

Computer Technology (1DT301)

#### *Lab 1:*

(How to use the PORTs, Digital input/output, Subroutine call)

#### Authors:

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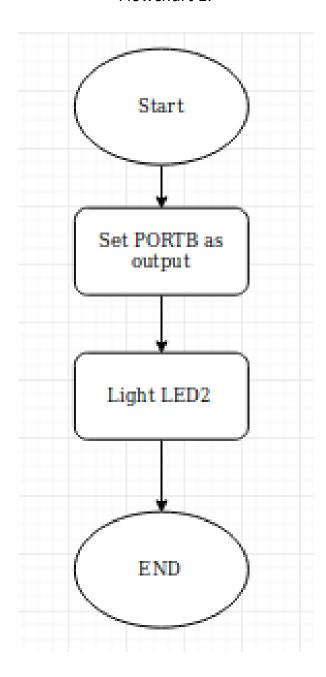
Task 1:	
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Task 4:	
Task 5:	
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### Task 1:

Write a program in Assembly language to light LED 2. You can use any of the four ports, but start with PORTB. The program should be very short! How many instructions is minimum number?

```
; 1DT301, Computer Technology I
  ; Date: 2019-09-09
4
   ; Author: Andrei Neagu(an223kj)
             Konstantinos Tatsis (kt222iq)
6
   ; Lab number:
  ; Title:
8
                      How to use the PORTs. Digital input /output.
9
                      Subroutine call.
11 ; Hardware:
                    STK600, CPU ATmega2560
  ; Function: Lights LED2 on PORTB
14
   ; Input ports:
                      No input used
16 ;
  ; Output ports:
                      PIN2 on PORTB
18
   ; Subroutines:
                      No subroutines used
  ; Included files: m2560def.inc
  ; Other information: In order to light a led, you have to set
24
                                         the number of the PIN you want to use as 0
                                         For example: LED2 on would be 0b11111011
  ; Changes in program:
28
                                         2019-09-09
   .include "m2560def.inc"
34 ldi r16, 0b00000100 ; Loading bit value to the register
35 out DDRB, r16; Writing to "Data Direction register for port B" the bit value that we loaded above.
```

#### Flowchart 1:

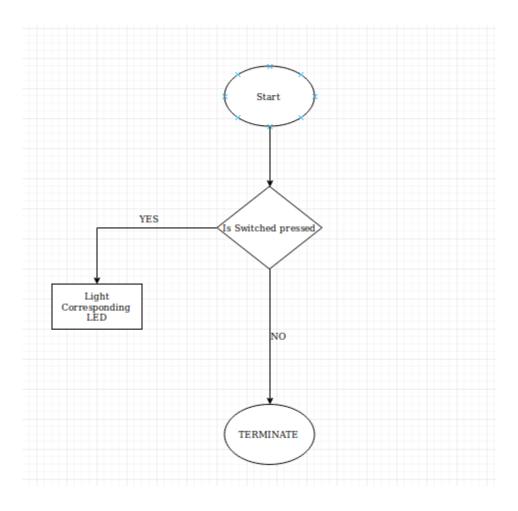


#### Task 2:

Write a program in Assembly language to read the switches and light the corresponding LED. Example: When you press SW5, LED5 so should light. Make an initialization part of the program and after that an infinite loop.

```
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            Konstantinos Tatsis (kt222iq)
7 ; Lab number:
8 ; Title:
                     How to use the PORTs. Digital input /output.
                      Subroutine call.
9 ;
10 ;
  ; Hardware: STK600, CPU ATmega2560
   ; Function: Light LED in PORTB corresponding its Switch in PORTA
14
   ; Input ports:
                     PORTA
16
   ; Output ports: PORTB
   ; Subroutines: No subroutines used
20
   ; Included files: m2560def.inc
  ; Other information: In order to light a led, you have to press
                                           a switch. The input from the switch will
                                           activate the corresponding led.
26
27 ; Changes in program:
28
                                      2019-09-09
29
30
   .include "m2560def.inc"
  loop:
   ldi r17,0b000000000; loads the binary value to 17
38
   out DDRA,r17 ; sets PORTA using DDRA as a input port using the binary value stored r17
   ldi r17, 0b11111111 ;loads the binary value to 17
                      ; sets PORTB using DDRB as an output port using the binary value stored r17
   in r17, PINA ;loads the inputted pin address of port A to r17
43
44
   out PORTB, r17 ; outputs the value of r17 to PORTB
45
46 rjmp loop
```

#### Flowchart 2:

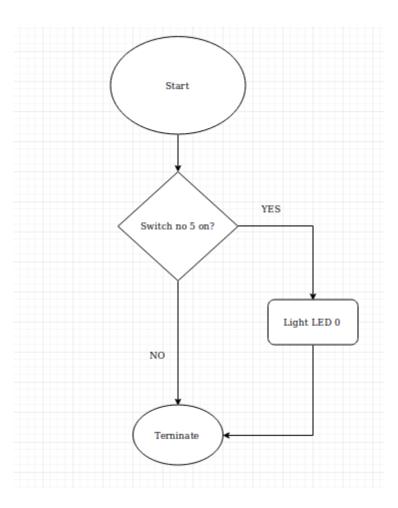


### Task 3:

Write a program in Assembly language to read the switches and light LEDO when you press SW5. For all other switches there should be no activity.

```
2 ; 1DT301, Computer Technology I
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4 ; Author: Andrei Neagu (an223kj)
              Konstantinos Tatsis (kt222iq)
    ; Lab number:
   ; Title:
8
                         How to use the PORTs. Digital input /output.
9
                        Subroutine call.
10
                        STK600, CPU ATmega2560
11 ; Hardware:
                        Light LED0 if SW5 is pressed
13
       Function:
14
                         PORTA
       Input ports:
17 ; Output ports:
                        PORTB
18 ;
19 ;
       Subroutines:
                       No subroutines used
20
       Included files: m2560def.inc
       Other information: If other switch rather than switch 5 is pressed
24
                                               no led should light.
26 ; Changes in program:
27 ;
                                               2019-09-09
28
   .include "m2560def.inc"
    ldi r16, 0b1111_1111 ;value to set the DDRB as outputs
   out DDRB, r16 ;sets PORTB using DDRB as a output port using the binary value stored r1
34
35 ldi r16, 0b0000_0000 ;value to set the DDRA as inputs
36 out DDRA, r16 ;sets PORTA using DDRA as a input port using the binary value stored r16
38 ldi r16, 0b1111_1111 ;turn off the leds
    out portB, r16
40
41
    ldi r18, 0b1101_1111 ; when sw5 is pressed PINA5 is 0
42
    ldi r19, 0b1111_1110 ;code for LED0
43
44 loop:
45
          in r17, PINA ; read PINA
46
          cp r17, r18; compare r18 and r17
           breq equal; if r17 equal to r18 go to light
47
48 rjmp loop
```

#### Flowchart 3:



# Task 4:

Task 4 must be performed on the computer cannot be displayed. Continue to task 5.

#### Task 5:

Write a program in Assembly language that creates a Ring Counter. The values should be displayed with the LEDs. Use shift instructions, LSL or LSR. Make a delay of approximately 0.5 sec in between each count. Write the delay as a subroutine. For using the subroutine, you must initialize the Stack Pointer, SP. Include the following instructions in beginning of your program:

\_\_\_\_\_\_

```
; Initialize SP, Stack Pointer

Idi r20, HIGH(RAMEND); ; R20 = high part of RAMEND address

out SPH,R20; ; SPH = high part of RAMEND address

Idi R20, Iow(RAMEND) ; R20 = Iow part of RAMEND address

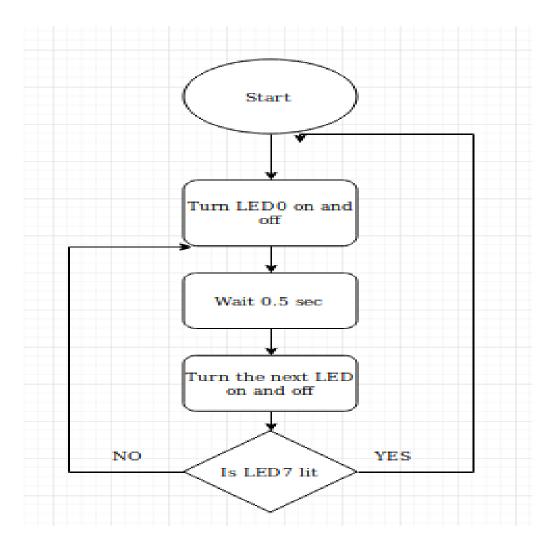
out SPL,R20 ; SPL = Iow part of RAMEND address
```

\_\_\_\_\_\_

```
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     Date: 2019-09-09
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            Konstantinos Tatsis (kt222iq)
     Lab number:
      Title:
                     How to use the PORTs. Digital input /output.
                     Subroutine call.
                     STK600, CPU ATmega2560
11
      Hardware:
12
13 ;
      Function:
                     Ring counter with a delay of 500ms
14 ;
      Input ports:
16
      Output ports: PORTB
17
      Subroutines: Delay
   ; Included files: m2560def.inc
21
22
     Other information: Ring counter with a delay of 500ms
     Changes in program:
                                        2019-09-09
   ;<<<<<<<<<<<<<<<<<
```

```
.include "m2560def.inc"
      ldi R20, HIGH (RAMEND)
      out SPH, R20
 34
      ldi R20, low(RAMEND)
       out SPL, R20
      start:
      ldi r16, 0x0000_0001
 38
                              ;initial led state
      out DDRB, R16
 39
                                            ;initial output to LED0
      rcall delay
                                            ;call delay of 500ms
 43
      loop:
 44
      lsl R16
                                                    ;shift bits to the left
      out DDRB, R16
                                            ;output of shifted value again
      cpi R16, 0x00
                                            ;if r16 equals to 0x00 then restart loop
      breq again
                                                    ;by going to again
      rcall delay
                                            ;delay again
      rjmp loop
                                                    ;repeat if not equal to 0x00
       again:
      rjmp start
 54
      delay:
                                                    ;this delay is approx 500ms
           ldi r18, 5
         ldi r19, 15
         ldi r20, 242
 58
     L1: dec r20
 59
         brne L1
         dec r19
 61
         brne L1
         dec r18
         brne L1
 64
67 RET
```

#### Flowchart 5:



### Task 6:

Write a program in Assembly language that creates a Johnson Counter in an infinite loop.

```
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   ; Date: 2019-09-09
   ; Author: Andrei Neagu (an223kj)
            Konstantinos Tatsis (kt222ig)
   ; Lab number:
                     1
   ; Title:
8
                     How to use the PORTs. Digital input /output.
                     Subroutine call.
18 ;
11
     Handware:
                     STK600, CPU ATmega2560
12
   ; Function: Program with Johnson Counter with an infinite loop
13
14.
15 ; Input ports:
16
17 ; Output ports: PORTB
18.
19 ; Subroutines: Delay
21 ; Included files: m2560def.inc
  ; Other information: Program with Johnson Counter with an infinite loop
25 ; Changes in program:
                                         2819-89-89
26
  .include "m2560def.inc"
31
   ldi r20, HIGH (RAMEND)
   out SPH, R20 ; SPH high part of the RAMEND
    ldi R20, low (RAMEND)
    out SPL, R28
                    ; SPL low pard of RAMEND
    ldi r16, 0xFF
    out DDRB, r16 ; DDRB is set as an output port
    ldi r21, 0b1111_1110 ; initial led state
                  ; leds off
    ldi r22, exFF
41
    ldi r23, 0x00
                    ; leds on
```

```
42
      loop:
43
              out PORTB, r21 ; initial led state
                               ; shift leds to left
              LSL r21
45
              CALL Delay
                               ; delay of 500ms
46
47
                               ; when r21 equals to r23 go to light
              cp r21, r23
              breq light
     rjmp loop
51
     light:
54
                                    ; leds on
              out PORTB, r23
                                     ; delay of 500ms
              CALL Delay
              ldi r21, 0b1000_0000 ; initialize the leds to go to the right
              out PORTB, r21
              Sec loop:
                                                 ; initialize the leds to go to th
                             out PORTB, r21
                             ASR r21
                                                 ; shift the bits to the right
                                                 ; delay of 500ms
61
                             CALL Delay
                                                 ; if r21 equals r22 go back to lc
                             cp r21, r22
                             breg loop
                     rjmp Sec loop
     Delay:
              ldi r18, 21
              ldi r19, 140
              ldi r20, 174
    L1: dec r20
71
72
              brne L1
              dec r19
74
              brne L1
              dec r18
              brne L1
              rjmp PC+1
77
78.
     RET
```

Flowchart 6:

