

1 Kmod 运行时调试图

1.1 编译安装运行调试图

1.1.1 wget 下载源码包

```
$ wget https://www.kernel.org/pub/linux/utils/kernel/kmod/kmod-11.tar.gz
--2013-06-18 01:08:47-- https://www.kernel.org/pub/linux/utils/kernel/kmod/kmod-11.tar.gz
Resolving www.kernel.org (www.kernel.org)... 149.20.4.69, 198.145.20.140
Connecting to www.kernel.org (www.kernel.org)|149.20.4.69|:
443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 3458574 (3.3M) [application/x-gzip]
Saving to: `kmod-11.tar.gz'

100%[=====>] 3,458,574 795K/s
in 5.3s

2013-06-18 01:08:54 (641 KB/s) - `kmod-11.tar.gz' saved [3458574/3458574]
```

1.1.2 tar 解压源码包

```
$ tar xzf kmod-11.tar.gz
$ cd kmod-11
$ ls
aclocal.m4  configure  libkmod  Makefile.in  README  tools
build-aux  configure.ac  m4  man  testsuite
config.h.in  COPYING  Makefile.am  NEWS  TODO
$
```

1.1.3 configure 配置项目源码

```
Terminal
$ wget https://www.kernel.org/pub/linux/utils/kernel/kmod/kmod-11.tar.gz
--2013-06-22 08:58:01-- https://www.kernel.org/pub/linux/utils/kernel/kmod/kmod-11.tar.gz
Resolving www.kernel.org (www.kernel.org)... 149.20.4.69, 198.145.20.140
Connecting to www.kernel.org (www.kernel.org)|149.20.4.69|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 3458574 (3.3M) [application/x-gzip]
Saving to: `kmod-11.tar.gz'

100%[=====>] 3,458,574    540K/s   in 9.0s

2013-06-22 08:58:11 (375 KB/s) - `kmod-11.tar.gz' saved [3458574/3458574]

$
```

Figure 1: wget 下载源码包

```
Terminal
$ tar xzf kmod-11.tar.gz
$ cd kmod-11
$ ls
aclocal.m4    configure    libkmod      Makefile.in  README      tools
build-aux    configure.ac m4           man          testsuite
config.h.in  COPYING     Makefile.am  NEWS         TODO
$
```

Figure 2: tar 解压源码包

```

$ ./configure CFLAGS="-g -O2" --prefix=/usr --sysconfdir=/etc --
libdir=/usr/lib
checking for a BSD-compatible install... /usr/bin/install -c
checking whether build environment is sane... yes
checking for a thread-safe mkdir -p... /bin/mkdir -p
checking for gawk... no
checking for mawk... mawk
checking whether make sets $(MAKE)... yes
checking whether make supports nested variables... yes
checking how to create a pax tar archive... gnutar
checking for style of include used by make... GNU
checking for gcc... gcc
checking whether the C compiler works... yes
checking for C compiler default output file name... a.out
checking for suffix of executables...
checking whether we are cross compiling... no
checking for suffix of object files... o
checking whether we are using the GNU C compiler... yes
checking whether gcc accepts -g... yes
checking for gcc option to accept ISO C89... none needed
checking dependency style of gcc... gcc3
...
kmod 11
=====

prefix:          /usr
sysconfdir:      /etc
libdir:          /usr/lib
rootlibdir:      /usr/lib
includedir:      ${prefix}/include
bindir:          ${exec_prefix}/bin

compiler:        gcc -std=gnu99
cflags:          -pipe -DANOTHER_BRICK_IN_THE -
Wall -W -Wextra -Wno-inline -Wvla -Wundef -Wformat=2 -
Wlogical-op -Wsign-compare -Wformat-security -Wmissing-include-
dirs -Wformat-nonliteral -Wold-style-definition -Wpointer-
arith -Winit-self -Wdeclaration-after-statement -Wfloat-
equal -Wmissing-prototypes -Wstrict-prototypes -Wredundant-
decls -Wmissing-declarations -Wmissing-noreturn -Wshadow -
Wendif-labels -Wstrict-aliasing=2 -Wwrite-strings -Wno-
long-long -Wno-overlength-strings -Wno-unused-parameter -

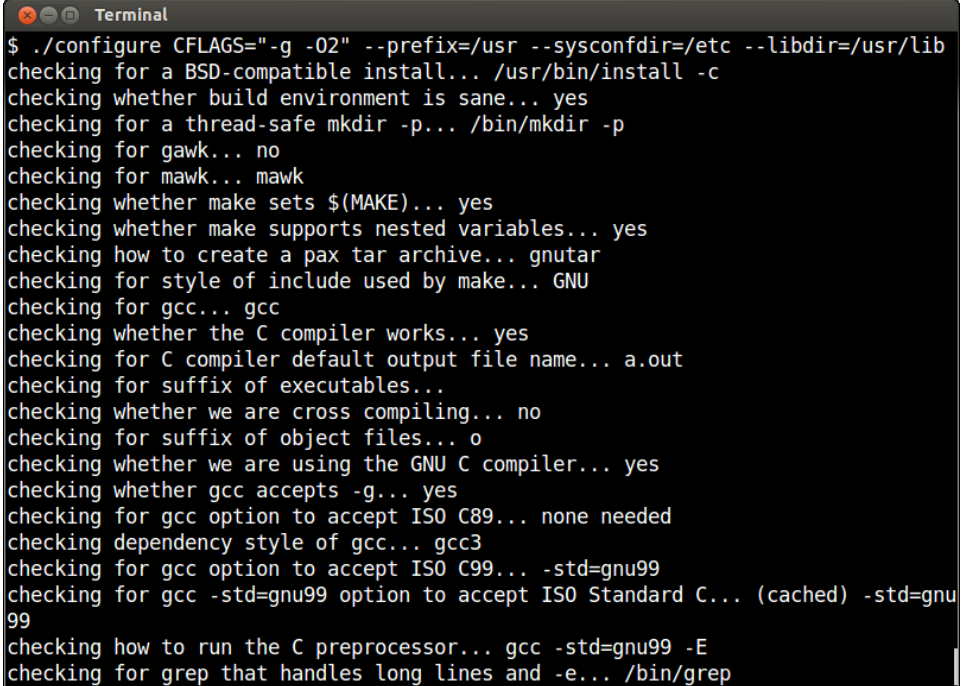
```

```

Wno-missing-field-initializers -Wno-unused-result -Wnested-
externs -Wchar-subscripts -Wtype-limits -Wuninitialized -
fno-common -fdiagnostics-show-option -fvisibility=hidden -
ffunction-sections -fdata-sections -g -O2
ldflags:          -Wl,--as-needed -Wl,--gc-sections

tools:            yes
logging:          yes
compression:      xz=no  zlib=no
debug:            no
doc:              no
man:              yes

```



```

Terminal
$ ./configure CFLAGS="-g -O2" --prefix=/usr --sysconfdir=/etc --libdir=/usr/lib
checking for a BSD-compatible install... /usr/bin/install -c
checking whether build environment is sane... yes
checking for a thread-safe mkdir -p... /bin/mkdir -p
checking for gawk... no
checking for mawk... mawk
checking whether make sets $(MAKE)... yes
checking whether make supports nested variables... yes
checking how to create a pax tar archive... gnutar
checking for style of include used by make... GNU
checking for gcc... gcc
checking whether the C compiler works... yes
checking for C compiler default output file name... a.out
checking for suffix of executables...
checking whether we are cross compiling... no
checking for suffix of object files... o
checking whether we are using the GNU C compiler... yes
checking whether gcc accepts -g... yes
checking for gcc option to accept ISO C89... none needed
checking dependency style of gcc... gcc3
checking for gcc option to accept ISO C99... -std=gnu99
checking for gcc -std=gnu99 option to accept ISO Standard C... (cached) -std=gnu99
checking how to run the C preprocessor... gcc -std=gnu99 -E
checking for grep that handles long lines and -e... /bin/grep

```

Figure 3: configure 配置源码包

1.1.4 编译项目源码

```
$ make
```

```

make --no-print-directory all-recursive
Making all in .
  CC      libkmod/libkmod.lo
  CC      libkmod/libkmod-list.lo
  CC      libkmod/libkmod-config.lo
  CC      libkmod/libkmod-index.lo
  CC      libkmod/libkmod-module.lo
  CC      libkmod/libkmod-file.lo
  CC      libkmod/libkmod-elf.lo
  CC      libkmod/libkmod-hash.lo
  CC      libkmod/libkmod-array.lo
  CC      libkmod/libkmod-util.lo
  CCLD    libkmod/libkmod-util.la
  CCLD    libkmod/libkmod.la
  CCLD    libkmod/libkmod-private.la
  CC      tools/kmod.o
  CC      tools/lsmmod.o
  CC      tools/rmmmod.o
  CC      tools/insmod.o
  CC      tools/modinfo.o
  CC      tools/modprobe.o
  CC      tools/depmod.o
  CC      tools/log.o
  CCLD    tools/kmod
  CCLD    tools/kmod-nolib
  GEN     tools/insmod
  GEN     tools/rmmmod
  GEN     tools/lsmmod
  GEN     tools/modprobe
  GEN     tools/modinfo
  GEN     tools/depmod
  GEN     libkmod/libkmod.pc
Making all in libkmod/docs
make[2]: Nothing to be done for `all'.
Making all in man
make[2]: Nothing to be done for `all'.

```

1.1.5 测试生成命令

```
$ ./tools/insmod -h
```

```
Terminal
$ make
make --no-print-directory all-recursive
Making all in .
CC      libkmod/libkmod.lo
CC      libkmod/libkmod-list.lo
CC      libkmod/libkmod-config.lo
CC      libkmod/libkmod-index.lo
CC      libkmod/libkmod-module.lo
CC      libkmod/libkmod-file.lo
CC      libkmod/libkmod-elf.lo
CC      libkmod/libkmod-hash.lo
CC      libkmod/libkmod-array.lo
CC      libkmod/libkmod-util.lo
CCLD    libkmod/libkmod-util.la
CCLD    libkmod/libkmod.la
CCLD    libkmod/libkmod-private.la
CC      tools/kmod.o
CC      tools/lsmmod.o
CC      tools/rmmod.o
CC      tools/insmod.o
CC      tools/modinfo.o
CC      tools/modprobe.o
CC      tools/depmod.o
CC      tools/log.o
CCLD    tools/kmod
```

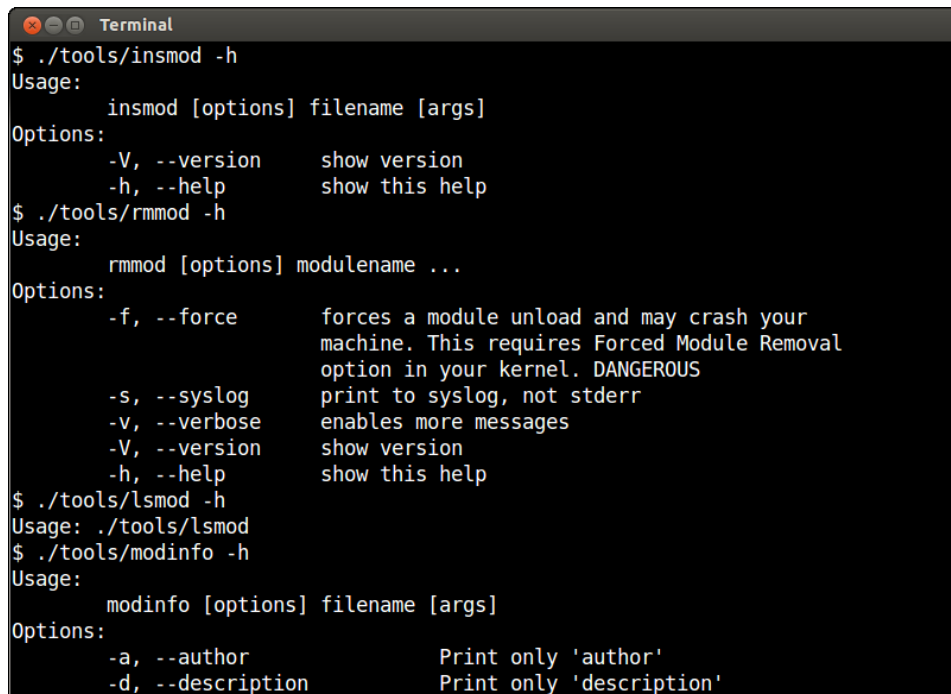
Figure 4: make 编译源码包

```
Usage:
  insmod [options] filename [args]
Options:
  -V, --version      show version
  -h, --help         show this help
$ ./tools/rmmod -h
Usage:
  rmmod [options] modulename ...
Options:
  -f, --force        forces a module unload and may crash your
                    machine. This requires Forced Module Removal
                    option in your kernel. DANGEROUS
  -s, --syslog       print to syslog, not stderr
  -v, --verbose      enables more messages
  -V, --version      show version
  -h, --help         show this help
$ ./tools/lsmmod -h
Usage: ./tools/lsmmod
$ ./tools/modinfo -h
Usage:
```

```

    modinfo [options] filename [args]
Options:
    -a, --author          Print only 'author'
    -d, --description     Print only 'description'
    -l, --license         Print only 'license'
    -p, --parameters     Print only 'parm'
    -n, --filename        Print only 'filename'
    -O, --null            Use \0 instead of \n
    -F, --field=FIELD     Print only provided FIELD
    -k, --set-version=VERSION Use VERSION instead of `uname -
r`
    -b, --basedir=DIR     Use DIR as filesystem root for /
lib/modules
    -V, --version         Show version
    -h, --help            Show this help
$

```



```

Terminal
$ ./tools/insmod -h
Usage:
    insmod [options] filename [args]
Options:
    -V, --version      show version
    -h, --help         show this help
$ ./tools/rmmod -h
Usage:
    rmmod [options] modulename ...
Options:
    -f, --force        forces a module unload and may crash your
                        machine. This requires Forced Module Removal
                        option in your kernel. DANGEROUS
    -s, --syslog       print to syslog, not stderr
    -v, --verbose       enables more messages
    -V, --version      show version
    -h, --help         show this help
$ ./tools/lsmod -h
Usage: ./tools/lsmod
$ ./tools/modinfo -h
Usage:
    modinfo [options] filename [args]
Options:
    -a, --author          Print only 'author'
    -d, --description     Print only 'description'

```

Figure 5: 测试生成命令

1.2 项目 Debug 版运行调试图

1.2.1 配置时加上 `--enable-debug`, `--enable-logging` 参数

```
$ ./configure CFLAGS="-g -O2" --prefix=/usr --sysconfdir=/etc --  
libdir=/usr/lib --enable-debug --enable-logging  
checking for a BSD-compatible install... /usr/bin/install -c  
checking whether build environment is sane... yes  
checking for a thread-safe mkdir -p... /bin/mkdir -p  
checking for gawk... no  
checking for mawk... mawk  
checking whether make sets $(MAKE)... yes  
checking whether make supports nested variables... yes  
checking how to create a pax tar archive... gnutar  
checking for style of include used by make... GNU  
checking for gcc... gcc  
checking whether the C compiler works... yes  
checking for C compiler default output file name... a.out  
checking for suffix of executables...  
checking whether we are cross compiling... no  
checking for suffix of object files... o  
checking whether we are using the GNU C compiler... yes  
checking whether gcc accepts -g... yes  
checking for gcc option to accept ISO C89... none needed  
checking dependency style of gcc... gcc3  
checking for gcc option to accept ISO C99... -std=gnu99  
checking for gcc -std=gnu99 option to accept ISO Standard C... (cached) -  
std=gnu99  
checking how to run the C preprocessor... gcc -std=gnu99 -E  
checking for grep that handles long lines and -e... /bin/grep  
checking for egrep... /bin/grep -E  
checking for ANSI C header files... yes  
checking for sys/types.h... yes  
checking for sys/stat.h... yes  
checking for stdlib.h... yes  
checking for string.h... yes  
checking for memory.h... yes  
checking for strings.h... yes  
checking for inttypes.h... yes  
checking for stdint.h... yes  
checking for unistd.h... yes  
checking minix/config.h usability... no
```



```

checking minix/config.h presence... no
checking for minix/config.h... no
checking whether it is safe to define __EXTENSIONS__... yes
checking for special C compiler options needed for large files... no
checking for _FILE_OFFSET_BITS value needed for large files... 64
checking whether make supports nested variables... (cached) yes
checking build system type... i686-pc-linux-gnu
checking host system type... i686-pc-linux-gnu
checking how to print strings... printf
checking for a sed that does not truncate output... /bin/sed
checking for fgrep... /bin/grep -F
checking for ld used by gcc -std=gnu99... /usr/bin/ld
checking if the linker (/usr/bin/ld) is GNU ld... yes
checking for BSD- or MS-compatible name lister (nm)... /usr/bin/
nm -B
checking the name lister (/usr/bin/nm -B) interface... BSD nm
checking whether ln -s works... yes
checking the maximum length of command line arguments... 1572864
checking whether the shell understands some XSI constructs... yes
checking whether the shell understands "+="... yes
checking how to convert i686-pc-linux-gnu file names to i686-
pc-linux-gnu format... func_convert_file_noop
checking      how      to      convert      i686-  pc-  linux-
gnu file names to toolchain format... func_convert_file_noop
checking for /usr/bin/ld option to reload object files... -r
checking for objdump... objdump
checking how to recognize dependent libraries... pass_all
checking for dlltool... no
checking how to associate runtime and link libraries... printf %s
\n
checking for ar... ar
checking for archiver @FILE support... @
checking for strip... strip
checking for ranlib... ranlib
checking command to parse /usr/bin/nm -B output from gcc -
std=gnu99 object... ok
checking for sysroot... no
checking for mt... mt
checking if mt is a manifest tool... no
checking for dlfcn.h... yes
checking for objdir... .libs
checking  if  gcc  -std=gnu99  supports  -fno-rtti  -fno-

```

```

exceptions... no
checking for gcc -std=gnu99 option to produce PIC... -fPIC -DPIC
checking if gcc -std=gnu99 PIC flag -fPIC -DPIC works... yes
checking if gcc -std=gnu99 static flag -static works... yes
checking if gcc -std=gnu99 supports -c -o file.o... yes
checking if gcc -std=gnu99 supports -c -o file.o... (cached) yes
checking whether the gcc -std=gnu99 linker (/usr/bin/ld) supports shared libraries... yes
checking whether -lc should be explicitly linked in... no
checking dynamic linker characteristics... GNU/Linux ld.so
checking how to hardcode library paths into programs... immediate
checking whether stripping libraries is possible... yes
checking if libtool supports shared libraries... yes
checking whether to build shared libraries... yes
checking whether to build static libraries... no
checking for gcc... (cached) gcc
checking whether we are using the GNU C compiler... (cached) yes
checking whether gcc accepts -g... (cached) yes
checking for gcc option to accept ISO C89... (cached) none needed
checking dependency style of gcc... (cached) gcc3
checking for gcc option to accept ISO C99... (cached) -std=gnu99
checking for typeof syntax and keyword spelling... typeof
checking whether gcc -std=gnu99 and cc understand -c and -o together... yes
checking whether gcc -std=gnu99 needs -traditional... no
checking whether byte ordering is bigendian... no
checking for a sed that does not truncate output... (cached) /bin/sed
checking for pkg-config... /usr/bin/pkg-config
checking pkg-config is at least version 0.9.0... yes
checking for __xstat... yes
checking for struct stat.st_mtim... yes
configure: Xz support not requested
configure: zlib support not requested
checking for xsltproc... /usr/bin/xsltproc
checking for gtkdoc-check... no
checking for gtkdoc-rebase... no
checking for gtkdoc-mkpdf... no
checking whether to build gtk-doc documentation... no
checking if gcc -std=gnu99 supports flag -pipe in envvar CFLAGS... yes
checking if gcc -std=gnu99 supports flag -

```

```

DANOTHER_BRICK_IN_THE in envvar CFLAGS... yes
checking if gcc -std=gnu99 supports flag -
Wall in envvar CFLAGS... yes
checking if gcc -std=gnu99 supports flag -
W in envvar CFLAGS... yes
checking if gcc -std=gnu99 supports flag -
Wextra in envvar CFLAGS... yes
checking if gcc -std=gnu99 supports flag - Wno-
inline in envvar CFLAGS... yes
checking if gcc -std=gnu99 supports flag -
Wvla in envvar CFLAGS... yes
checking if gcc -std=gnu99 supports flag -
Wundef in envvar CFLAGS... yes
checking if gcc -std=gnu99 supports flag -
Wformat=2 in envvar CFLAGS... yes
checking if gcc -std=gnu99 supports flag - Wlogical-
op in envvar CFLAGS... yes
checking if gcc -std=gnu99 supports flag - Wsign-
compare in envvar CFLAGS... yes
checking if gcc -std=gnu99 supports flag - Wformat-
security in envvar CFLAGS... yes
checking if gcc -std=gnu99 supports flag - Wmissing-include-
dirs in envvar CFLAGS... yes
checking if gcc -std=gnu99 supports flag - Wformat-
nonliteral in envvar CFLAGS... yes
checking if gcc -std=gnu99 supports flag - Wold-style-
definition in envvar CFLAGS... yes
checking if gcc -std=gnu99 supports flag - Wpointer-
arith in envvar CFLAGS... yes
checking if gcc -std=gnu99 supports flag - Winit-
self in envvar CFLAGS... yes
checking if gcc -std=gnu99 supports flag - Wdeclaration-after-
statement in envvar CFLAGS... yes
checking if gcc -std=gnu99 supports flag - Wfloat-
equal in envvar CFLAGS... yes
checking if gcc -std=gnu99 supports flag - Wmissing-
prototypes in envvar CFLAGS... yes
checking if gcc -std=gnu99 supports flag - Wstrict-
prototypes in envvar CFLAGS... yes
checking if gcc -std=gnu99 supports flag - Wredundant-
decls in envvar CFLAGS... yes
checking if gcc -std=gnu99 supports flag - Wmissing-

```

```

declarations in envvar CFLAGS... yes
checking if gcc -std=gnu99 supports flag -Wmissing-
noreturn in envvar CFLAGS... yes
checking if gcc -std=gnu99 supports flag -
Wshadow in envvar CFLAGS... yes
checking if gcc -std=gnu99 supports flag -Wendif-
labels in envvar CFLAGS... yes
checking if gcc -std=gnu99 supports flag -Wstrict-
aliasing=2 in envvar CFLAGS... yes
checking if gcc -std=gnu99 supports flag -Wwrite-
strings in envvar CFLAGS... yes
checking if gcc -std=gnu99 supports flag -Wno-long-
long in envvar CFLAGS... yes
checking if gcc -std=gnu99 supports flag -Wno-overlength-
strings in envvar CFLAGS... yes
checking if gcc -std=gnu99 supports flag -Wno-unused-
parameter in envvar CFLAGS... yes
checking if gcc -std=gnu99 supports flag -Wno-missing-field-
initializers in envvar CFLAGS... yes
checking if gcc -std=gnu99 supports flag -Wno-unused-
result in envvar CFLAGS... yes
checking if gcc -std=gnu99 supports flag -Wnested-
externs in envvar CFLAGS... yes
checking if gcc -std=gnu99 supports flag -Wchar-
subscripts in envvar CFLAGS... yes
checking if gcc -std=gnu99 supports flag -Wtype-
limits in envvar CFLAGS... yes
checking if gcc -std=gnu99 supports flag -
Wuninitialized in envvar CFLAGS... yes
checking if gcc -std=gnu99 supports flag -fno-
common in envvar CFLAGS... yes
checking if gcc -std=gnu99 supports flag -fdiagnostics-show-
option in envvar CFLAGS... yes
checking if gcc -std=gnu99 supports flag -
fvisibility=hidden in envvar CFLAGS... yes
checking if gcc -std=gnu99 supports flag -ffunction-
sections in envvar CFLAGS... yes
checking if gcc -std=gnu99 supports flag -fdata-
sections in envvar CFLAGS... yes
checking if gcc -std=gnu99 supports flag -Wl,-- as-
needed in envvar LDFLAGS... yes
checking if gcc -std=gnu99 supports flag -Wl,-- gc-

```

```

sections in envvar LDFLAGS... yes
checking that generated files are newer than configure... done
configure: creating ./config.status
config.status: creating Makefile
config.status: creating man/Makefile
config.status: creating libkmod/docs/Makefile
config.status: creating libkmod/docs/version.xml
config.status: creating config.h
config.status: executing depfiles commands

config.status: executing libtool commands

kmod 11
=====

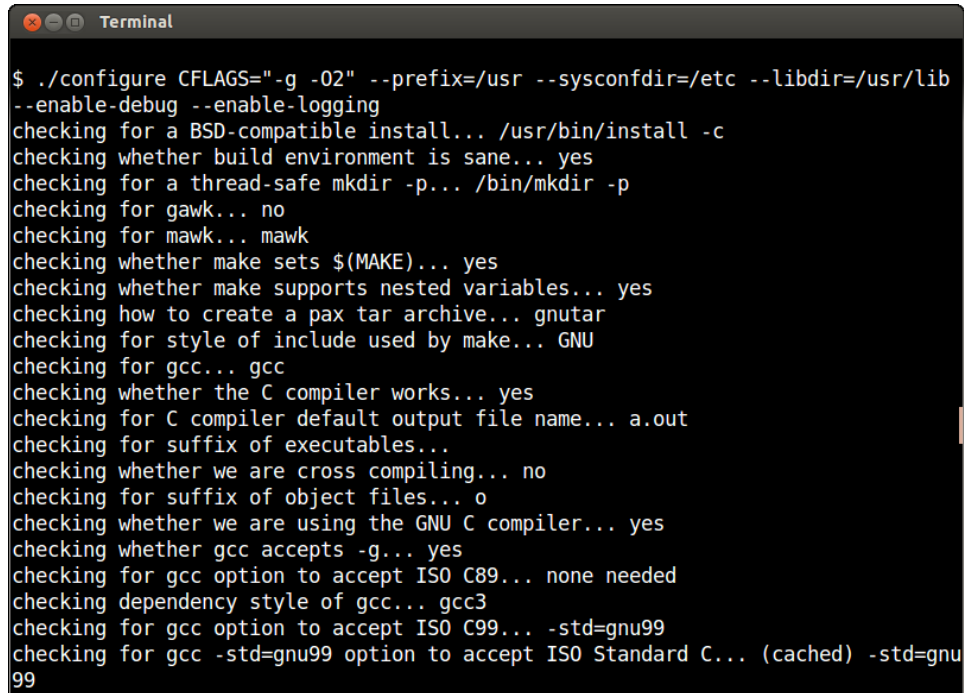
prefix:      /usr
sysconfdir:  /etc
libdir:      /usr/lib
rootlibdir:  /usr/lib
includedir:  ${prefix}/include
bindir:      ${exec_prefix}/bin

compiler:    gcc -std=gnu99
cflags:      -pipe -DANOTHER_BRICK_IN_THE -
Wall -W -Wextra -Wno-inline -Wvla -Wundef -Wformat=2 -
Wlogical-op -Wsign-compare -Wformat-security -Wmissing-include-
dirs -Wformat-nonliteral -Wold-style-definition -Wpointer-
arith -Winit-self -Wdeclaration-after-statement -Wfloat-
equal -Wmissing-prototypes -Wstrict-prototypes -Wredundant-
decls -Wmissing-declarations -Wmissing-noreturn -Wshadow -
Wendif-labels -Wstrict-aliasing=2 -Wwrite-strings -Wno-
long-long -Wno-overlength-strings -Wno-unused-parameter -
Wno-missing-field-initializers -Wno-unused-result -Wnested-
externs -Wchar-subscripts -Wtype-limits -Wuninitialized -
fno-common -fdiagnostics-show-option -fvisibility=hidden -
ffunction-sections -fdata-sections -g -O2
ldflags:     -Wl,--as-needed -Wl,--gc-sections

tools:       yes
logging:     yes
compression: xz=no  zlib=no
debug:       yes

```

```
doc:          no
man:          yes
```



```
Terminal
$ ./configure CFLAGS="-g -O2" --prefix=/usr --sysconfdir=/etc --libdir=/usr/lib
--enable-debug --enable-logging
checking for a BSD-compatible install... /usr/bin/install -c
checking whether build environment is sane... yes
checking for a thread-safe mkdir -p... /bin/mkdir -p
checking for gawk... no
checking for mawk... mawk
checking whether make sets $(MAKE)... yes
checking whether make supports nested variables... yes
checking how to create a pax tar archive... gnutar
checking for style of include used by make... GNU
checking for gcc... gcc
checking whether the C compiler works... yes
checking for C compiler default output file name... a.out
checking for suffix of executables...
checking whether we are cross compiling... no
checking for suffix of object files... o
checking whether we are using the GNU C compiler... yes
checking whether gcc accepts -g... yes
checking for gcc option to accept ISO C89... none needed
checking dependency style of gcc... gcc3
checking for gcc option to accept ISO C99... -std=gnu99
checking for gcc -std=gnu99 option to accept ISO Standard C... (cached) -std=gnu99
```

Figure 6: 配置时加上调试参数

1.2.2 make clean && make 重新编译

```
$ make clean && make
Making clean in .
rm -f tools/kmod
test -z "testsuite/uname.la testsuite/path.la testsuite/
init_module.la testsuite/delete_module.la testsuite/
libtestsuite.la" || rm -f testsuite/uname.la testsuite/
path.la testsuite/init_module.la testsuite/
delete_module.la testsuite/libtestsuite.la
rm -f testsuite/so_locations
rm -f testsuite/test-init testsuite/test-testsuite testsuite/
test-loaded testsuite/test-modinfo testsuite/test-
```

```

alias      testsuite/ test- new- module      testsuite/ test-
modprobe   testsuite/ test- blacklist      testsuite/ test-
dependencies testsuite/test-depmod
test -z "libkmod/libkmod.pc" || rm -f libkmod/libkmod.pc
test -z "libkmod/libkmod.la" || rm -f libkmod/libkmod.la
rm -f libkmod/so_locations
rm -rf .libs _libs
rm -rf libkmod/.libs libkmod/_libs
rm -rf testsuite/.libs testsuite/_libs
rm -rf tools/.libs tools/_libs
test -z "libkmod/ libkmod- util.la libkmod/ libkmod-
private.la" || rm -f libkmod/libkmod-util.la libkmod/libkmod-
private.la
rm -f libkmod/so_locations
rm -f tools/kmod-nolib
rm -f *.o
rm -f libkmod/*.o
rm -f libkmod/*.lo
rm -f testsuite/*.o
rm -f testsuite/*.lo
rm -f tools/*.o
rm -f *.lo
Making clean in libkmod/docs
test -z "" || rm -f
rm -rf .libs _libs
rm -f *.lo
Making clean in man
test -z "depmod.d.5 modprobe.d.5 modules.dep.5 depmod.8 insmod.
8 lsmod.8 rmmmod.8 modprobe.8 modinfo.8 modules.dep.bin.5" || rm -
f depmod.d.5 modprobe.d.5 modules.dep.5 depmod.8 insmod.8 lsmod.
8 rmmmod.8 modprobe.8 modinfo.8 modules.dep.bin.5
rm -rf .libs _libs
rm -f *.lo
make --no-print-directory all-recursive
Making all in .
CC      libkmod/libkmod.lo
CC      libkmod/libkmod-list.lo
CC      libkmod/libkmod-config.lo
CC      libkmod/libkmod-index.lo
CC      libkmod/libkmod-module.lo
CC      libkmod/libkmod-file.lo
CC      libkmod/libkmod-elf.lo

```

```

CC      libkmod/libkmod-hash.lo
CC      libkmod/libkmod-array.lo
CC      libkmod/libkmod-util.lo
CCLD    libkmod/libkmod-util.la
CCLD    libkmod/libkmod.la
CCLD    libkmod/libkmod-private.la
CC      tools/kmod.o
CC      tools/lsmmod.o
CC      tools/rmmod.o
CC      tools/insmod.o
CC      tools/modinfo.o
CC      tools/modprobe.o
CC      tools/depmod.o
CC      tools/log.o
CCLD    tools/kmod
CCLD    tools/kmod-nolib
GEN      libkmod/libkmod.pc
Making all in libkmod/docs
make[2]: Nothing to be done for `all'.
Making all in man
GEN      depmod.d.5
GEN      modprobe.d.5
GEN      modules.dep.5
GEN      depmod.8
GEN      insmod.8
GEN      lsmod.8
GEN      rmmod.8
GEN      modprobe.8
GEN      modinfo.8
$

```

1.2.3 设置日志优先级 KMOD_LOG=7

```

$ sudo KMOD_LOG=7 ./tools/insmod ../hello-module/hello.ko
libkmod: INFO libkmod/libkmod.c:275 kmod_new: ctx 0x9243008 created
libkmod: DEBUG libkmod/libkmod.c:276 kmod_new: log_priority=7
libkmod:          DEBUG          libkmod/      libkmod.c:
389 kmod_pool_get_module: get module name='hello' found=(nil)
libkmod:          DEBUG          libkmod/      libkmod.c:
389 kmod_pool_get_module: get module name='hello' found=(nil)

```



```

Terminal
$ make clean && make
Making clean in .
rm -f tools/kmod
test -z "testsuite/uname.la testsuite/path.la testsuite/init_module.la testsuite/delete_module.la testsuite/libtestsuite.la" || rm -f testsuite/uname.la testsuite/path.la testsuite/init_module.la testsuite/delete_module.la testsuite/libtestsuite.la
rm -f testsuite/so_locations
rm -f testsuite/test-init testsuite/test-testsuite testsuite/test-loaded testsuite/test-modinfo testsuite/test-alias testsuite/test-new-module testsuite/test-modprobe testsuite/test-blacklist testsuite/test-dependencies testsuite/test-depm
od
test -z "libkmod/libkmod.pc" || rm -f libkmod/libkmod.pc
test -z "libkmod/libkmod.la" || rm -f libkmod/libkmod.la
rm -f libkmod/so_locations
rm -rf .libs _libs
rm -rf libkmod/.libs libkmod/_libs
rm -rf testsuite/.libs testsuite/_libs
rm -rf tools/.libs tools/_libs
test -z "libkmod/libkmod-util.la libkmod/libkmod-private.la" || rm -f libkmod/libkmod-util.la libkmod/libkmod-private.la
rm -f libkmod/so_locations
rm -f tools/kmod-nolib
rm -f *.o
rm -f libkmod/*.o

```

Figure 7: make 重新编译

```

libkmod:          DEBUG          libkmod/    libkmod.c:
397 kmod_pool_add_module: add 0x9243088 key='hello'
libkmod:          DEBUG          libkmod/    libkmod-  module.c:
718 kmod_module_get_path: name='hello' path='/home/akaedu/
Github/test-kmod-11/kmod-11/./hello-module/hello.ko'
libkmod:          DEBUG          libkmod/    libkmod-  module.c:
440 kmod_module_unref: kmod_module 0x9243088 released
libkmod:          DEBUG          libkmod/    libkmod.c:
405 kmod_pool_del_module: del 0x9243088 key='hello'
libkmod: INFO libkmod/libkmod.c:318 kmod_unref: context 0x9243008 released
$

```

1.2.4 卸载模块以便进行下一次插入

```

$ sudo KMOD_LOG=7 ./tools/rmmod ../hello-module/hello.ko
libkmod: INFO libkmod/libkmod.c:275 kmod_new: ctx 0x9584008 created
libkmod: DEBUG libkmod/libkmod.c:276 kmod_new: log_priority=7

```

```
Terminal
$ sudo KMOD_LOG=7 ./tools/insmod ../hello-module/hello.ko
libkmod: INFO libkmod/libkmod.c:275 kmod_new: ctx 0x9243008 created
libkmod: DEBUG libkmod/libkmod.c:276 kmod_new: log_priority=7
libkmod: DEBUG libkmod/libkmod.c:389 kmod_pool_get_module: get module name='hello' found=(nil)
libkmod: DEBUG libkmod/libkmod.c:389 kmod_pool_get_module: get module name='hello' found=(nil)
libkmod: DEBUG libkmod/libkmod.c:397 kmod_pool_add_module: add 0x9243088 key='hello'
libkmod: DEBUG libkmod/libkmod-module.c:718 kmod_module_get_path: name='hello' path='/home/akaedu/Github/test-kmod-11/kmod-11/./hello-module/hello.ko'
libkmod: DEBUG libkmod/libkmod-module.c:440 kmod_module_unref: kmod_module 0x9243088 released
libkmod: DEBUG libkmod/libkmod.c:405 kmod_pool_del_module: del 0x9243088 key='hello'
libkmod: INFO libkmod/libkmod.c:318 kmod_unref: context 0x9243008 released
$
```

Figure 8: 设置 KMOD_LOG=7 模式下插入模块

```
$
```

1.2.5 设置日志优先级 KMOD_LOG=6

```
$ sudo KMOD_LOG=6 ./tools/insmod ../hello-module/hello.ko
libkmod: INFO libkmod/libkmod.c:275 kmod_new: ctx 0x9c46008 created
libkmod: INFO libkmod/libkmod.c:318 kmod_unref: context 0x9c46008 released
$

$ sudo KMOD_LOG=6 ./tools/rmmod ../hello-module/hello.ko
libkmod: INFO libkmod/libkmod.c:275 kmod_new: ctx 0x9584008 created
libkmod: DEBUG libkmod/libkmod.c:276 kmod_new: log_priority=7
$
```

```
Terminal
$ sudo KMOD_LOG=6 ./tools/insmod ../hello-module/hello.ko
libkmod: INFO libkmod/libkmod.c:275 kmod_new: ctx 0x8dae008 created
libkmod: INFO libkmod/libkmod.c:318 kmod_unref: context 0x8dae008 released
$
$ sudo KMOD_LOG=6 ./tools/rmmod ../hello-module/hello.ko
libkmod: INFO libkmod/libkmod.c:275 kmod_new: ctx 0x9ad7008 created
$
```

Figure 9: 设置 KMOD_LOG=6 模式下插入模块

1.3 源码修改运行调试图

1.3.1 修改 modprobe.c 源码

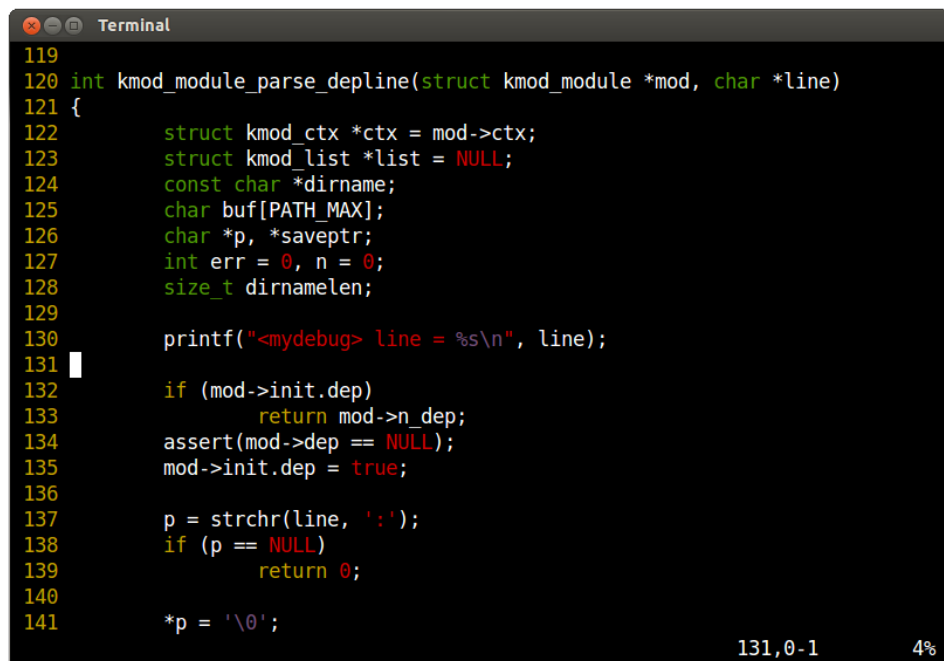
1.3.2 修改 kmod_module_parse_depline 函数

```
$ vi kmod-11/libkmod/libkmod-module.c +120
120 int kmod_module_parse_depline(struct kmod_module *mod, char *line)
121 {
122     struct kmod_ctx *ctx = mod->ctx;
123     struct kmod_list *list = NULL;
124     const char *dirname;
125     char buf[PATH_MAX];
126     char *p, *saveptr;
127     int err = 0, n = 0;
128     size_t dirnamelen;
129
130     printf("<mydebug> line = %s\n", line);
131
132     if (mod->init.dep)
```

```

133         return mod->n_dep;
134     assert(mod->dep == NULL);
135     mod->init.dep = true;
136
137     p = strchr(line, ':');
138     if (p == NULL)
139         return 0;
140

```



```

119
120 int kmod_module_parse_depline(struct kmod_module *mod, char *line)
121 {
122     struct kmod_ctx *ctx = mod->ctx;
123     struct kmod_list *list = NULL;
124     const char *dirname;
125     char buf[PATH_MAX];
126     char *p, *saveptr;
127     int err = 0, n = 0;
128     size_t dirnamelen;
129
130     printf("<mydebug> line = %s\n", line);
131
132     if (mod->init.dep)
133         return mod->n_dep;
134     assert(mod->dep == NULL);
135     mod->init.dep = true;
136
137     p = strchr(line, ':');
138     if (p == NULL)
139         return 0;
140
141     *p = '\0';

```

131,0-1 4%

Figure 10: 插入 130 行的打印 line 的语句

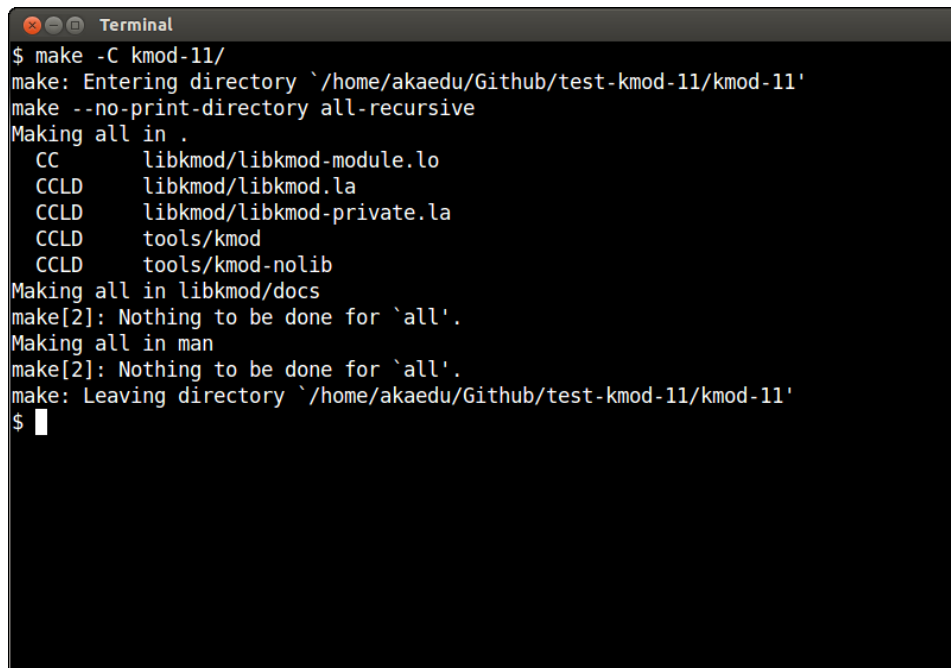
1.3.3 重新编译生成新的 modprobe

```

$ make -C kmod-11/
make: Entering directory `/home/akaedu/Github/test-kmod-11/
kmod-11'
make --no-print-directory all-recursive
Making all in .

```

```
CC      libkmod/libkmod-module.lo
CCLD    libkmod/libkmod.la
CCLD    libkmod/libkmod-private.la
CCLD    tools/kmod
CCLD    tools/kmod-nolib
Making all in libkmod/docs
make[2]: Nothing to be done for `all'.
Making all in man
make[2]: Nothing to be done for `all'.
make: Leaving directory `/home/akaedu/Github/test-kmod-11/
kmod-11'
$
```



```
Terminal
$ make -C kmod-11/
make: Entering directory `/home/akaedu/Github/test-kmod-11/kmod-11'
make --no-print-directory all-recursive
Making all in .
CC      libkmod/libkmod-module.lo
CCLD    libkmod/libkmod.la
CCLD    libkmod/libkmod-private.la
CCLD    tools/kmod
CCLD    tools/kmod-nolib
Making all in libkmod/docs
make[2]: Nothing to be done for `all'.
Making all in man
make[2]: Nothing to be done for `all'.
make: Leaving directory `/home/akaedu/Github/test-kmod-11/kmod-11'
$
```

Figure 11: make 编译成功, 增量编译了 libkmod-module 模块

1.3.4 运行 modprobe nfs

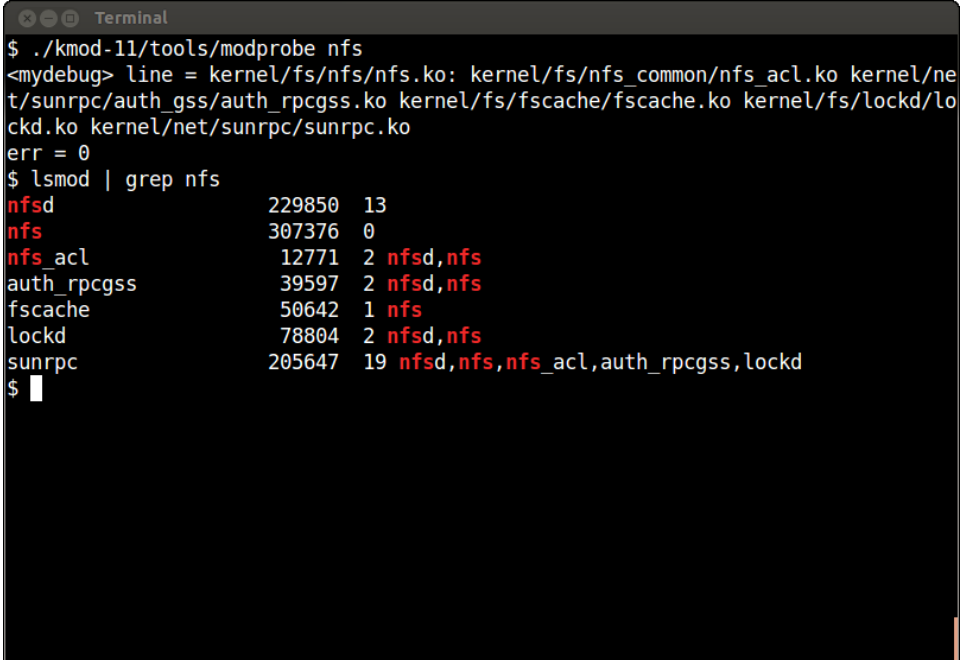
```
$ ./kmod-11/tools/modprobe nfs
```

```

<mydebug> line = kernel/fs/nfs/nfs.ko: kernel/fs/nfs_common/
nfs_acl.ko kernel/net/sunrpc/auth_gss/auth_rpcgss.ko kernel/fs/
fscache/fscache.ko kernel/fs/lockd/lockd.ko kernel/net/sunrpc/
sunrpc.ko

$ lsmod | grep nfs
nfsd                229850  13
nfs                  307376   0
nfs_acl              12771   2 nfsd,nfs
auth_rpcgss          39597   2 nfsd,nfs
fscache              50642   1 nfs
lockd                78804   2 nfsd,nfs
sunrpc               205647  19 nfsd,nfs,nfs_acl,auth_rpcgss,lockd
$

```



```

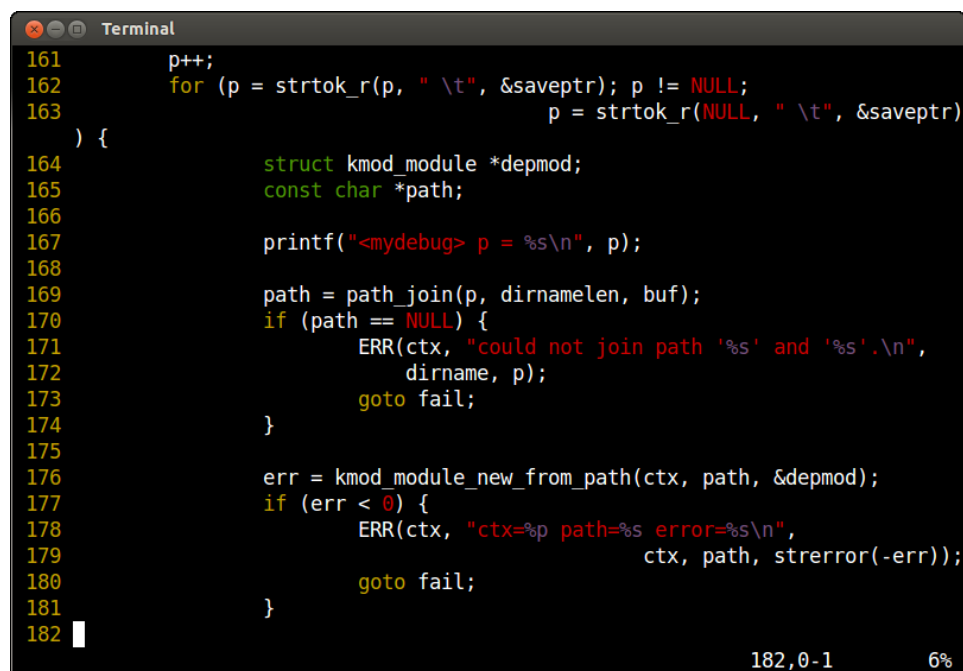
Terminal
$ ./kmod-ll/tools/modprobe nfs
<mydebug> line = kernel/fs/nfs/nfs.ko: kernel/fs/nfs_common/nfs_acl.ko kernel/ne
t/sunrpc/auth_gss/auth_rpcgss.ko kernel/fs/fscache/fscache.ko kernel/fs/lockd/lo
ckd.ko kernel/net/sunrpc/sunrpc.ko
err = 0
$ lsmod | grep nfs
nfsd                229850  13
nfs                  307376   0
nfs_acl              12771   2 nfsd,nfs
auth_rpcgss          39597   2 nfsd,nfs
fscache              50642   1 nfs
lockd                78804   2 nfsd,nfs
sunrpc               205647  19 nfsd,nfs,nfs_acl,auth_rpcgss,lockd
$

```

Figure 12: 运行 modprobe nfs 完成插入

1.3.5 插入 167 行打印语句

```
$ vi kmod-11/libkmod/libkmod-module.c +161
161         p++;
162         for (p = strtok_r(p, " \t", &saveptr); p != NULL;
163             p = strtok_r(NULL, " \t", &saveptr) ) {
164             struct kmod_module *depmod;
165             const char *path;
166
167             printf("<mydebug> p = %s\n", p);
168             path = path_join(p, dirnamelen, buf);
169             if (path == NULL) {
170                 ERR(ctx, "could not join path '%s' and '%s'.
171 \n",
172                 dirname, p);
173                 goto fail;
174             }
175
176             err = kmod_module_new_from_path(ctx, path, &depmod);
177             if (err < 0) {
178                 ERR(ctx, "ctx=%p path=%s error=%s\n",
179                     ctx, path, strerror(-err));
180                 goto fail;
181             }
182         }
```



```
Terminal
161         p++;
162         for (p = strtok_r(p, " \t", &saveptr); p != NULL;
163             p = strtok_r(NULL, " \t", &saveptr) ) {
164             struct kmod_module *depmod;
165             const char *path;
166
167             printf("<mydebug> p = %s\n", p);
168             path = path_join(p, dirnamelen, buf);
169             if (path == NULL) {
170                 ERR(ctx, "could not join path '%s' and '%s'.
171 \n",
172                 dirname, p);
173                 goto fail;
174             }
175
176             err = kmod_module_new_from_path(ctx, path, &depmod);
177             if (err < 0) {
178                 ERR(ctx, "ctx=%p path=%s error=%s\n",
179                     ctx, path, strerror(-err));
180                 goto fail;
181             }
182         }
```

Figure 13: 插入打印每个模块名称的调试代码

1.3.6 重新编译生成新的 modprobe

```
$ make -C kmod-11/
make: Entering directory `/home/akaedu/Github/test-kmod-11/
kmod-11'
make --no-print-directory all-recursive
Making all in .
  CC      libkmod/libkmod-module.lo
  CCLD    libkmod/libkmod.la
  CCLD    libkmod/libkmod-private.la
  CCLD    tools/kmod
  CCLD    tools/kmod-nolib
Making all in libkmod/docs
make[2]: Nothing to be done for `all'.
Making all in man
make[2]: Nothing to be done for `all'.
make: Leaving directory `/home/akaedu/Github/test-kmod-11/
kmod-11'
$
```

1.3.7 运行 modprobe nfs

```
$ ./kmod-11/tools/modprobe nfs
<mydebug> line = kernel/fs/nfs/nfs.ko: kernel/fs/nfs_common/
nfs_acl.ko kernel/net/sunrpc/auth_gss/auth_rpcgss.ko kernel/fs/
fscache/fscache.ko kernel/fs/lockd/lockd.ko kernel/net/sunrpc/
sunrpc.ko
<mydebug> p = kernel/fs/nfs_common/nfs_acl.ko
<mydebug> p = kernel/net/sunrpc/auth_gss/auth_rpcgss.ko
<mydebug> p = kernel/fs/fscache/fscache.ko
<mydebug> p = kernel/fs/lockd/lockd.ko
<mydebug> p = kernel/net/sunrpc/sunrpc.ko
```



```
Terminal
$ ./kmod-11/tools/modprobe nfs
<mydebug> line = kernel/fs/nfs/nfs.ko: kernel/fs/nfs_common/nfs_acl.ko kernel/ne
t/sunrpc/auth_gss/auth_rpcgss.ko kernel/fs/fscache/fscache.ko kernel/fs/lockd/lo
ckd.ko kernel/net/sunrpc/sunrpc.ko
<mydebug> p = kernel/fs/nfs_common/nfs_acl.ko
<mydebug> p = kernel/net/sunrpc/auth_gss/auth_rpcgss.ko
<mydebug> p = kernel/fs/fscache/fscache.ko
<mydebug> p = kernel/fs/lockd/lockd.ko
<mydebug> p = kernel/net/sunrpc/sunrpc.ko
err = 0
$
```

Figure 14: 调试代码输出详细调试信息