

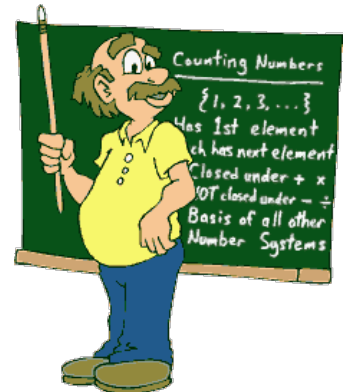


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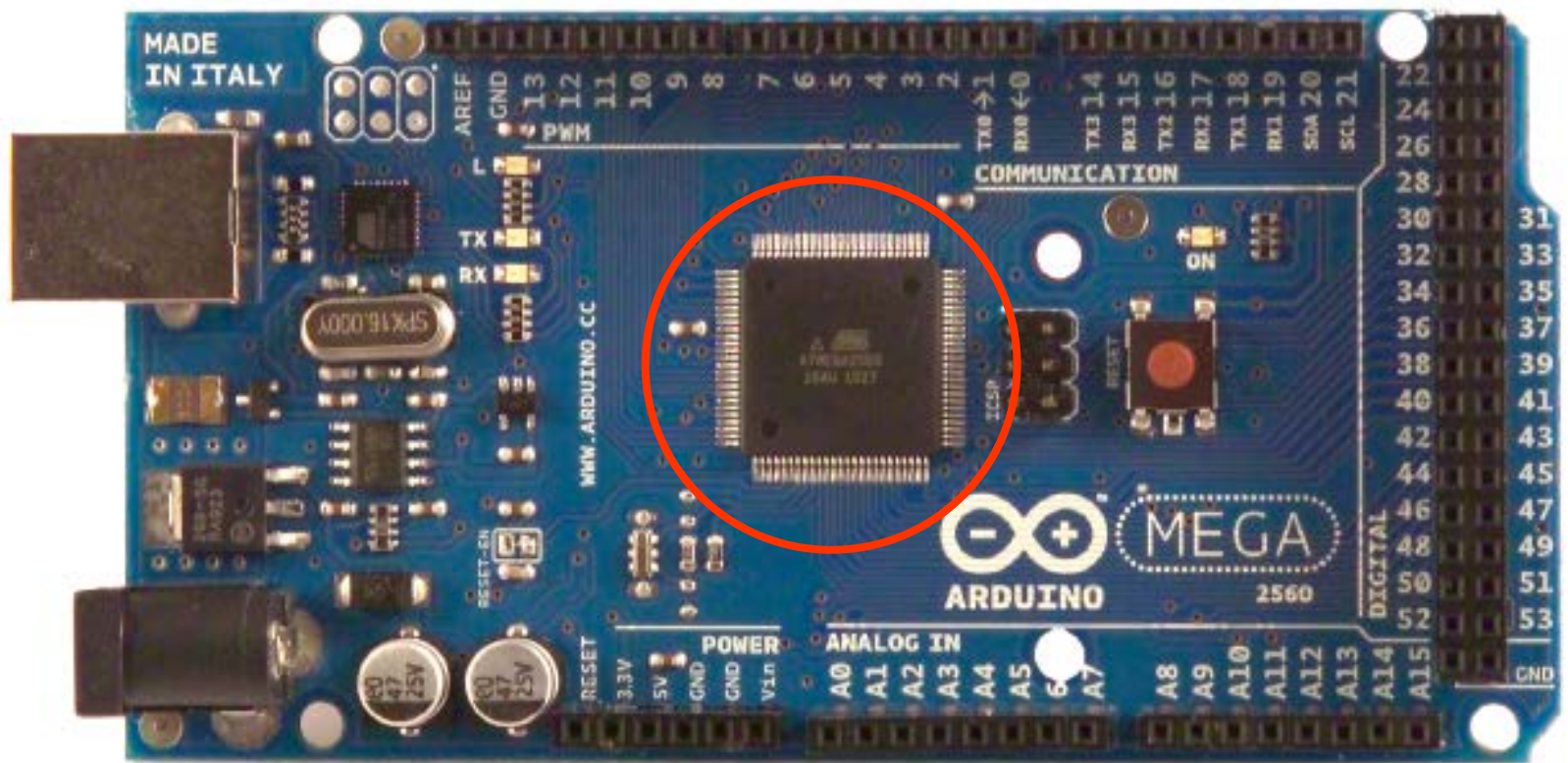
# MSYS

## Microcontroller Systems

### Lektion 3: Arduino Mega2560 og Atmel Studio



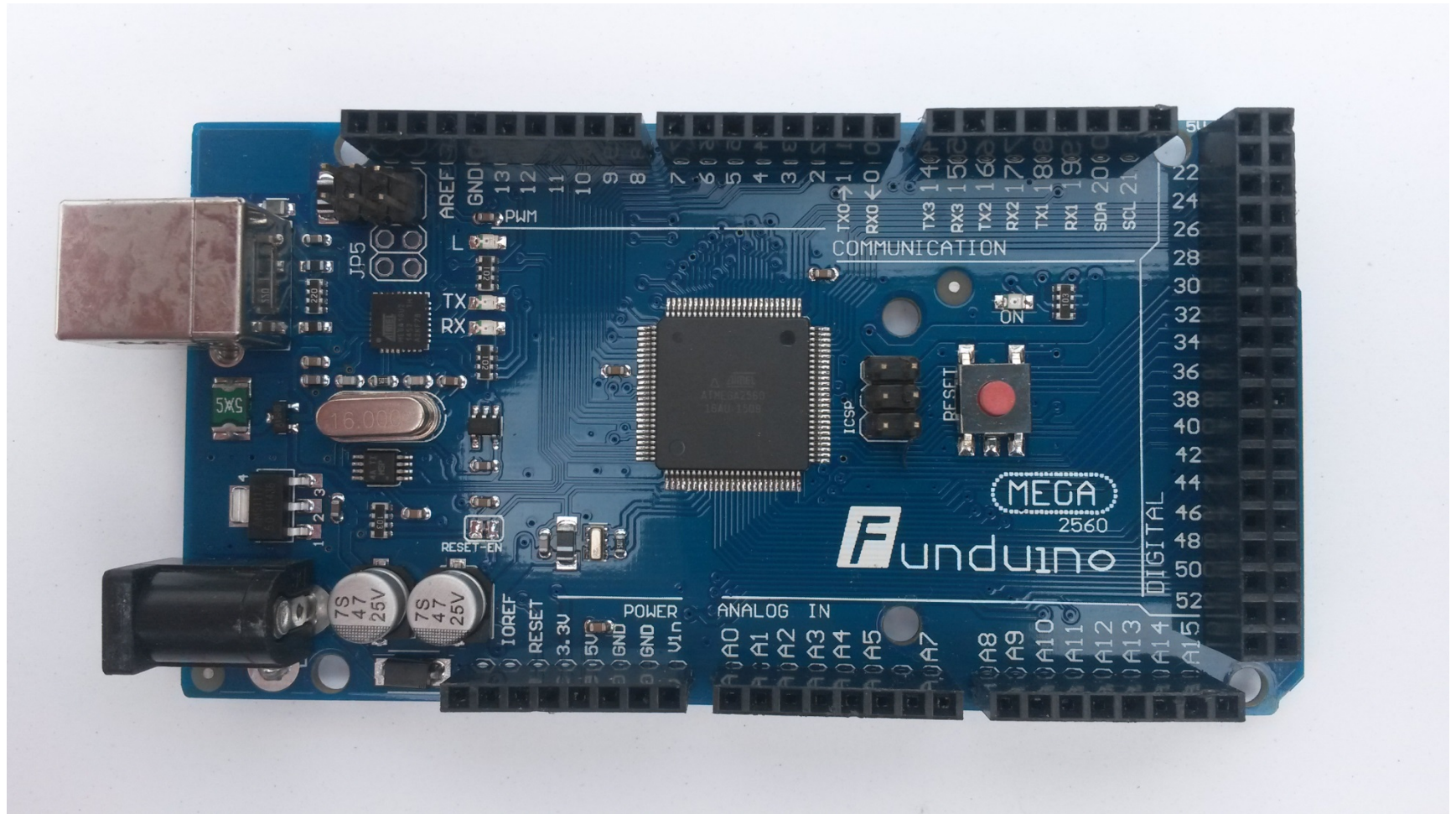
# "Arduino Mega2560"



Husk at dette ikke må opfattes som "vores computer".

Den monterede microcontroller er "vores computer".

# "Funduino Mega2560"



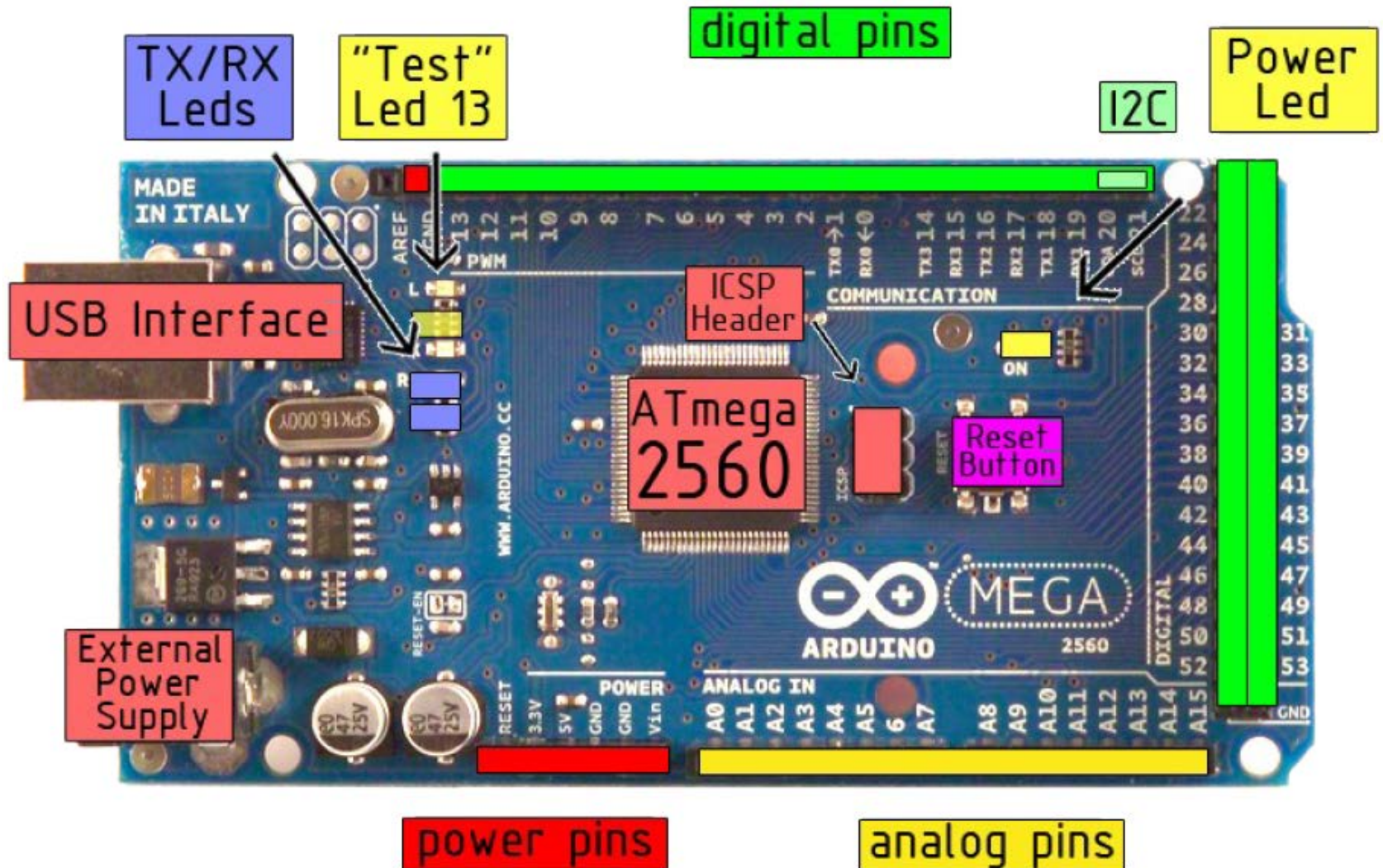
# "Arduino Mega2560"

Microcontroller	ATmega2560
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	54 (of which 14 provide PWM output)
Analog Input Pins	16
DC Current per I/O Pin	40 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	256 KB of which 8 KB used by bootloader
SRAM	8 KB
EEPROM	4 KB
Clock Speed	16 MHz



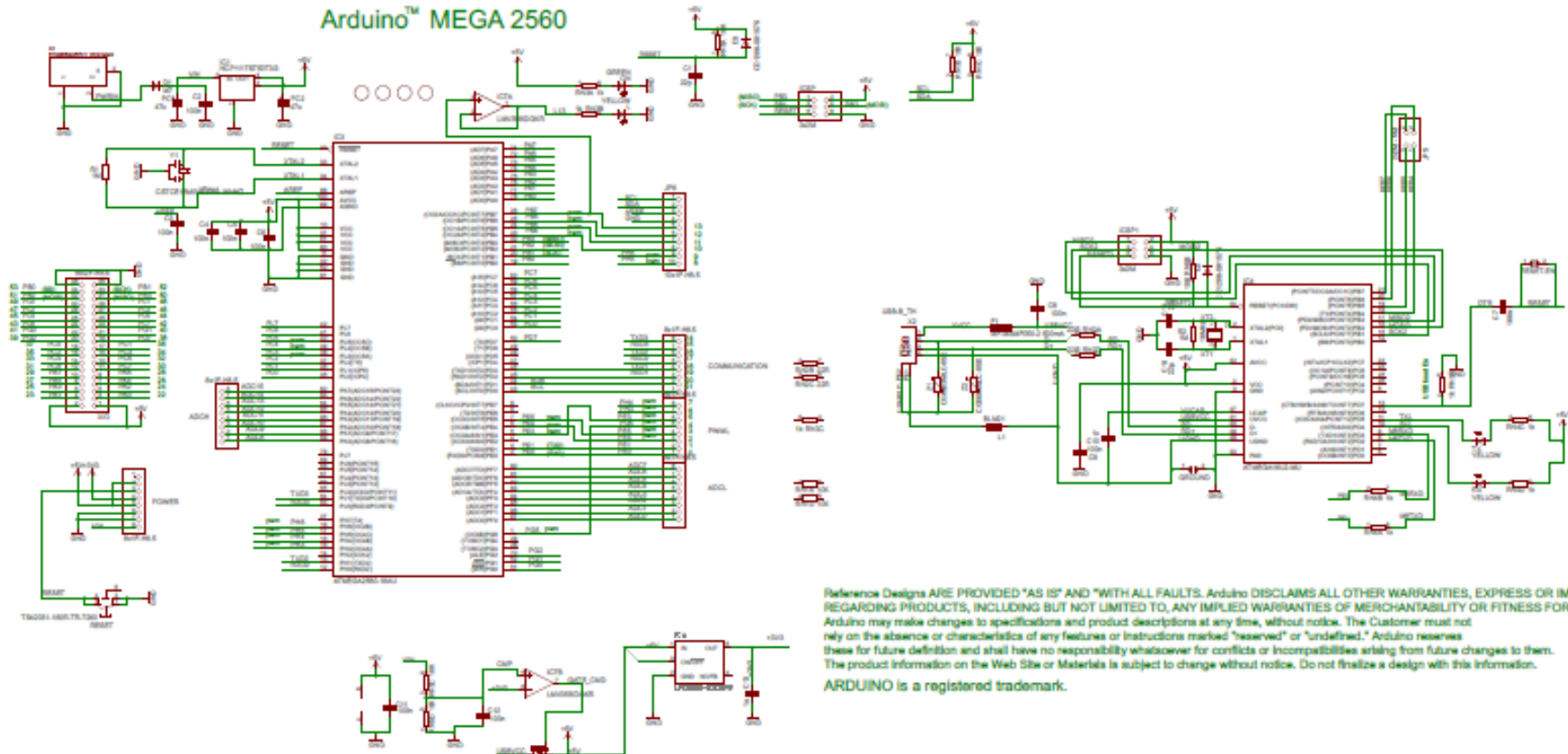


# "Arduino Mega2560"





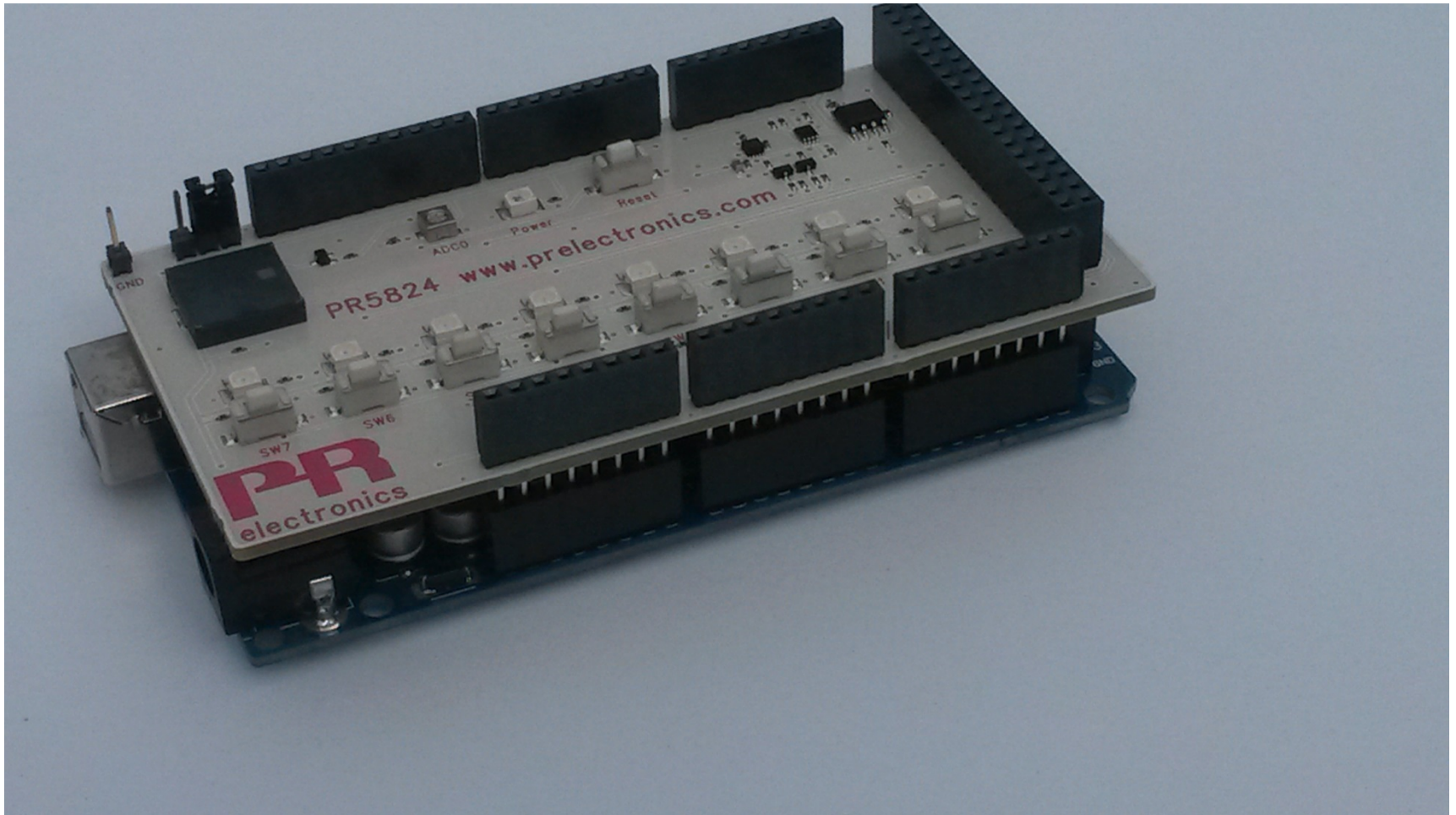
# Diagram for "Arduino Mega2560"



Findes på MSYS Blackboard

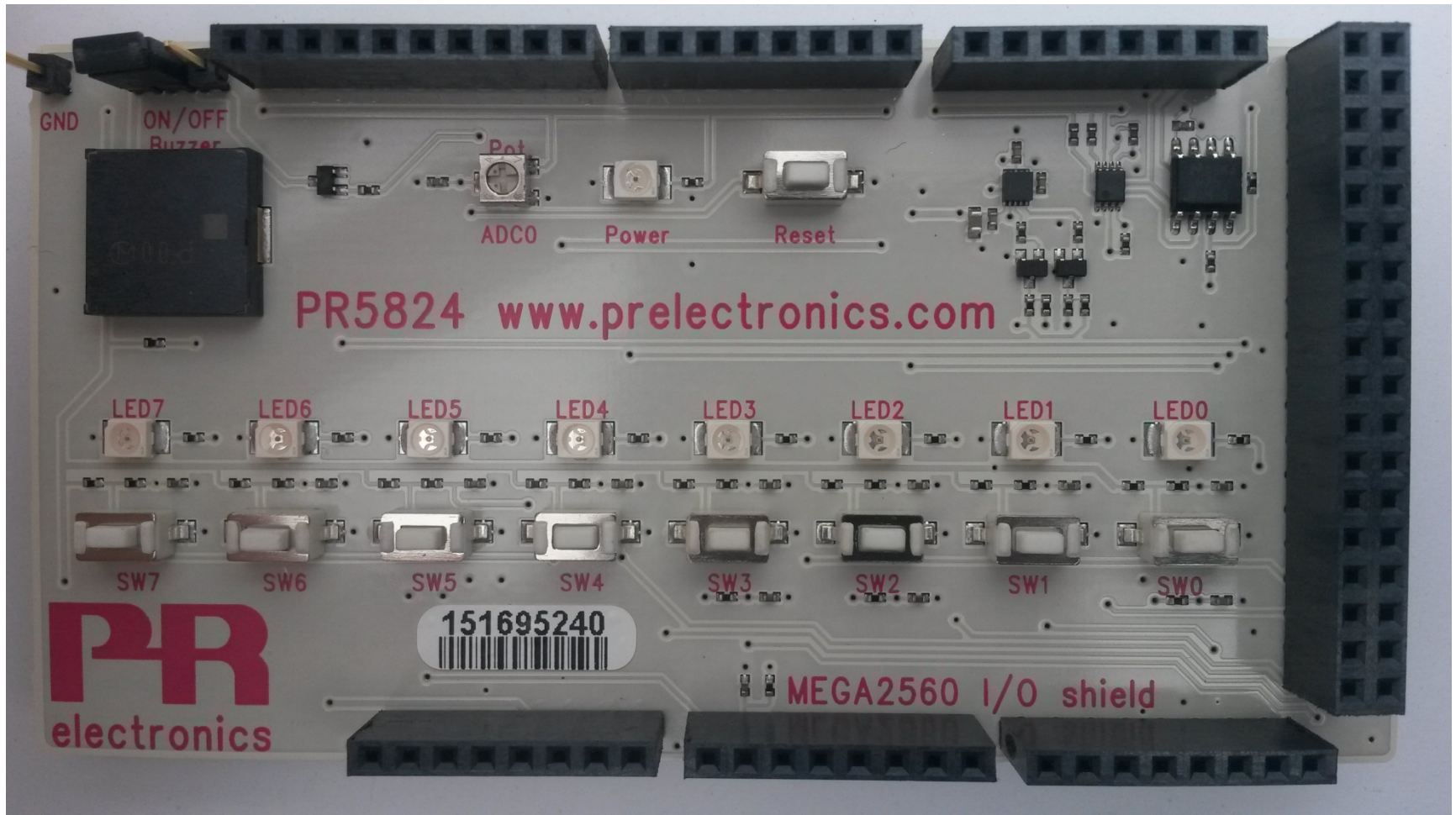


# "Arduino Mega2560" + "Mega2560 I/O Shield"





# "Mega2560 I/O Shield"



# "Mega2560 I/O Shield"

- Power on LED (rød)
- Reset knap
- 8 lyddioder (LED7....LED0) = PORTB
- 8 trykknapper (SW7....SW0) = PORTA
- Lysgiver (buzzer) = PORTB, bit 5
- On/off jumper for lyd giver
- Potentiometer for A/D konverter (ADC0 = PF0)
- Low pass filter for PWM -> Analog
- 2 interrupt trykknapper (INT3 = SW3, INT4 = SW4)
- 1 trykknapp for counting (T0 = PD7 = SW0)
- 1 digital temperaturmåler (LM75)
- 1 digital accelerometer (ICMA8652)

## Kursus-materiale

Mega32 / Mega2562

Arduino Mega2560 Board

Mega2560 I/O shield



# Lysdioderne (LED7....LED0)

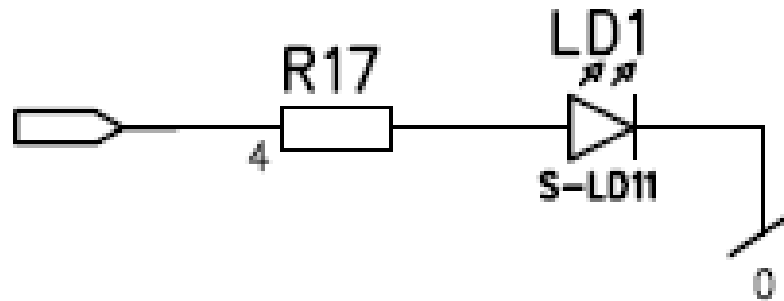


PORTB = LED7 – LED0



# Lysdiode (en af 8)

PORTB ben:  
0 ud = 0 volt  
1 ud = 5 volt



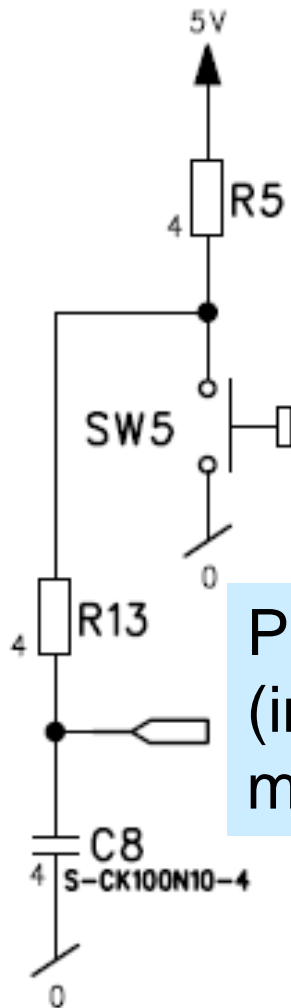
Hvordan virker det ?

# Trykknapperne (SW7....SW0)



# Trykknapper (en af 8)

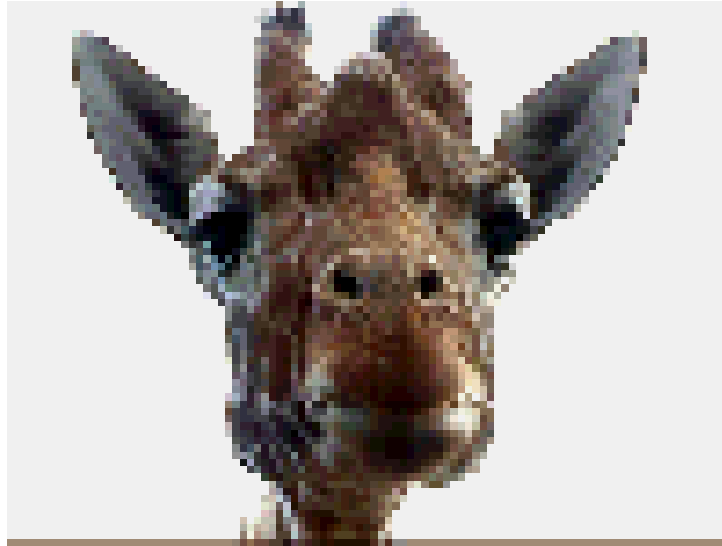
Hvordan virker det ?



PORTA ben:  
(indgang på  
microcontroller)



# Kommentarer?



**- eller spørgsmål til vores hardware?**

# Atmel Studio 6

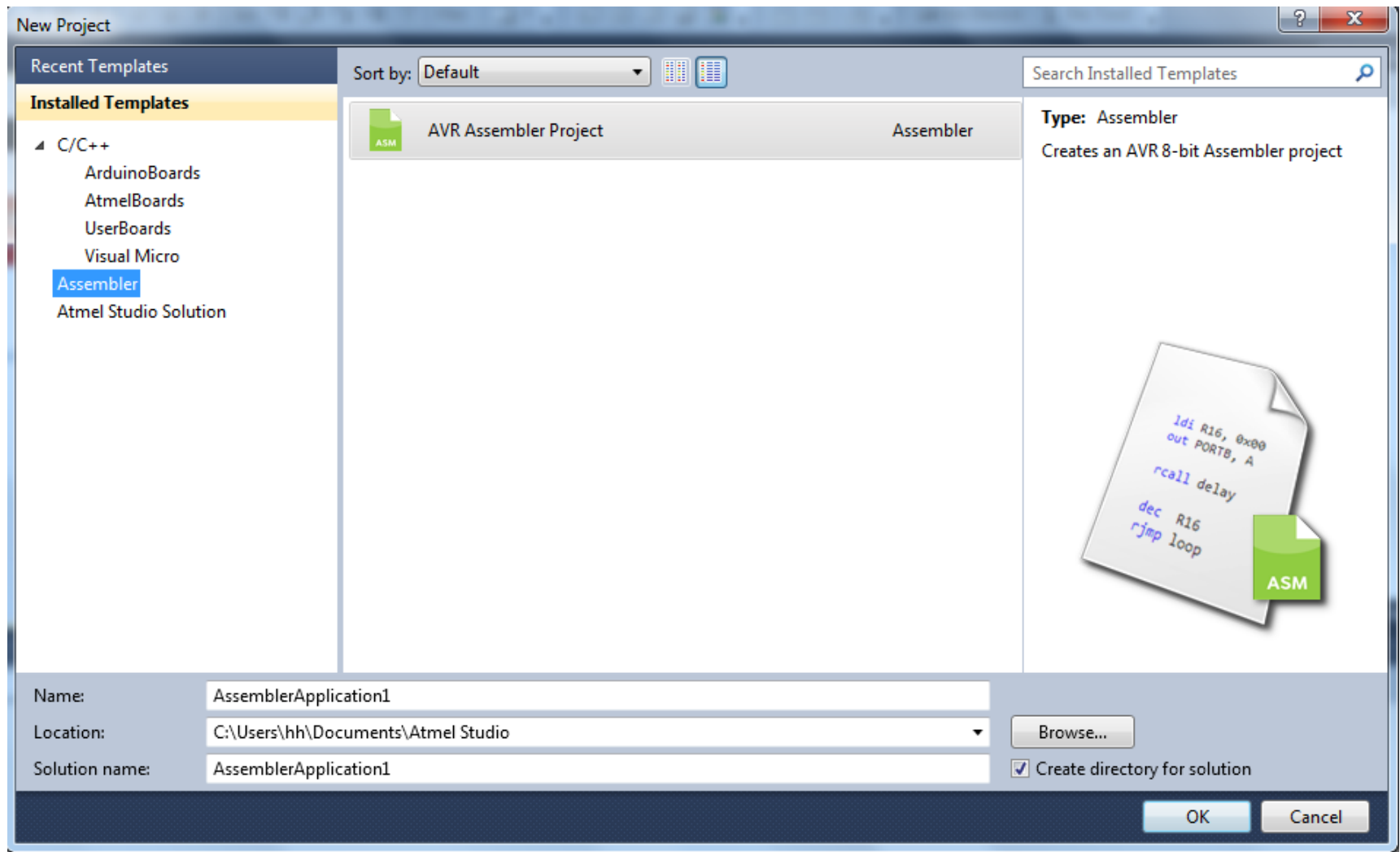


Atmel Studio 6 kan downloades fra [www.atmel.com](http://www.atmel.com) eller fra MSYS Blackboard.

Glimrende (gratis) værktøj, som vi bruger til :

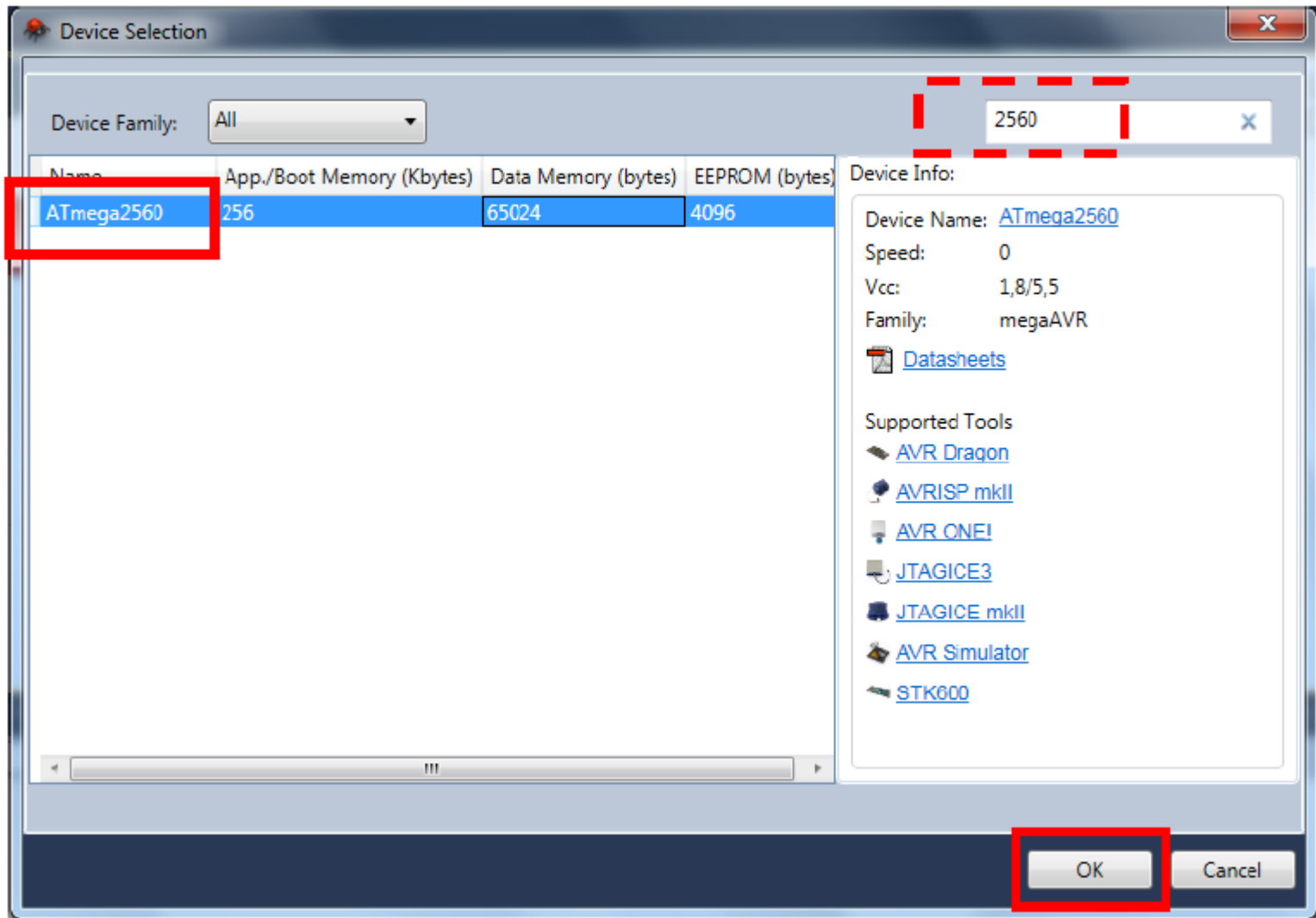
- Skrivning af **assembly-programmer**.
- Skrivning af **C-programmer (eller C++)**.
- **Download af program** til "Arduino Mega2560".
- **Test** (simulering) af programmer.

# Oprettelse af assembly projekt





# Valg af microcontroller (ATmega2560)



# Skriv assembly koden

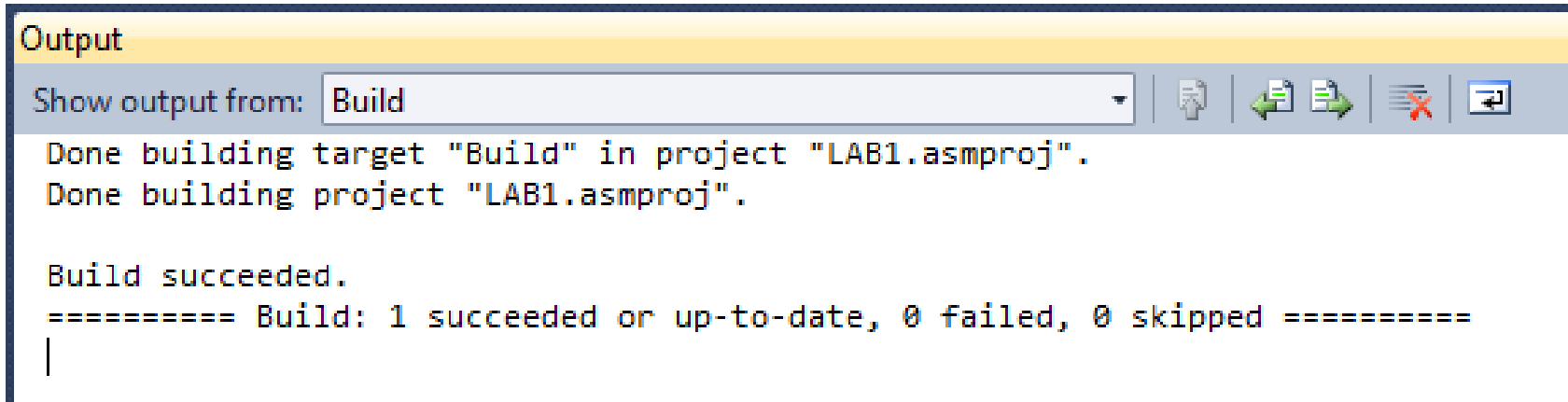
LAB1.asm X

```
;***** MSYS, LAB1 *****
;***** Henning Hargaard *****
;***** 14.august 2015 *****
;*****

;***** INITIERING *****
    LDI R16,HIGH(RAMEND) ;Initialize Stack Pointer
    OUT SPH,R16
    LDI R16,LOW(RAMEND)
    OUT SPL,R16
    SER R16                ;PORTB = Outputs
    OUT DDRB,R16

;***** PROGRAM-LOOP *****
    CLR R16
LOOP:
    LDI R17,9                ;R17 = 9
    ADD R16,R17              ;R16 = R16 + R17
    CALL DISP_AND_DELAY      ;Display R16
    JMP LOOP                 ;Jump to "LOOP"
```

# Build (F7)



The screenshot shows the 'Output' window of an IDE. The title bar is yellow and says 'Output'. Below it is a toolbar with icons for showing output from a specific target, refreshing, saving, deleting, and zooming. The main text area shows the following output:

```
Show output from: Build
Done building target "Build" in project "LAB1.asmproj".
Done building project "LAB1.asmproj".

Build succeeded.
===== Build: 1 succeeded or up-to-date, 0 failed, 0 skipped =====
|
```

Herved assembleres koden (og vi får dannet en "hex-fil" med maskinkoderne)

# Programming of Mega2560 = Kode

Output

Show output from: Serial Program COM14 Mega2560

```
avrdude.exe: 54 bytes of flash verified  
  
avrdude.exe: safemode: Fuses OK  
  
avrdude.exe done.  Thank you.
```











# Simulering (debug)

LAB1.asm X

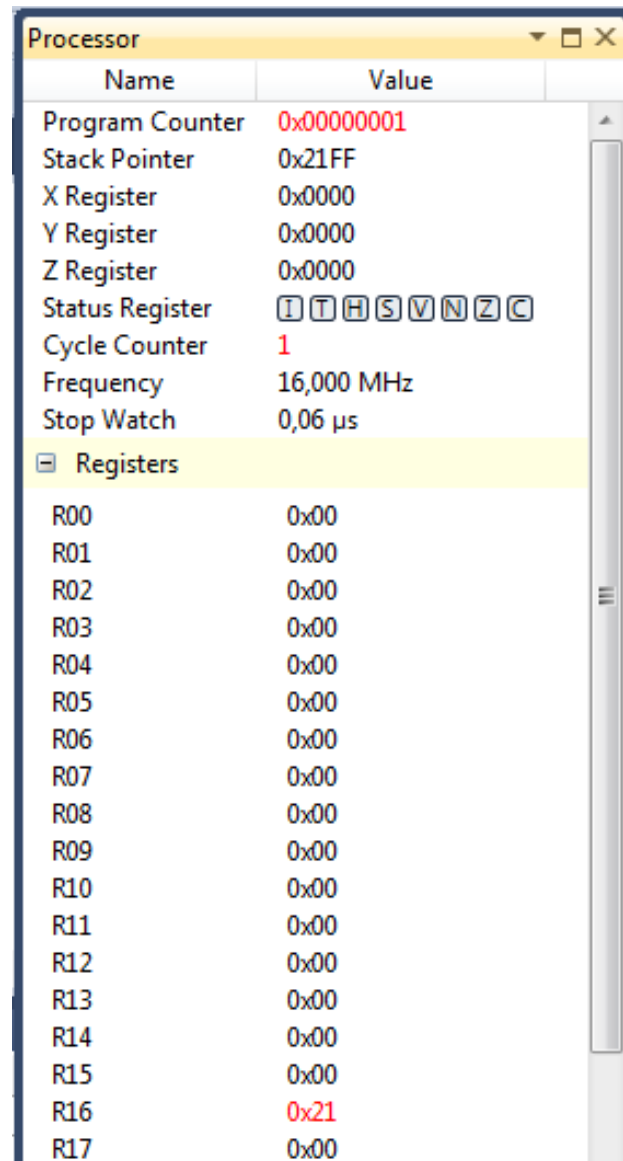
```
;***** MSYS, LAB1 *****  
;***** Henning Hargaard *****  
;***** 14.august 2015 *****  
;*****  
  
;***** INITIERING *****  
⇒ LDI R16,HIGH(RAMEND) ;Initialize Stack Pointer  
   OUT SPH,R16  
   LDI R16,LOW(RAMEND)  
   OUT SPL,R16  
   SER R16 ;PORTB = Outputs  
   OUT DDRB,R16  
  
;***** PROGRAM-LOOP *****  
   CLR R16  
LOOP:  
   LDI R17,9 ;R17 = 9  
   ADD R16,R17 ;R16 = R16 + R17  
   CALL DISP_AND_DELAY ;Display R16  
   JMP LOOP ;Jump to "LOOP"
```



# Debug control

Windows	1	
 Continue	2	F5
 Break All	3	Ctrl+Alt+Break
 Stop Debugging	4	Shift+F5
 Detach All	5	
Terminate All	6	
 Restart	7	Ctrl+Shift+F5
 Reset	8	
 Attach to Process...	9	
Exceptions...	10	Ctrl+Alt+E
 Step Into	11	F11
 Step Over	12	F10
 Step Out	13	Shift+F11
 QuickWatch...	14	Shift+F9
Toggle Breakpoint	15	F9
New Breakpoint	16	

# Registre (R0 – R31)



The screenshot shows a 'Processor' window with a table of registers. The 'Program Counter' is at 0x00000001, 'Stack Pointer' at 0x21FF, and 'Cycle Counter' at 1. The 'Status Register' shows flags I, T, H, S, V, N, Z, C. The 'Registers' section lists R0 through R17, with R16 highlighted in red at 0x21.

Name	Value
Program Counter	0x00000001
Stack Pointer	0x21FF
X Register	0x0000
Y Register	0x0000
Z Register	0x0000
Status Register	I T H S V N Z C
Cycle Counter	1
Frequency	16,000 MHz
Stop Watch	0,06 µs
Registers	
R00	0x00
R01	0x00
R02	0x00
R03	0x00
R04	0x00
R05	0x00
R06	0x00
R07	0x00
R08	0x00
R09	0x00
R10	0x00
R11	0x00
R12	0x00
R13	0x00
R14	0x00
R15	0x00
R16	0x21
R17	0x00

# Watch vindue

Watch 1			
Name	Value	Type	
PORTB	24	dword	
R17	242	byte{reg	
R18	0	byte{reg	
R19	10	byte{reg	





# I/O View

LAB1.asm IO View X ASF Explorer Solution Explorer Properties

Filter:

Name	Value
+ CPU	
+ EEPROM	
+ EXTERNAL_INTERRUPT	
JTAG	
I/O PORTA	
I/O PORTB	
I/O PORTC	
I/O PORTD	
I/O PORTE	
I/O PORTF	
I/O PORTG	

Name	Address	Value	Bits
I/O PINB	0x23	0xF2	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
I/O DDRB	0x24	0xFF	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
I/O PORTB	0x25	0xF2	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

# Slut på MSYS lektion 3

