

Report lec.3 unit 3

Startup.o sections

```
mark@DESKTOP-KJ5VTUS MINGW32 /g/Embedded diploma/LED1
$ 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          00000008  00000000  00000000  00000034  2**1
    CONTENTS, ALLOC, LOAD, RELOC, READONLY, CODE
  1 .data          00000000  00000000  00000000  0000003c  2**0
    CONTENTS, ALLOC, LOAD, DATA
  2 .bss           00000000  00000000  00000000  0000003c  2**0
    ALLOC
  3 .vectors       00000038  00000000  00000000  0000003c  2**0
    CONTENTS, RELOC, READONLY
  4 .ARM.attributes 00000021  00000000  00000000  00000074  2**0
    CONTENTS, READONLY
  5 .debug_line    0000003b  00000000  00000000  00000095  2**0
    CONTENTS, RELOC, READONLY, DEBUGGING
  6 .debug_info    0000004b  00000000  00000000  000000d0  2**0
    CONTENTS, RELOC, READONLY, DEBUGGING
  7 .debug_abbrev  00000014  00000000  00000000  0000011b  2**0
    CONTENTS, READONLY, DEBUGGING
  8 .debug_aranges 00000020  00000000  00000000  00000130  2**3
    CONTENTS, RELOC, READONLY, DEBUGGING

mark@DESKTOP-KJ5VTUS MINGW32 /g/Embedded diploma/LED1
$
```

Symbol table

```
mark@DESKTOP-KJ5VTUS MINGW32 /g/Embedded diploma/LED1
$ arm-none-eabi-nm.exe LED2.elf
08000038 t _reset
080000e8 T const_var
080000f0 D g_var
08000040 T main
080000ec D R_ODR
0800003e t vector_handler
```

Sections of object files

main.o

```
mark@DESKTOP-KJ5VTUS MINGW32 /g/Embedded diploma/LED1
$ 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          000000a8  00000000  00000000  00000034  2**2
    CONTENTS, ALLOC, LOAD, RELOC, READONLY, CODE
  1 .data          00000008  00000000  00000000  000000dc  2**2
    CONTENTS, ALLOC, LOAD, DATA
  2 .bss           00000000  00000000  00000000  000000e4  2**0
    ALLOC
  3 .rodata        00000004  00000000  00000000  000000e4  2**2
    CONTENTS, ALLOC, LOAD, READONLY, DATA
  4 .debug_info    00000186  00000000  00000000  000000e8  2**0
    CONTENTS, RELOC, READONLY, DEBUGGING
  5 .debug_abbrev  000000f9  00000000  00000000  0000026e  2**0
    CONTENTS, READONLY, DEBUGGING
  6 .debug_loc     00000038  00000000  00000000  00000367  2**0
    CONTENTS, READONLY, DEBUGGING
  7 .debug_aranges 00000020  00000000  00000000  0000039f  2**0
    CONTENTS, RELOC, READONLY, DEBUGGING
  8 .debug_line    00000056  00000000  00000000  000003bf  2**0
    CONTENTS, RELOC, READONLY, DEBUGGING
  9 .debug_str     00000106  00000000  00000000  00000415  2**0
    CONTENTS, READONLY, DEBUGGING
10 .comment       00000012  00000000  00000000  0000051b  2**0
    CONTENTS, READONLY
11 .ARM.attributes 00000033  00000000  00000000  0000052d  2**0
    CONTENTS, READONLY
12 .debug_frame   0000002c  00000000  00000000  00000560  2**2
    CONTENTS, RELOC, READONLY, DEBUGGING

mark@DESKTOP-KJ5VTUS MINGW32 /g/Embedded diploma/LED1
$
```

Output file sections

```
mark@DESKTOP-KJ5VTUS /cygdrive/g/Embedded diploma/LED1
$ arm-none-eabi-objdump.exe LED2.elf -h

LED2.elf:      file format elf32-littlearm

Sections:
Idx Name          Size      VMA           LMA           File off  Algn
  0 .text          000000ec  08000000  08000000  00008000  2**2
    CONTENTS, ALLOC, LOAD, READONLY, CODE
  1 .data          00000008  0800000c  0800000c  0000800c  2**2
    CONTENTS, ALLOC, LOAD, DATA
  2 .ARM.attributes 0000002f  00000000  00000000  000080f4  2**0
    CONTENTS, READONLY
  3 .comment        00000011  00000000  00000000  00008123  2**0
    CONTENTS, READONLY
  4 .debug_line     00000091  00000000  00000000  00008134  2**0
    CONTENTS, READONLY, DEBUGGING
  5 .debug_info     000001d1  00000000  00000000  000081c5  2**0
    CONTENTS, READONLY, DEBUGGING
  6 .debug_abbrev   0000010d  00000000  00000000  00008396  2**0
    CONTENTS, READONLY, DEBUGGING
  7 .debug_aranges  00000040  00000000  00000000  000084a8  2**3
    CONTENTS, READONLY, DEBUGGING
  8 .debug_loc      00000038  00000000  00000000  000084e8  2**0
    CONTENTS, READONLY, DEBUGGING
  9 .debug_str      000000cd  00000000  00000000  00008520  2**0
    CONTENTS, READONLY, DEBUGGING
 10 .debug_frame    0000002c  00000000  00000000  000085f0  2**2
    CONTENTS, READONLY, DEBUGGING

mark@DESKTOP-KJ5VTUS /cygdrive/g/Embedded diploma/LED1
$
```

Building startup.c

The image shows a code editor window with the file `startup.c` open. The code defines several handlers and a vector table. A terminal window in the background shows the build process.

```
//startup.c
//made by mark 2024

#include <stdint.h>

void Reset_Handler ();
void Default_Handler () {
    Reset_Handler ();
}

//weak -> specifies a fun() can be overwritten by another file
//alias -> to specify that the current symbol point to one handler containing all the addresses
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_Handler (void) __attribute__((weak, alias ("Default_Handler")));
void Usage_Fault_Handler (void) __attribute__((weak, alias ("Default_Handler")));

//option for the toolchain compiler to specify the desired section
uint32_t vectors[] __attribute__((section(".vectors"))) =
{
    (uint32_t) 0x20001000,
    (uint32_t) &Reset_Handler,
    (uint32_t) &NMI_Handler,
    (uint32_t) &H_Fault_Handler,
    (uint32_t) &MM_Fault_Handler,
    (uint32_t) &Bus_Handler,
    (uint32_t) &Usage_Fault_Handler
};

void Reset_Handler (void) {
    main();
}
```

The terminal window shows the following output:

```
mark@DESKTOP-KJ5VTUS /cygdrive/g/Embedded diploma/LED1/Assignment
$ make
arm-none-eabi-gcc.exe -mcpu=cortex-m3 -mthumb -gdwarf-2 -std=c99 -c -I
startup.c: In function 'Reset_Handler':
startup.c:31:5: warning: implicit declaration of function 'main' [-Wimpl
arm-none-eabi-ld.exe -T linker_script.ld main.o startup.o -o LED2.elf -
arm-none-eabi-objcopy.exe -O binary LED2.elf LED2.bin
DONE

mark@DESKTOP-KJ5VTUS /cygdrive/g/Embedded diploma/LED1/Assignment
$ arm-none-eabi-nm.exe LED2.elf
080000c4 W Bus_Handler
080000dc T const_var
080000c4 T Default_Handler
080000e4 D g_var
080000c4 W H_Fault_Handler
0800001c T main
080000c4 W MM_Fault_Handler
080000c4 W NMI_Handler
080000e0 D R_ODR
080000d0 T Reset_Handler
080000c4 W Usage_Fault_Handler
08000000 T vectors

mark@DESKTOP-KJ5VTUS /cygdrive/g/Embedded diploma/LED1/Assignment
$
```

Symbol table

```
mark@DESKTOP-KJ5VTUS MINGW32 /g/Embedded diploma/LED1/Part_2
$ arm-none-eabi-nm.exe startup.o
                 U _E_bss
                 U _E_Data
                 U _E_text
                 U _S_bss
                 U _S_Data
                 U _stack_top
00000000 W Bus_Handler
00000000 T Default_Handler
00000000 W H_Fault_Handler
                 U main
00000000 W MM_Fault_Handler
00000000 W NMI_Handler
0000000c T Reset_Handler
00000000 W Usage_Fault_Handler
00000000 D vectors
```

Main.o

```
mark@DESKTOP-KJ5VTUS MINGW32 /g/Embedded diploma/LED1/Part_2
$ 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          000000a8  00000000  00000000  00000034  2**2
    CONTENTS, ALLOC, LOAD, RELOC, READONLY, CODE
  1 .data          00000008  00000000  00000000  000000dc  2**2
    CONTENTS, ALLOC, LOAD, DATA
  2 .bss           00000000  00000000  00000000  000000e4  2**0
    ALLOC
  3 .rodata        00000004  00000000  00000000  000000e4  2**2
    CONTENTS, ALLOC, LOAD, READONLY, DATA
  4 .debug_info    00000186  00000000  00000000  000000e8  2**0
    CONTENTS, RELOC, READONLY, DEBUGGING
  5 .debug_abbrev  000000f9  00000000  00000000  0000026e  2**0
    CONTENTS, READONLY, DEBUGGING
  6 .debug_loc     00000038  00000000  00000000  00000367  2**0
    CONTENTS, READONLY, DEBUGGING
  7 .debug_aranges 00000020  00000000  00000000  0000039f  2**0
    CONTENTS, RELOC, READONLY, DEBUGGING
  8 .debug_line    00000056  00000000  00000000  000003bf  2**0
    CONTENTS, RELOC, READONLY, DEBUGGING
  9 .debug_str     00000111  00000000  00000000  00000415  2**0
    CONTENTS, READONLY, DEBUGGING
 10 .comment       00000012  00000000  00000000  00000526  2**0
    CONTENTS, READONLY
 11 .ARM.attributes 00000033  00000000  00000000  00000538  2**0
    CONTENTS, READONLY
 12 .debug_frame   0000002c  00000000  00000000  0000056c  2**2
    CONTENTS, RELOC, READONLY, DEBUGGING
```

Startup.o

```
mark@DESKTOP-KJ5VTUS MINGW32 /g/Embedded diploma/LED1/Part_2
$ 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          000000b4  00000000  00000000  00000034  2**2
    CONTENTS, ALLOC, LOAD, RELOC, READONLY, CODE
  1 .data          00000000  00000000  00000000  000000e8  2**0
    CONTENTS, ALLOC, LOAD, DATA
  2 .bss           00000000  00000000  00000000  000000e8  2**0
    ALLOC
  3 .vectors       0000001c  00000000  00000000  000000e8  2**2
    CONTENTS, ALLOC, LOAD, RELOC, DATA
  4 .debug_info    0000018c  00000000  00000000  00000104  2**0
    CONTENTS, RELOC, READONLY, DEBUGGING
  5 .debug_abbrev  000000d6  00000000  00000000  00000290  2**0
    CONTENTS, READONLY, DEBUGGING
  6 .debug_loc     00000064  00000000  00000000  00000366  2**0
    CONTENTS, READONLY, DEBUGGING
  7 .debug_aranges 00000020  00000000  00000000  000003ca  2**0
    CONTENTS, RELOC, READONLY, DEBUGGING
  8 .debug_line    000000ab  00000000  00000000  000003ea  2**0
    CONTENTS, RELOC, READONLY, DEBUGGING
  9 .debug_str     00000151  00000000  00000000  00000495  2**0
    CONTENTS, READONLY, DEBUGGING
10 .comment       00000012  00000000  00000000  000005e6  2**0
    CONTENTS, READONLY
11 .ARM.attributes 00000033  00000000  00000000  000005f8  2**0
    CONTENTS, READONLY
12 .debug_frame   0000004c  00000000  00000000  0000062c  2**2
    CONTENTS, RELOC, READONLY, DEBUGGING
```

mapfile

	0x080000c4	Usage_Fault_Handler
	0x080000c4	NMI_Handler
	0x080000d0	Reset_Handler
(.rodata)		
.rodata	0x08000178	0x4 main.o
	0x08000178	const_var
	0x0800017c	_E_text = .
.glue_7	0x0800017c	0x0
.glue_7	0x00000000	0x0 linker stubs
.glue_7t	0x0800017c	0x0
.glue_7t	0x00000000	0x0 linker stubs
.vfp11_veneer	0x0800017c	0x0
.vfp11_veneer	0x00000000	0x0 linker stubs
.v4_bx	0x0800017c	0x0
.v4_bx	0x00000000	0x0 linker stubs
.iplt	0x0800017c	0x0
.iplt	0x00000000	0x0 main.o
.rel.dyn	0x0800017c	0x0
.rel.iplt	0x00000000	0x0 main.o
.data	0x20000000	0x8 load address 0x0800017c
	0x20000000	_S_Data = .
(.data)		
.data	0x20000000	0x8 main.o
	0x20000000	R_ODR
	0x20000004	g_var
.data	0x20000008	0x0 startup.o
	0x20000008	. = ALIGN (0x4)
	0x20000008	_E_Data = .
.igot.plt	0x20000008	0x0 load address 0x08000184
.igot.plt	0x00000000	0x0 main.o
.bss	0x20000008	0x1000 load address 0x08000184
	0x20000008	_S_bss = .
(.bss)		
.bss	0x20000008	0x0 main.o
.bss	0x20000008	0x0 startup.o
	0x20000008	_E_bss = .
	0x20000008	. = ALIGN (0x4)
	0x20001008	. = (. + 0x1000)
fill	0x20000008	0x1000
	0x20001008	_stack_top = .