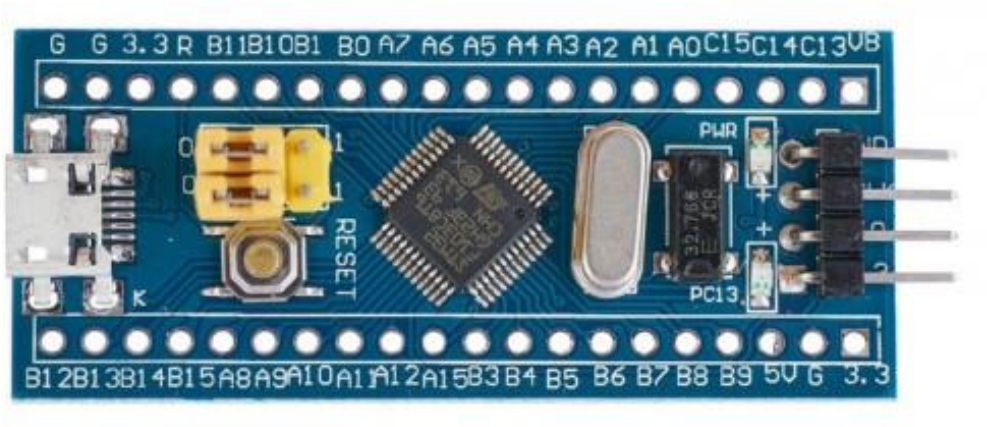
Embedded C Unit3 Lab (2)



ARM CORTEX-M3 STM32F103

Unit 3 Lesson 3 Lab (2)

Name : Mohammed Hassan Ahmed

Embedded C Unit3 Lab (2)

1 – The .obj files of (main.o & startup.o):

Main.o

```
mohas@DESKTOP-VP4AFMT MINGW32 ~/OneDrive/Desktop/Lab 2/startup.c
$ arm-none-eabi-objdump.exe -h main.o

main.o:     file format elf32-littlearm

Sections:
Idx Name          Size      VMA       LMA       File off  Algn
  0 .text         00000094  00000000  00000000  00000034  2**2
                  CONTENTS, ALLOC, LOAD, RELOC, READONLY, CODE
  1 .data         0000001c  00000000  00000000  000000c8  2**2
                  CONTENTS, ALLOC, LOAD, DATA
  2 .bss          00000000  00000000  00000000  000000e4  2**0
                  ALLOC
  3 .debug_info   000001cf  00000000  00000000  000000e4  2**0
                  CONTENTS, RELOC, READONLY, DEBUGGING
  4 .debug_abbrev 00000111  00000000  00000000  000002b3  2**0
                  CONTENTS, READONLY, DEBUGGING
  5 .debug_loc    000000c0  00000000  00000000  000003c4  2**0
                  CONTENTS, READONLY, DEBUGGING
  6 .debug_aranges 00000020  00000000  00000000  00000484  2**0
                  CONTENTS, RELOC, READONLY, DEBUGGING
  7 .debug_line   0000006e  00000000  00000000  000004a4  2**0
                  CONTENTS, RELOC, READONLY, DEBUGGING
  8 .debug_str    00000190  00000000  00000000  00000512  2**0
                  CONTENTS, READONLY, DEBUGGING
  9 .comment      0000007f  00000000  00000000  000006a2  2**0
                  CONTENTS, READONLY
 10 .debug_frame  0000006c  00000000  00000000  00000724  2**2
                  CONTENTS, RELOC, READONLY, DEBUGGING
 11 .ARM.attributes 00000033  00000000  00000000  00000790  2**0
                  CONTENTS, READONLY
```

Embedded C Unit3 Lab (2)

Startup.o

```
mohas@DESKTOP-VP4AFMT MINGW32 ~/OneDrive/Desktop/Lab 2/startup.c
$ arm-none-eabi-objdump.exe -h startup.o

startup.o:     file format elf32-littlearm

Sections:
Idx Name          Size      VMA       LMA       File off  Algn
  0 .text         00000090  00000000  00000000  00000034  2**2
                  CONTENTS, ALLOC, LOAD, RELOC, READONLY, CODE
  1 .data         00000000  00000000  00000000  000000c4  2**0
                  CONTENTS, ALLOC, LOAD, DATA
  2 .bss          00000000  00000000  00000000  000000c4  2**0
                  ALLOC
  3 .vectors      0000001c  00000000  00000000  000000c4  2**2
                  CONTENTS, ALLOC, LOAD, RELOC, DATA
  4 .debug_info   0000019e  00000000  00000000  000000e0  2**0
                  CONTENTS, RELOC, READONLY, DEBUGGING
  5 .debug_abbrev 000000d6  00000000  00000000  0000027e  2**0
                  CONTENTS, READONLY, DEBUGGING
  6 .debug_loc    0000007c  00000000  00000000  00000354  2**0
                  CONTENTS, READONLY, DEBUGGING
  7 .debug_aranges 00000020  00000000  00000000  000003d0  2**0
                  CONTENTS, RELOC, READONLY, DEBUGGING
  8 .debug_line   0000007d  00000000  00000000  000003f0  2**0
                  CONTENTS, RELOC, READONLY, DEBUGGING
  9 .debug_str    000001ab  00000000  00000000  0000046d  2**0
                  CONTENTS, READONLY, DEBUGGING
 10 .comment      0000007f  00000000  00000000  00000618  2**0
                  CONTENTS, READONLY
 11 .debug_frame  00000050  00000000  00000000  00000698  2**2
                  CONTENTS, RELOC, READONLY, DEBUGGING
 12 .ARM.attributes 00000033  00000000  00000000  000006e8  2**0
                  CONTENTS, READONLY
```

Embedded C Unit3 Lab (2)

Alias & Weak

We can override on weak symbols

```
mohas@DESKTOP-VP4AFMT MINGW32 ~/OneDrive/Desktop/Lab 2/startup.c
$ arm-none-eabi-nm.exe learn-in-depth.elf
2000001c B _E_Bss
2000001c D _E_Data
08000140 T _E_Text
2000001c B _S_Bss
20000000 D _S_Data
2000101c B _Stack_Top
08000028 T Bus_Fault
20000010 D const_variavles
080000b0 T Default_Handler
20000004 D global_variables
080000b0 W H_Fault_Handler
08000034 T main
080000b0 W MM_Fault_Handler
0800001c T NMI_Handler
20000000 D R_ODR
080000bc T Reset_Handler
080000b0 W Usage_Fault_Handler
08000000 T vectors
```

Embedded C Unit3 Lab (2)

Main.c

C:\Users\mohas\OneDrive\Desktop\Lab 2\startup.c\main.c - Sublime Text (UNREGISTERED)

File Edit Selection Find View Goto Tools Project Preferences Help

Platform_Types.h | main.c | startup.c | linker_script.ld | Map_File.map | log.txt

```c
/*
 ================================================================================
 Name        : main.c
 Author      : Mohammed Hassan
 Created on  : 9/20/2023
 Description : Unit 3==>> Lesson 3 ==>> Lab(2)
 ================================================================================
 */
#include "Platform_Types.h"

#define RCC_BASE     0x40021000
#define PortA_BASE   0x40010800

#define RCC_APB2ENR *(vuint32_t *) (RCC_BASE + 0x18)
#define GPIO_CRH    *(vuint32_t *) (PortA_BASE + 0x04)
#define GPIO_ODR    *(vuint32_t *) (PortA_BASE + 0x0C)

typedef union
{
    vuint32_t all_fields ;

    struct
    {
        vuint32_t reserved : 13 ;
        vuint32_t pin_13 : 1 ;
    } pin;

} R_ODR_t;

volatile R_ODR_t *R_ODR = (volatile R_ODR_t *)(PortA_BASE + 0x0C) ;
vuint32_t global_variables[3] = {1,2,3};
vuint32_t const const_variavles[3] = {1,2,3};

extern void NMI_Handler(void)
{

}

extern void Bus_Fault(void)
{

}

int main(void)
{
    RCC_APB2ENR |= (1<<2) ; //set pit 2
    GPIO_CRH    &= 0xff0fffff ;
    GPIO_CRH    |= 0x00200000 ; //set pits(20-24) 2

    while(1)
    {
        R_ODR->pin.pin_13 = 1 ;
        for(int i = 0 ; i < 5000 ; i++);
        R_ODR->pin.pin_13 = 0 ;
        for(int i = 0 ; i < 5000 ; i++);
    }
    return 0 ;
}
```

Line 1, Column 1 Tab Size: 4 C

Embedded C Unit3 Lab (2)

Startup.c

C:\Users\mohas\OneDrive\Desktop\Lab 2\startup.c\startup.c - Sublime Text (UNREGISTERED)

File Edit Selection Find View Goto Tools Project Preferences Help

Platform_Types.h | main.c | startup.c | linker_script.ld | Map_File.map | log.txt

```c
/*=============================================================================
 Name        : startup.c
 Author      : Mohammed Hassan
 Created on  : 9/20/2023
 Description : Unit 3==>> Lesson 3 ==>> Lab(2)
 ============================================================================*/
#include "Platform_Types.h"

extern int main(void);
extern uint32_t _Stack_Top ;
extern uint32_t _E_Text ;
extern uint32_t _S_Data ;
extern uint32_t _E_Data ;
extern uint32_t _S_Bss ;
extern uint32_t _E_Bss ;

void Reset_Handler(void);

void Default_Handler()
{
    Reset_Handler();
}

void NMI_Handler(void)          __attribute__ ((weak, alias("Default_Handler")));
void H_Fault_Handler(void)      __attribute__ ((weak, alias("Default_Handler")));
void MM_Fault_Handler(void)     __attribute__ ((weak, alias("Default_Handler")));
void Bus_Fault(void)            __attribute__ ((weak, alias("Default_Handler")));
void Usage_Fault_Handler(void)  __attribute__ ((weak, alias("Default_Handler")));

uint32_t vectors[] __attribute__ ((section(".vectors"))) =
{
    (uint32_t) &_Stack_Top ,
    (uint32_t) &Reset_Handler ,
    (uint32_t) &NMI_Handler ,
    (uint32_t) &H_Fault_Handler ,
    (uint32_t) &MM_Fault_Handler ,
    (uint32_t) &Bus_Fault ,
    (uint32_t) &Usage_Fault_Handler
};

void Reset_Handler(void)
{
    //Copy Data From Rom to Ram
    uint32_t Data_Size = (uint8_t*)&_E_Data - (uint8_t*)&_S_Data ;
    uint8_t* P_src = (uint8_t*)&_E_Text ;
    uint8_t* P_dst = (uint8_t*)&_S_Data ;

    for(int i =0 ; i < Data_Size ; i++)
    {
        *((uint8_t*)P_dst++) = *((uint8_t*)P_src++) ;
    }

    // init the .bss with 0

    uint32_t Bss_Size = (uint8_t*)&_E_Bss - (uint8_t*)&_S_Bss ;
    P_dst = (uint8_t*)&_S_Bss ;

    for(int i =0 ; i < Bss_Size ; i++)
    {
        *((uint8_t*)P_dst++) = (uint8_t)0 ;
    }

    // jump to main()
    main();
}
```

Line 29, Column 1 Tab Size: 4 C

Embedded C Unit3 Lab (2)

Linker_Script.ld

C:\Users\mohas\OneDrive\Desktop\Lab 2\startup.c\linker_script.ld - Sublime Text (UNREGISTERED)

File Edit Selection Find View Goto Tools Project Preferences Help

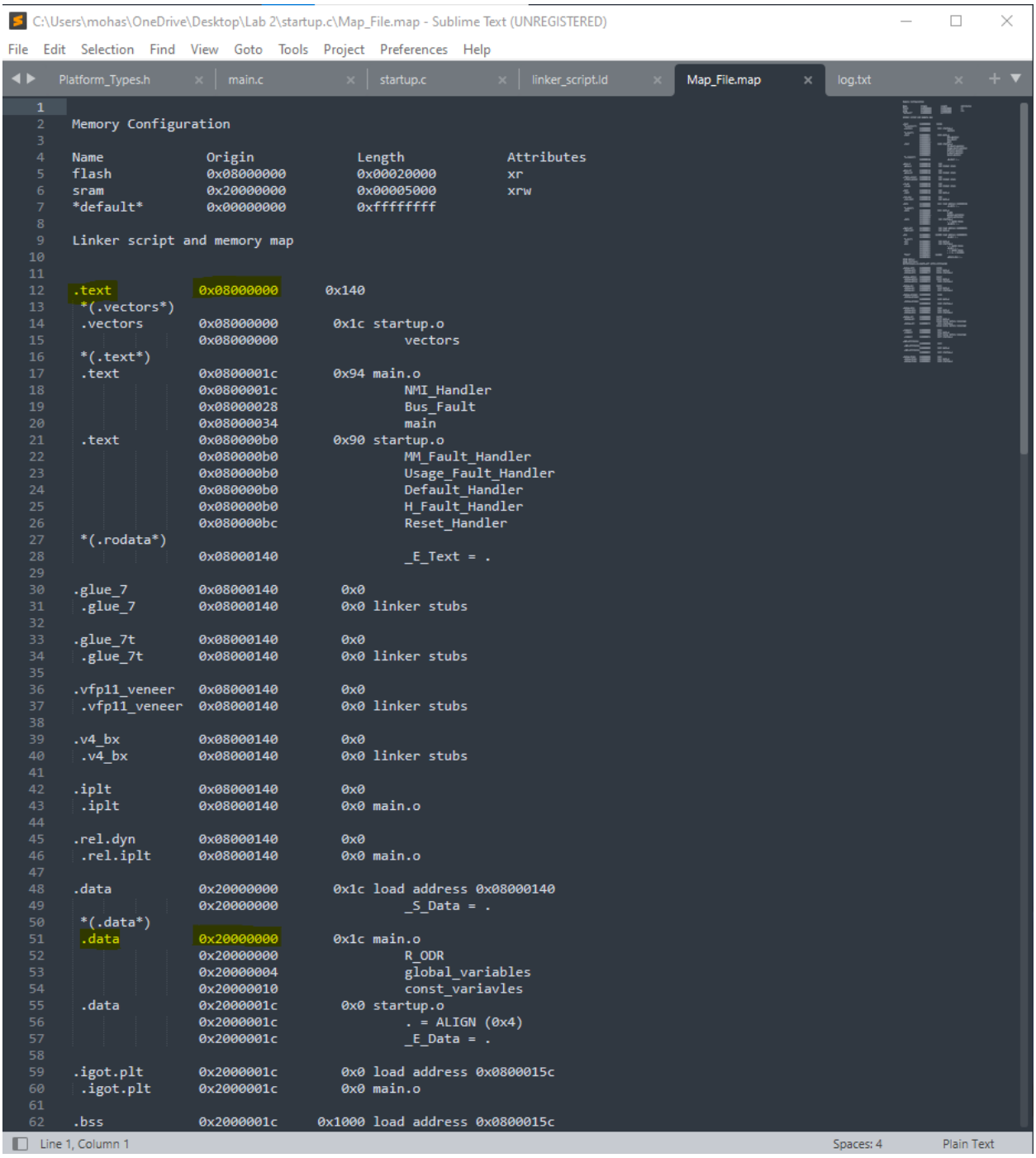
Platform_Types.h | main.c | startup.c | linker_script.ld | Map_File.map | log.txt

```
/*=============================================================================
 Name        : linker_script.ld
 Author      : Mohammed Hassan
 Created on  : 9/20/2023
 Description : Unit 3==>> Lesson 3 ==>> Lab(2)
 ============================================================================*/
MEMORY
{
    flash(RX) : ORIGIN = 0x08000000, LENGTH = 128K
    sram(RWX) : ORIGIN = 0x20000000, LENGTH = 20K
}

SECTIONS
{
    .text : {
        *(.vectors*)
        *(.text*)
        *(.rodata*)
        _E_Text = . ;
    }>flash

    .data : {
        _S_Data = . ;
        *(.data*)
        . = ALIGN(4);
        _E_Data = . ;
    }>sram AT> flash

    .bss : {
        _S_Bss = . ;
        *(.bss*)
        . = ALIGN(4);
        _E_Bss = . ;

        . = ALIGN(4);
        . = . + 0x1000 ;
        _Stack_Top = . ;
    }>sram
}

```

Line 1, Column 1 Tab Size: 4 Plain Text

Embedded C Unit3 Lab (2)

Map_File .map



C:\Users\mohas\OneDrive\Desktop\Lab 2\startup.c\Map_File.map - Sublime Text (UNREGISTERED)

File Edit Selection Find View Goto Tools Project Preferences Help

Platform_Types.h | main.c | startup.c | linker_script.ld | Map_File.map | log.txt

```
Memory Configuration

Name             Origin             Length             Attributes
flash            0x08000000         0x00020000         xr
sram             0x20000000         0x00005000         xrw
*default*        0x00000000         0xffffffff

Linker script and memory map


.text           0x08000000      0x140
 *(.vectors*)
 .vectors       0x08000000       0x1c startup.o
                0x08000000                vectors
 *(.text*)
 .text          0x0800001c       0x94 main.o
                0x0800001c                NMI_Handler
                0x08000028                Bus_Fault
                0x08000034                main
 .text          0x080000b0       0x90 startup.o
                0x080000b0                MM_Fault_Handler
                0x080000b0                Usage_Fault_Handler
                0x080000b0                Default_Handler
                0x080000b0                H_Fault_Handler
                0x080000bc                Reset_Handler
 *(.rodata*)
                0x08000140                _E_Text = .

.glue_7         0x08000140        0x0
 .glue_7        0x08000140        0x0 linker stubs

.glue_7t        0x08000140        0x0
 .glue_7t       0x08000140        0x0 linker stubs

.vfp11_veneer   0x08000140        0x0
 .vfp11_veneer  0x08000140        0x0 linker stubs

.v4_bx          0x08000140        0x0
 .v4_bx         0x08000140        0x0 linker stubs

.iplt           0x08000140        0x0
 .iplt          0x08000140        0x0 main.o

.rel.dyn        0x08000140        0x0
 .rel.iplt      0x08000140        0x0 main.o

.data           0x20000000       0x1c load address 0x08000140
                0x20000000                _S_Data = .
 *(.data*)
 .data          0x20000000       0x1c main.o
                0x20000000                R_ODR
                0x20000004                global_variables
                0x20000010                const_variavles
 .data          0x2000001c        0x0 startup.o
                0x2000001c                . = ALIGN (0x4)
                0x2000001c                _E_Data = .

.igot.plt       0x2000001c        0x0 load address 0x0800015c
 .igot.plt      0x2000001c        0x0 main.o

.bss            0x2000001c     0x1000 load address 0x0800015c
```

Line 1, Column 1 Spaces: 4 Plain Text

Embedded C Unit3 Lab (2)

Startup.s

C:\Users\mohas\OneDrive\Desktop\Lab 2\startup.s\startup.s - Sublime Text (UNREGISTERED)

File Edit Selection Find View Goto Tools Project Preferences Help

Platform_Types.h | main.c | startup.c | linker_script.ld | Map_File.map | log.txt | startup.s

```
/*=============================================================================
 Name        : startup.s
 Author      : Mohammed Hassan
 Created on  : 9/20/2023
 Description : Unit 3==>> Lesson 3 ==>> Lab(2)
 ============================================================================*/

.section .vectors

.word 0x20001000            /* stack top address */
.word _reset                /* 1 Reset */
.word Vector_Handler        /* 2 NMI */
.word Vector_Handler        /* 3 Hard Fault */
.word Vector_Handler        /* 4 MM Fault */
.word Vector_Handler        /* 5 Bus Fault */
.word Vector_Handler        /* 6 Usage Fault */
.word Vector_Handler        /* 7 RESERVED */
.word Vector_Handler        /* 8 RESERVED */
.word Vector_Handler        /* 9 RESERVED */
.word Vector_Handler        /* 10 RESERVED */
.word Vector_Handler        /* 11 SV Call */
.word Vector_Handler        /* 12 Debug Reserved */
.word Vector_Handler        /* 13 RESERVED */
.word Vector_Handler        /* 14 PendSV */
.word Vector_Handler        /* 15 SysTick */
.word Vector_Handler        /* 16 IRQ0 */
.word Vector_Handler        /* 17 IRQ1 */
.word Vector_Handler        /* 18 IRQ2 */
.word Vector_Handler        /* 19 ... */

.section .text
_reset:
	bl main
	b .     /*After finishing main loop in your self*/

.thumb_func    /*For using 16 bits & 32 bits instuction*/
Vector_Handler:
	b _reset
```

Line 38, Column 17 Tab Size: 4 Plain Text

Embedded C Unit3 Lab (2)

Simulation