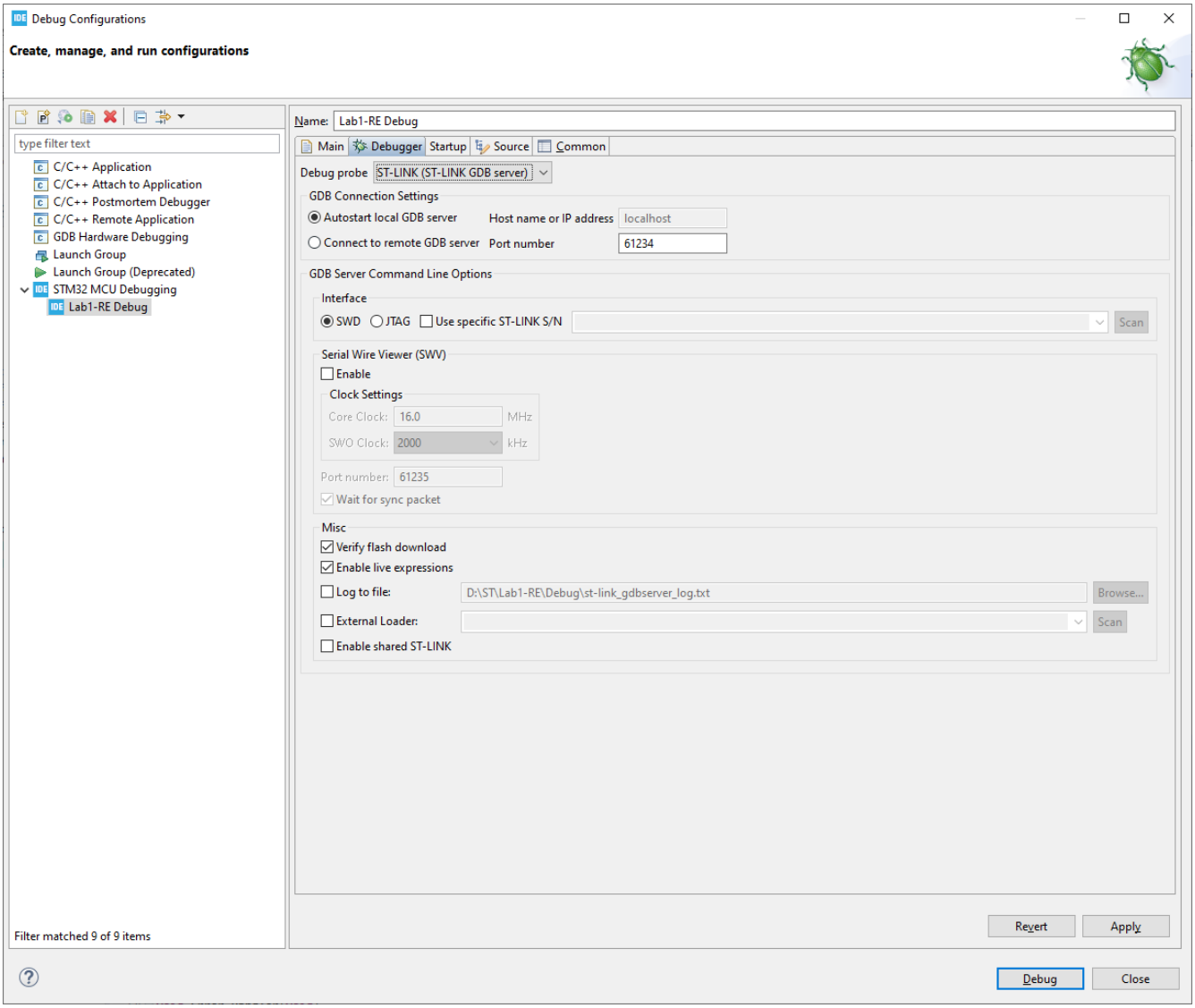

If you are using the board STM32F4Discovery from the lab, they are likely to be pre-install debugger as J-Link, if not, it would be ST-Link. You can change the debugger probe between ST-Link and J-Link here.

You can then hit "Debug"

Lab Exercises

1 Create a new STM32 Project by following the Getting Started guide, and insert new main function code as below.

```
int main(void)
{

  /* USER CODE BEGIN 1 */
    uint32_t i,j;
```

```
  /* USER CODE END 1 */

  /* MCU Configuration--------------------------------------------------------*/

  /* Reset of all peripherals, Initializes the Flash interface and the Systick. */
  HAL_Init();

  /* Configure the system clock */
  SystemClock_Config();

  /* Initialize all configured peripherals */
  MX_GPIO_Init();

  /* USER CODE BEGIN 2 */
  /* USER CODE END 2 */

  /* Infinite loop */
  /* USER CODE BEGIN WHILE */
  while (1)
  {
  /* USER CODE END WHILE */
            int j;
            GPIOA->ODR ^= 1<<5;
            for(j=0;j<2000000;j++);


  /* USER CODE BEGIN 3 */

  }
  /* USER CODE END 3 */
}
```

2 Using debugging feature, set Breakpoint at "for loop", then debug on STM32F4 Discovery Board.

2.1 From STM32F4XX Reference manual, what are these GPIO registers

2.1.1 GPIOD_MODER

GPIO port mode register

2.1.2 GPIOD_OTYPER

GPIO port output type register

2.1.3 GPIOD_OSPEEDR

GPIO port output speed register

2.1.4 GPOD_PUPDR

GPIO port pull-up / pull down register

2.1.5 GPIOD_ODR

GPIO port output data register

2.2 Using step/suspend/resume debugging feature on SW4STM32, what is the value of GPIOD_MODER and GPIOD_ODR from the start of debugging and breakpoint. What are the relations to LEDs' Discovery Board.

	Start	Breakpoint	
GPIOA - MODER	0x48000000	0x48000400	
GPIOA - ODR	0x48000000	0x20 LED ON	0x0 LED OFF

3 Create a new project with 4 times speed of System Clock using "Clock Configuration" on STM32CubeMX. What are the value of PLLP, PLLN and PLLM register, before and after set the new speed. (Look at RCC register on STM32F407 Reference manual)

	Sys Clock = 24	Sys Clock = 96
PLLP	2	6
PLLN	96	72
PLLM	8	8

4 Use a STM32 Cube embedded software libraries instead of direct register assignation and for loop delay (using functions from stm32f4xx_hal.c and stm32f4xx_hal_gpio.c in STM32F4xx_HAL_Driver) to create a same behavior as example code on 1.