

CSE2005L - Operating Systems Lab

## User-level & Kenel-Level Threads

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### Kernel Thread

#### kernelthread.c

```
#include <linux/module.h>
#include <linux/times.h>
#include <linux/kthread.h>
#include <linux/kernel.h>
#include <linux/delay.h>
#include <linux/init.h> // included for __init and __exit macros
static struct task_struct *thread_st;
struct timeval t0,t1;
static int thread_fn(void *unused_var){
while(!kthread_should_stop()){
printk(KERN_INFO "Kernel Thread running");
do_gettimeofday(&t1);
printk("time taken: %ld millisec\n",
1000 * (t1.tv_sec - t0.tv_sec) +
(t1.tv_usec - t0.tv_usec) / 1000);
ssleep(5);
}
do_exit(0);
return 0;
}
static int __init init_thread(void){
do_gettimeofday(&t0);
printk(KERN_INFO "Creating thread\n");
thread_st = kthread_run(thread_fn, NULL, "sThread");
if(thread_st){
printk("Thread created successfully");
}
else{
printk(KERN_ERR "Thread creation failed");
```

```

}
return 0;
}

static void __exit cleanup_thread(void){
printk(KERN_INFO "Cleaning Up\n");
if (thread_st)
{
kthread_stop(thread_st);
printk(KERN_INFO "Thread stopped");
}
}
MODULE_LICENSE("GPL");
MODULE_AUTHOR("PRANAVCHENDUR T K");
module_init(init_thread);
module_exit(cleanup_thread);

```

### **Makefile**

```

obj-m += kernelthread.o
all:
    make -C /lib/modules/$(shell uname -r)/build M=$(PWD) modules
clean:
    make -C /lib/modules/$(shell uname -r)/build M=$(PWD) clean

```

### **Terminal Log**

```

os3@administrator-OptiPlex-390
~/Documents/bce97/20170321_15BCE1097_Threads/kernelthread $ make
make -C /lib/modules/3.13.0-37-generic/build
M=/home/os3/Documents/bce97/20170321_15BCE1097_Threads/kernelthread modules
make[1]: Entering directory `/usr/src/linux-headers-3.13.0-37-generic'
CC [M]
/home/os3/Documents/bce97/20170321_15BCE1097_Threads/kernelthread/kernelthread.o
Building modules, stage 2.
MODPOST 1 modules
CC
/home/os3/Documents/bce97/20170321_15BCE1097_Threads/kernelthread/kernelthread.mod.o
LD [M]
/home/os3/Documents/bce97/20170321_15BCE1097_Threads/kernelthread/kernelthread.ko

```

make[1]: Leaving directory `/usr/src/linux-headers-3.13.0-37-generic'

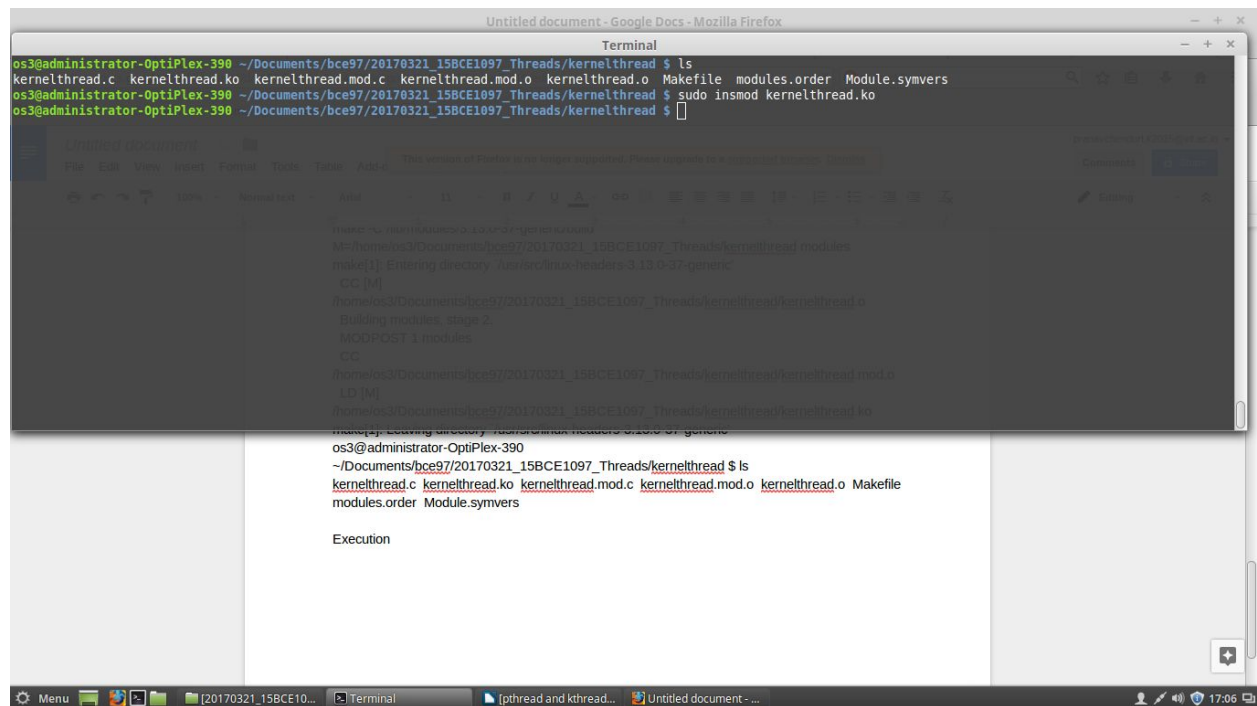
os3@administrator-OptiPlex-390

~/Documents/bce97/20170321\_15BCE1097\_Threads/kernelthread \$ ls

kernelthread.c kernelthread.ko kernelthread.mod.c kernelthread.mod.o kernelthread.o

Makefile modules.order Module.symvers

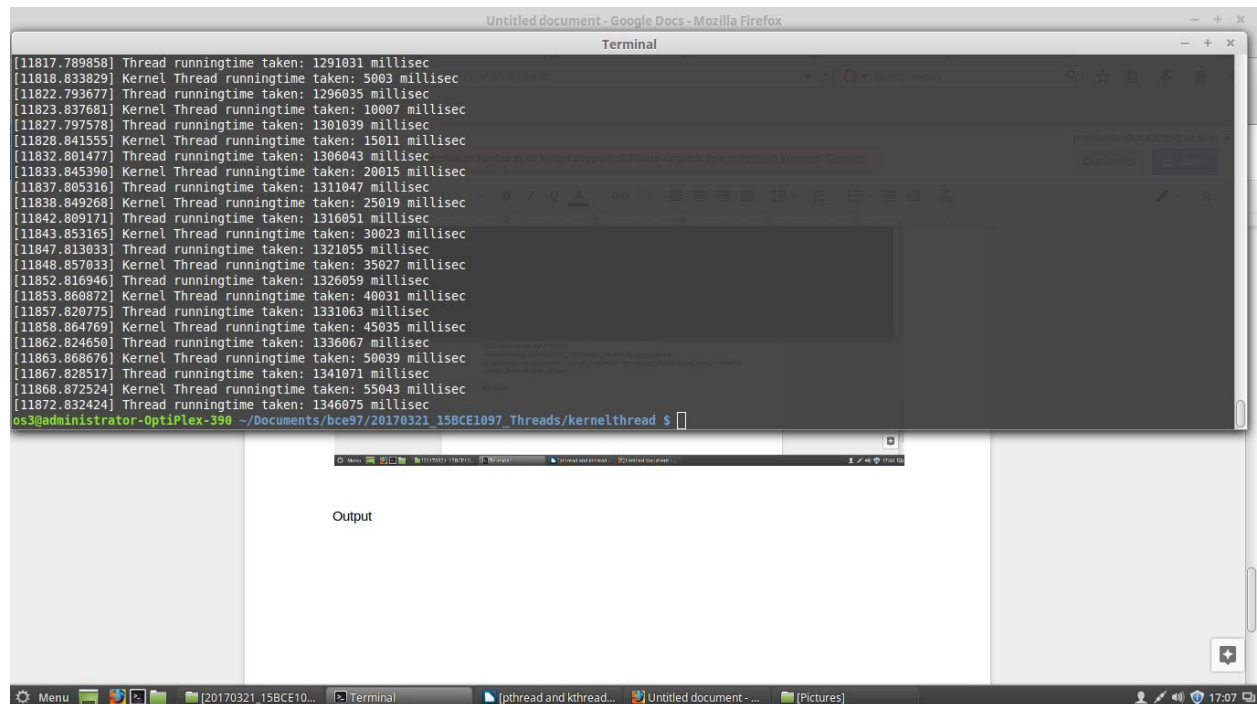
## Execution



```
os3@administrator-OptiPlex-390 ~/Documents/bce97/20170321_15BCE1097_Threads/kernelthread $ ls
kernelthread.c  kernelthread.ko  kernelthread.mod.c  kernelthread.mod.o  kernelthread.o  Makefile  modules.order  Module.symvers
os3@administrator-OptiPlex-390 ~/Documents/bce97/20170321_15BCE1097_Threads/kernelthread $ sudo insmod kernelthread.ko
os3@administrator-OptiPlex-390 ~/Documents/bce97/20170321_15BCE1097_Threads/kernelthread $
```

Execution

## Output



```
[11817.789858] Thread runtime taken: 1291031 millisec
[11818.833829] Kernel Thread runtime taken: 5003 millisec
[11822.793677] Thread runtime taken: 1296035 millisec
[11823.837681] Kernel Thread runtime taken: 10007 millisec
[11827.797578] Thread runtime taken: 1301039 millisec
[11828.841555] Kernel Thread runtime taken: 15011 millisec
[11832.801477] Thread runtime taken: 1306043 millisec
[11833.845390] Kernel Thread runtime taken: 20015 millisec
[11837.805316] Thread runtime taken: 1311047 millisec
[11838.849268] Kernel Thread runtime taken: 25019 millisec
[11842.809171] Thread runtime taken: 1316051 millisec
[11843.853165] Kernel Thread runtime taken: 30023 millisec
[11847.813033] Thread runtime taken: 1321055 millisec
[11848.857033] Kernel Thread runtime taken: 35027 millisec
[11852.816946] Thread runtime taken: 1326059 millisec
[11853.860872] Kernel Thread runtime taken: 40031 millisec
[11857.820775] Thread runtime taken: 1331063 millisec
[11858.864769] Kernel Thread runtime taken: 45035 millisec
[11862.824650] Thread runtime taken: 1336067 millisec
[11863.868676] Kernel Thread runtime taken: 50039 millisec
[11867.828517] Thread runtime taken: 1341071 millisec
[11868.872524] Kernel Thread runtime taken: 55043 millisec
[11872.832424] Thread runtime taken: 1346075 millisec
os3@administrator-OptiPlex-390 ~/Documents/bce97/20170321_15BCE1097_Threads/kernelthread $
```

Output

[11833.845390] Kernel Thread runtime taken: 20015 millisec

[11837.805316] Thread runningtime taken: 1311047 millisec  
[11838.849268] Kernel Thread runningtime taken: 25019 millisec  
[11843.853165] Kernel Thread runningtime taken: 30023 millisec  
[11848.857033] Kernel Thread runningtime taken: 35027 millisec  
[11853.860872] Kernel Thread runningtime taken: 40031 millisec  
[11858.864769] Kernel Thread runningtime taken: 45035 millisec  
[11863.868676] Kernel Thread runningtime taken: 50039 millisec  
[11868.872524] Kernel Thread runningtime taken: 55043 millisec

## User-level Thread

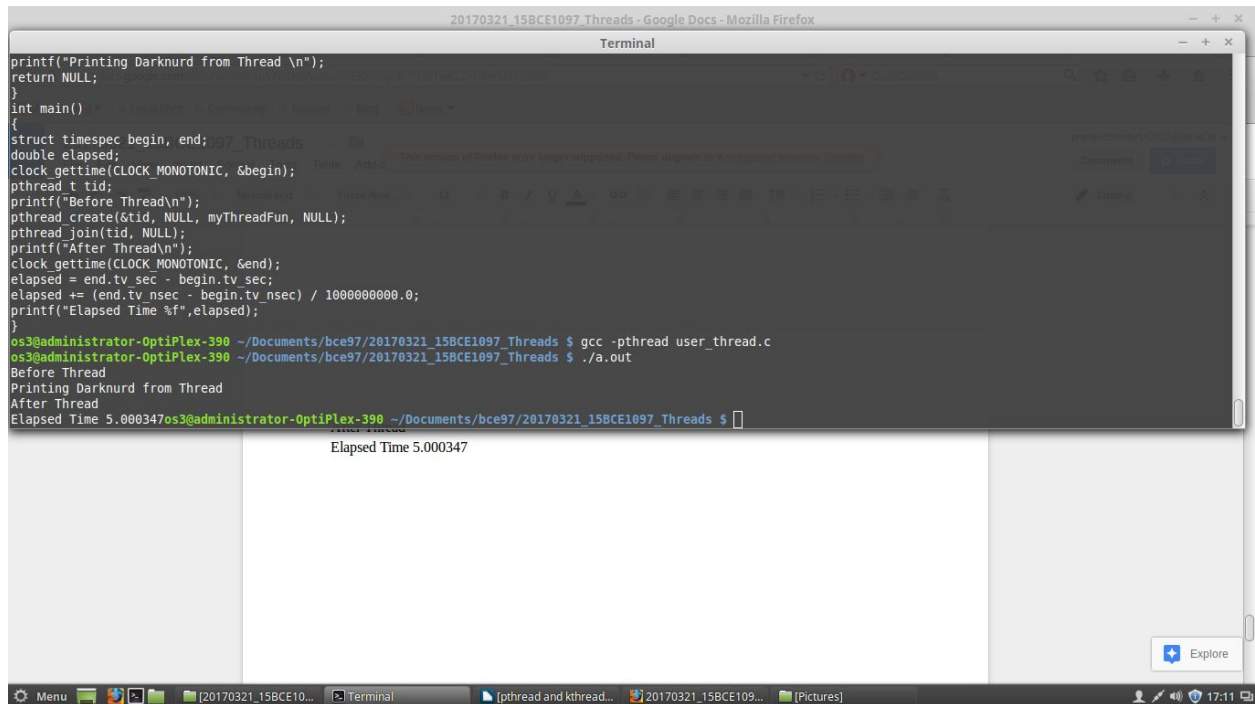
### user\_thread.c

```
#include <stdio.h>
#include <stdlib.h>
#include <unistd.h>
#include <linux/times.h>
#include <pthread.h>
#include <linux/kernel.h>
void *myThreadFun(void *vargp)
{
    sleep(5);
    printf("Printing Darknurd from Thread \n");
    return NULL;
}
int main()
{
    struct timespec begin, end;
    double elapsed;
    clock_gettime(CLOCK_MONOTONIC, &begin);
    pthread_t tid;
    printf("Before Thread\n");
    pthread_create(&tid, NULL, myThreadFun, NULL);
    pthread_join(tid, NULL);
    printf("After Thread\n");
    clock_gettime(CLOCK_MONOTONIC, &end);
    elapsed = end.tv_sec - begin.tv_sec;
    elapsed += (end.tv_nsec - begin.tv_nsec) / 1000000000.0;
    printf("Elapsed Time %f", elapsed);
}
```

### Output (Terminal Log)

```
os3@administrator-OptiPlex-390 ~/Documents/bce97/20170321_15BCE1097_Threads $ gcc
-pthread user_thread.c
os3@administrator-OptiPlex-390 ~/Documents/bce97/20170321_15BCE1097_Threads $ ./a.out
Before Thread
Printing Darknurd from Thread
```

After Thread  
Elapsed Time 5.000347



```
20170321_158CE1097_Threads - Google Docs - Mozilla Firefox
Terminal
printf("Printing Darknurd from Thread \n");
return NULL;
}
int main()
{
    struct timespec begin, end;
    double elapsed;
    clock_gettime(CLOCK_MONOTONIC, &begin);
    pthread_t tid;
    printf("Before Thread\n");
    pthread_create(&tid, NULL, myThreadFun, NULL);
    pthread_join(tid, NULL);
    printf("After Thread\n");
    clock_gettime(CLOCK_MONOTONIC, &end);
    elapsed = end.tv_sec - begin.tv_sec;
    elapsed += (end.tv_nsec - begin.tv_nsec) / 1000000000.0;
    printf("Elapsed Time %f", elapsed);
}
os3@administrator-OptiPlex-390 ~/Documents/bce97/20170321_158CE1097_Threads $ gcc -pthread user_thread.c
os3@administrator-OptiPlex-390 ~/Documents/bce97/20170321_158CE1097_Threads $ ./a.out
Before Thread
Printing Darknurd from Thread
After Thread
Elapsed Time 5.000347os3@administrator-OptiPlex-390 ~/Documents/bce97/20170321_158CE1097_Threads $
```