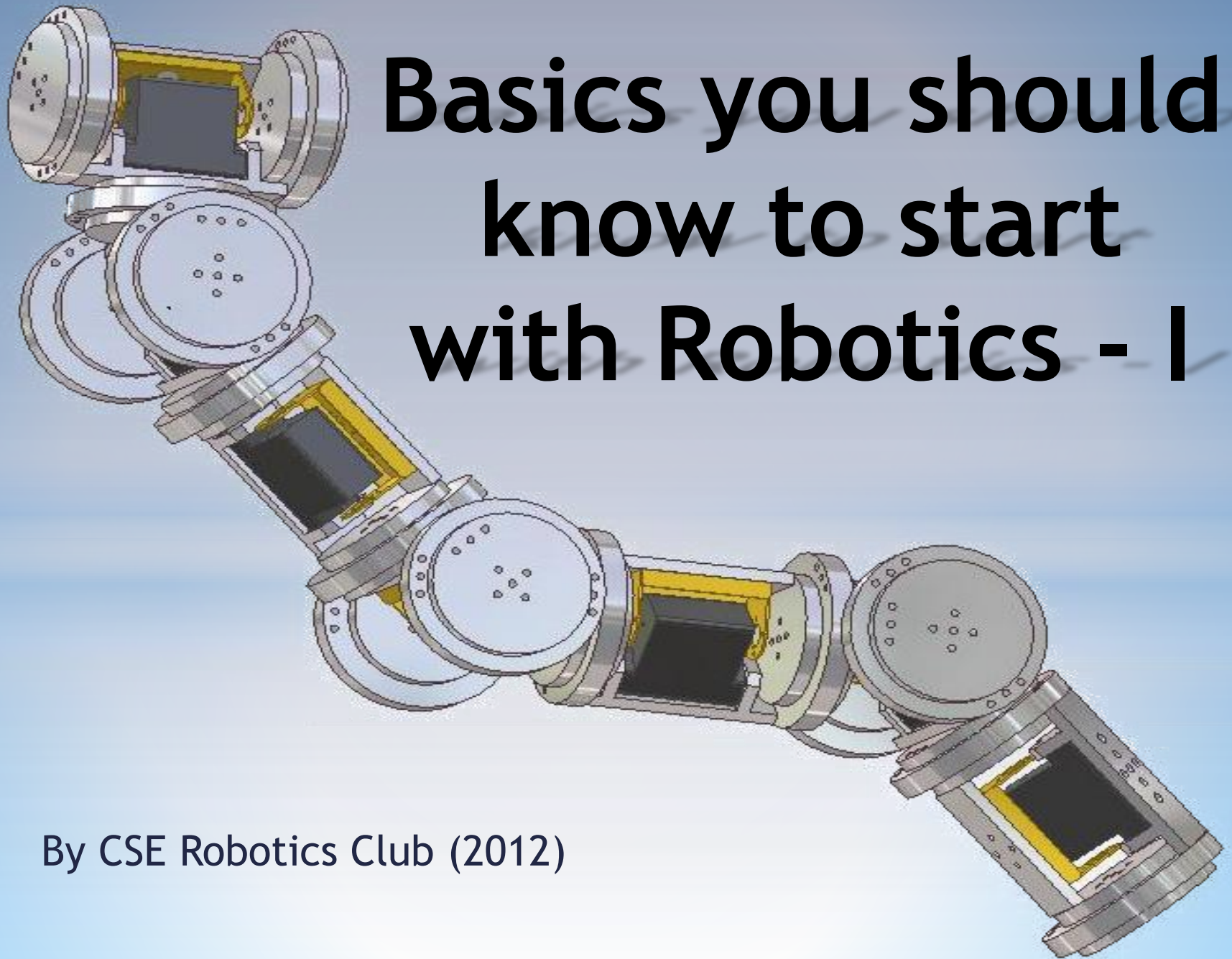


Basics you should know to start with Robotics - I



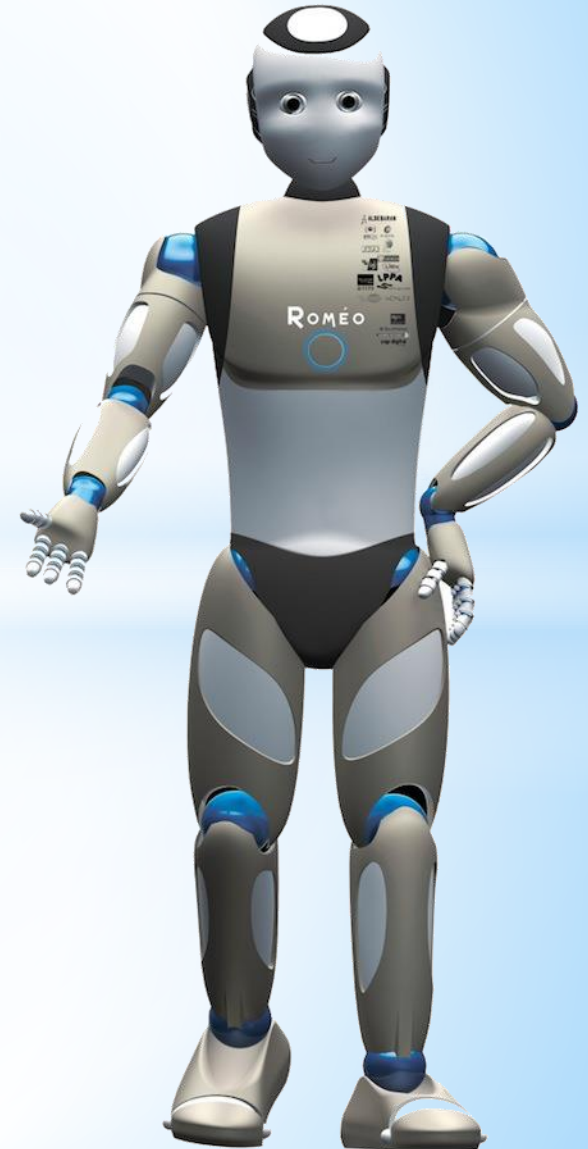
By CSE Robotics Club (2012)

Robotics...

Robots are intelligent machines which can take the place of humans.

This field overlaps many fields like,

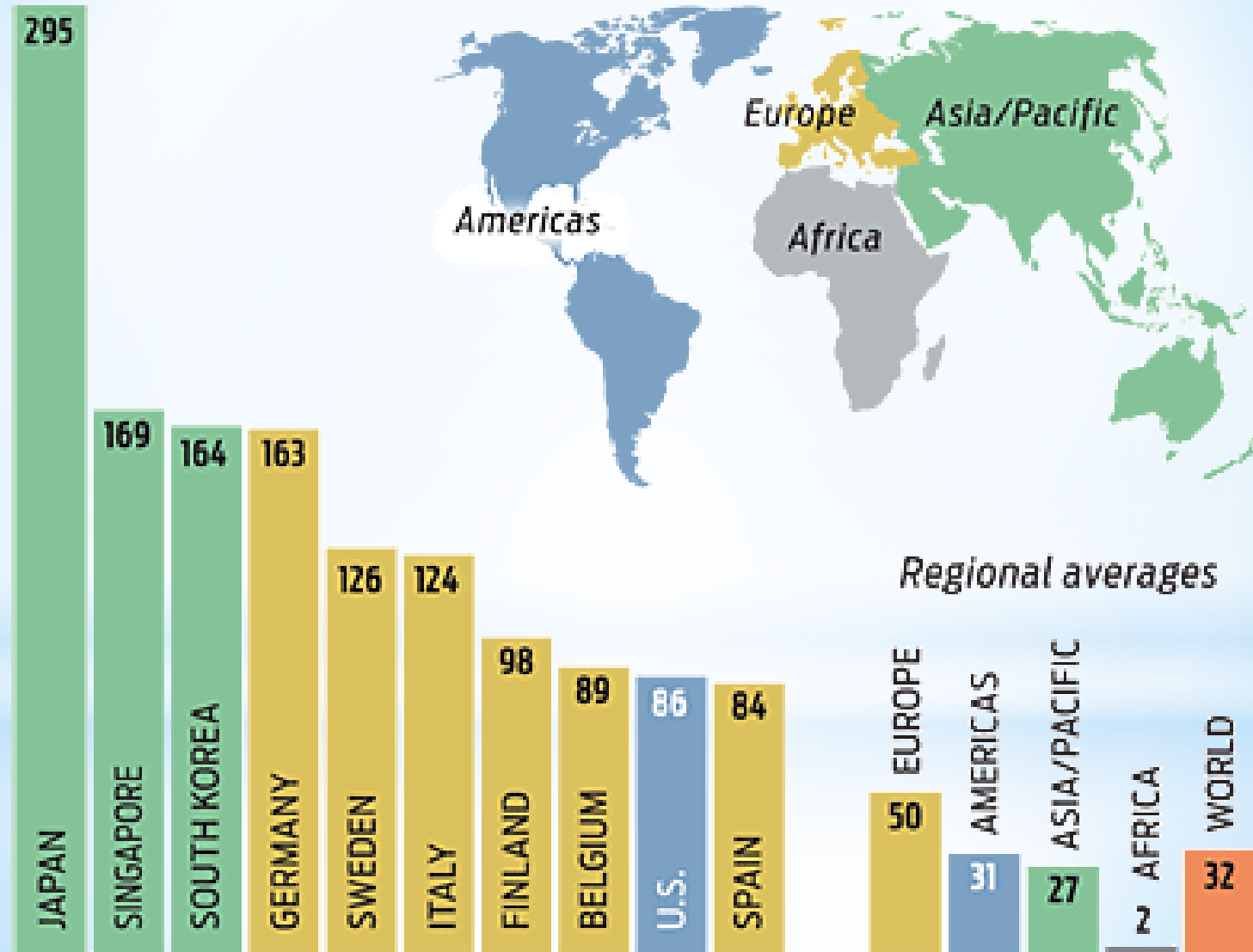
- Electronics
- Computer science
- Mechanics
- Artificial intelligence





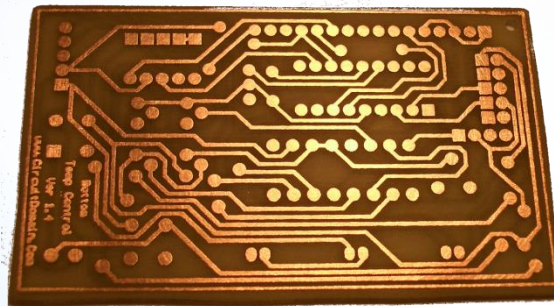
TOP 10 COUNTRIES BY ROBOT DENSITY

(Industrial robots per 10 000 manufacturing workers)



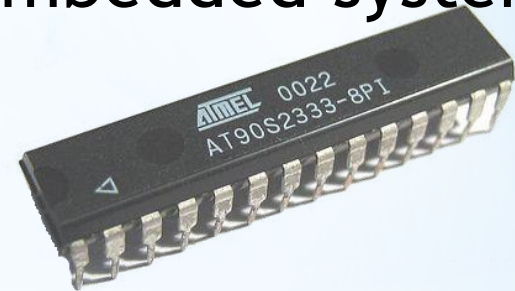
We will focus on...

- About Programmable devices
- How to program a microcontroller
- Use of software to design and simulate
- Sensors to get details from the environment
- Handling movements
- Prepare a PCB (Printed Circuit Board)



Microcontrollers

Programmable devices, used in embedded systems



PIC - **P**eripheral **I**nterface **C**ontroller

Microcontrollers manufactured by Microchip

AVR - Microcontrollers developed by **Atmel Corp**

AVR - not an acronym

Alf and Vegard's **Risc** processor.

(Be concerned about allowed voltages and currents)

Features of a microcontroller

A small computer on a single integrated circuit containing ...

- **processor core**
Registers
- **memory**
RAM, ROM, EPROM, EEPROM,
Flash EEPROM
- **programmable input and output peripherals**
Ports
etc.

TRIS REGISTER

- Control pins associated with it
- A separate tris for each port
- Mention whether the pin gives output or receive an input (1=input & 0=output)

Eg:

In port C: pin 0-inputs others-outputs

```
SET_TRIS_C(0b00000001)
```


Port Register

- Give output or check pins
- A separate register for each port

If a pin is selected to give outputs

1 = give out 5V

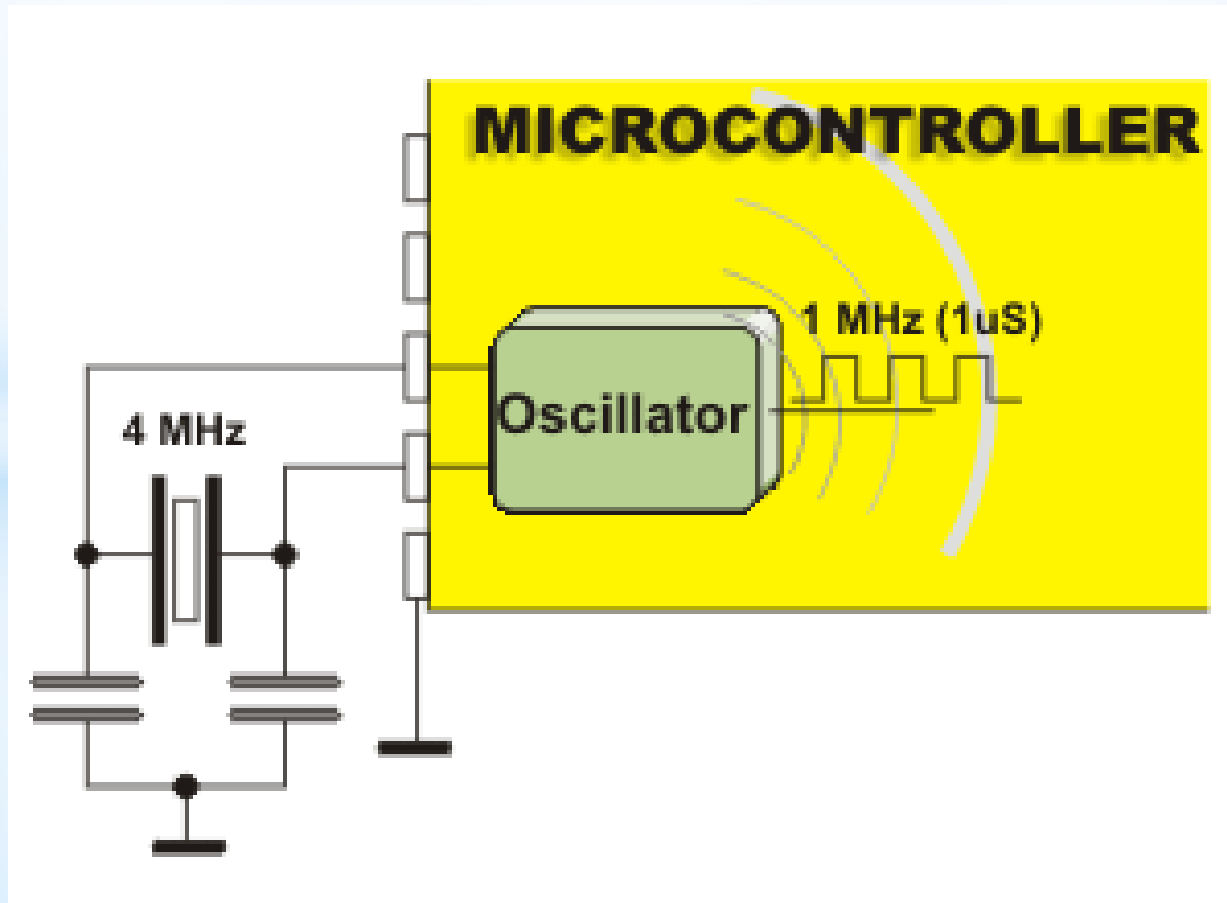
0 = give out 0V

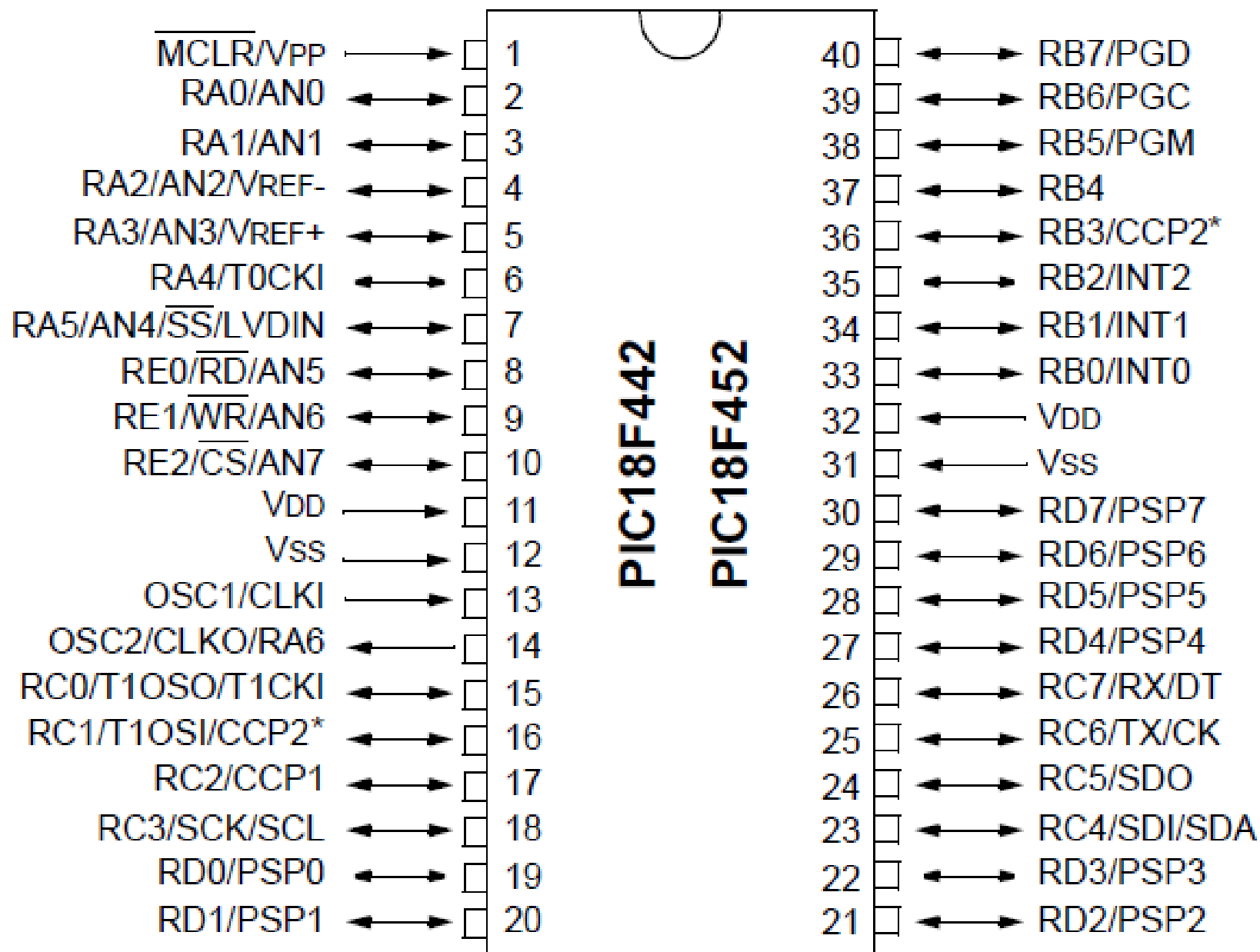
If a pin is selected to receive inputs

1 = pin received 5V

0 = pin received 0V

Keep track of time





Circuit Designing and Simulation

➤ Traditional method

design → build circuit → test and repeat the process

➤ Building the circuit takes time, and cost

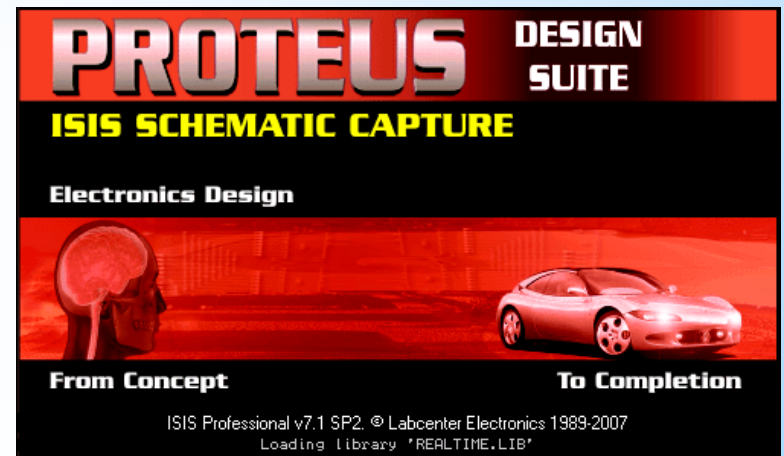
➤ Simulation software helps to test without building

Proteus Design Suite

Consists of a set of tools

- Schematic design tool
- Circuit simulator
- PCB layout tools
- And many advanced tools

we will discuss today



Let's Start Designing...

➤ Interface

➤ Selecting components

➤ Placing components

➤ Using generators

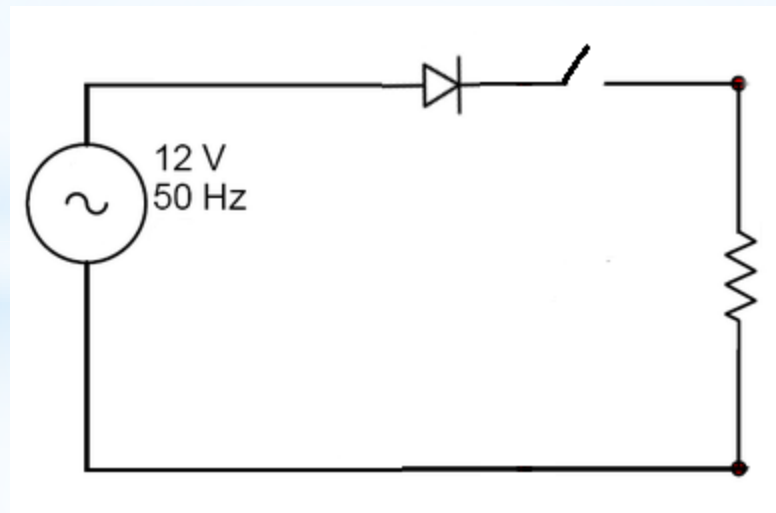
➤ Using instruments

➤ Using probes

➤ Using terminals

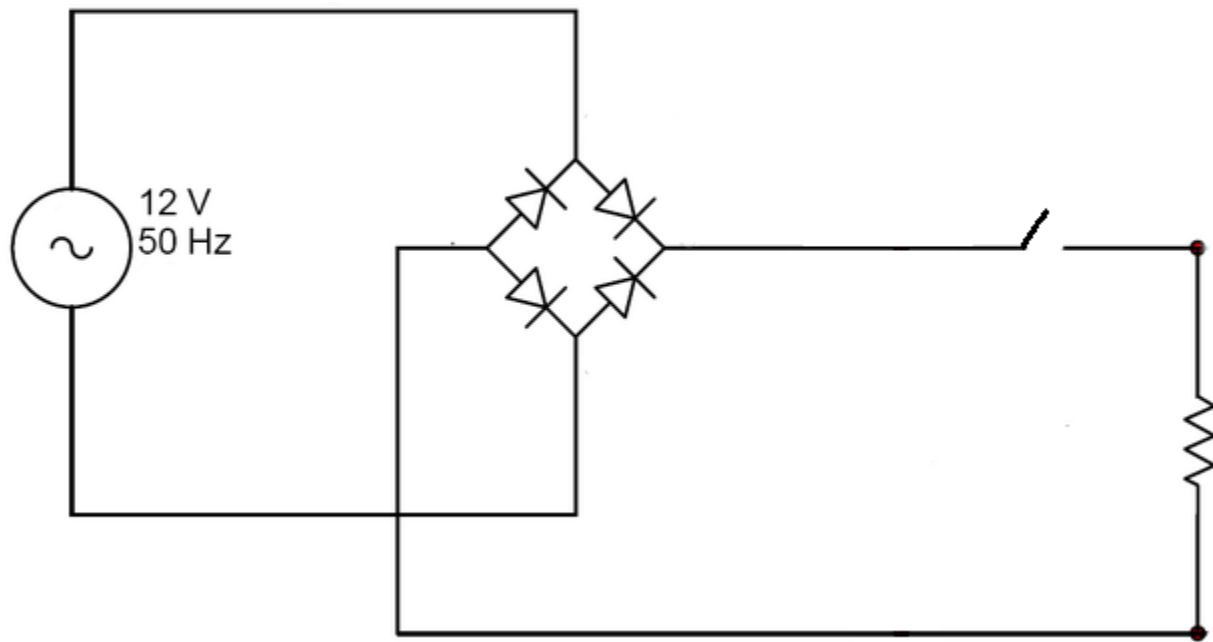
Now your chance...

Design a half-wave rectifier



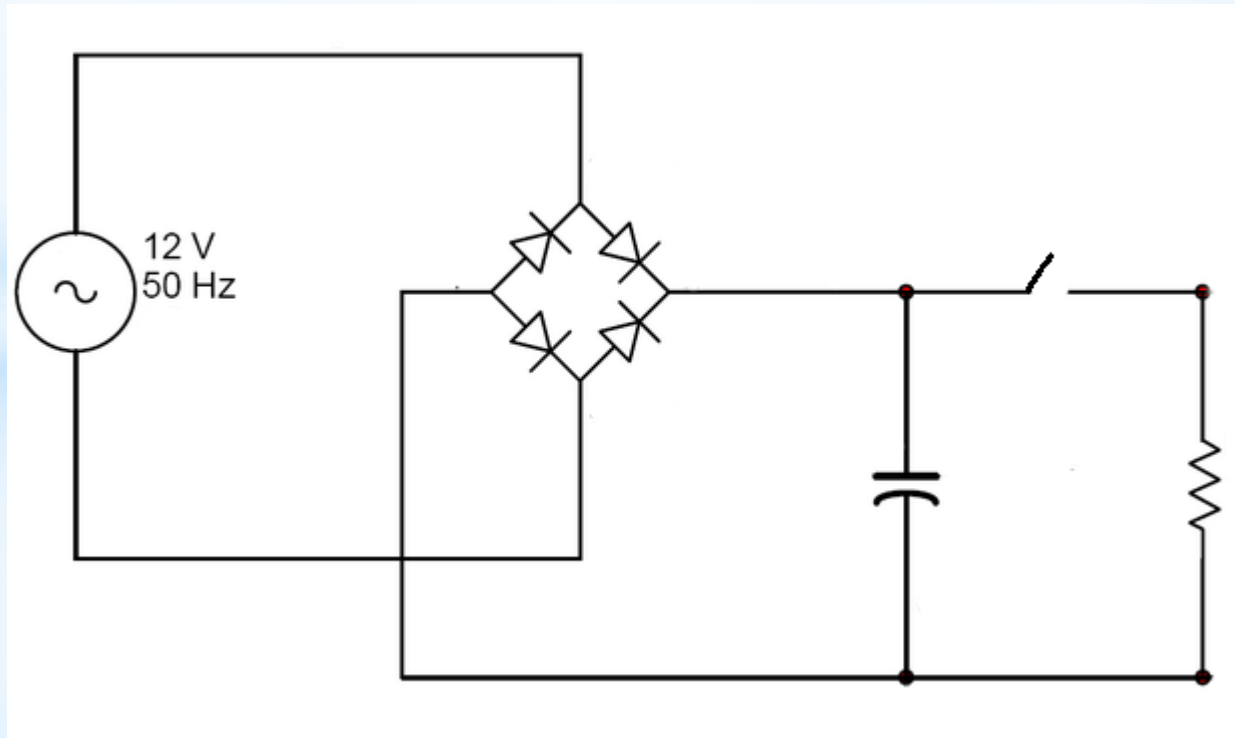
Now your chance...

Make it a full-wave rectifier



Now your chance...

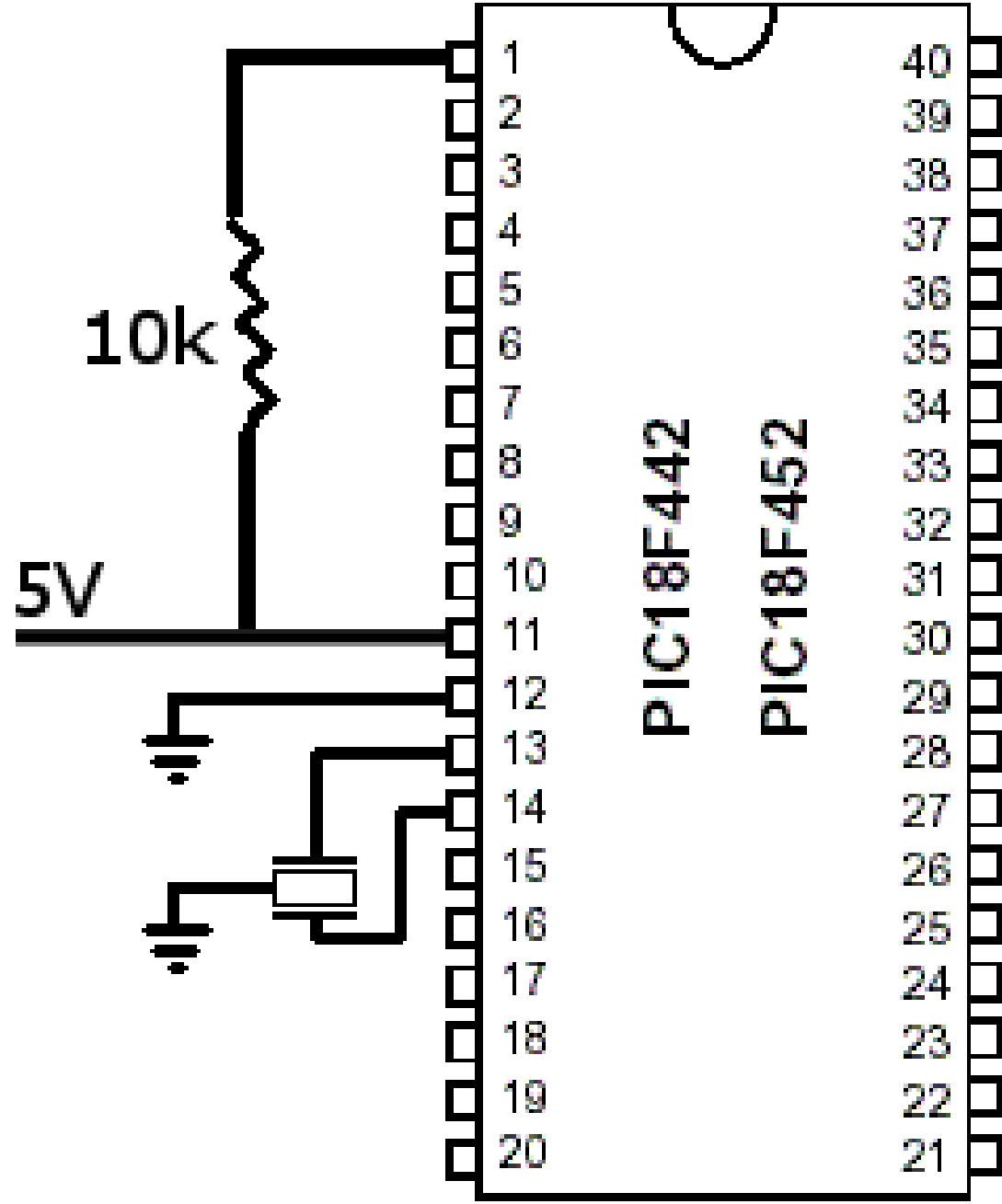
Add a capacitor



Get a PIC Up and Running

Need to check the following

- Power pin (V_{dd}/V_{cc}) should be connected to 5V (or 3.6V in some cases)
- Ground pin (V_{ss}/V_{ee}) should be connected to the ground.
- A crystal oscillator should be connected to CLK0 and CLK1 pins and both should be grounded using capacitors (or use a resonator).
- \overline{MCLR} pin should be high.



PLC programming

Software : CCS C , MPLab, MikroC, etc.



Data types in CCS C

- **int1** Defines a 1 bit number
- **int8** Defines an 8 bit number
- **int16** Defines a 16 bit number
- **int32** Defines a 32 bit number
- **char** Defines a 8 bit character
- **float** Defines a 32 bit floating point number
- **short** By default the same as int1
- **Int** By default the same as int8
- **long** By default the same as int16
- **void** Indicates no specific type



Operators

+	Addition Operator
+=	Addition assignment operator, $x+=y$, is the same as $x=x+y$
&=	Bitwise and assignment operator, $x\&y$, is the same as $x=x\&y$
&	Address operator
&	Bitwise and operator
^=	Bitwise exclusive or assignment operator, x^y , is the same as $x=x^y$
^	Bitwise exclusive or operator
=	Bitwise inclusive or assignment operator, $x y$, is the same as $x=x y$
	Bitwise inclusive or operator
?:	Conditional Expression operator
--	Decrement
/=	Division assignment operator, $x/=y$, is the same as $x=x/y$
/	Division operator
==	Equality
>	Greater than operator
>=	Greater than or equal to operator
++	Increment
*	Indirection operator
!=	Inequality
<<=	Left shift assignment operator, $x<<y$, is the same as $x=x<<y$
<	Less than operator
<<	Left Shift operator
<=	Less than or equal to operator
&&	Logical AND operator
!	Logical negation operator
	Logical OR operator
%=	Modules assignment operator $x\%=y$, is the same as $x=x\%y$
%	Modules operator
=	Multiplication assignment operator, $x=y$, is the same as $x=x*y$
*	Multiplication operator
~	One's complement operator
>>=	Right shift assignment, $x>>y$, is the same as $x=x>>y$
>>	Right shift operator
->	Structure Pointer operation
-=	Subtraction assignment operator
-	Subtraction operator
sizeof	Determines size in bytes of operand

Syntax

Setting TRIS registers :

```
SET_TRIS_A(2);
```

```
SET_TRIS_A( 0x02 );
```

```
SET_TRIS_A(0b00000010)
```

Give outputs:

```
OUTPUT_HIGH(PIN_A1); //for only one pin
```

```
OUTPUT_A(5); // for port at once
```

Cancel outputs:

```
OUTPUT_LOW(PIN_A1) ); //for only one pin
```

```
OUTPUT_A(0); // for port at once
```

Syntax

Check input:

```
INPUT(PIN_B2); //return 1 if high else return 0  
INPUT_A(); //return the 8 bit int representing  
port input data
```

Eg: `If(INPUT(PIN_B2)==0){ //do something}`

Delays:

```
Delay_ms(100); //delay for 100 milliseconds  
Delay_us(100); //delay for 100 microseconds
```


Let's do an example

Example : Blinking LED

Use PIC wizard to create a project

- Select a PIC
- Set Oscillator and clock speed
- Define Input & output pins
- etc... (Interrupts, Timers, Other)



Programming and Simulation

➤ Proteus

➤ Pic 18 Simulator

➤ PicKit 2

