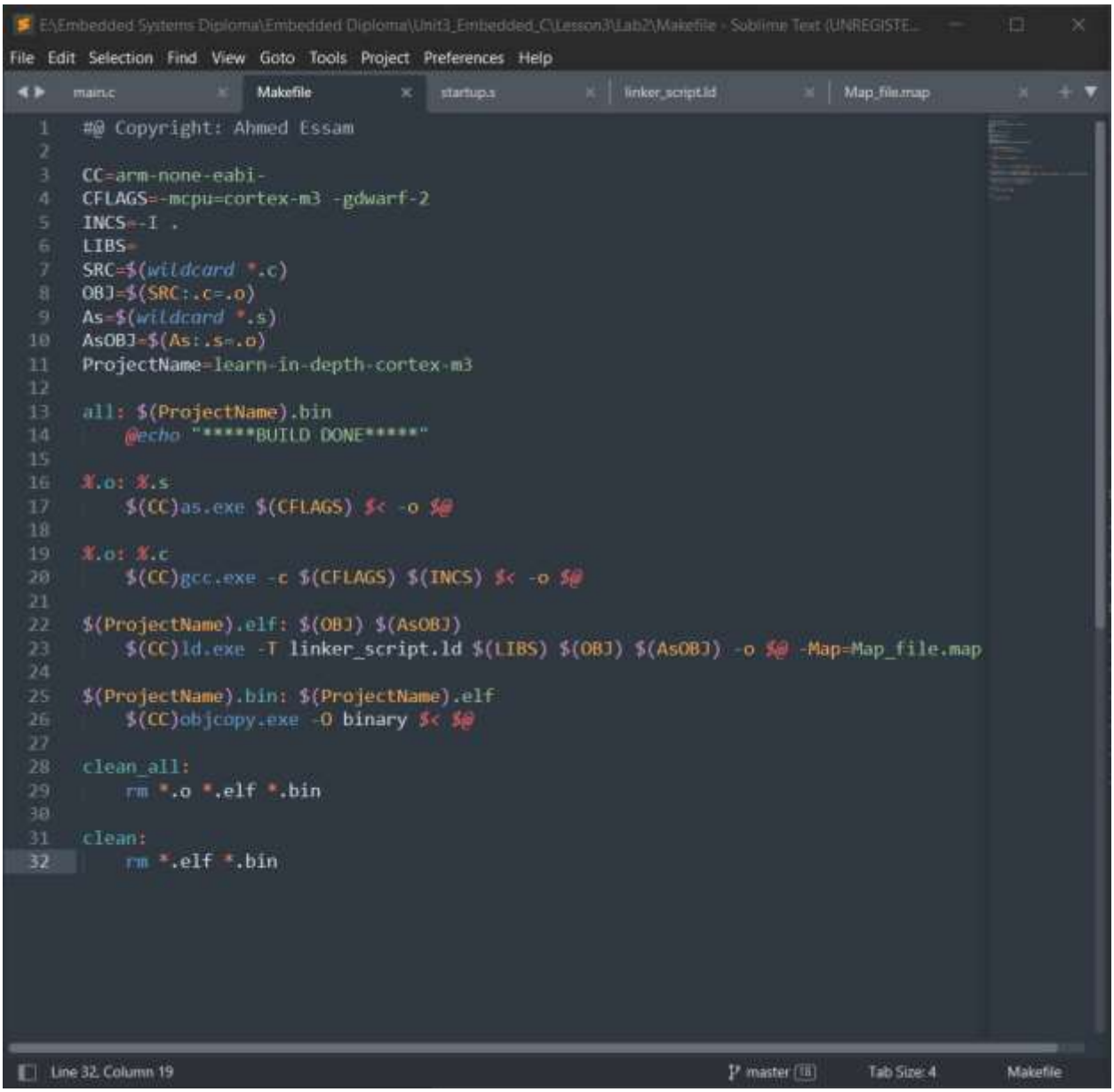
Mastering Embedded Systems

Unit 3

Embedded C

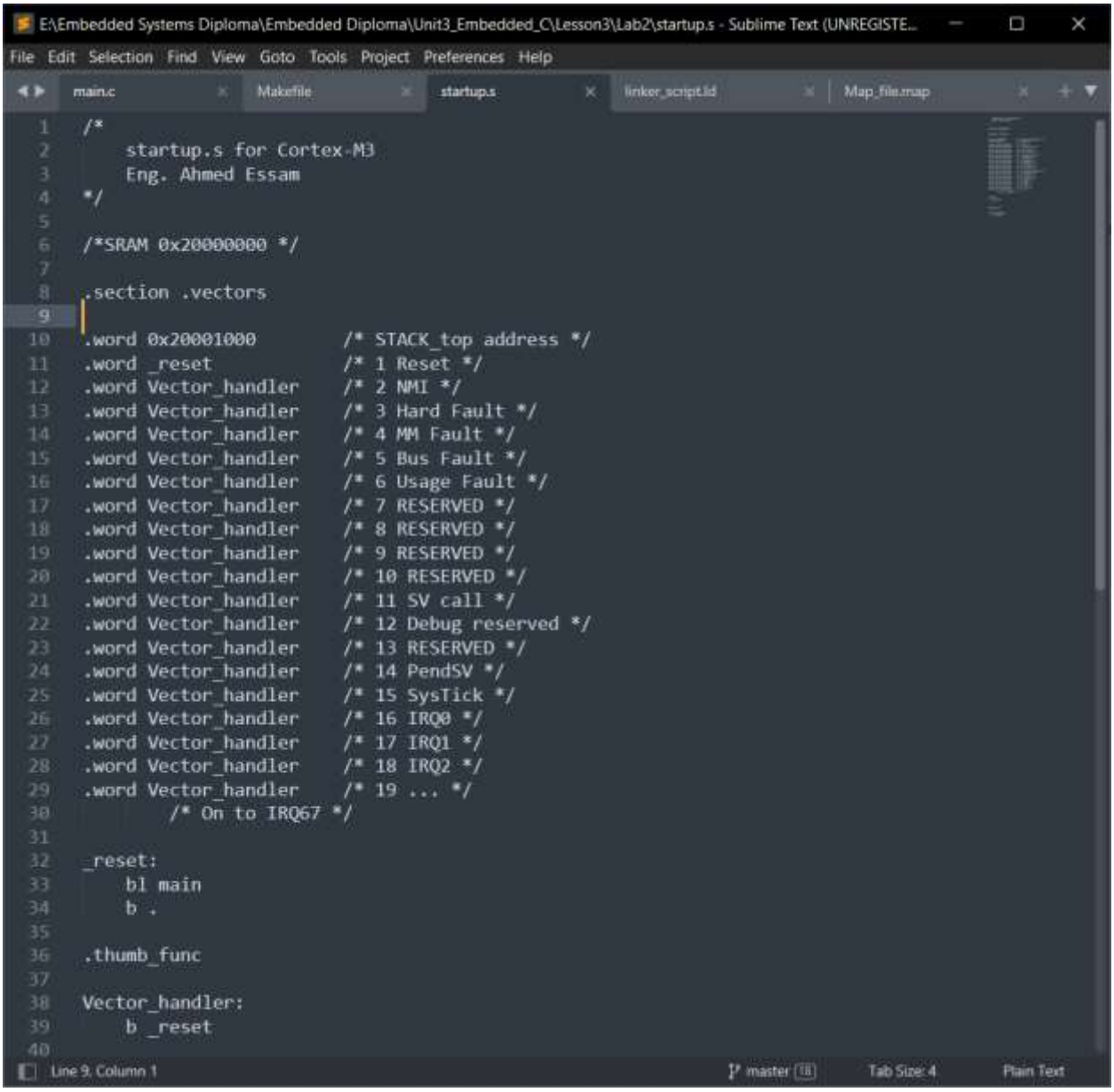
Lab 2

Makefile “As generic as possible”:

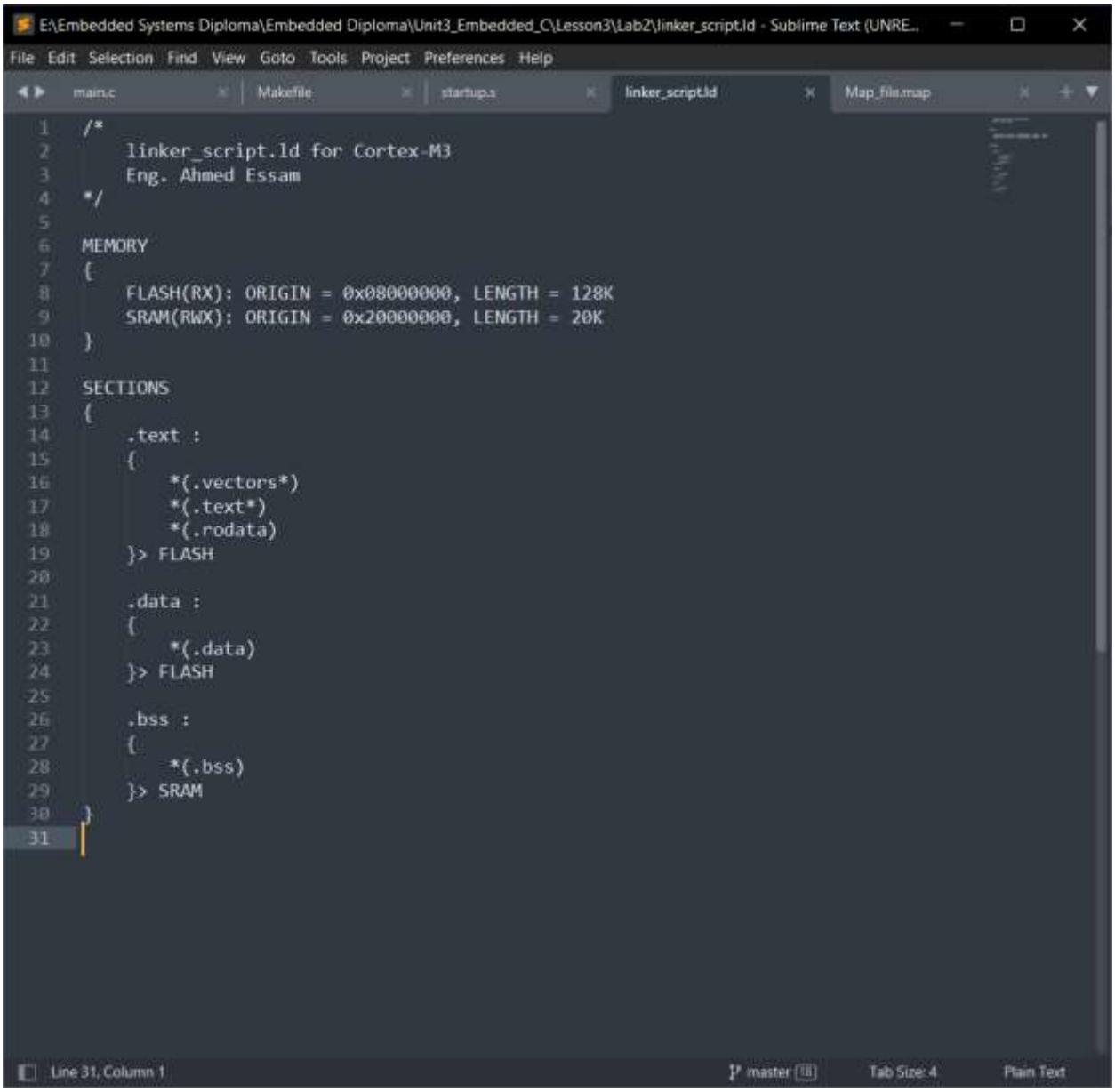


Part 1:

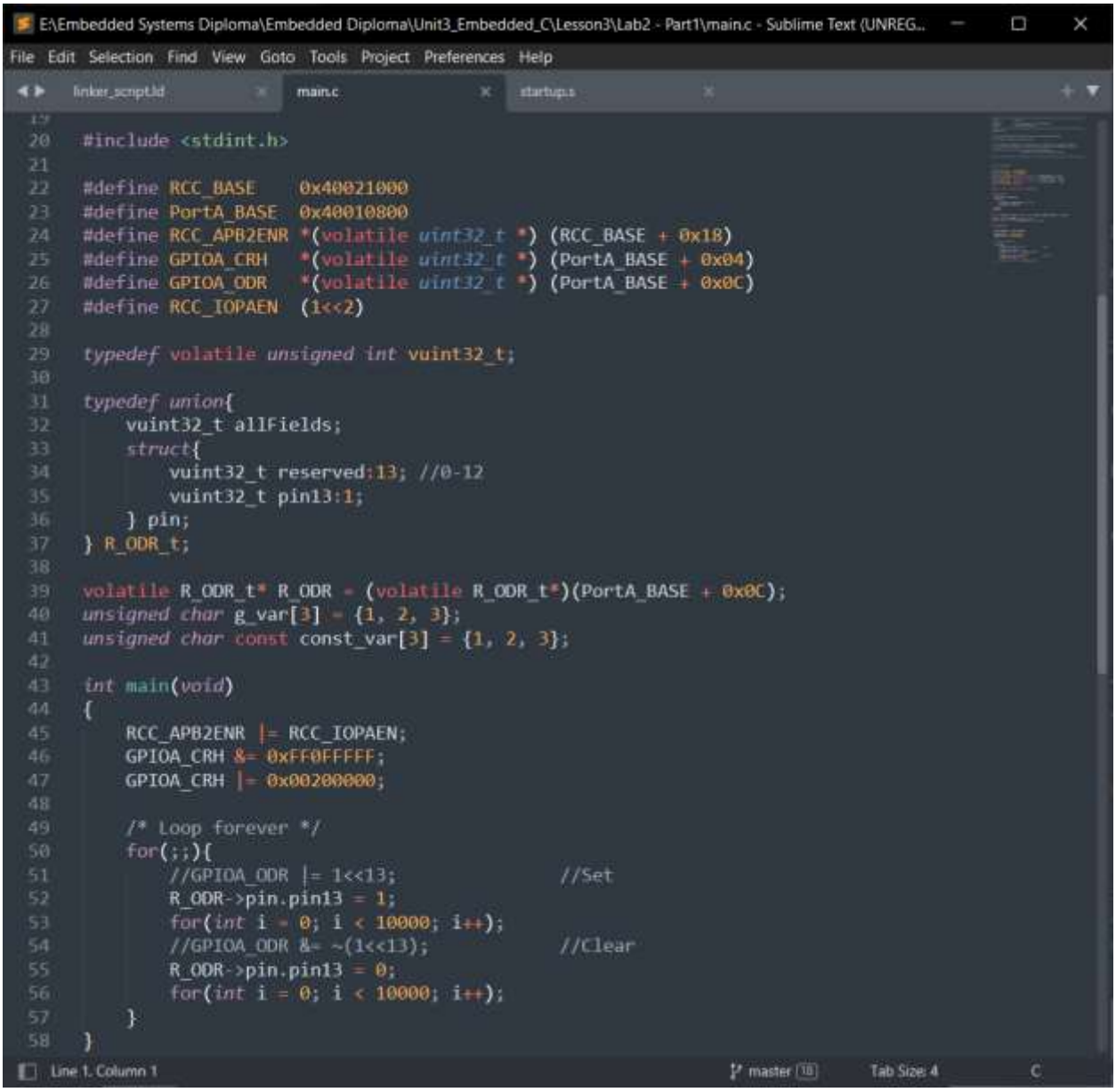
Startup.s:



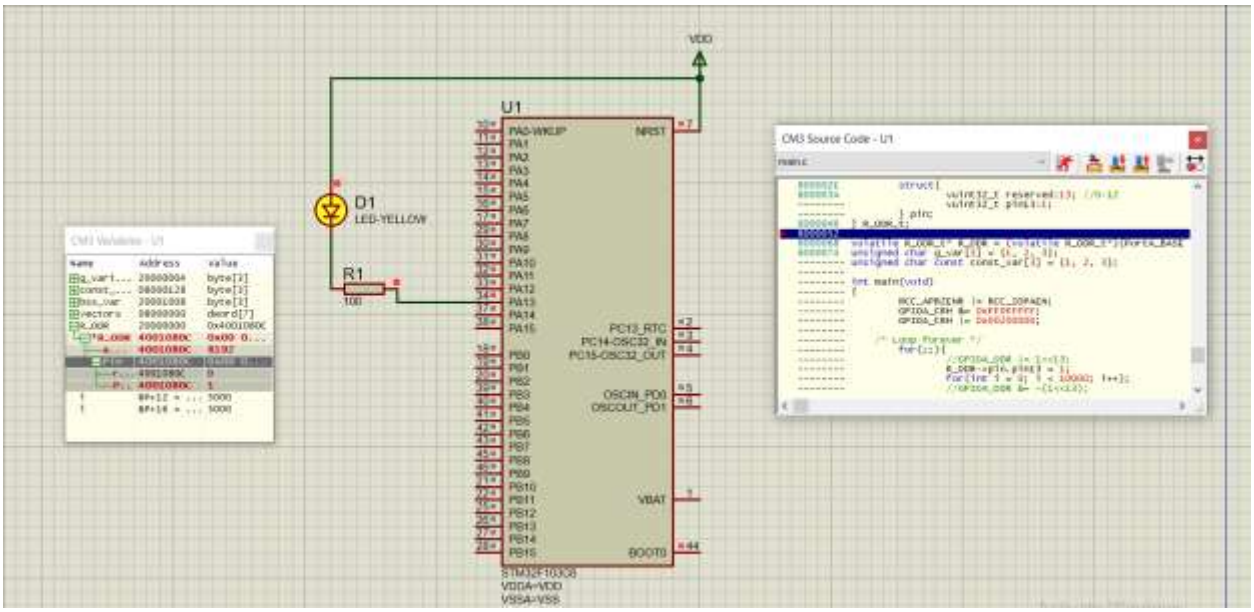
Linker_script.ld:



Main.c:

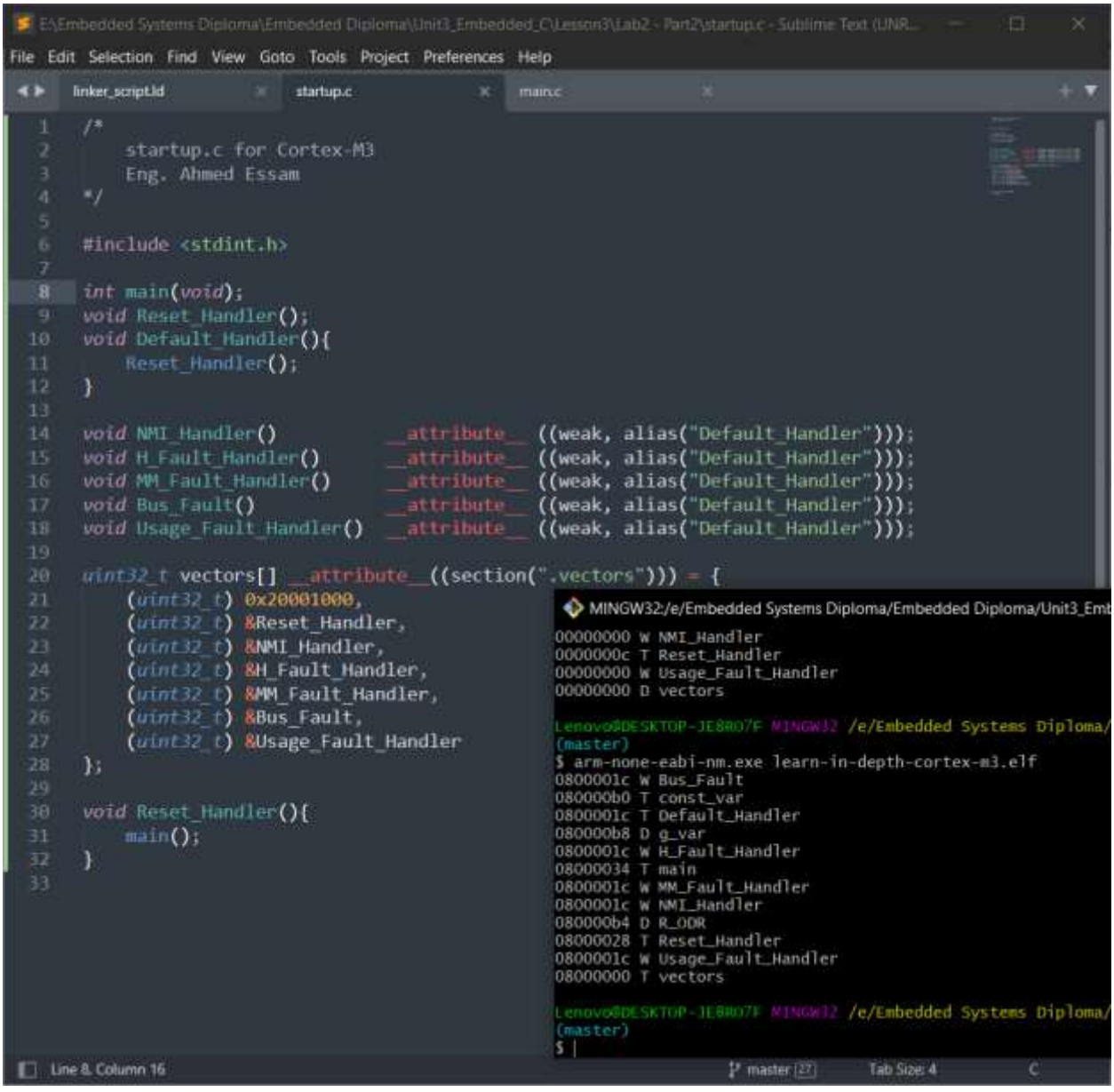

E:\Embedded Systems Diploma\Embedded Diploma\Unit3_Embedded_C\Lesson3\Lab2 - Part1\main.c - Sublime Text (UNREG...
File Edit Selection Find View Goto Tools Project Preferences Help
linker_script.ld
main.c
startup.s
#include <stdint.h>
#define RCC_BASE 0x40021000
#define PortA_BASE 0x40010800
#define RCC_APB2ENR *(volatile uint32_t *) (RCC_BASE + 0x18)
#define GPIOA_CRH *(volatile uint32_t *) (PortA_BASE + 0x04)
#define GPIOA_ODR *(volatile uint32_t *) (PortA_BASE + 0x0C)
#define RCC_IOPAEN (1<<2)
typedef volatile unsigned int vuint32_t;
typedef union{
vuint32_t allFields;
struct{
vuint32_t reserved:13; //0-12
vuint32_t pin13:1;
} pin;
} R_ODR_t;
volatile R_ODR_t* R_ODR = (volatile R_ODR_t*)(PortA_BASE + 0x0C);
unsigned char g_var[3] = {1, 2, 3};
unsigned char const const_var[3] = {1, 2, 3};
int main(void)
{
RCC_APB2ENR |= RCC_IOPAEN;
GPIOA_CRH &= 0xFF0FFFFF;
GPIOA_CRH |= 0x00200000;
/* Loop forever */
for(;;){
//GPIOA_ODR |= 1<<13; //Set
R_ODR->pin.pin13 = 1;
for(int i = 0; i < 10000; i++);
//GPIOA_ODR &= ~(1<<13); //Clear
R_ODR->pin.pin13 = 0;
for(int i = 0; i < 10000; i++);
}
}
Line 1, Column 1
master
Tab Size: 4
C

Proteus screenshot:

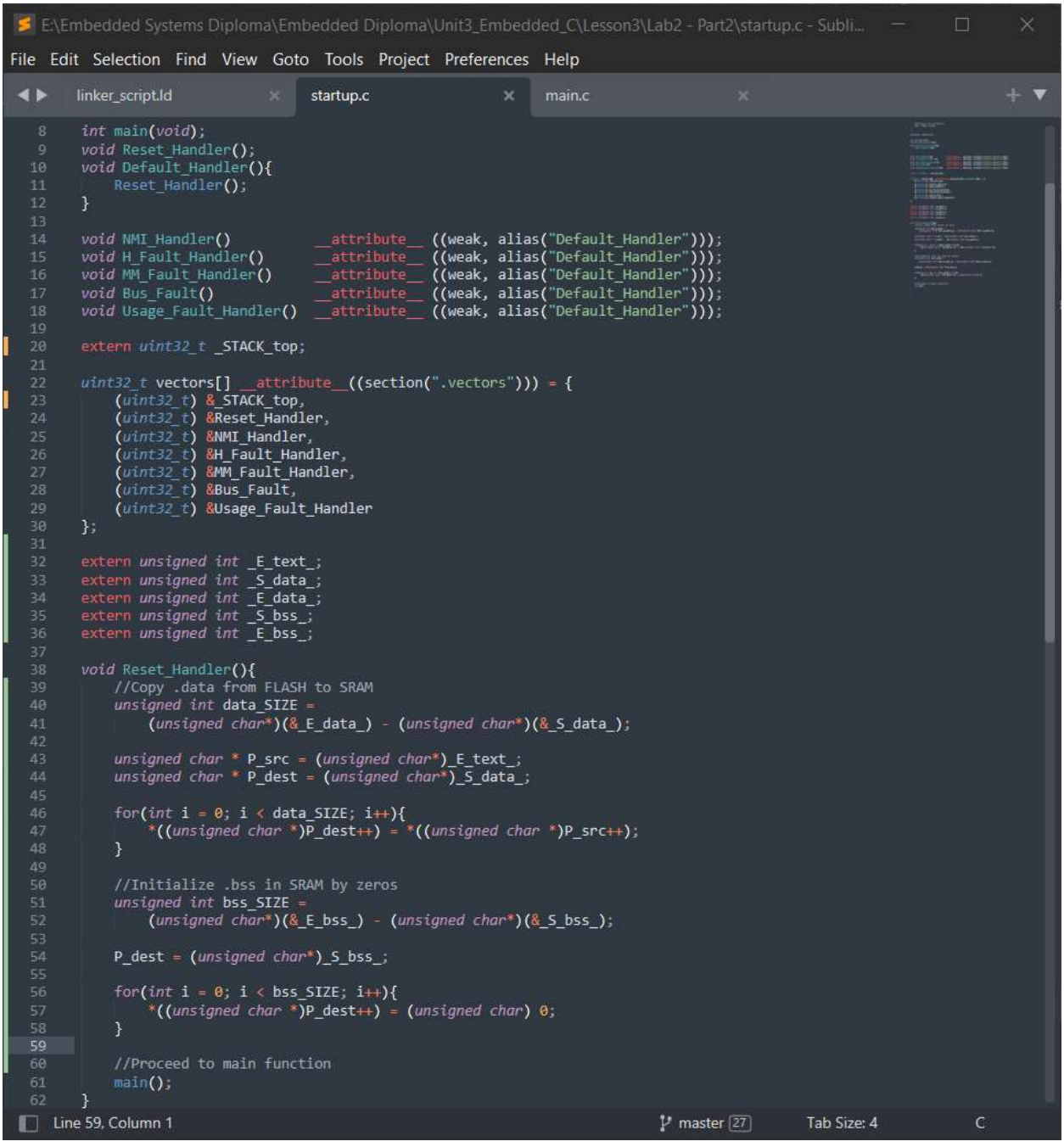


Part 2:

Adding __attribute__ ((weak, alias("Default_Handler"))) to current handlers and viewing their symbols corresponding to their address:

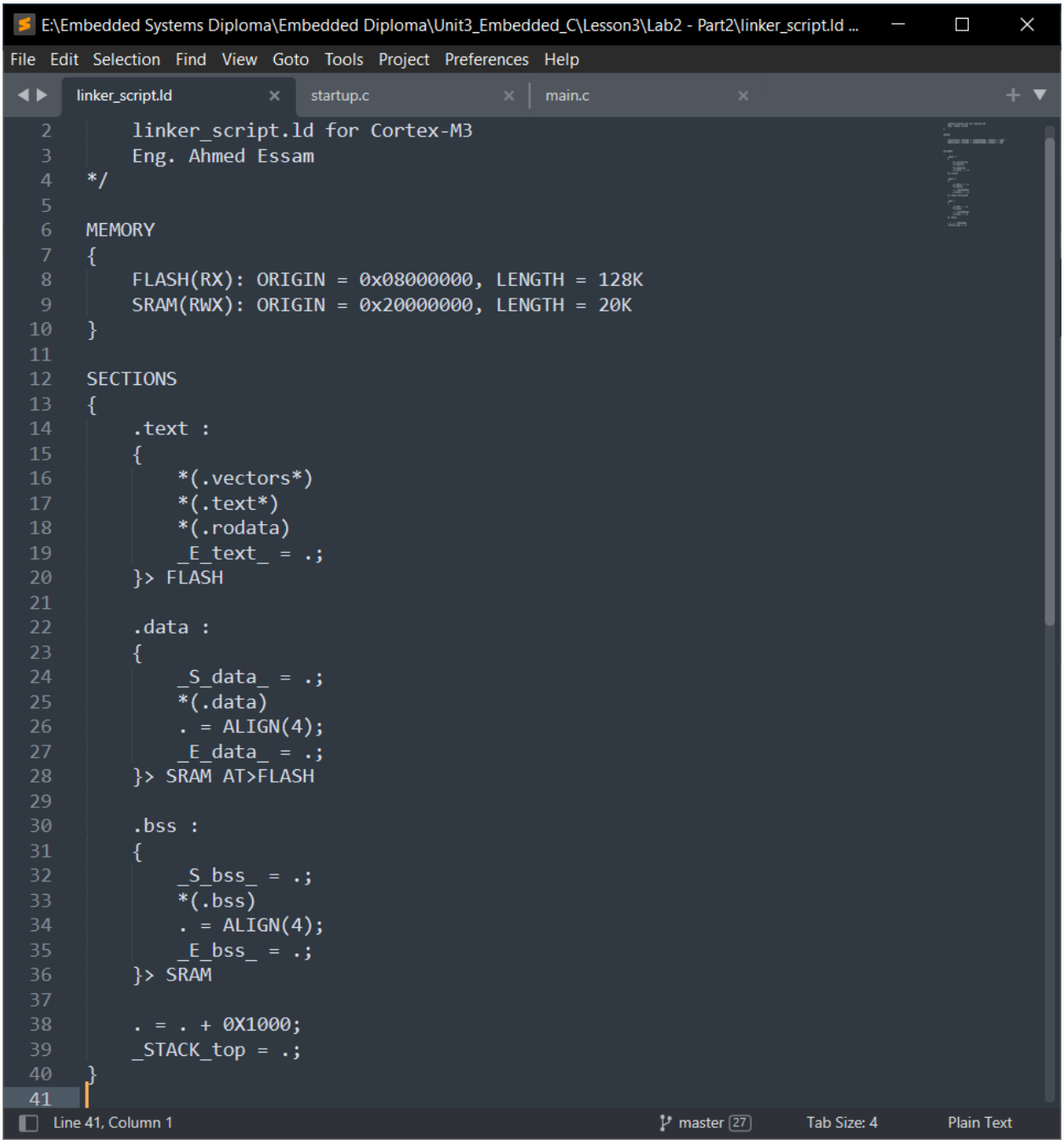


Startup.c:

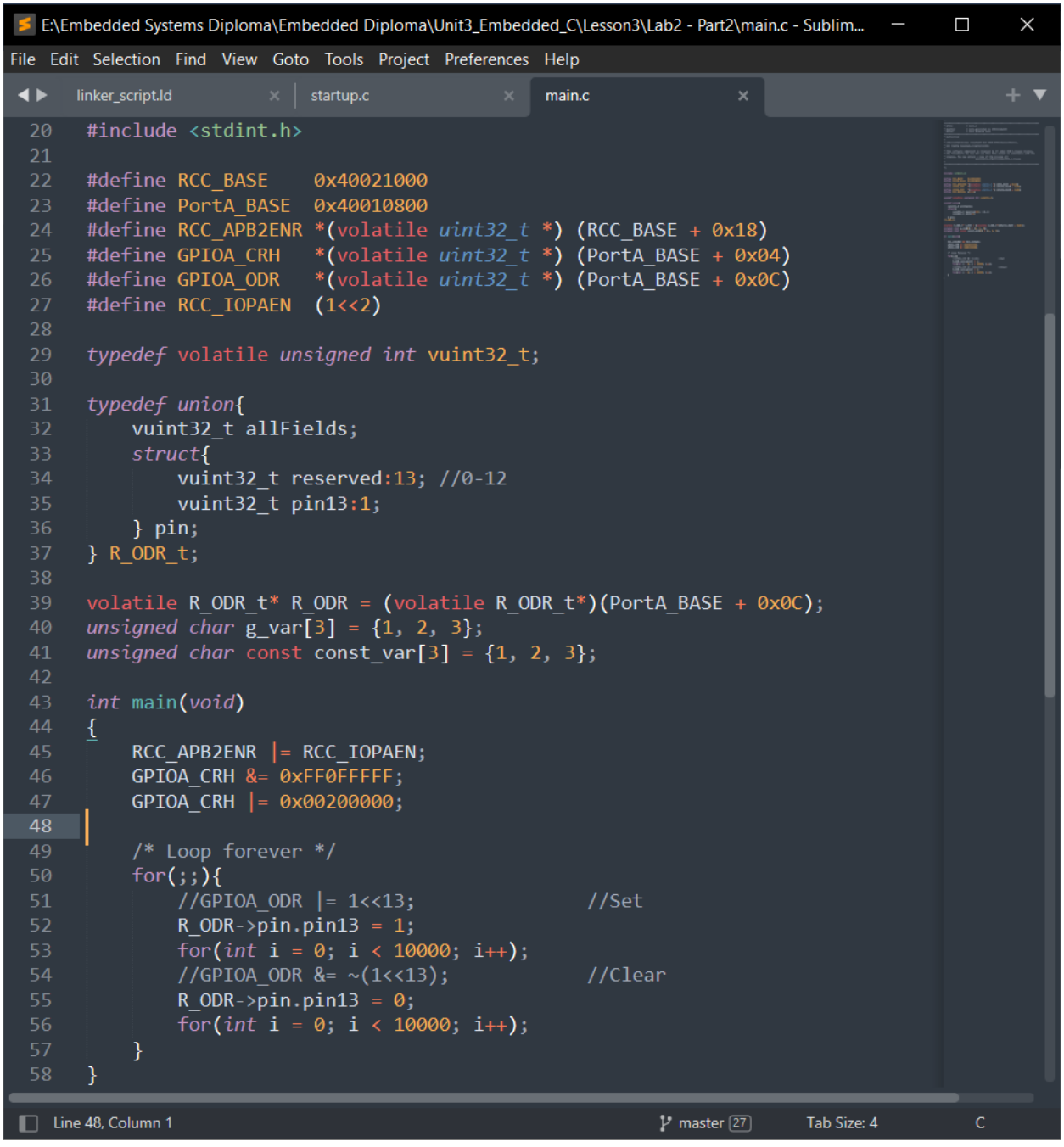



```c
int main(void);
void Reset_Handler();
void Default_Handler(){
    Reset_Handler();
}

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

extern uint32_t _STACK_top;

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
};

extern unsigned int _E_text_;
extern unsigned int _S_data_;
extern unsigned int _E_data_;
extern unsigned int _S_bss_;
extern unsigned int _E_bss_;

void Reset_Handler(){
    //Copy .data from FLASH to SRAM
    unsigned int data_SIZE =
        (unsigned char*)(&_E_data_) - (unsigned char*)(&_S_data_);

    unsigned char * P_src = (unsigned char*)_E_text_;
    unsigned char * P_dest = (unsigned char*)_S_data_;

    for(int i = 0; i < data_SIZE; i++){
        *((unsigned char *)P_dest++) = *((unsigned char *)P_src++);
    }

    //Initialize .bss in SRAM by zeros
    unsigned int bss_SIZE =
        (unsigned char*)(&_E_bss_) - (unsigned char*)(&_S_bss_);

    P_dest = (unsigned char*)_S_bss_;

    for(int i = 0; i < bss_SIZE; i++){
        *((unsigned char *)P_dest++) = (unsigned char) 0;
    }

    //Proceed to main function
    main();
}
```

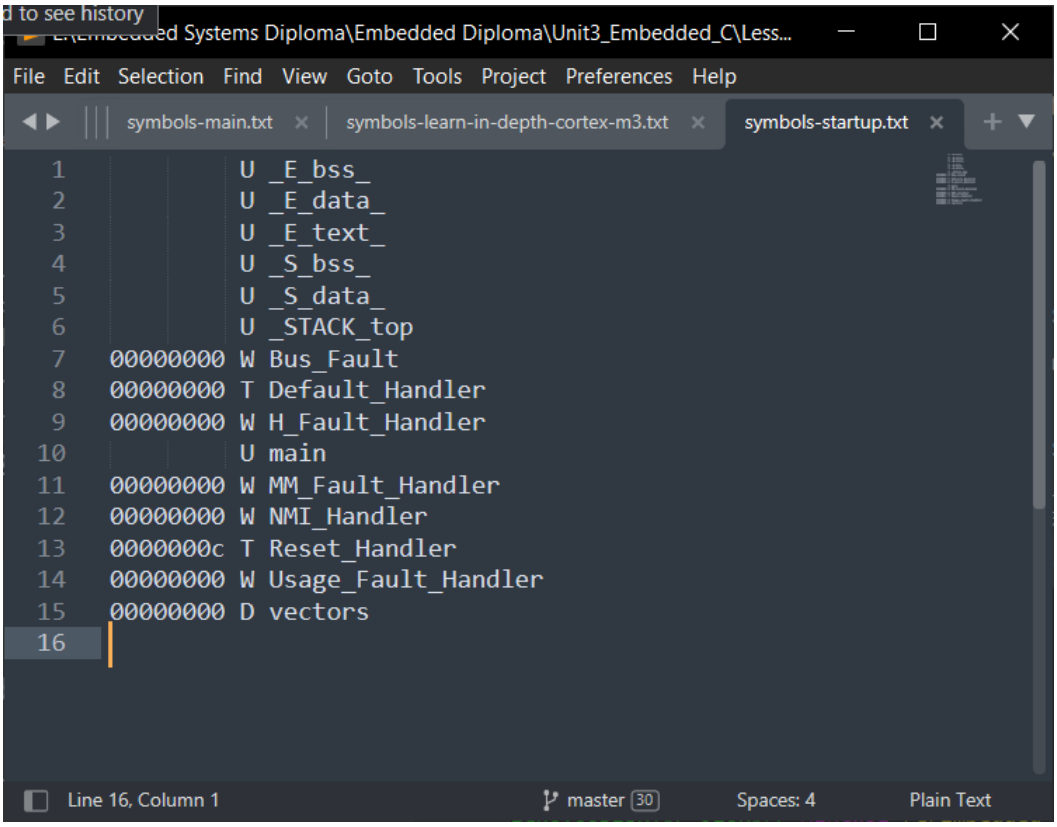
Linker_script.ld:



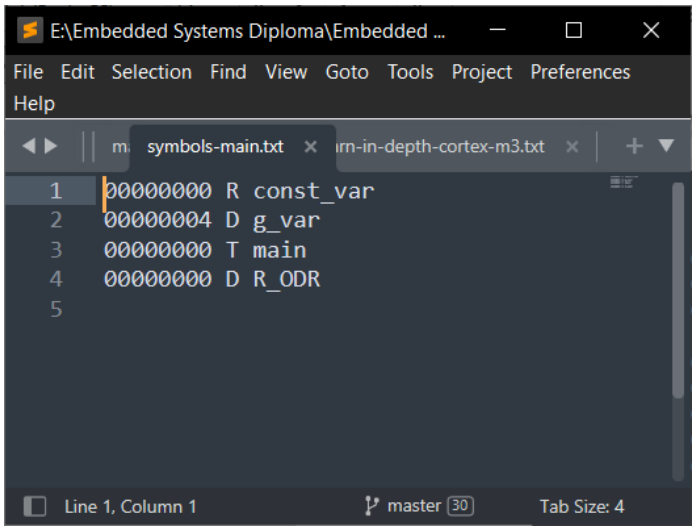
Main.c:


E:\Embedded Systems Diploma\Embedded Diploma\Unit3_Embedded_C\Lesson3\Lab2 - Part2\main.c - Sublim...
File Edit Selection Find View Goto Tools Project Preferences Help
linker_script.ld
startup.c
main.c
#include <stdint.h>
#define RCC_BASE 0x40021000
#define PortA_BASE 0x40010800
#define RCC_APB2ENR *(volatile uint32_t *) (RCC_BASE + 0x18)
#define GPIOA_CRH *(volatile uint32_t *) (PortA_BASE + 0x04)
#define GPIOA_ODR *(volatile uint32_t *) (PortA_BASE + 0x0C)
#define RCC_IOPAEN (1<<2)
typedef volatile unsigned int vuint32_t;
typedef union{
vuint32_t allFields;
struct{
vuint32_t reserved:13; //0-12
vuint32_t pin13:1;
} pin;
} R_ODR_t;
volatile R_ODR_t* R_ODR = (volatile R_ODR_t*)(PortA_BASE + 0x0C);
unsigned char g_var[3] = {1, 2, 3};
unsigned char const const_var[3] = {1, 2, 3};
int main(void)
{
RCC_APB2ENR |= RCC_IOPAEN;
GPIOA_CRH &= 0xFF0FFFFF;
GPIOA_CRH |= 0x00200000;
/* Loop forever */
for(;;){
//GPIOA_ODR |= 1<<13; //Set
R_ODR->pin.pin13 = 1;
for(int i = 0; i < 10000; i++);
//GPIOA_ODR &= ~(1<<13); //Clear
R_ODR->pin.pin13 = 0;
for(int i = 0; i < 10000; i++);
}
}
Line 48, Column 1
master 27
Tab Size: 4
C

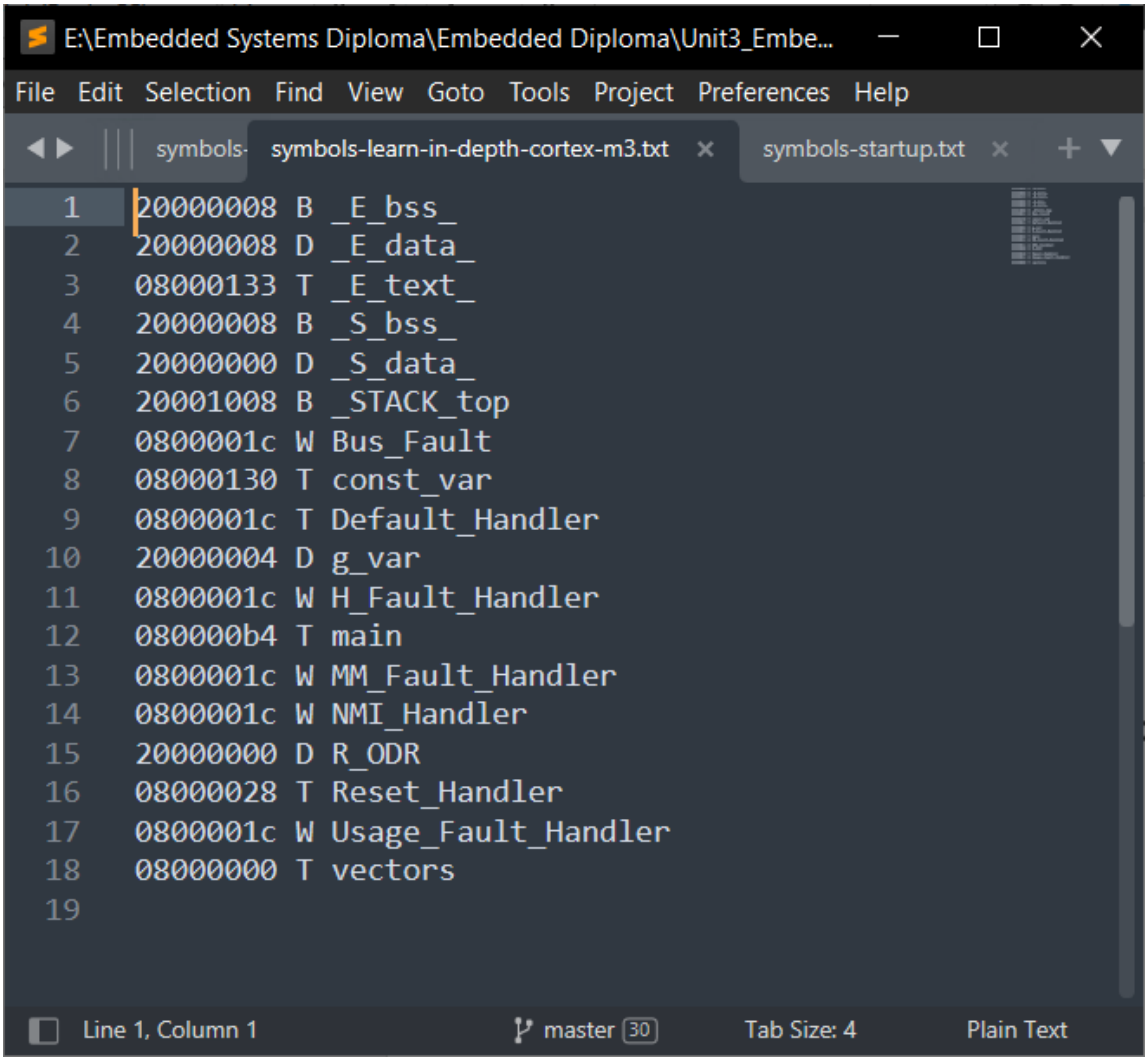
Symbols of startup.o:



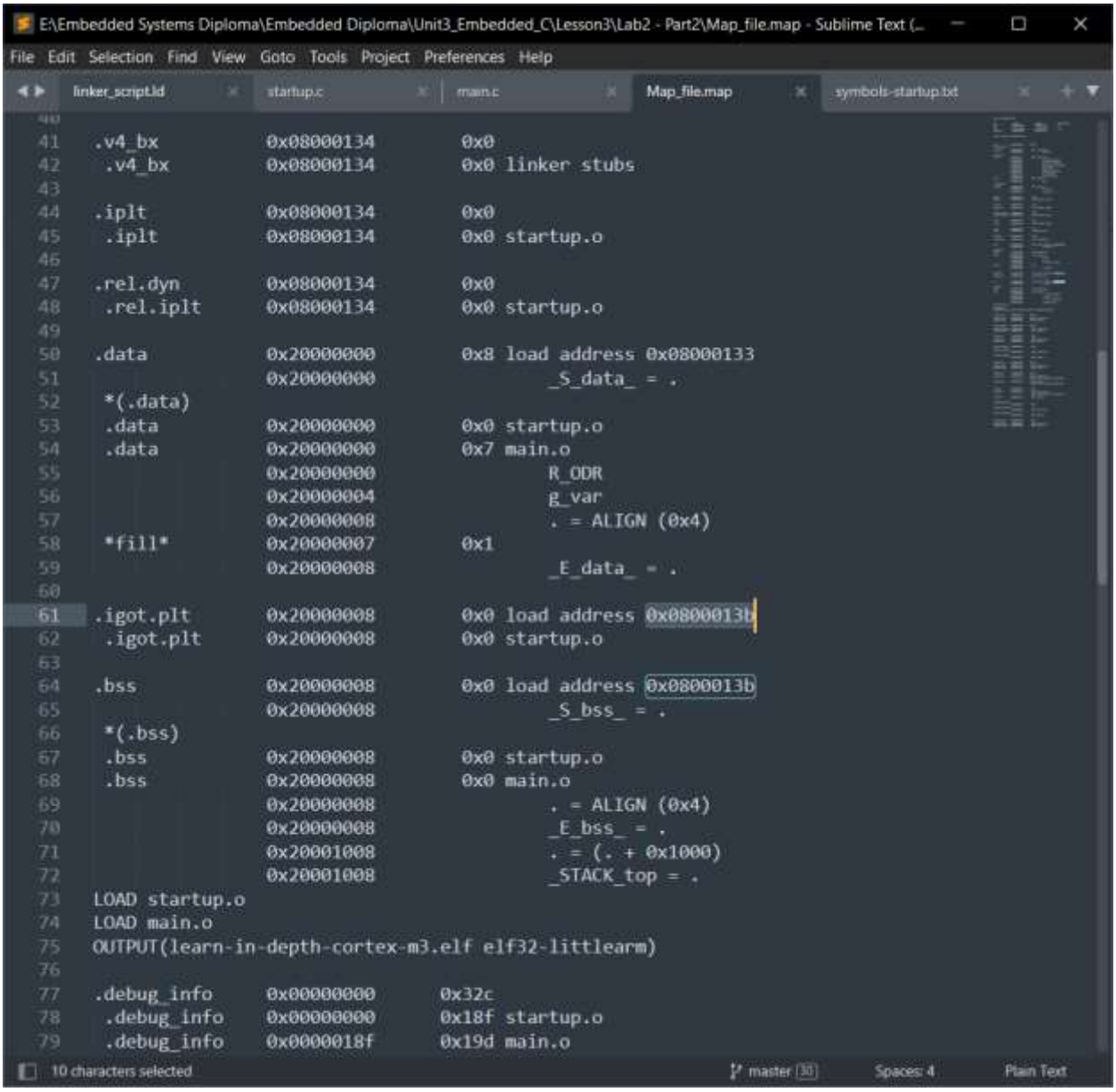
Symbols of main.o:



Symbols of learn-in-depth-cortex-m3.elf:



Mapfile.map: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File Edit Selection Find View Goto Tools Project Preferences Help
linker_script.ld
startup.c
main.c
Map_file.map
symbols-startup.txt
41 .v4_bx 0x08000134 0x0
42 .v4_bx 0x08000134 0x0 linker stubs
43
44 .iplt 0x08000134 0x0
45 .iplt 0x08000134 0x0 startup.o
46
47 .rel.dyn 0x08000134 0x0
48 .rel.iplt 0x08000134 0x0 startup.o
49
50 .data 0x20000000 0x8 load address 0x08000133
51 0x20000000 _S_data_ = .
52 *(.data)
53 .data 0x20000000 0x0 startup.o
54 .data 0x20000000 0x7 main.o
55 0x20000000 R_ODR
56 0x20000004 g_var
57 0x20000008 . = ALIGN (0x4)
58 *fill* 0x20000007 0x1
59 0x20000008 _E_data_ = .
60
61 .igot.plt 0x20000008 0x0 load address 0x0800013b
62 .igot.plt 0x20000008 0x0 startup.o
63
64 .bss 0x20000008 0x0 load address 0x0800013b
65 0x20000008 _S_bss_ = .
66 *(.bss)
67 .bss 0x20000008 0x0 startup.o
68 .bss 0x20000008 0x0 main.o
69 0x20000008 . = ALIGN (0x4)
70 0x20000008 _E_bss_ = .
71 0x20001008 . = (. + 0x1000)
72 0x20001008 _STACK_top = .
73 LOAD startup.o
74 LOAD main.o
75 OUTPUT(learn-in-depth-cortex-m3.elf elf32-littlearm)
76
77 .debug_info 0x00000000 0x32c
78 .debug_info 0x00000000 0x18f startup.o
79 .debug_info 0x0000018f 0x19d main.o
10 characters selected
master 30
Spaces: 4
Plain Text

Proteus screenshot: