

Hands-on Session

- ◀ Communicate with FPGA peripheral within Linux

Exercise 8: Using FPGA Peripherals within Linux

- ◀ We will use the red LEDs and the slider switches
- ◀ The program copies the value of the switches to the LEDs

MMAP

```
// Open /dev/mem
if( ( fd = open( "/dev/mem", ( O_RDWR | O_SYNC ) ) ) == -1 ) {
    printf( "ERROR: could not open \"/dev/mem\"...\n" );
    return( 1 );
}

// get virtual addr that maps to physical
virtual_base = mmap( NULL, HW_REGS_SPAN, ( PROT_READ | PROT_WRITE ),
    MAP_SHARED, fd, HW_REGS_BASE );

if( virtual_base == MAP_FAILED ) {
    printf( "ERROR: mmap() failed...\n" );
    close( fd );
    return(1);
}
```

Using the Virtual Address

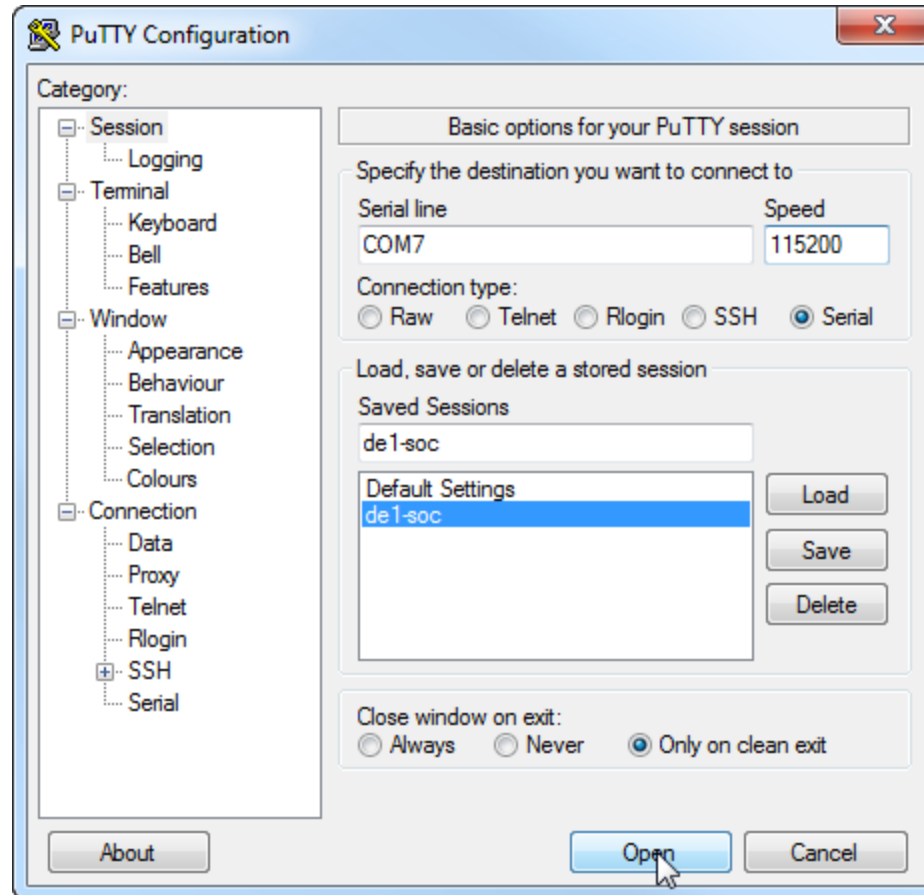
```
// Get the address that maps to the LEDs
h2p_lw_led_addr=(unsigned int *)(virtual_base + (( LED_PIO_BASE ) & (
    HW_REGS_MASK ) ));
h2p_lw_sw_addr=(unsigned int *)(virtual_base + (( SW_PIO_BASE ) & (
    HW_REGS_MASK ) ));

while(!stop){
    *h2p_lw_led_addr = *h2p_lw_sw_addr;
}
```

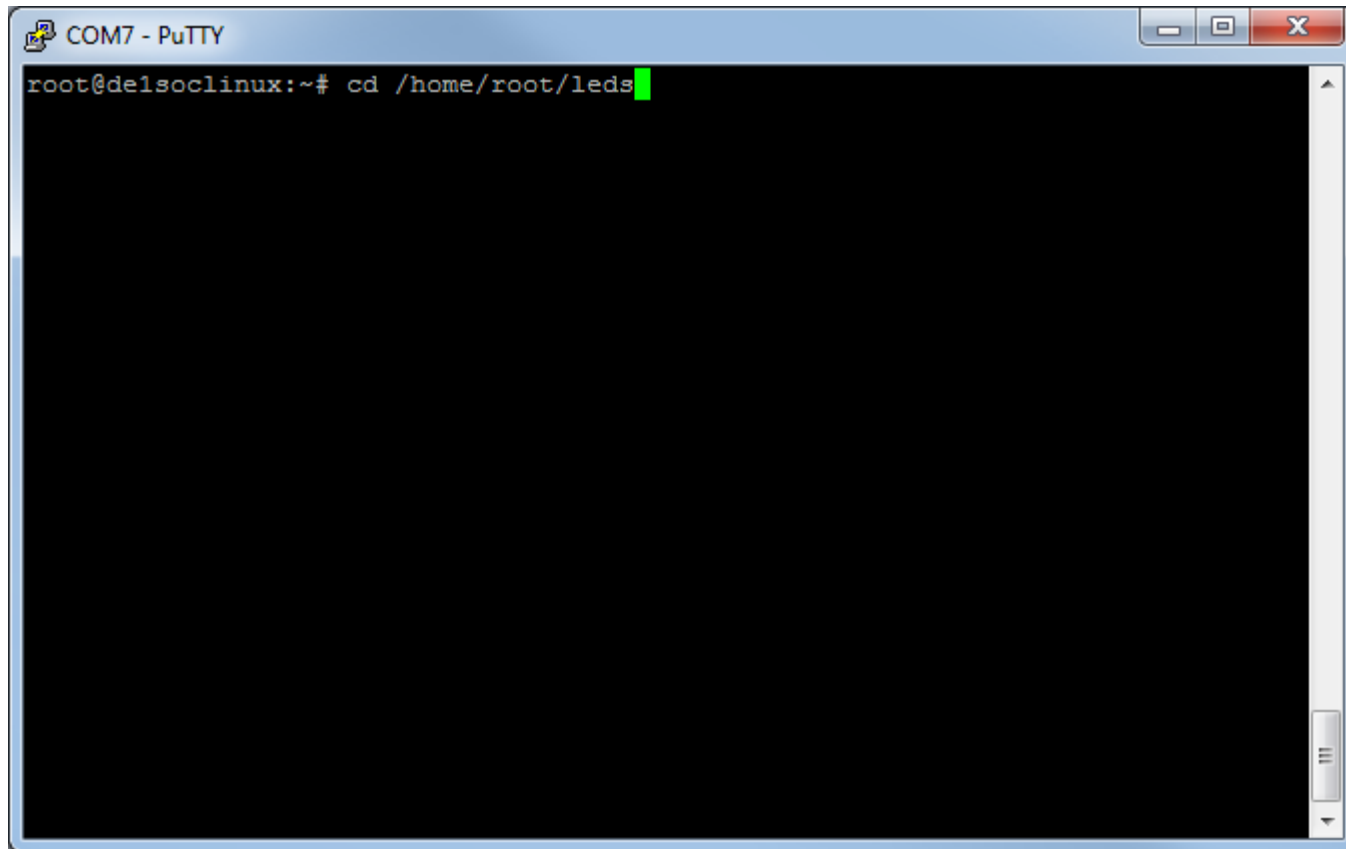
MUNMAP

```
if( munmap( virtual_base, HW_REGS_SPAN ) != 0 ) {  
    printf( "ERROR: munmap() failed...\n" );  
    close( fd );  
    return( 1 );  
}  
  
close( fd );
```

Step 1: Open the Connection to the DE1-SoC using Putty

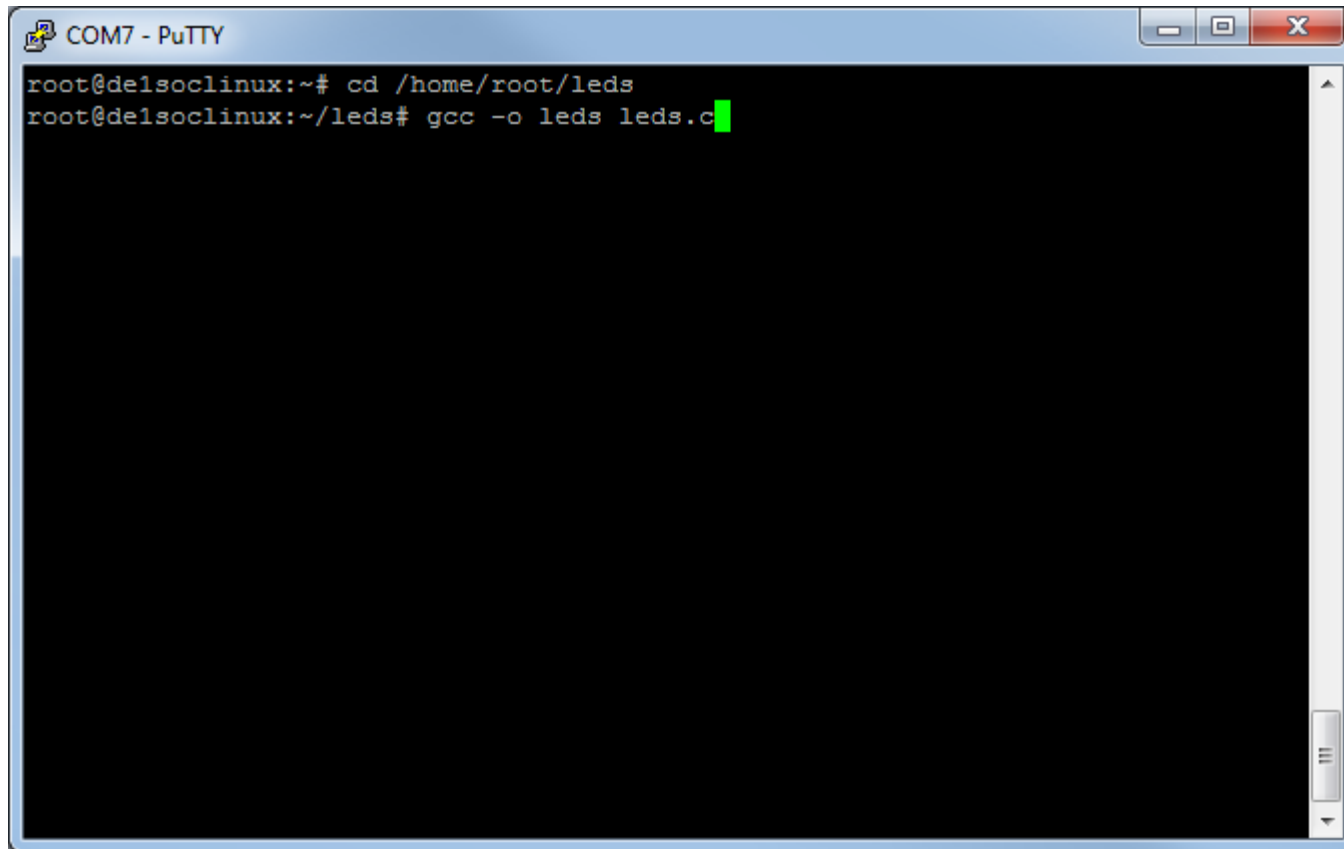


Step 2: Change to the Example Directory



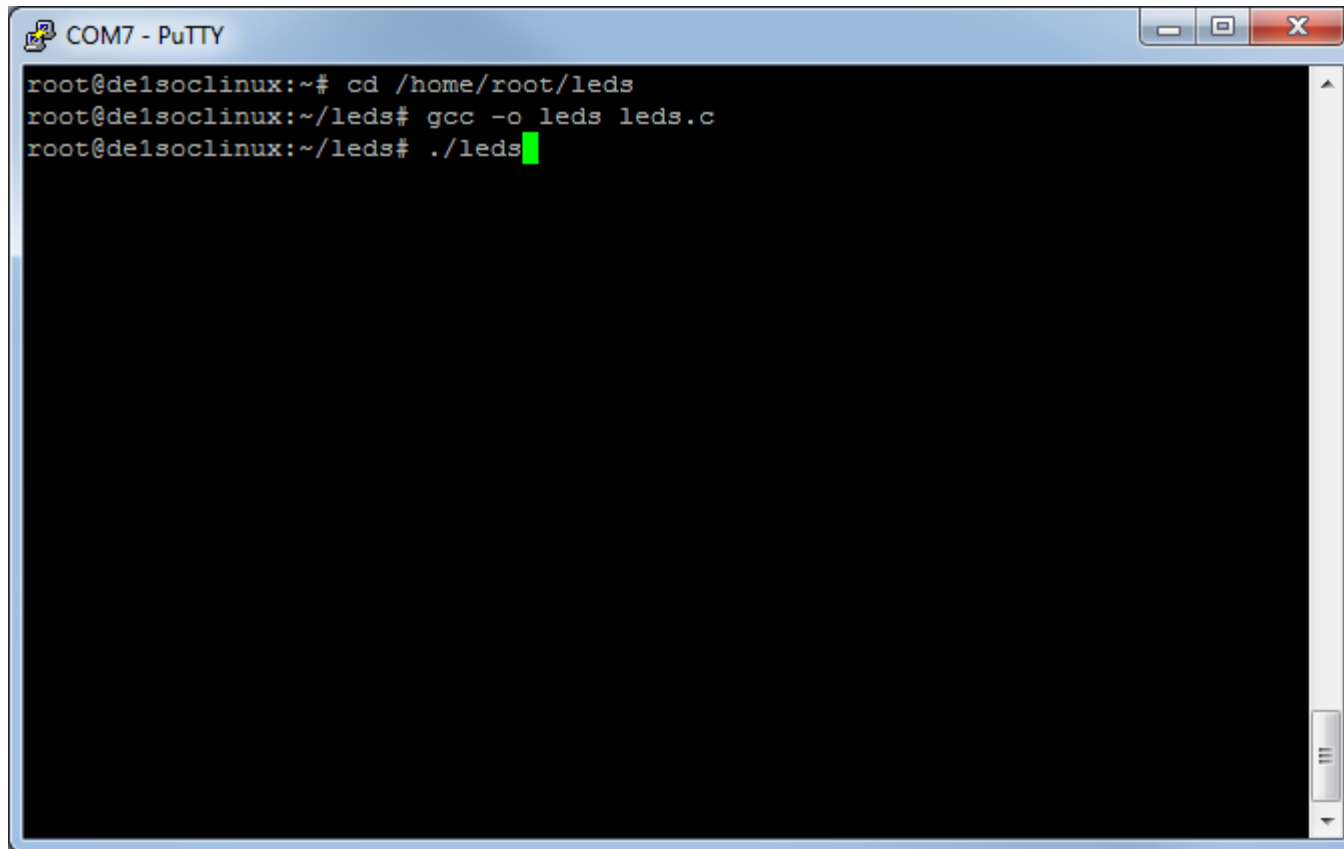
```
COM7 - PuTTY
root@delsoclinux:~# cd /home/root/leds
```

Step 3: Compile the Sample Program



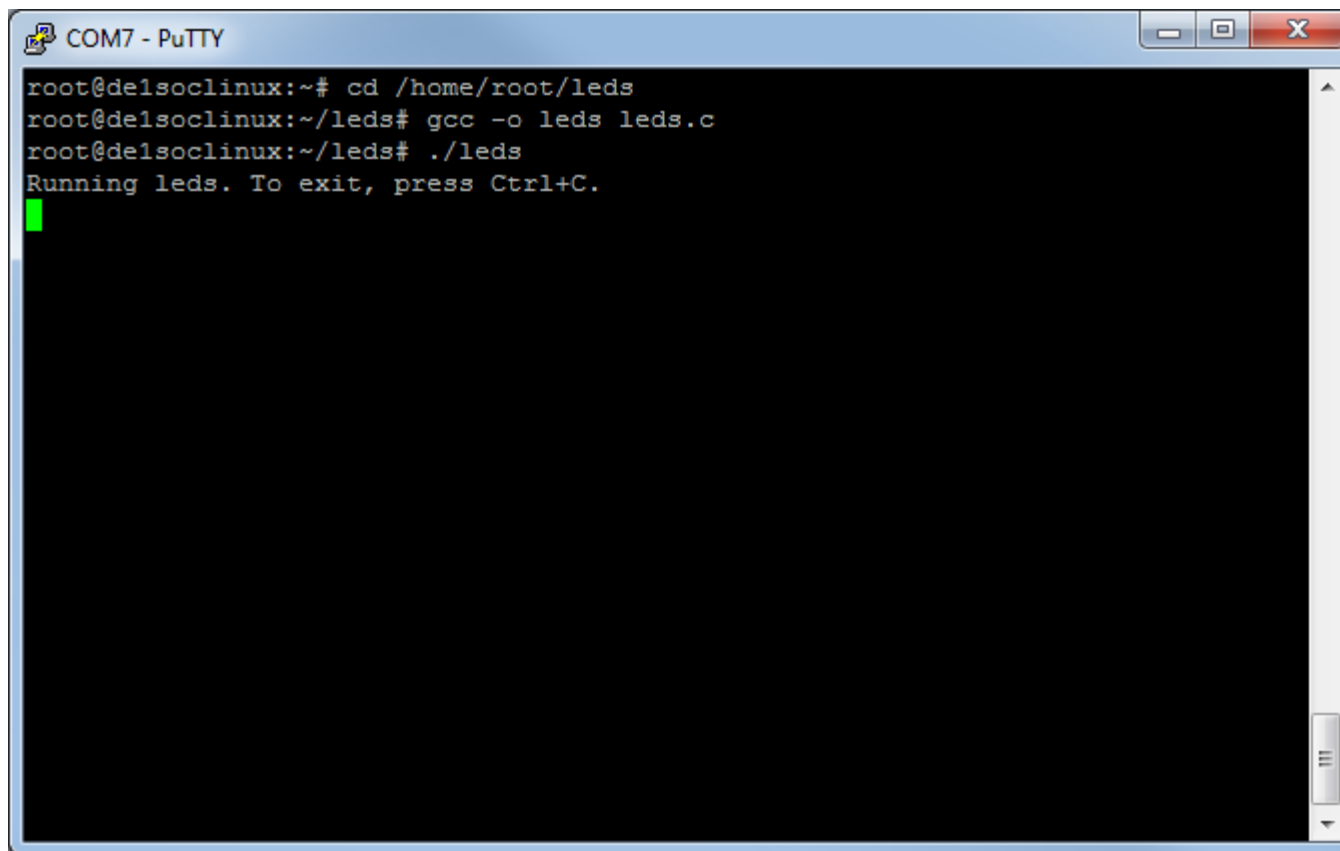
```
COM7 - PuTTY
root@delsoclinux:~# cd /home/root/leds
root@delsoclinux:~/leds# gcc -o leds leds.c
```


Step 4: Execute the Sample Program



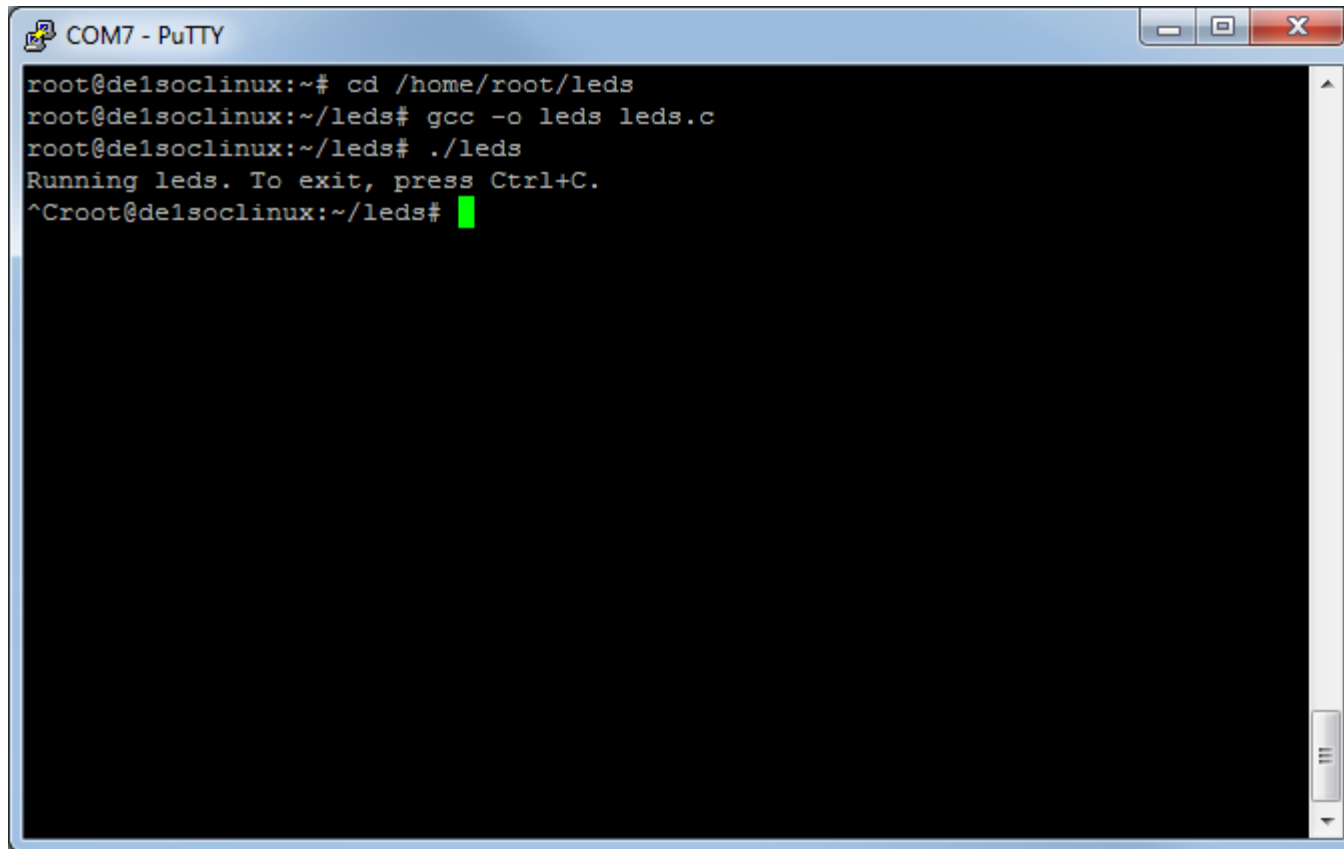
```
COM7 - PuTTY
root@de1soclinux:~# cd /home/root/leds
root@de1soclinux:~/leds# gcc -o leds leds.c
root@de1soclinux:~/leds# ./leds
```

Step 5: The Program is Running. Try Toggling the Switches.



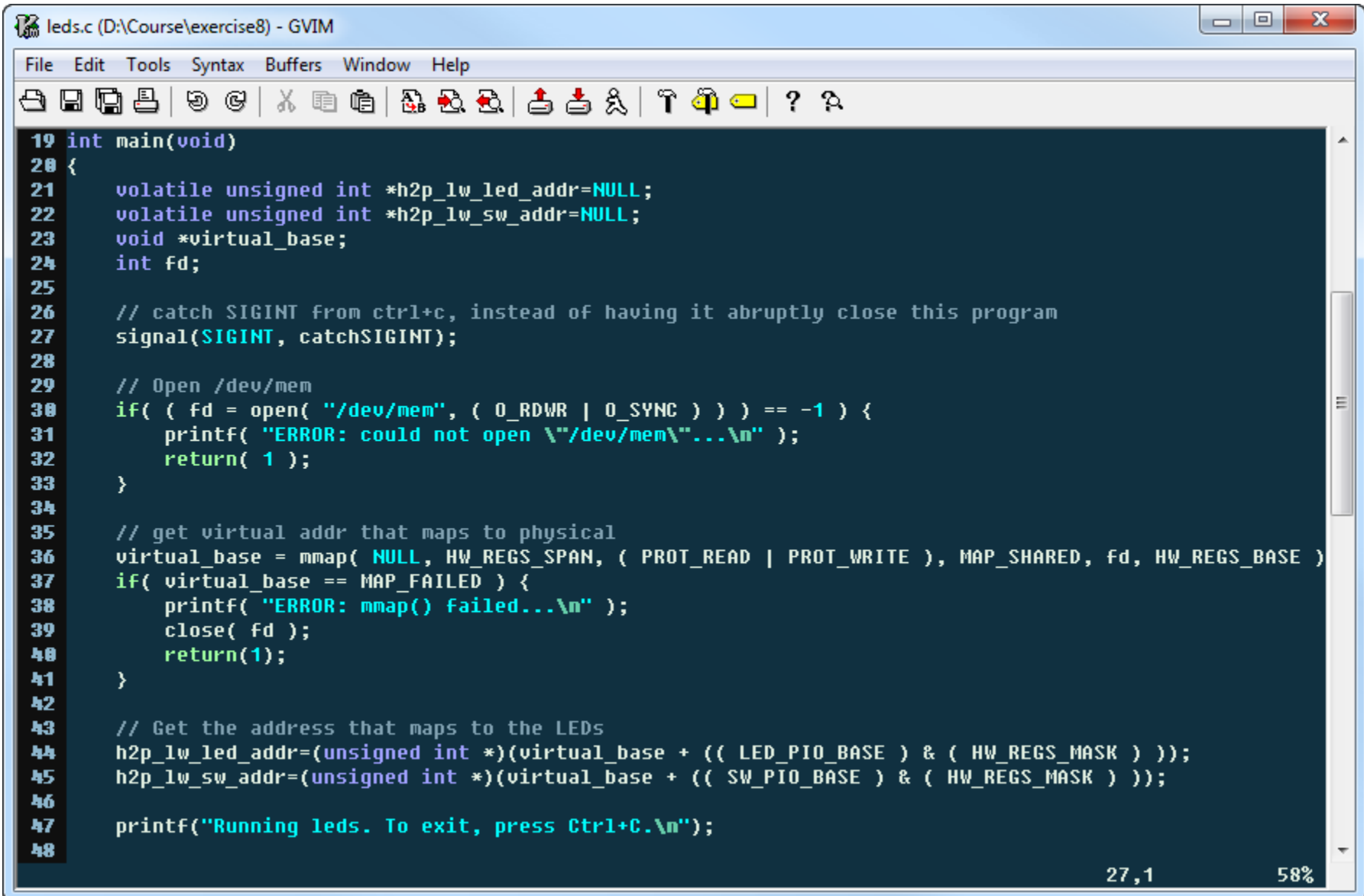
```
COM7 - PuTTY
root@delsoclinux:~# cd /home/root/leds
root@delsoclinux:~/leds# gcc -o leds leds.c
root@delsoclinux:~/leds# ./leds
Running leds. To exit, press Ctrl+C.
█
```

Step 6: Press Control-C to Exit the Program



```
COM7 - PuTTY
root@de1soclinux:~# cd /home/root/leds
root@de1soclinux:~/leds# gcc -o leds leds.c
root@de1soclinux:~/leds# ./leds
Running leds. To exit, press Ctrl+C.
^Croot@de1soclinux:~/leds#
```

Step 7: Open the leds.c file. See the mmap usage.



```
19 int main(void)
20 {
21     volatile unsigned int *h2p_lw_led_addr=NULL;
22     volatile unsigned int *h2p_lw_sw_addr=NULL;
23     void *virtual_base;
24     int fd;
25
26     // catch SIGINT from ctrl+c, instead of having it abruptly close this program
27     signal(SIGINT, catchSIGINT);
28
29     // Open /dev/mem
30     if( ( fd = open( "/dev/mem", ( O_RDWR | O_SYNC ) ) ) == -1 ) {
31         printf( "ERROR: could not open \"/dev/mem\"...\n" );
32         return( 1 );
33     }
34
35     // get virtual addr that maps to physical
36     virtual_base = mmap( NULL, HW_REGS_SPAN, ( PROT_READ | PROT_WRITE ), MAP_SHARED, fd, HW_REGS_BASE );
37     if( virtual_base == MAP_FAILED ) {
38         printf( "ERROR: mmap() failed...\n" );
39         close( fd );
40         return(1);
41     }
42
43     // Get the address that maps to the LEDs
44     h2p_lw_led_addr=(unsigned int *)(virtual_base + (( LED_PIO_BASE ) & ( HW_REGS_MASK ) ));
45     h2p_lw_sw_addr=(unsigned int *)(virtual_base + (( SW_PIO_BASE ) & ( HW_REGS_MASK ) ));
46
47     printf("Running leds. To exit, press Ctrl+C.\n");
48 }
```

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