Unit3_Lesson(3)

write codes

main.c

```c
typedef volatile unsigned int  vuint32;

#define RCC_Base   0x40021000
#define GPIOPA_Base   0x40010800

#define RCC_APB2ENR    *(vuint32*)(RCC_Base+0x18)
#define GPIO_PA_CRH    *(vuint32*)(GPIOPA_Base+0x04)


#define SetClock   (1<<2)

typedef union{
    vuint32 all;
    struct{
        vuint32 reserved: 13;
        vuint32 pin13: 1;
    }pin;
}P_IN;

volatile P_IN* ptr = (volatile P_IN*)(GPIOPA_Base+0x0c);
int main(void)
{
    RCC_APB2ENR|=SetClock;
    GPIO_PA_CRH &= 0xff0fffff;
    GPIO_PA_CRH|=  0x00200000;
    while(1){
        ptr->pin.pin13=1;
        for(int i=0 ;i<50000;i++);
        ptr->pin.pin13=0;
        for(int i=0 ;i<50000;i++);
    }

}
```

startUp.s

```
/* learn-in-depth
    Unit3_lesson3
    Eng\ Hazem Abd El-Halim
    */

.section .vectors
.word 0x20001000          //stack_top
.word _reset              //1   reset
.word vector_handler      // 2  NMI
.word vector_handler      // 3  MM fault
.word vector_handler      // 4  Bus fault
.word vector_handler      // 5  Usage fault
.word vector_handler      // 6  Reserved
.word vector_handler      // 7  Reserved
.word vector_handler      // 8  Reserved
.word vector_handler      // 9  Reserved
.word vector_handler      // 10 Reserved
.word vector_handler      // 11 SVL 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 IRQ1
.word vector_handler      // 17 IRQ2
.word vector_handler      // 18 IRQ3
.word vector_handler      // 19 ...

.section .text
_reset:
    bl main
    b .

.thumb_func
vector_handler:
    b _reset
```

linker_script.ld

```
/* learn-in-depth
    Unit3_lesson3
    Eng\ Hazem Abd El-Halim
    */


MEMORY
{
flash (RX) : ORIGIN = 0x08000000, LENGTH = 128k
sram (RWX) : ORIGIN = 0x20000000, LENGTH = 20k
}

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

    .data : {
            *(.data)
    } >flash

    .bss : {
            *(.bss*)
    } >sram
}
```

Makefile

```
CC=arm-none-eabi-
CFLAGS=-gdwarf-2 -mcpu=cortex-m3
INCS= -I .
LIBS=
SRC=$(wildcard *.c)
OBJ=$(SRC:.c=.o)
As_s=$(wildcard *.s)
As_o=$(As_s:.s=.o)
project_name= toggle_LED_cortexM3

all:$(project_name).bin

%.o: %.s
    $(CC)as.exe $(CFLAGS) $< -o $@

%.o: %.c
    $(CC)gcc.exe -c $(CFLAGS) $(INCS)  $< -o $@

$(project_name).elf: $(OBJ) $(As_o)
    $(CC)ld.exe -T linker_script.ld  $(LIBS) $(As_o)  $(OBJ)  -o  $@     -Map=Map_file.map

$(project_name).bin: $(project_name).elf
    $(CC)objcopy.exe -O binary $<  $@

clear_all:
    rm *.o *.elf *.bin
```

main.o

mingw32-make.exe main.o

startUp.o

mingw32-make.exe startUp.o

To show sections for object_file

main.o

```
$ 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         0000007c  00000000  00000000  00000034  2**2
                  CONTENTS, ALLOC, LOAD, RELOC, READONLY, CODE
  1 .data         00000004  00000000  00000000  000000b0  2**2
                  CONTENTS, ALLOC, LOAD, DATA
  2 .bss          00000000  00000000  00000000  000000b4  2**0
                  ALLOC
  3 .debug_info   00000105  00000000  00000000  000000b4  2**0
                  CONTENTS, RELOC, READONLY, DEBUGGING
  4 .debug_abbrev 000000d3  00000000  00000000  000001b9  2**0
                  CONTENTS, READONLY, DEBUGGING
  5 .debug_loc    00000038  00000000  00000000  0000028c  2**0
                  CONTENTS, READONLY, DEBUGGING
  6 .debug_aranges 00000020  00000000  00000000  000002c4  2**0
                  CONTENTS, RELOC, READONLY, DEBUGGING
  7 .debug_line   00000056  00000000  00000000  000002e4  2**0
                  CONTENTS, RELOC, READONLY, DEBUGGING
  8 .debug_str    000000b1  00000000  00000000  0000033a  2**0
                  CONTENTS, READONLY, DEBUGGING
  9 .comment      0000007f  00000000  00000000  000003eb  2**0
                  CONTENTS, READONLY
 10 .debug_frame  0000002c  00000000  00000000  0000046c  2**2
                  CONTENTS, RELOC, READONLY, DEBUGGING
 11 .ARM.attributes 00000033  00000000  00000000  00000498  2**0
                  CONTENTS, READONLY
```

Startup.o

```
$ 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      00000050  00000000  00000000  0000003c  2**0
                  CONTENTS, RELOC, READONLY
  4 .debug_line   0000003b  00000000  00000000  0000008c  2**0
                  CONTENTS, RELOC, READONLY, DEBUGGING
  5 .debug_info   00000026  00000000  00000000  000000c7  2**0
                  CONTENTS, RELOC, READONLY, DEBUGGING
  6 .debug_abbrev 00000014  00000000  00000000  000000ed  2**0
                  CONTENTS, READONLY, DEBUGGING
  7 .debug_aranges 00000020  00000000  00000000  00000108  2**3
                  CONTENTS, RELOC, READONLY, DEBUGGING
  8 .debug_str    0000002a  00000000  00000000  00000128  2**0
                  CONTENTS, READONLY, DEBUGGING
  9 .ARM.attributes 00000021  00000000  00000000  00000152  2**0
                  CONTENTS, READONLY
```

To show symbol table for main.o and startUp.o

```
$ arm-none-eabi-nm.exe  main.o
00000000 T main
00000000 D ptr
```

```
$ arm-none-eabi-nm.exe  startUp.o
00000000 t _reset
         U main
00000006 t vector_handler
```

use linker_script to get executable_file (toggle_LED_cortexM3.elf) and Map_file.map

mingw32-make-exe toggle_LED_cortexM3.elf

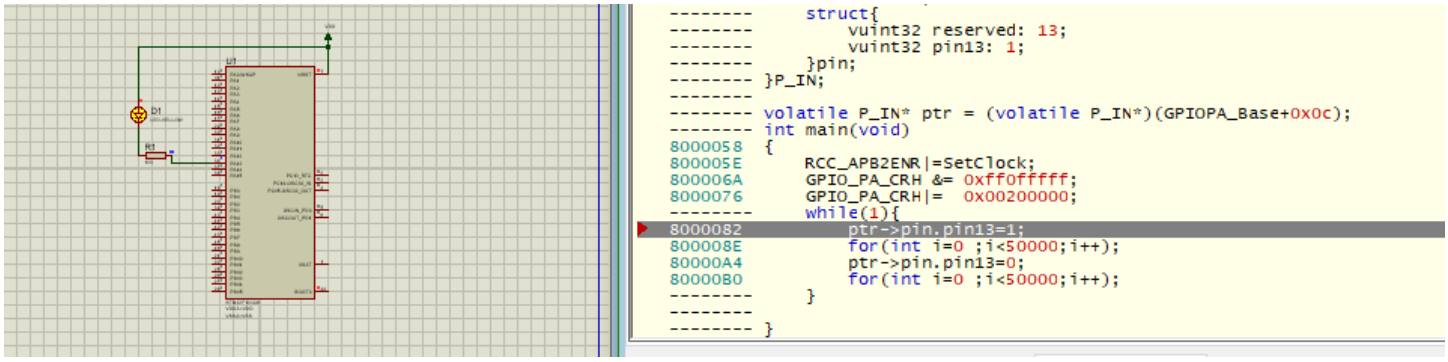
To show sections for toggle_LED_cortexM3.elf

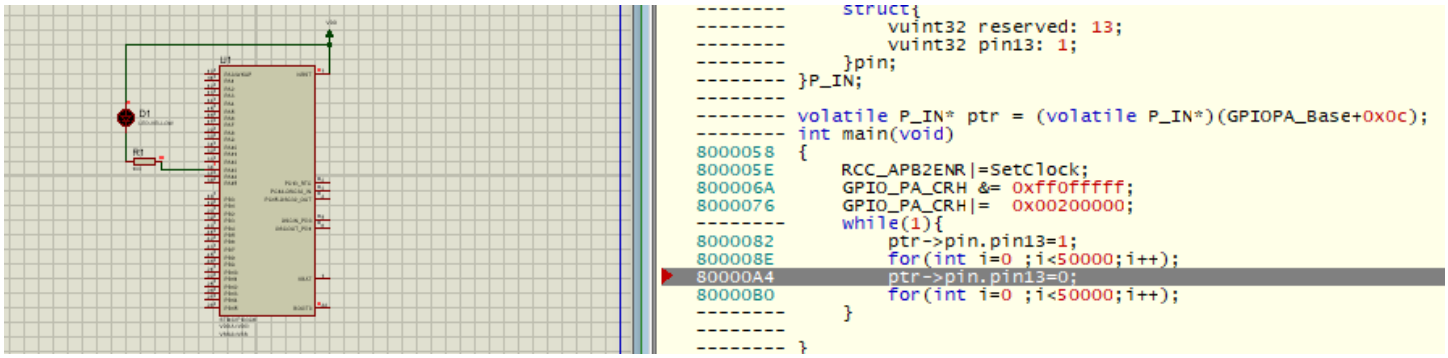
```
$ arm-none-eabi-objdump.exe -h toggle_LED_cortexM3.elf

toggle_LED_cortexM3.elf:     file format elf32-littlearm

Sections:
Idx Name          Size      VMA       LMA       File off  Algn
  0 .text         000000d4  08000000  08000000  00010000  2**2
                  CONTENTS, ALLOC, LOAD, READONLY, CODE
  1 .data         00000004  080000d4  080000d4  000100d4  2**2
                  CONTENTS, ALLOC, LOAD, DATA
  2 .ARM.attributes 0000002f  00000000  00000000  000100d8  2**0
                  CONTENTS, READONLY
  3 .comment      0000007e  00000000  00000000  00010107  2**0
                  CONTENTS, READONLY
  4 .debug_line   00000091  00000000  00000000  00010185  2**0
                  CONTENTS, READONLY, DEBUGGING
  5 .debug_info   0000012b  00000000  00000000  00010216  2**0
                  CONTENTS, READONLY, DEBUGGING
  6 .debug_abbrev 000000e7  00000000  00000000  00010341  2**0
                  CONTENTS, READONLY, DEBUGGING
  7 .debug_aranges 00000040  00000000  00000000  00010428  2**3
                  CONTENTS, READONLY, DEBUGGING
  8 .debug_str    000000ca  00000000  00000000  00010468  2**0
                  CONTENTS, READONLY, DEBUGGING
  9 .debug_loc    00000038  00000000  00000000  00010532  2**0
                  CONTENTS, READONLY, DEBUGGING
 10 .debug_frame  0000002c  00000000  00000000  0001056c  2**2
                  CONTENTS, READONLY, DEBUGGING
```

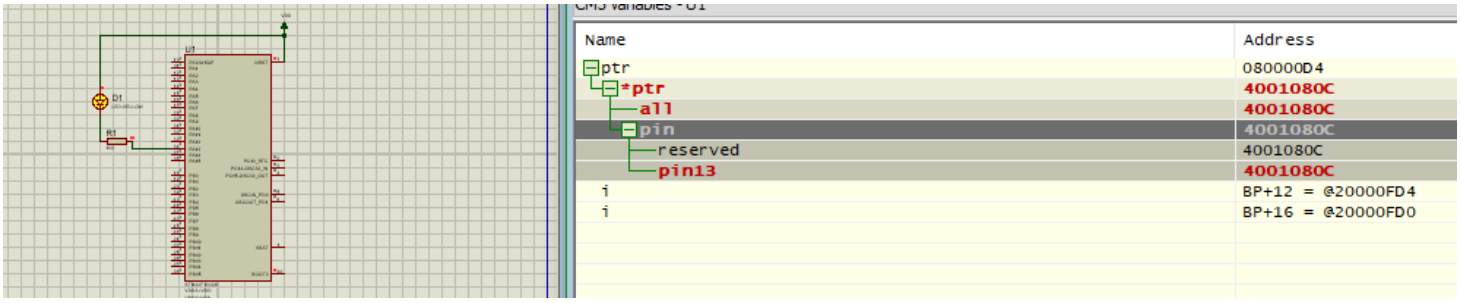
To show symbol table for toggle_LED_cortexM3.elf

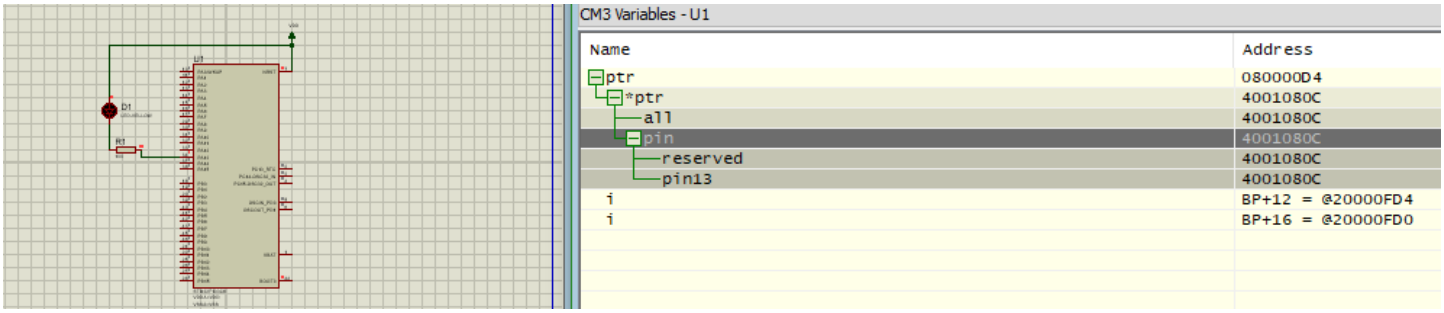
```
$ arm-none-eabi-nm.exe  toggle_LED_cortexM3.elf
08000050 t _reset
08000058 T main
080000d4 D ptr
08000056 t vector_handler
```

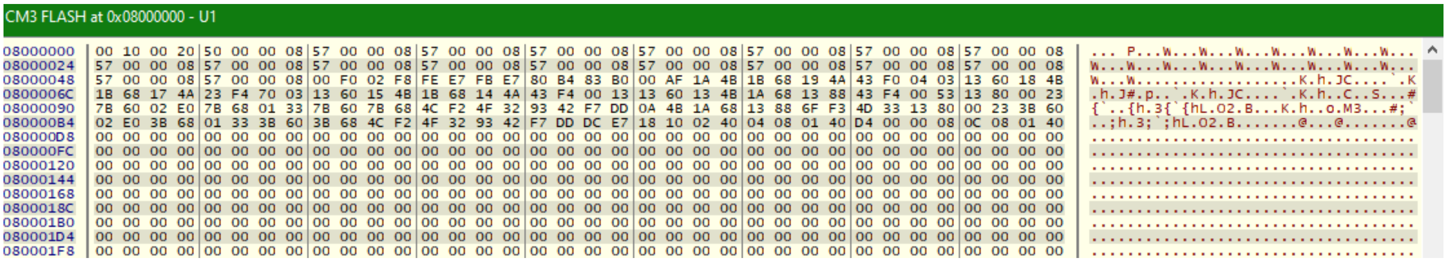
Proteus simulation











CM3 FLASH at 0x08000000 - U1

```
08000000 | 00 10 00 20|50 00 00 08|57 00 00 08|57 00 00 08|57 00 00 08|57 00 00 08|57 00 00 08|57 00 00 08|57 00 00 08 | ... P...W...W...W...W...W...W...W...
08000024 | 57 00 00 08|57 00 00 08|57 00 00 08|57 00 00 08|57 00 00 08|57 00 00 08|57 00 00 08|57 00 00 08|57 00 00 08 | W...W...W...W...W...W...W...W...W...
08000048 | 57 00 00 08|57 00 00 08|00 F0 02 F8|FE E7 FB E7|80 B4 83 B0|00 AF 1A 4B|1B 68 19 4A|43 F0 04 03|13 60 18 4B | W...W...............K.h.JC....`.K
0800006C | 1B 68 17 4A|23 F4 70 03|13 60 15 4B|1B 68 14 4A|43 F4 00 13|13 60 13 4B|1A 68 13 88|43 F4 00 53|13 80 00 23 | .h.J#.p..`.K.h.JC....`.K.h..C..S...#
08000090 | 7B 60 02 E0|7B 68 01 33|7B 60 7B 68|4C F2 4F 32|93 42 F7 DD|0A 4B 1A 68|13 88 6F F3|4D 33 13 80|00 23 3B 60 | {`..{h.3{`{hL.O2.B...K.h..o.M3...#;`
080000B4 | 02 E0 3B 68|01 33 3B 60|3B 68 4C F2|4F 32 93 42|F7 DD DC E7|18 10 02 40|04 08 01 40|D4 00 00 08|0C 08 01 40 | ..;h.3;`;hL.O2.B.......@...@.......@
080000D8 | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
080000FC | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
08000120 | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
08000144 | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
08000168 | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
0800018C | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
080001B0 | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
080001D4 | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
080001F8 | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
```

CM3 RAM at 0x20000000 - U1

```
20000BF4 | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
20000C18 | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
20000C3C | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
20000C60 | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
20000C84 | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
20000CA8 | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
20000CCC | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
20000CF0 | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
20000D14 | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
20000D38 | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
20000D5C | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
20000D80 | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
20000DA4 | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
20000DC8 | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
20000DEC | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
20000E10 | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
20000E34 | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
20000E58 | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
20000E7C | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
20000EA0 | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
20000EC4 | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
20000EE8 | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
20000F0C | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
20000F30 | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
20000F54 | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
20000F78 | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
20000F9C | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
20000FC0 | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|50 C3 00 00|50 C3 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ................P...P...............
20000FE4 | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|FF FF FF FF|54 00 00 08|00 00 00 00|00 00 00 00|00 00 00 00 | ....................T...............
20001008 | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
2000102C | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
20001050 | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
20001074 | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
20001098 | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
200010BC | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
200010E0 | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
20001104 | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
20001128 | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
2000114C | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
20001170 | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
20001194 | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
200011B8 | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
200011DC | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
20001200 | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
20001224 | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
20001248 | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
2000126C | 00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|00 00 00 00 | ....................................
```