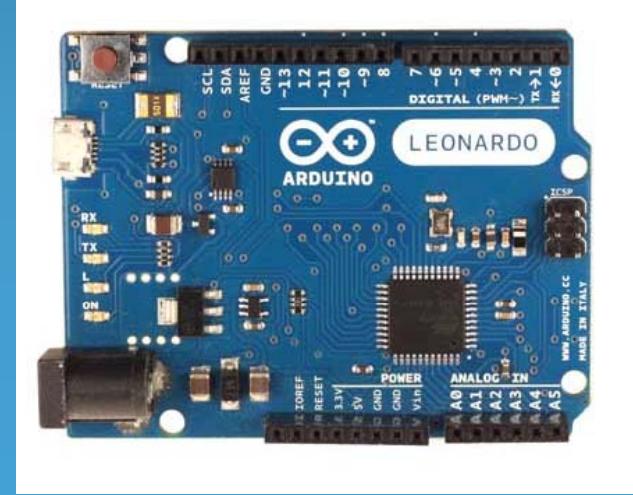


Arduino

An Introduction





Who am I?

Charley Jones
Dataman
Dataman@SynShop.Org

A+, MCP, MOUS, MCSE,
MCSA, MCAD, MCDBA,
MCTS, MCITP, ITIL, PMP



In English Please?

Charley Jones
Dataman

Dataman@SynShop.Org

I'm a Tech, Networker, Administrator,
Databaser, Developer, Instructor, and
Project Manager.
(Lots and Lots of Tests)

Who are We?



SynShop

The Las Vegas
Hacker Space

SynShop.Org



English Again Please?

We are a hacker collective. We freely share knowledge for the sake of learning more. We are a non-profit, and will soon have store space downtown. We depend on membership and donations to survive.

And Thank You So

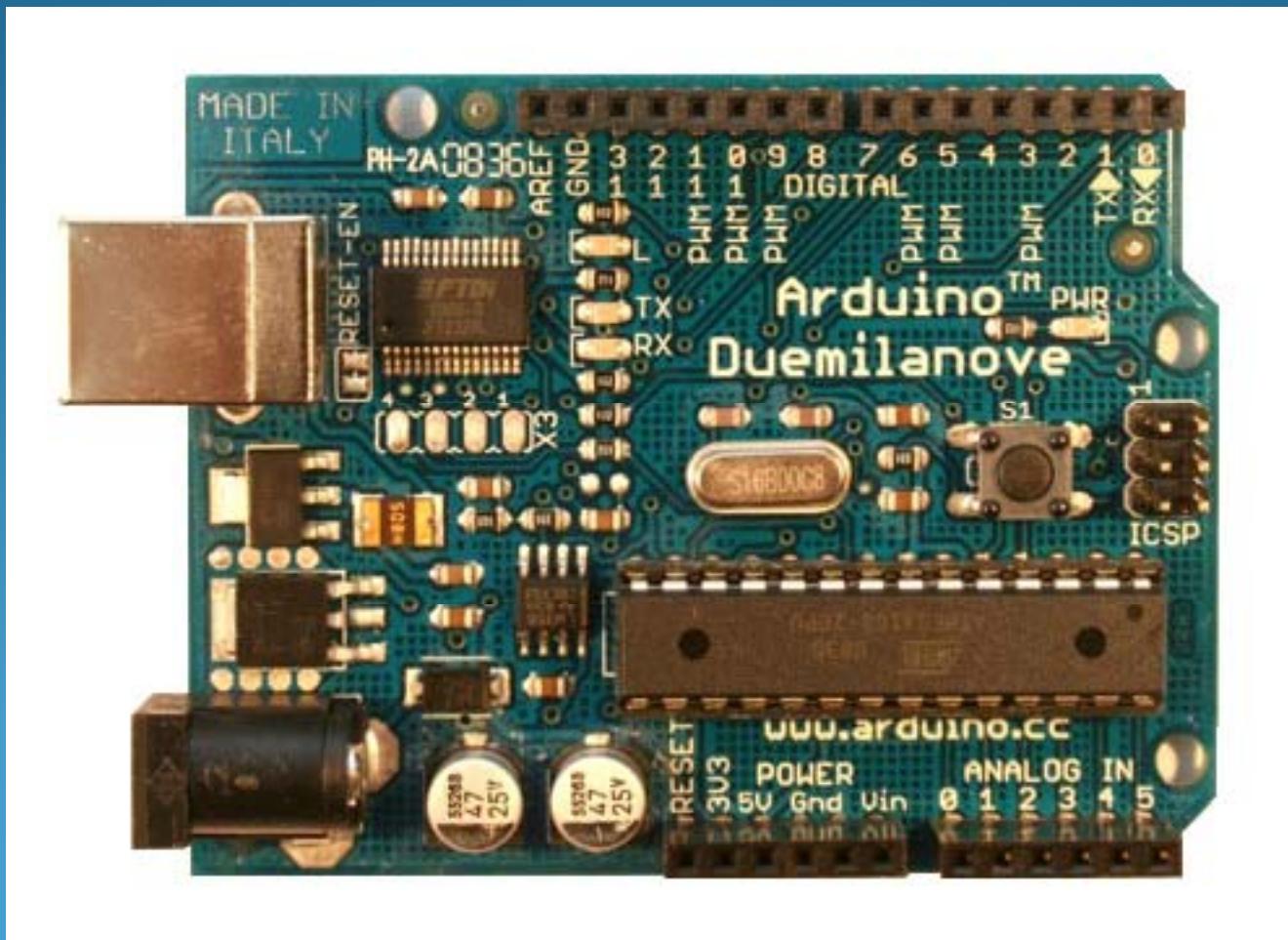
Much!!!!



To the owners and employees of
Pololu Robotics and Electronics for
hosting our group free of charge.

We are so lucky to have a world class
leader in electronics here in Las
Vegas! Thank you!

So, What is it?



What's that again?

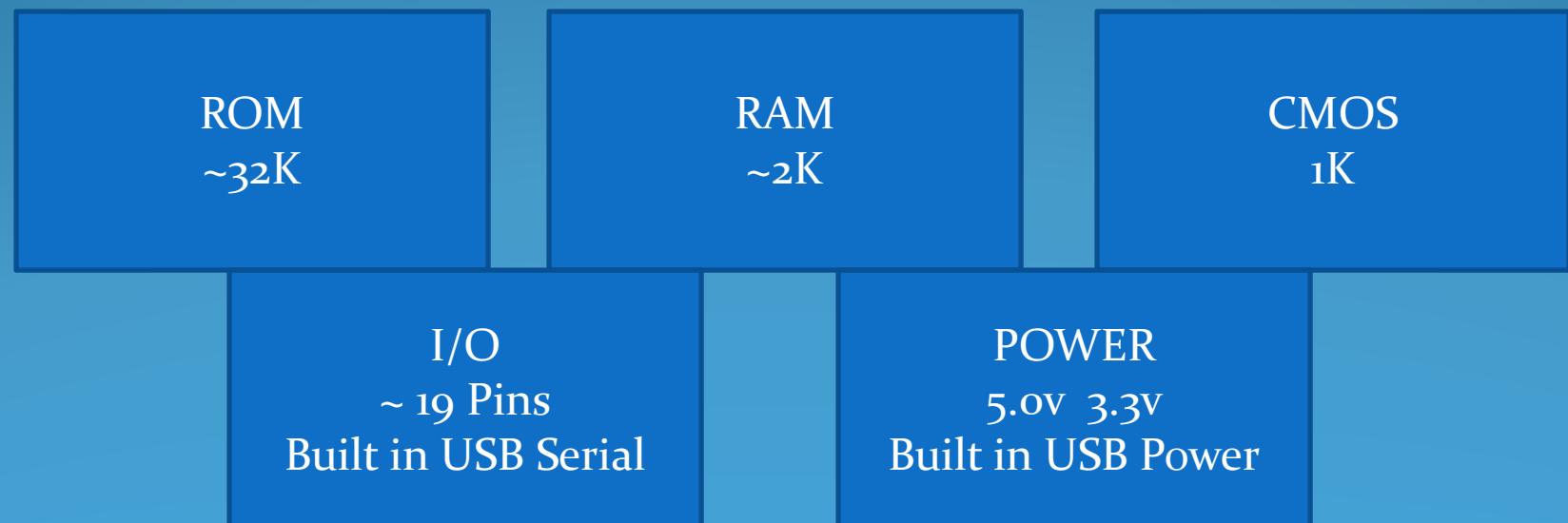


Arduino
are DWEE no

Duemilanove
Dwee Meel Ah No Vay

What is it?

In general terms,
it's a minicomputer.

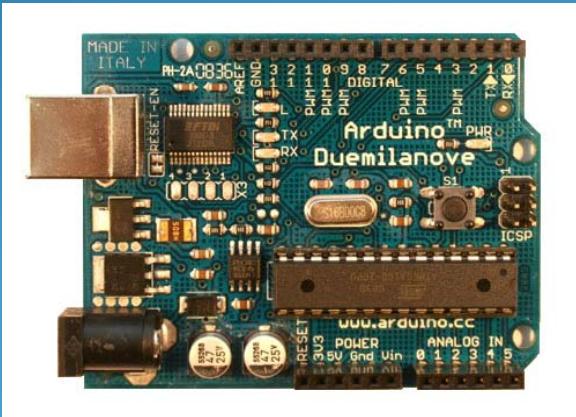


How fast is it?



IBM PC XT

Speed = 1



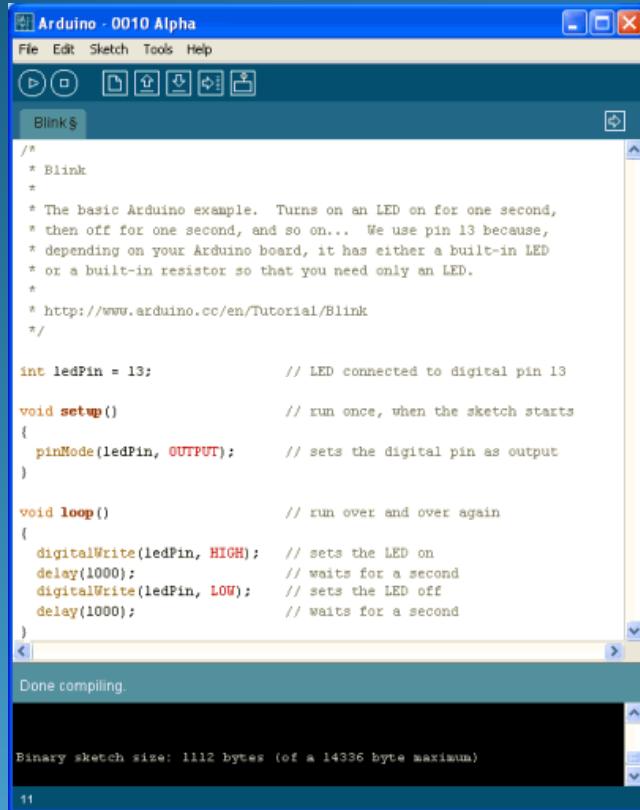
Arduino 2009

Speed = 12-16

What is it?

Think about this as
a self supporting
extension to your
pc. A sattelite.

What else do I need?



The image shows a screenshot of the Arduino IDE. The window title is "Arduino - 0010 Alpha". The menu bar includes File, Edit, Sketch, Tools, Help, and a toolbar with various icons. The main area displays the "Blink" sketch. The code is as follows:

```
/*
 * Blink
 *
 * 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
}

Done compiling.

Binary sketch size: 1112 bytes (of a 14336 byte maximum)
```

The Arduino
studio is free!
Arduino.cc
PC/Mac/Linux

What else...

Arduino studio is based on Processing. It's basically C / C++, with a few new concepts and keywords.

What else...

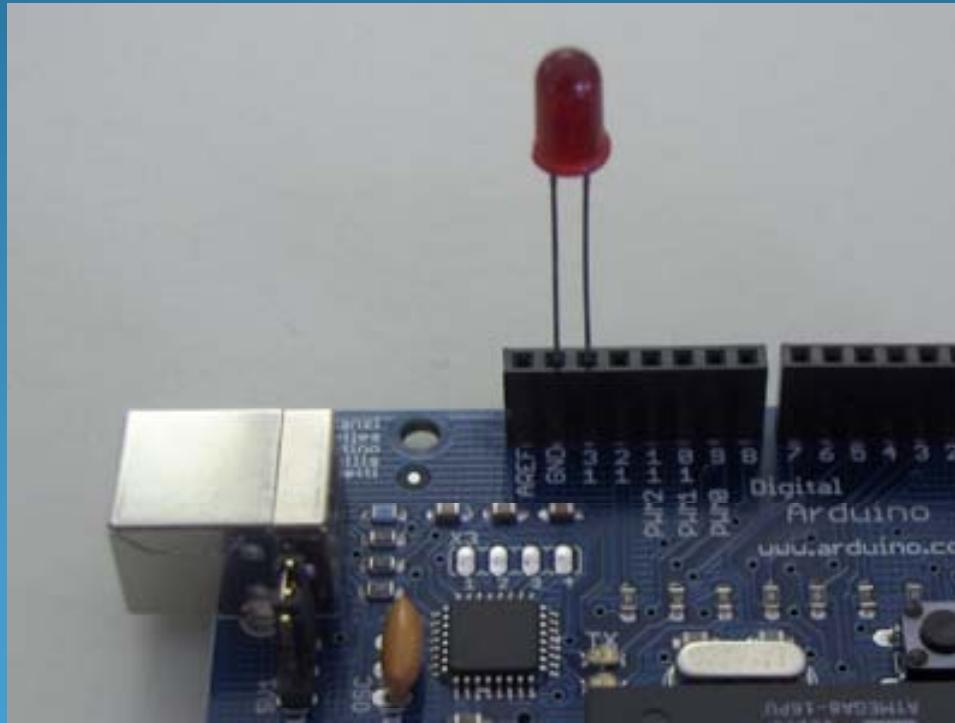
It's not the only way to
program, but it is the
easiest!

Other options
AVRStudio, WinAVR, ...

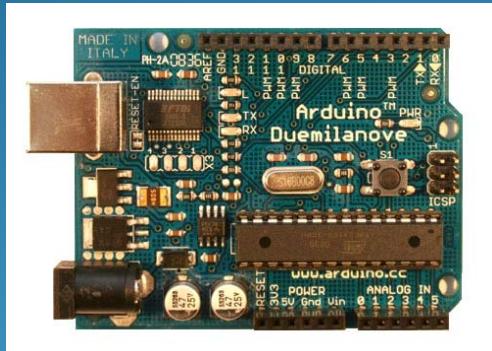
**Start with an idea
Turn ON an LED**



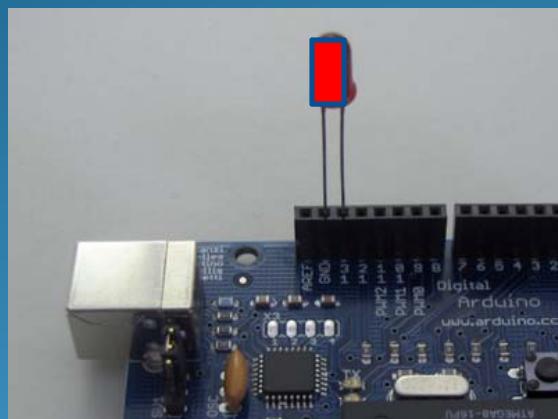
Build the Circuit



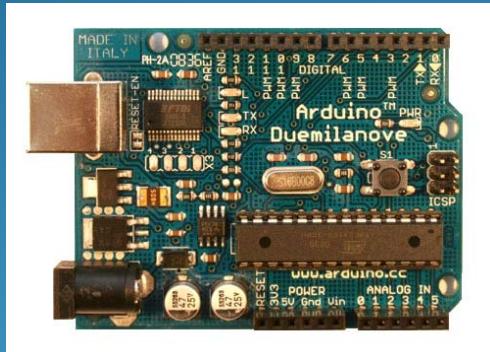
Program from PC



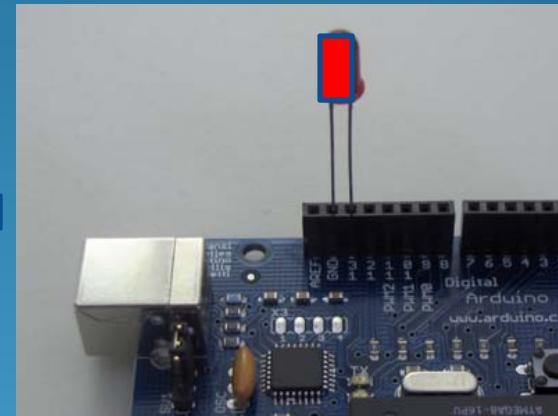
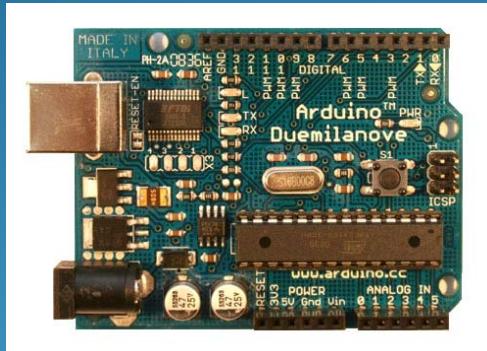
Test



Connect to Power



Program Still Runs!



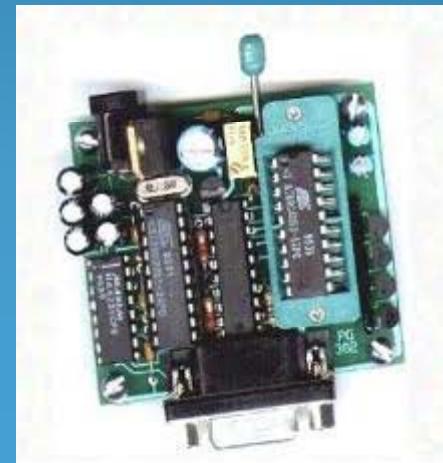
That's Simple!

Exactly!

But it wasn't always
this way...

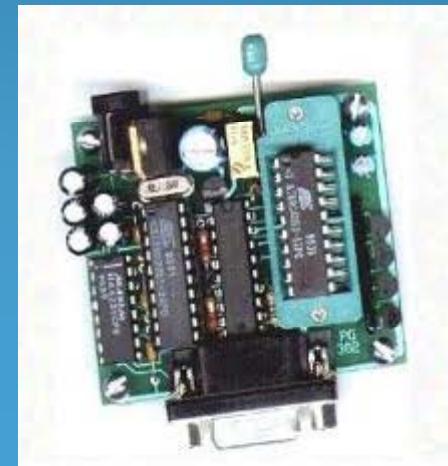
We used to...

Put chip in
programmer



We used to...

Connect programmer to PC



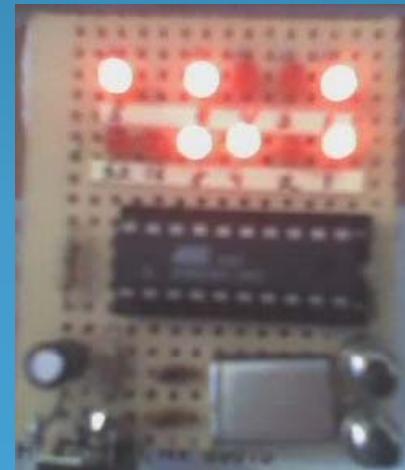
We used to...

Pull chip out of
programmer



We used to...

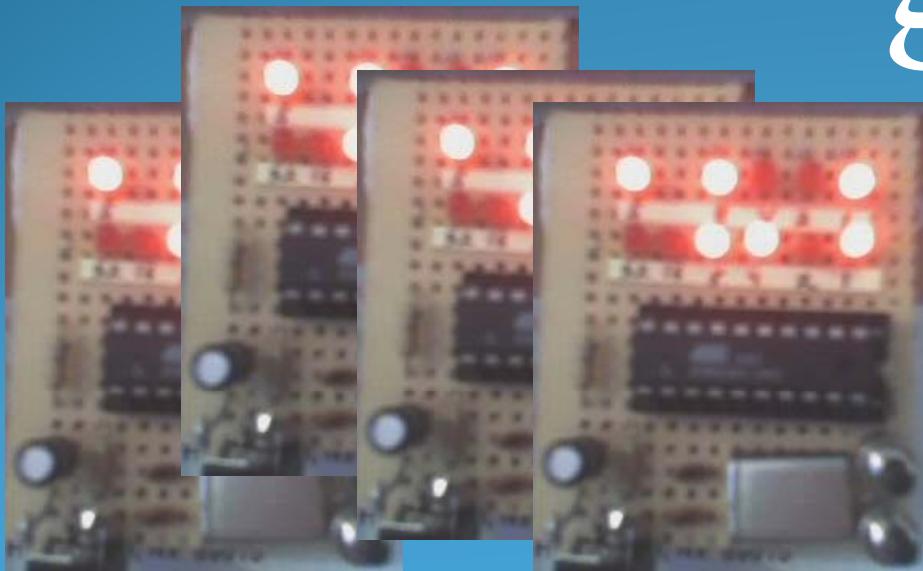
Test in
Circuit



We used to...

Repeat until you

get it right



Arduino is better!

Thank these guys...



The
Arduino
Team

Ardunio.CC

Especially this guy



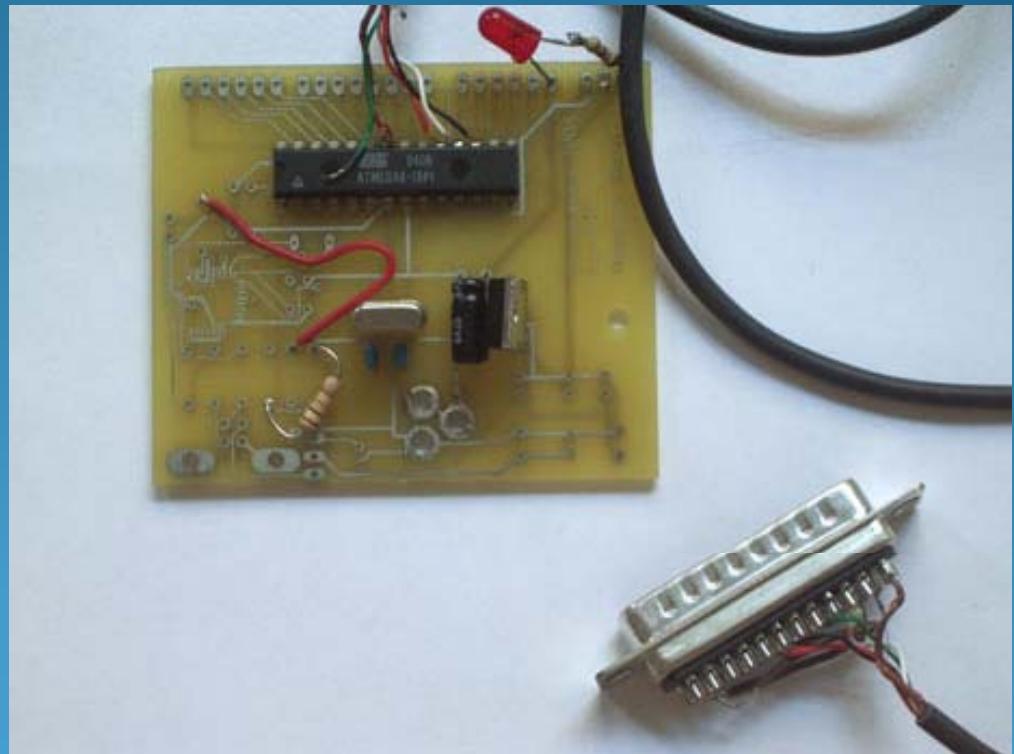
Massimo Banzi
Arduino's Father.

Start with an idea

I need a cheap
and easy way
to teach
electronics to
students.

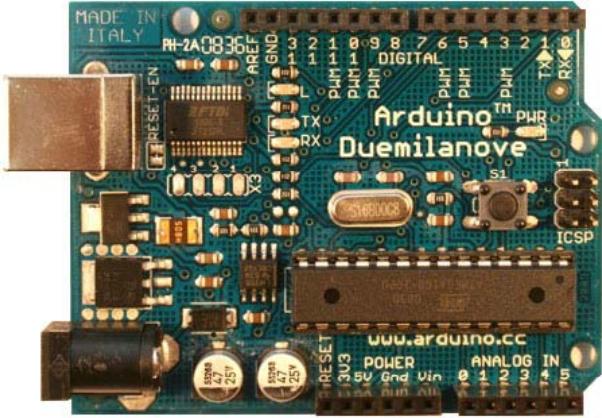


2005, a great year
Arduino
was given
freely to
the world!



Many Models

Over the years,
Arduino.CC has released
several models of
Arduino. Refinements and
specializations.



Duemilanove

Released in 2009, this is
the basic arduino.



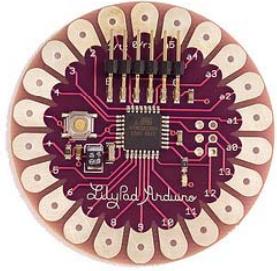
Uno R3

The successor of the Duemilanove, R3 is the latest in the refinement of this series.



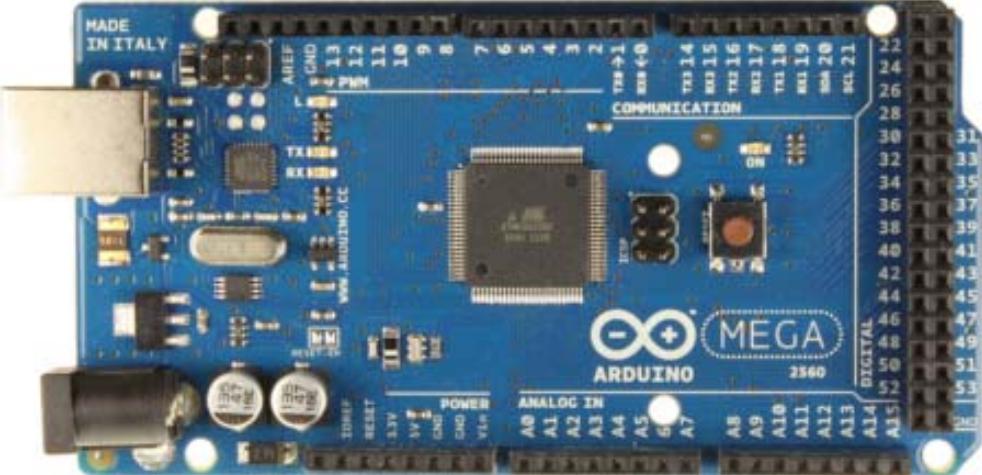
Leonardo

The new kid on the block.
May not be backward
compatible in some cases.
Uses a mini usb-b
connector.



LilyPad

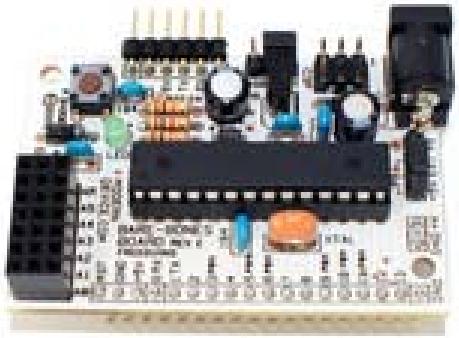
A specialized version
meant to be sewn into
clothing with conductive
thread.



Mega128

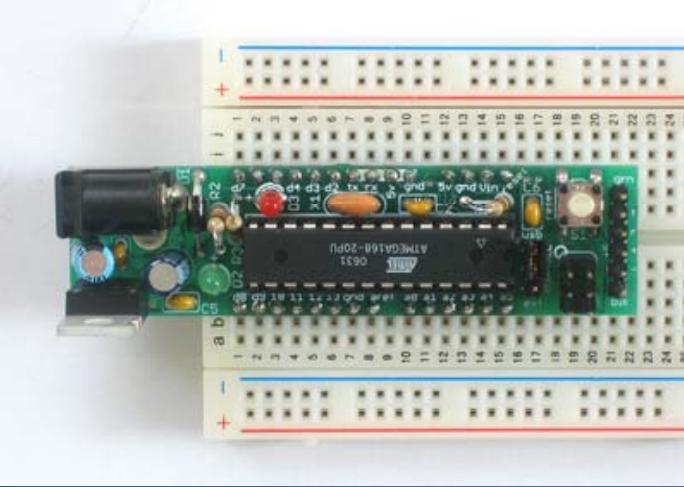
Mega256

Specialized versions of the
Arduino supporting 51
more pins and memory.



Send in the Clones

Since Arduino was released into the public domain, third parties have been free to create clones. Specialized Connectors.



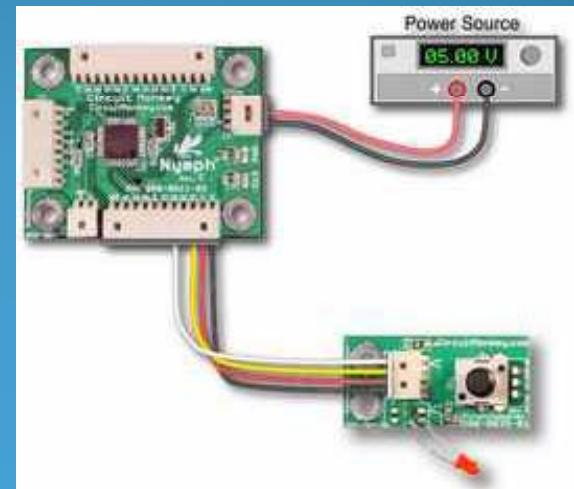
RBBB Boarduino

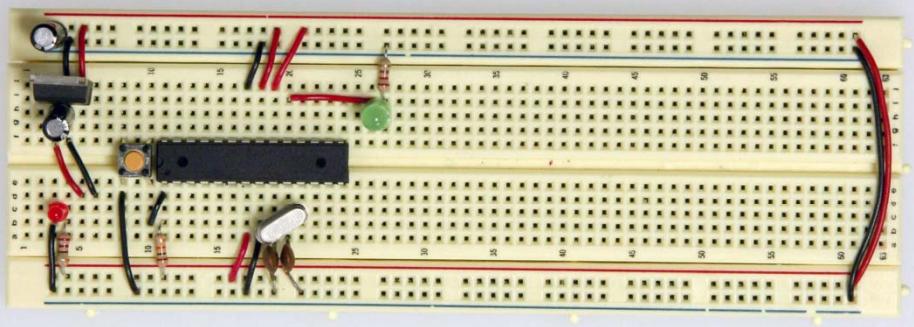
These clones plug directly into breadboards to simply prototyping. Very small, they also implement very well in projects.



Nymph

The Nymph from CircuitMonkey is an embedded arduino featuring secure connectors.



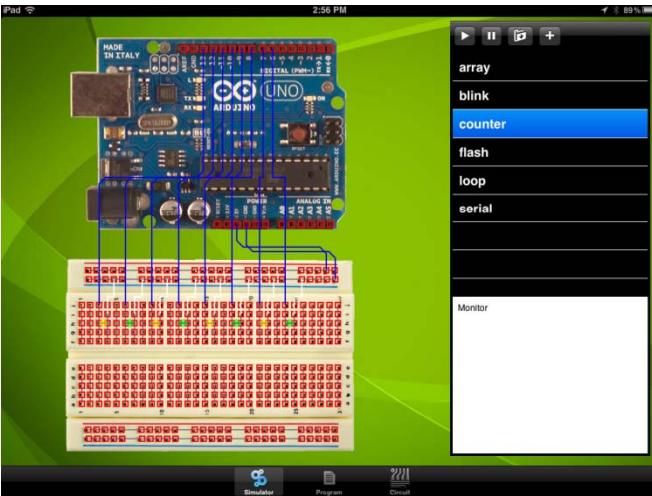


Standalone

For about \$3 in parts,
you can build a working
arduino directly on a
bread board.

Virtual!

Simduino



A little primitive, but
handy in a crunch when
you want to hack out a
circuit... Simduino on
iTunes.

Ok, so it blinks LEDs?

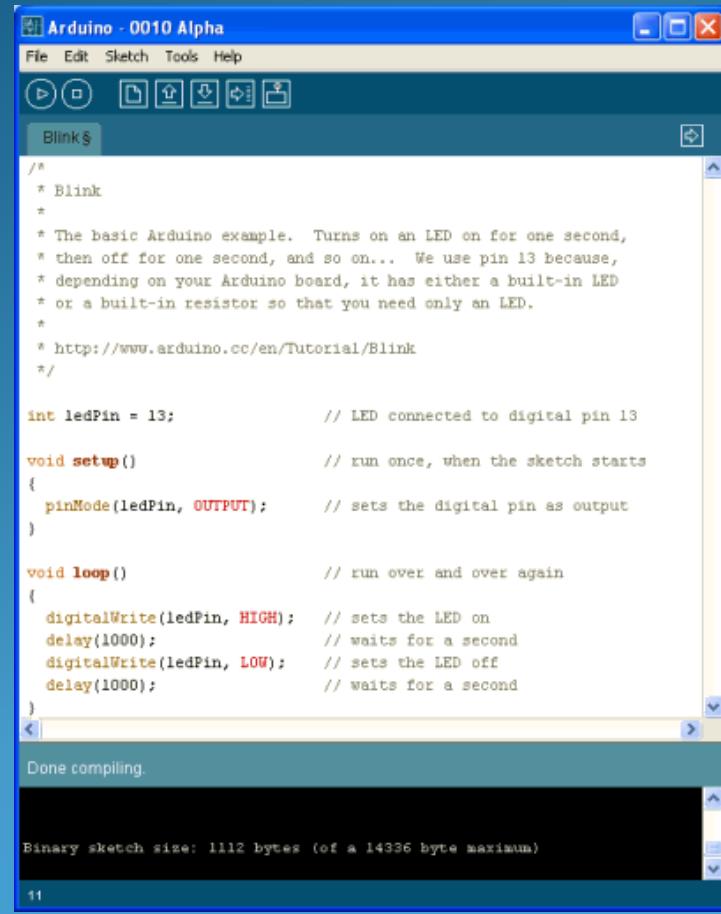


Kind of
like saying
a Ferrari is
just a car...

It's all about the I/O

Part of the problem
with any computer is
getting the data in
and out again..

Arduino Does I/O



The image shows a screenshot of the Arduino IDE version 0010 Alpha. The window title is "Arduino - 0010 Alpha". The menu bar includes File, Edit, Sketch, Tools, and Help. Below the menu is a toolbar with icons for Open, Save, Print, and others. The main area displays the "Blink" sketch. The code is as follows:

```
/*
 * Blink
 *
 * 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
}

Done compiling.

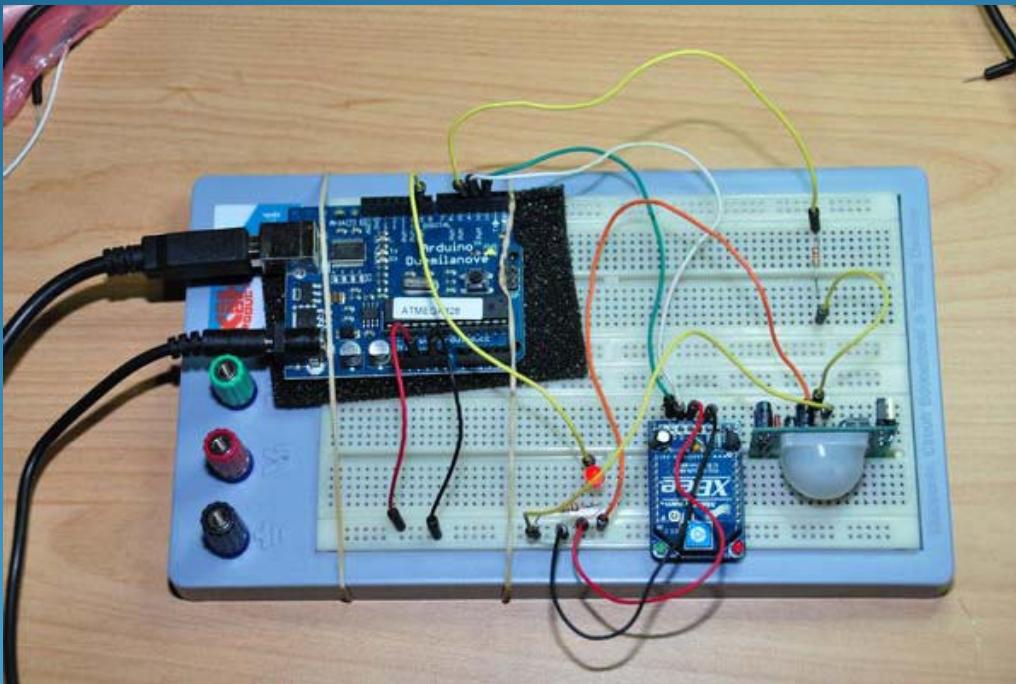
Binary sketch size: 1112 bytes (of a 14336 byte maximum)
```

The status bar at the bottom left says "Done compiling." and "Binary sketch size: 1112 bytes (of a 14336 byte maximum)".

We know
we can
program it.

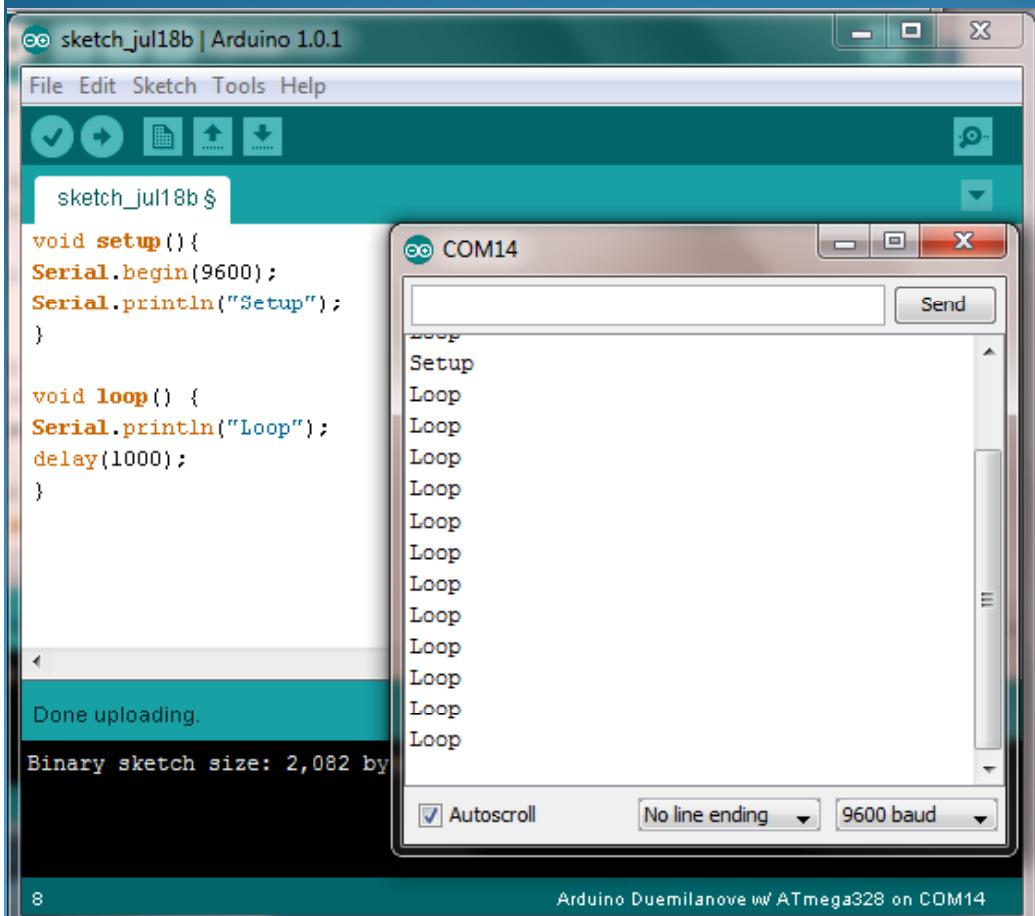
Arduino Does I/O

We can
connect
things
to it



Arduino Does I/O

And we
can read
data back
from it.
Serial



Arduino Does I/O

I/O is so common, the team created shields for common functions.

Arduino Does I/O

Ethernet

Shield, plugs
directly into
Arduino.



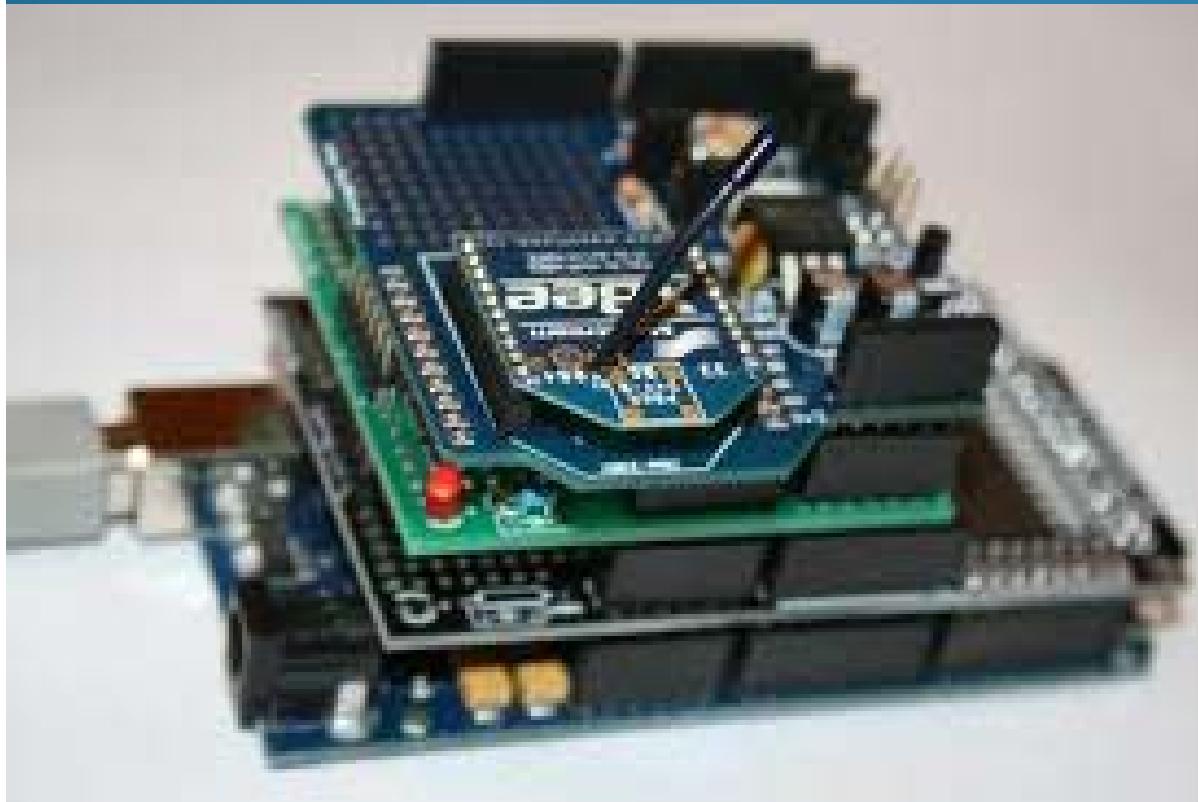
Arduino Does I/O

And they
stack!

A tiny Web
Server!



Arduino Does I/O

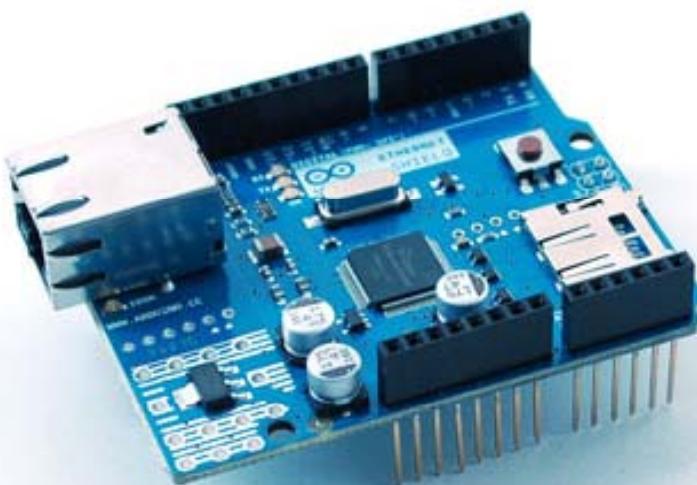


And
stack..

Shield Basics

Ethernet
Shield.

Lets us talk
on the net.



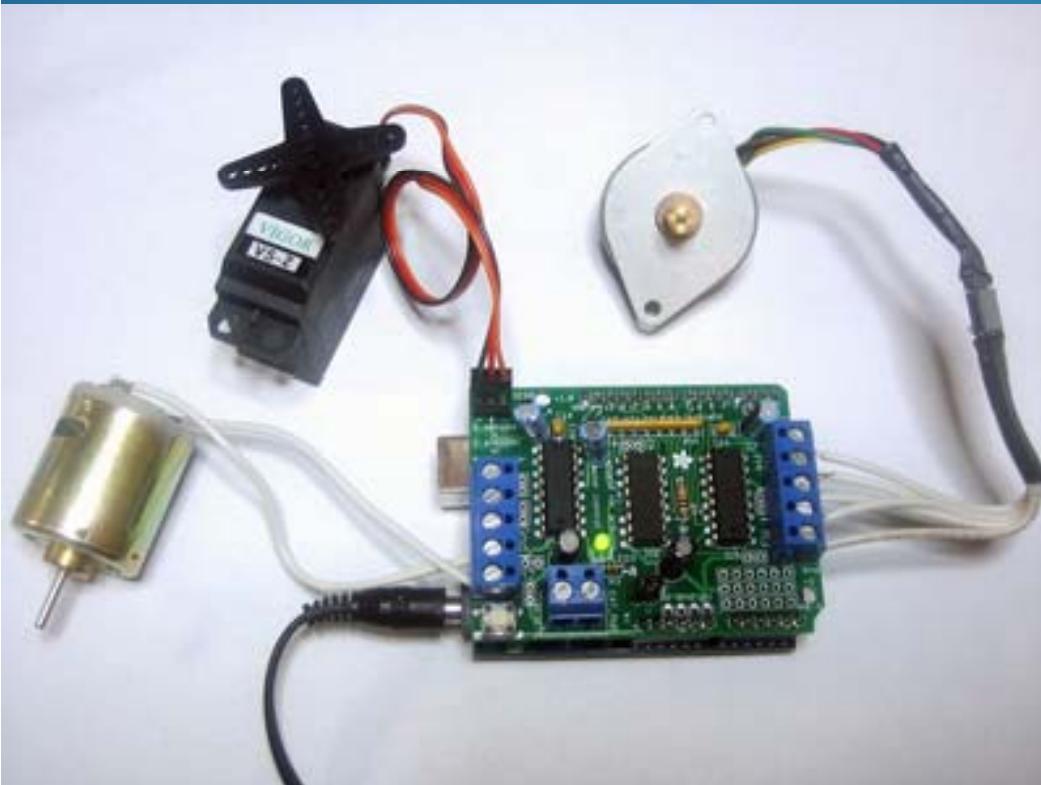
Shield Basics

Proto Shield.
Lets us more
easily build
test circuits.



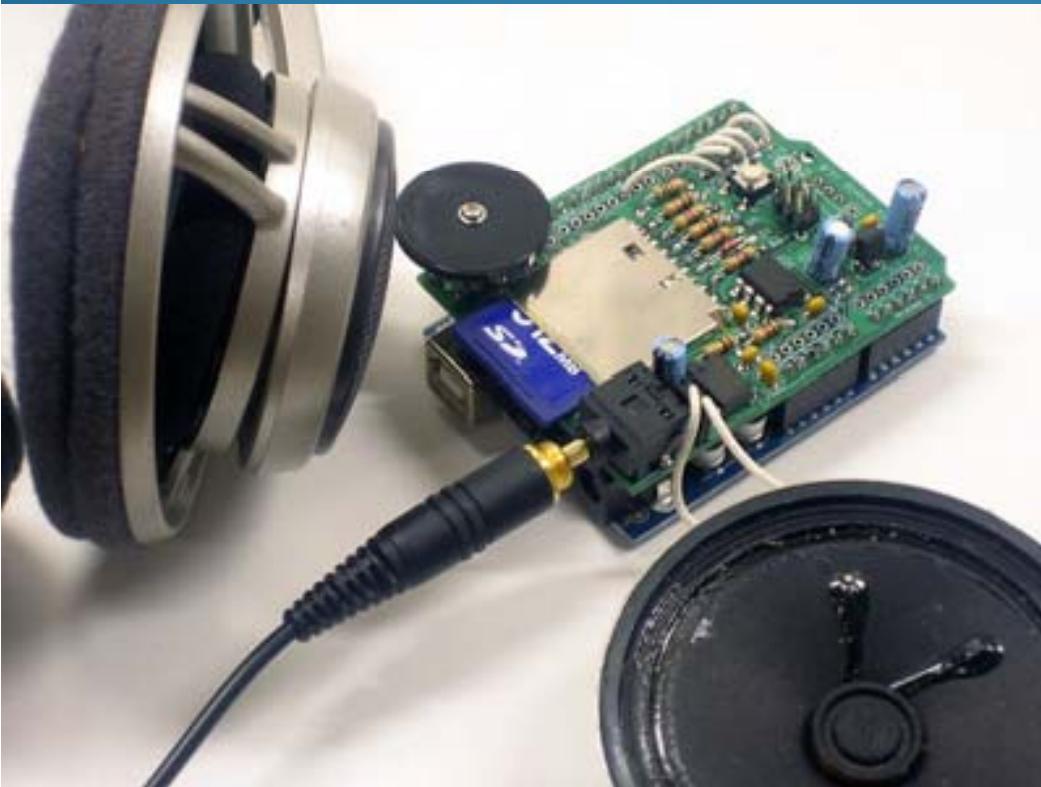
Shield Basics

Motor
Shield.
Lets us
control
motors.



Shield Basics

Wave
Shield.
Lets us
playback
audio.



Shield Basics

We are going to be
experimenting with
all four! And More!

Shield Basics

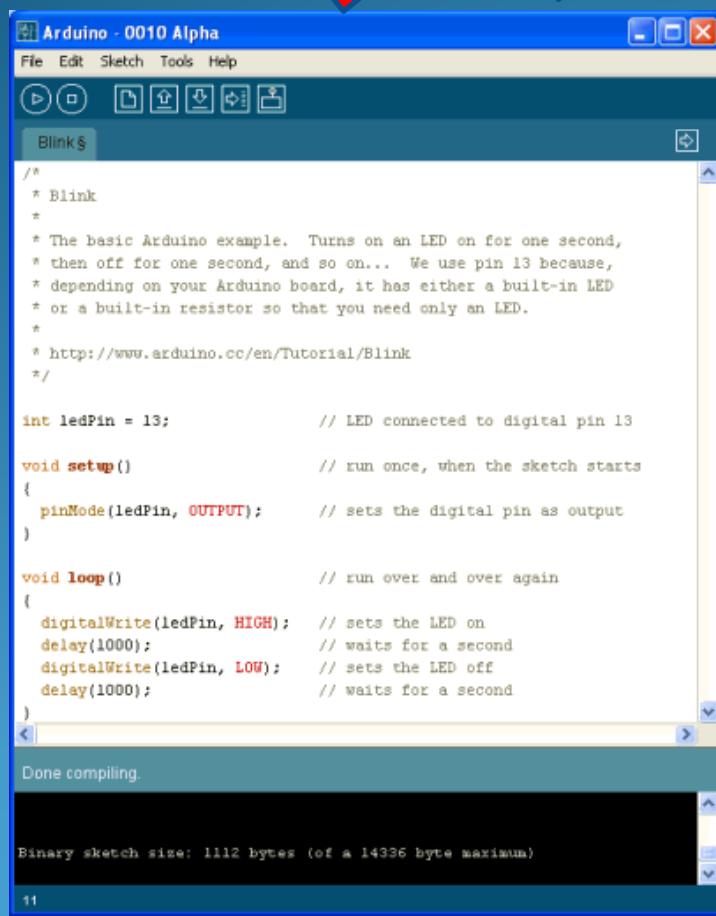
But it's gotta be difficult
to program a Wave
Shield, right?

Ethernet

Motor

Wave

Shield Basics



The image shows a screenshot of the Arduino IDE version 0010 Alpha. The window title is "Arduino - 0010 Alpha". The menu bar includes File, Edit, Sketch, Tools, and Help. Below the menu is a toolbar with various icons. The main area displays the "Blink" sketch code. At the bottom of the IDE, there is a status bar showing "Done compiling." and "Binary sketch size: 1112 bytes (of a 14336 byte maximum)".

```
/*
 * Blink
 *
 * 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
}

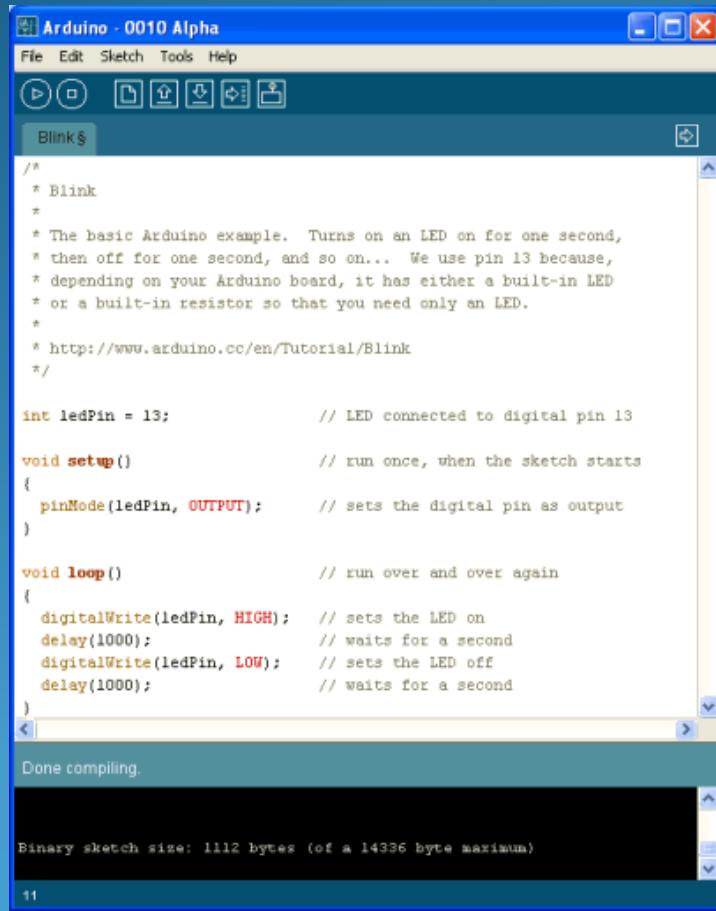
Done compiling.

Binary sketch size: 1112 bytes (of a 14336 byte maximum)
```

The team
made it easy
to extend
arduino with
libraries!

Shield Basics

And most
libraries
come
with built in
examples.



The image shows a screenshot of the Arduino IDE version 0010 Alpha. The window title is "Arduino - 0010 Alpha". The menu bar includes File, Edit, Sketch, Tools, and Help. Below the menu is a toolbar with icons for Open, Save, Print, and others. The main area displays the "Blink" example sketch. The code is as follows:

```
/*
 * Blink
 *
 * 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

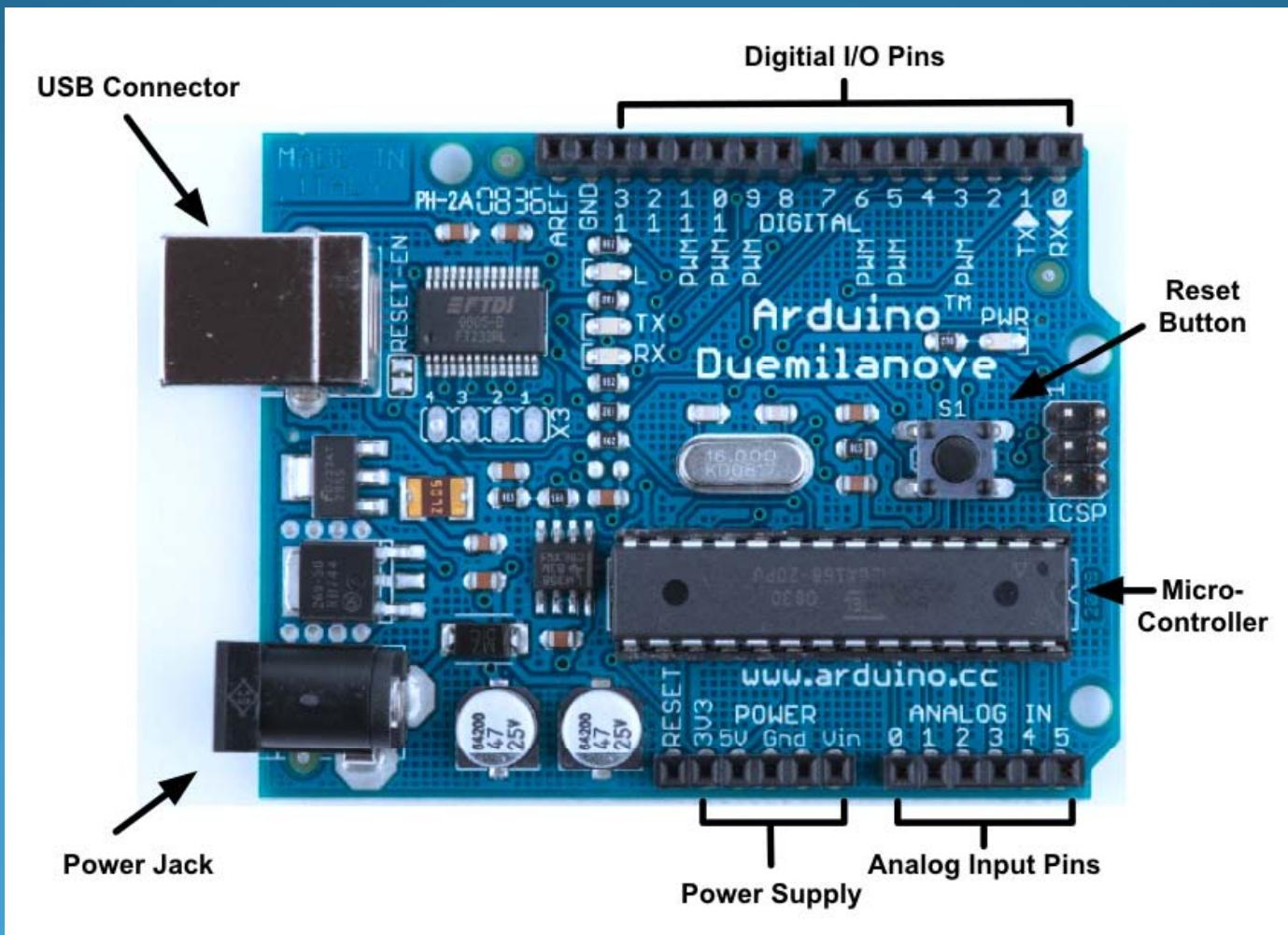
void setup()              // run once, when the sketch starts
{
  pinMode(ledPin, OUTPUT); // sets the digital pin as output
}

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
}

Done compiling.

Binary sketch size: 1112 bytes (of a 14336 byte maximum)
```

Arudino Basics



Arudino Basics

14 Digital I/O Pins(1/o)

6 Analog Pins (0-255)

USB Power, 5V Power

Reset, Power Pins

Arudino Basics

Some Shared Pins:

0/1-USB Rx/Tx

13-LED

11,10,9,6,5,3-PWM

(Pulse Width Modulation)

Arudino Basics

Some Shared Pins:

Gnd – 3 Ground Pins

5V-Regulated 5V

3v3-Regulated 3.3V

Arudino Basics

Vin – Unregulated

Reset – Low Resets

Aref-Used by Analog

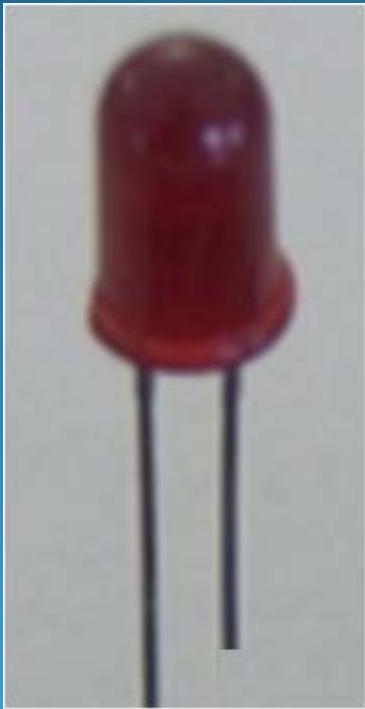
Button = Reset

LED Basics

Long Leg = +
Short Leg = -

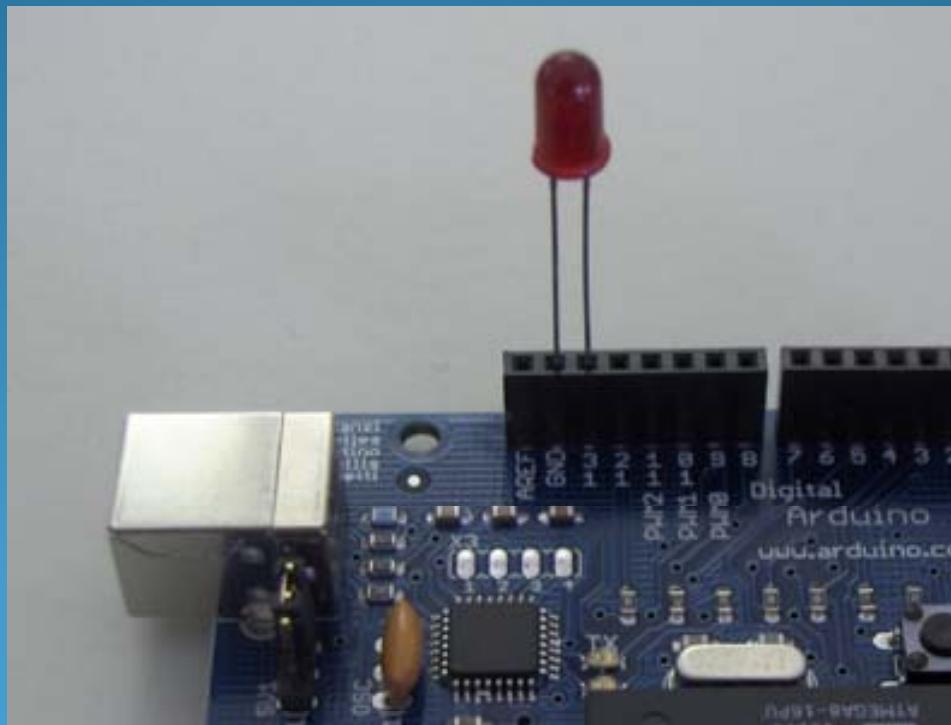


LED Basics



Long Leg = 13
Short Leg = Gnd

LED Basics



Programming Basics

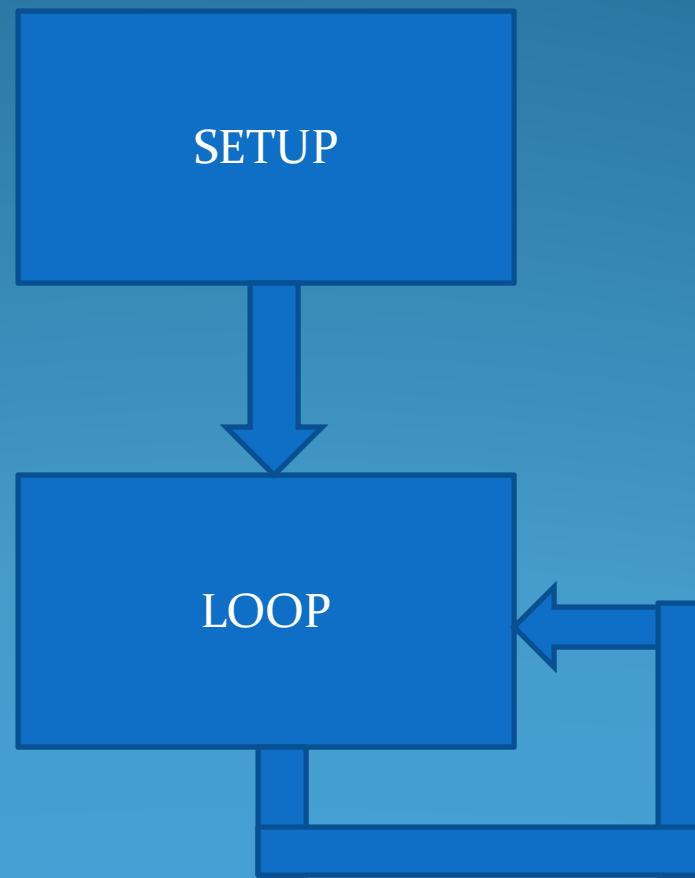
Setup

Executed once when
program starts.

Programming Basics

Loop
Executed continuously.
Once completed, starts
again.

Programming Basics



Setup

Set up initial variables.
Typically set up Pin to
INPUT or OUTPUT, set
HIGH or LOW.

Setup

```
pinMode(4,OUTPUT);  
digitalWrite(4,LOW);  
Set up pin 4 as output,  
and set initial value to  
GND.
```

This really is Setup code

```
void setup() {  
  pinMode(3,INPUT);  
  pinMode(4,OUTPUT);  
}
```

Loop

```
int i = digitalRead(3);
```

```
digitalWrite(4,i);
```

Read pin 3, store it in a variable i. Turn around and set pin 4 to i.

This really is Loop code

```
void loop() {  
    int i=digitalRead(3);  
    digitalWrite(4,i);  
}
```

Loop

Remember, this keeps looping, so we'd continuously copy pin 3 to pin 4.

Globals

Sometimes you need to keep variables around between iterations of Loop. We can do that with globals.

Globals

Globals are placed in code before Setup().

Can be initialized inline or inside setup. They retain value when Loop is exited and restarted.

Globals

```
int i = 0;  
void setup() {  
    i = 0;  
}  
void loop() {  
    i = i + 1;  
}
```

Shortcuts

Some actions in C are so common, they have short cuts:

$i = i + 1;$

Can be written as:

$i++;$

Shortcuts

If (i=0) i=1;

Else i=1;

Can be written as:

i=!i;

Programming Basics

Lets put this all together into a program to blink the LED. Most arduinos have an internal LED on 13, so this is easy.

Programming Basics

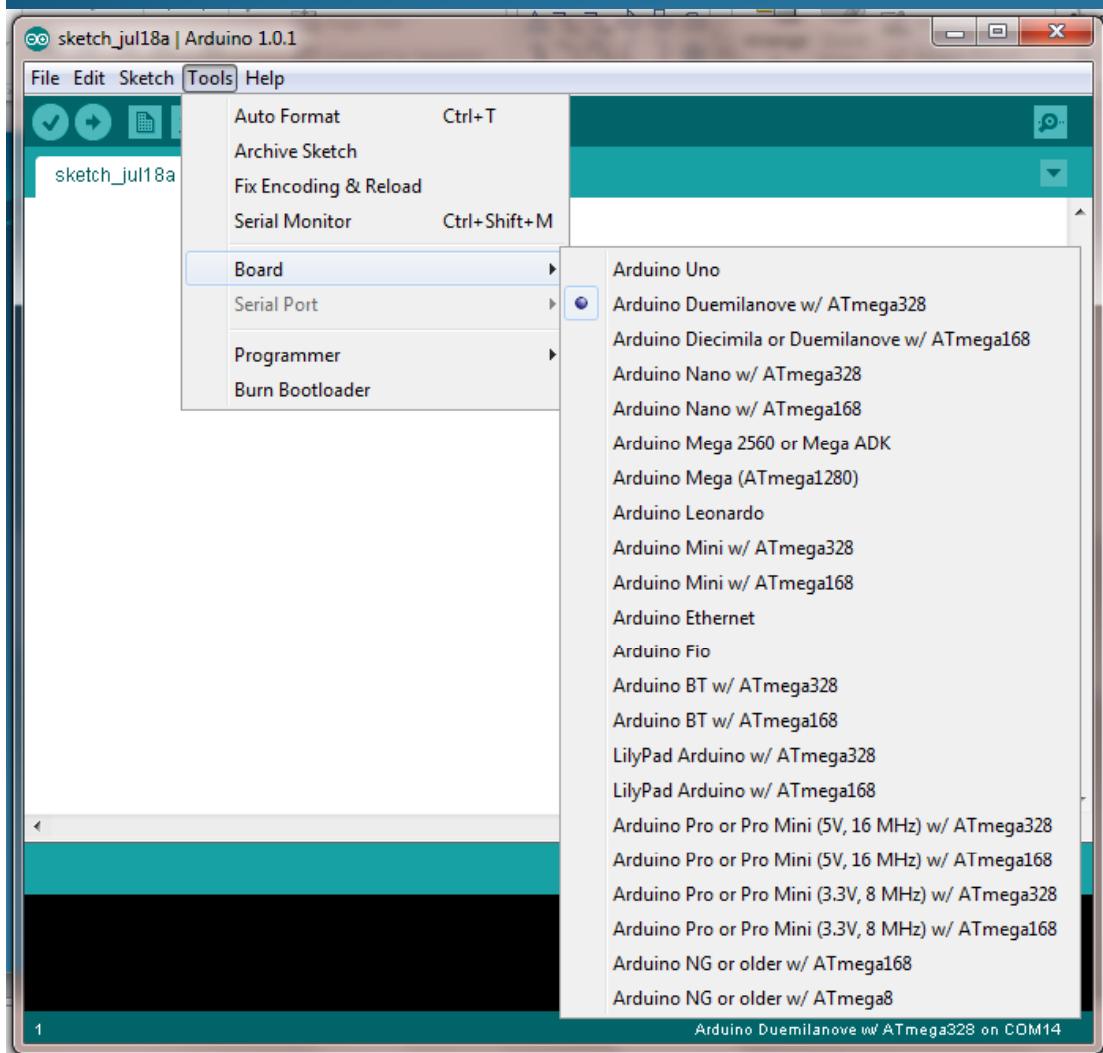
```
int i = 0;  
void setup() {  
    pinMode(13,OUTPUT);  
}
```

Programming Basics

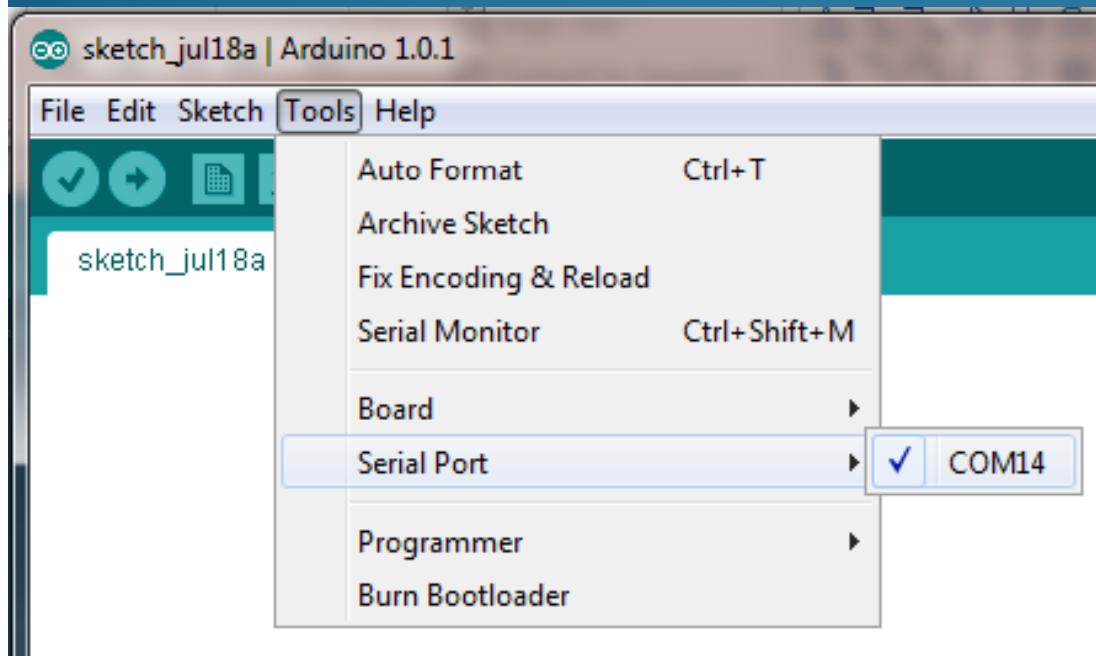
```
void loop() {  
    i = !i;  
    digitalWrite(13,i);  
    delay(500);  
}
```

Programming Basics

Set board

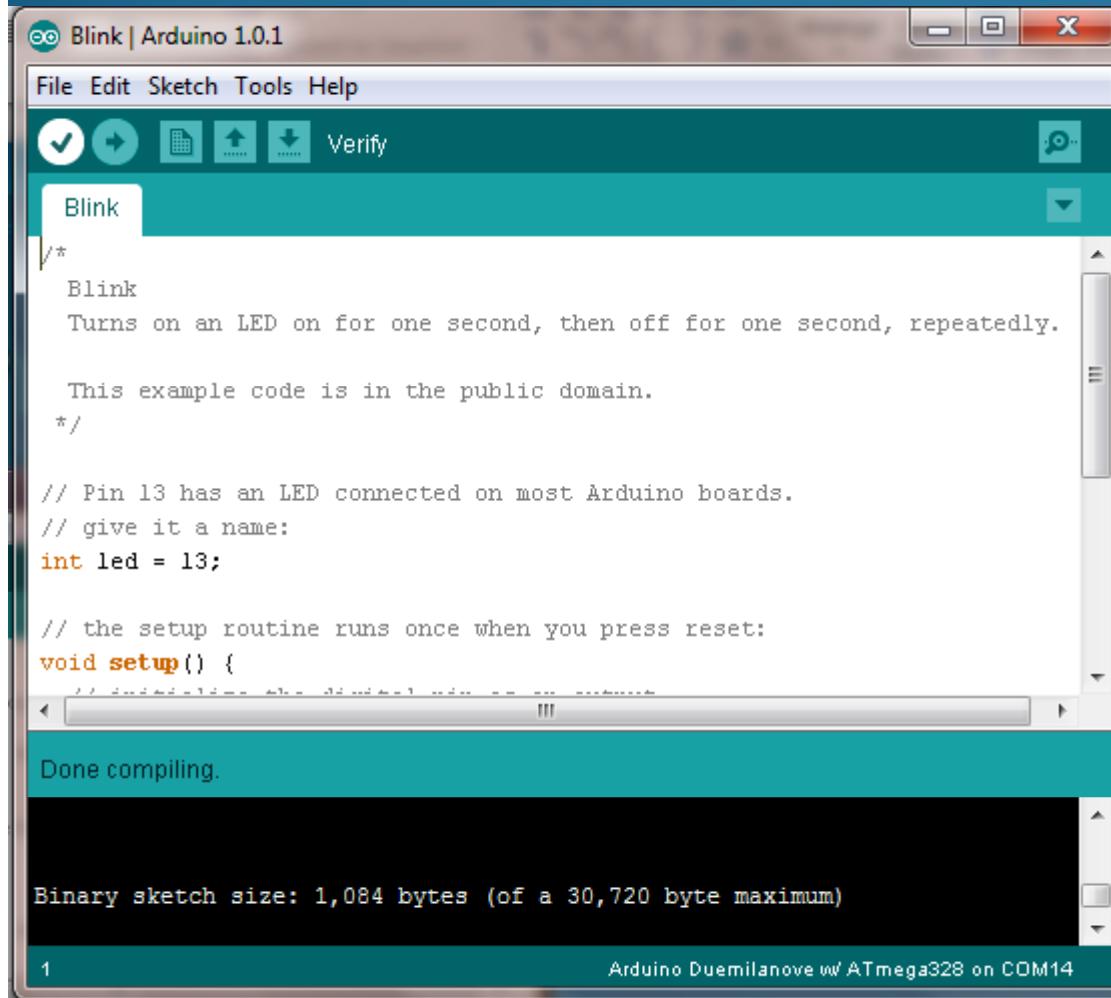


Programming Basics



Set port

Programming Basics



The image shows a screenshot of the Arduino IDE interface. The title bar reads "Blink | Arduino 1.0.1". The menu bar includes File, Edit, Sketch, Tools, and Help. Below the menu is a toolbar with icons for Save, Undo, Redo, Open, Upload, and Verify. The main window displays the "Blink" sketch code. The code is as follows:

```
/*
Blink
Turns on an LED on for one second, then off for one second, repeatedly.

This example code is in the public domain.
*/

// Pin 13 has an LED connected on most Arduino boards.
// give it a name:
int led = 13;

// the setup routine runs once when you press reset:
void setup() {
}

Done compiling.

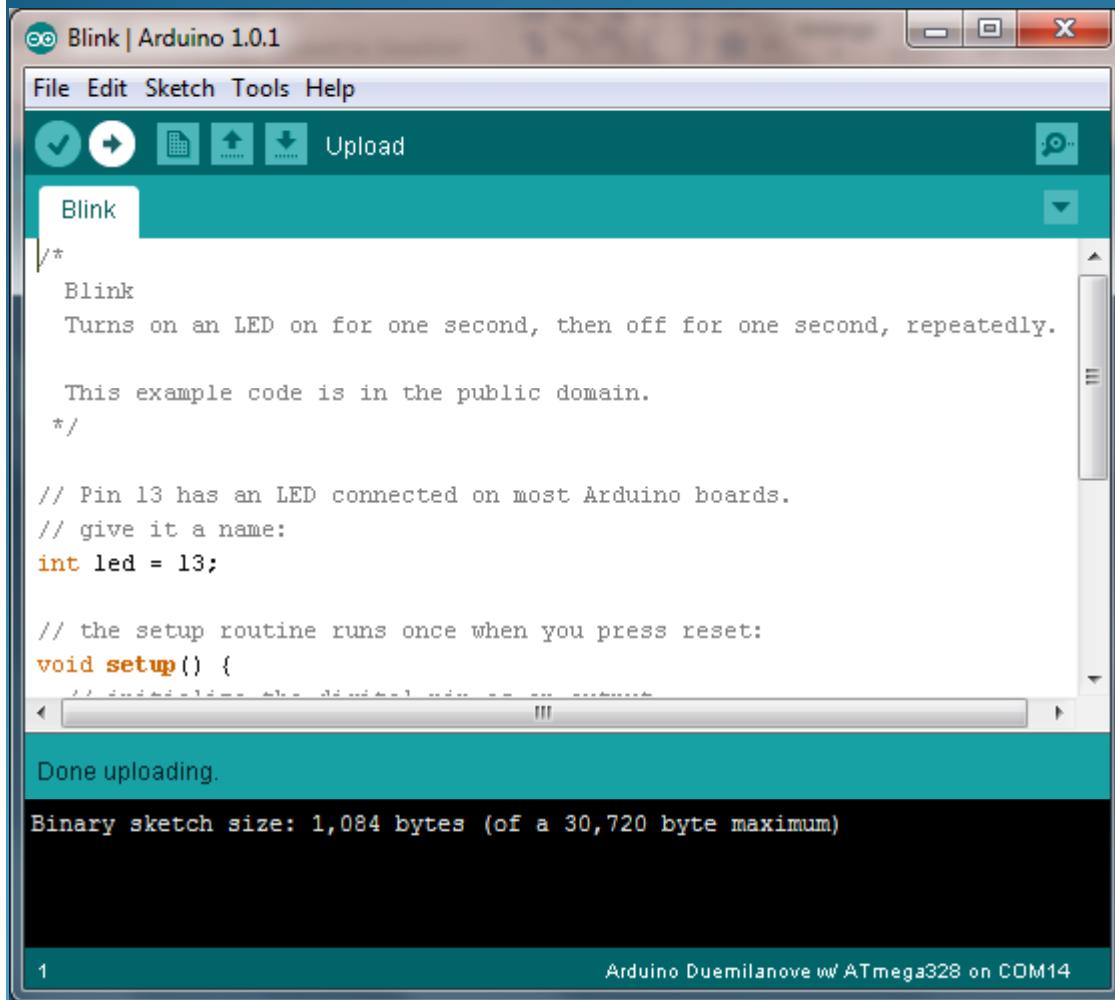
Binary sketch size: 1,084 bytes (of a 30,720 byte maximum)
```

The status bar at the bottom indicates "1" and "Arduino Duemilanove w/ ATmega328 on COM14".

Verify

Programming Basics

Upload



The image shows a screenshot of the Arduino IDE interface. The title bar reads "Blink | Arduino 1.0.1". The menu bar includes File, Edit, Sketch, Tools, and Help. Below the menu is a toolbar with icons for upload, refresh, and other functions. The main window displays the "Blink" sketch. The code is as follows:

```
File Edit Sketch Tools Help
Blink
/*
Blink
Turns on an LED on for one second, then off for one second, repeatedly.

This example code is in the public domain.
*/
// Pin 13 has an LED connected on most Arduino boards.
// give it a name:
int led = 13;

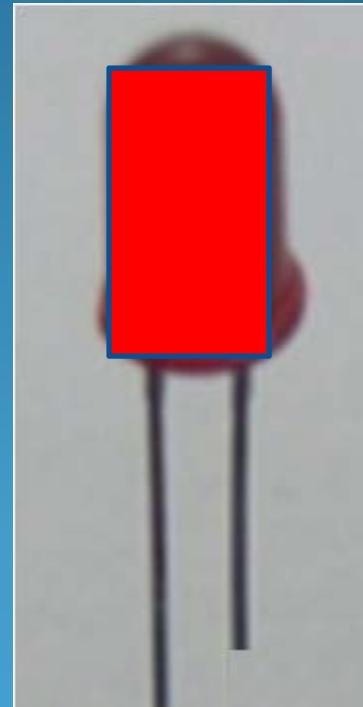
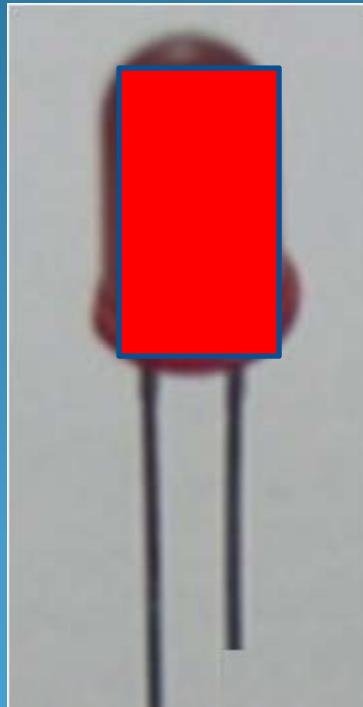
// the setup routine runs once when you press reset:
void setup() {
}

Done uploading.

Binary sketch size: 1,084 bytes (of a 30,720 byte maximum)
1
Arduino Duemilanove w/ ATmega328 on COM14
```

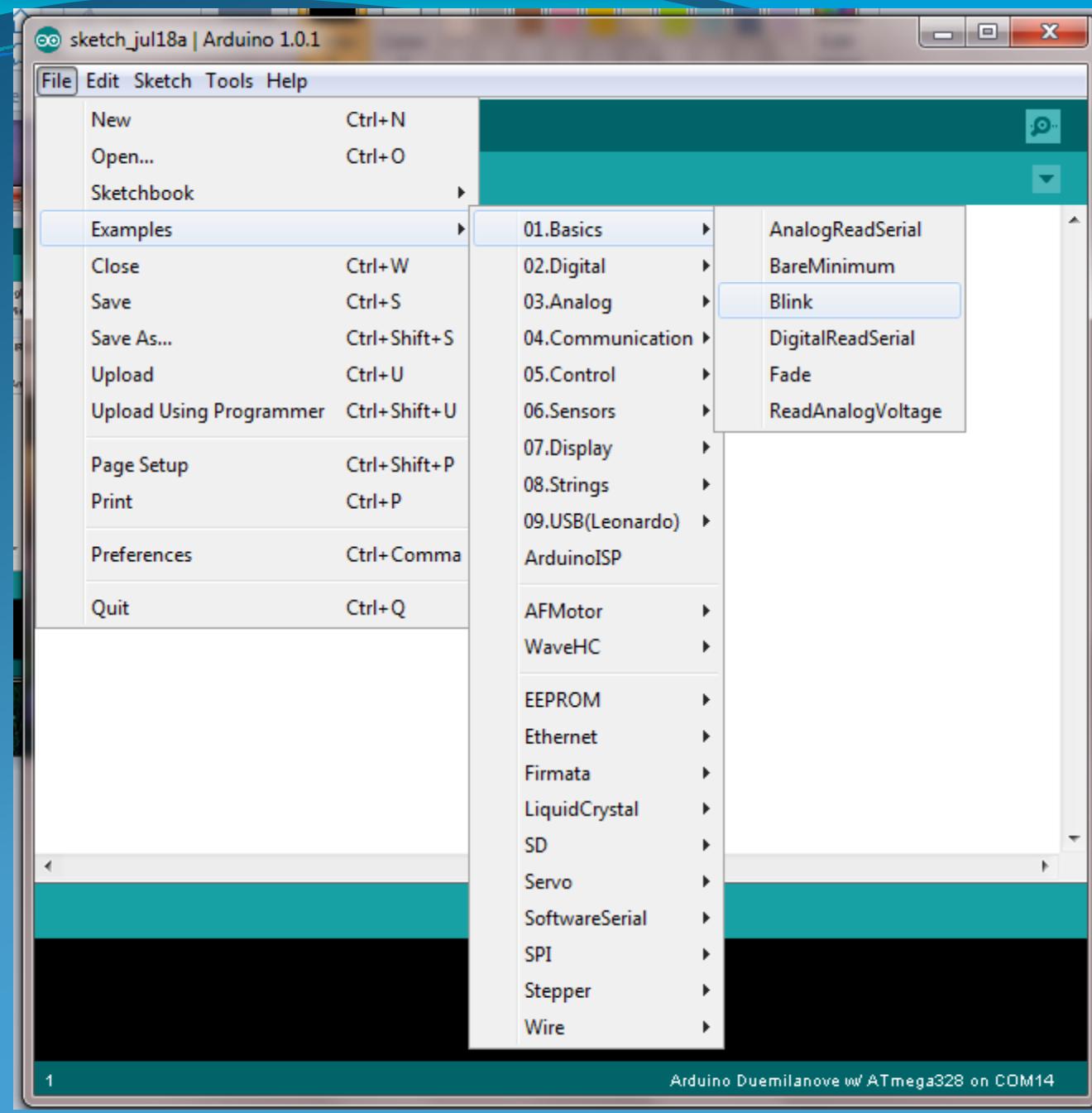
The status bar at the bottom indicates "Done uploading." and "Binary sketch size: 1,084 bytes (of a 30,720 byte maximum)". The port is listed as "Arduino Duemilanove w/ ATmega328 on COM14".

Programming Basics



Loading Examples

The team also realized they'd need to give you good examples, so they are built right into studio.

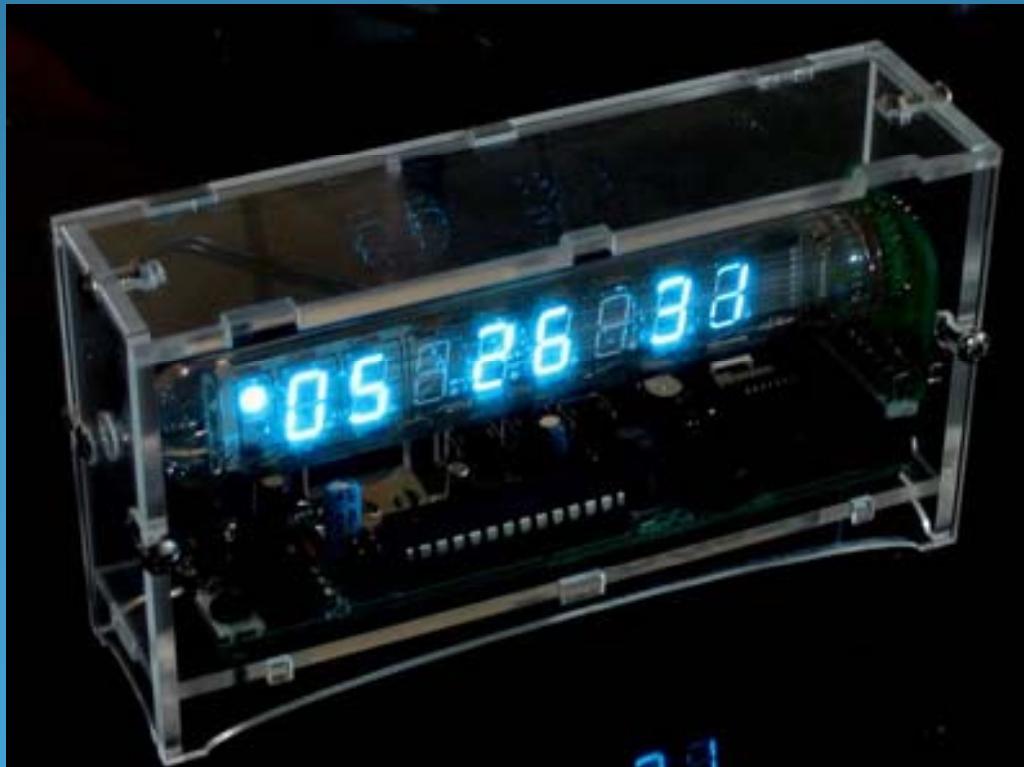


Embedded Arduino

It really is that easy to program and use arduino, so many kits have been designed that include arduino.

Embedded Arduino

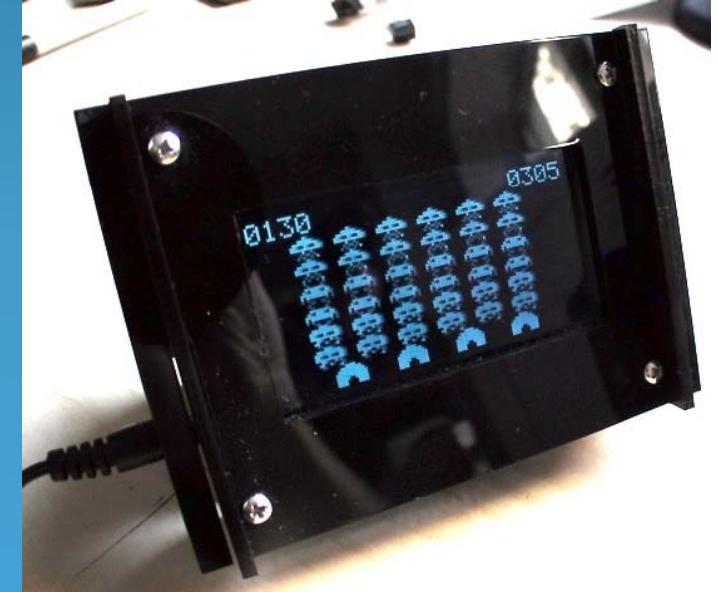
IceTubeClock – Adafruit



Embedded Arduino

MonoChron – Adafruit

MultiChron - Dataman



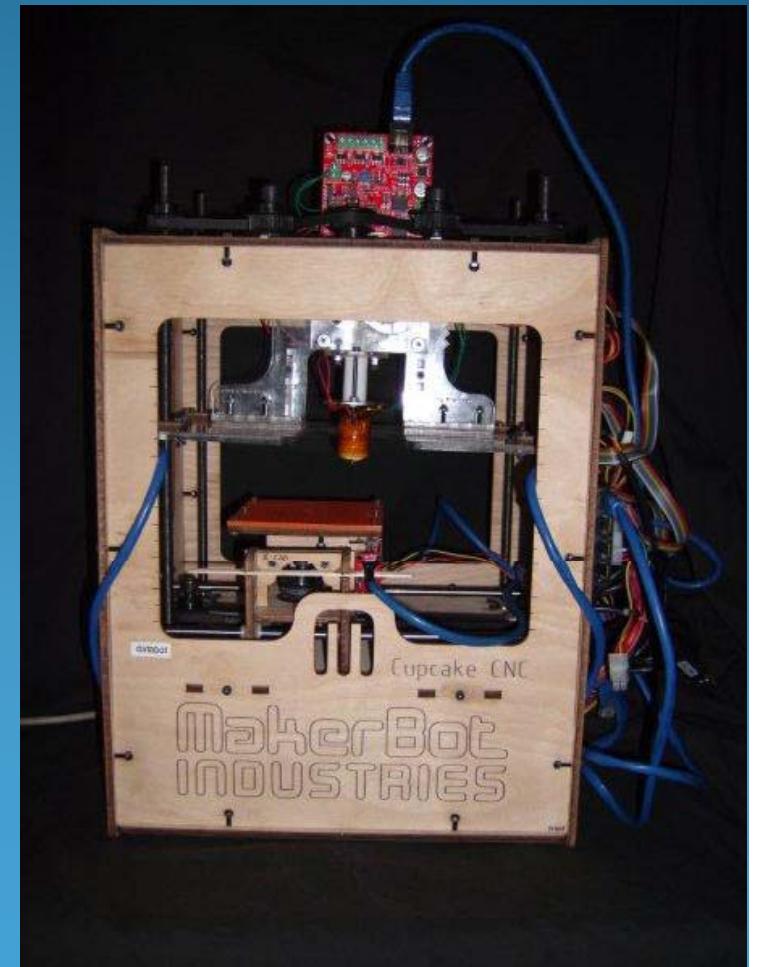
Embedded Arduino

BulbDial EvilMadScientist



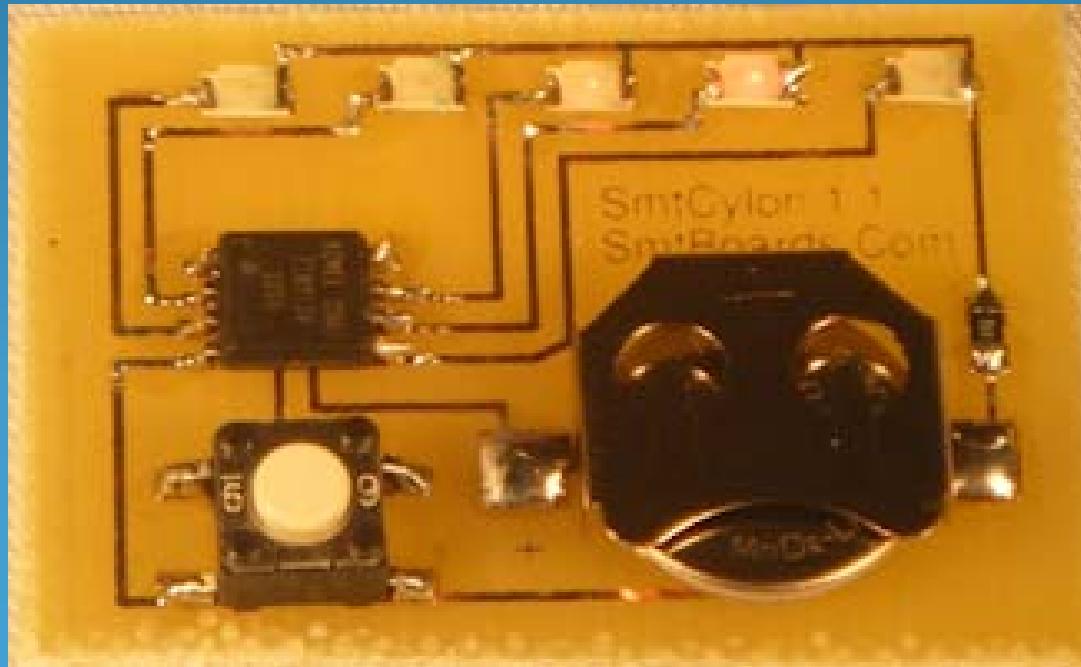
Embedded Arduino

MakerBot
In fact,
Two inter-
communicating
Arduinos.



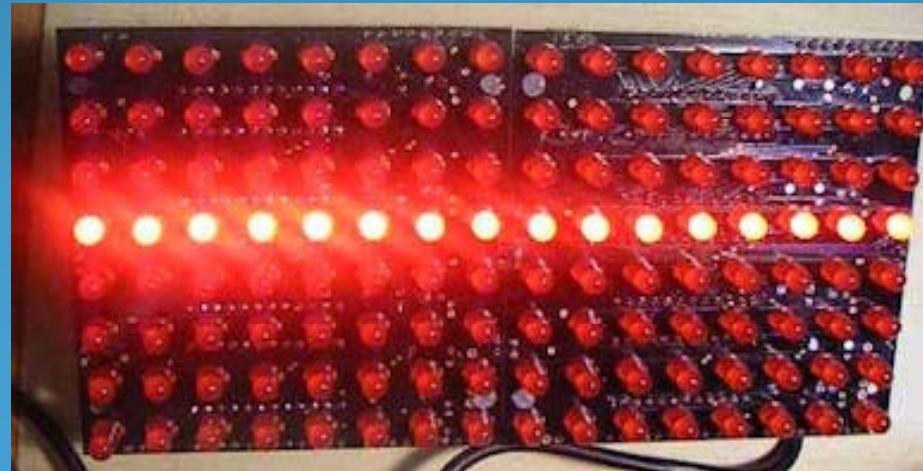
Embedded Arduino

SMT Cylon – Dataman



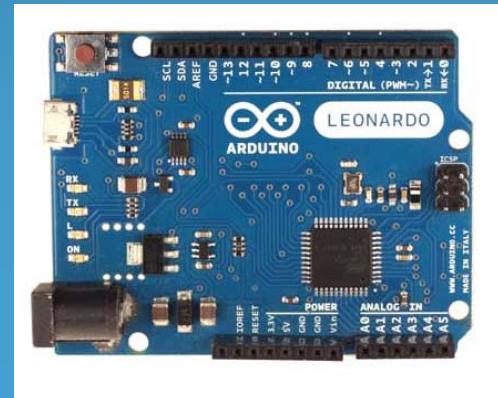
Embedded Arduino

Panel8x8 – ModernDevice
Library - Dataman



Arduino is just a winning platform!

Thank you Massimo and the entire team!





Hands On

We are now going to break into groups, sit down, and actually use Arduino.



Hands On

You'll be spending 5-10 minutes per station. When everyone is finished, we'll rotate stations.



Hands On

At each station, please have one group member run the lab. Rotate the member each lab.



Hands On

The lab facilitator is there to answer questions, as well as me.



Hands On

I also have free parts for anyone wanting to try some labs on their own.



A great place to share code. This presentation is posted under Dataman as Introduction-To-Arduino



*Thank
you*

Thank you

Thank you for attending.
I hope you have a great
time.

Dataman@SynShop.Org