

Sistemas Operacionais B

Professor: Prof. Edmar Rezende

Experimento 2 - Instalação do Kernel

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Introdução:

Nesse experimento, nos deparamos com a construção e compilação de módulos de Kernel. No decorrer do experimento, fomos capazes de construir e executar os mesmos, corrigindo erros relacionados à *MODULES LICENCES* e *print*. Além da ambientação de interfaces de construção de código, comandos de terminal para *debug* e compilação.

Desenvolvimento:

De início, abrimos o documento *The Linux Programming Guide* (Disponibilizado no ambiente *Canvas*), iniciamos o terminal (*Ctrl + T*) e executamos o seguinte comando: *sudo apt-get install build-essential kmod*. Com este comando, foi possível executar instruções como o *insmod*, que insere um módulo no Kernel do Linux.

Em seguida, executamos o comando *sudo apt-cache search linux-headers-\$(uname -r)* que instala os arquivos de cabeçalho para o kernel.

Então, criamos um diretório para podermos executar o módulo de kernel, usando o comando *mkdir -p ~/develop/kernel/hello-1* e acessamos o mesmo usando

`cd ~/develop/kernel/hello-1.` Já no diretório criamos um arquivo usando o *gedit* (*gedit hello-1.c*) e usamos o código *hello-1.c*, disponibilizado no documento mencionado.

Por fim, criamos um arquivo, no mesmo diretório chamado *Makefile*(não utilizamos nenhuma extensão) e colamos o código mencionado no documento, com algumas alterações:

```
obj-m += hello-1.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
```

Para o *Makefile* funcionar, há de se usar as tabulações corretas e quebras de linha da mesma forma que o mostrado acima.

E então, é utilizado o comando *sudo make* para criar os objetos.

Após isso, executamos o comando: *sudo insmod hello-1.ko*, e, com o comando sendo executado sem erros, verificamos as mensagens do kernel executando *sudo journalctl --since "1 hour ago" | grep kernel*

Abaixo temos as inclusões e remoções dos módulos no Kernel. O comando *journalctl* para exibir as modificações realizadas e conferir seu sucesso.

Hello-1 - Inclusão

```
luiz@luiz-VirtualBox: ~/develop/kernel/hello-1
Ago 30 14:06:55 luiz-VirtualBox kernel: Adding 998396k swap on /dev/sda5. Priority:-2 extents:1 across:99
8396k FS
Ago 30 14:06:58 luiz-VirtualBox NetworkManager[686]: <info> [1598807218.0505] manager[0x17841c0]: monitoring kernel firmware directory '/lib/firmware'.
Ago 30 14:07:00 luiz-VirtualBox kernel: IPv6: ADDRCONF(NETDEV_UP): enp0s3: link is not ready
Ago 30 14:07:00 luiz-VirtualBox kernel: IPv6: ADDRCONF(NETDEV_UP): enp0s3: link is not ready
Ago 30 14:07:00 luiz-VirtualBox kernel: e1000: enp0s3 NIC Link is Up 1000 Mbps Full Duplex, Flow Control: RX
Ago 30 14:07:00 luiz-VirtualBox kernel: IPv6: ADDRCONF(NETDEV_CHANGE): enp0s3: link becomes ready
Ago 30 14:07:41 luiz-VirtualBox systemd[1]: Startup finished in 2.581s (kernel) + 57.511s (userspace) = 1m
in 92ms.
Ago 30 14:29:33 luiz-VirtualBox sudo[3362]:      luiz : TTY=pts/7 ; PWD=/ ; USER=root ; COMMAND=/bin/mkdir
-p /home/luiz/develop/kernel/hello-1
Ago 30 14:43:20 luiz-VirtualBox sudo[4478]:      luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/usr/bin/make
Ago 30 14:44:01 luiz-VirtualBox sudo[4571]:      luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/usr/bin/make
Ago 30 14:44:44 luiz-VirtualBox sudo[4689]:      luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/sbin/modinfo hello-1.ko
Ago 30 14:45:00 luiz-VirtualBox sudo[4709]:      luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/sbin/insmod hello-1.ko
Ago 30 14:45:00 luiz-VirtualBox kernel: hello_1: loading out-of-tree module taints kernel.
Ago 30 14:45:00 luiz-VirtualBox kernel: hello_1: module license 'unspecified' taints kernel.
Ago 30 14:45:00 luiz-VirtualBox kernel: Disabling lock debugging due to kernel taint
Ago 30 14:45:00 luiz-VirtualBox kernel: hello_1: module verification failed: signature and/or required key
missing - tainting kernel
Ago 30 14:45:00 luiz-VirtualBox kernel: Hello world 1.
Ago 30 14:45:16 luiz-VirtualBox sudo[4720]:      luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/bin/journalctl --since 1 hour ago
luiz@luiz-VirtualBox:~/develop/kernel/hello-1$
```

Hello-1 - Exclusão

```
luiz@luiz-VirtualBox: ~/develop/kernel/hello-1
Ago 30 14:07:00 luiz-VirtualBox kernel: IPv6: ADDRCONF(NETDEV_UP): enp0s3: link is not ready
Ago 30 14:07:00 luiz-VirtualBox kernel: e1000: enp0s3 NIC Link is Up 1000 Mbps Full Duplex, Flow Control: RX
Ago 30 14:07:00 luiz-VirtualBox kernel: IPv6: ADDRCONF(NETDEV_CHANGE): enp0s3: link becomes ready
Ago 30 14:07:41 luiz-VirtualBox systemd[1]: Startup finished in 2.581s (kernel) + 57.511s (userspace) = 1m
in 92ms.
Ago 30 14:29:33 luiz-VirtualBox sudo[3362]:      luiz : TTY=pts/7 ; PWD=/ ; USER=root ; COMMAND=/bin/mkdir
-p /home/luiz/develop/kernel/hello-1
Ago 30 14:43:20 luiz-VirtualBox sudo[4478]:      luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/usr/bin/make
Ago 30 14:44:01 luiz-VirtualBox sudo[4571]:      luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/usr/bin/make
Ago 30 14:44:44 luiz-VirtualBox sudo[4689]:      luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/sbin/modinfo hello-1.ko
Ago 30 14:45:00 luiz-VirtualBox sudo[4709]:      luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/sbin/insmod hello-1.ko
Ago 30 14:45:00 luiz-VirtualBox kernel: hello_1: loading out-of-tree module taints kernel.
Ago 30 14:45:00 luiz-VirtualBox kernel: hello_1: module license 'unspecified' taints kernel.
Ago 30 14:45:00 luiz-VirtualBox kernel: Disabling lock debugging due to kernel taint
Ago 30 14:45:00 luiz-VirtualBox kernel: hello_1: module verification failed: signature and/or required key
missing - tainting kernel
Ago 30 14:45:00 luiz-VirtualBox kernel: Hello world 1.
Ago 30 14:45:16 luiz-VirtualBox sudo[4720]:      luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/bin/journalctl --since 1 hour ago
Ago 30 14:45:45 luiz-VirtualBox sudo[4762]:      luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/sbin/rmmod hello_1
Ago 30 14:45:45 luiz-VirtualBox kernel: Goodbye world 1.
Ago 30 14:45:49 luiz-VirtualBox sudo[4765]:      luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/bin/journalctl --since 1 hour ago
luiz@luiz-VirtualBox:~/develop/kernel/hello-1$
```

Hello-2 - Inclusão

```
luiz@luiz-VirtualBox: ~/develop/kernel/hello-1
[  0.000000] kernel: hello_1: loading out-of-tree module taints kernel.
[  0.000000] kernel: hello_1: module license 'unspecified' taints kernel.
[  0.000000] kernel: Disabling lock debugging due to kernel taint
[  0.000000] kernel: hello_1: module verification failed: signature and/or required key
[  0.000000] kernel: missing - tainting kernel
[  0.000000] kernel: Hello world 1.
[  0.000000] luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
[  0.000000] USER=root ; COMMAND=/bin/journalctl --since 1 hour ago
[  0.000000] luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
[  0.000000] USER=root ; COMMAND=/sbin/rmmod hello_1
[  0.000000] luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 .
[  0.000000] luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
[  0.000000] USER=root ; COMMAND=/bin/journalctl --since 1 hour ago
[  0.000000] luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
[  0.000000] USER=root ; COMMAND=/usr/bin/make
[  0.000000] luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
[  0.000000] USER=root ; COMMAND=/sbin/modinfo hello2.ko
[  0.000000] luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
[  0.000000] USER=root ; COMMAND=/sbin/modinfo hello2.ko
[  0.000000] luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
[  0.000000] USER=root ; COMMAND=/sbin/modinfo hello-2.ko
[  0.000000] luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
[  0.000000] USER=root ; COMMAND=/sbin/modinfo hello-2.ko
[  0.000000] luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
[  0.000000] USER=root ; COMMAND=/sbin/insmod hello-2.ko
[  0.000000] luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
[  0.000000] USER=root ; COMMAND=/bin/journalctl --since 1 hour ago
[  0.000000] luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
[  0.000000] USER=root ; COMMAND=/sbin/rmmod hello_2
[  0.000000] luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 .
[  0.000000] luiz@luiz-VirtualBox:~/develop/kernel/hello-1$
```

Hello-2 - Exclusão

```
luiz@luiz-VirtualBox: ~/develop/kernel/hello-1
[  0.000000] kernel: hello_1: loading out-of-tree module taints kernel.
[  0.000000] kernel: hello_1: module license 'unspecified' taints kernel.
[  0.000000] kernel: Disabling lock debugging due to kernel taint
[  0.000000] kernel: hello_1: module verification failed: signature and/or required key
[  0.000000] kernel: missing - tainting kernel
[  0.000000] kernel: Hello world 1.
[  0.000000] luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
[  0.000000] USER=root ; COMMAND=/bin/journalctl --since 1 hour ago
[  0.000000] luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
[  0.000000] USER=root ; COMMAND=/sbin/rmmod hello_1
[  0.000000] luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 .
[  0.000000] luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
[  0.000000] USER=root ; COMMAND=/bin/journalctl --since 1 hour ago
[  0.000000] luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
[  0.000000] USER=root ; COMMAND=/usr/bin/make
[  0.000000] luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
[  0.000000] USER=root ; COMMAND=/sbin/modinfo hello2.ko
[  0.000000] luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
[  0.000000] USER=root ; COMMAND=/sbin/modinfo hello2.ko
[  0.000000] luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
[  0.000000] USER=root ; COMMAND=/sbin/modinfo hello-2.ko
[  0.000000] luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
[  0.000000] USER=root ; COMMAND=/sbin/modinfo hello-2.ko
[  0.000000] luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
[  0.000000] USER=root ; COMMAND=/sbin/insmod hello-2.ko
[  0.000000] luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
[  0.000000] USER=root ; COMMAND=/bin/journalctl --since 1 hour ago
[  0.000000] luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
[  0.000000] USER=root ; COMMAND=/sbin/rmmod hello_2
[  0.000000] luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 .
[  0.000000] luiz@luiz-VirtualBox:~/develop/kernel/hello-1$
```

Hello-2 - Inclusão

```
luiz@luiz-VirtualBox: ~/develop/kernel/hello-1
[1] 15:00
USER=root ; COMMAND=/bin/journalctl --since 1 hour ago
Ago 30 14:45:49 luiz-VirtualBox sudo[4765]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/usr/bin/make
Ago 30 14:48:02 luiz-VirtualBox sudo[4847]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/sbin/modinfo hello2.ko
Ago 30 14:48:43 luiz-VirtualBox sudo[5000]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/sbin/modinfo hello2.ko
Ago 30 14:48:53 luiz-VirtualBox sudo[5002]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/sbin/modinfo hello2.ko
Ago 30 14:49:01 luiz-VirtualBox sudo[5018]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/sbin/modinfo hello-2.ko
Ago 30 14:49:22 luiz-VirtualBox sudo[5064]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/sbin/insmod hello-2.ko
Ago 30 14:49:22 luiz-VirtualBox kernel: Hello, world 2
Ago 30 14:49:46 luiz-VirtualBox sudo[5081]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/bin/journalctl --since 1 hour ago
Ago 30 14:50:17 luiz-VirtualBox sudo[5119]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/sbin/rmmod hello_2
Ago 30 14:50:17 luiz-VirtualBox kernel: Goodbye, world 2
Ago 30 14:53:23 luiz-VirtualBox sudo[5541]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/usr/bin/gedit hello-3.c
Ago 30 14:57:53 luiz-VirtualBox sudo[5592]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/usr/bin/gedit Makefile
Ago 30 14:58:17 luiz-VirtualBox sudo[5736]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/usr/bin/make
Ago 30 14:59:01 luiz-VirtualBox sudo[5841]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/sbin/insmod hello-3.ko
Ago 30 14:59:01 luiz-VirtualBox kernel: Hello, world 3
Ago 30 14:59:54 luiz-VirtualBox sudo[5926]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/bin/journalctl --since 1 hour ago
luiz@luiz-VirtualBox:~/develop/kernel/hello-1$
```

Hello-3 - Exclusão

```
root@luiz-VirtualBox: /home/luiz/develop/kernel/hello-1
[1] 15:01
USER=root ; COMMAND=/sbin/modinfo hello2.ko
Ago 30 14:48:53 luiz-VirtualBox sudo[5002]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/sbin/modinfo hello2.ko
Ago 30 14:49:01 luiz-VirtualBox sudo[5018]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/sbin/modinfo hello-2.ko
Ago 30 14:49:22 luiz-VirtualBox sudo[5064]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/sbin/insmod hello-2.ko
Ago 30 14:49:22 luiz-VirtualBox kernel: Hello, world 2
Ago 30 14:49:46 luiz-VirtualBox sudo[5081]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/bin/journalctl --since 1 hour ago
Ago 30 14:50:17 luiz-VirtualBox sudo[5119]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/sbin/rmmod hello_2
Ago 30 14:50:17 luiz-VirtualBox kernel: Goodbye, world 2
Ago 30 14:53:23 luiz-VirtualBox sudo[5541]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/usr/bin/gedit hello-3.c
Ago 30 14:57:53 luiz-VirtualBox sudo[5592]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/usr/bin/gedit Makefile
Ago 30 14:58:17 luiz-VirtualBox sudo[5736]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/usr/bin/make
Ago 30 14:59:01 luiz-VirtualBox sudo[5841]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/sbin/insmod hello-3.ko
Ago 30 14:59:01 luiz-VirtualBox kernel: Hello, world 3
Ago 30 14:59:54 luiz-VirtualBox sudo[5926]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/bin/journalctl --since 1 hour ago
Ago 30 15:00:42 luiz-VirtualBox sudo[5990]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/sbin/rmmod hello_3
Ago 30 15:00:42 luiz-VirtualBox kernel: Goodbye, world 3
Ago 30 15:00:50 luiz-VirtualBox sudo[5995]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/bin/su
root@luiz-VirtualBox:/home/luiz/develop/kernel/hello-1#
```

Hello-4 - Inclusão

```
root@luiz-VirtualBox: /home/luiz/develop/kernel/hello-4
Ago 30 14:48:53 luiz-VirtualBox sudo[5002]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/sbin/modinfo hello2.ko
Ago 30 14:49:01 luiz-VirtualBox sudo[5018]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/sbin/modinfo hello-2.ko
Ago 30 14:49:22 luiz-VirtualBox sudo[5064]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/sbin/insmod hello-2.ko
Ago 30 14:49:22 luiz-VirtualBox kernel: Hello, world 2
Ago 30 14:49:46 luiz-VirtualBox sudo[5081]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/bin/journalctl --since 1 hour ago
Ago 30 14:50:17 luiz-VirtualBox sudo[5119]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/sbin/rmmod hello_2
Ago 30 14:50:17 luiz-VirtualBox kernel: Goodbye, world 2
Ago 30 14:53:23 luiz-VirtualBox sudo[5541]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/usr/bin/gedit hello-3.c
Ago 30 14:57:53 luiz-VirtualBox sudo[5592]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/usr/bin/gedit Makefile
Ago 30 14:58:17 luiz-VirtualBox sudo[5736]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/usr/bin/make
Ago 30 14:59:01 luiz-VirtualBox sudo[5841]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/sbin/insmod hello-3.ko
Ago 30 14:59:01 luiz-VirtualBox kernel: Hello, world 3
Ago 30 14:59:54 luiz-VirtualBox sudo[5926]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/bin/journalctl --since 1 hour ago
*Ago 30 15:00:42 luiz-VirtualBox sudo[5990]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/sbin/rmmod hello_3
Ago 30 15:00:42 luiz-VirtualBox kernel: Goodbye, world 3
Ago 30 15:00:50 luiz-VirtualBox sudo[5995]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/bin/su
Ago 30 15:07:56 luiz-VirtualBox kernel: Hello, world 4
root@luiz-VirtualBox:/home/luiz/develop/kernel/hello-4#
```

Hello-4 - Exclusão

```
root@luiz-VirtualBox: /home/luiz/develop/kernel/hello-4
USER=root ; COMMAND=/sbin/modinfo hello2.ko
Ago 30 14:49:01 luiz-VirtualBox sudo[5018]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/sbin/modinfo hello-2.ko
Ago 30 14:49:22 luiz-VirtualBox sudo[5064]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/sbin/insmod hello-2.ko
Ago 30 14:49:22 luiz-VirtualBox kernel: Hello, world 2
Ago 30 14:49:46 luiz-VirtualBox sudo[5081]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/bin/journalctl --since 1 hour ago
Ago 30 14:50:17 luiz-VirtualBox sudo[5119]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/sbin/rmmod hello_2
Ago 30 14:50:17 luiz-VirtualBox kernel: Goodbye, world 2
Ago 30 14:53:23 luiz-VirtualBox sudo[5541]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/usr/bin/gedit hello-3.c
Ago 30 14:57:53 luiz-VirtualBox sudo[5592]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/usr/bin/gedit Makefile
Ago 30 14:58:17 luiz-VirtualBox sudo[5736]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/usr/bin/make
Ago 30 14:59:01 luiz-VirtualBox sudo[5841]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/sbin/insmod hello-3.ko
Ago 30 14:59:01 luiz-VirtualBox kernel: Hello, world 3
Ago 30 14:59:54 luiz-VirtualBox sudo[5926]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/bin/journalctl --since 1 hour ago
Ago 30 15:00:42 luiz-VirtualBox sudo[5990]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/sbin/rmmod hello_3
Ago 30 15:00:42 luiz-VirtualBox kernel: Goodbye, world 3
Ago 30 15:00:50 luiz-VirtualBox sudo[5995]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/bin/su
Ago 30 15:07:56 luiz-VirtualBox kernel: Hello, world 4
Ago 30 15:09:16 luiz-VirtualBox kernel: Goodbye, world 4
root@luiz-VirtualBox:/home/luiz/develop/kernel/hello-4#
```

Hello-5 - Inclusão, é possível verificar os *settings* realizados na passagem de parâmetros.

```
root@luiz-VirtualBox: /home/luiz/develop/kernel/hello-4
[  ] 15:18
 Ago 30 14:50:17 luiz-VirtualBox kernel: Goodbye, world 2
 Ago 30 14:53:23 luiz-VirtualBox sudo[5541]:      luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
 USER=root ; COMMAND=/usr/bin/gedit hello-3.c
 Ago 30 14:57:53 luiz-VirtualBox sudo[5592]:      luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
 USER=root ; COMMAND=/usr/bin/gedit Makefile
 Ago 30 14:58:17 luiz-VirtualBox sudo[5736]:      luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
 USER=root ; COMMAND=/usr/bin/make
 Ago 30 14:59:01 luiz-VirtualBox sudo[5841]:      luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
 USER=root ; COMMAND=/sbin/insmod hello-3.ko
 Ago 30 14:59:01 luiz-VirtualBox kernel: Hello, world 3
 Ago 30 14:59:54 luiz-VirtualBox sudo[5926]:      luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
 USER=root ; COMMAND=/bin/journalctl --since 1 hour ago
 Ago 30 15:00:42 luiz-VirtualBox sudo[5990]:      luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
 USER=root ; COMMAND=/sbin/rmmod hello_3
 Ago 30 15:00:42 luiz-VirtualBox kernel: Goodbye, world 3
 Ago 30 15:00:50 luiz-VirtualBox sudo[5995]:      luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
 USER=root ; COMMAND=/bin/su
 Ago 30 15:07:56 luiz-VirtualBox kernel: Hello, world 4
 Ago 30 15:09:16 luiz-VirtualBox kernel: Goodbye, world 4
 Ago 30 15:17:16 luiz-VirtualBox kernel: hello_5: unknown parameter 'mybyte' ignored
 Ago 30 15:17:16 luiz-VirtualBox kernel: Hello, world 5
 Ago 30 15:17:16 luiz-VirtualBox kernel: myshort is a short integer: 1
 Ago 30 15:17:16 luiz-VirtualBox kernel: myint is an integer: 420
 Ago 30 15:17:16 luiz-VirtualBox kernel: mylong is a long integer: 9999
 Ago 30 15:17:16 luiz-VirtualBox kernel: mystring is a string: bebop
 Ago 30 15:17:16 luiz-VirtualBox kernel: myIntArray[0] = -1
 Ago 30 15:17:16 luiz-VirtualBox kernel: myIntArray[1] = -1
 Ago 30 15:17:16 luiz-VirtualBox kernel: got 1 arguments for myIntArray.
root@luiz-VirtualBox:/home/luiz/develop/kernel/hello-4# gedit hello-5.c
```

Hello-5 - Exclusão

```
root@luiz-VirtualBox: /home/luiz/develop/kernel/hello-4
[  ] 15:18
 Ago 30 14:50:17 luiz-VirtualBox kernel: Goodbye, world 2
 Ago 30 14:53:23 luiz-VirtualBox sudo[5541]:      luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
 USER=root ; COMMAND=/usr/bin/gedit hello-3.c
 Ago 30 14:57:53 luiz-VirtualBox sudo[5592]:      luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
 USER=root ; COMMAND=/usr/bin/gedit Makefile
 Ago 30 14:58:17 luiz-VirtualBox sudo[5736]:      luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
 USER=root ; COMMAND=/usr/bin/make
 Ago 30 14:59:01 luiz-VirtualBox sudo[5841]:      luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
 USER=root ; COMMAND=/sbin/insmod hello-3.ko
 Ago 30 14:59:01 luiz-VirtualBox kernel: Hello, world 3
 Ago 30 14:59:54 luiz-VirtualBox sudo[5926]:      luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
 USER=root ; COMMAND=/bin/journalctl --since 1 hour ago
 Ago 30 15:00:42 luiz-VirtualBox sudo[5990]:      luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
 USER=root ; COMMAND=/sbin/rmmod hello_3
 Ago 30 15:00:42 luiz-VirtualBox kernel: Goodbye, world 3
 Ago 30 15:00:50 luiz-VirtualBox sudo[5995]:      luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
 USER=root ; COMMAND=/bin/su
 Ago 30 15:07:56 luiz-VirtualBox kernel: Hello, world 4
 Ago 30 15:09:16 luiz-VirtualBox kernel: Goodbye, world 4
 Ago 30 15:17:16 luiz-VirtualBox kernel: hello_5: unknown parameter 'mybyte' ignored
 Ago 30 15:17:16 luiz-VirtualBox kernel: Hello, world 5
 Ago 30 15:17:16 luiz-VirtualBox kernel: myshort is a short integer: 1
 Ago 30 15:17:16 luiz-VirtualBox kernel: myint is an integer: 420
 Ago 30 15:17:16 luiz-VirtualBox kernel: mylong is a long integer: 9999
 Ago 30 15:17:16 luiz-VirtualBox kernel: mystring is a string: bebop
 Ago 30 15:17:16 luiz-VirtualBox kernel: myIntArray[0] = -1
 Ago 30 15:17:16 luiz-VirtualBox kernel: myIntArray[1] = -1
 Ago 30 15:17:16 luiz-VirtualBox kernel: got 1 arguments for myIntArray.
 Ago 30 15:18:42 luiz-VirtualBox kernel: Goodbye, world 5
root@luiz-VirtualBox:/home/luiz/develop/kernel/hello-4#
```

StartStop - Inclusão

```
root@luiz-VirtualBox:/home/luiz/develop/kernel/hello-1
[1] 11:14:53:23 luiz-VirtualBox sudo[5541]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/usr/bin/gedit hello-3.c
[2] 11:14:57:53 luiz-VirtualBox sudo[5592]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/usr/bin/gedit Makefile
[3] 11:14:58:17 luiz-VirtualBox sudo[5736]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/usr/bin/make
[4] 11:14:59:01 luiz-VirtualBox sudo[5841]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/sbin/insmod hello_3.ko
[5] 11:14:59:01 luiz-VirtualBox kernel: Hello, world 3
[6] 11:14:59:54 luiz-VirtualBox sudo[5926]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/bin/journalctl --since 1 hour ago
[7] 11:15:00:42 luiz-VirtualBox sudo[5990]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/sbin/rmmod hello_3
[8] 11:15:00:42 luiz-VirtualBox kernel: Goodbye, world 3
[9] 11:15:00:50 luiz-VirtualBox sudo[5995]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/bin/su
[10] 11:15:07:56 luiz-VirtualBox kernel: Hello, world 4
[11] 11:15:09:16 luiz-VirtualBox kernel: Goodbye, world 4
[12] 11:15:17:16 luiz-VirtualBox kernel: hello_5: unknown parameter 'mybyte' ignored
[13] 11:15:17:16 luiz-VirtualBox kernel: Hello, world 5
[14] 11:15:17:16 luiz-VirtualBox kernel: myshort is a short integer: 1
[15] 11:15:17:16 luiz-VirtualBox kernel: myint is an integer: 420
[16] 11:15:17:16 luiz-VirtualBox kernel: mylong is a long integer: 9999
[17] 11:15:17:16 luiz-VirtualBox kernel: mystring is a string: bebop
[18] 11:15:17:16 luiz-VirtualBox kernel: myIntArray[0] = -1
[19] 11:15:17:16 luiz-VirtualBox kernel: myIntArray[1] = -1
[20] 11:15:17:16 luiz-VirtualBox kernel: got 1 arguments for myIntArray.
[21] 11:15:18:42 luiz-VirtualBox kernel: Goodbye, world 5
[22] 11:15:34:52 luiz-VirtualBox kernel: Hello, world - this is the kernel speaking
root@luiz-VirtualBox:/home/luiz/develop/kernel/hello-1#
```

StartStop - Exclusão

```
root@luiz-VirtualBox:/home/luiz/develop/kernel/hello-1
[1] 11:14:57:53 luiz-VirtualBox sudo[5592]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/usr/bin/gedit hello-3.c
[2] 11:14:58:17 luiz-VirtualBox sudo[5736]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/usr/bin/make
[3] 11:14:59:01 luiz-VirtualBox sudo[5841]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/sbin/insmod hello_3.ko
[4] 11:14:59:01 luiz-VirtualBox kernel: Hello, world 3
[5] 11:14:59:54 luiz-VirtualBox sudo[5926]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/bin/journalctl --since 1 hour ago
[6] 11:15:00:42 luiz-VirtualBox sudo[5990]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/sbin/rmmod hello_3
[7] 11:15:00:42 luiz-VirtualBox kernel: Goodbye, world 3
[8] 11:15:00:50 luiz-VirtualBox sudo[5995]:    luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/bin/su
[9] 11:15:07:56 luiz-VirtualBox kernel: Hello, world 4
[10] 11:15:09:16 luiz-VirtualBox kernel: Goodbye, world 4
[11] 11:15:17:16 luiz-VirtualBox kernel: hello_5: unknown parameter 'mybyte' ignored
[12] 11:15:17:16 luiz-VirtualBox kernel: Hello, world 5
[13] 11:15:17:16 luiz-VirtualBox kernel: myshort is a short integer: 1
[14] 11:15:17:16 luiz-VirtualBox kernel: myint is an integer: 420
[15] 11:15:17:16 luiz-VirtualBox kernel: mylong is a long integer: 9999
[16] 11:15:17:16 luiz-VirtualBox kernel: mystring is a string: bebop
[17] 11:15:17:16 luiz-VirtualBox kernel: myIntArray[0] = -1
[18] 11:15:17:16 luiz-VirtualBox kernel: myIntArray[1] = -1
[19] 11:15:17:16 luiz-VirtualBox kernel: got 1 arguments for myIntArray.
[20] 11:15:18:42 luiz-VirtualBox kernel: Goodbye, world 5
[21] 11:15:34:52 luiz-VirtualBox kernel: Hello, world - this is the kernel speaking
[22] 11:15:36:27 luiz-VirtualBox kernel: Short is the life of a kernel module
root@luiz-VirtualBox:/home/luiz/develop/kernel/hello-1#
```

Chardev - Inclusão, conferência com o comando `cat proc/chardev`

```
root@luiz-VirtualBox:/home/luiz/develop/kernel/chardev
Ago 30 15:48:17 luiz-VirtualBox kernel: chardev: Unknown symbol class_destroy (err 0)
Ago 30 15:48:17 luiz-VirtualBox kernel: chardev: Unknown symbol device_create (err 0)
Ago 30 15:48:17 luiz-VirtualBox kernel: chardev: Unknown symbol device_destroy (err 0)
Ago 30 15:50:14 luiz-VirtualBox kernel: chardev: Unknown symbol __class_create (err 0)
Ago 30 15:50:14 luiz-VirtualBox kernel: chardev: Unknown symbol class_destroy (err 0)
Ago 30 15:50:14 luiz-VirtualBox kernel: chardev: Unknown symbol device_create (err 0)
Ago 30 15:50:14 luiz-VirtualBox kernel: chardev: Unknown symbol device_destroy (err 0)
Ago 30 15:50:31 luiz-VirtualBox kernel: chardev: Unknown symbol __class_create (err 0)
Ago 30 15:50:31 luiz-VirtualBox kernel: chardev: Unknown symbol class_destroy (err 0)
Ago 30 15:50:31 luiz-VirtualBox kernel: chardev: Unknown symbol device_create (err 0)
Ago 30 15:50:31 luiz-VirtualBox kernel: chardev: Unknown symbol device_destroy (err 0)
Ago 30 15:56:25 luiz-VirtualBox kernel: chardev: Unknown symbol __class_create (err 0)
Ago 30 15:56:25 luiz-VirtualBox kernel: chardev: Unknown symbol class_destroy (err 0)
Ago 30 15:56:25 luiz-VirtualBox kernel: chardev: Unknown symbol device_create (err 0)
Ago 30 16:03:08 luiz-VirtualBox kernel: chardev: Unknown symbol __class_create (err 0)
Ago 30 16:03:08 luiz-VirtualBox kernel: chardev: Unknown symbol class_destroy (err 0)
Ago 30 16:03:08 luiz-VirtualBox kernel: chardev: Unknown symbol device_create (err 0)
Ago 30 16:03:08 luiz-VirtualBox kernel: chardev: Unknown symbol device_destroy (err 0)
Ago 30 16:03:12 luiz-VirtualBox kernel: chardev: Unknown symbol __class_create (err 0)
Ago 30 16:03:12 luiz-VirtualBox kernel: chardev: Unknown symbol class_destroy (err 0)
Ago 30 16:03:12 luiz-VirtualBox kernel: chardev: Unknown symbol device_create (err 0)
Ago 30 16:03:12 luiz-VirtualBox kernel: chardev: Unknown symbol device_destroy (err 0)
Ago 30 16:07:08 luiz-VirtualBox kernel: chardev: Unknown symbol __class_create (err 0)
Ago 30 16:07:08 luiz-VirtualBox kernel: chardev: Unknown symbol class_destroy (err 0)
Ago 30 16:07:08 luiz-VirtualBox kernel: chardev: Unknown symbol device_create (err 0)
Ago 30 16:07:08 luiz-VirtualBox kernel: chardev: Unknown symbol device_destroy (err 0)
Ago 30 16:11:06 luiz-VirtualBox kernel: I was assigned major number 243.
Ago 30 16:11:06 luiz-VirtualBox kernel: Device created on /dev/chardev
root@luiz-VirtualBox:/home/luiz/develop/kernel/chardev#
```

Chardev - Conferência com o comando `cat proc/chardev`

```
root@luiz-VirtualBox:/home/luiz/develop/kernel/chardev
7 vcs
10 misc
13 input
21 sg
29 fb
89 i2c
99 ppdev
108 ppp
116 alsa
128 ptm
136 pts
180 usb
189 usb_device
204 ttyMAX
226 drm
244 hidraw
245 aux
246 bsg
247 hmm device
248 watchdog
249 rtc
250 dax
251 dimmctl
252 ndctl
253 tpm
254 gpiochip
Block devices:
 7 loop
 8 sd
```

Procfs1- Inclusão

```
root@luiz-VirtualBox:/home/luiz/develop/kernel/procfs1# Ago 30 15:50:31 luiz-VirtualBox kernel: chardev: Unknown symbol class_destroy (err 0)
Ago 30 15:50:31 luiz-VirtualBox kernel: chardev: Unknown symbol device_create (err 0)
Ago 30 15:56:25 luiz-VirtualBox kernel: chardev: Unknown symbol device_destroy (err 0)
Ago 30 15:56:25 luiz-VirtualBox kernel: chardev: Unknown symbol __class_create (err 0)
Ago 30 15:56:25 luiz-VirtualBox kernel: chardev: Unknown symbol class_destroy (err 0)
Ago 30 15:56:25 luiz-VirtualBox kernel: chardev: Unknown symbol device_create (err 0)
Ago 30 15:56:25 luiz-VirtualBox kernel: chardev: Unknown symbol device_destroy (err 0)
Ago 30 16:03:08 luiz-VirtualBox kernel: chardev: Unknown symbol __class_create (err 0)
Ago 30 16:03:08 luiz-VirtualBox kernel: chardev: Unknown symbol class_destroy (err 0)
Ago 30 16:03:08 luiz-VirtualBox kernel: chardev: Unknown symbol device_create (err 0)
Ago 30 16:03:08 luiz-VirtualBox kernel: chardev: Unknown symbol device_destroy (err 0)
Ago 30 16:03:12 luiz-VirtualBox kernel: chardev: Unknown symbol __class_create (err 0)
Ago 30 16:03:12 luiz-VirtualBox kernel: chardev: Unknown symbol class_destroy (err 0)
Ago 30 16:03:12 luiz-VirtualBox kernel: chardev: Unknown symbol device_create (err 0)
Ago 30 16:07:08 luiz-VirtualBox kernel: chardev: Unknown symbol __class_create (err 0)
Ago 30 16:07:08 luiz-VirtualBox kernel: chardev: Unknown symbol class_destroy (err 0)
Ago 30 16:07:08 luiz-VirtualBox kernel: chardev: Unknown symbol device_create (err 0)
Ago 30 16:07:08 luiz-VirtualBox kernel: chardev: Unknown symbol device_destroy (err 0)
Ago 30 16:11:06 luiz-VirtualBox kernel: I was assigned major number 243.
Ago 30 16:11:06 luiz-VirtualBox kernel: Device created on /dev/chardev
Ago 30 16:12:12 luiz-VirtualBox sudo[9798]:    luiz : TTY=pts/7 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/bin/su
Ago 30 16:17:02 luiz-VirtualBox kernel: kauditd_printk_skb: 11 callbacks suppressed
Ago 30 16:17:02 luiz-VirtualBox kernel: audit: type=1400 audit(1598815022.145:23): apparmor="DENIED" operation="open" profile="/usr/bin/evince" name="/home/luiz/.config/dconf/user" pid=3280 comm="evince" requested_mask="r" denied_mask="r" fsuid=1000 ouid=0
Ago 30 16:35:58 luiz-VirtualBox kernel: /proc/helloworld created
Ago 30 16:36:32 luiz-VirtualBox kernel: procfile read helloworld
root@luiz-VirtualBox:/home/luiz/develop/kernel/procfs1#
```

Procfs1- Conferência de funcionamento

```
root@luiz-VirtualBox:/home/luiz/develop/kernel/procfs1# d_mask="r" denied_mask="r" fsuid=1000 ouid=0
Ago 30 16:35:58 luiz-VirtualBox kernel: /proc/helloworld created
root@luiz-VirtualBox:/home/luiz/develop/kernel/procfs1# cat /proc
cat: /proc: Is a directory
root@luiz-VirtualBox:/home/luiz/develop/kernel/procfs1# cat /proc/helloworld
HelloWorld!
root@luiz-VirtualBox:/home/luiz/develop/kernel/procfs1# ls /proc
  1      12     1420   1778   2      2561   3280   5128   698    9800      interrupts      partitions
  10     1211   1427   1789   20     2562   3288   5163   699    9813      iomem        sched_debug
  100    1236   15     18     200    2563   33     5220   7      9835      ioports      schedstat
  10097  1244   1598   1802   201    2564   34     5276   701    99       irq         scsi
  101    1246   16     1812   202    2565   36     53     705    acpi      kallsyms      self
  10184  1250   1604   1819   203    2566   37     5309   721    asound      kcore        slabinfo
  102    1252   1608   1865   204    257    3748   5357   7282    buddyinfo      softirqs
  10296  1270   1635   1868   2088   26     38     54     7839    bus       key-users      stat
  103    1277   1636   1874   2095   2699   39     55     7840    cgroups      kmssg
  10308  1284   1637   1884   2099   27     4      5548   8      cmdline      kpagegroup
  1070   1286   1638   1888   21     2761   40     5549   811    consoles      kpagecount
  1075   1288   1639   1895   2106   28     41     5552   817    cpufreq      kpageflags
  1076   1298   1640   19     2179   299    42     5890   848    crypto       loadavg      thread-self
  1079   13      1641   1907   22     30     43     5995   853    devices      locks
  109    1300   1642   1910   227    3030   439    5996   876    diskstats      mdstat      timer_list
  10951  136    1643   1912   228    3041   44     5997   8793    dma      meminfo      tty
  11     1392   1658   1924   238    3043   45     6      9      driver      misc
  1153   1394   1718   194    24     31     46     6060   934    execdomains      modules      uptime
  1160   1396   1719   1948   2465   3128   47     670    9788    fb      mounts      version
  119    14     1728   196    25     3135   4771   686    9798    filesystems      mtrr      vmallocinfo
  1190   1409   1740   1962   2559   32     48     687    9799    fs      net      vmstat
  1198   1412   1763   1988   2560   323    49     690    98     helloworld      pagetypeinfo      zoneinfo
root@luiz-VirtualBox:/home/luiz/develop/kernel/procfs1#
```

É possível perceber que, ao executarmos uma leitura do arquivo *helloworld* criado no caminho */proc/*, ele retorna *HelloWorld!*, além de ser possível realizar a verificação visual do arquivo na pasta */proc*.

Procfs1- Exclusão

```
root@luiz-VirtualBox:/home/luiz/develop/kernel/procfs1
Ago 30 15:50:31 luiz-VirtualBox kernel: chardev: Unknown symbol device_create (err 0)
Ago 30 15:50:31 luiz-VirtualBox kernel: chardev: Unknown symbol device_destroy (err 0)
Ago 30 15:56:25 luiz-VirtualBox kernel: chardev: Unknown symbol __class_create (err 0)
Ago 30 15:56:25 luiz-VirtualBox kernel: chardev: Unknown symbol class_destroy (err 0)
Ago 30 15:56:25 luiz-VirtualBox kernel: chardev: Unknown symbol device_create (err 0)
Ago 30 15:56:25 luiz-VirtualBox kernel: chardev: Unknown symbol device_destroy (err 0)
Ago 30 16:03:08 luiz-VirtualBox kernel: chardev: Unknown symbol __class_create (err 0)
Ago 30 16:03:08 luiz-VirtualBox kernel: chardev: Unknown symbol class_destroy (err 0)
Ago 30 16:03:08 luiz-VirtualBox kernel: chardev: Unknown symbol device_create (err 0)
Ago 30 16:03:08 luiz-VirtualBox kernel: chardev: Unknown symbol device_destroy (err 0)
Ago 30 16:03:12 luiz-VirtualBox kernel: chardev: Unknown symbol __class_create (err 0)
Ago 30 16:03:12 luiz-VirtualBox kernel: chardev: Unknown symbol class_destroy (err 0)
Ago 30 16:03:12 luiz-VirtualBox kernel: chardev: Unknown symbol device_create (err 0)
Ago 30 16:03:12 luiz-VirtualBox kernel: chardev: Unknown symbol device_destroy (err 0)
Ago 30 16:07:08 luiz-VirtualBox kernel: chardev: Unknown symbol __class_create (err 0)
Ago 30 16:07:08 luiz-VirtualBox kernel: chardev: Unknown symbol class_destroy (err 0)
Ago 30 16:07:08 luiz-VirtualBox kernel: chardev: Unknown symbol device_create (err 0)
Ago 30 16:07:08 luiz-VirtualBox kernel: chardev: Unknown symbol device_destroy (err 0)
Ago 30 16:07:08 luiz-VirtualBox kernel: I was assigned major number 243.
Ago 30 16:11:06 luiz-VirtualBox kernel: Device created on /dev/chardev
Ago 30 16:12:12 luiz-VirtualBox sudo[9798]:    luiz : TTY=pts/7 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/bin/su
Ago 30 16:17:02 luiz-VirtualBox kernel: kauditd_printk_skb: 11 callbacks suppressed
Ago 30 16:17:02 luiz-VirtualBox kernel: audit: type=1400 audit(1598815022.145:23): apparmor="DENIED" operation="open" profile="/usr/bin/evince" name="/home/luiz/.config/dconf/user" pid=3280 comm="evince" requested_mask="r" denied_mask="r" fsuid=1000 ouid=0
Ago 30 16:35:58 luiz-VirtualBox kernel: /proc/helloworld created
Ago 30 16:36:32 luiz-VirtualBox kernel: procfile read helloworld
Ago 30 16:38:52 luiz-VirtualBox kernel: /proc/helloworld removed
root@luiz-VirtualBox:/home/luiz/develop/kernel/procfs1#
```

Procfs2- Inclusão

```
root@luiz-VirtualBox:/home/luiz/develop/kernel/procfs2
Ago 30 15:56:25 luiz-VirtualBox kernel: chardev: Unknown symbol device_destroy (err 0)
Ago 30 16:03:08 luiz-VirtualBox kernel: chardev: Unknown symbol __class_create (err 0)
Ago 30 16:03:08 luiz-VirtualBox kernel: chardev: Unknown symbol class_destroy (err 0)
Ago 30 16:03:08 luiz-VirtualBox kernel: chardev: Unknown symbol device_create (err 0)
Ago 30 16:03:08 luiz-VirtualBox kernel: chardev: Unknown symbol device_destroy (err 0)
Ago 30 16:03:12 luiz-VirtualBox kernel: chardev: Unknown symbol __class_create (err 0)
Ago 30 16:03:12 luiz-VirtualBox kernel: chardev: Unknown symbol class_destroy (err 0)
Ago 30 16:03:12 luiz-VirtualBox kernel: chardev: Unknown symbol device_create (err 0)
Ago 30 16:03:12 luiz-VirtualBox kernel: chardev: Unknown symbol device_destroy (err 0)
Ago 30 16:07:08 luiz-VirtualBox kernel: chardev: Unknown symbol __class_create (err 0)
Ago 30 16:07:08 luiz-VirtualBox kernel: chardev: Unknown symbol class_destroy (err 0)
Ago 30 16:07:08 luiz-VirtualBox kernel: chardev: Unknown symbol device_create (err 0)
Ago 30 16:07:08 luiz-VirtualBox kernel: chardev: Unknown symbol device_destroy (err 0)
Ago 30 16:07:08 luiz-VirtualBox kernel: I was assigned major number 243.
Ago 30 16:11:06 luiz-VirtualBox kernel: Device created on /dev/chardev
Ago 30 16:12:12 luiz-VirtualBox sudo[9798]:    luiz : TTY=pts/7 ; PWD=/home/luiz/develop/kernel/hello-1 ;
USER=root ; COMMAND=/bin/su
Ago 30 16:17:02 luiz-VirtualBox kernel: kauditd_printk_skb: 11 callbacks suppressed
Ago 30 16:17:02 luiz-VirtualBox kernel: audit: type=1400 audit(1598815022.145:23): apparmor="DENIED" operation="open" profile="/usr/bin/evince" name="/home/luiz/.config/dconf/user" pid=3280 comm="evince" requested_mask="r" denied_mask="r" fsuid=1000 ouid=0
Ago 30 16:35:58 luiz-VirtualBox kernel: /proc/helloworld created
Ago 30 16:36:32 luiz-VirtualBox kernel: procfile read helloworld
Ago 30 16:38:52 luiz-VirtualBox kernel: /proc/helloworld removed
Ago 30 16:41:12 luiz-VirtualBox kernel: audit: type=1400 audit(1598816472.856:24): apparmor="DENIED" operation="open" profile="/usr/bin/evince" name="/home/luiz/.config/dconf/user" pid=3280 comm="evince" requested_mask="r" denied_mask="r" fsuid=1000 ouid=0
Ago 30 16:45:07 luiz-VirtualBox kernel: /proc/buffer1k created
Ago 30 16:45:35 luiz-VirtualBox kernel: procfile read buffer1k
root@luiz-VirtualBox:/home/luiz/develop/kernel/procfs2#
```

Procfs2- Conferência de inclusão

```
root@luiz-VirtualBox:/home/luiz/develop/kernel/procfs2# cat /proc/buffer1k
d_mask="r" denied_mask="r" fsuid=1000 ouid=0
Ago 30 16:45:07 luiz-VirtualBox kernel: /proc/buffer1k created
root@luiz-VirtualBox:/home/luiz/develop/kernel/procfs2# cat /proc/buffer1k
HelloWorld!
root@luiz-VirtualBox:/home/luiz/develop/kernel/procfs2# ls /proc
1/    1190/ 1420/ 18/   202/ 257/ 4/   5890/ 8793/  driver/   mtrr
10/   1198/ 1427/ 1802/ 203/ 26/   40/   5995/ 9/   execdomains  net@
100/   12/   15/   1812/ 204/ 2699/ 41/   5996/ 934/   fb       pagetypeinfo
10097/ 1211/ 1598/ 1819/ 2088/ 27/   42/   5997/ 9788/   filesystems partitions
101/   1236/ 16/   1865/ 2095/ 2761/ 43/   6/   9798/   fs/      sched_debug
10184/ 1244/ 1604/ 1868/ 2099/ 28/   439/  6060/ 9799/   interrupts  schedstat
102/   1246/ 1608/ 1874/ 21/   299/  44/   670/   98/   iomem    scsi/
10296/ 1250/ 1635/ 1884/ 2106/ 30/   45/   686/  9800/   ioports  self@
103/   1252/ 1636/ 1888/ 2179/ 3030/ 46/   687/  9813/   irq/     slabinfo
10308/ 1270/ 1637/ 1895/ 22/   3041/ 47/   690/  9835/   kallsyms softirqs
1070/   1277/ 1638/ 19/   227/  3043/ 4771/ 698/   99/   kcore    stat
1075/   1284/ 1639/ 1907/ 228/   31/   48/   699/   acpi/   keys    swaps
1076/   1286/ 1640/ 1910/ 238/   3128/ 49/   7/    asound/  key-users sys/
1079/   1288/ 1641/ 1912/ 24/   3135/ 5163/ 701/   buddyinfo kmsg   sysrq-trigger
109/   1298/ 1642/ 1924/ 2465/ 32/   5220/ 705/   buffer1k kpagecgroup thread-self@
10991/ 13/   1643/ 194/   25/   323/  5276/ 721/   bus/     kpagecount kpageflags timer_list
11/   1300/ 1658/ 1948/ 2559/ 3280/ 53/   7282/   cgroups  kpagemflags loadavg
11122/ 136/   1718/ 196/   2560/ 3288/ 5309/ 7839/   cmdline  kpagemflags tty/
11166/ 1392/ 1719/ 1962/ 2561/ 33/   5357/ 8/    consoles locks   uptime
1153/   1394/ 1728/ 1988/ 2562/ 34/   54/   811/   cpuinfo mdstat version
1160/   1396/ 1740/ 2/    2563/ 36/   55/   817/   crypto meminfo version_signature
11862/ 14/   1763/ 20/   2564/ 37/   5548/ 848/   devices misc   vmallocinfo
11899/ 1409/ 1778/ 200/  2565/ 38/   5549/ 853/   diskstats modules vmstat
119/   1412/ 1789/ 201/  2566/ 39/   5552/ 876/   dma    mounts@ zoneinfo
root@luiz-VirtualBox:/home/luiz/develop/kernel/procfs2#
```

Podemos visualizar o arquivo *buffer1k* criado na pasta */proc*, bem como o resultado do comando *cat /proc/buffer1k*.

Procfs2- Exclusão e conferência

```
root@luiz-VirtualBox:/home/luiz/develop/kernel/procfs2#
Ago 30 16:45:07 luiz-VirtualBox kernel: /proc/buffer1k created
Ago 30 16:45:35 luiz-VirtualBox kernel: procfile read buffer1k
Ago 30 16:47:05 luiz-VirtualBox kernel: /proc/buffer1k removed
root@luiz-VirtualBox:/home/luiz/develop/kernel/procfs2# ls proc
ls: cannot access 'proc': No such file or directory
root@luiz-VirtualBox:/home/luiz/develop/kernel/procfs2# ls /proc
1/    1190/ 1394/ 1719/ 196/ 2559/ 323/ 5220/ 701/  asound    key-users  swaps
10/   11902/ 1396/ 1728/ 1962/ 2560/ 3280/ 5276/ 705/  buddyinfo  kmsg    sys
100/   11942/ 14/   1740/ 1988/ 2561/ 3288/ 53/   721/  bus/     kpagecgroup sysrq-trigger
10097/ 11945/ 1409/ 1763/ 2/   2562/ 33/   5309/ 7282/   cgroups  kpagecount sysvipc
101/   11952/ 1412/ 1778/ 20/   2563/ 34/   5357/ 7839/   cmdline  kpageflags thread-self@
10184/ 1198/ 1420/ 1789/ 200/  2564/ 36/   54/   8/    consoles  loadavg  timer_list
102/   12/   1427/ 18/   201/  2565/ 37/   55/   811/   cpuinfo locks   tty
10296/ 1211/ 15/   1802/ 202/  2566/ 38/   5548/ 817/   crypto  mdstat   uptime
103/   1236/ 1598/ 1812/ 203/  257/ 39/   5549/ 848/   devices  meminfo version
10308/ 1244/ 16/   1819/ 204/  26/   4/   5552/ 853/   diskstats  misc   version_signature
1070/   1246/ 1604/ 1865/ 2088/ 2699/ 40/   5890/ 876/   dma    modules  vmallocinfo
1075/   1250/ 1608/ 1868/ 2095/ 27/   41/   5995/ 8793/   driver  mounts@  vmstat
1076/   1252/ 1635/ 1874/ 2099/ 2761/ 42/   5996/ 9/    execdomains  mtrr   zoneinfo
1079/   1270/ 1636/ 1884/ 21/   28/   43/   5997/ 934/   fb       net
109/   1277/ 1637/ 1888/ 2106/ 299/ 439/ 6/    9788/   filesystems partitions
10991/ 1284/ 1638/ 1895/ 2179/ 30/   44/   6060/ 9798/   fs/      sched_debug
11/   1286/ 1639/ 19/   22/   3030/ 45/   670/   9799/   interrupts  schedstat
11122/ 1288/ 1640/ 1907/ 227/  3041/ 46/   686/   98/   iomem    scsi
11166/ 1298/ 1641/ 1910/ 228/  3043/ 47/   687/  9800/   ioports  self
1153/   13/   1642/ 1912/ 238/  31/   4771/ 690/  9813/   irq/     slabinfo
1160/   1300/ 1643/ 1924/ 24/   3128/ 48/   698/  9835/   kallsyms softirqs
11899/ 136/   1658/ 194/   2465/ 3135/ 49/   699/  99/   kcore    stat
119/   1392/ 1718/ 1948/ 25/   32/   5163/ 7/    acpi/   keys    swaps
root@luiz-VirtualBox:/home/luiz/develop/kernel/procfs2#
```

Podemos perceber que o arquivo *buffer1k* foi removido da pasta */proc*.

Procfs3- Inclusão e conferência

```
root@luiz-VirtualBox:/home/luiz/develop/kernel/procfs3
Ago 30 17:09:02 luiz-VirtualBox kernel: audit: type=1400 audit(1598818142.380:34): apparmor="STATUS" operation="profile_load" profile="unconfined" name="snap.code.code" pid=13530 comm="apparmor_parser"
Ago 30 17:09:02 luiz-VirtualBox kernel: audit: type=1400 audit(1598818142.384:35): apparmor="STATUS" operation="profile_load" profile="unconfined" name="snap.code.url-handler" pid=13531 comm="apparmor_parser"
Ago 30 17:09:02 luiz-VirtualBox kernel: audit: type=1400 audit(1598818142.384:36): apparmor="STATUS" operation="profile_load" profile="unconfined" name="snap-update-ns.code" pid=13529 comm="apparmor_parser"
Ago 30 17:16:53 luiz-VirtualBox sudo[14219]:      luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/procfs3 ; USER=root ; COMMAND=/bin/su
Ago 30 17:20:14 luiz-VirtualBox kernel: /proc/buffer2k created
root@luiz-VirtualBox:/home/luiz/develop/kernel/procfs3# cat /proc/buffer2k
root@luiz-VirtualBox:/home/luiz/develop/kernel/procfs3# cat /proc/buffer2k
root@luiz-VirtualBox:/home/luiz/develop/kernel/procfs3#
root@luiz-VirtualBox:/home/luiz/develop/kernel/procfs3# ls /proc
  1   1236  13689  14378  1778  200  2565  4   6    acpi      keys      swaps
  10  1244  13699  14493  1789  201  2566  40  6060  asound    key-users  sys
  100 1246  13754  14509  18   202  257  41  670  buddyinfo  kmsg      sysrq-trigger
  101 1250  13840  14677  1802  203  26   42  686  buffer2k  kpagemgroup  sysvipc
  102 1252  13847  15    1812  204  2699  43  687  bus      kpagemcount  thread-self
  103 1270  13869  1598  1819  2088 27   439  690  cgroups  kpagemflags  timer_list
  10308 1277  13893  16    1865  2095 2761 44  698  cmdline  loadavg   tty
  1070 1284  13907  1604  1868  2099 28   45  699  consoles  locks     uptime
  1075 1286  1392   1608  1874  21    299  46  7   cpufreq  mdstat   version
  1076 1288  1394   1635  1884  2106 30   47  701  crypto   meminfo  version_signature
  1079 12882 13943  1636  1888  2179 3030 48  705  devices  misc     vmallocinfo
  109 12939 1396   1637  1895  22   3041 49  721  diskstats  modules  vmstat
  11   1298   14    1638  19   227   3043 5163 8   dma      mounts   zoneinfo
  11122 13   14018 1639  1907  228   31   5220 811  driver   mtrr
  11166 1300  1409   1640  1910  238   32   5276 817  execdomains  net
  1153 13199 1412   1641  1912  24    323  53  848  fb      pagetypeinfo
  1160 13201 14169  1642  1924  2465 3280 5309 853  filesystems partitions
  1160 13201 14169  1642  1924  2465 3280 5309 853  filesystems partitions
```

Podemos perceber que o arquivo *buffer2k* foi incluído no pasta */proc*.

Procfs3- Remoção e conferência

```
root@luiz-VirtualBox:/home/luiz/develop/kernel/procfs3
Ago 30 17:16:53 luiz-VirtualBox sudo[14219]:      luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/procfs3 ; USER=root ; COMMAND=/bin/su
Ago 30 17:20:14 luiz-VirtualBox kernel: /proc/buffer2k created
root@luiz-VirtualBox:/home/luiz/develop/kernel/procfs3# ls /proc
  1   1236  13689  14378  1763  20  2564  39  5890  99    keys      swaps
  10  1244  13699  14493  1778  200  2565  4   6    acpi      key-users  sys
  100 1246  13754  14509  1789  201  2566  40  6060  asound    kpagemgroup  sysvipc
  101 1250  13840  14719  18   202  257  41  670  buddyinfo  kpagemcount  thread-self
  102 1252  13847  14724  1802  203  26   42  686  bus      kpagemflags  timer_list
  103 1270  13869  15    1812  204  2699  43  687  cgroups  loadavg   tty
  10308 1277  13893  1598  1819  2088 27   439  690  cmdline  locks     uptime
  1070 1284  13907  16    1865  2095 2761 44  698  consoles  mdstat   version
  1075 1286  1392   1604  1868  2099 28   45  699  cpufreq  crypto   meminfo  version_signature
  1076 1288  1394   1608  1874  21    299  46  7   cpufreq  devices  misc     vmallocinfo
  1079 12882 13943  1635  1884  2106 30   47  701  diskstats  modules  vmstat
  109 12939 1396   1637  1888  2179 3030 48  705  dma      mounts   zoneinfo
  11   1298   14    1637  1895  22   3041 49  721  driver   mtrr
  11122 13   14018 1638  19   227   3043 5163 8   driver   net
  11166 1300  1409   1639  1907  228   31   5220 811  execdomains  pagetypeinfo
  1153 13199 1412   1640  1910  238   32   5276 817  filesystems partitions
  1160 13201 14169  1642  1924  2465 3280 5309 853  filesystems partitions
  119 13313 14179  1642  1924  2465 3280 5309 853  fs      sched_debug
  1190 13364 1420   1643  194   25  3288 5357 876  interrupts  schedstat
  11902 13365 14219  1658  1948  2559 33   54  8793  iomem    scsi
  11945 13513 14220  1718  196   2560 34   55  9   ioports   self
  1198 136 14221   1719  1962  2561 36   5548 934  irq      slabinfo
  12  13664 14243   1728  1988  2562 37   5549 98   kallsyms  softirqs
  1211 13666 1427   1740  2    2563 38   5552 9813  kcore    stat
```

Podemos perceber que o arquivo *buffer2k* foi removido da pasta */proc*.

Procfs4 - Inclusão e conferência

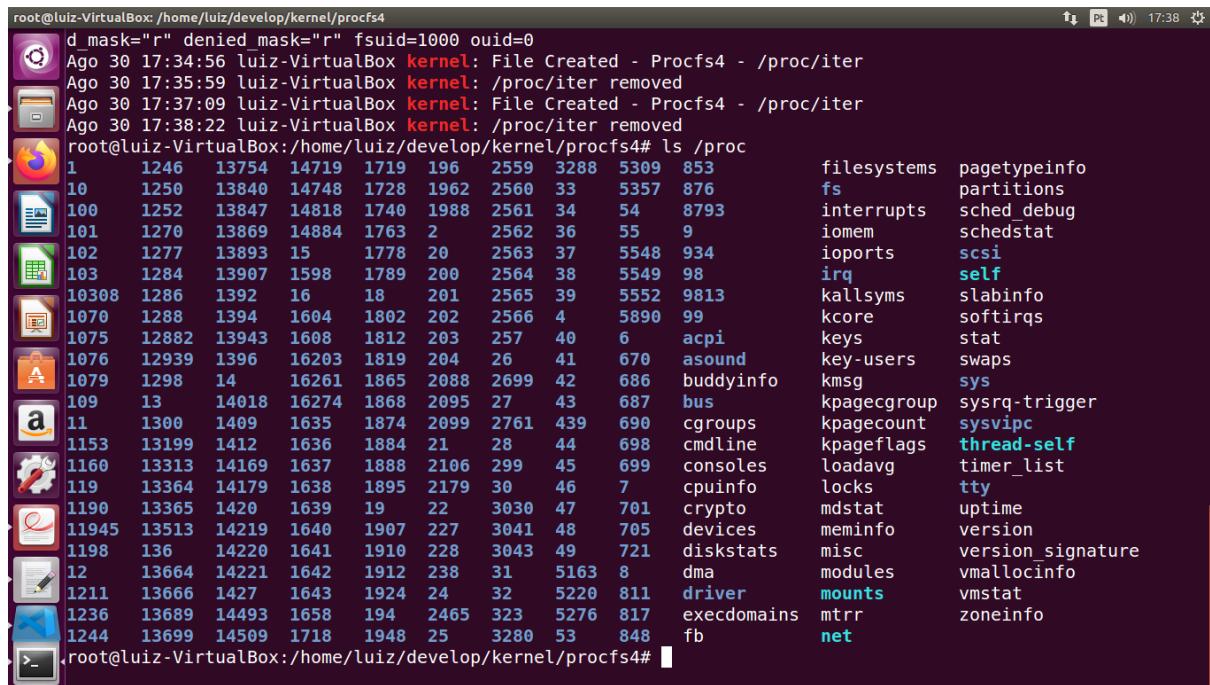
```
root@luiz-VirtualBox:/home/luiz/develop/kernel/procfs4# ls /proc
1          1246  13754  14509  1719  196  2559  3288  5309  853      fileystems  net
10         1250  13840  14719  1728  1962  2560  33   5357  876      fs        pagetypeinfo
100        1252  13847  14748  1740  1988  2561  34   54   8793     interrupts partitions
101        1270  13869  14818  1763  2     2562  36   55   9      iomem    sched_debug
102        1277  13893  14884  1778  20    2563  37   5548  934     iports   schedstat
103        1284  13907  15    1789  200   2564  38   5549  98      irq      scsi
10308      1286  1392  1598  18    201   2565  39   5552  9813     iter     self
1070       1288  1394  16    1802  202   2566  4    5890  99      kallsyms slabinfo
1075       12882 13943  1604  1812  203   257   40   6      acpi    softirqs
1076       12939 1396  1608  1819  204   26    41   670   asound   keys
1079       1298  14    16203 1865  2088  2699  42   686   buddyinfo key-users
109        14018 14018 16221 1868  2095  27    43   687   bus
11         1300  1409  1635  1874  2099  2761  439  690   cgroups kpagegroup
1153       13199 1412  1636  1884  21    28   44   698   cmdline kpagecount
1160       13313 14169 1637  1888  2106  299   45   699   consoles kpageflags
119        13364 14179 1638  1895  2179  30    46   7      cpufreq loadavg
1190       13365 1420  1639  19    22   3030  47   701   crypto locks
11945      13513 14219 1640  1907  227   3041  48   705   devices
1198       136  14220 1641  1910  228   3043  49   721   diskstats meminfo
12         13664 14221 1642  1912  238   31   5163  8      dma  misc
1211       13666 1427  1643  1924  24    32   5220  811   driver modules
1236       13689 14378 1658  194   2465  323   5276  817   execdomains mounts
1244       13699 14493 1718  1948  25    3280  53   848   fb
                                         mtrr
                                         zoneinfo
root@luiz-VirtualBox:/home/luiz/develop/kernel/procfs4#
```

É possível ver que o arquivo `iter` foi criado na pasta `/proc`.

```
root@luiz-VirtualBox:/home/luiz/develop/kernel/procfs4# mm="apparmor_parser"
Ago 30 17:08:30 luiz-VirtualBox kernel: audit: type=1400 audit(1598818110.316:31): apparmor="STATUS" operation="profile_replace" profile="unconfined" name="/snap/core/9804/usr/lib/snapd/snap-confine//mount-namespace-capture-helper" pid=13415 comm="apparmor_parser"
Ago 30 17:08:30 luiz-VirtualBox kernel: audit: type=1400 audit(1598818110.320:32): apparmor="STATUS" operation="profile_replace" info="same as current profile, skipping" profile="unconfined" name="snap-update-ns.core" pid=13417 comm="apparmor_parser"
Ago 30 17:08:30 luiz-VirtualBox kernel: audit: type=1400 audit(1598818110.320:33): apparmor="STATUS" operation="profile_replace" info="same as current profile, skipping" profile="unconfined" name="snap.core.hook.configure" pid=13418 comm="apparmor_parser"
Ago 30 17:09:02 luiz-VirtualBox kernel: audit: type=1400 audit(1598818142.380:34): apparmor="STATUS" operation="profile_load" profile="unconfined" name="snap.code.code" pid=13530 comm="apparmor_parser"
Ago 30 17:09:02 luiz-VirtualBox kernel: audit: type=1400 audit(1598818142.384:35): apparmor="STATUS" operation="profile_load" profile="unconfined" name="snap.code.url-handler" pid=13531 comm="apparmor_parser"
Ago 30 17:09:02 luiz-VirtualBox kernel: audit: type=1400 audit(1598818142.384:36): apparmor="STATUS" operation="profile_load" profile="unconfined" name="snap-update-ns.code" pid=13529 comm="apparmor_parser"
Ago 30 17:16:53 luiz-VirtualBox sudo[14219]:      luiz : TTY=pts/1 ; PWD=/home/luiz/develop/kernel/procfs3 ; USER=root ; COMMAND=/bin/su
Ago 30 17:20:14 luiz-VirtualBox kernel: /proc/buffer2k created
Ago 30 17:23:31 luiz-VirtualBox kernel: audit: type=1400 audit(1598819011.317:37): apparmor="DENIED" operation="open" profile="/usr/bin/evince" name="/home/luiz/.config/dconf/user" pid=3280 comm="evince" requested_mask="r" denied_mask="r" fsuid=1000 ouid=0
Ago 30 17:34:56 luiz-VirtualBox kernel: File Created - Procfs4 - /proc/iter
root@luiz-VirtualBox:/home/luiz/develop/kernel/procfs4# cat /proc/iter
0
root@luiz-VirtualBox:/home/luiz/develop/kernel/procfs4# cat /proc/iter
1
root@luiz-VirtualBox:/home/luiz/develop/kernel/procfs4# cat /proc/iter
2
root@luiz-VirtualBox:/home/luiz/develop/kernel/procfs4#
```

É possível ver que o arquivo `iter` está salvando o número de vezes que o arquivo é lido.

Procfs4 - Exclusão e conferência



A screenshot of a Linux terminal window titled "root@luiz-VirtualBox: /home/luiz/develop/kernel/procfs4#". The window shows a list of files in the /proc directory. The output of the 'ls' command is as follows:

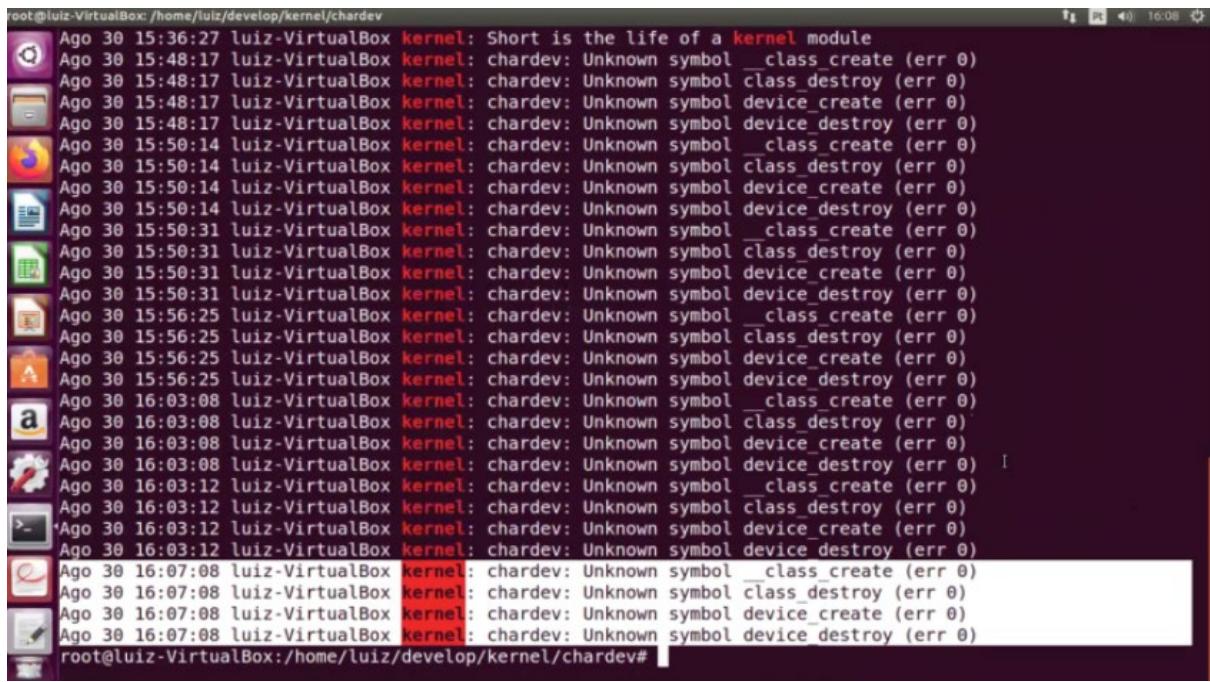
```
d_mask="r" denied_mask="r" fsuid=1000 ouid=0
Ago 30 17:34:56 luiz-VirtualBox kernel: File Created - Procfs4 - /proc/iter
Ago 30 17:35:59 luiz-VirtualBox kernel: /proc/iter removed
Ago 30 17:37:09 luiz-VirtualBox kernel: File Created - Procfs4 - /proc/iter
Ago 30 17:38:22 luiz-VirtualBox kernel: /proc/iter removed
root@luiz-VirtualBox:/home/luiz/develop/kernel/procfs4# ls /proc
1      1246  13754  14719  1719  196   2559  3288  5309  853      filesystems pagetypeinfo
10     1250  13840  14748  1728  1962  2560  33    5357  876      fs        partitions
100    1252  13847  14818  1740  1988  2561  34    54    8793     interrupts sched_debug
101    1270  13869  14884  1763  2      2562  36    55    9       iomem    schedstat
102    1277  13893  15     1778  20    2563  37    5548  934     ioports   scsi
103    1284  13907  1598  1789  200   2564  38    5549  98      irq      self
10308  1286  1392  16     18    201   2565  39    5552  9813     kallsyms slabinfo
1070   1288  1394  1604  1802  202   2566  4     5890  99      kcore    softirqs
1075   12882 13943  1608  1812  203   257   40    6       acpi     keys      stat
1076   12939 1396  16203 1819  204   26    41    670    asound   key-users swaps
1079   1298  14     16261 1865  2088  2699  42    686    buddyinfo  kmsg      sys
109    13     14018 16274 1868  2095  27    43    687    bus      kpagecgroup sysrq-trigger
11     1300  1409  1635  1874  2099  2761  439   690    cgroups  kpagedcount sysv ipc
1153   13199 1412  1636  1884  21    28    44    698    cmdline  kpagedflags thread-self
1160   13313 14169 1637  1888  2106  299   45    699    consoles  loadavg   timer_list
119    13364 14179 1638  1895  2179  30    46    7       cpufreq  locks      tty
1190   13365 1420  1639  19    22    3030  47    701    crypto   mdstat   uptime
11945  13513 14219 1640  1907  227   3041  48    705    devices  meminfo  version
1198   136     14220 1641  1910  228   3043  49    721    diskstats  misc      version_signature
12     13664 14221 1642  1912  238   31    5163  8     dma      modules  vmallocinfo
1211   13666 1427  1643  1924  24    32    5220  811   driver   mounts   vmstat
1236   13689 14493 1658  194   2465  323   5276  817   execdomains  mtrr      zoneinfo
1244   13699 14509 1718  1948  25    3280  53    848    fb      net
```

É possível ver que o arquivo iter foi removido da pasta /proc.

Erros Encontrados:

Inicialmente, ao tentar usar o comando make, encontramos o erro: *no rule to make target 'arch/x86/entry/syscalls/syscall_32.tbl'*. Esse erro foi corrigido ao modificarmos o termo *M=\$(PWD)* para o termo *M=\$(shell pwd)* na área *all* do *Makefile*. Este problema só foi experienciado no computador de um dos integrantes do grupo (Victor Soldera).

Também, ao tentarmos realizar a instalação do módulo *chardev*, o seguinte erro foi encontrado:



```
root@luiz-VirtualBox: /home/luiz/develop/kernel/chardev
Ago 30 15:36:27 luiz-VirtualBox kernel: Short is the life of a kernel module
Ago 30 15:48:17 luiz-VirtualBox kernel: chardev: Unknown symbol _class_create (err 0)
Ago 30 15:48:17 luiz-VirtualBox kernel: chardev: Unknown symbol class_destroy (err 0)
Ago 30 15:48:17 luiz-VirtualBox kernel: chardev: Unknown symbol device_create (err 0)
Ago 30 15:48:17 luiz-VirtualBox kernel: chardev: Unknown symbol device_destroy (err 0)
Ago 30 15:50:14 luiz-VirtualBox kernel: chardev: Unknown symbol _class_create (err 0)
Ago 30 15:50:14 luiz-VirtualBox kernel: chardev: Unknown symbol class_destroy (err 0)
Ago 30 15:50:14 luiz-VirtualBox kernel: chardev: Unknown symbol device_create (err 0)
Ago 30 15:50:14 luiz-VirtualBox kernel: chardev: Unknown symbol device_destroy (err 0)
Ago 30 15:50:31 luiz-VirtualBox kernel: chardev: Unknown symbol _class_create (err 0)
Ago 30 15:50:31 luiz-VirtualBox kernel: chardev: Unknown symbol class_destroy (err 0)
Ago 30 15:50:31 luiz-VirtualBox kernel: chardev: Unknown symbol device_create (err 0)
Ago 30 15:50:31 luiz-VirtualBox kernel: chardev: Unknown symbol device_destroy (err 0)
Ago 30 15:56:25 luiz-VirtualBox kernel: chardev: Unknown symbol _class_create (err 0)
Ago 30 15:56:25 luiz-VirtualBox kernel: chardev: Unknown symbol class_destroy (err 0)
Ago 30 15:56:25 luiz-VirtualBox kernel: chardev: Unknown symbol device_create (err 0)
Ago 30 15:56:25 luiz-VirtualBox kernel: chardev: Unknown symbol device_destroy (err 0)
Ago 30 16:03:08 luiz-VirtualBox kernel: chardev: Unknown symbol _class_create (err 0)
Ago 30 16:03:08 luiz-VirtualBox kernel: chardev: Unknown symbol class_destroy (err 0)
Ago 30 16:03:08 luiz-VirtualBox kernel: chardev: Unknown symbol device_create (err 0)
Ago 30 16:03:08 luiz-VirtualBox kernel: chardev: Unknown symbol device_destroy (err 0)
Ago 30 16:03:12 luiz-VirtualBox kernel: chardev: Unknown symbol _class_create (err 0)
Ago 30 16:03:12 luiz-VirtualBox kernel: chardev: Unknown symbol class_destroy (err 0)
Ago 30 16:03:12 luiz-VirtualBox kernel: chardev: Unknown symbol device_create (err 0)
Ago 30 16:03:12 luiz-VirtualBox kernel: chardev: Unknown symbol device_destroy (err 0)
Ago 30 16:07:08 luiz-VirtualBox kernel: chardev: Unknown symbol _class_create (err 0)
Ago 30 16:07:08 luiz-VirtualBox kernel: chardev: Unknown symbol class_destroy (err 0)
Ago 30 16:07:08 luiz-VirtualBox kernel: chardev: Unknown symbol device_create (err 0)
Ago 30 16:07:08 luiz-VirtualBox kernel: chardev: Unknown symbol device_destroy (err 0)
root@luiz-VirtualBox:/home/luiz/develop/kernel/chardev#
```

O erro foi resolvido com a simples adição de *MODULE_LICENSE("GPL")*; de forma a permitir a visualização de símbolos exportados por *EXPORT_SYMBOL_GPL()*.

Para facilitar a visualização em alguns módulos, foram alterados alguns comandos *pr_debug()* para *pr_info()*, de forma a aparecer quando realizado o comando *journalctl --since "1 hour ago" | grep kernel* sem necessidade de utilizar *dynamic_debug*.

Conclusão:

Durante o trabalho utilizamos informações obtidas através dos textos que foram passadas para auxiliar na hora de compilar os módulos do kernel. No começo não foram encontrados muitos erros, mas com o decorrer da atividade encontramos alguns como o de instalação do *chardev* e também o do comando *make*, que foram mencionado anteriormente.