

# Arduino Programming Part I

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# Overview

- Discuss details, now that you had a taste
- Arduino Environment
- Basic code components
  - ❖ Two required functions: `startup()` and `loop()`
  - ❖ Variables
  - ❖ Calling built-in functions

# References

- These notes borrow from
  - ❖ Arduino web site
    - ▶ <http://arduino.cc/en/Guide/Environment>
    - ▶ <http://arduino.cc/en/Tutorial/HomePage>
  - ❖ Adafruit tutorial #1 and 2
    - ▶ <http://www.ladyada.net/learn/arduino/lesson2.html>
  - ❖ Leah Buechley's Introduction to Arduino
    - ▶ [http://web.media.mit.edu/~leah/LilyPad/03\\_arduino\\_intro.html](http://web.media.mit.edu/~leah/LilyPad/03_arduino_intro.html)

# Basic Process

## Design the circuit:

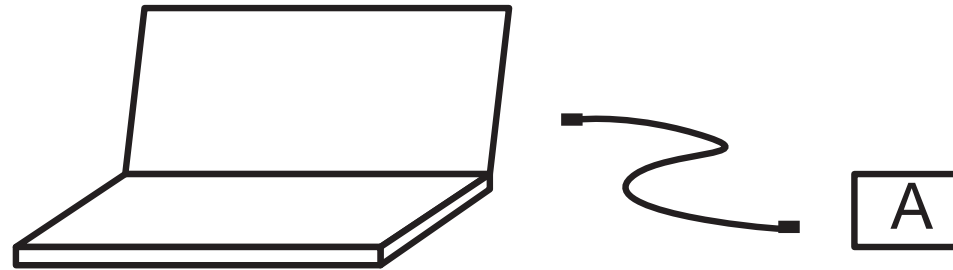
- ❖ What are electrical requirements of the sensors or actuators?
- ❖ Identify inputs (analog inputs)
- ❖ Identify digital outputs

## Write the code

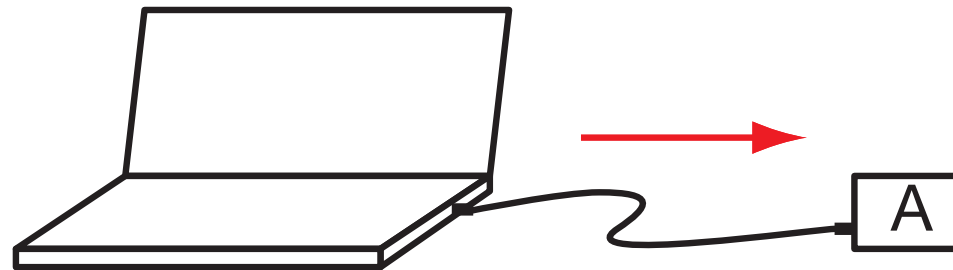
- ❖ Build incrementally
  - ▶ Get the simplest piece to work first
  - ▶ Add complexity and test at each stage
  - ▶ Save and Backup frequently
- ❖ Use variables, not constants
- ❖ Comment liberally

# Writing and Downloading Code

Write sketch on PC

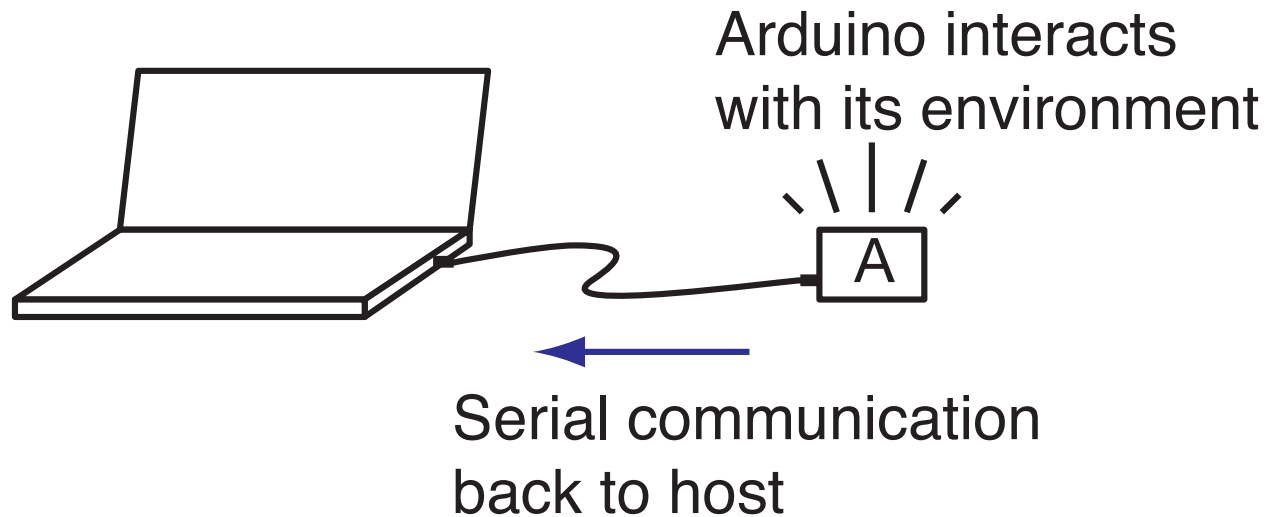


Download sketch to Arduino



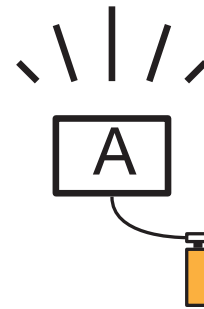
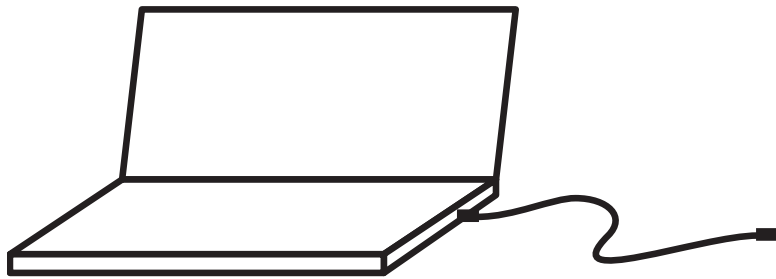
# Running Code While Tethered

Run sketch on Arduino  
and send data back to PC



# Running Code Stand-Alone

Run Arduino in stand alone mode



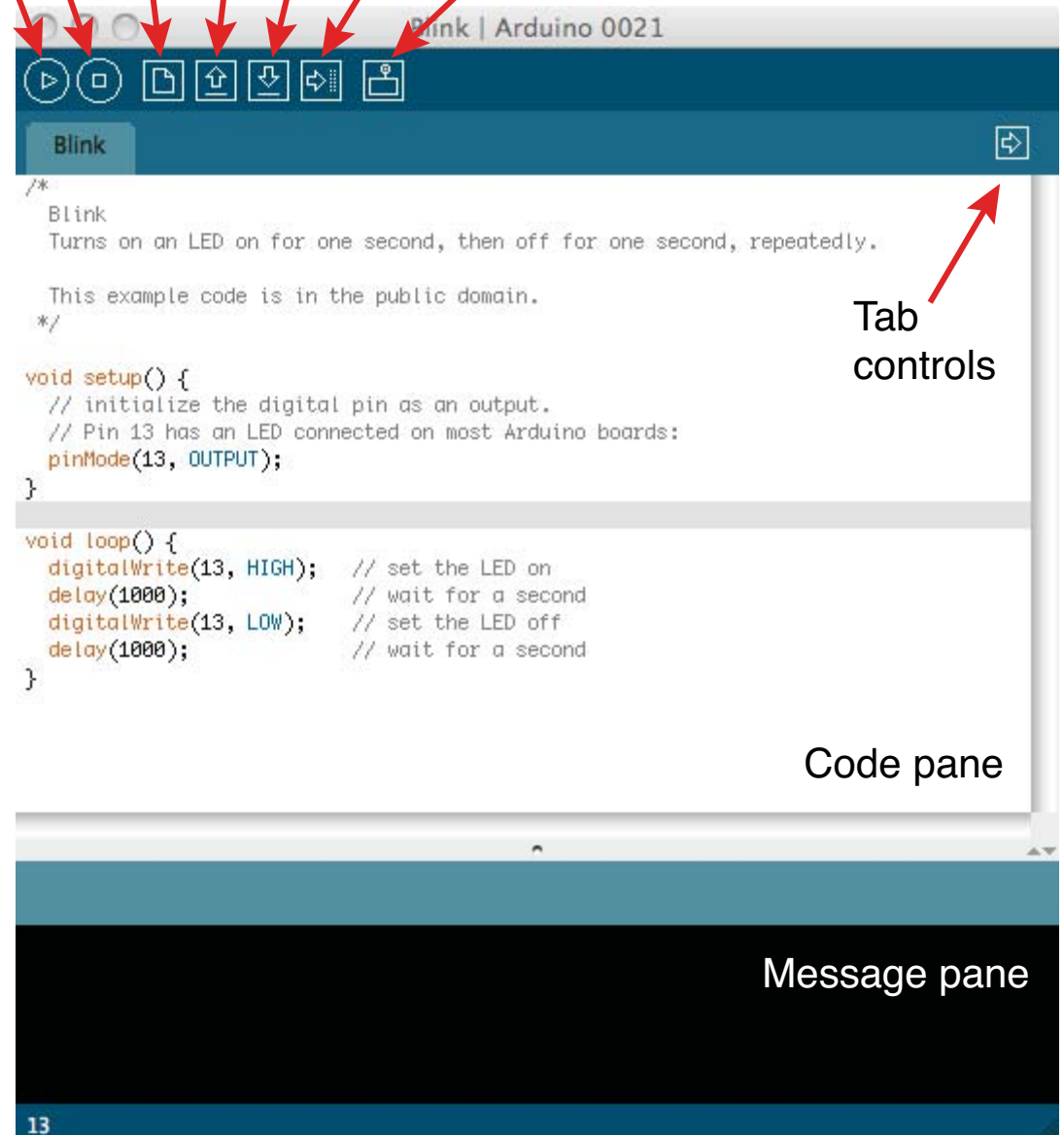
Arduino interacts with its environment and runs on battery power

# Arduino IDE

IDE =  
Integrated  
Development  
Environment

<http://www.arduino.cc/en/Guide/Environment>

Stop serial monitor  
Verify/Compile  
New sketch  
Open sketch  
Save sketch  
Upload sketch  
Open Serial monitor





# Arduino IDE

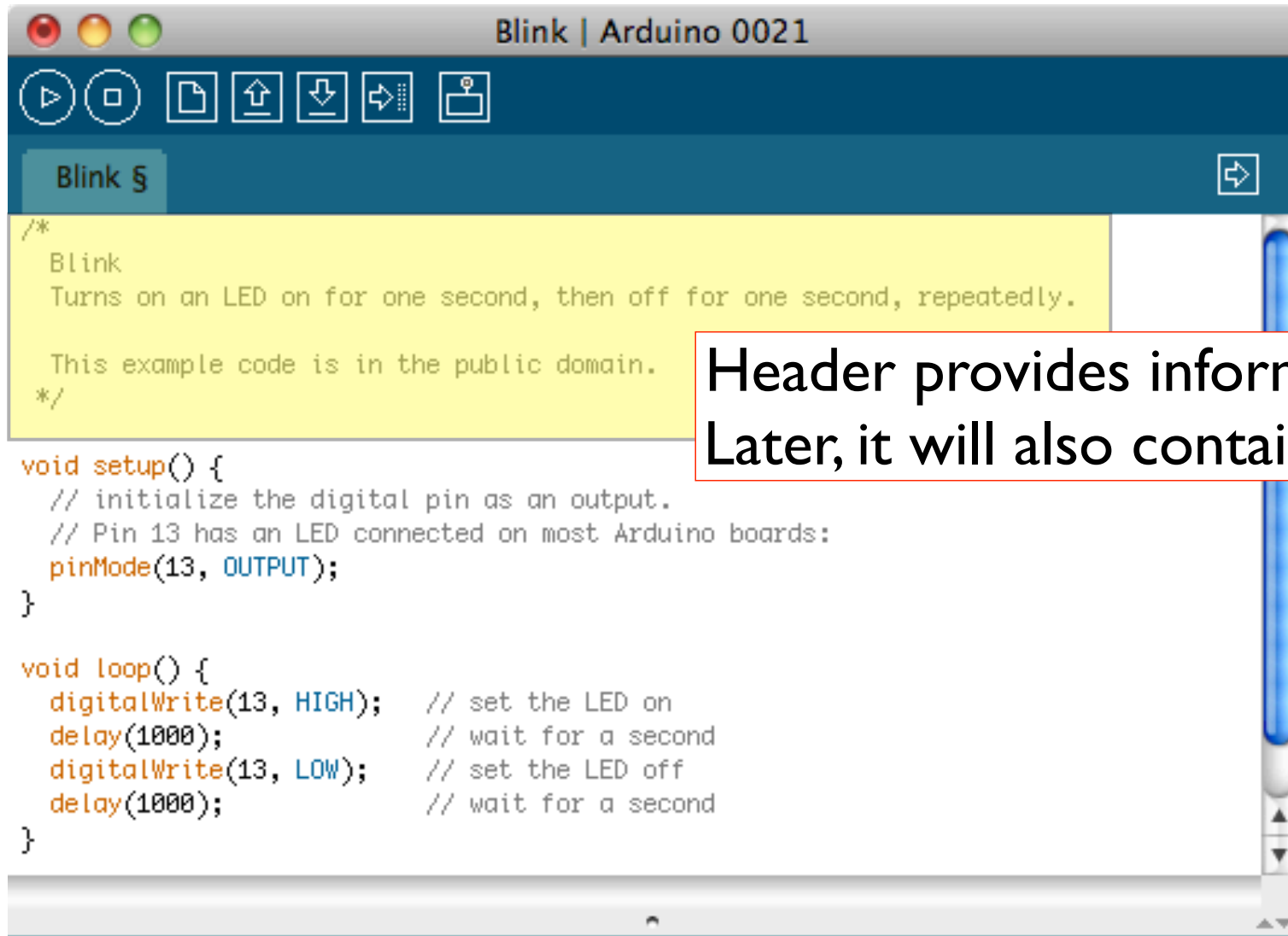


<http://www.arduino.cc/en/Guide/Environment>

# Arduino Web Site References

- Overview of the development environment
  - ❖ <http://www.arduino.cc/en/Guide/Environment>
- Language reference
  - ❖ <http://arduino.cc/en/Reference/HomePage>
- Code tutorials
  - ❖ <http://arduino.cc/en/Tutorial/HomePage>

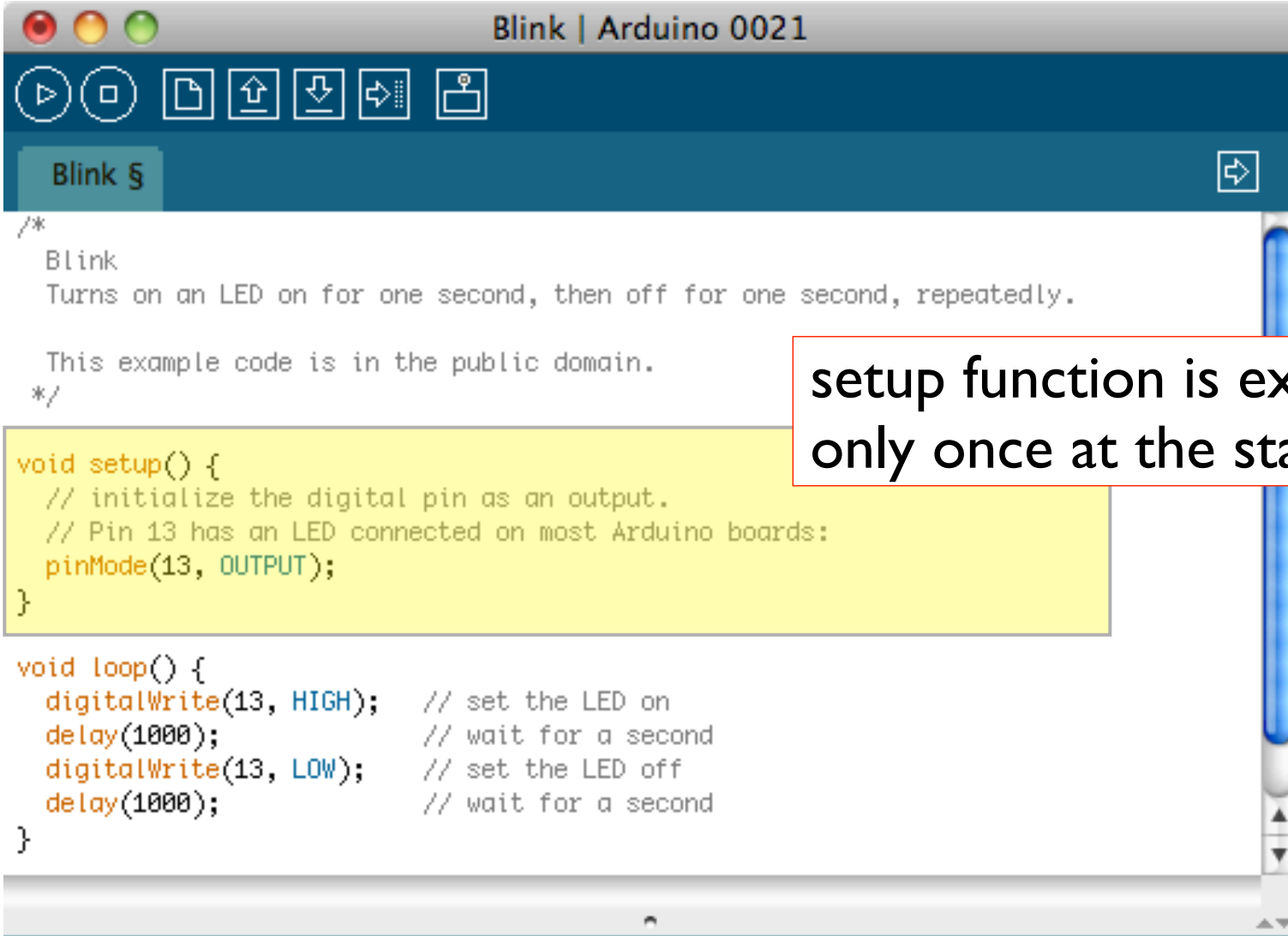
# Code Structure: Header



```
/*  
  Blink  
  Turns on an LED on for one second, then off for one second, repeatedly.  
  
  This example code is in the public domain.  
  */  
  
void setup() {  
  // initialize the digital pin as an output.  
  // Pin 13 has an LED connected on most Arduino boards:  
  pinMode(13, OUTPUT);  
}  
  
void loop() {  
  digitalWrite(13, HIGH); // set the LED on  
  delay(1000);           // wait for a second  
  digitalWrite(13, LOW); // set the LED off  
  delay(1000);           // wait for a second  
}
```

Header provides information.  
Later, it will also contain code

# Code Structure: setup function



```
Blink | Arduino 0021
Blink §
/*
  Blink
  Turns on an LED on for one second, then off for one second, repeatedly.

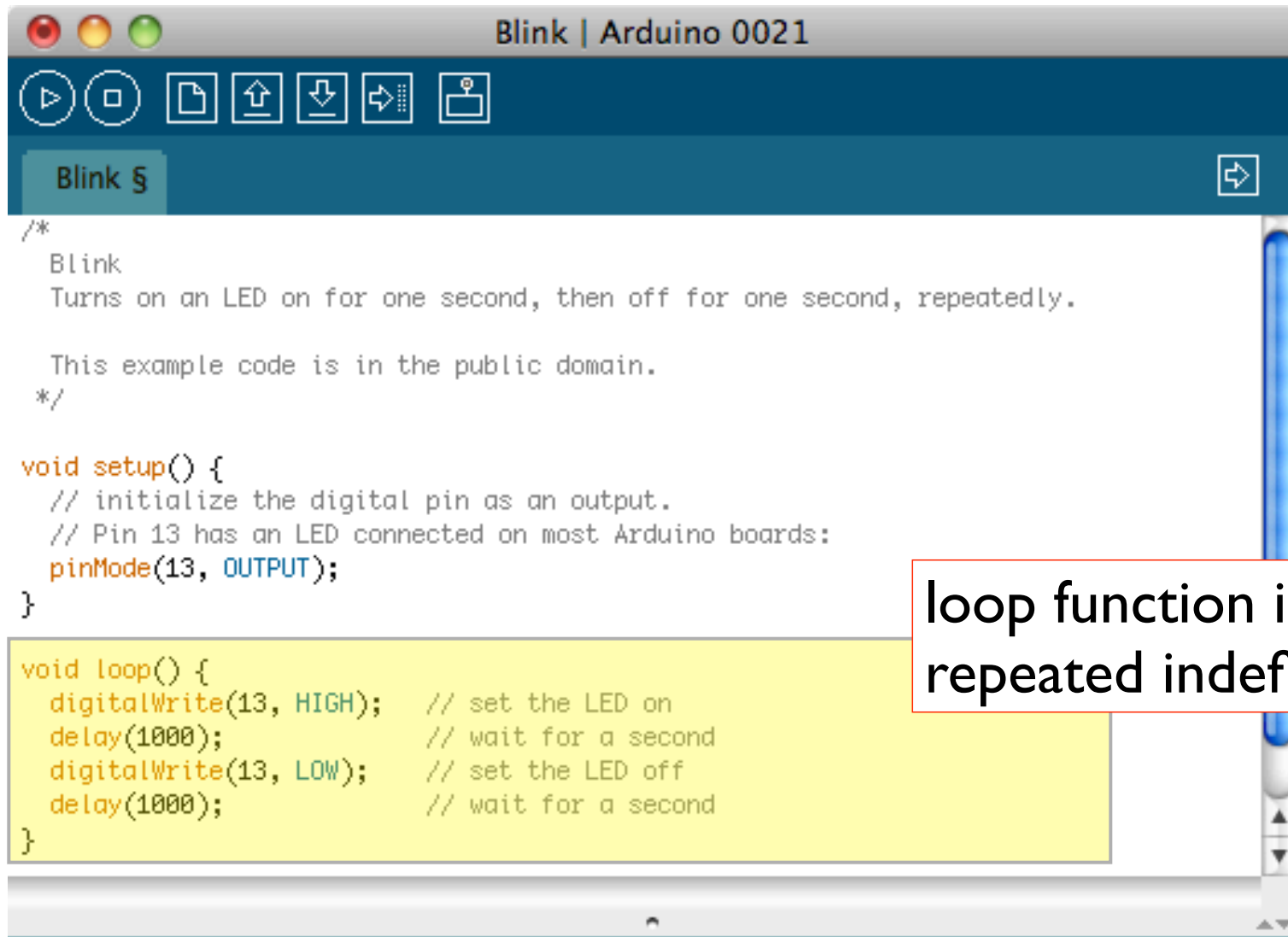
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void setup() {
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  pinMode(13, OUTPUT);
}

void loop() {
  digitalWrite(13, HIGH); // set the LED on
  delay(1000);           // wait for a second
  digitalWrite(13, LOW); // set the LED off
  delay(1000);          // wait for a second
}
```

setup function is executed only once at the start

# Code Structure: loop function



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

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  */

void setup() {
  // initialize the digital pin as an output.
  // Pin 13 has an LED connected on most Arduino boards:
  pinMode(13, OUTPUT);
}

void loop() {
  digitalWrite(13, HIGH); // set the LED on
  delay(1000);           // wait for a second
  digitalWrite(13, LOW); // set the LED off
  delay(1000);           // wait for a second
}
```

loop function is repeated indefinitely

# Code

```
Blink | Arduino 0021
Blink §
/*
  Blink
  Turns on an LED on for one second, then off for one second, then on again.

  This example code is in the public domain.
  */

void setup() {
  // initialize the digital pin as an output.
  // Pin 13 has an LED connected on most Arduino boards:
  pinMode(13, OUTPUT);
}

void loop() {
  digitalWrite(13, HIGH); // set the LED on
  delay(1000);           // wait for a second
  digitalWrite(13, LOW); // set the LED off
  delay(1000);           // wait for a second
}
```

pinMode(13, Output)  
prepare pin 13 for  
outputs of voltage

Digital I/O Functions:  
pinMode  
digitalWrite  
digitalRead

# Code

```
Blink | Arduino 0021
Blink §
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void loop() {
  digitalWrite(13, HIGH); // set the LED on
  delay(1000);           // wait for a second
  digitalWrite(13, LOW); // set the LED off
  delay(1000);          // wait for a second
}
```

`digitalWrite(13, HIGH)`  
Sets pin 13 to voltage  
that means “on”

Digital I/O Functions:  
pinMode  
digitalWrite  
digitalRead

# Code

```
Blink | Arduino 0021
Blink §
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  delay(1000);           // wait for a second
  digitalWrite(13, LOW); // set the LED off
  delay(1000);          // wait for a second
}
```

`delay(1000);`  
tells microcontroller to do nothing for 1000 ms = 1 s

Digital I/O Functions:  
pinMode  
digitalWrite  
digitalRead



# Code

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Blink §
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  pinMode(13, OUTPUT);
}

void loop() {
  digitalWrite(13, HIGH); // set the LED on
  delay(1000);           // wait for a second
  digitalWrite(13, LOW); // set the LED off
  delay(1000);          // wait for a second
}
```

`digitalWrite(13, LOW)`  
Sets pin 13 to voltage that means “off”

Digital I/O Functions:  
pinMode  
digitalWrite  
digitalRead

# Arduino Variable Types

int	Integer values: 1, 2, 3, -4, 7234
float	Values with non-zero fractional part, 7 digits
double	Currently the same as a float. Normally a double stores values with non-zero fractional part, 15 digits
char	Character values: 'a', 'b', 'D', 'I'
boolean	True or false values

# Using variables and functions

## Assigning values:

```
int red_LED_pin = 5;
```

Defines the variable name as red\_LED\_pin

Defines the variable type as an integer

```
pinMode( red_LED_pin, OUTPUT );
```

Uses the value stored in red\_LED\_pin

calls the function named "pinMode"

HIGH and OUTPUT are pre-defined constants

```
digitalWrite( red_LED_pin, HIGH );
```

calls the function named "digitalWrite"