El toolchain de GNU

Programació a Baix Nivell – iTIC

Sebastià Vila-Marta

Escola Politècnica Superior d'Enginyeria de Manresa Universitat Politècnica de Catalunya

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led.c

```
#include <avr/io.h>
#include <util/delay.h>
int main (void) {
  uint8_t counter;
  DDRB = 0xFF; /* port B en mode output */
  while (1) {
    PORTB = 0xFF:
    for (counter = 0; counter != 5; counter++)
     delay loop 2(30000);
    PORTB = 0x00:
    for (counter = 0; counter != 50; counter++)
     _delay_loop_2(30000);
 return 1;
```

led.c preprocessat

```
int main (void) {
  uint8 t counter;
  (*(volatile uint8_t *)((0x04) + 0x20)) = 0xFF;
  while (1) {
    (*(volatile uint8_t *)((0x05) + 0x20)) = 0xFF;
    for (counter = 0; counter != 5; counter++)
      _delay_loop_2(30000);
    (*(volatile uint8 t *)((0x05) + 0x20)) = 0x00;
    for (counter = 0; counter != 50; counter++)
      delay loop 2(30000);
  return 1;
```

led.c traduït

```
.file "led.c"
                                                    movw r24, r20
         _{\rm _{zero_{reg_{-}}}} = 1
                                           1: sbiw r24,1
                                                    brne 1b
        text
        .global main
                                                    movw r24, r20
        .type main, @function
                                           1: sbiw r24,1
main:
                                                    brne 1b
        Idi r24, lo8(-1)
                                                    movw r24, r20
        out 36-32.r24
                                           1: sbiw r24,1
        Idi r19, lo8(-1)
                                                    brne 1b
        Idi r20,lo8(30000)
                                                    out 37-32, zero reg
        Idi r21,hi8(30000)
                                                    Idi r18, lo8(0)
.L3: out 37–32,r19
                                           .L2: movw r24, r20
        movw r24, r20
                                           1: sbiw r24,1
1: sbiw r24.1
                                                    brne 1b
        brne 1b
                                                    subi r18, lo8(-(1))
                                                    cpi r18, lo8(50)
        movw r24, r20
1: sbiw r24.1
                                                    brne .L2
        brne 1b
                                                    rimp .L3
                                                    .size main, .-main
```

Makefile del projecte

```
.PHONY: implanta

led.hex: led
    avr-objcopy -Oihex led led.hex

led.o: led.c
    avr-gcc -Os -mmcu=atmega328p -DF_CPU=16000000UL -c led.c

led: led.o
    avr-gcc -mmcu=atmega328p -o led led.o

implanta:
```

sudo avrdude —c arduino —p atmega328p —P /dev/ttyACM0 —U led.hex