Programmazione Microcontrollori

Programmazione Microcontrollori

Cosa Serve

- PC with **Windows** (XP / Vista / 7 / 8 /…)
- Development **board (STM32-XX Discovery)**
- MINI **USB** cable
- **Keil uVision IDE** for **ARM**

Keil uVision IDE for ARM

- Download the product from:

  http://www.keil.com/arm/mdk.asp

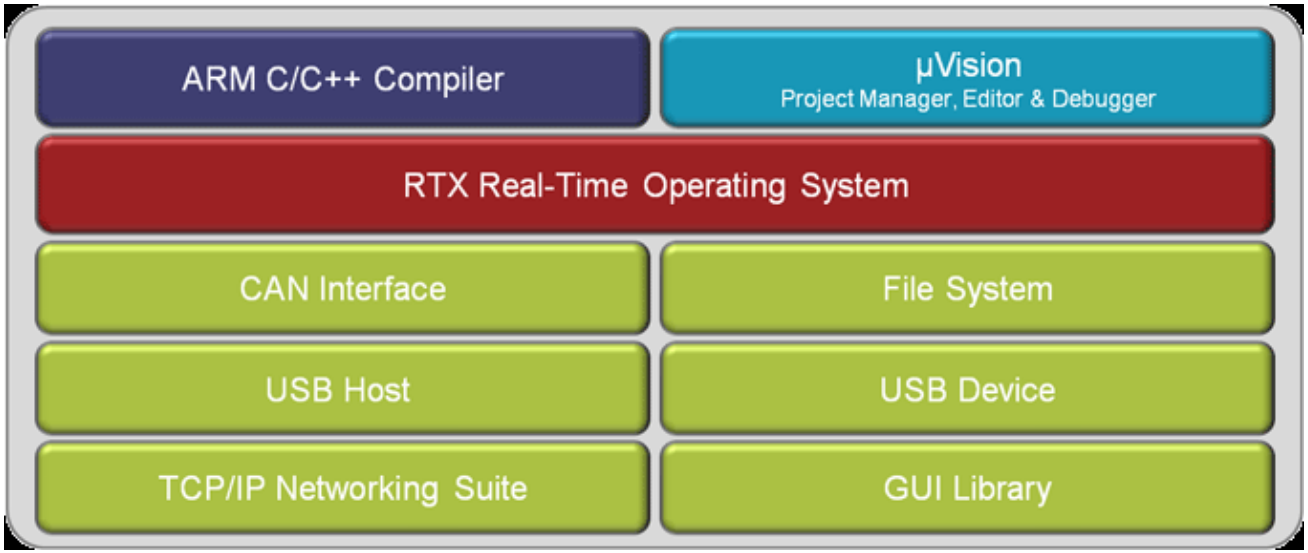
- Run the downloaded executable

- Follow the instructions displayed by the SETUP program

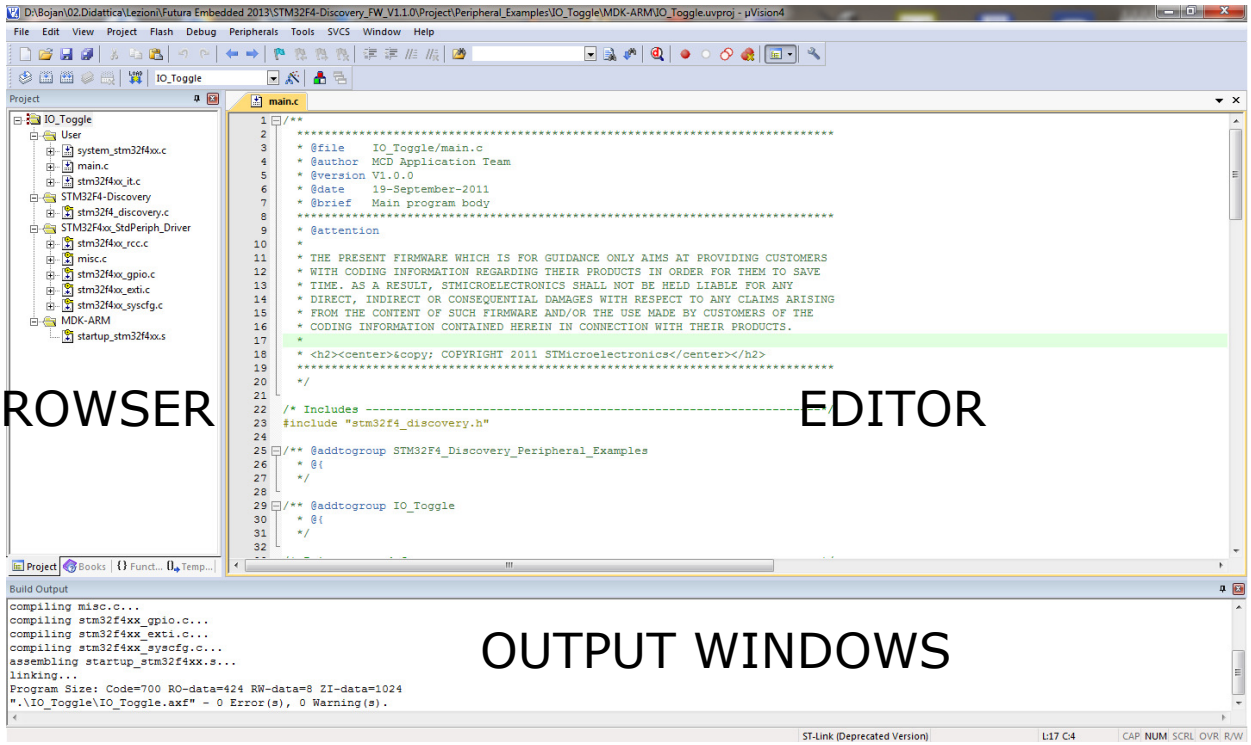
- Install ST-Link Driver and update ST-Link Firmware

Keil uVision IDE for ARM

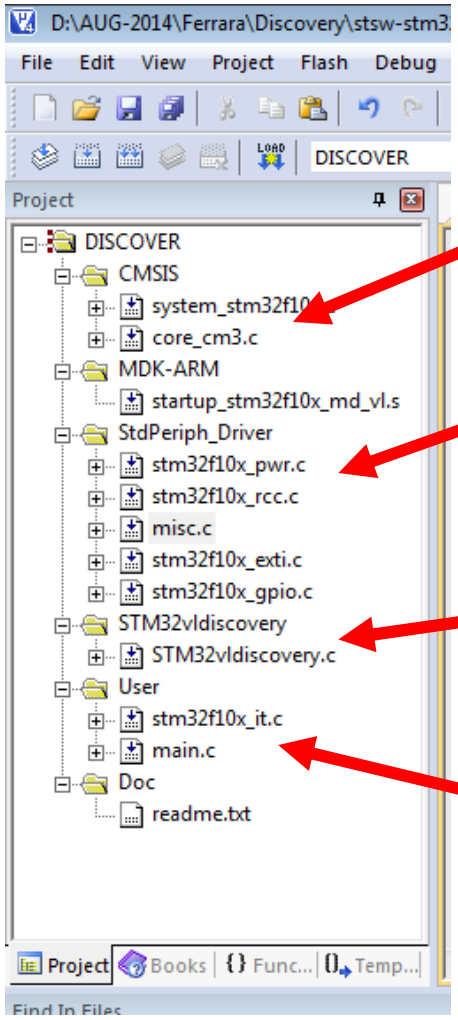
The MDK-ARM is a complete software development environment for Cortex™-M, Cortex-R4, ARM7™ and ARM9™ processor-based devices. MDK-ARM is specifically designed for microcontroller applications, it is easy to learn and use, yet powerful enough for the most demanding embedded applications.



Keil uVision IDE for ARM



Keil uVision IDE for ARM



Core library CMSIS and MDK-ARM (startup and system)

ST StdPeriph_Driver library (on-chip devices init and use)

Discovery Library (on-board devices init and use)

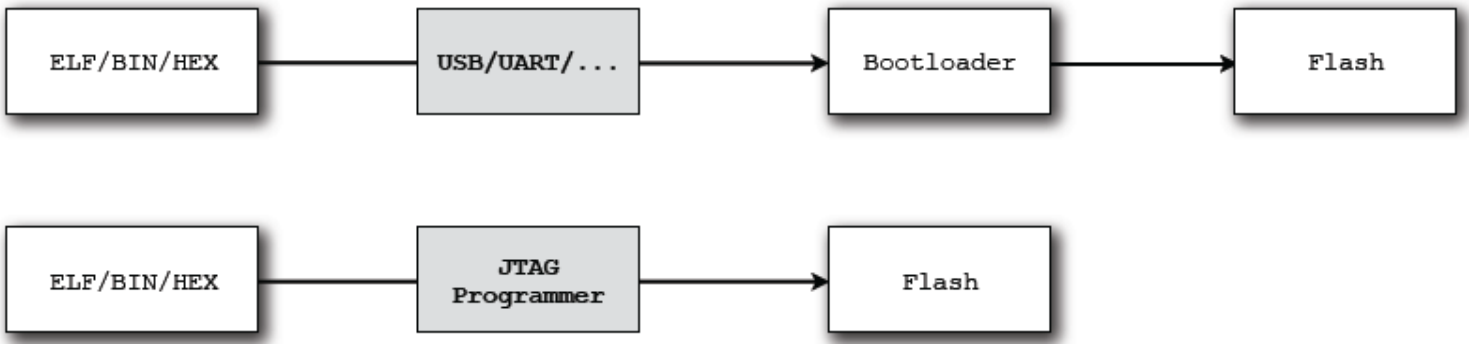
User code (main and all the application code)

PROGRAMMING

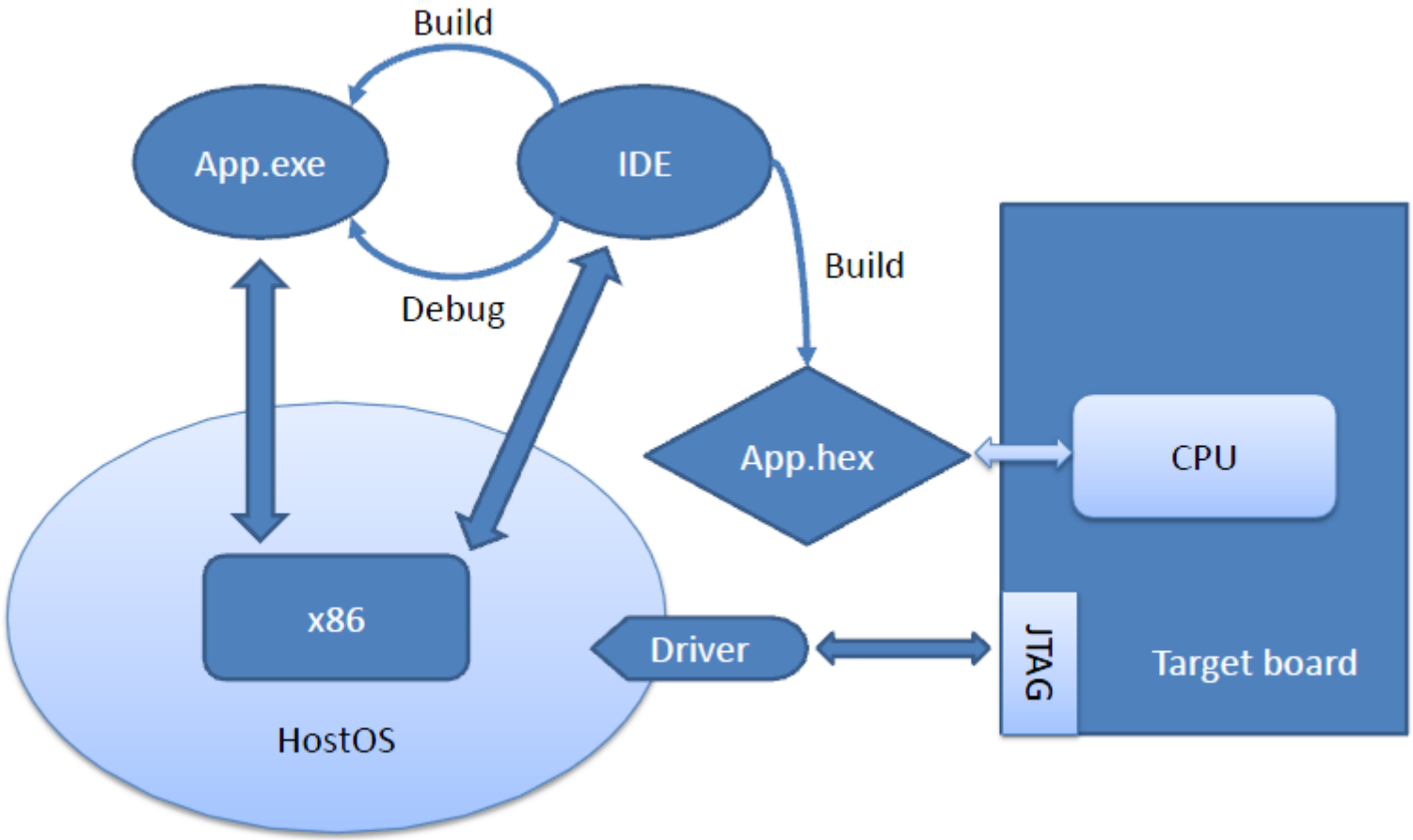
DUE OPZIONI:

–USB / UART / … connection in **bootloader mode**

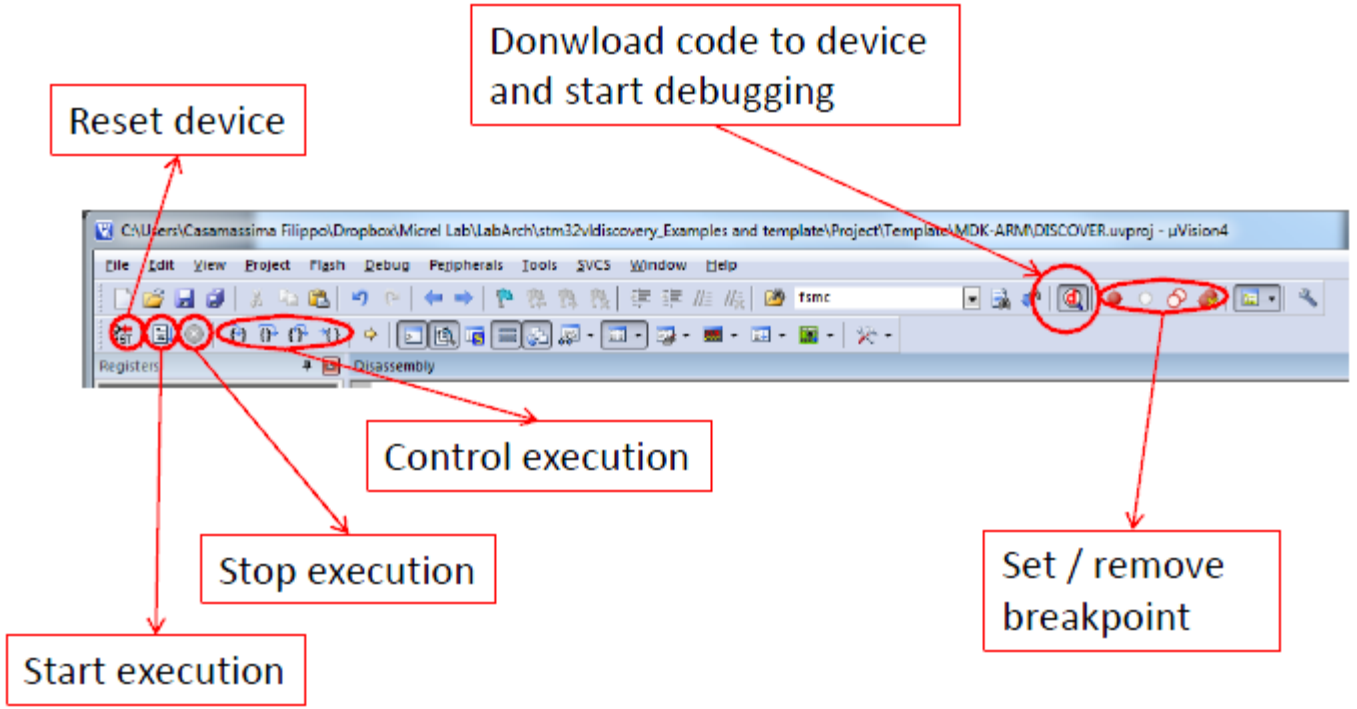
–JTAG and programmer **to write flash memory**



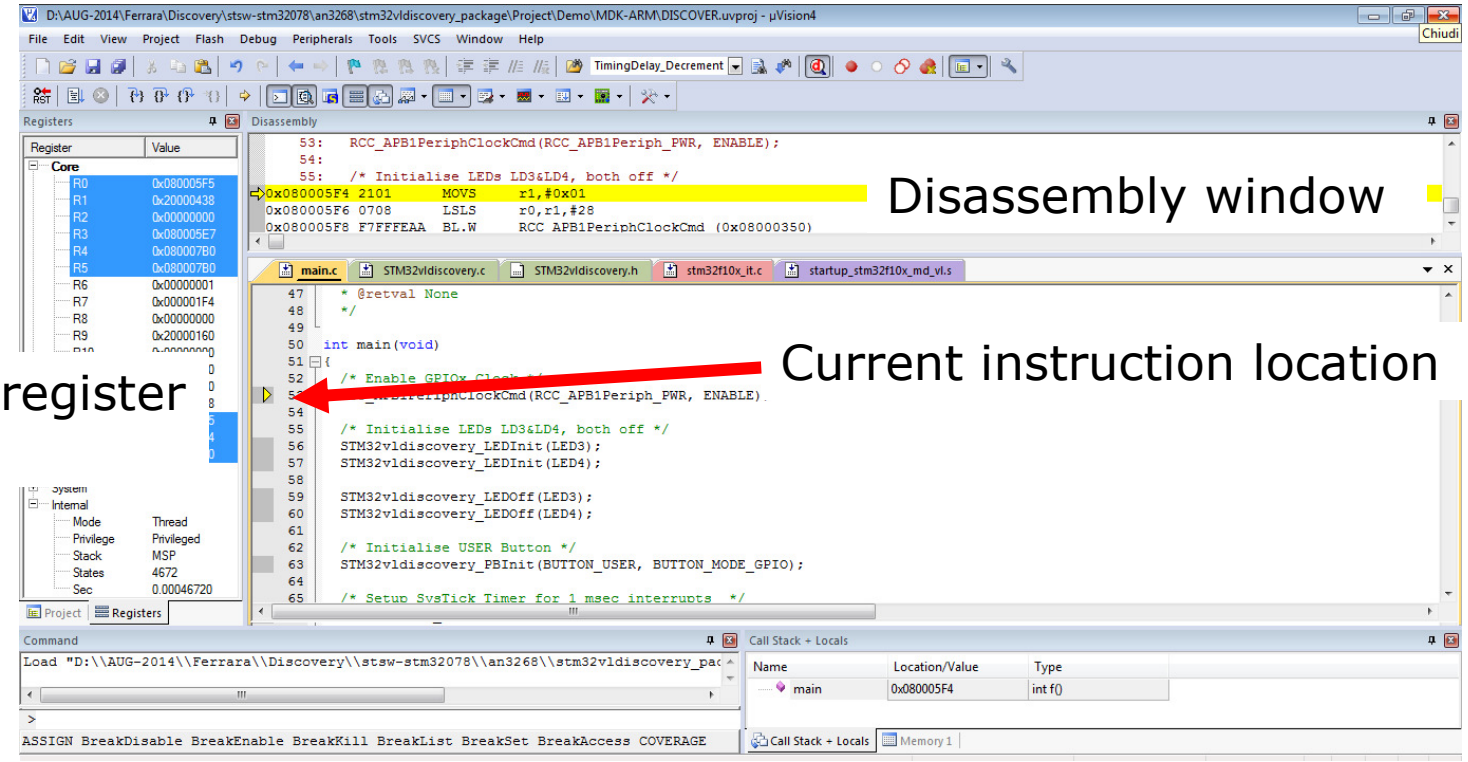
DEBUGGING


Build
App.exe
IDE
Debug
Build
App.hex
CPU
x86
Driver
JTAG
Target board
HostOS

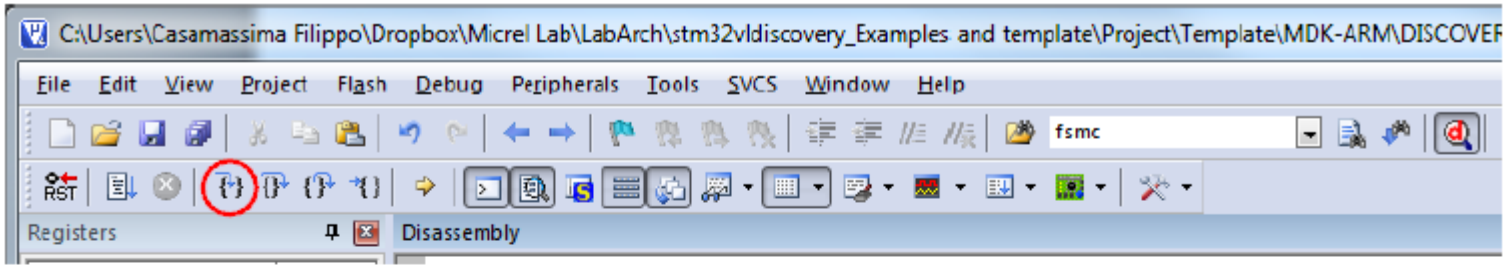
DEBUGGING


Donwload code to device and start debugging
Reset device
Control execution
Stop execution
Start execution
Set / remove breakpoint

DEBUGGING


Disassembly window
Current instruction location
ARM Internal register status

DEBUGGING



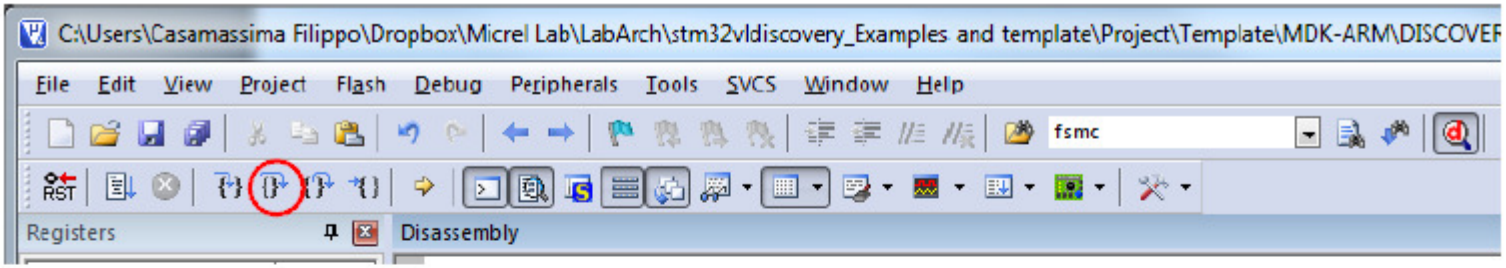
Step: executes next instruction

```
int main(void)
{
 u16 count = 0;
 u32 b = 0;
 int c =0;
 c = SumValues(5, 18);
  /* main while */
  while(1)
  {
       count++;
       if (count==10000)
       b++;
  }

}

SumValues(int add1, int add2){
          volatile int sum_result = 0;
          sum_result = add1 + add2;
          return sum_result;
}
```

DEBUGGING



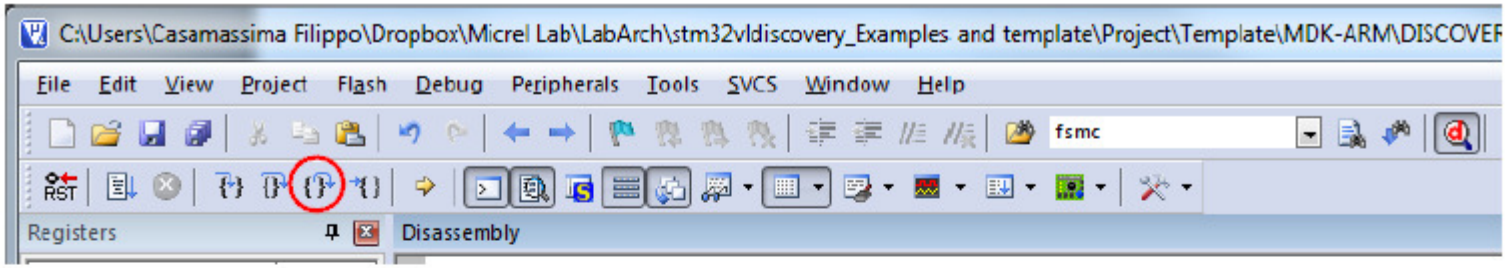
Step Over: executes next line

```
int main(void)
{
 u16 count = 0;
 u32 b = 0;
 int c =0;
 c = SumValues(5, 18);
  /* main while */
  while(1)
  {
       count++;
       if (count==10000)
       b++;
  }

}

SumValues(int add1, int add2){
           volatile int sum_result = 0;
           sum_result = add1 + add2;
           return sum_result;
}
```

DEBUGGING



Step Out: Exit from the current function

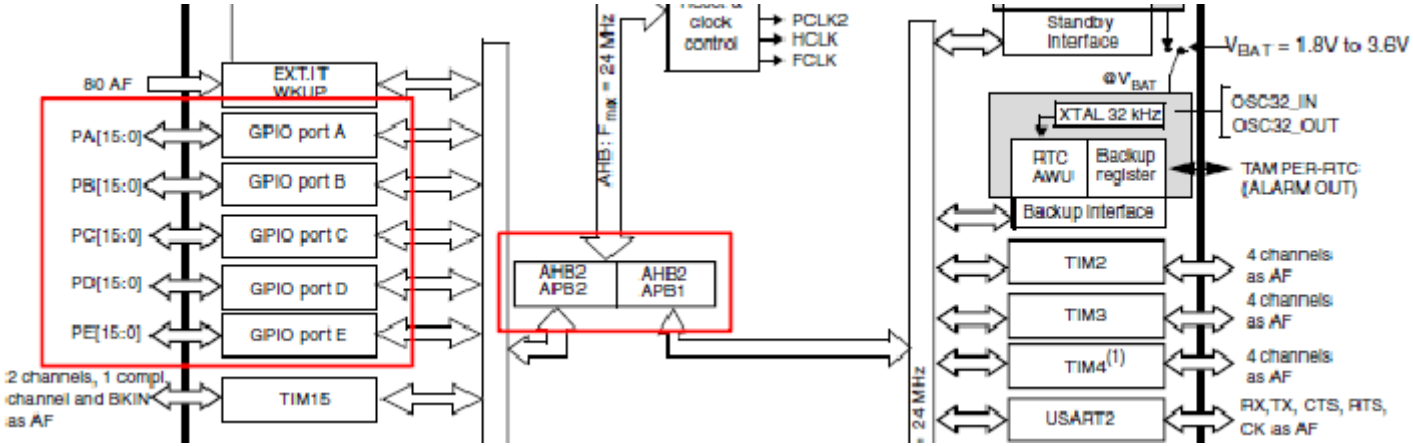
```
int main(void)
{
 u16 count = 0;
 u32 b = 0;
 int c =0;
 c = SumValues(5, 18);
  /* main while */
  while(1)
  {
       count++;
       if (count==10000)
       b++;
  }

}

SumValues(int add1, int add2){
          volatile int sum_result = 0;
          sum_result = add1 + add2;
          return sum_result;
}
```

EXAMPLES: led

The STM32 is well served with general purpose IO pins, having up to 80 bidirectional IO pins. The IO pins are arranged as five ports each having 16 IO lines.



EXAMPLES: led – come usare i GPIO

Which bus GPIOs are connected to?

➡GPIO ports are always on the APB2 bus

Which port are we going to use?

➡Green LED is connected to the I/O Port C of STM32F100RB

➡Blue LED is connected to the I/O Port C of STM32F100RB

Which PINs the LEDs are connected to?

➡Green LED is connected to the pin 9 of Port C

➡Blue LED is connected to the pin 8 of Port C

What do I need to do with this GPIO? (input, output, ...)

➡I need to write (output)

EXAMPLES: led – Informazioni sulle connessioni

➡The **datasheet** contains all the information we need

➡Look at the **UM0919 User Manual**

https://www1.elfa.se/data1/wwwroot/assets/datasheets/STM32_discovery_eng_manual.pdf

EXAMPLES: led - Accensione

We need to enable the High Speed APB (APB2) peripheral.

➡void RCC_APB2PeriphClockCmd(uint32_t RCC_APB2Periph, FunctionalState NewState);

(Look at: stm32f10x_rcc.c)

We need to configure the GPIO Port

➡Fill up a GPIO_InitTypeDef structure (Look at: stm32f10x_gpio.h)

➡Init the GPIO Port with void GPIO_Init(GPIO_TypeDef* GPIOx, GPIO_InitTypeDef* GPIO_InitStruct);

(Look at: stm32f10x_gpio.c)

Turn ON the LED (Look at :stm32f10x_gpio.c)

➡void GPIO_SetBits(GPIO_TypeDef* GPIOx, uint16_t GPIO_Pin)

EXAMPLES: led

main.c (green LED)

```
#include "stm32f10x.h"
#include "stm32f10x_conf.h"

int main(void)
{
   GPIO_InitTypeDef  GPIO_InitStructure;

   /* Enable the GPIO_LED Clock */
   RCC_APB2PeriphClockCmd(RCC_APB2Periph_GPIOC, ENABLE);

   /* Configure the GPIO_LED pin */
   GPIO_InitStructure.GPIO_Pin = GPIO_Pin_9;
   GPIO_InitStructure.GPIO_Mode = GPIO_Mode_Out_PP;
   GPIO_InitStructure.GPIO_Speed = GPIO_Speed_50MHz;
   GPIO_Init(GPIOC, &GPIO_InitStructure);

   /* Turn ON */
   GPIO_SetBits(GPIOC, GPIO_Pin_9);

   while(1);
}
```

must include stm32f10x_gpio.h

Enable APB2 bus Port C

Configuration for Pin 9 Port C as output

"And light was made"

SYSTick

SysTick is used to schedule **periodic** events

When the SysTick expires an **IRQhandler** is called

How can I use SysTick?

We need to setup the SysTick (Look at `core_cm3.h`)

➡static __INLINE uint32_t SysTick_Config(uint32_t ticks)

ticks: the number of ticks between two interrupts

➡SystemCoreClock is the number of ticks in 1 sec

We need to setup the callback (Interrupt Service Routine)

➡The ISR is always define in `stm32f10x_it.c`

➡The name of the ISR for SysTick is `void SysTick_Handler(void)`

SYSTick

main.c

```
#include "stm32f10x.h"
#include "stm32f10x_conf.h"

int main(void)
{
   if (SysTick_Config(SystemCoreClock / 1000))   {
       /* Capture error */
       while (1);
    }

  while (1);
}
```

ISR executed every 1 ms

stm32f10x_it.c

```
...

void SysTick_Handler(void){
   /* Here goes the code to periodically execute */}

...
```