

# Results of codes seen in class 4

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module code:

```
#include <linux/module.h>
#include <linux/kernel.h>
#include <linux/init.h>
#include <linux/gfp.h>

#define PRINT_PREF "[LOWLEVEL]: "
#define PAGES_ORDER_REQUESTED 3
#define INTS_IN_PAGE (PAGE_SIZE/sizeof(int))

unsigned long virt_addr;

static int __init my_mod_init(void)
{
    int *int_array;
    int i;

    printk(PRINT_PREF " Entering module.\n");

    virt_addr = __get_free_pages(GFP_KERNEL, PAGES_ORDER_REQUESTED);
    if(!virt_addr) {
        printk(PRINT_PREF " Error in allocation\n " ) ;
        return -1;
    }
    int_array = (int *)virt_addr;
    for(i=0; i<INTS_IN_PAGE; i++)
        int_array[i] = i;

    for(i=0; i<INTS_IN_PAGE; i++)
        printk(PRINT_PREF "array[%d] = %d\n", i, int_array[i]);
    return 0;
}

static void __exit my_mod_exit(void)
{
    free_pages(virt_addr, PAGES_ORDER_REQUESTED);
    printk(PRINT_PREF "Exiting module.\n");
}

module_init(my_mod_init);
module_exit(my_mod_exit);
```

output of printk()

```
Nov 20 19:06:03 nicolas-Lemur kernel: [ 7865.325043] [LOWLEVEL]: Entering module.\n
Nov 20 19:06:03 nicolas-Lemur kernel: [ 7865.325055] [LOWLEVEL]: array[0] = 0\n
Nov 20 19:06:03 nicolas-Lemur kernel: [ 7865.325057] [LOWLEVEL]: array[1] = 1\n
Nov 20 19:06:03 nicolas-Lemur kernel: [ 7865.325059] [LOWLEVEL]: array[2] = 2\n
Nov 20 19:06:03 nicolas-Lemur kernel: [ 7865.325061] [LOWLEVEL]: array[3] = 3\n
Nov 20 19:06:03 nicolas-Lemur kernel: [ 7865.325063] [LOWLEVEL]: array[4] = 4\n
Nov 20 19:06:03 nicolas-Lemur kernel: [ 7865.325065] [LOWLEVEL]: array[5] = 5\n
Nov 20 19:06:03 nicolas-Lemur kernel: [ 7865.325067] [LOWLEVEL]: array[6] = 6\n
Nov 20 19:06:03 nicolas-Lemur kernel: [ 7865.325068] [LOWLEVEL]: array[7] = 7\n
Nov 20 19:06:03 nicolas-Lemur kernel: [ 7865.325071] [LOWLEVEL]: array[8] = 8\n
Nov 20 19:06:03 nicolas-Lemur kernel: [ 7865.325072] [LOWLEVEL]: array[9] = 9\n
Nov 20 19:06:03 nicolas-Lemur kernel: [ 7865.325075] [LOWLEVEL]: array[10] = 10\n
Nov 20 19:06:03 nicolas-Lemur kernel: [ 7865.325077] [LOWLEVEL]: array[11] = 11\n
Nov 20 19:06:03 nicolas-Lemur kernel: [ 7865.325078] [LOWLEVEL]: array[12] = 12\n
Nov 20 19:06:03 nicolas-Lemur kernel: [ 7865.325080] [LOWLEVEL]: array[13] = 13\n
Nov 20 19:06:03 nicolas-Lemur kernel: [ 7865.325082] [LOWLEVEL]: array[14] = 14\n
Nov 20 19:06:03 nicolas-Lemur kernel: [ 7865.325084] [LOWLEVEL]: array[15] = 15\n
```

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```

Nov 20 19:06:03 nicolas-Lemur kernel: [ 7865.326723] [LOWLEVEL]: array[991] = 991¥n
Nov 20 19:06:03 nicolas-Lemur kernel: [ 7865.326724] [LOWLEVEL]: array[992] = 992¥n
Nov 20 19:06:03 nicolas-Lemur kernel: [ 7865.326725] [LOWLEVEL]: array[993] = 993¥n
Nov 20 19:06:03 nicolas-Lemur kernel: [ 7865.326727] [LOWLEVEL]: array[994] = 994¥n
Nov 20 19:06:03 nicolas-Lemur kernel: [ 7865.326728] [LOWLEVEL]: array[995] = 995¥n
Nov 20 19:06:03 nicolas-Lemur kernel: [ 7865.326729] [LOWLEVEL]: array[996] = 996¥n
Nov 20 19:06:03 nicolas-Lemur kernel: [ 7865.326731] [LOWLEVEL]: array[997] = 997¥n
Nov 20 19:06:03 nicolas-Lemur kernel: [ 7865.326732] [LOWLEVEL]: array[998] = 998¥n
Nov 20 19:06:03 nicolas-Lemur kernel: [ 7865.326733] [LOWLEVEL]: array[999] = 999¥n
Nov 20 19:06:03 nicolas-Lemur kernel: [ 7865.326735] [LOWLEVEL]: array[1000] = 1000¥n
Nov 20 19:06:03 nicolas-Lemur kernel: [ 7865.326736] [LOWLEVEL]: array[1001] = 1001¥n
Nov 20 19:06:03 nicolas-Lemur kernel: [ 7865.326738] [LOWLEVEL]: array[1002] = 1002¥n
Nov 20 19:06:03 nicolas-Lemur kernel: [ 7865.326739] [LOWLEVEL]: array[1003] = 1003¥n
Nov 20 19:06:03 nicolas-Lemur kernel: [ 7865.326740] [LOWLEVEL]: array[1004] = 1004¥n
Nov 20 19:06:03 nicolas-Lemur kernel: [ 7865.326742] [LOWLEVEL]: array[1005] = 1005¥n
Nov 20 19:06:03 nicolas-Lemur kernel: [ 7865.326743] [LOWLEVEL]: array[1006] = 1006¥n
Nov 20 19:06:03 nicolas-Lemur kernel: [ 7865.326744] [LOWLEVEL]: array[1007] = 1007¥n
Nov 20 19:06:03 nicolas-Lemur kernel: [ 7865.326746] [LOWLEVEL]: array[1008] = 1008¥n
Nov 20 19:06:03 nicolas-Lemur kernel: [ 7865.326747] [LOWLEVEL]: array[1009] = 1009¥n
Nov 20 19:06:03 nicolas-Lemur kernel: [ 7865.326748] [LOWLEVEL]: array[1010] = 1010¥n
Nov 20 19:06:03 nicolas-Lemur kernel: [ 7865.326750] [LOWLEVEL]: array[1011] = 1011¥n
Nov 20 19:06:03 nicolas-Lemur kernel: [ 7865.326751] [LOWLEVEL]: array[1012] = 1012¥n
Nov 20 19:06:03 nicolas-Lemur kernel: [ 7865.326752] [LOWLEVEL]: array[1013] = 1013¥n
Nov 20 19:06:03 nicolas-Lemur kernel: [ 7865.326754] [LOWLEVEL]: array[1014] = 1014¥n
Nov 20 19:06:03 nicolas-Lemur kernel: [ 7865.326755] [LOWLEVEL]: array[1015] = 1015¥n
Nov 20 19:06:03 nicolas-Lemur kernel: [ 7865.326756] [LOWLEVEL]: array[1016] = 1016¥n
Nov 20 19:06:03 nicolas-Lemur kernel: [ 7865.326758] [LOWLEVEL]: array[1017] = 1017¥n
Nov 20 19:06:03 nicolas-Lemur kernel: [ 7865.326759] [LOWLEVEL]: array[1018] = 1018¥n
Nov 20 19:06:03 nicolas-Lemur kernel: [ 7865.326761] [LOWLEVEL]: array[1019] = 1019¥n
Nov 20 19:06:03 nicolas-Lemur kernel: [ 7865.326762] [LOWLEVEL]: array[1020] = 1020¥n
Nov 20 19:06:03 nicolas-Lemur kernel: [ 7865.326763] [LOWLEVEL]: array[1021] = 1021¥n
Nov 20 19:06:03 nicolas-Lemur kernel: [ 7865.326765] [LOWLEVEL]: array[1022] = 1022¥n

```

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module code

```

#include <linux/module.h>
#include <linux/kernel.h>
#include <linux/init.h>
#include <linux/gfp.h>
#include <linux/slab.h>

#define PRINT_PREF "[KMALLOC_TEST]: "

static int __init my_mod_init(void)
{
    unsigned long i;
    void *ptr;

    printk(PRINT_PREF " Entering module.¥n");

    for (i=1;;i*=2) {
        ptr = kmalloc(i, GFP_KERNEL);
        if(!ptr) {
            printk(PRINT_PREF "could not allocate %lu bytes¥n", i) ;
            break;
        }
        kfree(ptr);
    }

    return 0;
}

static void __exit my_mod_exit(void)
{
    printk(PRINT_PREF "Exiting module.¥n");
}

module_init(my_mod_init);
module_exit(my_mod_exit);

```

```
MODULE_LICENSE("GPL");
```

```
out of printk()
```

```
Nov 20 19:28:57 nicolas-Lemur kernel: [ 9239.931712] [KMALLOC_TEST]: Entering module.
Nov 20 19:28:57 nicolas-Lemur kernel: [ 9239.931792] -----[ cut here ]-----
Nov 20 19:28:57 nicolas-Lemur kernel: [ 9239.931800] WARNING: CPU: 3 PID: 17749 at /build/linux-zYx
Nov 20 19:28:57 nicolas-Lemur kernel: [ 9239.931801] Modules linked in: kmallocANDvmalloc(OE+) hid_
Nov 20 19:28:57 nicolas-Lemur kernel: [ 9239.931842] snd rtsx_pci_ms cfg80211 memstick soundcore b
Nov 20 19:28:57 nicolas-Lemur kernel: [ 9239.931881] CPU: 3 PID: 17749 Comm: insmod Tainted: P
Nov 20 19:28:57 nicolas-Lemur kernel: [ 9239.931882] Hardware name: System76
Nov 20 19:28:57 nicolas-Lemur kernel: [ 9239.931883] Call Trace:
Nov 20 19:28:57 nicolas-Lemur kernel: [ 9239.931890] dump_stack+0x63/0x81
Nov 20 19:28:57 nicolas-Lemur kernel: [ 9239.931893] __warn+0xcb/0xf0
Nov 20 19:28:57 nicolas-Lemur kernel: [ 9239.931895] warn_slowpath_null+0x1d/0x20
Nov 20 19:28:57 nicolas-Lemur kernel: [ 9239.931897] __alloc_pages_slowpath+0x9fe/0xba0
Nov 20 19:28:57 nicolas-Lemur kernel: [ 9239.931900] ? get_page_from_freelist+0x46a/0xb20
Nov 20 19:28:57 nicolas-Lemur kernel: [ 9239.931903] __alloc_pages_nodemask+0x209/0x260
Nov 20 19:28:57 nicolas-Lemur kernel: [ 9239.931907] alloc_pages_current+0x95/0x140
Nov 20 19:28:57 nicolas-Lemur kernel: [ 9239.931910] kmalloc_order+0x18/0x40
Nov 20 19:28:57 nicolas-Lemur kernel: [ 9239.931912] kmalloc_order_trace+0x24/0xa0
Nov 20 19:28:57 nicolas-Lemur kernel: [ 9239.931915] ? __kmalloc+0x1c7/0x1e0
Nov 20 19:28:57 nicolas-Lemur kernel: [ 9239.931917] __kmalloc+0x1c7/0x1e0
Nov 20 19:28:57 nicolas-Lemur kernel: [ 9239.931919] ? __free_pages+0x18/0x30
Nov 20 19:28:57 nicolas-Lemur kernel: [ 9239.931924] my_mod_init+0x23/0x100 [kmallocANDvmalloc]
Nov 20 19:28:57 nicolas-Lemur kernel: [ 9239.931925] ? 0xfffffffffc0322000
Nov 20 19:28:57 nicolas-Lemur kernel: [ 9239.931928] do_one_initcall+0x52/0x1b0
Nov 20 19:28:57 nicolas-Lemur kernel: [ 9239.931931] ? kmem_cache_alloc_trace+0xd7/0x190
Nov 20 19:28:57 nicolas-Lemur kernel: [ 9239.931935] do_init_module+0x5f/0x200
Nov 20 19:28:57 nicolas-Lemur kernel: [ 9239.931939] load_module+0x190b/0x1c70
Nov 20 19:28:57 nicolas-Lemur kernel: [ 9239.931942] ? __symbol_put+0x60/0x60
Nov 20 19:28:57 nicolas-Lemur kernel: [ 9239.931945] ? ima_post_read_file+0x7e/0xa0
Nov 20 19:28:57 nicolas-Lemur kernel: [ 9239.931947] ? security_kernel_post_read_file+0x6b/0x80
Nov 20 19:28:57 nicolas-Lemur kernel: [ 9239.931951] SYSC_finit_module+0xdf/0x110
Nov 20 19:28:57 nicolas-Lemur kernel: [ 9239.931954] Sys_finit_module+0xe/0x10
Nov 20 19:28:57 nicolas-Lemur kernel: [ 9239.931957] entry_SYSCALL_64_fastpath+0x1e/0xad
Nov 20 19:28:57 nicolas-Lemur kernel: [ 9239.931959] RIP: 0033:0x7f31c65d59f9
Nov 20 19:28:57 nicolas-Lemur kernel: [ 9239.931960] RSP: 002b:00007fff5dd93d18 EFLAGS: 00000246 OR
Nov 20 19:28:57 nicolas-Lemur kernel: [ 9239.931963] RAX: ffffffff00000000 RBX: 000055b4ff17da70 RC
Nov 20 19:28:57 nicolas-Lemur kernel: [ 9239.931964] RDX: 0000000000000000 RSI: 000055b4fd57df8b RD
Nov 20 19:28:57 nicolas-Lemur kernel: [ 9239.931965] RBP: 00007f31c6894b00 R08: 0000000000000000 R0
Nov 20 19:28:57 nicolas-Lemur kernel: [ 9239.931966] R10: 0000000000000003 R11: 0000000000000246 R1
Nov 20 19:28:57 nicolas-Lemur kernel: [ 9239.931967] R13: 00007f31c6894b58 R14: 000000000000270f R1
Nov 20 19:28:57 nicolas-Lemur kernel: [ 9239.931969] ---[ end trace f46b3484ca86724e ]---
```

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module code

```
#include <linux/module.h>
#include <linux/kernel.h>
#include <linux/init.h>
#include <linux/gfp.h>
#include <linux/slab.h>

#define PRINT_PREF "[SLAB_TEST]: "

struct my_struct {
    int int_param;
    long long_param;
};

static int __init my_mod_init(void)
{
    int ret = 0;
    struct my_struct *ptr1, *ptr2;
    struct kmem_cache *my_cache;
```

```

    printk(PRINT_PREF " Entering module.¥n");

    my_cache = kmem_cache_create("pierre-cache", sizeof(struct my_struct), 0, 0, NULL);

    if(!my_cache)
        return -1;
    ptr1=kmem_cache_alloc(my_cache, GFP_KERNEL);
    if(!ptr1){
        ret = -ENOMEM;
        goto destroy_cache;
    }

    ptr2=kmem_cache_alloc(my_cache, GFP_KERNEL);
    if(!ptr2){
        ret = -ENOMEM;
        goto freeptr1;
    }

    ptr1->int_param=42;
    ptr1->long_param=42;
    ptr2->int_param=43;
    ptr2->long_param=43;

    printk(PRINT_PREF "ptr1 = {%d, %1d}; ptr2={%d,%1d}¥n", ptr1->int_param,
        ptr1->long_param, ptr2->int_param, ptr2->long_param);

    kmem_cache_free(my_cache, ptr2);

    freeptr1:
        kmem_cache_free(my_cache, ptr1);

    destroy_cache:
        kmem_cache_destroy(my_cache);

    return ret;
}

static void __exit my_mod_exit(void)
{
    printk(PRINT_PREF "Exiting module.¥n");
}

module_init(my_mod_init);
module_exit(my_mod_exit);

MODULE_LICENSE("GPL");

```

out of printk()

```

Nov 20 19:58:50 nicolas-Lemur kernel: [11032.424435] [SLAB_TEST]: Entering module.¥n
Nov 20 20:02:07 nicolas-Lemur kernel: [11032.424448] [SLAB_TEST]: ptr1 = {42, 42}; ptr2={43,43}¥n

```

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module code

```

#include <linux/module.h>
#include <linux/kernel.h>
#include <linux/init.h>
#include <linux/gfp.h>
#include <linux/slab.h>
#include <linux/highmem.h>

#define PRINT_PREF "[HIGHMEM]: "
#define INTS_IN_PAGE (PAGE_SIZE/sizeof(int))

static int __init my_mod_init(void)
{
    struct page *my_page;
    void *my_ptr;

```



```

int i, *int_array;

printk(PRINT_PREF " Entering module.%n");

my_page = alloc_page(GFP_HIGHUSER);
if(!my_page)
    return -1;

my_ptr = kmap(my_page);
int_array = (int *)my_ptr;

for (i = 0; i <INTS_IN_PAGE; i++)
{
    int_array[i] = i;
    printk(PRINT_PREF "array[%d] = %d%n", i, int_array[i]);
}

kunmap(my_page);
__free_pages(my_page, 0);

return 0;
}

static void __exit my_mod_exit(void)
{
    printk(PRINT_PREF "Exiting module.%n");
}

module_init(my_mod_init);
module_exit(my_mod_exit);

```

out of printk()

```

Nov 20 22:00:57 nicolas-Lemur kernel: [13981.089535] [HIGHMEM]: Entering module.%n
Nov 20 22:00:57 nicolas-Lemur kernel: [13981.089538] [HIGHMEM]: array[0] = 0%n
Nov 20 22:00:57 nicolas-Lemur kernel: [13981.089540] [HIGHMEM]: array[1] = 1%n
Nov 20 22:00:57 nicolas-Lemur kernel: [13981.089541] [HIGHMEM]: array[2] = 2%n
Nov 20 22:00:57 nicolas-Lemur kernel: [13981.089543] [HIGHMEM]: array[3] = 3%n
Nov 20 22:00:57 nicolas-Lemur kernel: [13981.089544] [HIGHMEM]: array[4] = 4%n
Nov 20 22:00:57 nicolas-Lemur kernel: [13981.089545] [HIGHMEM]: array[5] = 5%n
Nov 20 22:00:57 nicolas-Lemur kernel: [13981.089546] [HIGHMEM]: array[6] = 6%n
Nov 20 22:00:57 nicolas-Lemur kernel: [13981.089547] [HIGHMEM]: array[7] = 7%n
Nov 20 22:00:57 nicolas-Lemur kernel: [13981.089548] [HIGHMEM]: array[8] = 8%n
Nov 20 22:00:57 nicolas-Lemur kernel: [13981.089550] [HIGHMEM]: array[9] = 9%n
Nov 20 22:00:57 nicolas-Lemur kernel: [13981.089551] [HIGHMEM]: array[10] = 10%n
Nov 20 22:00:57 nicolas-Lemur kernel: [13981.089552] [HIGHMEM]: array[11] = 11%n
Nov 20 22:00:57 nicolas-Lemur kernel: [13981.089554] [HIGHMEM]: array[12] = 12%n
Nov 20 22:00:57 nicolas-Lemur kernel: [13981.089555] [HIGHMEM]: array[13] = 13%n
Nov 20 22:00:57 nicolas-Lemur kernel: [13981.089556] [HIGHMEM]: array[14] = 14%n
Nov 20 22:00:57 nicolas-Lemur kernel: [13981.089557] [HIGHMEM]: array[15] = 15%n
Nov 20 22:00:57 nicolas-Lemur kernel: [13981.089558] [HIGHMEM]: array[16] = 16%n
Nov 20 22:00:57 nicolas-Lemur kernel: [13981.089560] [HIGHMEM]: array[17] = 17%n
Nov 20 22:00:57 nicolas-Lemur kernel: [13981.089561] [HIGHMEM]: array[18] = 18%n
Nov 20 22:00:57 nicolas-Lemur kernel: [13981.089562] [HIGHMEM]: array[19] = 19%n
Nov 20 22:00:57 nicolas-Lemur kernel: [13981.089563] [HIGHMEM]: array[20] = 20%n
Nov 20 22:00:57 nicolas-Lemur kernel: [13981.089564] [HIGHMEM]: array[21] = 21%n
Nov 20 22:00:57 nicolas-Lemur kernel: [13981.089566] [HIGHMEM]: array[22] = 22%n
Nov 20 22:00:57 nicolas-Lemur kernel: [13981.089567] [HIGHMEM]: array[23] = 23%n
Nov 20 22:00:57 nicolas-Lemur kernel: [13981.089568] [HIGHMEM]: array[24] = 24%n
Nov 20 22:00:57 nicolas-Lemur kernel: [13981.089569] [HIGHMEM]: array[25] = 25%n
Nov 20 22:00:57 nicolas-Lemur kernel: [13981.089571] [HIGHMEM]: array[26] = 26%n
Nov 20 22:00:57 nicolas-Lemur kernel: [13981.089572] [HIGHMEM]: array[27] = 27%n
Nov 20 22:00:57 nicolas-Lemur kernel: [13981.089573] [HIGHMEM]: array[28] = 28%n
Nov 20 22:00:57 nicolas-Lemur kernel: [13981.089574] [HIGHMEM]: array[29] = 29%n
Nov 20 22:00:57 nicolas-Lemur kernel: [13981.089576] [HIGHMEM]: array[30] = 30%n
Nov 20 22:00:57 nicolas-Lemur kernel: [13981.089577] [HIGHMEM]: array[31] = 31%n
Nov 20 22:00:57 nicolas-Lemur kernel: [13981.089578] [HIGHMEM]: array[32] = 32%n
Nov 20 22:00:57 nicolas-Lemur kernel: [13981.089580] [HIGHMEM]: array[33] = 33%n
Nov 20 22:00:57 nicolas-Lemur kernel: [13981.089581] [HIGHMEM]: array[34] = 34%n
Nov 20 22:00:57 nicolas-Lemur kernel: [13981.089582] [HIGHMEM]: array[35] = 35%n
Nov 20 22:00:57 nicolas-Lemur kernel: [13981.089583] [HIGHMEM]: array[36] = 36%n
Nov 20 22:00:57 nicolas-Lemur kernel: [13981.089585] [HIGHMEM]: array[37] = 37%n
Nov 20 22:00:57 nicolas-Lemur kernel: [13981.089586] [HIGHMEM]: array[38] = 38%n

```

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```

Nov 20 22:00:57 nicolas-Lemur kernel: [13981.091037] [HIGHMEM]: array[1014] = 1014¥n
Nov 20 22:00:57 nicolas-Lemur kernel: [13981.091038] [HIGHMEM]: array[1015] = 1015¥n
Nov 20 22:00:57 nicolas-Lemur kernel: [13981.091040] [HIGHMEM]: array[1016] = 1016¥n
Nov 20 22:00:57 nicolas-Lemur kernel: [13981.091041] [HIGHMEM]: array[1017] = 1017¥n
Nov 20 22:00:57 nicolas-Lemur kernel: [13981.091043] [HIGHMEM]: array[1018] = 1018¥n
Nov 20 22:00:57 nicolas-Lemur kernel: [13981.091044] [HIGHMEM]: array[1019] = 1019¥n
Nov 20 22:00:57 nicolas-Lemur kernel: [13981.091045] [HIGHMEM]: array[1020] = 1020¥n
Nov 20 22:00:57 nicolas-Lemur kernel: [13981.091047] [HIGHMEM]: array[1021] = 1021¥n
Nov 20 22:00:57 nicolas-Lemur kernel: [13981.091048] [HIGHMEM]: array[1022] = 1022¥n

```

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### module code

```

#include <linux/module.h>
#include <linux/kernel.h>
#include <linux/init.h>
#include <linux/percpu.h>
#include <linux/kthread.h>
#include <linux/sched.h>
#include <linux/delay.h>
#include <linux/smp.h>

#define PRINT_PREF "[PERCPU]: "

struct task_struct *thread1, *thread2, *thread3;
DEFINE_PER_CPU(int, my_var);

static int thread_function(void *data)
{
    while(!kthread_should_stop()) {
        int cpu;
        get_cpu_var(my_var)++;
        cpu = smp_processor_id();
        printk("cpu[%d] = %d¥n", cpu, get_cpu_var(my_var));
        put_cpu_var(my_var);
        msleep(500);
    }
}

static int __init my_mod_init(void)
{
    int cpu;

    printk(PRINT_PREF " Entering module.¥n");

    for (cpu = 0; cpu < NR_CPUS; cpu++)
        per_cpu(my_var, cpu) = 0;

    wmb();

    thread1 = kthread_run(thread_function, NULL, "percpu-thread1");
    thread2 = kthread_run(thread_function, NULL, "percpu-thread2");
    thread3 = kthread_run(thread_function, NULL, "percpu-thread3");

    return 0;
}

static void __exit my_mod_exit(void)
{
    kthread_stop(thread1);
    kthread_stop(thread2);
    kthread_stop(thread3);
    printk(PRINT_PREF "Exiting module.¥n");
}

module_init(my_mod_init);
module_exit(my_mod_exit);

MODULE_LICENSE("GPL");

```



out of printk()

```
Nov 20 22:28:54 nicolas-Lemur kernel: [15658.300472] [PERCPU]: Entering module.¥n
Nov 20 22:28:54 nicolas-Lemur kernel: [15658.300568] cpu[2] = 1¥n
Nov 20 22:28:54 nicolas-Lemur kernel: [15658.300784] cpu[3] = 1¥n
Nov 20 22:28:55 nicolas-Lemur kernel: [15658.300828] cpu[3] = 2¥n
Nov 20 22:28:55 nicolas-Lemur kernel: [15658.831872] cpu[2] = 2¥n
Nov 20 22:28:55 nicolas-Lemur kernel: [15658.831879] cpu[1] = 1¥n
Nov 20 22:28:55 nicolas-Lemur kernel: [15658.831907] cpu[3] = 3¥n
Nov 20 22:28:55 nicolas-Lemur kernel: [15659.343850] cpu[2] = 3¥n
Nov 20 22:28:55 nicolas-Lemur kernel: [15659.343854] cpu[1] = 2¥n
Nov 20 22:28:56 nicolas-Lemur kernel: [15659.343856] cpu[3] = 4¥n
Nov 20 22:28:56 nicolas-Lemur kernel: [15659.855794] cpu[2] = 4¥n
Nov 20 22:28:56 nicolas-Lemur kernel: [15659.855795] cpu[0] = 1¥n
Nov 20 22:28:56 nicolas-Lemur kernel: [15659.855803] cpu[2] = 5¥n
Nov 20 22:28:56 nicolas-Lemur kernel: [15660.367758] cpu[3] = 5¥n
Nov 20 22:28:56 nicolas-Lemur kernel: [15660.367769] cpu[2] = 6¥n
Nov 20 22:28:57 nicolas-Lemur kernel: [15660.367771] cpu[0] = 2¥n
Nov 20 22:28:57 nicolas-Lemur kernel: [15660.879670] cpu[0] = 3¥n
Nov 20 22:28:57 nicolas-Lemur kernel: [15660.879674] cpu[3] = 6¥n
Nov 20 22:28:57 nicolas-Lemur kernel: [15660.879683] cpu[0] = 4¥n
Nov 20 22:28:57 nicolas-Lemur kernel: [15661.391575] cpu[3] = 7¥n
Nov 20 22:28:57 nicolas-Lemur kernel: [15661.391633] cpu[2] = 7¥n
Nov 20 22:28:58 nicolas-Lemur kernel: [15661.391642] cpu[2] = 8¥n
Nov 20 22:28:58 nicolas-Lemur kernel: [15661.903583] cpu[0] = 5¥n
Nov 20 22:28:58 nicolas-Lemur kernel: [15661.903630] cpu[2] = 9¥n
Nov 20 22:28:58 nicolas-Lemur kernel: [15661.903635] cpu[3] = 8¥n
Nov 20 22:28:58 nicolas-Lemur kernel: [15662.415579] cpu[2] = 10¥n
Nov 20 22:28:58 nicolas-Lemur kernel: [15662.415581] cpu[0] = 6¥n
Nov 20 22:28:59 nicolas-Lemur kernel: [15662.419520] cpu[3] = 9¥n
Nov 20 22:28:59 nicolas-Lemur kernel: [15662.927479] cpu[3] = 10¥n
Nov 20 22:28:59 nicolas-Lemur kernel: [15662.927508] cpu[0] = 7¥n
Nov 20 22:28:59 nicolas-Lemur kernel: [15662.927510] cpu[2] = 11¥n
Nov 20 22:28:59 nicolas-Lemur kernel: [15663.439450] cpu[2] = 12¥n
Nov 20 22:28:59 nicolas-Lemur kernel: [15663.439455] cpu[3] = 11¥n
Nov 20 22:29:00 nicolas-Lemur kernel: [15663.439500] cpu[3] = 12¥n
Nov 20 22:29:00 nicolas-Lemur kernel: [15663.951399] cpu[1] = 3¥n
Nov 20 22:29:00 nicolas-Lemur kernel: [15663.951443] cpu[2] = 13¥n
Nov 20 22:29:00 nicolas-Lemur kernel: [15663.951447] cpu[3] = 13¥n
Nov 20 22:29:00 nicolas-Lemur kernel: [15664.463326] cpu[2] = 14¥n
Nov 20 22:29:00 nicolas-Lemur kernel: [15664.463334] cpu[3] = 14¥n
Nov 20 22:29:01 nicolas-Lemur kernel: [15664.463336] cpu[1] = 4¥n
Nov 20 22:29:01 nicolas-Lemur kernel: [15664.975252] cpu[0] = 8¥n
Nov 20 22:29:01 nicolas-Lemur kernel: [15664.975276] cpu[3] = 15¥n
Nov 20 22:29:01 nicolas-Lemur kernel: [15664.975278] cpu[1] = 5¥n
Nov 20 22:29:01 nicolas-Lemur kernel: [15665.487274] cpu[3] = 16¥n
Nov 20 22:29:01 nicolas-Lemur kernel: [15665.487276] cpu[1] = 6¥n
Nov 20 22:29:02 nicolas-Lemur kernel: [15665.487279] cpu[0] = 9¥n
Nov 20 22:29:02 nicolas-Lemur kernel: [15665.999224] cpu[0] = 10¥n
Nov 20 22:29:02 nicolas-Lemur kernel: [15665.999228] cpu[3] = 17¥n
Nov 20 22:29:02 nicolas-Lemur kernel: [15665.999230] cpu[1] = 7¥n
Nov 20 22:29:02 nicolas-Lemur kernel: [15666.511146] cpu[0] = 11¥n
Nov 20 22:29:02 nicolas-Lemur kernel: [15666.511153] cpu[1] = 8¥n
Nov 20 22:29:03 nicolas-Lemur kernel: [15666.511156] cpu[3] = 18¥n
Nov 20 22:29:03 nicolas-Lemur kernel: [15667.023089] cpu[0] = 12¥n
Nov 20 22:29:03 nicolas-Lemur kernel: [15667.023092] cpu[1] = 9¥n
Nov 20 22:29:03 nicolas-Lemur kernel: [15667.023095] cpu[3] = 19¥n
Nov 20 22:29:03 nicolas-Lemur kernel: [15667.535087] cpu[0] = 13¥n
Nov 20 22:29:03 nicolas-Lemur kernel: [15667.535102] cpu[1] = 10¥n
Nov 20 22:29:04 nicolas-Lemur kernel: [15667.535104] cpu[3] = 20¥n
Nov 20 22:29:04 nicolas-Lemur kernel: [15668.047048] cpu[0] = 14¥n
Nov 20 22:29:04 nicolas-Lemur kernel: [15668.047052] cpu[3] = 21¥n
Nov 20 22:29:04 nicolas-Lemur kernel: [15668.047055] cpu[1] = 11¥n
Nov 20 22:29:04 nicolas-Lemur kernel: [15668.558978] cpu[3] = 22¥n
Nov 20 22:29:04 nicolas-Lemur kernel: [15668.558983] cpu[2] = 15¥n
Nov 20 22:29:05 nicolas-Lemur kernel: [15668.558992] cpu[3] = 23¥n
Nov 20 22:29:05 nicolas-Lemur kernel: [15669.070890] cpu[0] = 15¥n
Nov 20 22:29:05 nicolas-Lemur kernel: [15669.070932] cpu[2] = 16¥n
Nov 20 22:29:05 nicolas-Lemur kernel: [15669.070950] cpu[1] = 12¥n
Nov 20 22:29:05 nicolas-Lemur kernel: [15669.582882] cpu[0] = 16¥n
Nov 20 22:29:05 nicolas-Lemur kernel: [15669.582885] cpu[2] = 17¥n
Nov 20 22:29:06 nicolas-Lemur kernel: [15669.582923] cpu[1] = 13¥n
Nov 20 22:29:06 nicolas-Lemur kernel: [15670.094829] cpu[3] = 24¥n
Nov 20 22:29:06 nicolas-Lemur kernel: [15670.094832] cpu[1] = 14¥n
```

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Nov 20 22:29:06 nicolas-Lemur kernel: [15670.094840] cpu[1] = 15¥n
Nov 20 22:29:06 nicolas-Lemur kernel: [15670.606790] cpu[3] = 25¥n
Nov 20 22:29:06 nicolas-Lemur kernel: [15670.606793] cpu[1] = 16¥n
Nov 20 22:29:07 nicolas-Lemur kernel: [15670.606801] cpu[1] = 17¥n
Nov 20 22:29:07 nicolas-Lemur kernel: [15671.118851] cpu[2] = 18¥n
Nov 20 22:29:07 nicolas-Lemur kernel: [15671.118864] cpu[3] = 26¥n
Nov 20 22:29:07 nicolas-Lemur kernel: [15671.118866] cpu[1] = 18¥n
Nov 20 22:29:07 nicolas-Lemur kernel: [15671.630732] cpu[2] = 19¥n
Nov 20 22:29:07 nicolas-Lemur kernel: [15671.630737] cpu[3] = 27¥n
Nov 20 22:29:08 nicolas-Lemur kernel: [15671.630739] cpu[1] = 19¥n
Nov 20 22:29:08 nicolas-Lemur kernel: [15672.142686] cpu[2] = 20¥n
Nov 20 22:29:08 nicolas-Lemur kernel: [15672.142690] cpu[1] = 20¥n
Nov 20 22:29:08 nicolas-Lemur kernel: [15672.142692] cpu[3] = 28¥n
Nov 20 22:29:08 nicolas-Lemur kernel: [15672.654619] cpu[3] = 29¥n
Nov 20 22:29:08 nicolas-Lemur kernel: [15672.654621] cpu[1] = 21¥n
Nov 20 22:29:09 nicolas-Lemur kernel: [15672.654630] cpu[0] = 17¥n
Nov 20 22:29:09 nicolas-Lemur kernel: [15673.166583] cpu[0] = 18¥n
Nov 20 22:29:09 nicolas-Lemur kernel: [15673.166588] cpu[3] = 30¥n
Nov 20 22:29:09 nicolas-Lemur kernel: [15673.166590] cpu[1] = 22¥n
Nov 20 22:29:09 nicolas-Lemur kernel: [15673.678532] cpu[0] = 19¥n
Nov 20 22:29:09 nicolas-Lemur kernel: [15673.678542] cpu[1] = 23¥n
Nov 20 22:29:10 nicolas-Lemur kernel: [15673.678545] cpu[3] = 31¥n
Nov 20 22:29:10 nicolas-Lemur kernel: [15674.190516] cpu[1] = 24¥n
Nov 20 22:29:10 nicolas-Lemur kernel: [15674.190518] cpu[3] = 32¥n
Nov 20 22:29:10 nicolas-Lemur kernel: [15674.194502] cpu[0] = 20¥n
Nov 20 22:29:10 nicolas-Lemur kernel: [15674.702399] cpu[0] = 21¥n
Nov 20 22:29:10 nicolas-Lemur kernel: [15674.702412] cpu[3] = 33¥n
Nov 20 22:29:11 nicolas-Lemur kernel: [15674.702414] cpu[1] = 25¥n
Nov 20 22:29:11 nicolas-Lemur kernel: [15675.214403] cpu[0] = 22¥n
Nov 20 22:29:11 nicolas-Lemur kernel: [15675.214408] cpu[3] = 34¥n
Nov 20 22:29:11 nicolas-Lemur kernel: [15675.218756] cpu[1] = 26¥n
Nov 20 22:29:11 nicolas-Lemur kernel: [15675.726368] cpu[3] = 35¥n
Nov 20 22:29:11 nicolas-Lemur kernel: [15675.726370] cpu[1] = 27¥n
Nov 20 22:29:12 nicolas-Lemur kernel: [15675.726374] cpu[0] = 23¥n
Nov 20 22:29:12 nicolas-Lemur kernel: [15676.238285] cpu[3] = 36¥n
Nov 20 22:29:12 nicolas-Lemur kernel: [15676.238288] cpu[1] = 28¥n
Nov 20 22:29:12 nicolas-Lemur kernel: [15676.238300] cpu[0] = 24¥n
Nov 20 22:29:12 nicolas-Lemur kernel: [15676.750281] cpu[1] = 29¥n
Nov 20 22:29:12 nicolas-Lemur kernel: [15676.750283] cpu[3] = 37¥n
Nov 20 22:29:13 nicolas-Lemur kernel: [15676.750303] cpu[0] = 25¥n
Nov 20 22:29:13 nicolas-Lemur kernel: [15677.262188] cpu[0] = 26¥n
Nov 20 22:29:13 nicolas-Lemur kernel: [15677.262200] cpu[1] = 30¥n
Nov 20 22:29:13 nicolas-Lemur kernel: [15677.262211] cpu[1] = 31¥n
Nov 20 22:29:13 nicolas-Lemur kernel: [15677.774164] cpu[2] = 21¥n
Nov 20 22:29:13 nicolas-Lemur kernel: [15677.774168] cpu[3] = 38¥n
Nov 20 22:29:14 nicolas-Lemur kernel: [15677.774210] cpu[0] = 27¥n
Nov 20 22:29:14 nicolas-Lemur kernel: [15678.286145] cpu[2] = 22¥n
Nov 20 22:29:14 nicolas-Lemur kernel: [15678.286155] cpu[3] = 39¥n
Nov 20 22:29:14 nicolas-Lemur kernel: [15678.286163] cpu[0] = 28¥n
Nov 20 22:29:14 nicolas-Lemur kernel: [15678.798074] cpu[3] = 40¥n
Nov 20 22:29:14 nicolas-Lemur kernel: [15678.798080] cpu[0] = 29¥n
Nov 20 22:29:15 nicolas-Lemur kernel: [15678.798082] cpu[2] = 23¥n
Nov 20 22:29:15 nicolas-Lemur kernel: [15679.310065] cpu[3] = 41¥n
Nov 20 22:29:15 nicolas-Lemur kernel: [15679.314036] cpu[0] = 30¥n
Nov 20 22:29:16 nicolas-Lemur kernel: [15679.314038] cpu[2] = 24¥n
Nov 20 22:29:16 nicolas-Lemur kernel: [15679.821972] cpu[2] = 25¥n
Nov 20 22:29:16 nicolas-Lemur kernel: [15679.821974] cpu[0] = 31¥n
Nov 20 22:29:16 nicolas-Lemur kernel: [15679.821978] cpu[3] = 42¥n
Nov 20 22:29:16 nicolas-Lemur kernel: [15680.333935] cpu[3] = 43¥n
Nov 20 22:29:16 nicolas-Lemur kernel: [15680.333939] cpu[0] = 32¥n
Nov 20 22:29:17 nicolas-Lemur kernel: [15680.333941] cpu[2] = 26¥n
Nov 20 22:29:17 nicolas-Lemur kernel: [15680.845908] cpu[0] = 33¥n
Nov 20 22:29:17 nicolas-Lemur kernel: [15680.845909] cpu[2] = 27¥n
Nov 20 22:29:17 nicolas-Lemur kernel: [15680.845911] cpu[3] = 44¥n
Nov 20 22:29:17 nicolas-Lemur kernel: [15681.357827] cpu[0] = 34¥n
Nov 20 22:29:17 nicolas-Lemur kernel: [15681.357830] cpu[2] = 28¥n
Nov 20 22:29:18 nicolas-Lemur kernel: [15681.357833] cpu[3] = 45¥n
Nov 20 22:29:18 nicolas-Lemur kernel: [15681.869799] cpu[0] = 35¥n
Nov 20 22:29:18 nicolas-Lemur kernel: [15681.869801] cpu[2] = 29¥n
Nov 20 22:29:18 nicolas-Lemur kernel: [15681.869805] cpu[3] = 46¥n
Nov 20 22:29:18 nicolas-Lemur kernel: [15682.381816] cpu[0] = 36¥n
Nov 20 22:29:18 nicolas-Lemur kernel: [15682.381818] cpu[2] = 30¥n
Nov 20 22:29:19 nicolas-Lemur kernel: [15682.381824] cpu[3] = 47¥n
Nov 20 22:29:19 nicolas-Lemur kernel: [15682.893769] cpu[2] = 31¥n
Nov 20 22:29:19 nicolas-Lemur kernel: [15682.893772] cpu[0] = 37¥n
```

```
Nov 20 22:29:19 nicolas-Lemur kernel: [15682.893775] cpu[3] = 48%  
Nov 20 22:29:19 nicolas-Lemur kernel: [15683.405697] cpu[2] = 32%  
Nov 20 22:29:19 nicolas-Lemur kernel: [15683.405699] cpu[0] = 38%  
Nov 20 22:29:20 nicolas-Lemur kernel: [15683.405701] cpu[3] = 49%  
Nov 20 22:29:20 nicolas-Lemur kernel: [15683.917587] cpu[1] = 32%  
Nov 20 22:29:20 nicolas-Lemur kernel: [15683.917620] cpu[0] = 39%  
Nov 20 22:29:20 nicolas-Lemur kernel: [15683.917622] cpu[2] = 33%  
Nov 20 22:29:20 nicolas-Lemur kernel: [15684.429527] cpu[0] = 40%  
Nov 20 22:29:20 nicolas-Lemur kernel: [15684.429528] cpu[1] = 33%  
Nov 20 22:29:21 nicolas-Lemur kernel: [15684.429529] cpu[2] = 34%  
Nov 20 22:29:21 nicolas-Lemur kernel: [15684.941512] cpu[2] = 35%  
Nov 20 22:29:21 nicolas-Lemur kernel: [15684.941527] cpu[1] = 34%  
Nov 20 22:29:21 nicolas-Lemur kernel: [15684.941530] cpu[1] = 35%  
Nov 20 22:29:21 nicolas-Lemur kernel: [15685.453435] cpu[0] = 41%  
Nov 20 22:29:21 nicolas-Lemur kernel: [15685.453449] cpu[3] = 50%  
Nov 20 22:29:22 nicolas-Lemur kernel: [15685.453459] cpu[1] = 36%  
Nov 20 22:29:22 nicolas-Lemur kernel: [15685.965424] cpu[3] = 51%  
Nov 20 22:29:22 nicolas-Lemur kernel: [15685.965425] cpu[1] = 37%  
Nov 20 22:29:22 nicolas-Lemur kernel: [15685.965426] cpu[0] = 42%  
Nov 20 22:29:22 nicolas-Lemur kernel: [15686.477385] cpu[0] = 43%  
Nov 20 22:29:22 nicolas-Lemur kernel: [15686.477387] cpu[1] = 38%  
Nov 20 22:29:23 nicolas-Lemur kernel: [15686.477392] cpu[0] = 44%  
Nov 20 22:29:23 nicolas-Lemur kernel: [15686.989409] cpu[0] = 45%  
Nov 20 22:29:23 nicolas-Lemur kernel: [15686.989415] cpu[1] = 39%  
Nov 20 22:29:23 nicolas-Lemur kernel: [15686.989427] cpu[0] = 46%  
Nov 20 22:29:23 nicolas-Lemur kernel: [15687.501303] cpu[2] = 36%  
Nov 20 22:29:23 nicolas-Lemur kernel: [15687.501352] cpu[0] = 47%  
Nov 20 22:29:24 nicolas-Lemur kernel: [15687.501368] cpu[1] = 40%  
Nov 20 22:29:24 nicolas-Lemur kernel: [15688.013260] cpu[3] = 52%  
Nov 20 22:29:24 nicolas-Lemur kernel: [15688.013283] cpu[2] = 37%  
Nov 20 22:29:24 nicolas-Lemur kernel: [15688.013285] cpu[0] = 48%  
Nov 20 22:29:24 nicolas-Lemur kernel: [15688.525274] cpu[3] = 53%  
Nov 20 22:29:24 nicolas-Lemur kernel: [15688.525282] cpu[2] = 38%  
Nov 20 22:29:25 nicolas-Lemur kernel: [15688.525284] cpu[0] = 49%  
Nov 20 22:29:25 nicolas-Lemur kernel: [15689.037214] cpu[3] = 54%  
Nov 20 22:29:25 nicolas-Lemur kernel: [15689.037221] cpu[2] = 39%  
Nov 20 22:29:25 nicolas-Lemur kernel: [15689.041245] cpu[2] = 40%  
Nov 20 22:29:25 nicolas-Lemur kernel: [15689.549130] cpu[0] = 50%  
Nov 20 22:29:25 nicolas-Lemur kernel: [15689.549179] cpu[2] = 41%  
Nov 20 22:29:26 nicolas-Lemur kernel: [15689.549185] cpu[2] = 42%  
Nov 20 22:29:26 nicolas-Lemur kernel: [15690.061118] cpu[2] = 43%  
Nov 20 22:29:26 nicolas-Lemur kernel: [15690.061119] cpu[0] = 51%  
Nov 20 22:29:26 nicolas-Lemur kernel: [15690.061123] cpu[3] = 55%  
Nov 20 22:29:26 nicolas-Lemur kernel: [15690.573177] cpu[2] = 44%  
Nov 20 22:29:26 nicolas-Lemur kernel: [15690.573179] cpu[0] = 52%  
Nov 20 22:29:27 nicolas-Lemur kernel: [15690.577084] cpu[3] = 56%  
Nov 20 22:29:27 nicolas-Lemur kernel: [15691.085012] cpu[3] = 57%  
Nov 20 22:29:27 nicolas-Lemur kernel: [15691.085031] cpu[2] = 45%  
Nov 20 22:29:27 nicolas-Lemur kernel: [15691.085036] cpu[1] = 41%  
Nov 20 22:29:27 nicolas-Lemur kernel: [15691.596995] cpu[3] = 58%  
Nov 20 22:29:27 nicolas-Lemur kernel: [15691.600983] cpu[0] = 53%  
Nov 20 22:29:28 nicolas-Lemur kernel: [15691.600990] cpu[2] = 46%  
Nov 20 22:29:28 nicolas-Lemur kernel: [15692.108937] cpu[1] = 42%  
Nov 20 22:29:28 nicolas-Lemur kernel: [15692.108967] cpu[3] = 59%  
Nov 20 22:29:28 nicolas-Lemur kernel: [15692.108971] cpu[3] = 60%  
Nov 20 22:29:28 nicolas-Lemur kernel: [15692.620879] cpu[2] = 47%  
Nov 20 22:29:28 nicolas-Lemur kernel: [15692.620924] cpu[0] = 54%  
Nov 20 22:29:29 nicolas-Lemur kernel: [15692.620971] cpu[3] = 61%  
Nov 20 22:29:29 nicolas-Lemur kernel: [15693.132889] cpu[3] = 62%  
Nov 20 22:29:29 nicolas-Lemur kernel: [15693.136857] cpu[1] = 43%  
Nov 20 22:29:29 nicolas-Lemur kernel: [15693.136871] cpu[2] = 48%  
Nov 20 22:29:29 nicolas-Lemur kernel: [15693.644833] cpu[1] = 44%  
Nov 20 22:29:29 nicolas-Lemur kernel: [15693.644834] cpu[3] = 63%  
Nov 20 22:29:30 nicolas-Lemur kernel: [15693.644850] cpu[2] = 49%  
Nov 20 22:29:30 nicolas-Lemur kernel: [15694.156729] cpu[1] = 45%  
Nov 20 22:29:30 nicolas-Lemur kernel: [15694.156743] cpu[2] = 50%  
Nov 20 22:29:30 nicolas-Lemur kernel: [15694.156744] cpu[3] = 64%  
Nov 20 22:29:30 nicolas-Lemur kernel: [15694.668794] cpu[3] = 65%  
Nov 20 22:29:30 nicolas-Lemur kernel: [15694.668797] cpu[1] = 46%  
Nov 20 22:29:31 nicolas-Lemur kernel: [15694.672756] cpu[2] = 51%  
Nov 20 22:29:31 nicolas-Lemur kernel: [15695.180708] cpu[1] = 47%  
Nov 20 22:29:31 nicolas-Lemur kernel: [15695.180710] cpu[3] = 66%  
Nov 20 22:29:31 nicolas-Lemur kernel: [15695.184702] cpu[3] = 67%  
Nov 20 22:29:31 nicolas-Lemur kernel: [15695.692704] cpu[0] = 55%  
Nov 20 22:29:31 nicolas-Lemur kernel: [15695.692729] cpu[1] = 48%
```

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Nov 20 22:29:32 nicolas-Lemur kernel: [15695.692731] cpu[3] = 68%  
Nov 20 22:29:32 nicolas-Lemur kernel: [15696.204653] cpu[1] = 49%  
Nov 20 22:29:32 nicolas-Lemur kernel: [15696.204655] cpu[3] = 69%  
Nov 20 22:29:32 nicolas-Lemur kernel: [15696.204660] cpu[0] = 56%  
Nov 20 22:29:32 nicolas-Lemur kernel: [15696.716620] cpu[0] = 57%  
Nov 20 22:29:32 nicolas-Lemur kernel: [15696.716630] cpu[1] = 50%  
Nov 20 22:29:33 nicolas-Lemur kernel: [15696.716636] cpu[1] = 51%  
Nov 20 22:29:33 nicolas-Lemur kernel: [15697.228548] cpu[2] = 52%  
Nov 20 22:29:33 nicolas-Lemur kernel: [15697.228553] cpu[1] = 52%  
Nov 20 22:29:33 nicolas-Lemur kernel: [15697.228563] cpu[1] = 53%  
Nov 20 22:29:33 nicolas-Lemur kernel: [15697.740520] cpu[3] = 70%  
Nov 20 22:29:33 nicolas-Lemur kernel: [15697.740555] cpu[2] = 53%  
Nov 20 22:29:34 nicolas-Lemur kernel: [15697.740557] cpu[1] = 54%  
Nov 20 22:29:34 nicolas-Lemur kernel: [15698.252463] cpu[3] = 71%  
Nov 20 22:29:34 nicolas-Lemur kernel: [15698.252501] cpu[2] = 54%  
Nov 20 22:29:34 nicolas-Lemur kernel: [15698.252510] cpu[0] = 58%  
Nov 20 22:29:34 nicolas-Lemur kernel: [15698.764417] cpu[3] = 72%  
Nov 20 22:29:34 nicolas-Lemur kernel: [15698.764420] cpu[0] = 59%  
Nov 20 22:29:35 nicolas-Lemur kernel: [15698.764423] cpu[2] = 55%  
Nov 20 22:29:35 nicolas-Lemur kernel: [15699.276382] cpu[2] = 56%  
Nov 20 22:29:35 nicolas-Lemur kernel: [15699.276384] cpu[0] = 60%  
Nov 20 22:29:35 nicolas-Lemur kernel: [15699.276391] cpu[0] = 61%  
Nov 20 22:29:35 nicolas-Lemur kernel: [15699.788392] cpu[2] = 57%  
Nov 20 22:29:35 nicolas-Lemur kernel: [15699.788394] cpu[0] = 62%  
Nov 20 22:29:36 nicolas-Lemur kernel: [15699.788402] cpu[0] = 63%  
Nov 20 22:29:36 nicolas-Lemur kernel: [15700.300355] cpu[0] = 64%  
Nov 20 22:29:36 nicolas-Lemur kernel: [15700.300365] cpu[0] = 65%  
Nov 20 22:29:37 nicolas-Lemur kernel: [15700.300371] cpu[0] = 66%  
Nov 20 22:29:37 nicolas-Lemur kernel: [15700.812240] cpu[2] = 58%  
Nov 20 22:29:37 nicolas-Lemur kernel: [15700.812296] cpu[0] = 67%  
Nov 20 22:29:37 nicolas-Lemur kernel: [15700.812303] cpu[0] = 68%  
Nov 20 22:29:37 nicolas-Lemur kernel: [15701.324222] cpu[2] = 59%  
Nov 20 22:29:37 nicolas-Lemur kernel: [15701.324224] cpu[0] = 69%  
Nov 20 22:29:38 nicolas-Lemur kernel: [15701.324231] cpu[2] = 60%  
Nov 20 22:29:38 nicolas-Lemur kernel: [15701.836169] cpu[0] = 70%  
Nov 20 22:29:38 nicolas-Lemur kernel: [15701.836169] cpu[2] = 61%  
Nov 20 22:29:38 nicolas-Lemur kernel: [15701.836171] cpu[2] = 62%  
Nov 20 22:29:38 nicolas-Lemur kernel: [15702.348164] cpu[2] = 63%  
Nov 20 22:29:38 nicolas-Lemur kernel: [15702.348165] cpu[0] = 71%  
Nov 20 22:29:39 nicolas-Lemur kernel: [15702.348170] cpu[2] = 64%  
Nov 20 22:29:39 nicolas-Lemur kernel: [15702.860115] cpu[2] = 65%  
Nov 20 22:29:39 nicolas-Lemur kernel: [15702.860122] cpu[2] = 66%  
Nov 20 22:29:39 nicolas-Lemur kernel: [15702.860127] cpu[2] = 67%  
Nov 20 22:29:39 nicolas-Lemur kernel: [15703.372072] cpu[0] = 72%  
Nov 20 22:29:39 nicolas-Lemur kernel: [15703.372098] cpu[3] = 73%  
Nov 20 22:29:40 nicolas-Lemur kernel: [15703.372120] cpu[2] = 68%  
Nov 20 22:29:40 nicolas-Lemur kernel: [15703.884045] cpu[3] = 74%  
Nov 20 22:29:40 nicolas-Lemur kernel: [15703.888086] cpu[2] = 69%  
Nov 20 22:29:40 nicolas-Lemur kernel: [15703.888088] cpu[0] = 73%  
Nov 20 22:29:40 nicolas-Lemur kernel: [15704.395961] cpu[0] = 74%  
Nov 20 22:29:40 nicolas-Lemur kernel: [15704.395962] cpu[2] = 70%  
Nov 20 22:29:41 nicolas-Lemur kernel: [15704.399965] cpu[2] = 71%  
Nov 20 22:29:41 nicolas-Lemur kernel: [15704.907976] cpu[0] = 75%  
Nov 20 22:29:41 nicolas-Lemur kernel: [15704.907977] cpu[3] = 75%  
Nov 20 22:29:41 nicolas-Lemur kernel: [15704.907988] cpu[2] = 72%  
Nov 20 22:29:41 nicolas-Lemur kernel: [15705.419975] cpu[3] = 76%  
Nov 20 22:29:41 nicolas-Lemur kernel: [15705.419979] cpu[2] = 73%  
Nov 20 22:29:42 nicolas-Lemur kernel: [15705.419981] cpu[0] = 76%  
Nov 20 22:29:42 nicolas-Lemur kernel: [15705.931939] cpu[2] = 74%  
Nov 20 22:29:42 nicolas-Lemur kernel: [15705.931942] cpu[0] = 77%  
Nov 20 22:29:42 nicolas-Lemur kernel: [15705.931946] cpu[3] = 77%  
Nov 20 22:29:42 nicolas-Lemur kernel: [15706.443837] cpu[3] = 78%  
Nov 20 22:29:42 nicolas-Lemur kernel: [15706.447833] cpu[2] = 75%  
Nov 20 22:29:43 nicolas-Lemur kernel: [15706.447833] cpu[0] = 78%  
Nov 20 22:29:43 nicolas-Lemur kernel: [15706.955782] cpu[3] = 79%  
Nov 20 22:29:43 nicolas-Lemur kernel: [15706.955788] cpu[0] = 79%  
Nov 20 22:29:43 nicolas-Lemur kernel: [15706.955794] cpu[0] = 80%  
Nov 20 22:29:43 nicolas-Lemur kernel: [15707.467715] cpu[2] = 76%  
Nov 20 22:29:43 nicolas-Lemur kernel: [15707.467718] cpu[1] = 55%  
Nov 20 22:29:44 nicolas-Lemur kernel: [15707.467739] cpu[0] = 81%  
Nov 20 22:29:44 nicolas-Lemur kernel: [15707.979744] cpu[3] = 80%  
Nov 20 22:29:44 nicolas-Lemur kernel: [15707.979831] cpu[1] = 56%  
Nov 20 22:29:44 nicolas-Lemur kernel: [15707.979840] cpu[1] = 57%  
Nov 20 22:29:44 nicolas-Lemur kernel: [15708.491715] cpu[2] = 77%  
Nov 20 22:29:44 nicolas-Lemur kernel: [15708.491717] cpu[0] = 82%
```



```
Nov 20 22:29:45 nicolas-Lemur kernel: [15708.491828] cpu[1] = 58%  
Nov 20 22:29:45 nicolas-Lemur kernel: [15709.003712] cpu[1] = 59%  
Nov 20 22:29:45 nicolas-Lemur kernel: [15709.003738] cpu[2] = 78%  
Nov 20 22:29:45 nicolas-Lemur kernel: [15709.003742] cpu[0] = 83%  
Nov 20 22:29:45 nicolas-Lemur kernel: [15709.515588] cpu[3] = 81%  
Nov 20 22:29:45 nicolas-Lemur kernel: [15709.515602] cpu[0] = 84%  
Nov 20 22:29:46 nicolas-Lemur kernel: [15709.515643] cpu[3] = 82%  
Nov 20 22:29:46 nicolas-Lemur kernel: [15710.027576] cpu[3] = 83%  
Nov 20 22:29:46 nicolas-Lemur kernel: [15710.027584] cpu[3] = 84%  
Nov 20 22:29:46 nicolas-Lemur kernel: [15710.027600] cpu[2] = 79%  
Nov 20 22:29:46 nicolas-Lemur kernel: [15710.539487] cpu[1] = 60%  
Nov 20 22:29:46 nicolas-Lemur kernel: [15710.539507] cpu[0] = 85%  
Nov 20 22:29:47 nicolas-Lemur kernel: [15710.539533] cpu[2] = 80%  
Nov 20 22:29:47 nicolas-Lemur kernel: [15711.051486] cpu[0] = 86%  
Nov 20 22:29:47 nicolas-Lemur kernel: [15711.051498] cpu[1] = 61%  
Nov 20 22:29:47 nicolas-Lemur kernel: [15711.051501] cpu[2] = 81%  
Nov 20 22:29:47 nicolas-Lemur kernel: [15711.563473] cpu[0] = 87%  
Nov 20 22:29:47 nicolas-Lemur kernel: [15711.563475] cpu[2] = 82%  
Nov 20 22:29:48 nicolas-Lemur kernel: [15711.563484] cpu[1] = 62%  
Nov 20 22:29:48 nicolas-Lemur kernel: [15712.075408] cpu[3] = 85%  
Nov 20 22:29:48 nicolas-Lemur kernel: [15712.075459] cpu[1] = 63%  
Nov 20 22:29:48 nicolas-Lemur kernel: [15712.075467] cpu[1] = 64%  
Nov 20 22:29:48 nicolas-Lemur kernel: [15712.587370] cpu[1] = 65%  
Nov 20 22:29:48 nicolas-Lemur kernel: [15712.587372] cpu[0] = 88%  
Nov 20 22:29:49 nicolas-Lemur kernel: [15712.587373] cpu[1] = 66%  
Nov 20 22:29:49 nicolas-Lemur kernel: [15713.099366] cpu[3] = 86%  
Nov 20 22:29:49 nicolas-Lemur kernel: [15713.099429] cpu[1] = 67%  
Nov 20 22:29:49 nicolas-Lemur kernel: [15713.099436] cpu[1] = 68%  
Nov 20 22:29:49 nicolas-Lemur kernel: [15713.611421] cpu[3] = 87%  
Nov 20 22:29:49 nicolas-Lemur kernel: [15713.611423] cpu[1] = 69%  
Nov 20 22:29:50 nicolas-Lemur kernel: [15713.611433] cpu[1] = 70%  
Nov 20 22:29:50 nicolas-Lemur kernel: [15714.123316] cpu[3] = 88%  
Nov 20 22:29:50 nicolas-Lemur kernel: [15714.123322] cpu[1] = 71%  
Nov 20 22:29:50 nicolas-Lemur kernel: [15714.123330] cpu[1] = 72%  
Nov 20 22:29:50 nicolas-Lemur kernel: [15714.635268] cpu[3] = 89%  
Nov 20 22:29:50 nicolas-Lemur kernel: [15714.635269] cpu[1] = 73%  
Nov 20 22:29:51 nicolas-Lemur kernel: [15714.635285] cpu[2] = 83%  
Nov 20 22:29:51 nicolas-Lemur kernel: [15715.147220] cpu[3] = 90%  
Nov 20 22:29:51 nicolas-Lemur kernel: [15715.147223] cpu[2] = 84%  
Nov 20 22:29:51 nicolas-Lemur kernel: [15715.147224] cpu[1] = 74%  
Nov 20 22:29:51 nicolas-Lemur kernel: [15715.659179] cpu[3] = 91%  
Nov 20 22:29:51 nicolas-Lemur kernel: [15715.659217] cpu[0] = 89%  
Nov 20 22:29:52 nicolas-Lemur kernel: [15715.659236] cpu[2] = 85%  
Nov 20 22:29:52 nicolas-Lemur kernel: [15716.171198] cpu[0] = 90%  
Nov 20 22:29:52 nicolas-Lemur kernel: [15716.171200] cpu[2] = 86%  
Nov 20 22:29:52 nicolas-Lemur kernel: [15716.171211] cpu[3] = 92%  
Nov 20 22:29:52 nicolas-Lemur kernel: [15716.683159] cpu[0] = 91%  
Nov 20 22:29:52 nicolas-Lemur kernel: [15716.683161] cpu[2] = 87%  
Nov 20 22:29:53 nicolas-Lemur kernel: [15716.683179] cpu[3] = 93%  
Nov 20 22:29:53 nicolas-Lemur kernel: [15717.195025] cpu[3] = 94%  
Nov 20 22:29:53 nicolas-Lemur kernel: [15717.195027] cpu[0] = 92%  
Nov 20 22:29:53 nicolas-Lemur kernel: [15717.195033] cpu[3] = 95%  
Nov 20 22:29:53 nicolas-Lemur kernel: [15717.706990] cpu[1] = 75%  
Nov 20 22:29:53 nicolas-Lemur kernel: [15717.707001] cpu[2] = 88%  
Nov 20 22:29:54 nicolas-Lemur kernel: [15717.707023] cpu[0] = 93%  
Nov 20 22:29:54 nicolas-Lemur kernel: [15718.219017] cpu[0] = 94%  
Nov 20 22:29:54 nicolas-Lemur kernel: [15718.219019] cpu[2] = 89%  
Nov 20 22:29:54 nicolas-Lemur kernel: [15718.219045] cpu[1] = 76%  
Nov 20 22:29:54 nicolas-Lemur kernel: [15718.730981] cpu[0] = 95%  
Nov 20 22:29:54 nicolas-Lemur kernel: [15718.730982] cpu[2] = 90%  
Nov 20 22:29:55 nicolas-Lemur kernel: [15718.735014] cpu[1] = 77%  
Nov 20 22:29:55 nicolas-Lemur kernel: [15719.243017] cpu[0] = 96%  
Nov 20 22:29:55 nicolas-Lemur kernel: [15719.243022] cpu[3] = 96%  
Nov 20 22:29:55 nicolas-Lemur kernel: [15719.243037] cpu[0] = 97%  
Nov 20 22:29:55 nicolas-Lemur kernel: [15719.754848] cpu[0] = 98%  
Nov 20 22:29:55 nicolas-Lemur kernel: [15719.754849] cpu[3] = 97%  
Nov 20 22:29:56 nicolas-Lemur kernel: [15719.754851] cpu[0] = 99%  
Nov 20 22:29:56 nicolas-Lemur kernel: [15720.266870] cpu[2] = 91%  
Nov 20 22:29:56 nicolas-Lemur kernel: [15720.266905] cpu[3] = 98%  
Nov 20 22:29:56 nicolas-Lemur kernel: [15720.266907] cpu[0] = 100%  
Nov 20 22:29:56 nicolas-Lemur kernel: [15720.778845] cpu[3] = 99%  
Nov 20 22:29:56 nicolas-Lemur kernel: [15720.778856] cpu[1] = 78%  
Nov 20 22:29:57 nicolas-Lemur kernel: [15720.778858] cpu[2] = 92%  
Nov 20 22:29:57 nicolas-Lemur kernel: [15721.290820] cpu[3] = 100%  
Nov 20 22:29:57 nicolas-Lemur kernel: [15721.294799] cpu[2] = 93%
```

```

Nov 20 22:29:58 nicolas-Lemur kernel: [15721.294804] cpu[1] = 79¥n
Nov 20 22:29:58 nicolas-Lemur kernel: [15721.802784] cpu[1] = 80¥n
Nov 20 22:29:58 nicolas-Lemur kernel: [15721.802789] cpu[2] = 94¥n
Nov 20 22:29:58 nicolas-Lemur kernel: [15721.802792] cpu[3] = 101¥n
Nov 20 22:30:22 nicolas-Lemur kernel: [15722.310937] [PERCPU]: Exiting module.¥n

```

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---

This module did not run correctly. Impossible to remove it with `rmmod` or `modprobe -rf`

module code

```

#include <linux/module.h>
#include <linux/kernel.h>
#include <linux/init.h>
#include <linux/percpu.h>
#include <linux/kthread.h>
#include <linux/sched.h>
#include <linux/delay.h>
#include <linux/smp.h>

#define PRINT_PREF "[PERCPU]: "

struct task_struct *thread1, *thread2, *thread3;
void *my_var2;
static int thread_function(void *data)
{
    while(!kthread_should_stop()) {
        int *local_ptr, cpu;
        local_ptr = get_cpu_ptr(my_var2);
        cpu = smp_processor_id();
        (*local_ptr)++;
        printk("cpu[%d] = %d¥n", cpu, *local_ptr);
        put_cpu_var(my_var2);
        msleep(500);
    }
    do_exit(0);
}

static int __init my_mod_init(void)
{
    int *local_ptr;
    int cpu;

    printk(PRINT_PREF " Entering module.¥n");

    my_var2 = alloc_percpu(int);
    if(!my_var2)
        return -1;

    for (cpu = 0; cpu < NR_CPUS; cpu++) {
        local_ptr = per_cpu_ptr(my_var2, cpu);
        *local_ptr = 0;
        put_cpu();
    }

    wmb();

    thread1 = kthread_run(thread_function, NULL, "percpu-thread1");
    thread2 = kthread_run(thread_function, NULL, "percpu-thread2");
    thread3 = kthread_run(thread_function, NULL, "percpu-thread3");

    return 0;
}

static void __exit my_mod_exit(void)
{
    kthread_stop(thread1);
    kthread_stop(thread2);
    kthread_stop(thread3);

    free_percpu(my_var2);
}

```

```

    printk(PRINT_PREF "Exiting module.¥n");
}

module_init(my_mod_init);
module_exit(my_mod_exit);

MODULE_LICENSE("GPL");

```

out of printk()

```

Nov 20 22:53:13 nicolas-Lemur kernel: [ 59.569503] percpu2: loading out-of-tree module taints kernel.
Nov 20 22:53:13 nicolas-Lemur kernel: [ 59.569532] percpu2: module verification failed: signature and/or
Nov 20 22:53:13 nicolas-Lemur kernel: [ 59.570577] [PERCPU]: Entering module.¥n
Nov 20 22:53:13 nicolas-Lemur kernel: [ 59.570592] BUG: unable to handle kernel paging request at 0000376
Nov 20 22:53:13 nicolas-Lemur kernel: [ 59.570637] IP: my_mod_init+0x43/0x1000 [percpu2]
Nov 20 22:53:13 nicolas-Lemur kernel: [ 59.570655] PGD 0
Nov 20 22:53:13 nicolas-Lemur kernel: [ 59.570656]
Nov 20 22:53:13 nicolas-Lemur kernel: [ 59.570667] Oops: 0002 [#1] SMP
Nov 20 22:53:13 nicolas-Lemur kernel: [ 59.570675] Modules linked in: percpu2(OE+) hid_generic hidp rfcomm
Nov 20 22:53:13 nicolas-Lemur kernel: [ 59.570837] memstick cfg80211 soundcore mei_me btusb mei btrtl in
Nov 20 22:53:13 nicolas-Lemur kernel: [ 59.570974] CPU: 3 PID: 3384 Comm: insmod Tainted: G OE
Nov 20 22:53:13 nicolas-Lemur kernel: [ 59.571002] Hardware name: System76 Lemur/L
Nov 20 22:53:13 nicolas-Lemur kernel: [ 59.571025] task: ffff88b3bbc41700 task.stack: ffffa01c83d6c000
Nov 20 22:53:13 nicolas-Lemur kernel: [ 59.571053] RIP: 0010:my_mod_init+0x43/0x1000 [percpu2]
Nov 20 22:53:13 nicolas-Lemur kernel: [ 59.571074] RSP: 0018:ffffa01c83d6fc98 EFLAGS: 00010283
Nov 20 22:53:13 nicolas-Lemur kernel: [ 59.571092] RAX: 0000000000000020 RBX: ffffffff02fc000 RCX: ffffff
Nov 20 22:53:13 nicolas-Lemur kernel: [ 59.571115] RDX: 0000376851006380 RSI: 0000000000000000 RDI: ffffff
Nov 20 22:53:13 nicolas-Lemur kernel: [ 59.571139] RBP: ffffa01c83d6fca0 R08: ffffffff8 R09: ffffc
Nov 20 22:53:13 nicolas-Lemur kernel: [ 59.571160] R10: 00000000000011ec R11: 0000000000006361 R12: ffffa
Nov 20 22:53:13 nicolas-Lemur kernel: [ 59.571181] R13: 0000000000000000 R14: ffff88b3f20e8d20 R15: ffff8
Nov 20 22:53:13 nicolas-Lemur kernel: [ 59.571208] FS: 00007f56f16fc700(0000) GS: ffff88b42ed80000(0000)
Nov 20 22:53:13 nicolas-Lemur kernel: [ 59.571239] CS: 0010 DS: 0000 ES: 0000 CR0: 0000000080050033

```