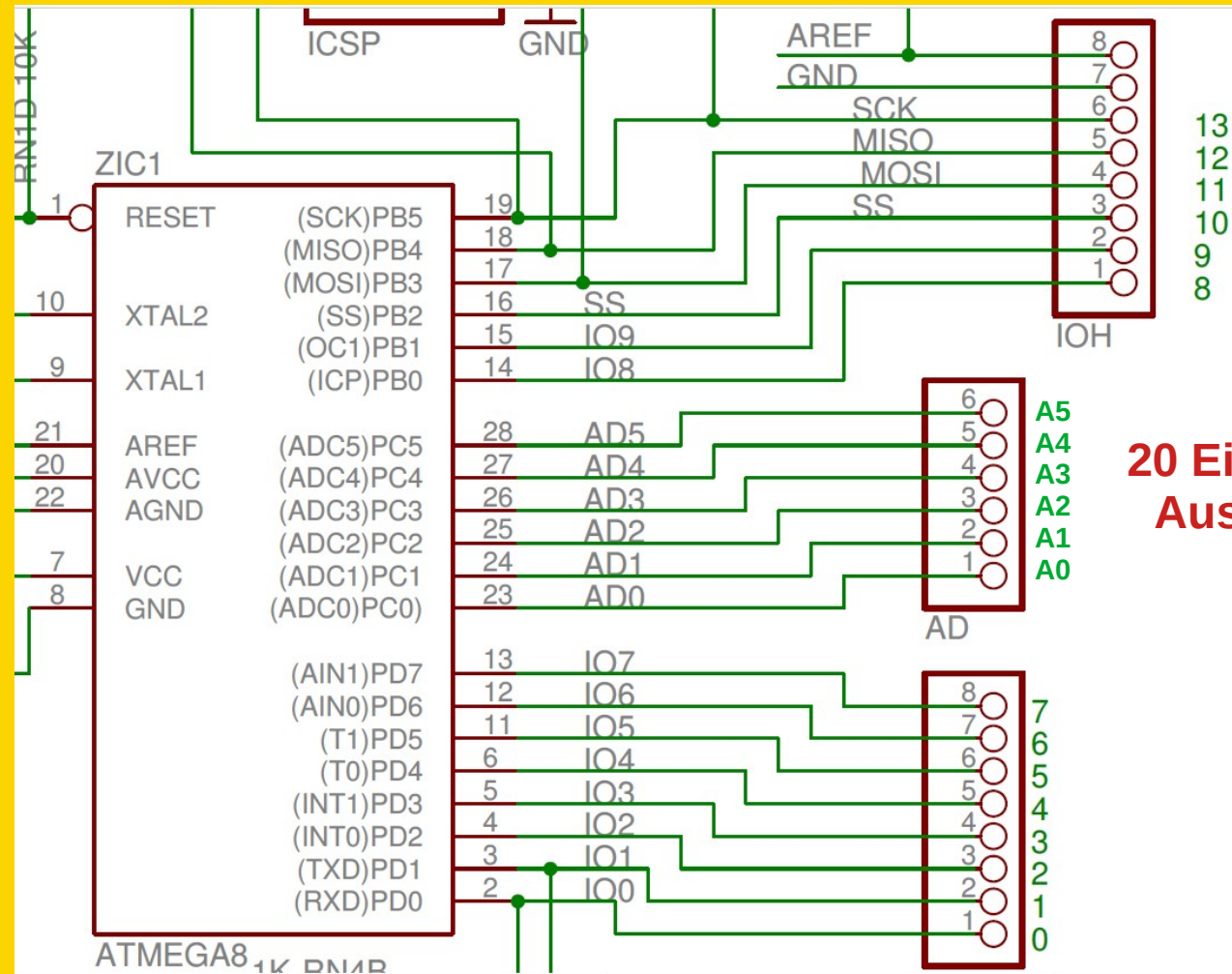


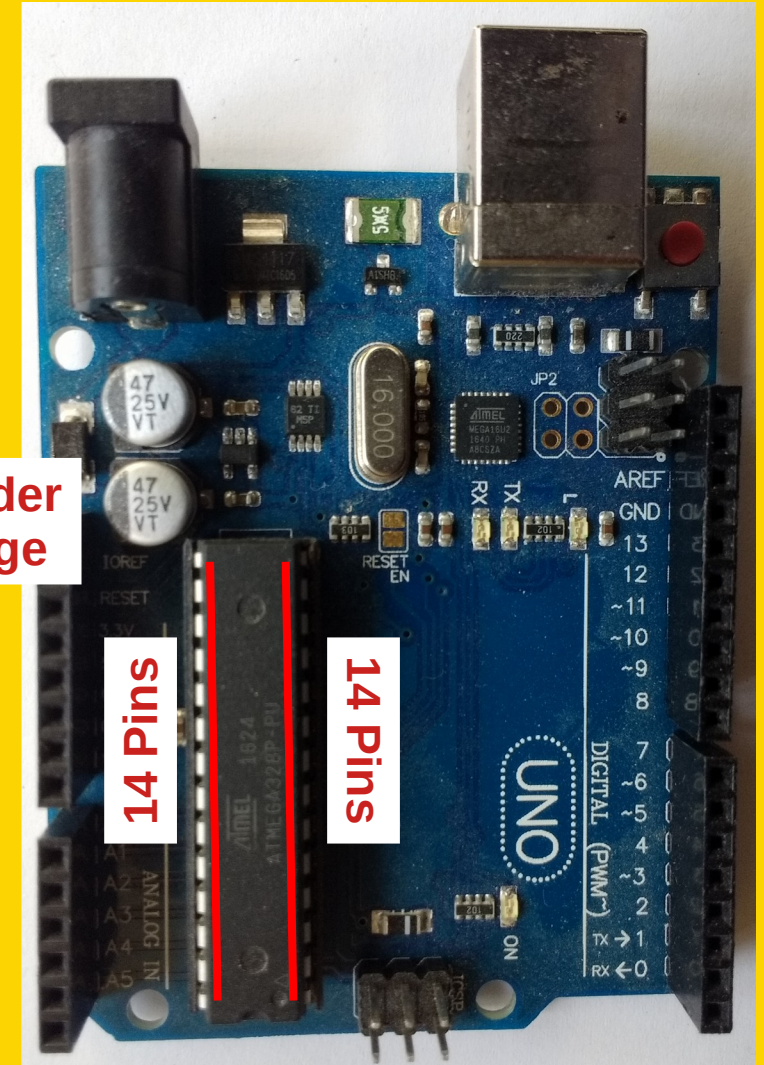
Montage und Programmierung
eines Roboters für
ROBOCUP JUNIOR RESCUE
mit Elegoo Car Kit
Teil 2.0: Hello World

Von Charlotte und Andreas

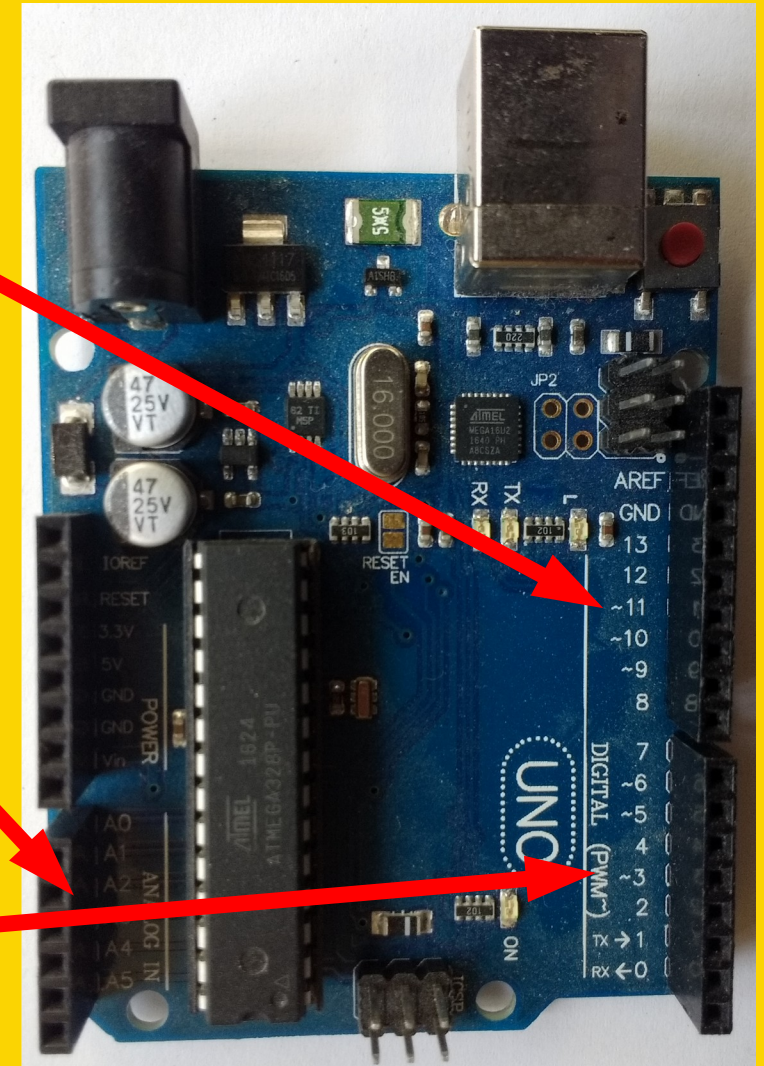
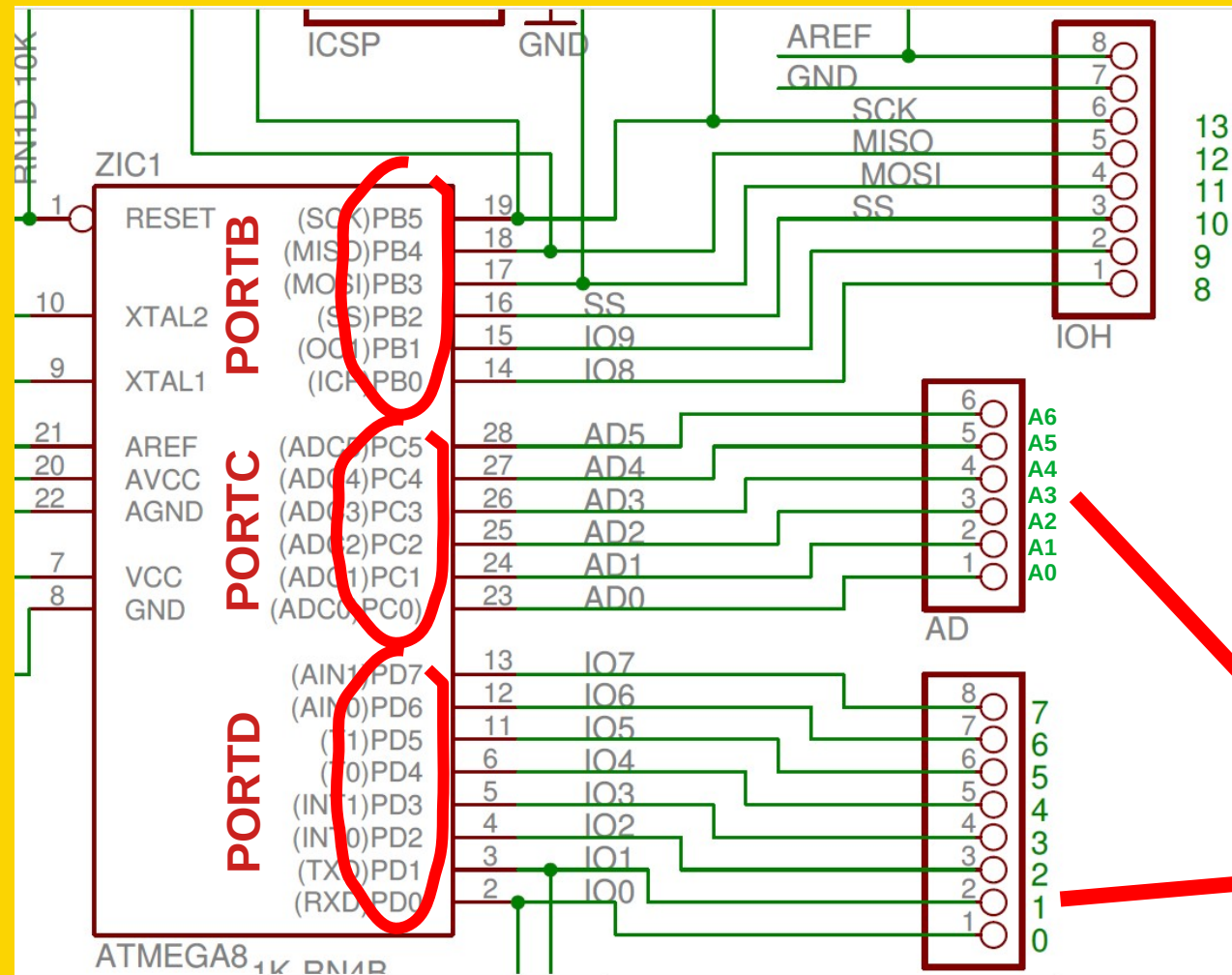
PORTS am Atmega328P



20 Ein- oder
Ausgänge

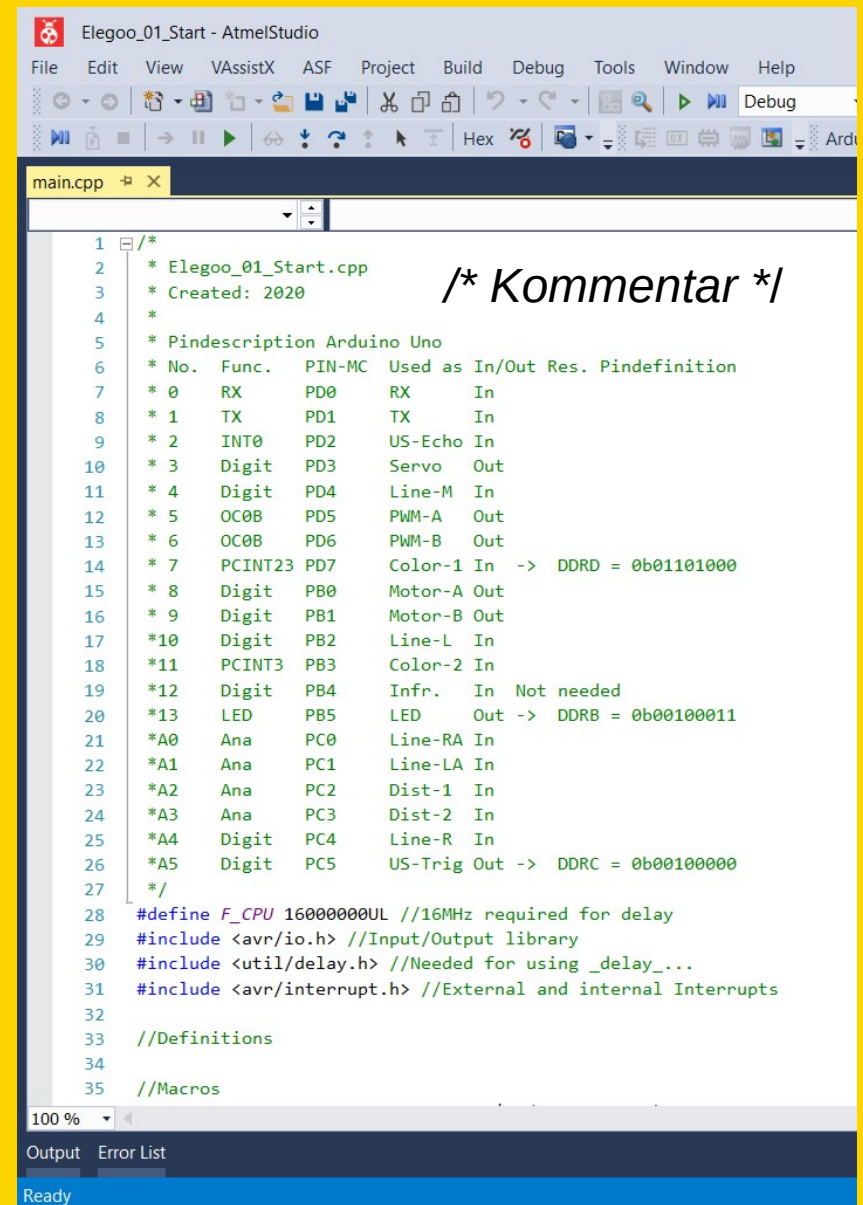


PORTS am Atmega328P



Pinbelegung

- 0 und 1 werden für Datenübertragungen gebraucht
- 2 Echo vom Ultraschall
- 3 Signalleitung vom Servo
- 4 Liniensensor Mitte digital
- 5 PulsweitenModulation A
- 6 PulsweitenModulation B
- 7 Frequenzeingang vom Farbsensor 1
- 8 Motorausgang A
- 9 Motorausgang B
- 10 Liniensensor links digital
- 11 Frequenzeingang vom Farbsensor 2
- 12 Infrarot Fernbedienungseingang
- 13 LED
- A0 Liniensensor rechts analog
- A1 Liniensensor links analog
- A2 Infrarot Entfernungsmesser 1
- A3 Infrarot Entfernungsmesser 2
- A4 Liniensensor rechts digital
- A5 Ultraschall Triggerleitung



```
1  /*
2  * Elegoo_01_Start.cpp
3  * Created: 2020
4  *
5  * Pindescription Arduino Uno
6  * No.  Func.  PIN-MC  Used as  In/Out  Res.  Pindefinition
7  * 0    RX    PD0     RX       In
8  * 1    TX    PD1     TX       In
9  * 2    INT0   PD2     US-Echo In
10 * 3    Digit  PD3     Servo   Out
11 * 4    Digit  PD4     Line-M  In
12 * 5    OC0B   PD5     PWM-A   Out
13 * 6    OC0B   PD6     PWM-B   Out
14 * 7    PCINT23 PD7     Color-1 In -> DDRD = 0b01101000
15 * 8    Digit  PB0     Motor-A Out
16 * 9    Digit  PB1     Motor-B Out
17 *10    Digit  PB2     Line-L  In
18 *11    PCINT3 PB3     Color-2 In
19 *12    Digit  PB4     Infr.   In  Not needed
20 *13    LED    PB5     LED     Out -> DDRB = 0b00100011
21 *A0    Ana    PC0     Line-RA In
22 *A1    Ana    PC1     Line-LA In
23 *A2    Ana    PC2     Dist-1  In
24 *A3    Ana    PC3     Dist-2  In
25 *A4    Digit  PC4     Line-R  In
26 *A5    Digit  PC5     US-Trig Out -> DDRC = 0b00100000
27 */
28 #define F_CPU 16000000UL //16MHz required for delay
29 #include <avr/io.h> //Input/Output library
30 #include <util/delay.h> //Needed for using _delay_...
31 #include <avr/interrupt.h> //External and internal Interrupts
32
33 //Definitions
34
35 //Macros
```

unsigned char

1 Byte bestehend aus 8 Bit

z.B.:

1	0	1	0	1	1	0	0
---	---	---	---	---	---	---	---

 = 172

Rechner

Programmierer

172

HEX	AC
DEC	172
OCT	254
BIN	1010 1100

QWORD MS M*

Bitweise Bitverschiebung

A	<<	>>	CE	<X
B	()	%	÷
C	7	8	9	×
D	4	5	6	-
E	1	2	3	+
F	+/-	0	,	=

0 bis 255

Rechner

Programmierer

255

HEX	FF
DEC	255
OCT	377
BIN	1111 1111

QWORD MS M*

Bitweise Bitverschiebung

A	<<	>>	CE	<X
B	()	%	÷
C	7	8	9	×
D	4	5	6	-
E	1	2	3	+
F	+/-	0	,	=

Elegoo_01_Start - AtmelStudio

File Edit View VAssistX ASF Project Build Debug Tools Window Help

main.cpp

```
40
41 //Variables
42 unsigned char z; //For tests
43
44
45 //Funktionen, declaration
46 void Init (void); //Initialize Microcontroller
47
48
49 //Main routine
50 int main(void) {
51     Init(); //Initialize the MC
52     //sei(); //Enable all interrupts
53     cli(); //Clear all interrupts
54     while (1) {
55         //At Pin 5 PORTB the LED of the Arduino board is mounted (Pin 13)
56         PORTB |= (1 << PORTB5); //Push PORTB pin 5 high (LED, pin 13 "Uno")
57         //PORTB &= ~(1 << PORTB5); //~ = "NOT" Operator, 1<<5 shifts the "1" five times to the left
58         //A not A
59         //0 1
60         //1 0
61         //PINB |= (1<<PINB5); //A "1" to "PIN" toggles the Pin of the PORT
62     }
63 }
64
65 //Initialize the Microcontroller
66 void Init (void) {
67     //Port settings (in brackets: pin of the arduino uno board, see above too)
68     //0 = Input, 1 = Output
69     DDRB = 0b00100011; //PortB Pin 5 to Output, LED on Arduino Uno board (13)
70 }
71
72
```

100 %

Output Error List VA Find References Results

void Funktionsname (void)

z.B.: void Init (void)

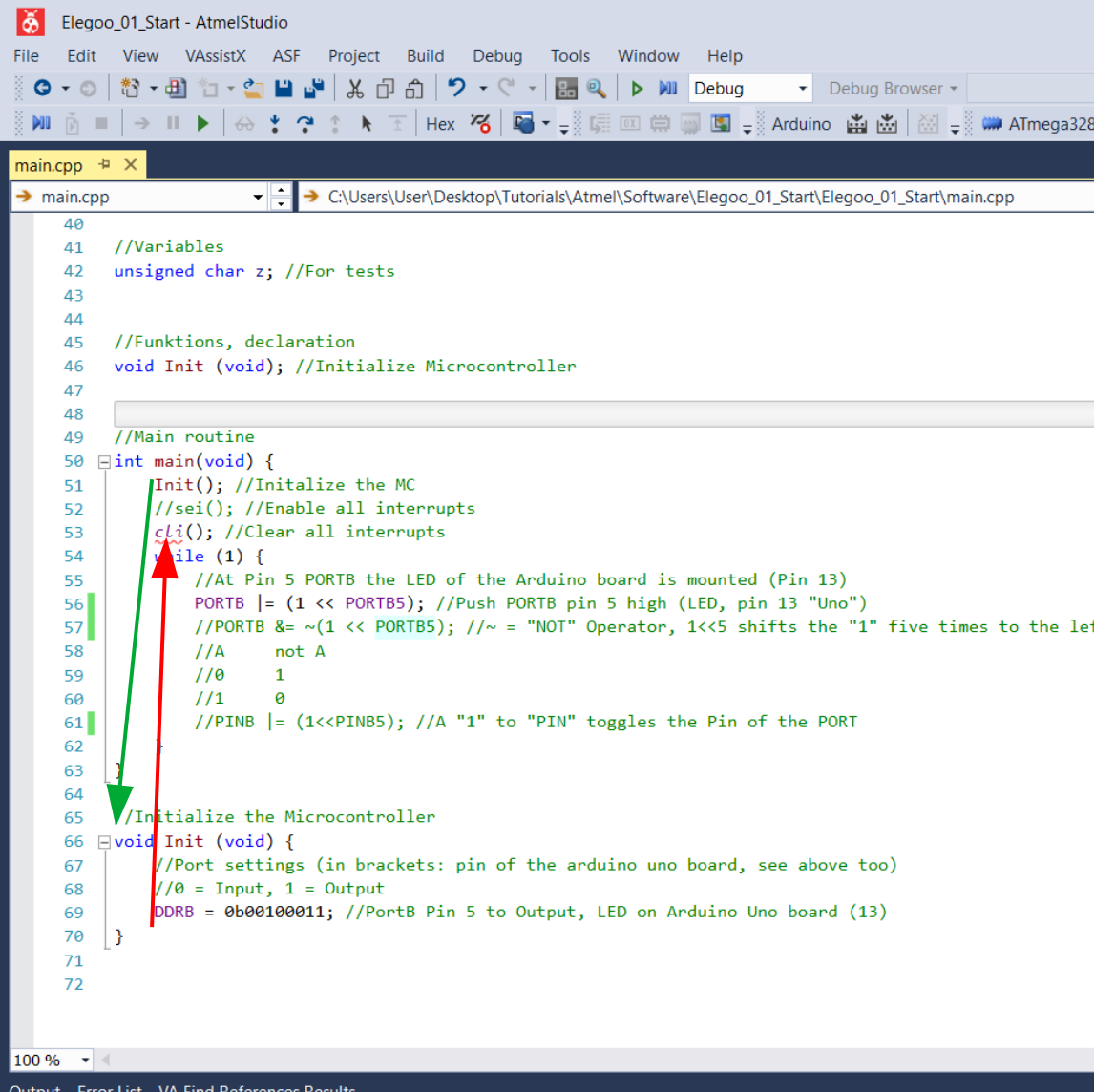
Deklaration für den Compiler im oberen Teil, vor der Hauptfunktion(main). Bekanntmachung der Funktion für den Compiler.

Aufruf im Hauptprogramm (oder woanders)

Definition im unteren Teil

Wenn die Funktion aufgerufen wird Init();
springt der Mikrocontroller dort hin, arbeitet die Funktion ab und springt an die Ausgangsstelle zurück.

void → nichts



```
Elegoo_01_Start - AtmelStudio
File Edit View VAssistX ASF Project Build Debug Tools Window Help
Debug Debug Browser
main.cpp
main.cpp C:\Users\User\Desktop\Tutorials\Atmel\Software\Elegoo_01_Start\Elegoo_01_Start\main.cpp
40
41 //Variables
42 unsigned char z; //For tests
43
44
45 //Funktions, declaration
46 void Init (void); //Initialize Microcontroller
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48
49 //Main routine
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51     Init(); //Inititalize the MC
52     //sei(); //Enable all interrupts
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55         //At Pin 5 PORTB the LED of the Arduino board is mounted (Pin 13)
56         PORTB |= (1 << PORTB5); //Push PORTB pin 5 high (LED, pin 13 "Uno")
57         //PORTB &= ~(1 << PORTB5); //~ = "NOT" Operator, 1<<5 shifts the "1" five times to the left
58         //A not A
59         //0 1
60         //1 0
61         //PINB |= (1<<PINB5); //A "1" to "PIN" toggles the Pin of the PORT
62     }
63
64     //Initialize the Microcontroller
65
66 void Init (void) {
67     //Port settings (in brackets: pin of the arduino uno board, see above too)
68     //0 = Input, 1 = Output
69     DDRB = 0b00100011; //PortB Pin 5 to Output, LED on Arduino Uno board (13)
70 }
71
72
100 %
Output Error List VA Find References Results
```

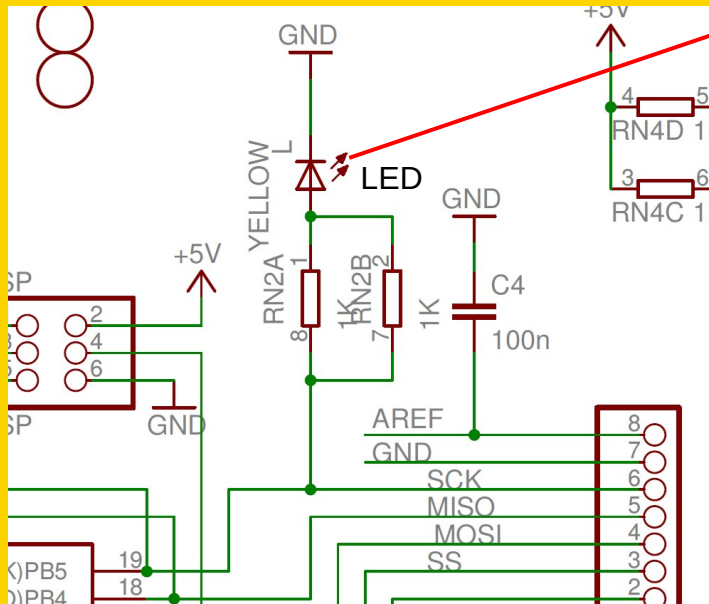
DDRB:

Data Direction Register für PORTB
0b... Die folgende Ziffernfolge gibt
eine Binärzahl wieder.

0b 0 0 1 0 0 0 0 0

Bit 5

Bit 0



Elegoo_01_Start - AtmelStudio

File Edit View VAssistX ASF Project Build Debug Tools Window

main.cpp

```
40
41 //Variables
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60         //1 0
61         //PINB |= (1<<PINB5
62     }
63 }
64
65 //Initialize the Microcontroller
66 void Init (void) {
67     //Port settings (in brackets)
68     //0 = Input, 1 = Output
69     DDRB = 0b00100011; //PortB Pin 5 to Output, LED on Arduino Uno board (13)
70 }
71
72
```

17 *10 Digit PB2 Line-L In
18 *11 PCINT3 PB3 Color-2 In
19 *12 Digit PB4 Infr. In Not needed
20 *13 LED PB5 LED Out -> DDRB = 0b00100011
21 *A0 Ana PC0 Line-RA In
22 *A1 Ana PC1 Line-LA In
23 *A2 Ana PC2 Dist-1 In
24 *A3 Ana PC3 Dist-2 In
25 *A4 Digit PC4 Line-R In
26 *A5 Digit PC5 US-Trig Out -> DDRC = 0b00100000

Bit 5

Int main (void):

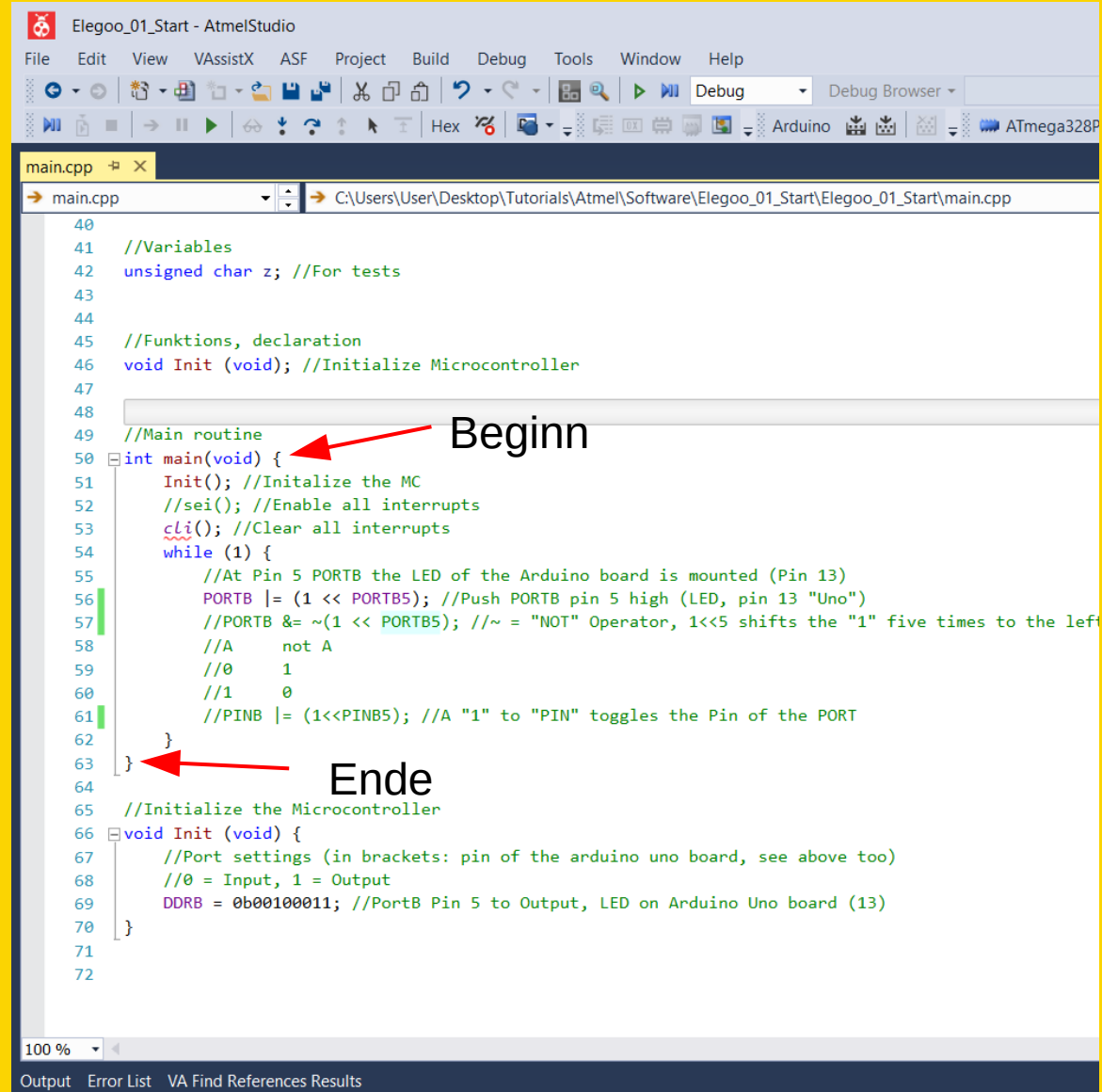
Der MC beginnt immer mit der main-Funktion

while:

Solange die Bedingung in den nachfolgenden runden Klammern erfüllt ist, wiederhole die Anweisungen zwischen den geschweiften Klammern der „while-Schleife“.

Eine Bedingung gilt dann als erfüllt, wenn sie

NICHT NULL
ist.



```
Elegoo_01_Start - AtmelStudio
File Edit View VAssistX ASF Project Build Debug Tools Window Help
Debug Debug Browser
main.cpp
main.cpp C:\Users\User\Desktop\Tutorials\Atmel\Software\Elegoo_01_Start\Elegoo_01_Start\main.cpp
40
41 //Variables
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57         //PORTB &= ~(1 << PORTB5); //~ = "NOT" Operator, 1<<5 shifts the "1" five times to the left
58         //A not A
59         //0 1
60         //1 0
61         //PINB |= (1<<PINB5); //A "1" to "PIN" toggles the Pin of the PORT
62     }
63 }
64 //Initialize the Microcontroller
65 void Init (void) {
66     //Port settings (in brackets: pin of the arduino uno board, see above too)
67     //0 = Input, 1 = Output
68     DDRB = 0b00100011; //PortB Pin 5 to Output, LED on Arduino Uno board (13)
69 }
70
71
72
```

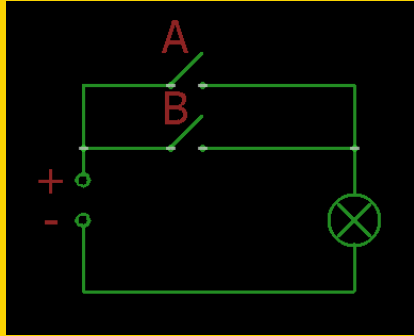
Beginn

Ende

Wahrheitstabelle:

Oder (Or |)

A	B	A B
0	0	0
0	1	1
1	0	1
1	1	1



0 0 0 0 0 0 0 0 = 0

oder

0 0 0 1 0 0 0 0 = 16

ergibt

0 0 0 1 0 0 0 0 = 16

oder

0 0 0 0 0 0 1 1 = 3

ergibt

0 0 0 1 0 0 1 1 = 19

Elegoo_01_Start - AtmelStudio

File Edit View VAssistX ASF Project

main.cpp

```

40
41 //Variables
42 unsigned char z; //For tests
43
44
45 //Funktionen, declaration
46 void Init (void); //Initialize Microcontroller
47
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49 //Main routine
50 int main(void) {
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52     //sei(); //Enable all interrupts
53     cli(); //Clear all interrupts
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57         //PORTB &= ~(1 << PORTB5); //~ = "NOT" Operator, 1<<5 shifts the "1" five times to the left
58         //A      not A
59         //0      1
60         //1      0
61         //PINB |= (1<<PINB5); //A "1" to "PIN" to
62     }
63 }
64
65 //Initialize the Microcontroller
66 void Init (void) {
67     //Port settings (in brackets: pin of the ardu
68     //0 = Input, 1 = Output
69     DDRB = 0b00100011; //PortB Pin 5 to Output, L
70 }
71
72

```

Rechner

Programmierer

0 OR 16 OR 3 = 19

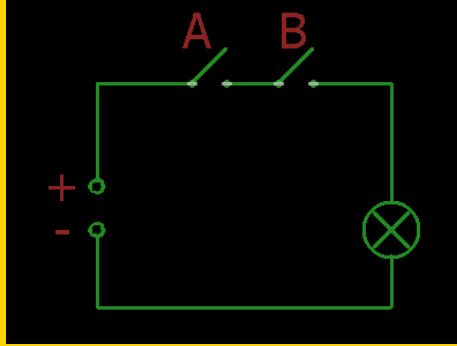
HEX 13
DEC 19
OCT 23
BIN 0001 0011

QWORD MS M*

Bitweise Bitverschiebung

Wahrheitstabelle: Und (And &)

A	B	A & B
0	0	0
0	1	0
1	0	0
1	1	1



0 0 0 1 0 0 1 1 = 19

und

1 1 1 0 1 1 1 0 = 238

gleich

0 0 0 0 0 0 1 0 = 2

Elegoo_01_Start - AtmelStudio

File Edit View VAssistX ASF Project Build Debug Tools Window Help

Debug Debug Browser

main.cpp

```

40
41 //Variables
42 unsigned char z; //For tests
43
44
45 //Funktionen, declaration
46 void Init (void); //Initialize Microcontroller
47
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49 //Main routine
50 int main(void) {
51     Init(); //Initialize the MC
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61         //PINB |= (1<<PINB5); //A "1" to "PIN" toggles the Pin of the PORT
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68     //0 = Input, 1 = Output
69     DDRB = 0b00100011; //PortB Pin 5 to Output, LED on Arduino Uno board (13)
70 }
71
72

```

100 %

Output Error List VA Find References Results

<< Operator:

Verschiebt ein Bit nach links

0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---

 = 0

(1 << 1) eine 1 einmal nach links schieben

0	0	0	0	0	0	1	0
---	---	---	---	---	---	---	---

 = 2

(1 << 4) eine 1 viermal nach links schieben

0	0	0	1	0	0	0	0
---	---	---	---	---	---	---	---

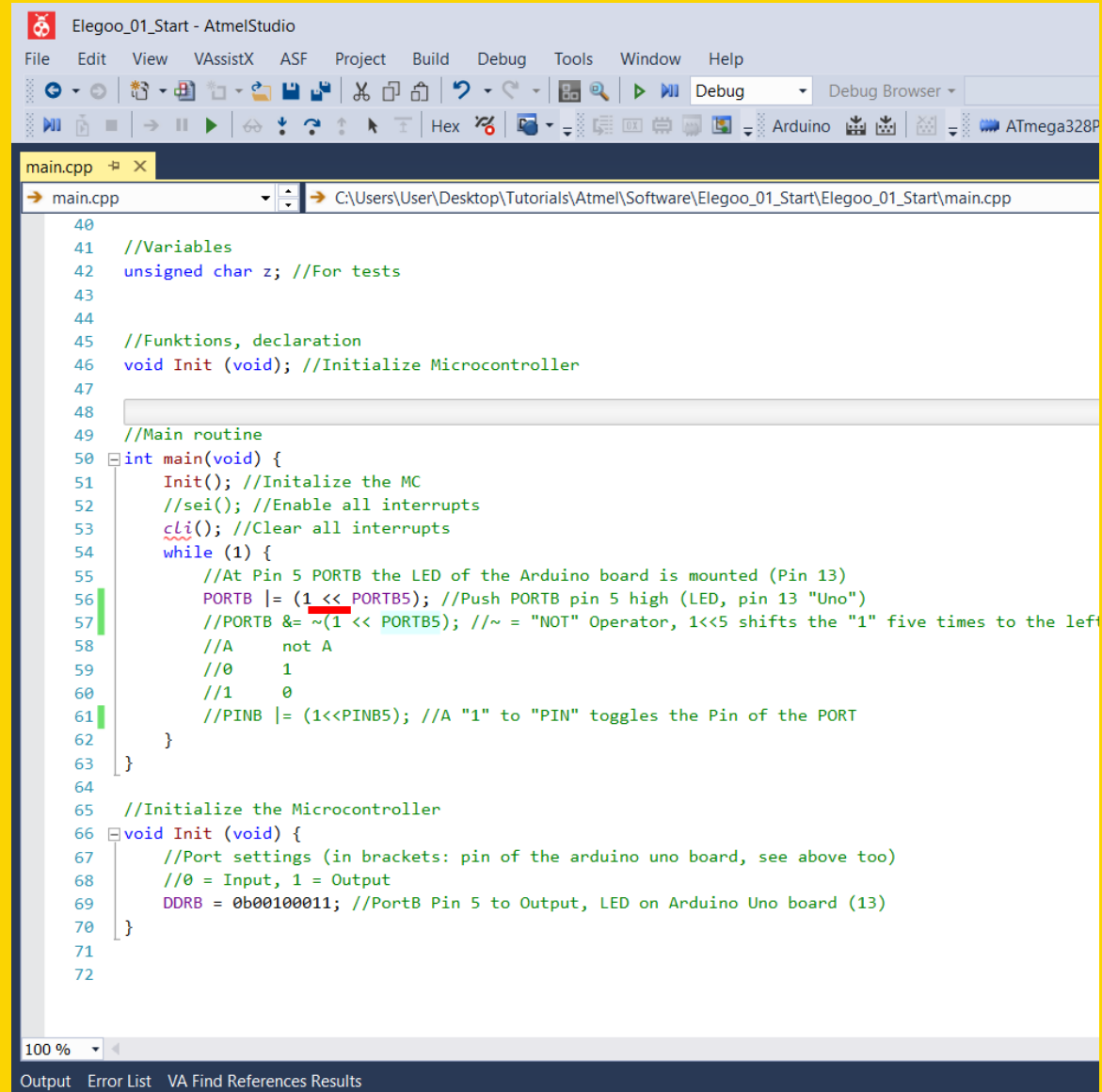
 = 16

| (1 << 6)

0	1	0	1	0	0	0	0
---	---	---	---	---	---	---	---

 = 80

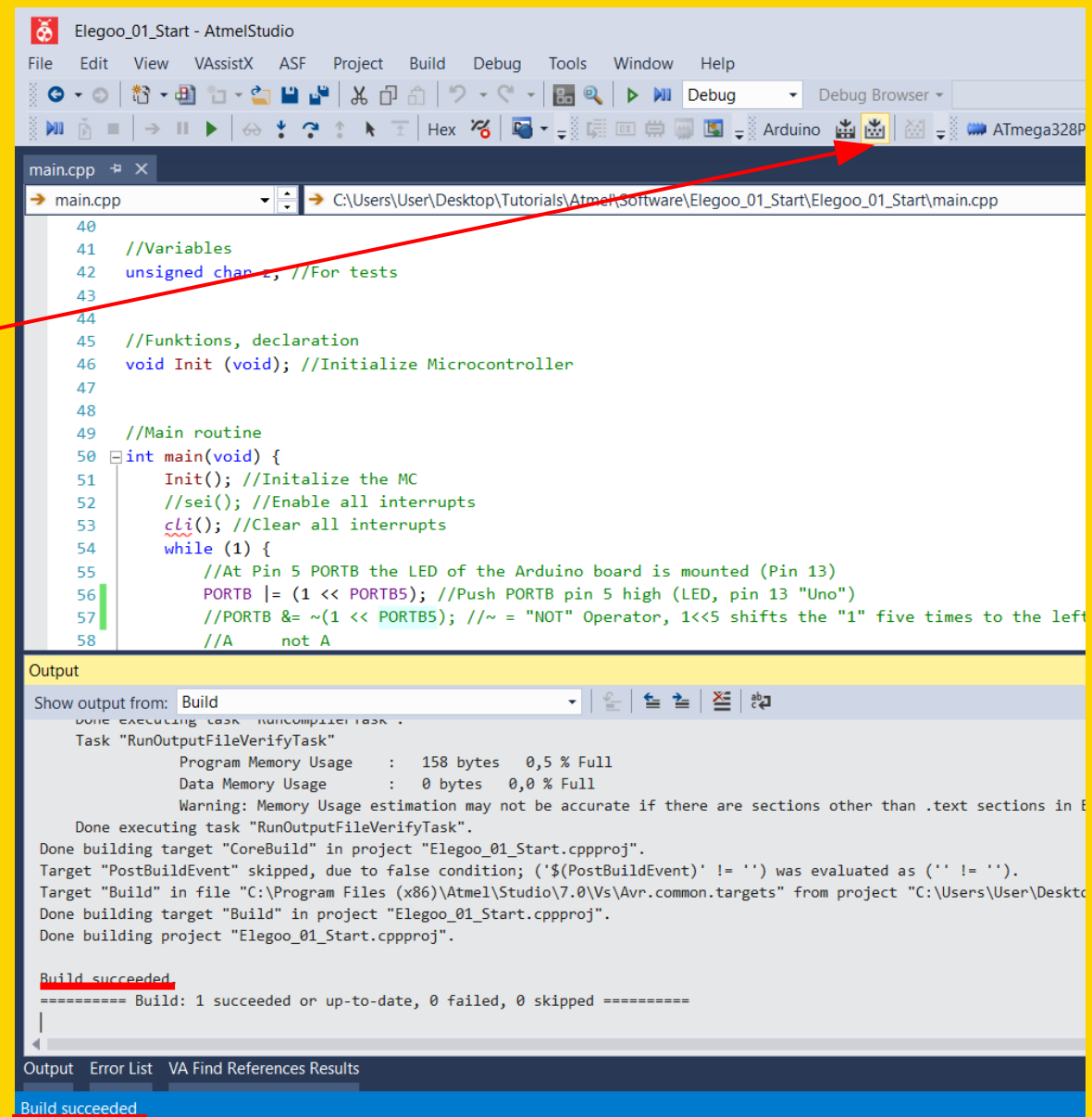
$\text{PORTB} |= (1 \ll \text{PORTB5})$ eine Abkürzung für
 $\text{PORTB} = \text{PORTB} | (1 \ll \text{PORTB5})$



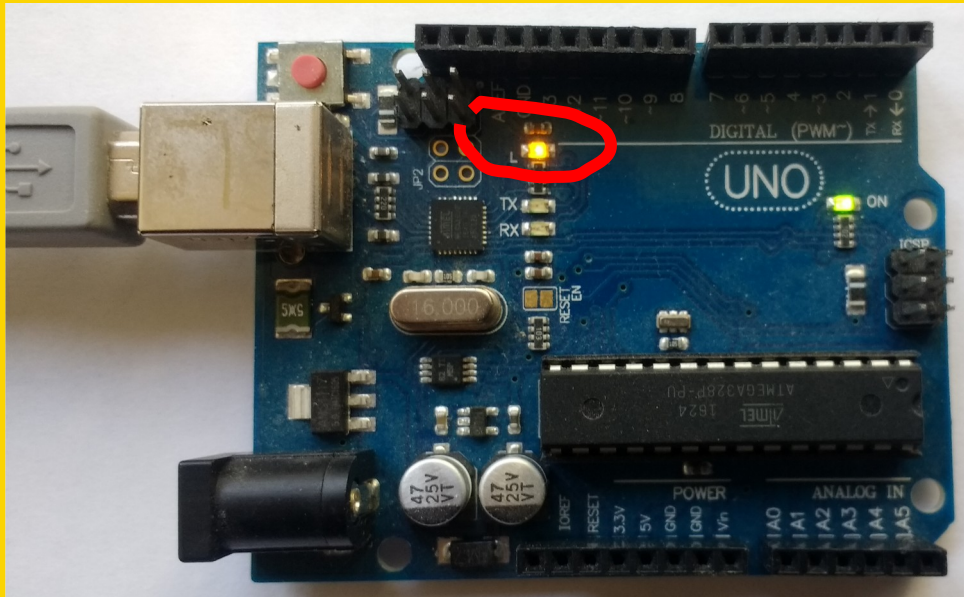
```
Elegoo_01_Start - AtmelStudio
File Edit View VAssistX ASF Project Build Debug Tools Window Help
Debug Debug Browser
main.cpp
main.cpp C:\Users\User\Desktop\Tutorials\Atmel\Software\Elegoo_01_Start\Elegoo_01_Start\main.cpp
40
41 //Variables
42 unsigned char z; //For tests
43
44
45 //Funktionen, declaration
46 void Init (void); //Initialize Microcontroller
47
48
49 //Main routine
50 int main(void) {
51     Init(); //Initialize the MC
52     sei(); //Enable all interrupts
53     cli(); //Clear all interrupts
54     while (1) {
55         //At Pin 5 PORTB the LED of the Arduino board is mounted (Pin 13)
56         PORTB |= (1 << PORTB5); //Push PORTB pin 5 high (LED, pin 13 "Uno")
57         //PORTB &= ~(1 << PORTB5); //~ = "NOT" Operator, 1<<5 shifts the "1" five times to the left
58         //A      not A
59         //0      1
60         //1      0
61         //PINB |= (1<<PINB5); //A "1" to "PIN" toggles the Pin of the PORT
62     }
63 }
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65 //Initialize the Microcontroller
66 void Init (void) {
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68     //0 = Input, 1 = Output
69     DDRB = 0b00100011; //PortB Pin 5 to Output, LED on Arduino Uno board (13)
70 }
71
72
100 %
Output Error List VA Find References Results
```

Compilieren:

das Programm, das wir verstehen,
wird umgewandelt in ein Programm,
das der Mikrocontroller versteht.



Flashen:
das Programm auf den
Mikrocontroller
downloaden.



Elegoo_01_Start - AtmelStudio

File Edit View VAssistX ASF Project Build Debug Tools Window Help

Debug Debug Browser

main.cpp

```
40
41 //Variables
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43
44
45 //Funktionen, declaration
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57         //PORTB &= ~(1 << PORTB5); //~ = "NOT" Operator, 1<<5 shifts the "1" five times to the left
58         //A not A
```

Output

Show output from: Arduino

```
avrdude.exe: 158 bytes of flash written
avrdude.exe: verifying flash memory against C:\Users\User\Desktop\Tutorials\Atmel\Software\Elegoo_01_Start\Elegoo_01_Start\main.cpp
avrdude.exe: load data flash data from input file C:\Users\User\Desktop\Tutorials\Atmel\Software\Elegoo_01_Start\Elegoo_01_Start\main.cpp
avrdude.exe: input file C:\Users\User\Desktop\Tutorials\Atmel\Software\Elegoo_01_Start\Elegoo_01_Start\main.cpp
avrdude.exe: reading on-chip flash data:

Reading | ##### | 100% 0.03s

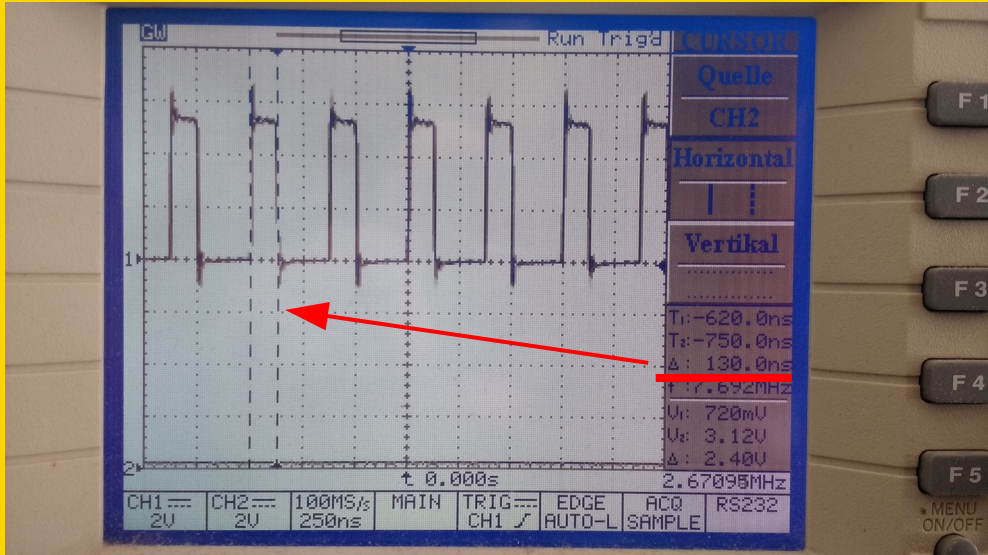
avrdude.exe: verifying ...
avrdude.exe: 158 bytes of flash verified

avrdude.exe done. Thank you.
```

Output Error List VA Find References Results

Ready

Kommentar aufheben:
Eine Zeile ins Programm
aufnehmen.



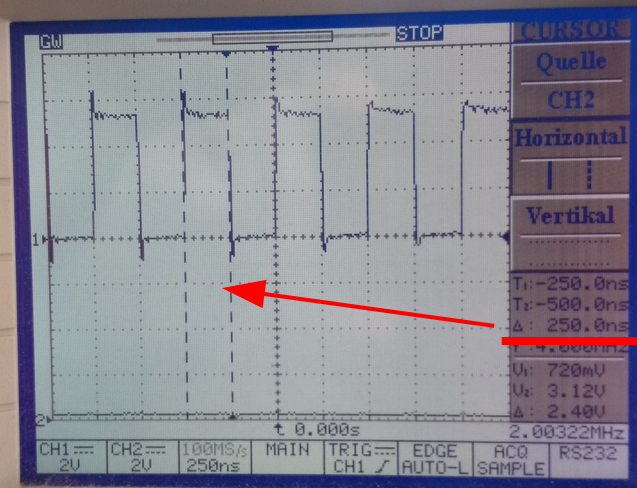
```
Elegoo_01_Start - AtmelStudio
File Edit View VAssistX ASF Project Build Debug Tools Window Help
Debug Debug Browser
main.cpp*
main.while while (1)
40
41 //Variables
42 unsigned char z; //For tests
43
44
45 //Funktionen, declaration
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48 //Main routine
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70 }
71
72
100 %
Output Error List VA Find References Results
Ready
```

Auskommentieren:

Eine Zeile aus dem Programm nehmen.

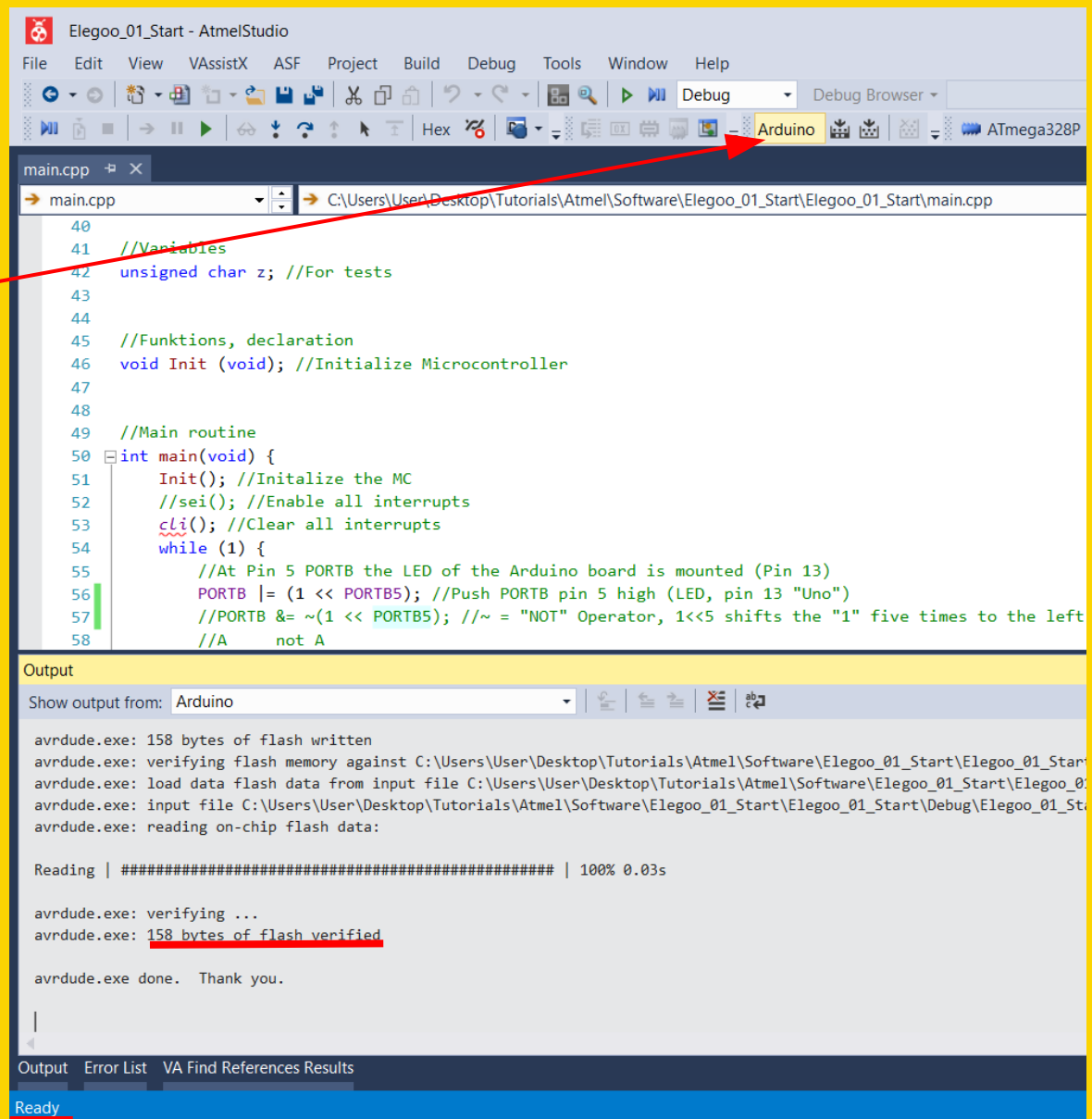
Kommentar aufheben:

Eine Zeile ins Programm aufnehmen.



```
Elegoo_01_Start - AtmelStudio
File Edit View VASistX ASF Project Build Debug Tools Window Help
Debug Debug Browser
main.cpp
main.cpp C:\Users\User\Desktop\Tutorials\Atmel\Software\Elegoo_01_Start\Elegoo_01_Start\main.cpp
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100 %
Output Error List VA Find References Results
Ready
```

Flashen:
das Programm auf den
Mikrocontroller
downloaden.



Montage und Programmierung
eines Roboters für
ROBOCUP JUNIOR RESCUE
mit Elegoo Car Kit
Teil 2.1: Hello World.2

Von Charlotte und Andreas