Computer Technology I

Lab. 1 : How to use the PORTs, Digital input/output, Subroutine call

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Area: Computer Science
Course code: 1DT301

Contents

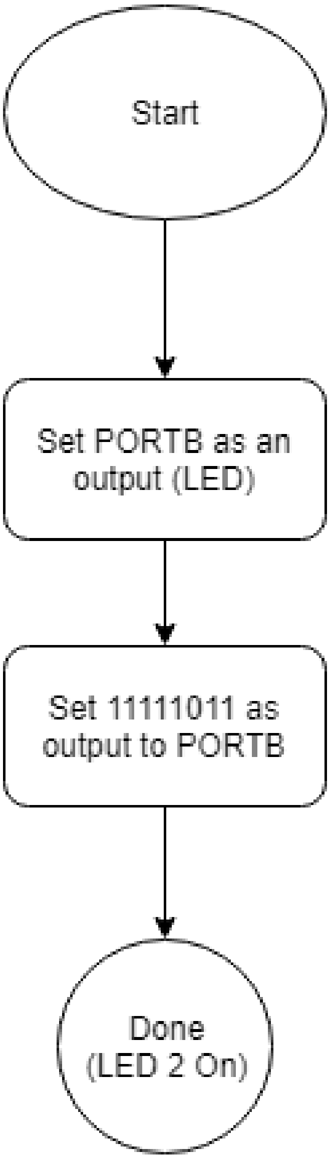
1 Task 1

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
; Author:
; Loic GALLAND
; Leonardo PEDRO
;
; Lab number: 1
; Title: How to use the PORTs. Digital input/output. Subroutine call.
;
; Hardware: STK600, CPU ATmega2560
;
; Function: Program to light up the LED number 2

; Input ports: NO inputs ports in this Task
;
; Output ports: The portB is used as an output port
;
; Subroutines: If applicable.
; Included files: m2560def.inc
;
; Other information:
;
; Changes in program: (Description and date)
;
;<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<

.includes "m2560def.inc"
ldi r16, 0xFF
out DDRB, r16

ldi r16 , 0b11111011
out portB, r16
```

To be able to light up the LEDs we need 4 lines of code. The first line is to store into the register r16 the value 0xFF. In the second line the register r16 is loaded to DDRB (Data Direction Register of port B). In the third line the desired binary code is stored into register r16. The binary number will determine which LED will light up. In the last line the register r16 is loaded into the PortB (Data Register of Port B).

This is the flowchart of the task 1:

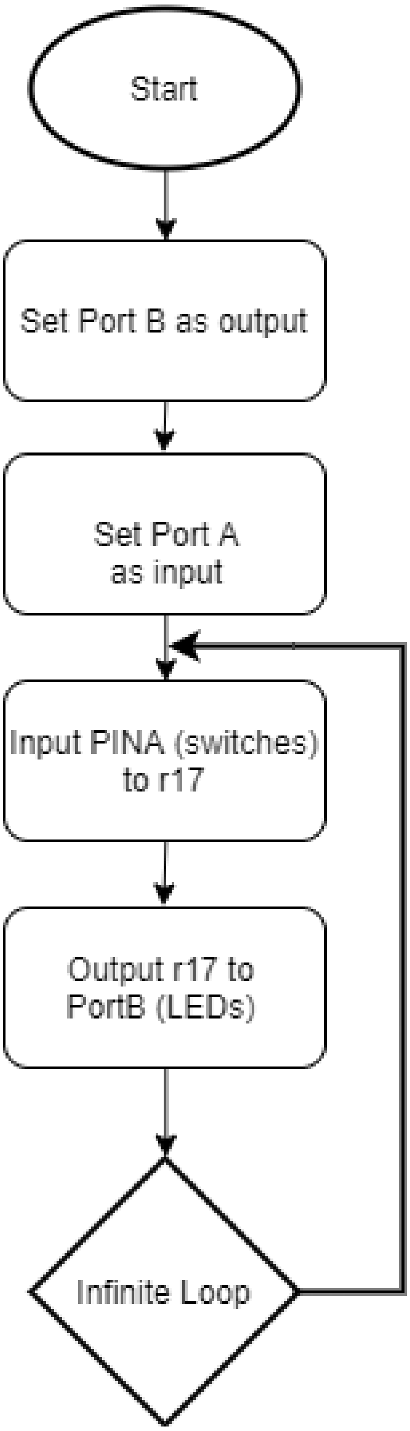


2 Task 2

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.

```
;>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>
; 1DT301, Computer Technology I
; Date: 2019-09-09
; Author:
; Loic GALLAND
; Leonardo PEDRO
;
; Lab number: 1
; Title: How to use the PORTs. Digital input/output. Subroutine call.
;
; Hardware: STK600, CPU ATmega2560
;
; Function: Program to light up the LED correponding to the switch. EX:
     (Switch number 1 will light up LED number 1)

; Input ports: PortA is used as input to get the information from the
    switches
;
; Output ports: The portB is used as an output ports to control the
    LEDs
;
; Subroutines: If applicable.
; Included files: m2560def.inc
;
; Other information:
;
; Changes in program: (Description and date)
;
;<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<

.include "m2560def.inc"
ldi r16, 0xFF            ;Setting up the data direction for Port B
out DDRB, r16            ;Set port B as output

ldi r16, 0x00            ;Setting up the data direction for Port A
out DDRA, r16            ;Set Port A as output

my_loop:                 ;Loop to always check which switch is pressed
        in r17,PINA ;Getting the information of which switch is pressed
        out portB, R17   ;Lighting up the corresponding LED
rjmp my_loop
```

This is the flowchart for Task 2:



3 Task 3

This is the code for the third task:

```
;>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>
; 1DT301, Computer Technology I
; Date: 2019-09-09
; Author:
; Loic GALLAND
; Leonardo PEDRO
;
; Lab number: 1
; Title: How to use the PORTs. Digital input/output. Subroutine call.
;
; Hardware: STK600, CPU ATmega2560
;
; Function: Program to only light up LED number 0 if the switch number
   5 is pressed. If any other switch is pressed, nothing will happen

; Input ports: The Port A will be used as an input port in this Task
;
; Output ports: The portB is used as an output port
;
; Subroutines: If applicable.
; Included files: m2560def.inc
;
; Other information:
;
; Changes in program: (Description and date)
;
ldi r16, 0xFF           ;Setting up the data direction for Port B
out DDRB, r16           ;Set port B as output

ldi r16, 0x00           ;Setting up the data direction for Port A
out DDRA, r16           ;Set Port A as output

ldi r16, 0xFF           ;Turn off all the LEDs
out portB, r16

ldi r18, 0b11011111
ldi r19, 0b11111110

my_loop:
        in r17, PINA    ;get the info from the switch
        cp r17, r18     ;compare switch info with desired one
        breq light      ;condition if r17=r18 go to the "light"
rjmp my_loop

light: out portB,r19    ;turns on the LED0
```

4 Task 5

This is the code for the fifth task:

```
;>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>
; 1DT301, Computer Technology I
; Date: 2019-09-09
; Author:
; Loic GALLAND
; Leonardo PEDRO
;
; Lab number: 1
; Title: How to use the PORTs. Digital input/output. Subroutine call.
;
; Hardware: STK600, CPU ATmega2560
;
; Function: Create a program that creates a Ring Counter with a delay
   of approximately 0.5 seconds between each step.

; Input ports: NO inputs ports in this Task
;
; Output ports: The portB is used as an output port
;
; Subroutines: A subroutine will be used when creating the 0.5 second
   delay.
; Included files: m2560def.inc
;
;<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<

.includes "m2560def.inc"

; Initialize SP, Stack Pointer
ldi r20, HIGH(RAMEND)   ; R20 = high part of RAMEND address
out SPH,R20             ; SPH = high part of RAMEND address
ldi R20, low(RAMEND)    ; R20 = low part of RAMEND address
out SPL,R20             ; SPL = low part of RAMEND address

ldi r16, 0xFF           ;Setting up the data direction for Port B
out DDRB, r16           ;Set port B as output

ldi r17, 0b11111110     ;Initial LED state
out PortB, r17

my_loop:
        out portB, r17
        CALL Delay
        com r17
        LSL r17
        com r17
rjmp my_loop

Delay:
;Generated by delay loop calculator
:at http://www.bretmulvey.com/avrdelay.html
;
;Delay 4 050 000 cycles
;500ms at 8.1 MHz

        ldi r18, 21
        ldi r19, 140
        ldi 20, 174
L1:     dec r20
        brne L1
        dec r19
        brne L1
        dec r18
        brne L1
        rjmp PC+1
RET
```

5 Task 6

This is the code for the sixth task:

```
;>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>
; 1DT301, Computer Technology I
; Date: 2019-09-09
; Author:
; Loic GALLAND
; Leonardo PEDRO
;
; Lab number: 1
; Title: How to use the PORTs. Digital input/output. Subroutine call.
;
; Hardware: STK600, CPU ATmega2560
;
; Function: Creates a program that creates a Johnson Counter in an
   infinite loop

; Input ports: NO inputs ports in this Task
;
; Output ports: The portB is used as an output port
;
; Subroutines: To be able to use the delay
; Included files: m2560def.inc
;<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<

.includes "m2560def.inc"

; Initialize SP, Stack Pointer
ldi r20, HIGH(RAMEND)    ; R20 = high part of RAMEND address
out SPH,R20              ; SPH = high part of RAMEND address
ldi R20, low(RAMEND)     ; R20 = low part of RAMEND address
out SPL,R20              ; SPL = low part of RAMEND address

ldi r16, 0xFF    ;Setting up the date direction register for Port B
out DDRB, r16    ;Set port B as output

ldi r16, 0xFF
out portB, r16

ldi r21, 0b11111110      ;Initial LED state
ldi r22, 0xFF    ;When all the LEDs are turned off
ldi r23, 0x00    ;When all the LEDs are turned on

my_loop:
        out portB, r21
        LSL r21
        CALL Delay
        ;Compare the current status of the LEDs to check if they are
           all turned on.
        cp r21, r23
        breq light
rjmp my_loop

light:
        out portB, r23
        CALL Delay
        ldi r21, 0b10000000
        out portB, r21
        Second_loop:
                out portB, r21
                ASR r21
                CALL Delay
                cp r21, r22                 ;Compare the current status to know if it needs to start going the other way
                breq my_loop
        rjmp Second_loop

Delay:
;Generated by delay loop calculator
:at http://www.bretmulvey.com/avrdelay.html
;
;Delay 4 050 000 cycles
;500ms at 8.1 MHz

        ldi r18, 21
        ldi r19, 140
        ldi 20, 174
L1:     dec r20
        brne L1
        dec r19
        brne L1
        dec r18
        brne L1
        rjmp PC+1
RET
```