

PRESENTATION

WHO ARE WE?

- **Markus Appelbäck**
 - Interaction Design program at Malmö University
 - Mobile networks and services
 - Mecatronics lab at K3, Malmö University
 - Developer, Arduino community
 - Music, programming, sound and image translations, interactive installations, haptics and tactile feedback...
- **Marcus Hannerstig**
 - Interaction Design program at Malmö University
 - Interactive installations
 - Mecatronics lab at K3, Malmö University
- **Marcus Ericsson**
 - Interaction Design program at Malmö University
 - Light installations
 - Snowboard
 - Mecatronics lab at K3, Malmö University
- **David Sjunnesson**
 - Interaction Design program at Malmö University
 - Light installations
 - Mecatronics lab at K3, Malmö University

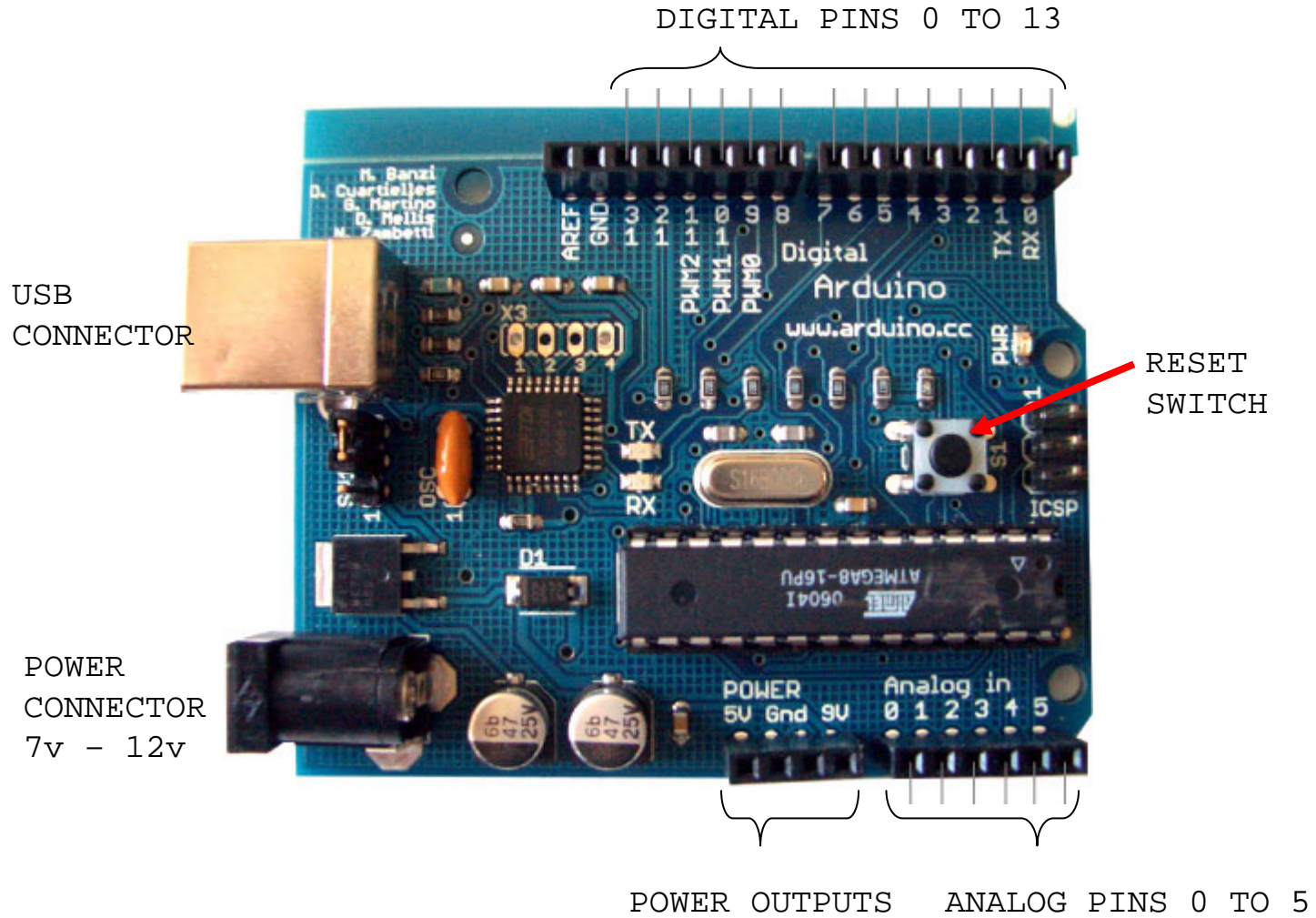
AGENDA

DAY 1

- WHAT WE DID LAST TIME...
- ANALOG INPUTS
 - BASIC ANALOG SENSORS | POTENTIOMETER
 - HANDS-ON (READ ANALOG INPUTS)
 - BASIC ANALOG SENSORS | RESISTIVE SENSORS (NTC, LDR)
 - HANDS-ON (READ ANALOG INPUTS)
 - TYPES OF RESISTIVE SENSORS
 - RANDOM NUMBERS AND THE %
 - HANDS-ON (READ ANALOG INPUTS)
- ANALOG OUTPUTS
 - PWM (PULSE WIDTH MODULATION)
 - HANDS-ON (DIMMING LEDS)
 - COMBINING THE TWO
 - HANDS-ON (READ ANALOG CONTROL LEDS)
- SERIAL COMMUNICATION
 - SENDING VALUES FROM THE ARDUINO
 - HANDS-ON (READING ANALOG SENSOR OVER SERIAL)

INTRODUCTION

BASIC ARDUINO KNOWLEDGE



ARDUINO IDE

FILE MENU
NEW, SAVE,
OPEN,
EXAMPLES...

EDIT MENU
CUT, PASTE,
FIND...

TOOLS MENU
COM-PORT
SETTINGS,
TOOLS,
SETTINGS...

```

Arduino - 0005 Alpha
File Edit Sketch Tools Help

digital_read

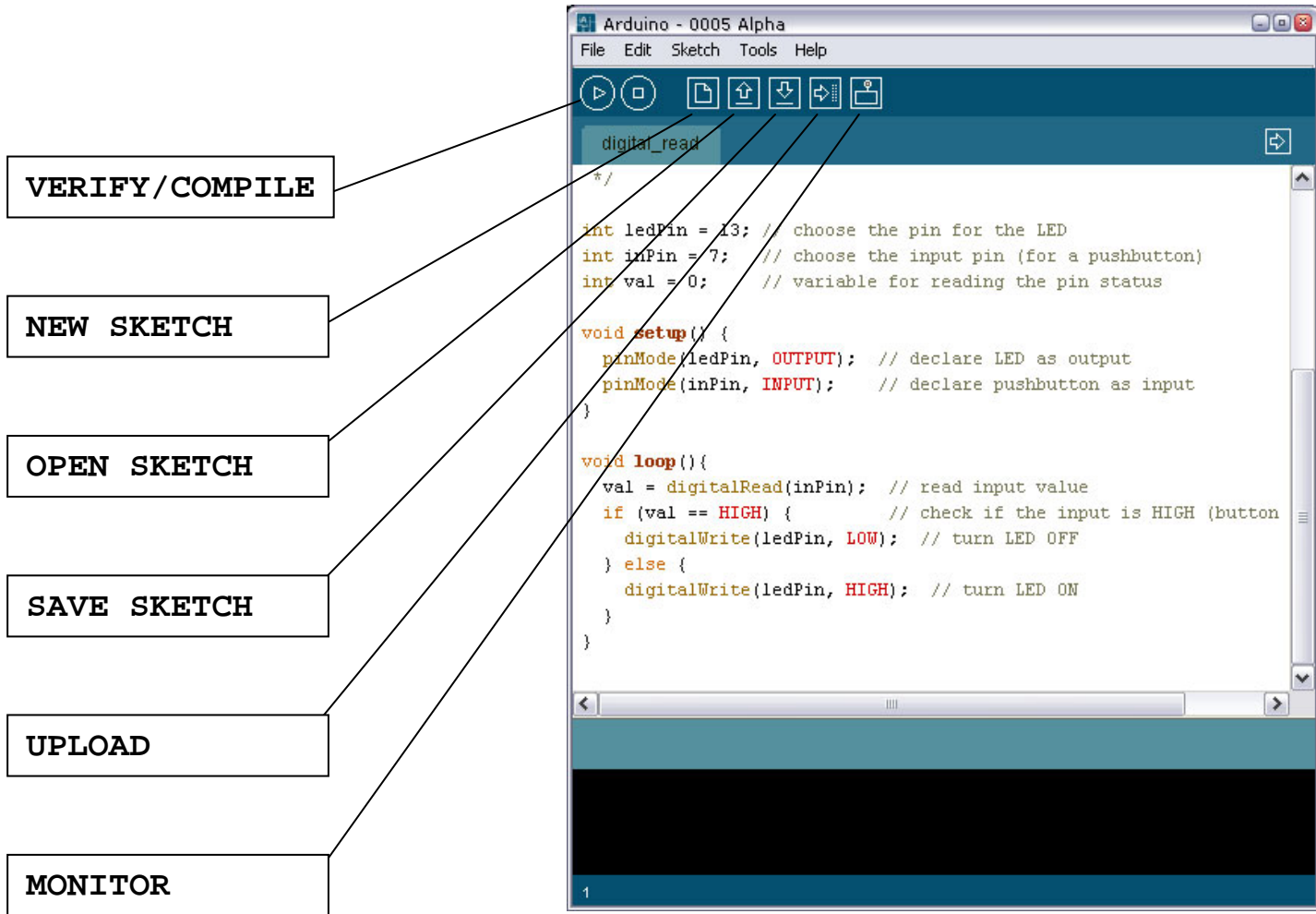
*/

int ledPin = 13; // choose the pin for the LED
int inPin = 7;   // choose the input pin (for a pushbutton)
int val = 0;    // variable for reading the pin status

void setup() {
  pinMode(ledPin, OUTPUT); // declare LED as output
  pinMode(inPin, INPUT);  // declare pushbutton as input
}

void loop(){
  val = digitalRead(inPin); // read input value
  if (val == HIGH) {        // check if the input is HIGH (button
    digitalWrite(ledPin, LOW); // turn LED OFF
  } else {
    digitalWrite(ledPin, HIGH); // turn LED ON
  }
}
  
```

ARDUINO IDE



ARDUINO IDE

PROGRAM STRUCTURE, VARIABLES

```

Arduino - 0005 Alpha
File Edit Sketch Tools Help

digital_read

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                                variabeldeklarationer

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  }
}
  
```

VARIABLES ARE NAMED CONTAINERS WHERE WE CAN STORE VALUES.

ANY NAME COULD BE GIVEN A VARIABLE (ALPHA NUMERIC CHARACTERS)

THE VALUE IN A VARIABLE CAN BE USED AND CHANGED DYNAMICALLY AS MANY TIMES AS WE LIKE

VARIABLES ARE GOOD FOR STORING VALUES THAT WE KNOW WILL BE USED MORE THAN ONCE IN OUR PROGRAM

ARDUINO IDE

PROGRAM STRUCTURE, SETUP

```

Arduino - 0005 Alpha
File Edit Sketch Tools Help

digital_read

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}
  
```

THE SETUP METHOD IS USED FOR INITIALIZING THE ARDUINO BEFORE EXECUTING THE PROGRAM

CONTAINS CALLS TO UNDERLAYING METHODS TO SET APPROPRIATE START UP OPTIONS

DEFINING IF PORTS ARE USED AS INPUTS OR OUTPUTS, IF WE ARE GOING TO USE SERIAL COMMUNICATION AND SO ON

ARDUINO IDE

PROGRAM STRUCTURE, LOOP

```

Arduino - 0005 Alpha
File Edit Sketch Tools Help

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  }
}
  
```

THE LOOP IS WHERE ALL THE ACTION IS!!

THIS IS THE PROGRAM RUNNING ON THE ARDUINO AFTER IT HAS BEEN UPLOADED.

EXECUTES FROM TOP TO BOTTOM AND THEN STARTS OVER.

PROGRAMMING

VARIABLES

- **DEFINED TYPES**
- **THE TYPE DETERMINS THE SIZE OF THE VALUE THIS VARIABLE IS ABLE TO STORE**
- **THREE BASIC VARIABLE TYPES**
 - **INT - 16 BIT, (-32768 TO 32767)**
PORT NUMBERS, VALUES READ FROM PORTS, RESULTS FROM CALCULATIONS...
 - **CHAR - 8 BIT (1 BYTE), (0 TO 256)**
CHARACTERS (A-Z), SMALL VALUES, NOT GOOD FOR CALCULATIONS, SENDING DATA OVER SERIAL...
 - **LONG - 32 BIT, (-2147483648 TO 2147483647)**
RESULTS FROM CALCULATIONS, COUNTING MILLISECONDS...
- **USE APPROPRIATE TYPE, PROGRAM SIZE LIMITED!**
- **USE NAMES THAT ARE EASY TO REMEMBER**
 - NOT myVariable, myValue, port...
 - INSTEAD firstInput, nbrOfOutputs...

PROGRAMMING

BASIC ARDUINO METHODS

- `pinMode(pin, MODE);`
 - SETS THE PORT ("*pin*") IN A SPECIFIC MODE, INPUT OR OUTPUT
 - USUALLY MADE IN THE SETUP METHOD, BUT ALLOWED IN LOOP METHOD
- `digitalWrite(pin, STATE);`
 - DIGITAL PINS HAVE TWO STATES, ON OR OFF!
WRITES A VALUE TO A DIGITAL PORT ("*pin*"). HIGH EQUALS ON, LOW EQUALS OFF.
- `delay(ms);`
 - DELAYS ANY FURTHER EXECUTION FOR A SPECIFIED NUMBER OF MILLISECONDS ("*ms*").
 - PROGRAM HALTS UNTIL SPECIFIED TIME HAVE ELAPSED.

PROGRAMMING

BASIC ARDUINO METHODS

- `pinMode(pin, MODE);`
 - SETS THE PORT ("*pin*") IN A SPECIFIC MODE, INPUT OR OUTPUT
 - USUALLY MADE IN THE SETUP METHOD, BUT ALLOWED IN LOOP METHOD
- `digitalRead(pin);`
 - RETURNS THE STATE OF THE PORT, ON OR OFF!
RETURNS A VALUE REPRESENTING THE STATE (HIGH OR LOW).
- `if(condition) { }`
 - THIS STATEMENT EVALUATES THE "*condition*". THE CONDITION IS EITHER TRUE OR FALSE. IF ITS TRUE THE CODE WITHIN THE CURLY BRACES IS EXECUTED.
- `else { }`
 - CORRESPONDS TO AN IF-STATEMENT. IF PRECEDING IF-STATEMENT IS FALSE THE ELSE-STATEMENT WILL BE EXECUTED.

PROGRAMMING

ARRAYS

- COLLECTION OF VARIABLES
- ONE NAME
 - `int outPin1 = 2;`
 - `int outPin2 = 3;`
 - ...
 - `int outPins[6] = {2,3,4,5,6,7};`
- INDEX TO RETREIVE ONE SPECIFIC
 - `outPins[index];`
- ANY TYPE
 - `int, byte, long..`

PROGRAMMING

LOOPS

- `for(counter=0; counter<end; counter++) { }`

The diagram shows the code `for(counter=0; counter<end; counter++) { }` with three curly braces underneath. The first brace is under `counter=0;` and is labeled "Counter initialization". The second brace is under `counter<end;` and is labeled "condition". The third brace is under `counter++` and is labeled "Counter increment" and "decrement".

- IF CONDITION IS TRUE EXECUTE CODE ELSE END LOOP
- AT THE END CHECKS CONDITION AGAIN
- IF CONDITION IS TRUE EXECUTE CODE ELSE END LOOP
- AT THE END...

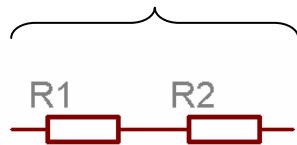
ELECTRONICS

CURRENT, VOLTAGE AND RESISTORS

- **CURRENT: THE NUMBER OF ELECTRONS**
- **VOLTAGE: THE PREASURE**
- **RESISTOR: RESTRICTING THE NUMBER OF ELECTRONS**

SERIES CIRCUIT

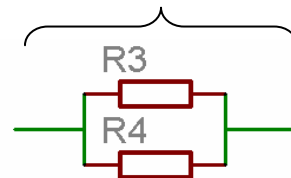
$$R_{tot} = R1 + R2$$



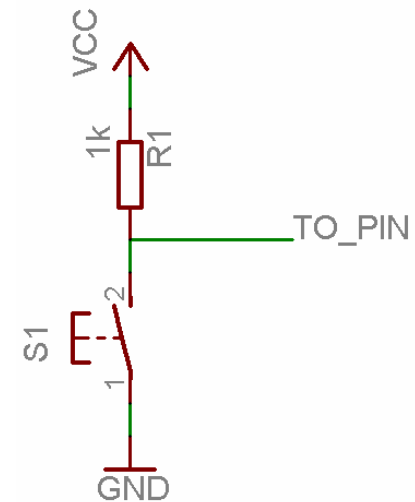
PARALLEL CIRCUIT

$$2 \text{ st} - R_{tot} = (R3 * R4) / (R3 + R4)$$

$$3 \text{ el fl.} - R_{tot} = 1 / (1/R1 + 1/R2 + 1/R3 \dots)$$



- **ELECTRONS TAKE THE EASIEST WAY!**
 - HAVE TO CHOOSE BETWEEN RESISTOR AND WIRE, IT CHOOSES WIRE...



ELECTRONICS

THE LED

- "LIGHT EMITTING DIODE"
- EMITTING LIGHT WHEN CURRENT GOING THROUGH
- HAVE TO BE PLACED THE RIGHT WAY (+ AND -)



SHORT LEG TO GROUND



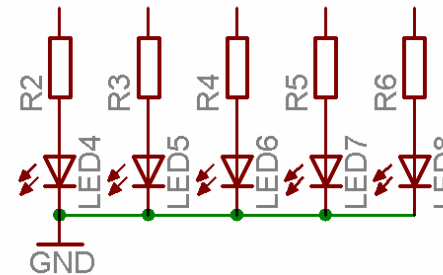
POLARIZED
SHORT LEG
TO GROUND



NOT
WORKING!



LIMIT
CURRENT!

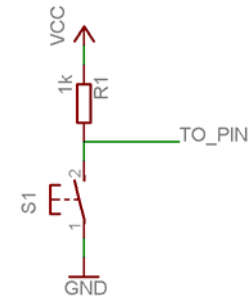
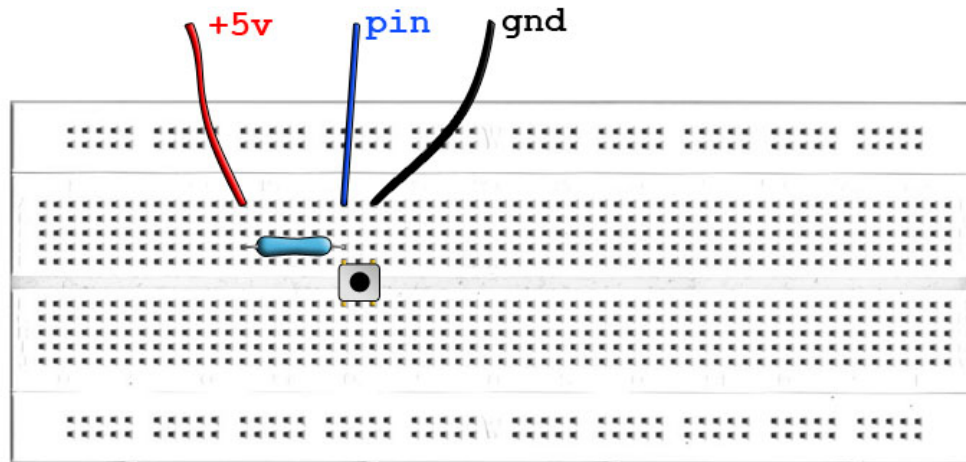


MULTIPLE LEDs,
COMMON GROUND

PRACTICAL EXAMPLE

BUTTONS

- CONNECT THE PUSHBUTTON USING A BREADBOARD:

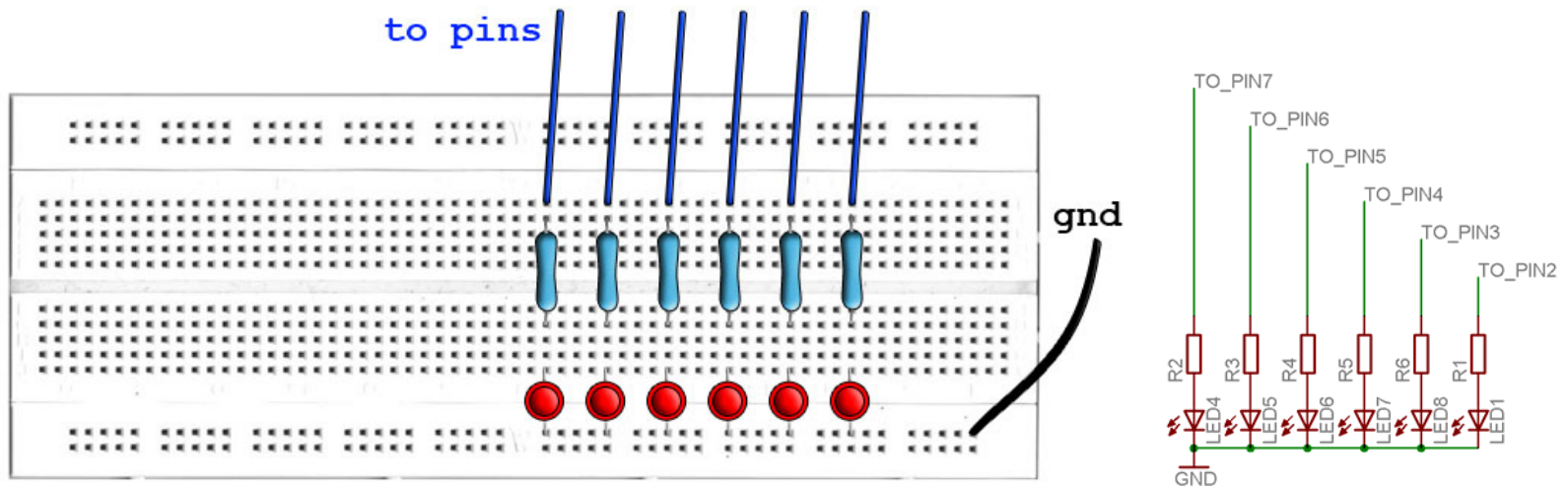


- OPEN THE "digital_read" EXAMPLE IN SKETCHBOOK - EXAMPLES
- COMPILE & UPLOAD

PRACTICAL EXAMPLE

KNIGHT RIDER

- CONNECT LEDS USING BREADBOARD

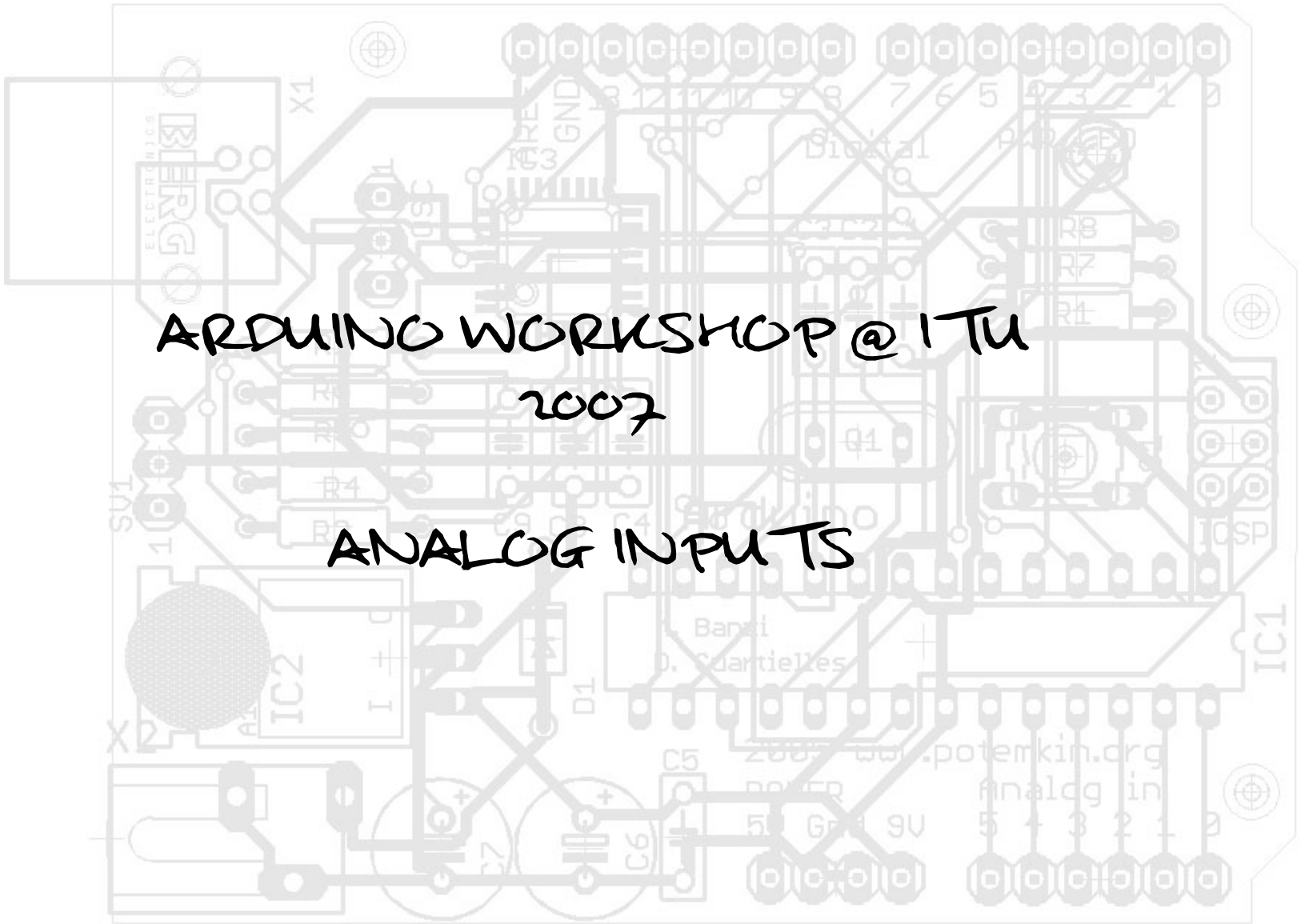


- "knight_rider1" FROM EXAMPLES
- "knight_rider2" FROM EXAMPLES

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2007

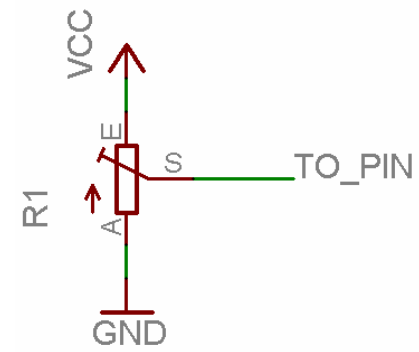
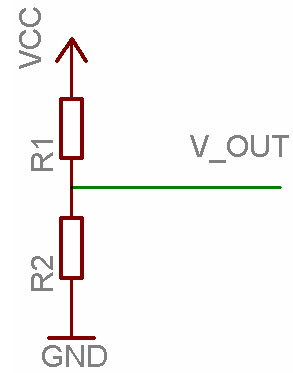
ANALOG INPUTS



ELECTRONICS

POTENTIOMETER

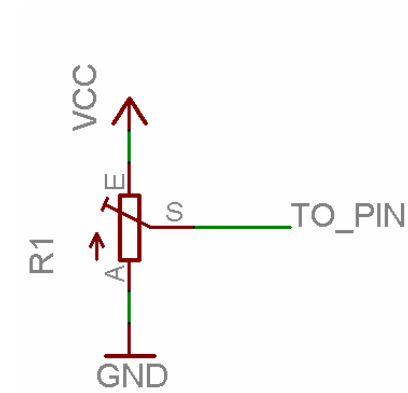
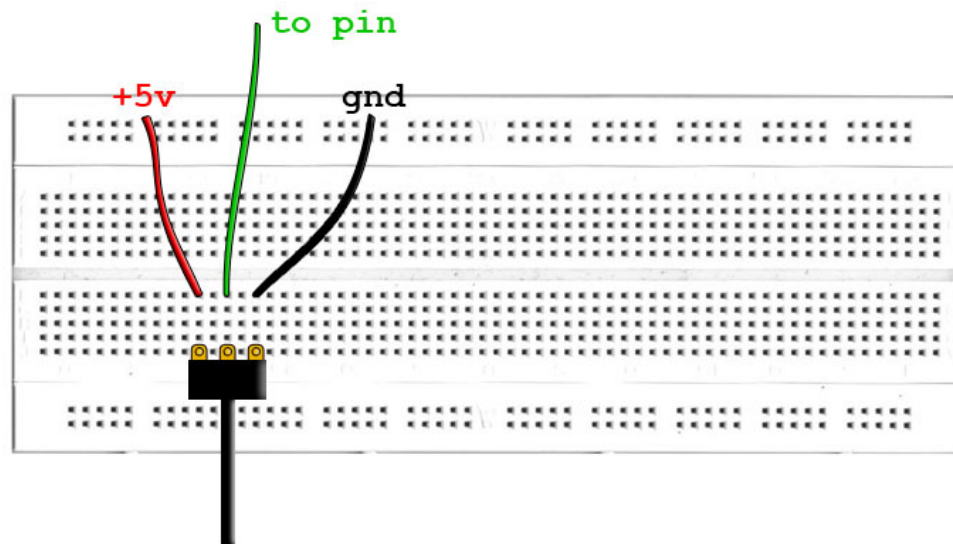
- VARIABLE RESISTANS
- VOLTAGE DIVIDER



PRACTICAL EXAMPLE

ANALOG SENSOR

- CONNECT POTENTIOMETER USING BREADBOARD



- OPEN `"sensors_resistive/analog_read_led"` FROM EXAMPLES
- CHANGE VALUE TO DELAY UP TO 10 SECONDS...

PROGRAMMING

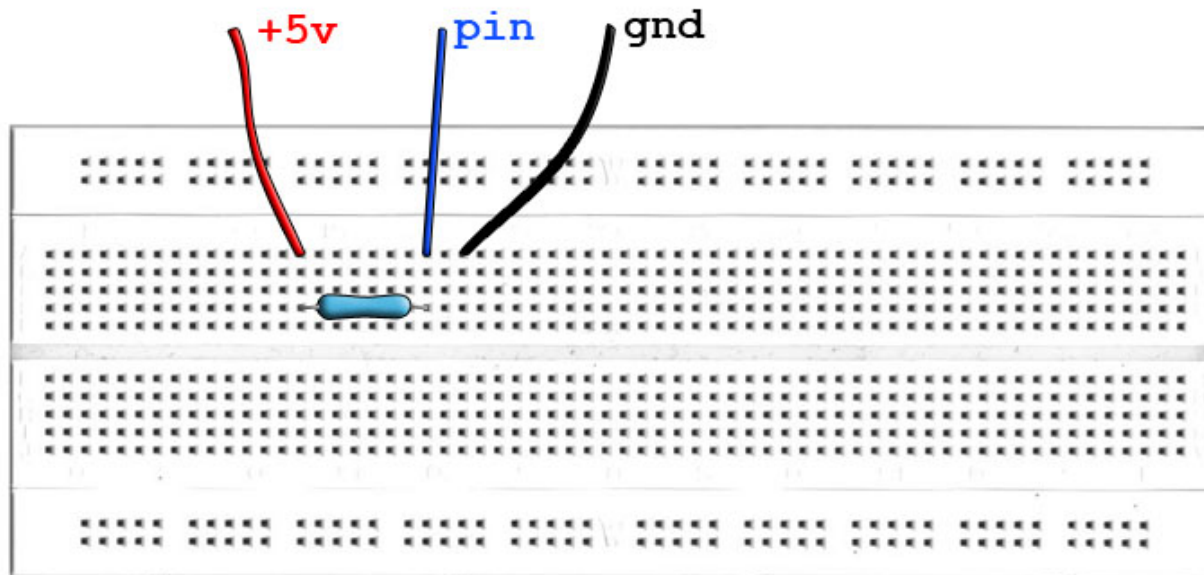
BASIC ARDUINO METHODS

- `analogRead(pin);`
 - RETURNS THE VALUE READ AT SPEPCIFIED ANALOG PORT
 - VALUES BETWEEN 0 AND 1023
 - 0v = 0
 - 5v = 1023
- BASIC CALCULATIONS
 - + - * /

HANDS-ON

NTC

- CONNECT USING BREADBOARD
- PIN = ONE OF THE ANALOG PINS



- CHOOSE RESISTOR ACCORDING TO SENSOR RESISTANCE
- USE DIGITAL OUTS (LEDS) TO SHOW RESULT

ANALOGUE SENSORS

EXAMPLES

- POTENTIOMETER
- LDR (LIGHT DEPENDENT RESISTOR)
- NTC

- PIEZO SPEAKER

- COMPLEX SENSORS...

ANALOGUE OUTPUT

PWM

- PWM (PULSE WIDTH MODULATION)
- SPECIFIC DIGITAL PINS



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SERIAL COMMUNICATION

SERIAL COMMUNICATION

SENDING DATA

FIN