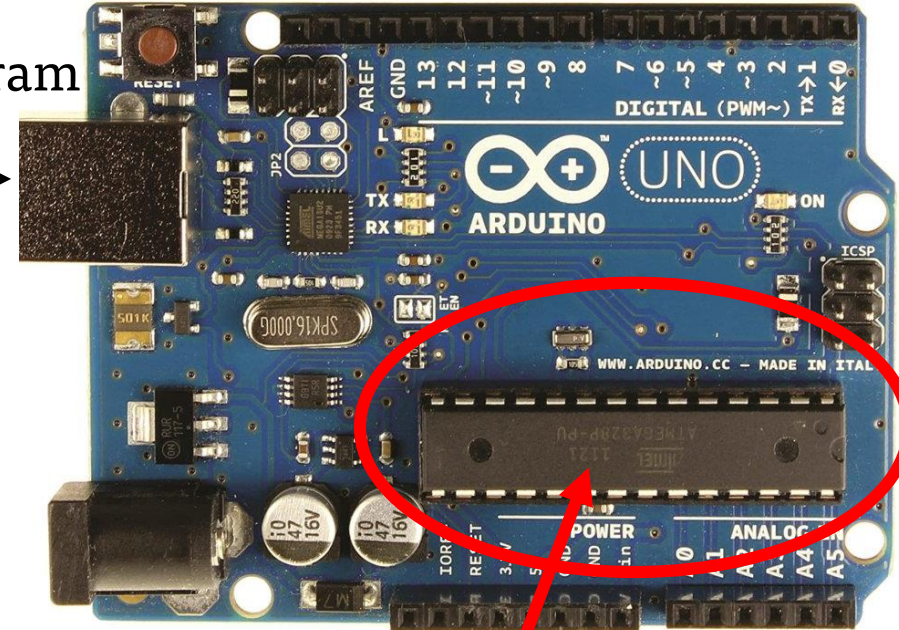
void setup()               // run once, when the sketch starts
{
  pinMode(ledPin, OUTPUT); // sets the digital pin as output
}

void loop()                // run over and over again
{
  digitalWrite(ledPin, HIGH); // sets the LED on
  delay(1000);                // waits for a second
  digitalWrite(ledPin, LOW);  // sets the LED off
  delay(1000);                // waits for a second
}
```

Download program
over USB



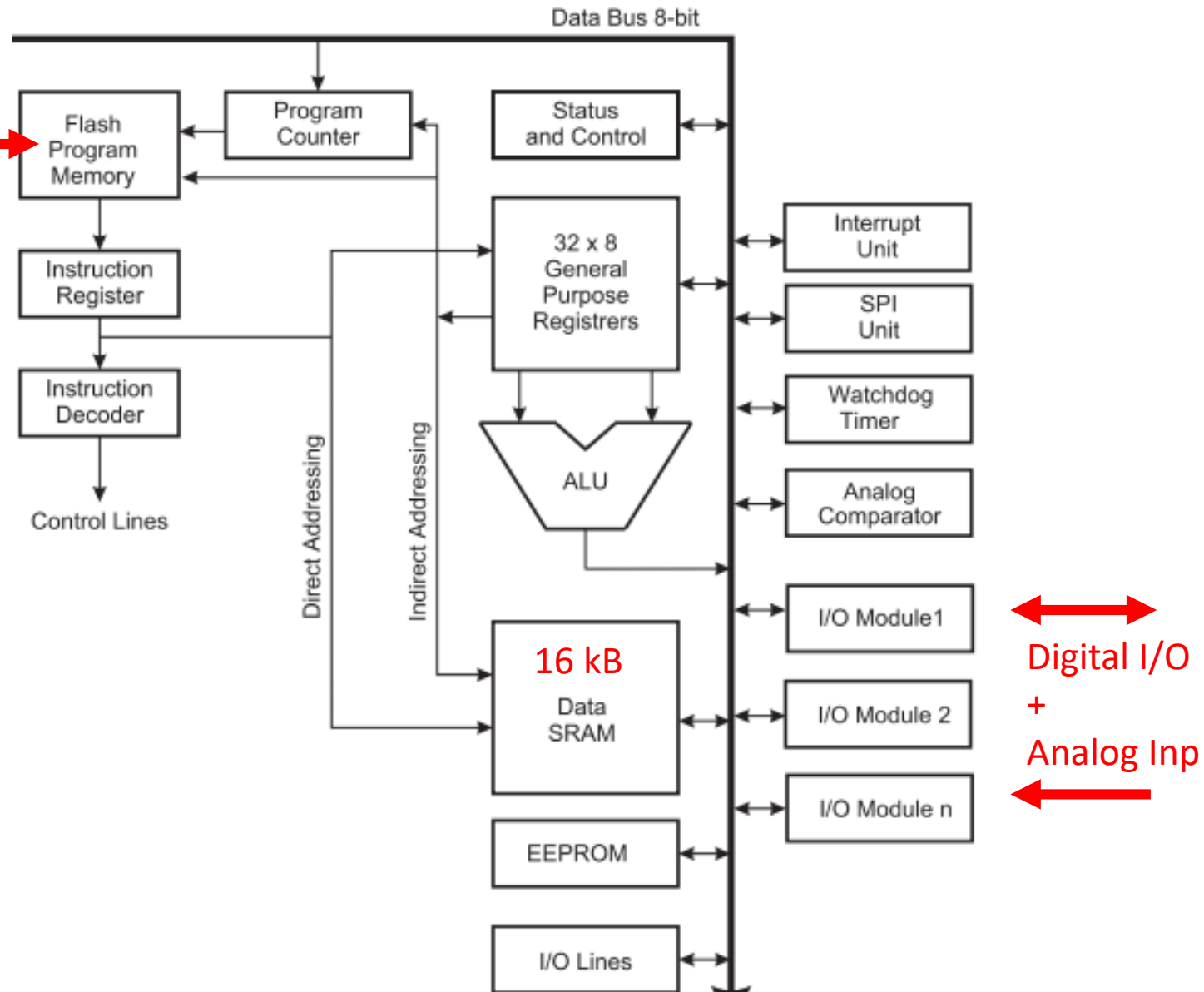
Arduino HW board



Atmega328
Microcontroller IC

Architecture of ATMEGA328

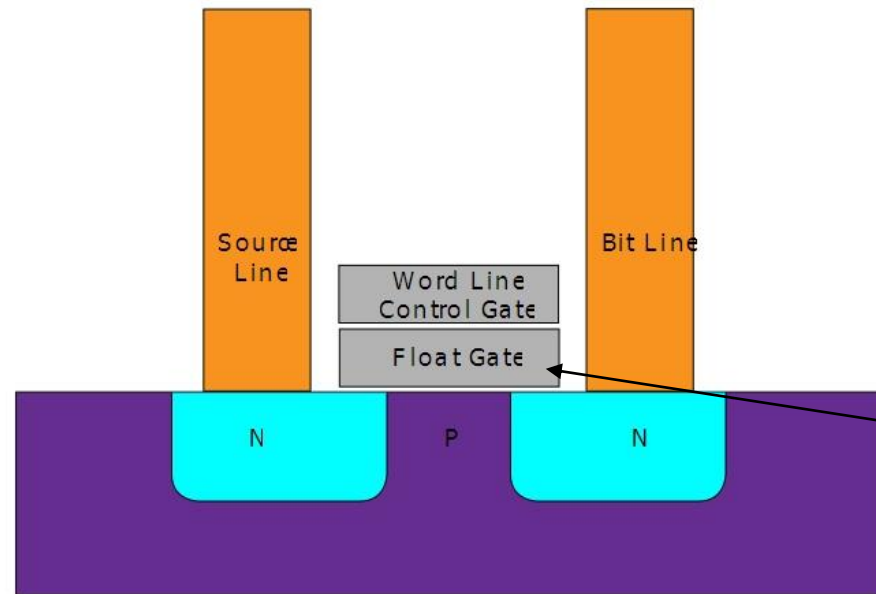
Compiled
program (32kB
max)
Loaded here



What does “uploading” program to Arduino mean?

- Program is loaded into the FlashRAM: opcodes aligned by compiler and loader to start @ program address 0
stored permanently (until you upload a new program).
- Every time Arduino is powered up, it starts execution @ prog. Addr. 0
- There is only one program in the FlashRAM.

How does FlashRAM retain data between power cycling?



Charge is stored here by control gate. Permanently keeps The transistor ON or OFF

1-bit Cell of Flash RAM