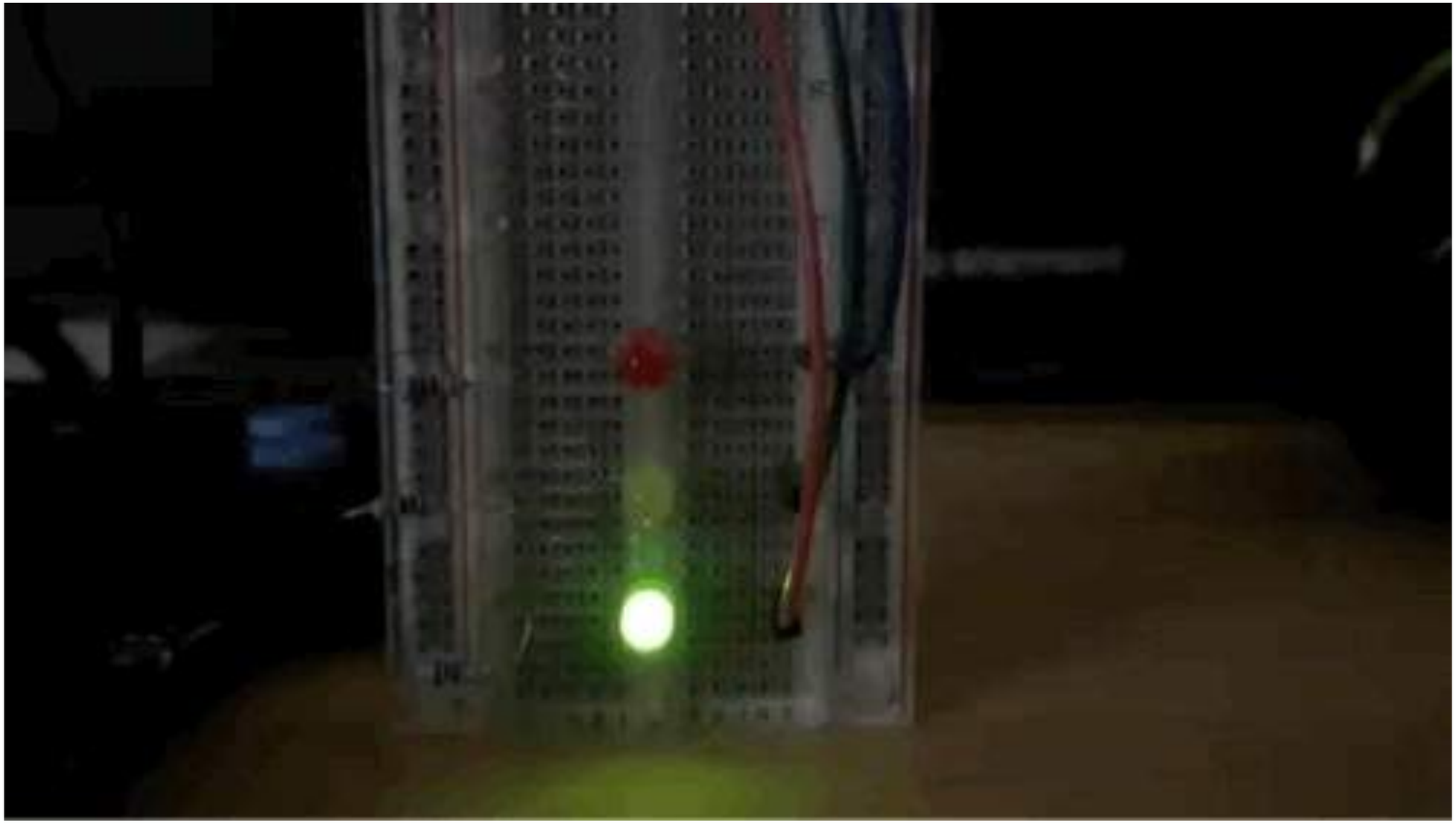
Electronics Engineering Eca

Block C Lesson 3

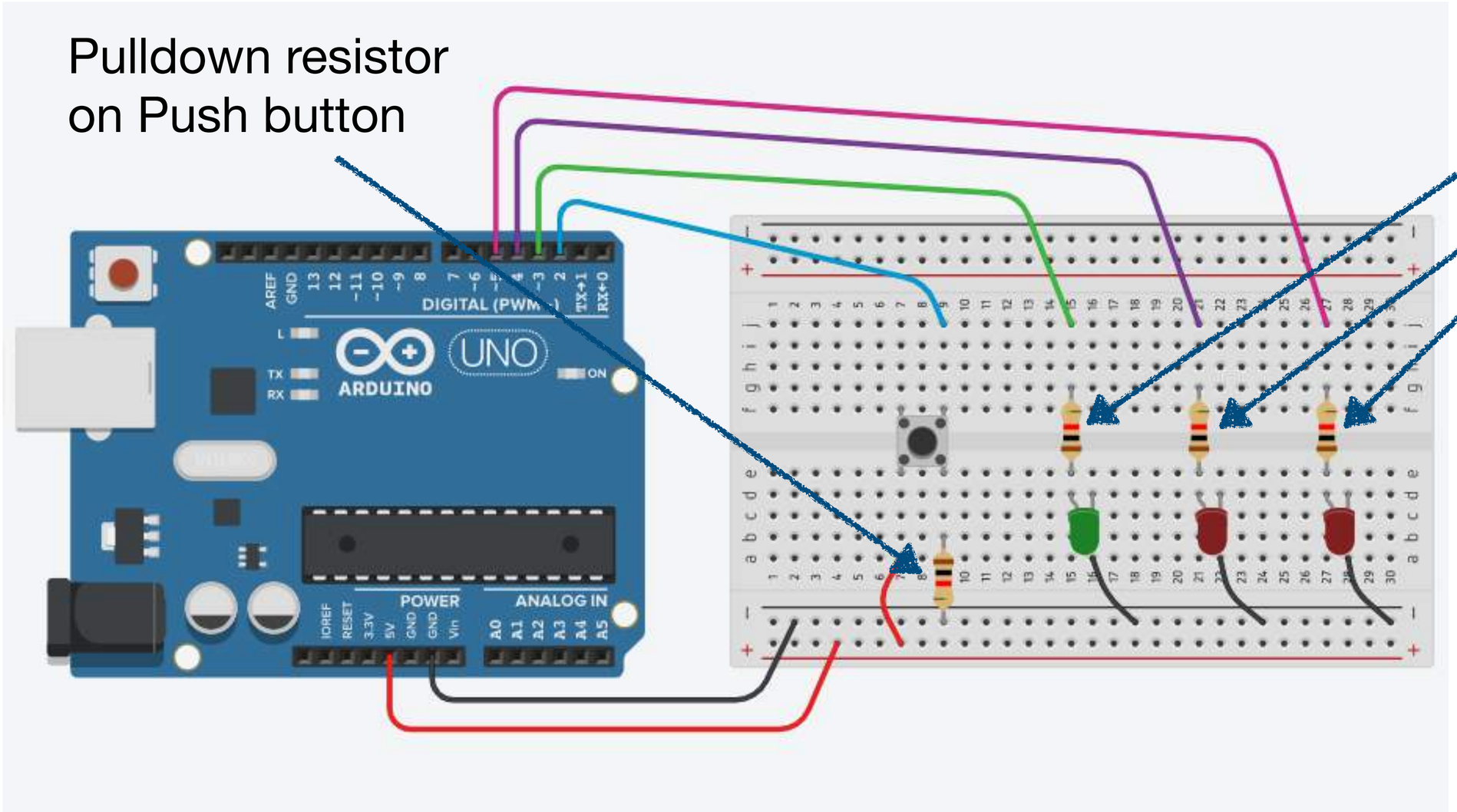
Controlling LEDs through code



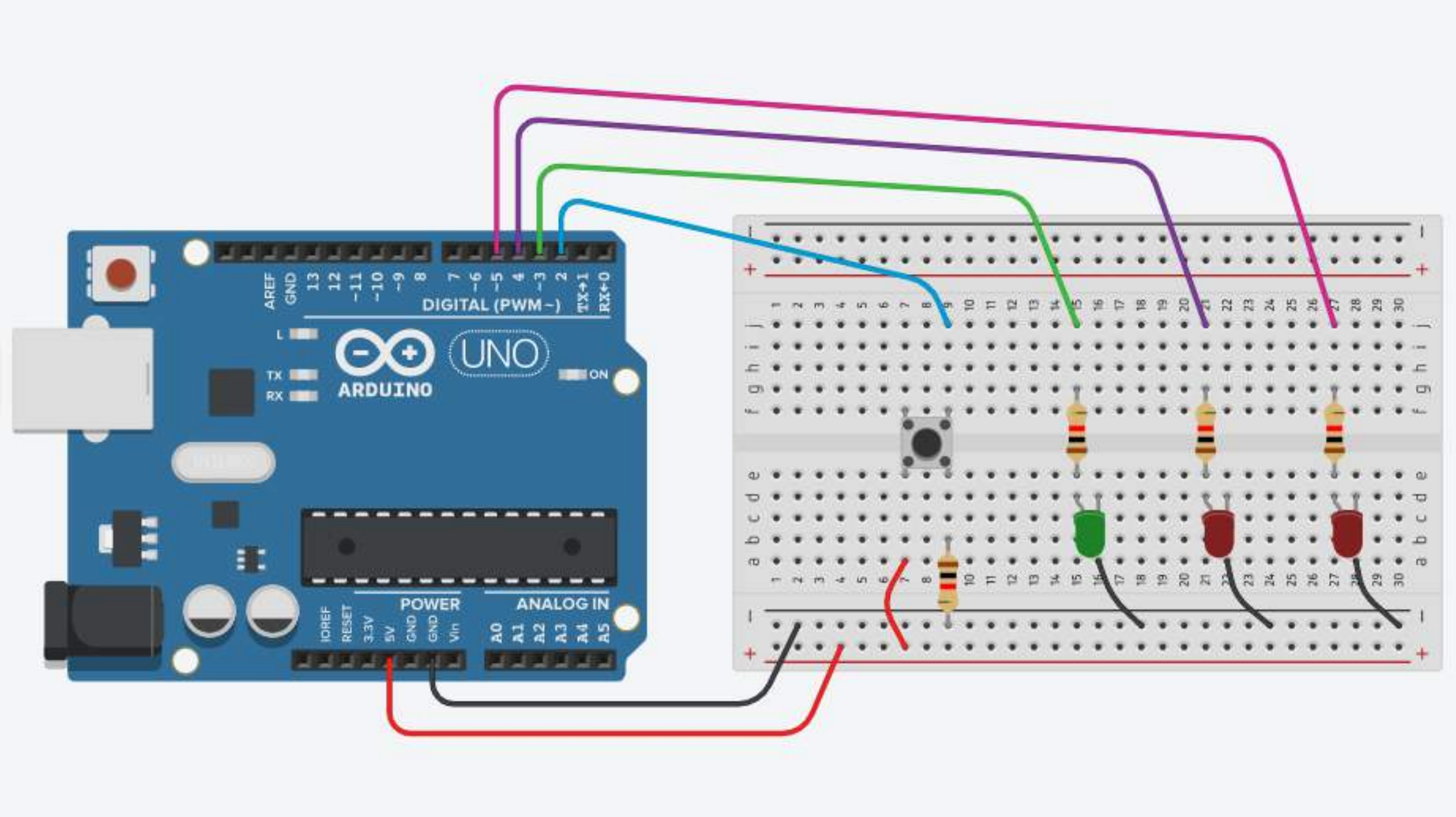
Circuit

Pulldown resistor
on Push button

220Ω Resistors
to limit current of
led



Circuit


AREF
GND
13
12
~11
~10
~9
8
7
~6
~5
4
~3
2
TX→1
RX←0
DIGITAL (PWM~)
L
TX
RX
ARDUINO
UNO
ON
POWER
ANALOG IN
IOREF
RESET
3.3V
5V
GND
GND
Vin
A0
A1
A2
A3
A4
A5

Function of traffic light

- Loop: Green (8s) - Yellow(2s) - Red(8s) 🔁
- When the button is pressed: Yellow(2s) - Green (8s)

Tasks

- Turn on and off any led
- Be able to detect button press

Controlling leds

```
#define LED1_PIN 4

pinMode(LED1_PIN, OUTPUT);

digitalWrite(BUTTON_PIN, HIGH);

digitalWrite(BUTTON_PIN, LOW);

delay(1000);
```

Arduino Programming Cheat Sheet

Primary source: Arduino Language Reference
https://www.arduino.cc/reference/en/

Structure & Flow

Basic Program Structure

```
void setup() {
  // Runs once when sketch starts
}
void loop() {
  // Runs repeatedly
}
```

Control Structures

```
if (x < 5) { ... } else { ... }
while (x < 5) { ... }
for (int i = 0; i < 10; i++) { ... }
break;     // Exit a loop immediately
continue;  // Go to next iteration
switch (var) {
  case 1:
    ...
    break;
  case 2:
    ...
    break;
  default:
    ...
}
return x;  // x must match return type
return;    // For void return type
```

Function Definitions

```
<ret. type> <name>(<params>) { ... }
e.g. int double(int x) {return x*2;}
```

Operators

General Operators

=	assignment		
+	add	-	subtract
*	multiply	/	divide
%	modulo		
==	equal to	!=	not equal to
<	less than	>	greater than
<=	less than or equal to		
>=	greater than or equal to		
&&	and	||	or
!	not		

Compound Operators

++	increment
--	decrement
+=	compound addition
-=	compound subtraction
*=	compound multiplication
/=	compound division
&=	compound bitwise and
|=	compound bitwise or

Bitwise Operators

&	bitwise and	|	bitwise or
^	bitwise xor	~	bitwise not
<<	shift left	>>	shift right

Pointer Access

&	reference: get a pointer
*	dereference: follow a pointer

Variables, Arrays, and Data

Data Types

bool	true | false
char	-128 - 127, 'a' '$' etc.
unsigned char	0 - 255
byte	0 - 255
int	-32768 - 32767
unsigned int	0 - 65535
word	0 - 65535
long	-2147483648 - 2147483647
unsigned long	0 - 4294967295
float	-3.4028e+38 - 3.4028e+38
double	currently same as float
void	return type: no return value

Strings

```
char str1[8] =
  {'A','r','d','u','i','n','o','\0'};
  // Includes \0 null termination
char str2[8] =
  {'A','r','d','u','i','n','o'};
  // Compiler adds null termination
char str3[] = "Arduino";
char str4[8] = "Arduino";
```

Numeric Constants

123	decimal
0b01111011	binary
0173	octal - base 8
0x7B	hexadecimal - base 16
123U	force unsigned
123L	force long
123UL	force unsigned long
123.0	force floating point
1.23e6	1.23*10^6 = 1230000

Qualifiers

static	persists between calls
volatile	in RAM (nice for ISR)
const	read-only
PROGMEM	in flash

Arrays

```
byte myPins[] = {2, 4, 8, 3, 6};
int myInts[6];   // Array of 6 ints
myInts[0] = 42;  // Assigning first
                 // index of myInts
myInts[6] = 12;  // ERROR! Indexes
                 // are 0 though 5
```

Built-in Functions

Pin Input/Output

```
Digital I/O - pins 0-13 A0-A5
  pinMode(pin,
    {INPUT|OUTPUT|INPUT_PULLUP})
  int digitalRead(pin)
  digitalWrite(pin, {HIGH|LOW})

Analog In - pins A0-A5
  int analogRead(pin)
  analogReference(
    {DEFAULT|INTERNAL|EXTERNAL})

PWM Out - pins 3 5 6 9 10 11
  analogWrite(pin, value) // 0-255
```

Advanced I/O

```
tone(pin, freq_Hz, [duration_msec])
noTone(pin)
shiftOut(dataPin, clockPin,
  {MSBFIRST|LSBFIRST}, value)
shiftIn(dataPin, clockPin,
  {MSBFIRST|LSBFIRST})
unsigned long pulseIn(pin,
  {HIGH|LOW}, [timeout_usec])
```

Time

```
unsigned long millis()
  // Overflows at 50 days
unsigned long micros()
  // Overflows at 70 minutes
delay(msec)
delayMicroseconds(usec)
```

Math

```
min(x, y)   max(x, y)   abs(x)
sin(rad)    cos(rad)    tan(rad)
sqrt(x)     pow(base, exponent)
constrain(x, minval, maxval)
map(val, fromL, fromH, toL, toH)
```

Random Numbers

```
randomSeed(seed) // long or int
long random(max) // 0 to max-1
long random(min, max)
```

Bits and Bytes

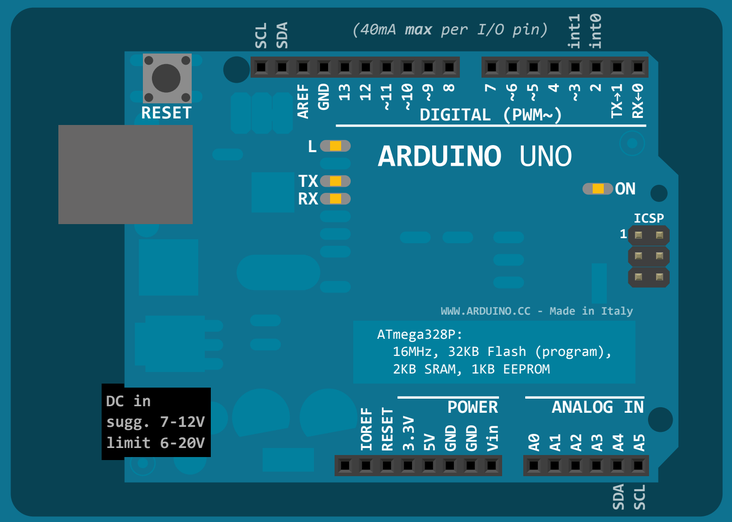
```
lowByte(x)    highByte(x)
bitRead(x, bitn)
bitWrite(x, bitn, bit)
bitSet(x, bitn)
bitClear(x, bitn)
bit(bitn)  // bitn: 0=LSB 7=MSB
```

Type Conversions

```
char(val)       byte(val)
int(val)        word(val)
long(val)       float(val)
```

External Interrupts

```
attachInterrupt(interrupt, func,
  {LOW|CHANGE|RISING|FALLING})
detachInterrupt(interrupt)
interrupts()
noInterrupts()
```



Libraries

Serial - *comm. with PC or via RX/TX*

```
begin(long speed)  // Up to 115200
end()
int available()  // #bytes available
int read()   // -1 if none available
int peek()   // Read w/o removing
flush()
print(data)    println(data)
write(byte)    write(char * string)
write(byte * data, size)
SerialEvent()  // Called if data rdy
```

SoftwareSerial.h - *comm. on any pin*

```
SoftwareSerial(rxPin, txPin)
begin(long speed)  // Up to 115200
listen()       // Only 1 can listen
isListening()  // at a time.
read, peek, print, println, write
  // Equivalent to Serial library
```

EEPROM.h - *access non-volatile memory*

```
byte read(addr)
write(addr, byte)
EEPROM[index]  // Access as array
```

Servo.h - *control servo motors*

```
attach(pin, [min_usec, max_usec])
write(angle)  // 0 to 180
writeMicroseconds(uS)
   // 1000-2000; 1500 is midpoint
int read()    // 0 to 180
bool attached()
detach()
```

Wire.h - *I²C communication*

```
begin()     // Join a master
begin(addr) // Join a slave @ addr
requestFrom(address, count)
beginTransmission(addr) // Step 1
send(byte)              // Step 2
send(char * string)
send(byte * data, size)
endTransmission()       // Step 3
int available() // #bytes available
byte receive()  // Get next byte
onReceive(handler)
onRequest(handler)
```


by Mark Liffiton

version: 2024-02-14

source: https://github.com/liffiton/Arduino-Cheat-Sheet/

Adapted from:
- Original: Gavin Smith
- SVG version: Frederic Dufourg
- Arduino board drawing: Fritzing.org