Binary Representations, Serial Communication and the Atmel 2560

Administration…

- Top Hat or Zyante problems?

Questions?

Quiz

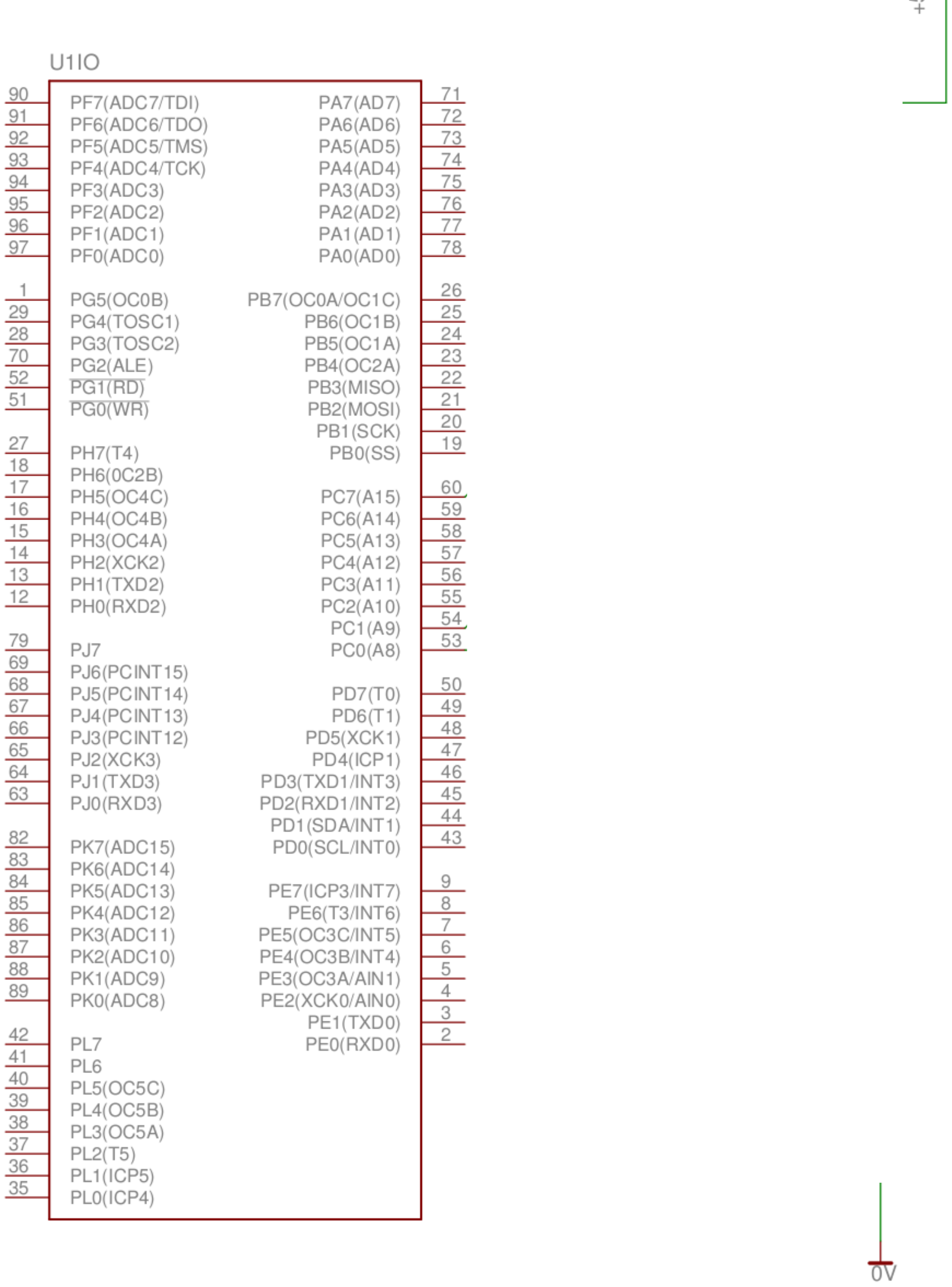
Data Types

- short, long, int: size depends on the particular microprocessor
- In order to be clear about sizes, gcc (our compiler) provides a set of types, including:
  - int8_t   8-bit signed
  - uint16_t   16-bit unsigned

  - Use these for our projects!

Atmel Mega2560 Microcontroller

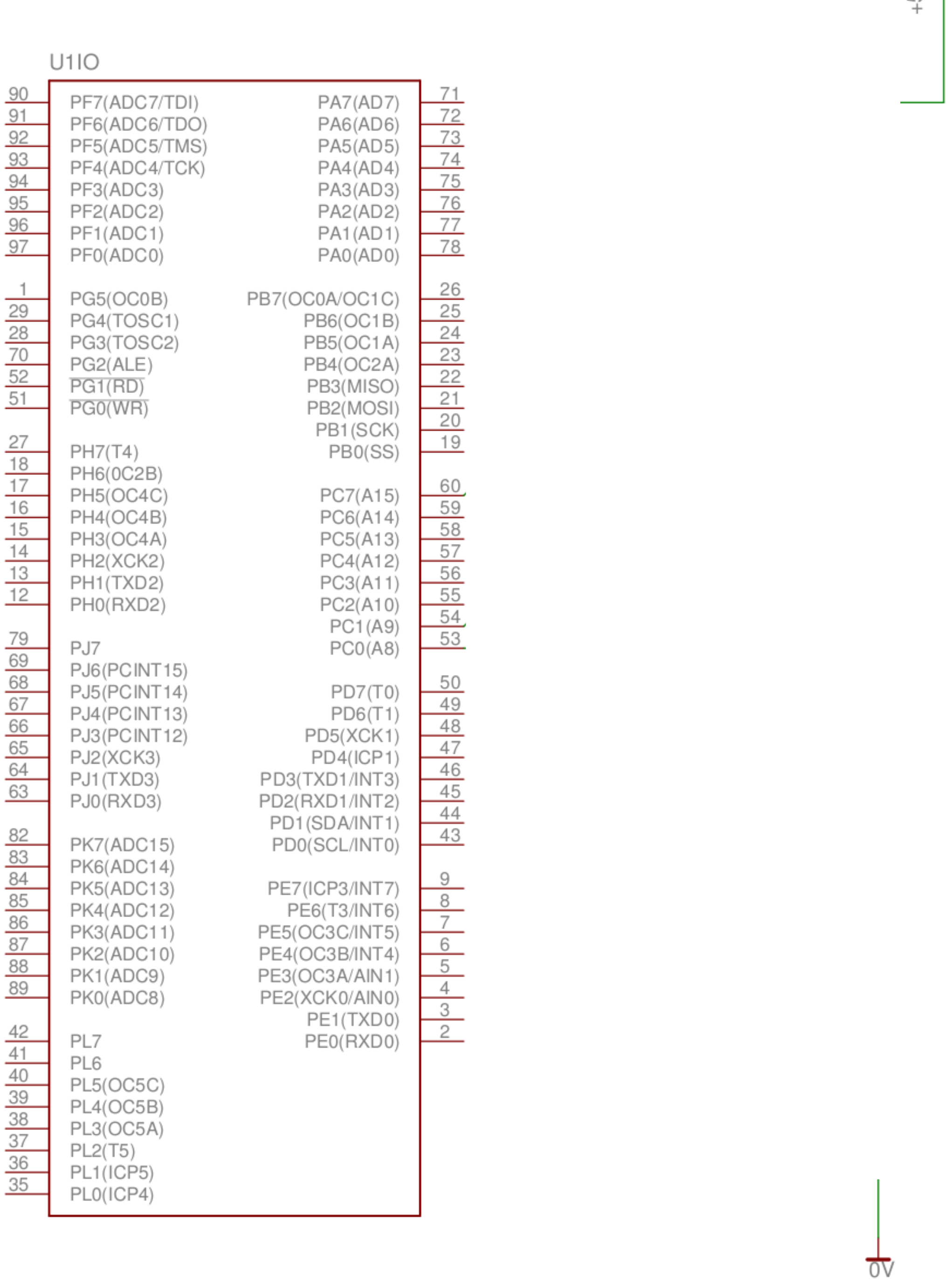
Atmel Mega2560



Atmel Mega2560

Pins are organized into 8-bit “Ports”:

- A, B, C … L
    - But no “I”



Digital Input/Output

- Each port has three special-purpose registers that control its behavior.
- For port B, they are:
  - DDRB: data direction register B
  - PORTB: port output register B
  - PINB: port input B

Data Direction Register: DDRx

- 8-bit wide register
    - Controls one pin with each bit
- 0 -> this is an input pin
- 1 -> this is an output pin

Port Output Register: PORTx

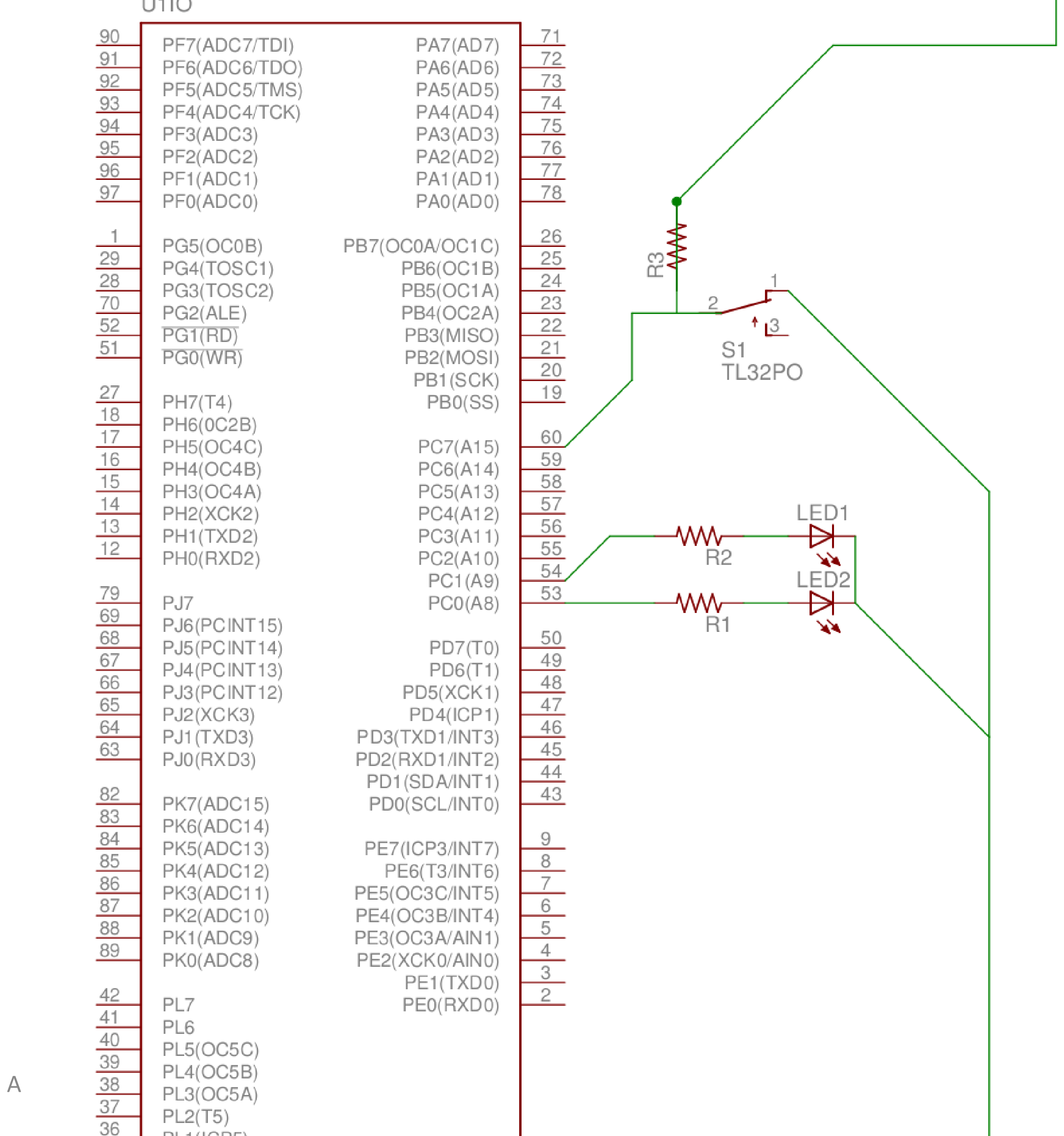
- Also one pin per bit
- If configured as an output:
    - 0 -> the pin is held at 0 V
    - 1 -> the pin is held at +5 V

- Note: only configure pins as an output if you really mean it!

Port INput register: PINx

- One pin per bit
- Reading from the register:
  - 0 -> the voltage of the pin is near 0 V
  - 1 -> the voltage of the pin is near +5 V
- If nothing is connected to the pin, then the pin will appear to be in a random state

A First Circuit

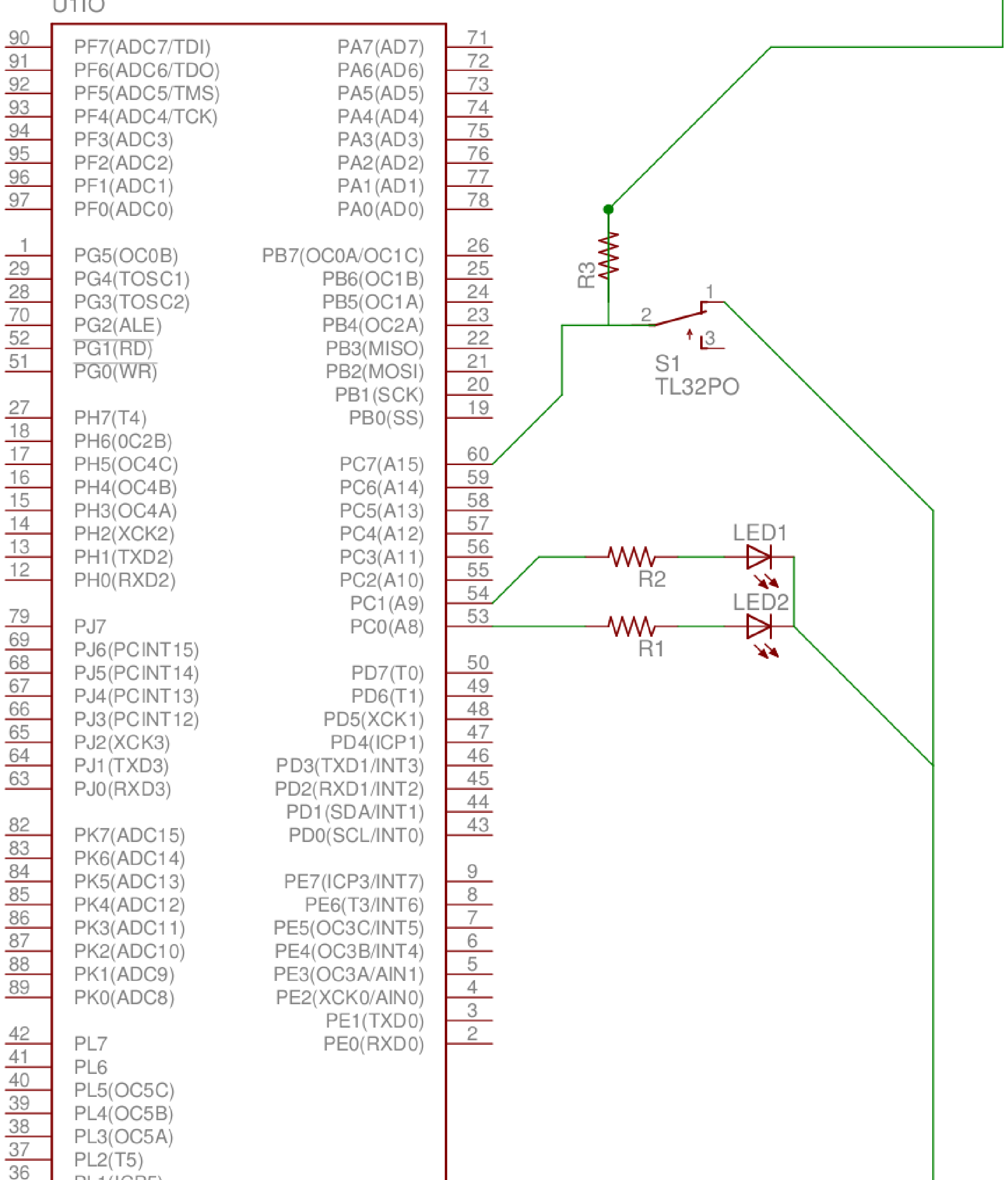


A First Program

Flash the LEDs at a regular interval

- How do we do this?

A



A First Program

```
main() {
   DDRC = 0x3;

   while(1)
   {
        PORTC = 0x1;

        delay_ms(100);

        PORTC = 0x0;

        delay_ms(100);
   }

}
```

A First Program

```
main() {
   DDRC = 0x3;

   while(1) {
        PORTC = 0x1;              // sets PC0 to 1
        delay_ms(100);
        PORTC = 0x0;              // set PC0 to 0
        delay_ms(100);
   }
}
```

A First Program

```
main() {
   DDRC = 1;   // Set port C pin 0 as an output

   while(1) {
       PORTC = PORTC ^ 0x1;   // XOR bit 0 with 1
       delay_ms(500);         // Pause for 500 msec
       }
}
```

A Second Program

```
main() {
   DDRC = 3;   // Set port C pins 0, and 1 as outputs

   while(1) {
       PORTC = 0x3;
       delay_ms(250);
       PORTC = 0x1;
       delay_ms(250);
       PORTC = 0x2;
       delay_ms(250);
       PORTC = 0x0;
       delay_ms(250);
   }
}
```

What does this program do?

A Second Program

```
main() {
   DDRC = 3;   // Set port C pins 0, and 1 as outputs

   while(1) {
       PORTC = 0x3;
       delay_ms(250);
       PORTC = 0x1;
       delay_ms(250);
       PORTC = 0x2;
       delay_ms(250);
       PORTC = 0x0;
       delay_ms(250);
   }
}
```

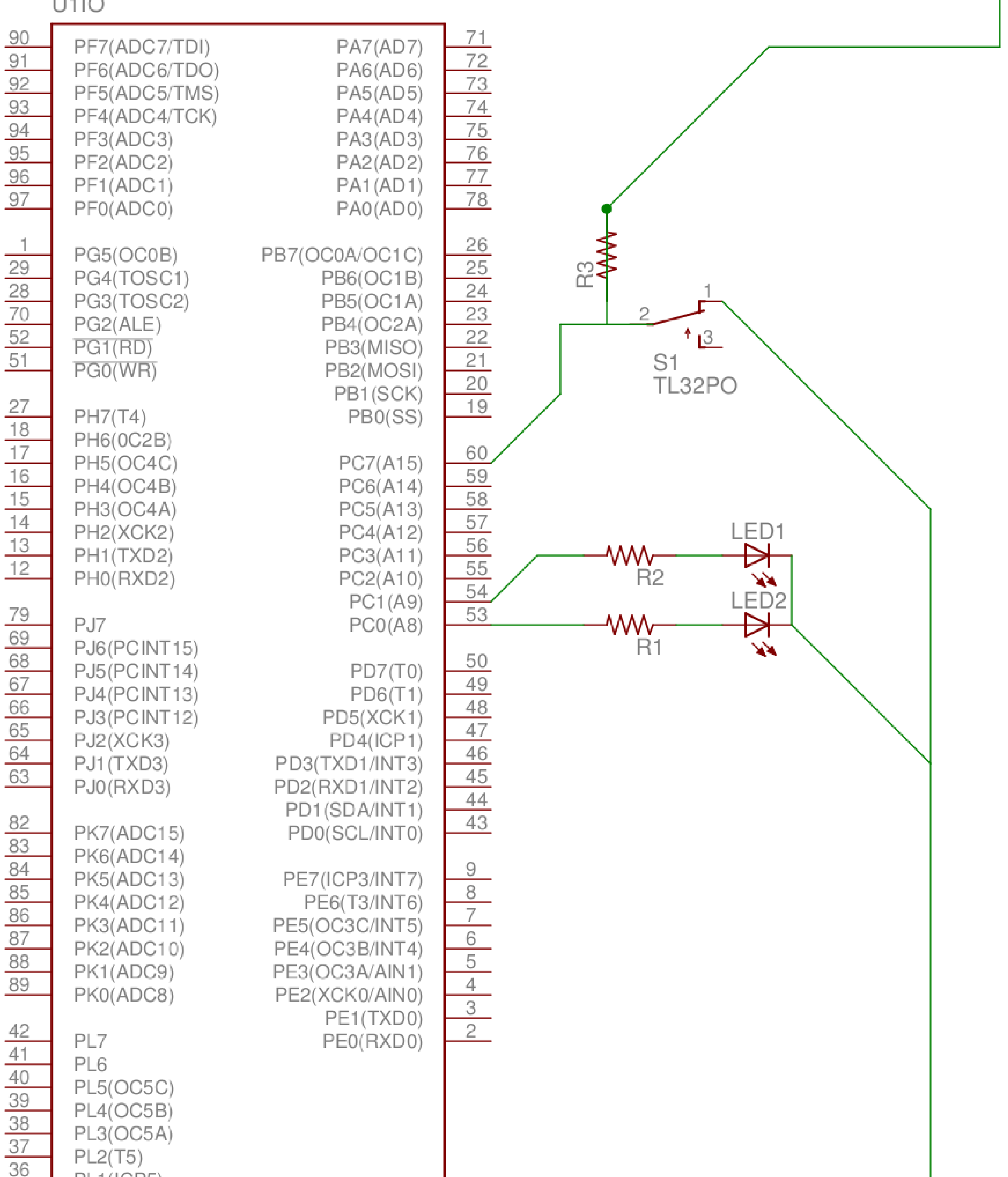
Flashes LED on PC1 at 2 Hz
on PC0: 1 Hz

Duty Cycle for each: 50%

A Third Program

If switch reads zero, turn PC0 on and PC1 off

Otherwize, turn PC0 off and PC1 on



A

A Third Program

```
main() {
   DDRC = 0x3;

   while(1){
        if(PINC & 0x80) {
                PORTC = 1;
        }else{
                PORTC = 2;
        }

   }
}
```

A Third Program

```
main() {
   DDRC = 0x3;

   while(1)
   {
       if(PINC & 0x80) {
             PORTC = 0x2;
       }else{
             PORTC = 0x1;
       }
   }
}
```

Port-Related Registers

Some of the C-accessible registers for controlling digital I/O:

	Directional control	Writing	Reading
Port B	DDRB	PORTB	PINB
Port C	DDRC	PORTC	PINC
Port D	DDRD	PORTD	PIND

Arduino Mega Board

(see schematic)