Lab 1: Git version-control system, AVR tools – David Garcia Torre

1. Submit the GitHub link to your `Digital-electronics-2` repository.

   https://github.com/davidgarcia23/digital-electronics-2

2. What is the meaning of |, &, ^, ~, <<, >> binary operators? Write a truth table and explain the use of operators with examples.

   | → OR

0	**0**	**0**
0	**1**	**1**
1	**0**	**1**
1	**1**	**1**

   & → AND

0	**0**	**0**
0	**1**	**0**
1	**0**	**0**
1	**1**	**1**

   ^ → XOR

0	**0**	**0**
0	**1**	**1**
1	**0**	**1**
1	**1**	**0**

   ~ → Complement

0	**1**
1	**0**

   << → Left shifting.

0001 << 2 → 0100

3. Morse code application.

```
*
 * morse.c
 * Author : TheGT23
 */


/* Defines -----------------------------------------------------------*/
#define LED_GREEN   PB5     // AVR pin where green LED is connected
#define SHORT_DELAY 500      // Delay in milliseconds
#define LONG_DELAY 1000      // Delay in milliseconds

#ifndef F_CPU
#define F_CPU 16000000      // CPU frequency in Hz required for delay
#endif

/* Includes ----------------------------------------------------------*/
#include <util/delay.h>     // Functions for busy-wait delay loops
#include <avr/io.h>         // AVR device-specific IO definitions


#include <avr/io.h>


int main(void){
    // Set pin as output in Data Direction Register
    // DDRB = DDRB or 0010 0000
    DDRB = DDRB | (1<<LED_GREEN);

    // Set pin LOW in Data Register (LED off)
    // PORTB = PORTB and 1101 1111
    PORTB = PORTB & ~(1<<LED_GREEN);

    for(;;) {

       // Letter D

             //LONG

                   // Set pin HIGH in Data Register (LED on)
                   // PORTB = PORTB and 1101 1111
                   PORTB = PORTB  | (1<<LED_GREEN);

                   // Pause several milliseconds
                   _delay_ms(LONG_DELAY);

                   // Set pin LOW in Data Register (LED off)
                   // PORTB = PORTB and 1101 1111
                   PORTB = PORTB & ~(1<<LED_GREEN);

                   // Pause several milliseconds
                   _delay_ms(SHORT_DELAY);

             //SHORT

                   // Set pin HIGH in Data Register (LED on)
                   // PORTB = PORTB and 1101 1111
                   PORTB = PORTB  | (1<<LED_GREEN);

```

```
62.                     // Pause several milliseconds
63.                     _delay_ms(SHORT_DELAY);
64.
65.                     // Set pin LOW in Data Register (LED off)
66.                     // PORTB = PORTB and 1101 1111
67.                     PORTB = PORTB & ~(1<<LED_GREEN);
68.
69.                     // Pause several milliseconds
70.                     _delay_ms(SHORT_DELAY);
71.
72.             //SHORT
73.
74.                     // Set pin HIGH in Data Register (LED on)
75.                     // PORTB = PORTB and 1101 1111
76.                     PORTB = PORTB  | (1<<LED_GREEN);
77.
78.                     // Pause several milliseconds
79.                     _delay_ms(SHORT_DELAY);
80.
81.                     // Set pin LOW in Data Register (LED off)
82.                     // PORTB = PORTB and 1101 1111
83.                     PORTB = PORTB & ~(1<<LED_GREEN);
84.
85.                     // Pause several milliseconds
86.                     _delay_ms(SHORT_DELAY);
87.
88.
89.       // Letter E
90.
91.             //SHORT
92.
93.                     // Set pin HIGH in Data Register (LED on)
94.                     // PORTB = PORTB and 1101 1111
95.                     PORTB = PORTB  | (1<<LED_GREEN);
96.
97.                     // Pause several milliseconds
98.                     _delay_ms(SHORT_DELAY);
99.
100.                            // Set pin LOW in Data Register (LED off)
101.                            // PORTB = PORTB and 1101 1111
102.                            PORTB = PORTB & ~(1<<LED_GREEN);
103.
104.                            // Pause several milliseconds
105.                            _delay_ms(SHORT_DELAY);
106.
107.
108.            // Number 2
109.
110.                    //SHORT
111.
112.                            // Set pin HIGH in Data Register (LED on)
113.                            // PORTB = PORTB and 1101 1111
114.                            PORTB = PORTB  | (1<<LED_GREEN);
115.
116.                            // Pause several milliseconds
117.                            _delay_ms(SHORT_DELAY);
118.
119.                            // Set pin LOW in Data Register (LED off)
120.                            // PORTB = PORTB and 1101 1111
121.                            PORTB = PORTB & ~(1<<LED_GREEN);
122.
123.                            // Pause several milliseconds
```

```
124.                        _delay_ms(SHORT_DELAY);
125.
126.                    //SHORT
127.
128.                        // Set pin HIGH in Data Register (LED on)
129.                        // PORTB = PORTB and 1101 1111
130.                        PORTB = PORTB  | (1<<LED_GREEN);
131.
132.                        // Pause several milliseconds
133.                        _delay_ms(SHORT_DELAY);
134.
135.                        // Set pin LOW in Data Register (LED off)
136.                        // PORTB = PORTB and 1101 1111
137.                        PORTB = PORTB & ~(1<<LED_GREEN);
138.
139.                        // Pause several milliseconds
140.                        _delay_ms(SHORT_DELAY);
141.
142.                    //LONG
143.
144.                        // Set pin HIGH in Data Register (LED on)
145.                        // PORTB = PORTB and 1101 1111
146.                        PORTB = PORTB  | (1<<LED_GREEN);
147.
148.                        // Pause several milliseconds
149.                        _delay_ms(LONG_DELAY);
150.
151.                        // Set pin LOW in Data Register (LED off)
152.                        // PORTB = PORTB and 1101 1111
153.                        PORTB = PORTB & ~(1<<LED_GREEN);
154.
155.                        // Pause several milliseconds
156.                        _delay_ms(SHORT_DELAY);
157.
158.                    //LONG
159.
160.                        // Set pin HIGH in Data Register (LED on)
161.                        // PORTB = PORTB and 1101 1111
162.                        PORTB = PORTB  | (1<<LED_GREEN);
163.
164.                        // Pause several milliseconds
165.                        _delay_ms(LONG_DELAY);
166.
167.                        // Set pin LOW in Data Register (LED off)
168.                        // PORTB = PORTB and 1101 1111
169.                        PORTB = PORTB & ~(1<<LED_GREEN);
170.
171.                        // Pause several milliseconds
172.                        _delay_ms(SHORT_DELAY);
173.
174.                    //LONG
175.
176.                        // Set pin HIGH in Data Register (LED on)
177.                        // PORTB = PORTB and 1101 1111
178.                        PORTB = PORTB  | (1<<LED_GREEN);
179.
180.                        // Pause several milliseconds
181.                        _delay_ms(LONG_DELAY);
182.
183.                        // Set pin LOW in Data Register (LED off)
184.                        // PORTB = PORTB and 1101 1111
185.                        PORTB = PORTB & ~(1<<LED_GREEN);
```

```
186.
187.                             // Pause several milliseconds
188.                             _delay_ms(SHORT_DELAY);
189.
190.           }
191.       }
192.
```

- Screenshot of SimulIDE circuit.