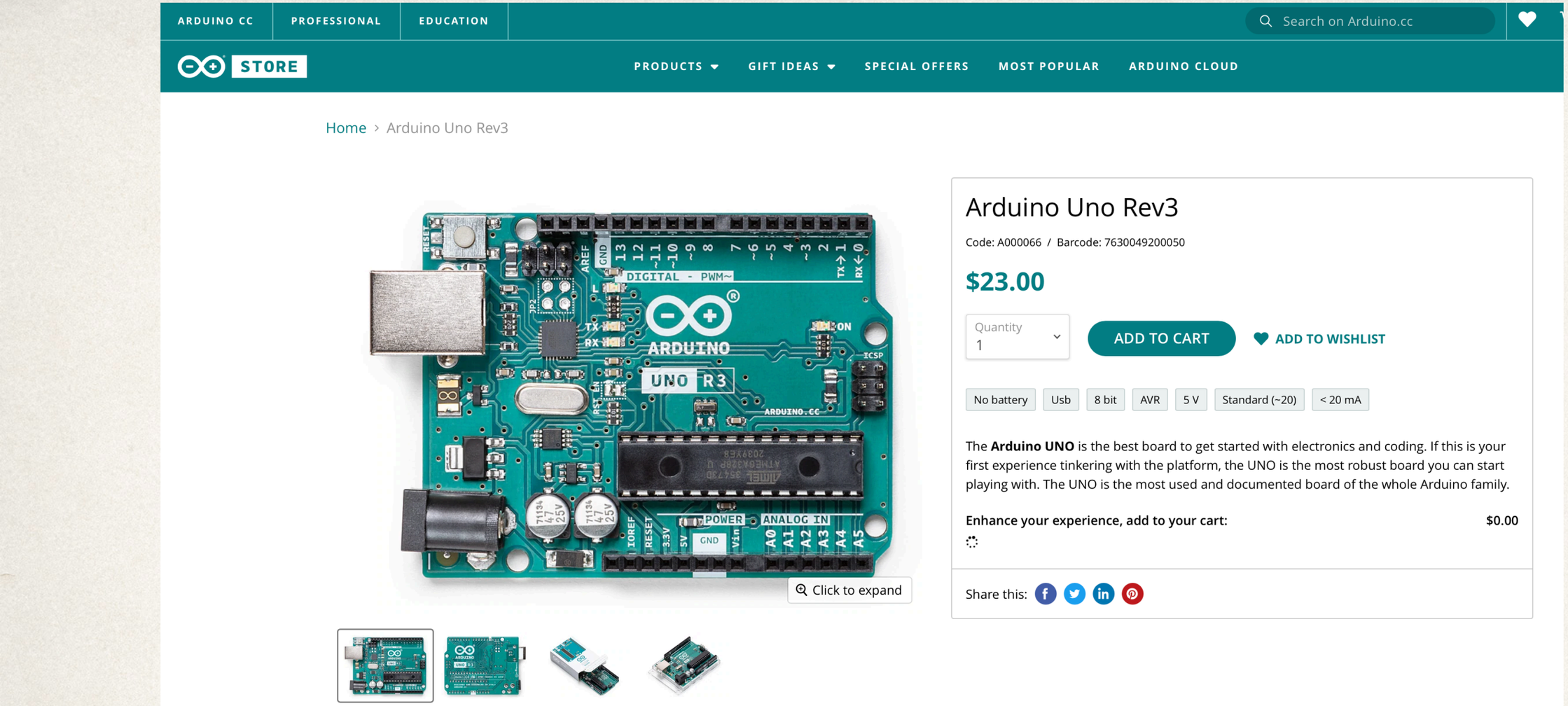


Arduino Boards and Model Railroads

J. Michael Dean, MD

February 19, 2022

Arduino Breakout Boards

- The microcontroller is a single chip. If you add a couple components, it will work.

- Circuit is open source, so Chinese companies did not "steal" it, and generally any source is as good as the "genuine" board from Italy.

- Numerous footprints for these boards.

What is a microcontroller?

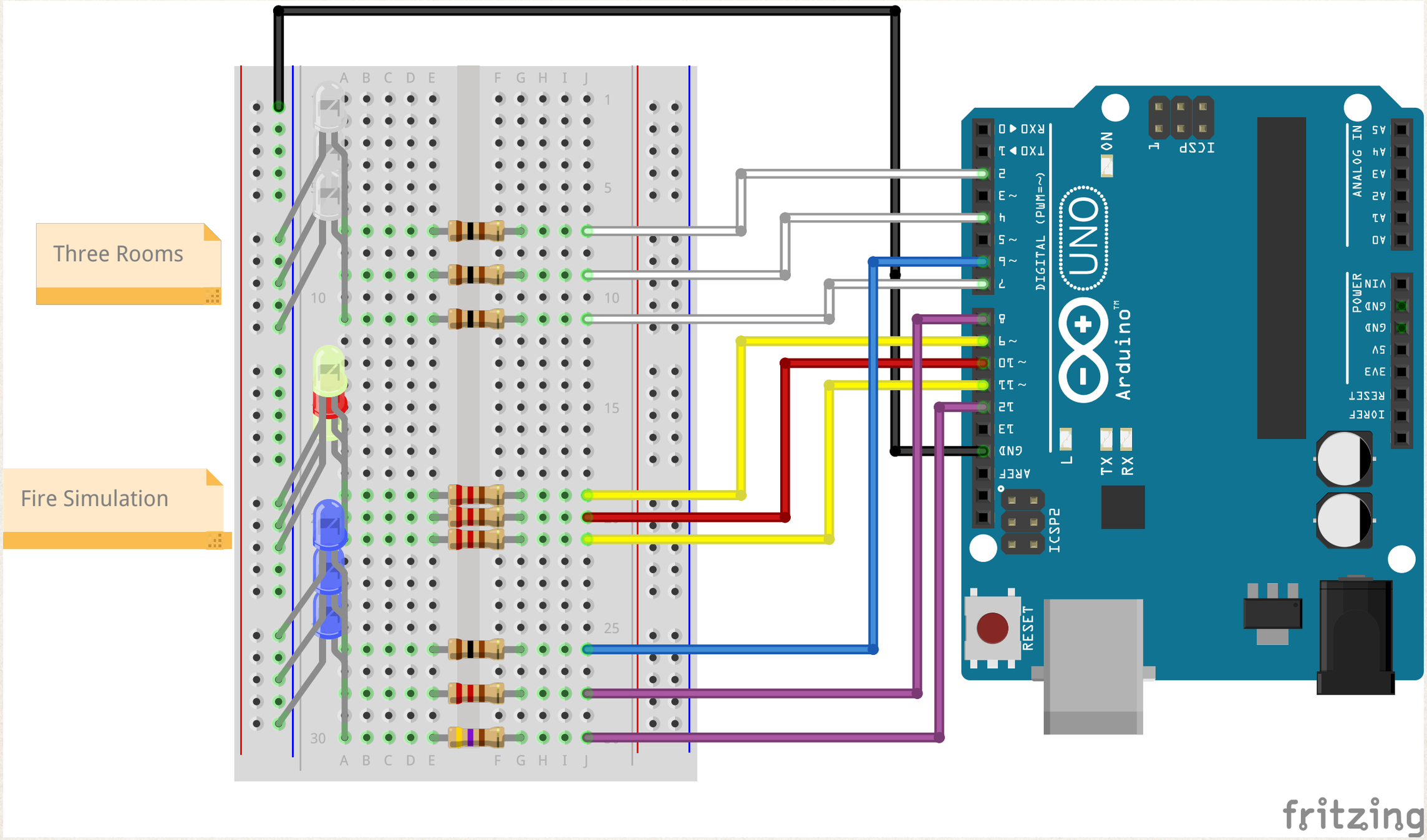
- Each pin can be an input or an output
- Think of the input as a voltmeter that can measure voltage, and if it is very low, then it is a digital zero, and if it is close to 5V, then it is a one.
- Think of the output as a 5V battery that you turn on and off.
- We are only using pins as outputs today. The board controls whether there is a 5V battery on the LED, or not.

Review what you did

- Blink sketch to LED on the board - tests the board
- LED 3 blue blinks to show three at once
- Using PWM to fade and brighten blue LED
- Flickering to simulate fire
- Lighting multiple rooms in a structure

Three Rooms

Fire Simulation



fritzing

Uses for Arduino

- Control light emitting diodes (LEDs) - today's topic!
- Control servo motors - use to move turnouts, other animation
- Current detection and signaling systems
- Create DCC system on the cheap

My Audience Includes

- People who want to experiment with all kinds of circuits on a breadboard and devise new applications.

- People who want to figure out how to stick an Arduino under their baseboard or in a building to light up things

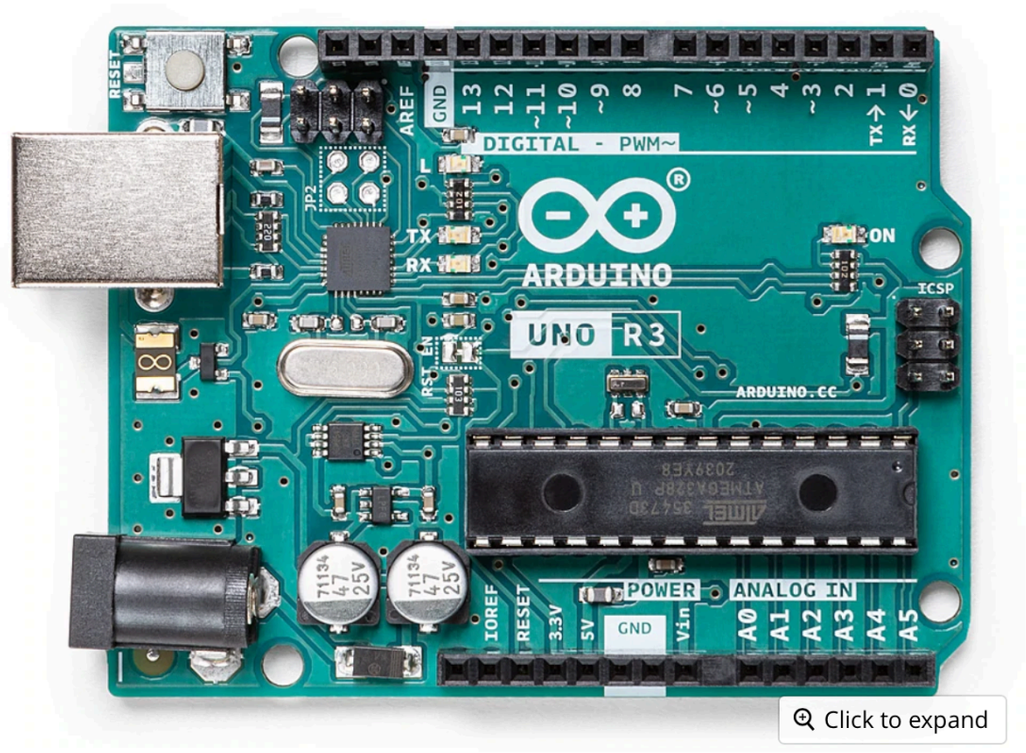
- People who came today out of curiosity, but frankly, when they go home, it will go on a shelf

My Goal

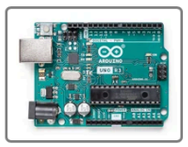
- If you leave here with a working Arduino that can go on your layout, then I succeeded for most of you.

- If this works, then you may be motivated to go further.

- Hopefully nobody gets disappointed and gives up, unless you were just curious and don’t care to use them.



Click to expand




Arduino Uno Rev3

Code: A000066 / Barcode: 7630049200050

$23.00

Quantity 1

ADD TO CART

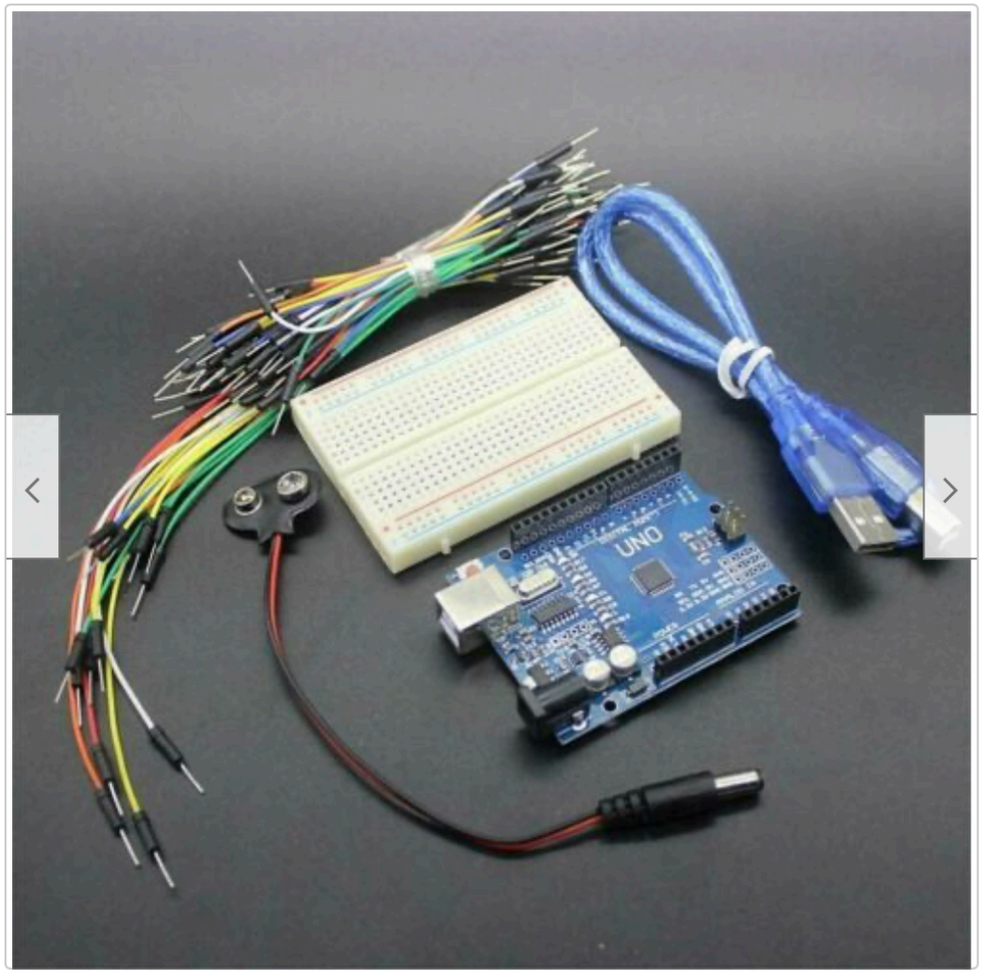
ADD TO WISHLIST

No battery | Usb | 8 bit | AVR | 5 V | Standard (~20) | < 20 mA

The **Arduino UNO** is the best board to get started with electronics and coding. If this is your first experience tinkering with the platform, the UNO is the most robust board you can start playing with. The UNO is the most used and documented board of the whole Arduino family.

Enhance your experience, add to your cart: **$0.00**

Share this:







Arduino Uno Compatible Starter Kit w/ Breadboard, Jumpers, USB & Battery Cables

4.5 out of 5 stars 19 product ratings

Condition: **New**

Bulk savings:

Buy 1	Buy 2	Buy 3
$13.29/ea	$12.63/ea	$11.96/ea

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More than 10 available
875 sold / See feedback

Price: **US $13.29/ea**

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Add to cart

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Shipping: **FREE** Standard Shipping | See details
Located in: Fort Collins, Colorado, United States

Delivery: Estimated between **Thu. Jan. 06** and **Tue. Jan. 11** to 84117

Returns: 30 days returns | Seller pays for return shipping | See details

Payments: PayPal, G Pay, VISA, Mastercard, AMEX, DISCOVER

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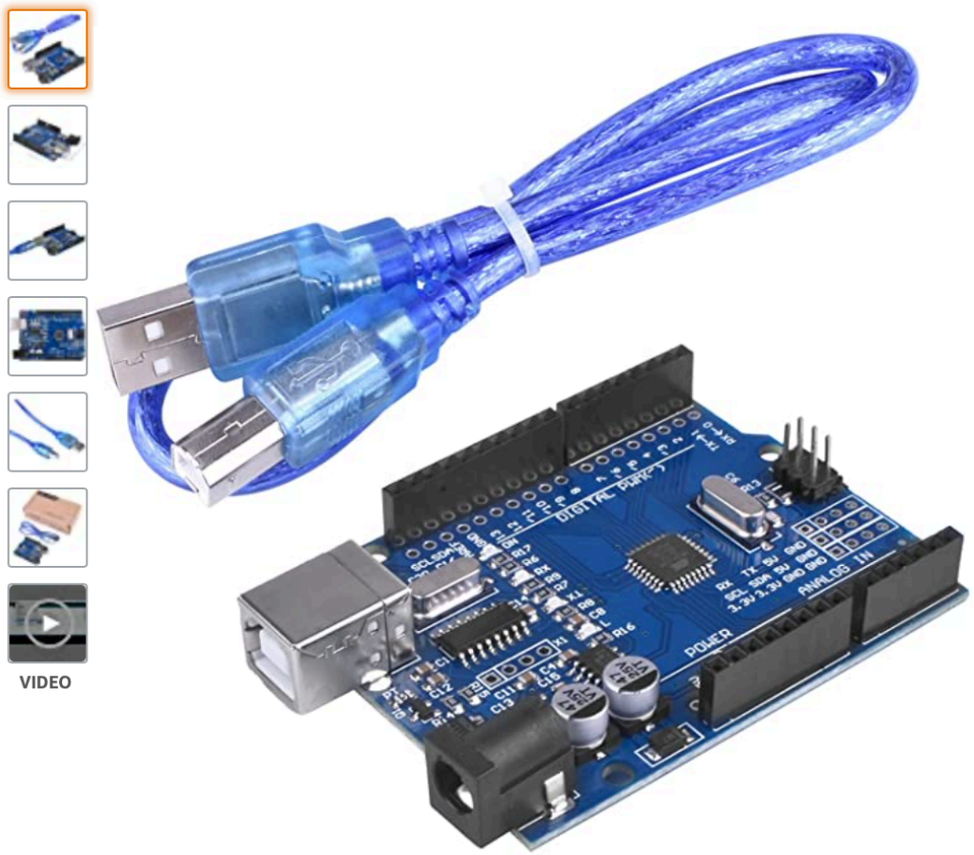

Roll over image to zoom in

Kuman UNO R3 Board ATmega328P with USB Cable for Arduino - Compatible With Arduino UNO R3 Mega 2560 Nano Robot for Arduino IDE AVR MCU Learner K53, Blue

Visit the kuman Store

4.5 out of 5 stars 229 ratings | 14 answered questions

Price: $10.69 prime & FREE Returns

Thank you for being a Prime Member. Get $125 off: Pay $0.00 ~~$10.69~~ upon approval for the Amazon Business Prime Card. Terms apply.

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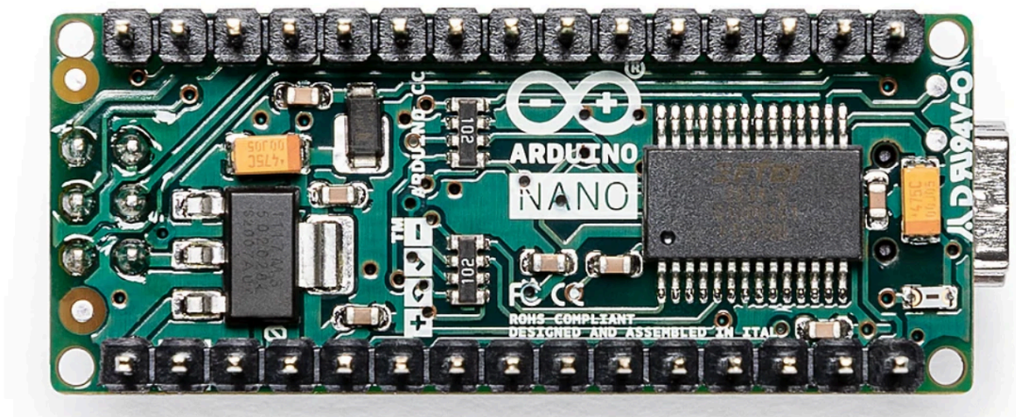
Specific Uses For Product	Business
Series	R3 Board ATmega328P with USB Cable for Arduino - Compatible
Ram Memory Installed Size	1 GB
Operating System	No
CPU Model	6X86
Brand	Kuman

See more



Click to expand





Arduino Nano

Code: A000005 / Barcode: 7630049200173

$20.70

Quantity 1

ADD TO CART

ADD TO WISHLIST

8 bit | AVR | 5 V | Standard (~20) | < 20 mA

The classic Arduino Nano is the smallest board to build your projects with.

Enhance your experience, add to your cart:	**$0.00**
Arduino Uno Rev3	$23.00
Arduino MKR ZERO (I2S bus & SD for sound, music & digital audio data)	$21.42
Arduino MKR RGB Shield	$44.90

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Product Details	Price Per Unit	Quantity	Order Total	Status	
 Pro Mini Module Atmega168 5V 16M For Arduino Compatible Nano (WeiJie Chen)	$ 1.45	50 Pieces	$ 72.50	Confirmation Timeout	ePacket Free Shipping Estimated Delivery Time: 12-20 Days Will be shipped within (Business days) 3 Days

Product Amount	Shipping Cost	Total Amount
US $ 72.50	US $ 10.55	US $ 86.37

Ask me

Where's my

Where's my

Product not

Why order c

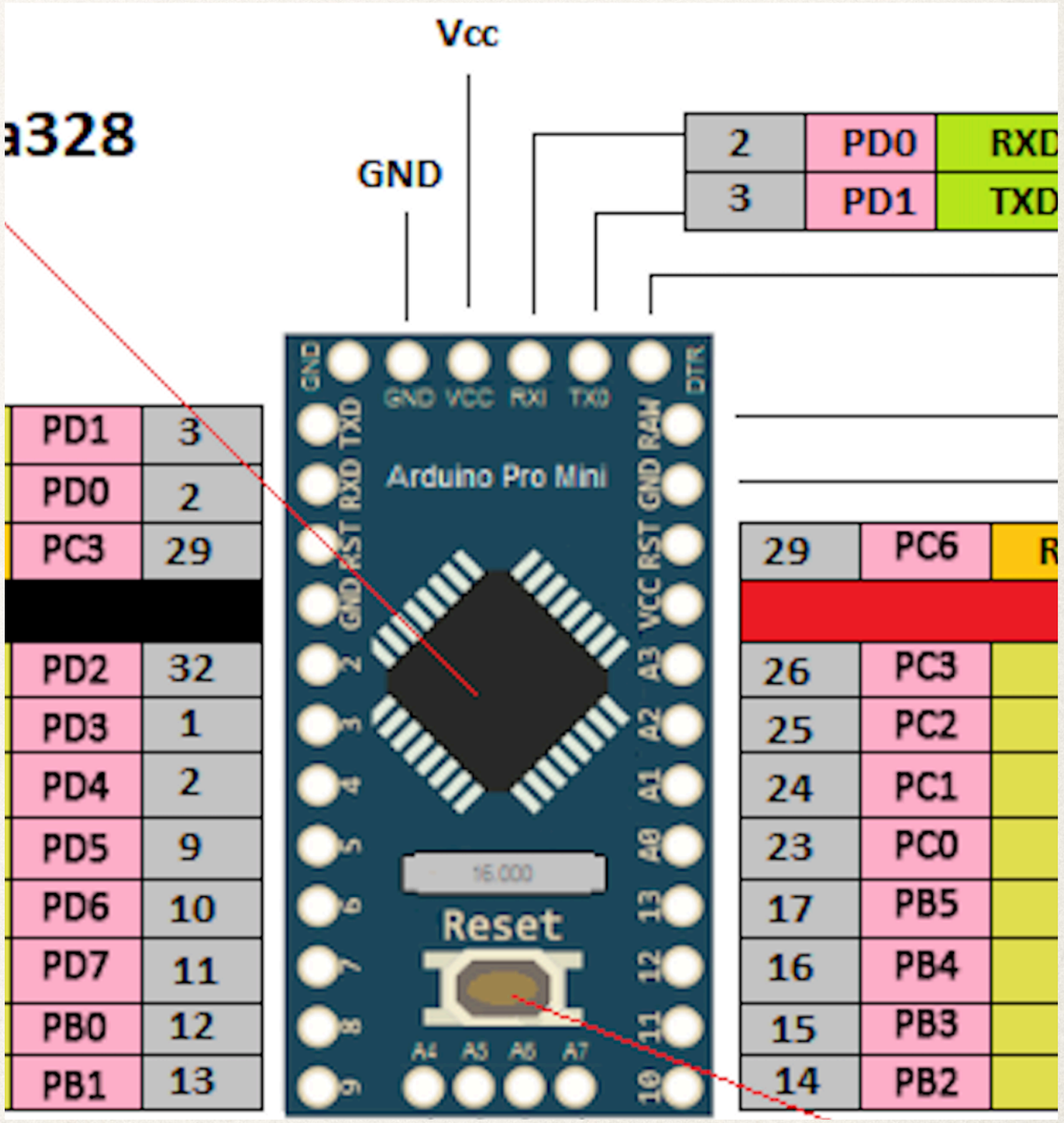
Ask

Arduino Pro Mini

- Tiny board that can fit in a building, even N scale
- Essentially identical to the Uno you have used
- Does not have a USB port so we have to set up a cable to program it.

Programming

- Cable with red adaptor board
- Look at the red board to make sure you connect it correctly to Arduino
- GND to GND, and DTR to DTR



Brief LED Lesson

- White and blue LEDs drop 3 volts, and red and yellow LEDs drop 2 volts

- Arduino output is 5 volts, so we need a resistor to limit the remaining current to below 20 mA

- I used 100 Ohm for white, and 220 Ohm for yellow and red LEDs

- White will have 20 mA, and others will have 9 mA

- DON'T CONNECT THESE TO A 9VOLT BATTERY.. WHY?

PRO MINI PINOUT

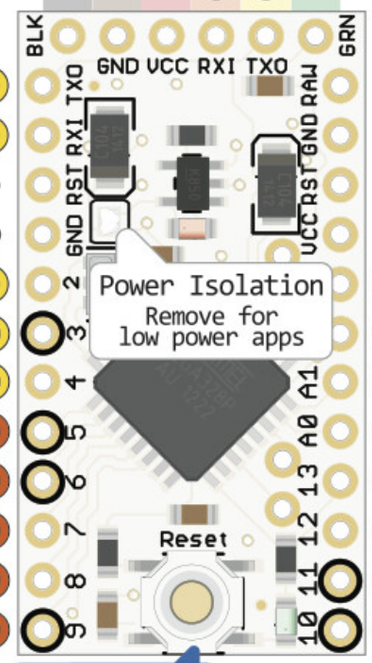
RAW When supplying unregulated power to the board, be sure to connect to this pin

FTDI Connector: GND, CTS, VCC, TXD, RXD, RTS

VCC
GND
GND

30 PD0 RXD PCINT16
31 PD1 TXD PCINT17
DTR — Connected to Reset Circuit

1 PCINT17 TXD PD1 31
0 PCINT16 RXD PD0 30
PCINT14 RESET PC6 29
GND
2 PCINT18 INT0 PD2 32
3 OC2B PCINT19 INT1 PD3 1
4 XCK PCINT20 T0 PD4 2
5 OC0B PCINT21 T1 PD5 9
6 OC0A PCINT22 AIN0 PD6 10
7 PCINT23 AIN1 PD7 11
8 ICP1 PCINT0 CLKO PB0 12
9 PCINT1 OC1A PB1 13



RAW
GND
29 PC6 RESET PCINT14
VCC
26 PC3 PCINT11 ADC3 — 17 A3
25 PC2 PCINT10 ADC2 — 16 A2
24 PC1 PCINT9 ADC1 — 15 A1
23 PC0 PCINT8 ADC0 — 14 A0
17 PB5 PCINT5 SCK — 13
16 PB4 PCINT4 MISO — 12
15 PB3 OC2 PCINT3 MOSI — 11
14 PB2 OC1B PCINT2 SS — 10

3.35V→12V for 3V3 model
5V→12V for 5V model

28 PC5 PCINT13 ADC5 SCL — 19 A5
27 PC4 PCINT12 ADC4 SDA — 18 A4

22 ADC7 — A7
19 ADC6 — A6

IDE
Power
GND
Serial Pin
Analog Pin
Control
INT
Physical Pin
Port Pin
Pin function
Interrupt Pin
PWM Pin
Port Power

Absolute MAX per pin 40mA
recommended 20mA

Absolute MAX 200mA
for entire package

Absolute MAX 150mA
when RAW powered

The power sum for each pin's group should not exceed 100mA

Analog exclusively Pins

bq
www.bq.com

18 JUL 2014
ver 3 rev 0

What you have in front of you

- Arduino pro mini on a breadboard
- Cable and adaptor for programming Arduino
- Three white, two yellow and one red LED with resistors already soldered in place
- The lead with the resistor in it is the NEGATIVE lead and needs to be connected to ground
- Additional Dupont connectors, LEDs and resistors

What we are going to do

- Connect to the computer with the cable and follow my instructions
- Demonstrate how to program the Pro Mini with the adaptor cable to blink the on board LED
- Program the Arduino with the combined sketch
- Add the LEDs to the breadboard and verify that the fire and room sketches are working
- Show you how to get rid of the breadboard

Couple Technical Details

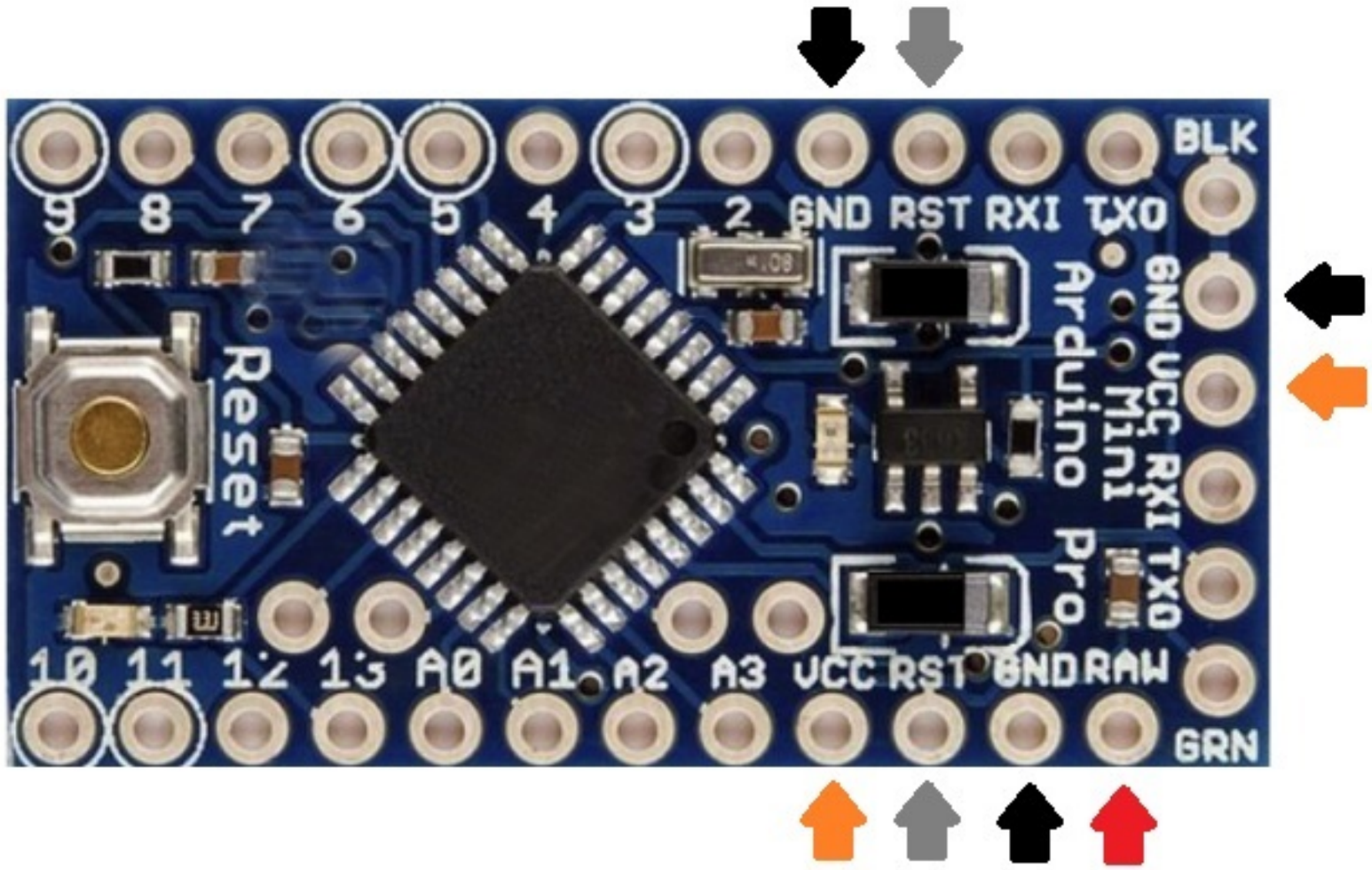
- Your boards are 5 volt boards; there ARE 3.3 v Arduino boards. Be careful what you buy.

- RAW can be 6V to 12V; VCC must be 5.0V or you will fry the board.

- You can run out of ground connections to the Arduino if you don't use a breadboard.

- Each output can only put out 40 mA and entire board should be kept below 200 mA.

Arduino Pro Mini Power Pins



Vcc Pins: Regulated Voltage (either 5V or 3.3V)

GND Pins: Ground (0V)

RAW Pin: Raw Voltage (Ranges from 5V to 12V)

RST Pins: Reset Pins (LOW signal will reset Mini)

Two Kinds of Boards

- I ran out of the old boards so some of you have newer boards
- ATMega168 versus ATMega328 - the adaptor connections are reversed!
- Everything else is the same. But you have to set the IDE correctly to communicate.
- I have attached all the adaptors correctly for your board.
- Remember, DTR to DTR, and GND to GND.
- LOOK AT YOUR BOARDS when you buy them. They vary on the programming edge of the board in the order. You may have to flip your adaptor.

If we had a lot of people….

- Two of the boards need to have their reset button pushed during upload of software.
- I don’t know why - they came in the same box of 50 units from China. But they still work.
- Your board will be labeled if this is true.

What we are NOT going to do.

- The sketches are written in the IDE that I have been demonstrating and will demonstrate. You can download this on your computer.

- Sketches are computer programs written in C++, but I am not teaching programming.

- I have written your programs. The code is in your handout.

- The Arduino IDE has tons of examples - if you aren't a programmer, just copy the examples.

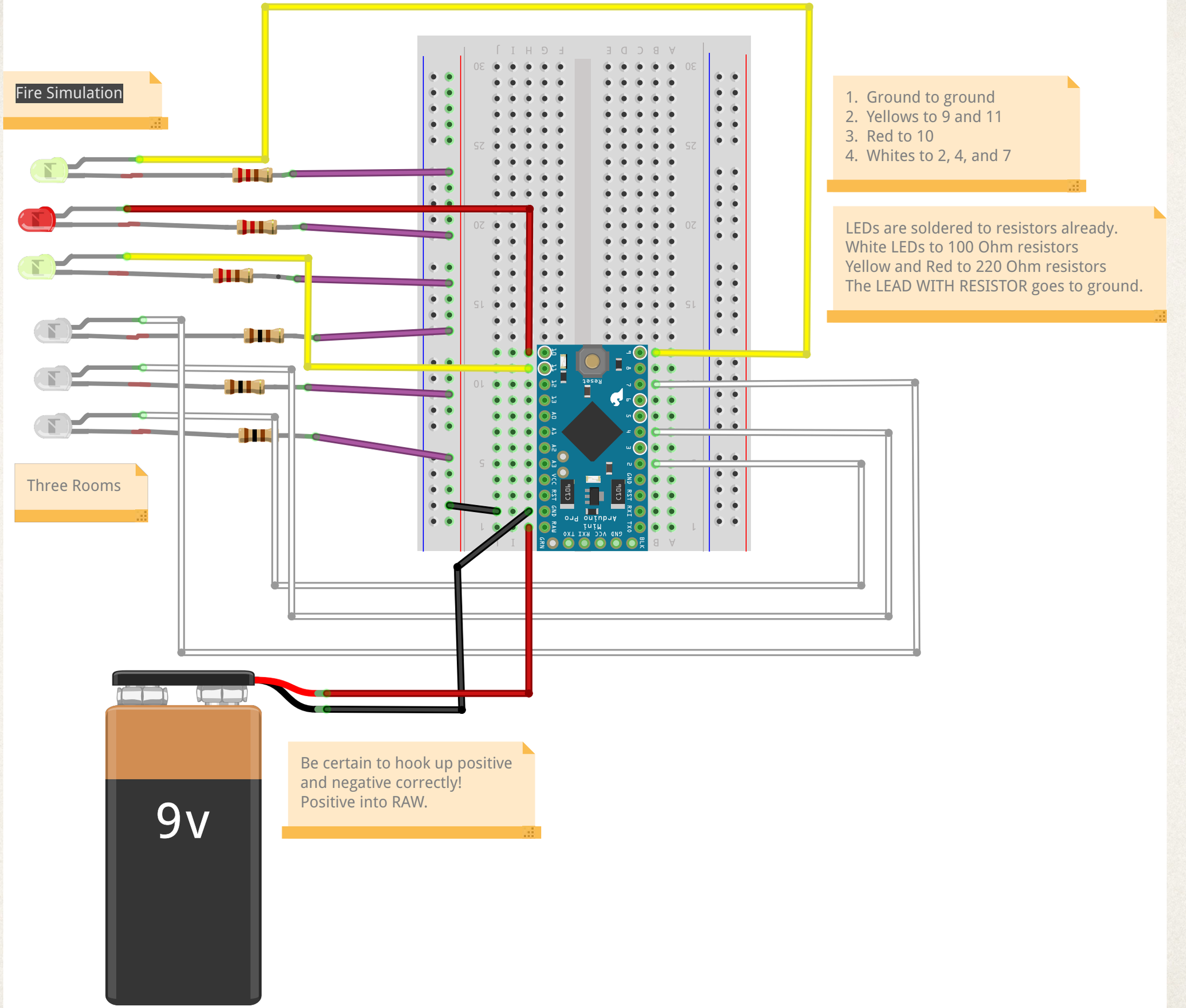
What is the combined sketch?

- I have combined the fire sketch and the three light room sketch so that they both run at the same time.

- You can hook up three white LEDs and stick in a building, or you can use the yellow and red LEDs and simulate fire, OR you can do both.

- No need to reprogram the board if you want to do one or both of these things on your layout.

Fire Simulation



1. Ground to ground
2. Yellows to 9 and 11
3. Red to 10
4. Whites to 2, 4, and 7

LEDs are soldered to resistors already.
White LEDs to 100 Ohm resistors
Yellow and Red to 220 Ohm resistors
The LEAD WITH RESISTOR goes to ground.

Be certain to hook up positive and negative correctly!
Positive into RAW.

fritzing