南京理工大学计算机科学与技术学院

软件课程设计Ⅲ实验报告

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目录

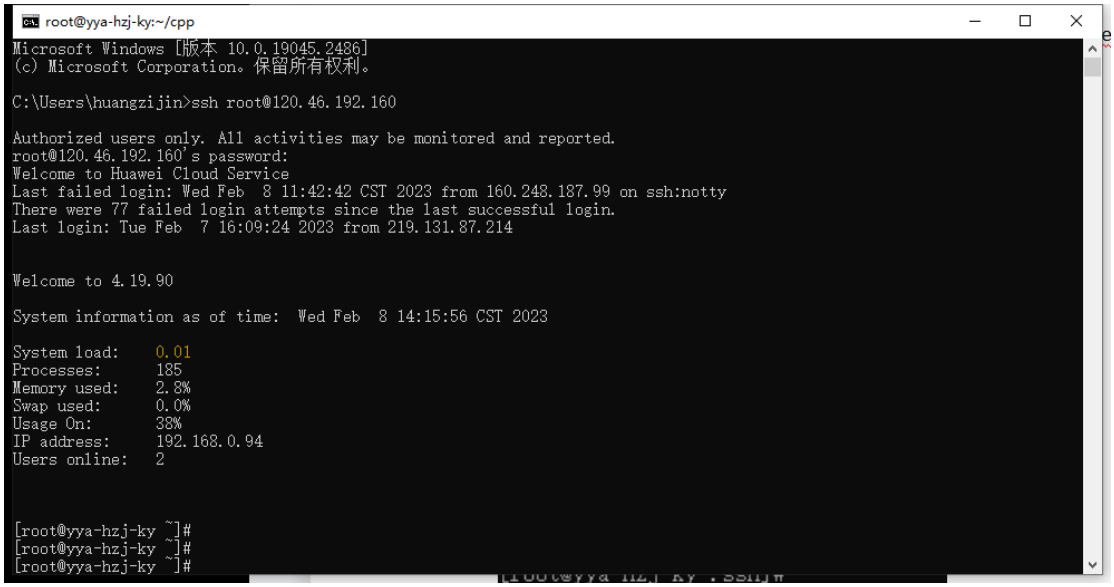
1 构建实验环境

1.1 实验介绍

openEuler 是一款通用服务器操作系统，支持 x86 和 ARM 等多种处理器架构，本实验旨在熟悉基于 Kunpeng 架构弹性云服务器 ECS 上 openEuler 操作系统基本系统环境、学习轻量级容器 iSulad 的基本用法以及了解智能调优引擎 A-Tune 的调优过程。

1.2 构建实验环境

我们购买了华为云服务器，搭载的是鲲鹏芯片，操作系统是 openEuler，ip 地址是 120.46.192.160，使用 ssh 命令登录服务器。



图表 1ssh 命令登录服务器

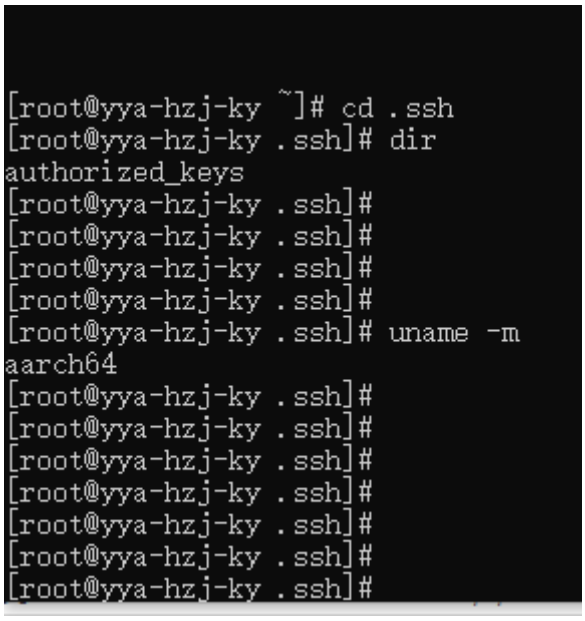
2 openEuler 系统环境实验

2.1 实验介绍

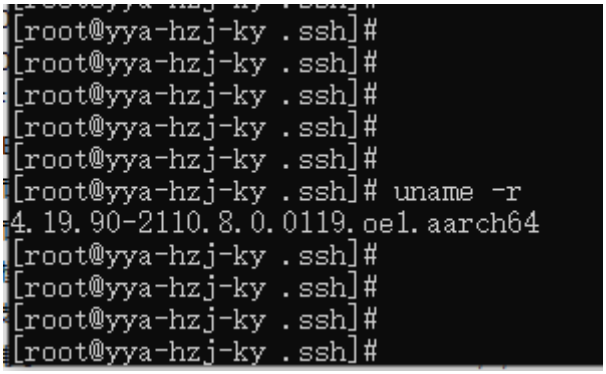
本实验通过运行 shell 命令查看系统信息以达到了解 openEuler 操作系统的目的。

2.2 系统编程环境实验

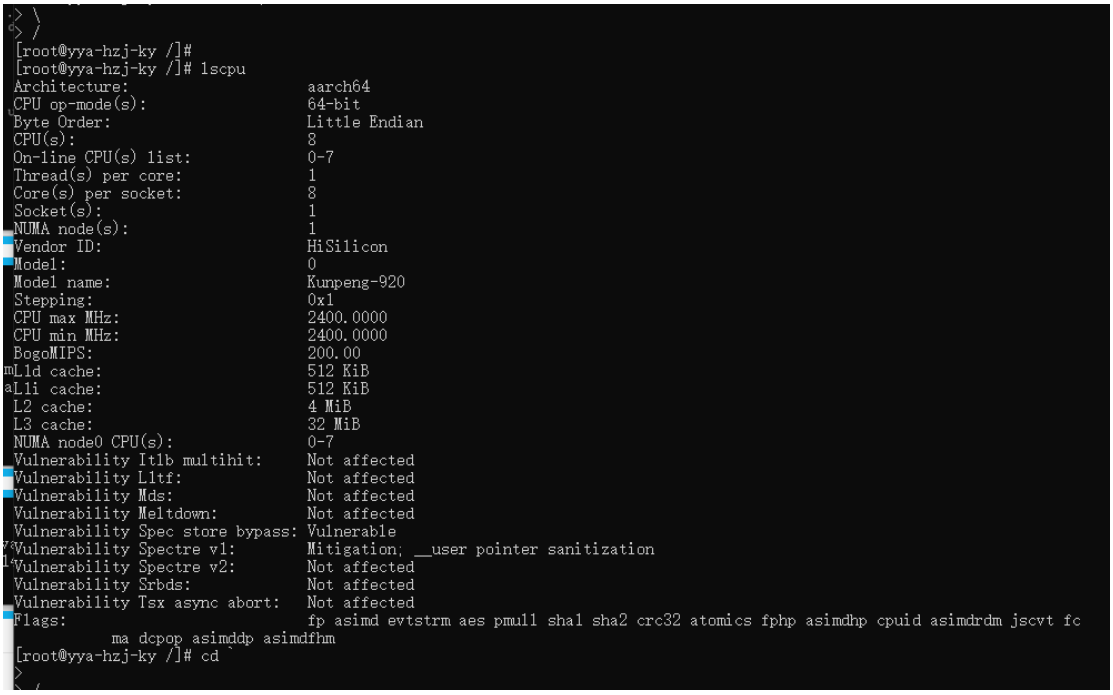
使用 uname -m 可以查看到，使用的是 aarch64 架构，如下图。



使用 uname -r 可以查看到版本号，如下图。



使用 lscpu 查看 cpu 的参数：8 个 cpu，编号从 0 到 7，有一个插槽，一个插槽 8 个核心，产商是 HiSilicon 半导体，鲲鹏 920 的芯片。如下图。



3 内核编程实验

3.1 实验介绍

3.1.1 关于本实验

本实验在鲲鹏云 ECS 上编译、安装 openEuler 操作系统内核并编写一个简单的内核模块以验证安装是否成功。

3.1.2 实验目的

- 熟悉 openEuler 内核的编译与安装；
- 了解内核模块编程的过程。

3.2 内核编程实验

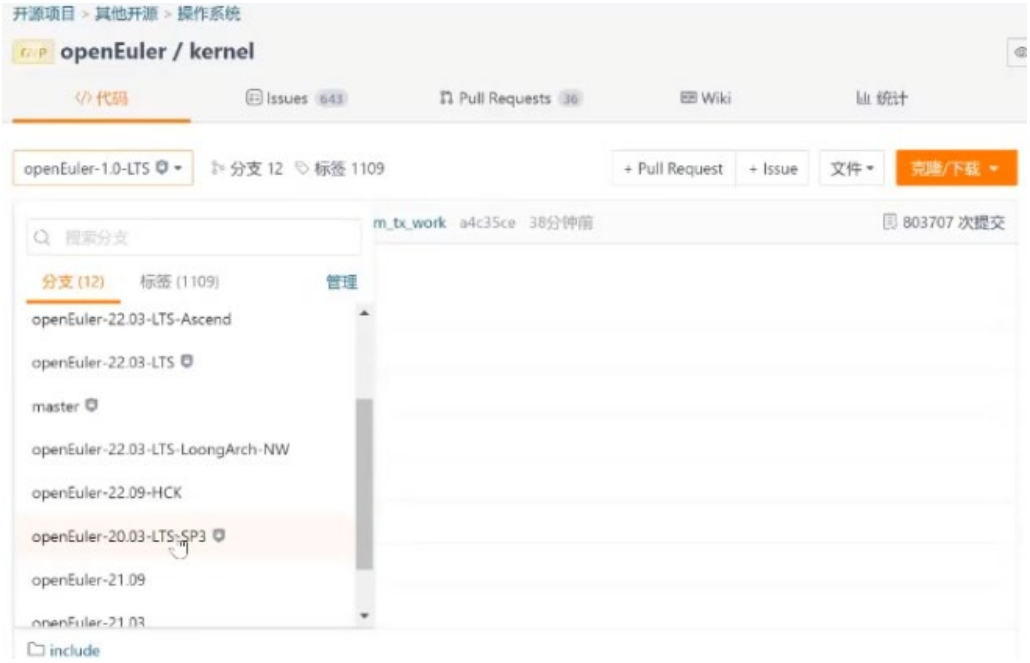
3.2.1 内核的编译与安装

安装环境

```
yum group install -y "Development Tools"
yum install -y bc
yum install -y openssl -devel --nogpgcheck
```

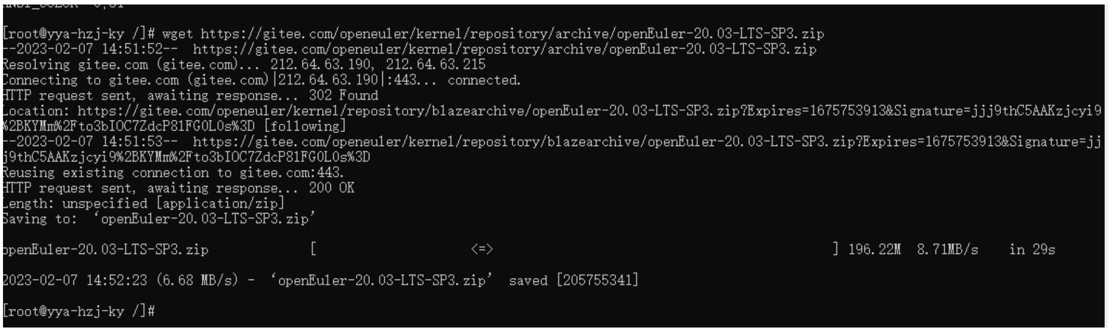
```
Total download size: 87 k
Installed size: 293 k
Downloading Packages:
bc-1.07.1-11.oe1.aarch64.rpm
--------------------------------------------------------------------------------
Total
Running transaction check
Transaction check succeeded.
Running transaction test
Transaction test succeeded.
Running transaction
  Preparing        :
  Installing       : bc-1.07.1-11.oe1.aarch64
  Verifying        : bc-1.07.1-11.oe1.aarch64

Installed:
  bc-1.07.1-11.oe1.aarch64

Complete!
[root@yya-hzj-ky /]# yum install -y openssl-devel
```

获取内核（从 openEuler 的 gitee 中获取下载链接）



下载内核

```
wget https://gitee.com/openeuler/kernel/repository/archive/openEuler-20.03-LTS-SP3.zip
```



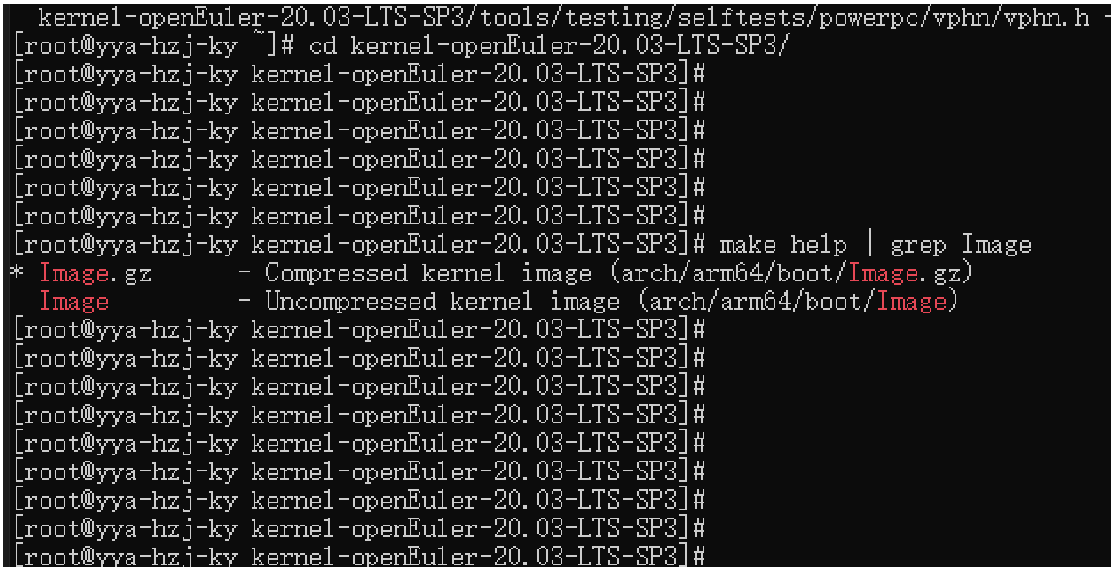
```
[root@yya-hzj-ky /]# wget https://gitee.com/openeuler/kernel/repository/archive/openEuler-20.03-LTS-SP3.zip
--2023-02-07 14:51:52--  https://gitee.com/openeuler/kernel/repository/archive/openEuler-20.03-LTS-SP3.zip
Resolving gitee.com (gitee.com)... 212.64.63.190, 212.64.63.215
Connecting to gitee.com (gitee.com)|212.64.63.190|:443... connected.
HTTP request sent, awaiting response... 302 Found
Location: https://gitee.com/openeuler/kernel/repository/blazearchive/openEuler-20.03-LTS-SP3.zip?Expires=1675753913&Signature=jjj9thC5AAKzjcyi9
%2BKYMm%2Fto3bIOC7ZdcP81FG0L0s%3D [following]
--2023-02-07 14:51:53--  https://gitee.com/openeuler/kernel/repository/blazearchive/openEuler-20.03-LTS-SP3.zip?Expires=1675753913&Signature=jj
j9thC5AAKzjcyi9%2BKYMm%2Fto3bIOC7ZdcP81FG0L0s%3D
Reusing existing connection to gitee.com:443.
HTTP request sent, awaiting response... 200 OK
Length: unspecified [application/zip]
Saving to: 'openEuler-20.03-LTS-SP3.zip'

openEuler-20.03-LTS-SP3.zip          [                  <=>                          ] 196.22M  8.71MB/s    in 29s

2023-02-07 14:52:23 (6.68 MB/s) - 'openEuler-20.03-LTS-SP3.zip' saved [205755341]

[root@yya-hzj-ky /]#
```

解压

unzip Euler-20.03-LTS-SP3.zip

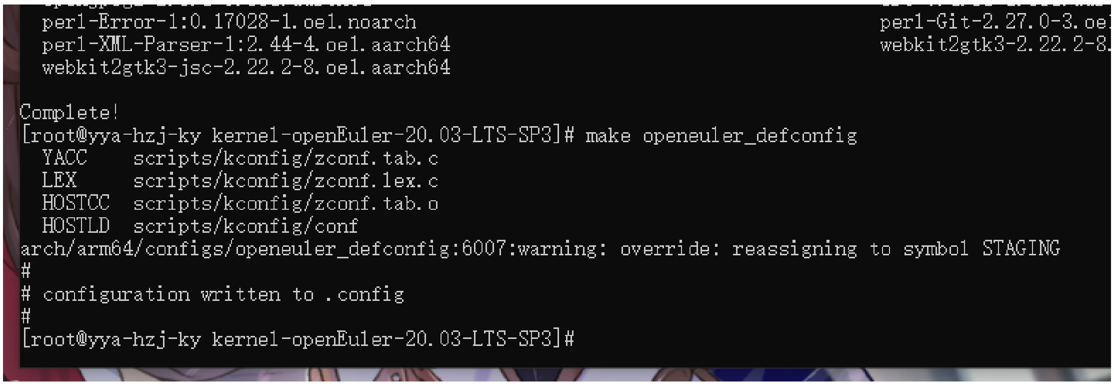
查看 image 类型，可以看到他可以压缩格式的

make help | grep Image



```
  kernel-openEuler-20.03-LTS-SP3/tools/testing/selftests/powerpc/vphn/vphn.h
[root@yya-hzj-ky ~]# cd kernel-openEuler-20.03-LTS-SP3/
[root@yya-hzj-ky kernel-openEuler-20.03-LTS-SP3]#
[root@yya-hzj-ky kernel-openEuler-20.03-LTS-SP3]#
[root@yya-hzj-ky kernel-openEuler-20.03-LTS-SP3]#
[root@yya-hzj-ky kernel-openEuler-20.03-LTS-SP3]#
[root@yya-hzj-ky kernel-openEuler-20.03-LTS-SP3]#
[root@yya-hzj-ky kernel-openEuler-20.03-LTS-SP3]#
[root@yya-hzj-ky kernel-openEuler-20.03-LTS-SP3]# make help | grep Image
* Image.gz      - Compressed kernel image (arch/arm64/boot/Image.gz)
  Image         - Uncompressed kernel image (arch/arm64/boot/Image)
[root@yya-hzj-ky kernel-openEuler-20.03-LTS-SP3]#
[root@yya-hzj-ky kernel-openEuler-20.03-LTS-SP3]#
[root@yya-hzj-ky kernel-openEuler-20.03-LTS-SP3]#
[root@yya-hzj-ky kernel-openEuler-20.03-LTS-SP3]#
[root@yya-hzj-ky kernel-openEuler-20.03-LTS-SP3]#
[root@yya-hzj-ky kernel-openEuler-20.03-LTS-SP3]#
[root@yya-hzj-ky kernel-openEuler-20.03-LTS-SP3]#
[root@yya-hzj-ky kernel-openEuler-20.03-LTS-SP3]#
[root@yya-hzj-ky kernel-openEuler-20.03-LTS-SP3]#
```

编译内核前要 make 一下配置，使用的是 menuconfig，产生了一个 config 文件



```
  perl-Error-1:0.17028-1.oe1.noarch                          perl-Git-2.27.0-3.oe1
  perl-XML-Parser-1:2.44-4.oe1.aarch64                       webkit2gtk3-2.22.2-8.
  webkit2gtk3-jsc-2.22.2-8.oe1.aarch64

Complete!
[root@yya-hzj-ky kernel-openEuler-20.03-LTS-SP3]# make openeuler_defconfig
  YACC    scripts/kconfig/zconf.tab.c
  LEX     scripts/kconfig/zconf.lex.c
  HOSTCC  scripts/kconfig/zconf.tab.o
  HOSTLD  scripts/kconfig/conf
arch/arm64/configs/openeuler_defconfig:6007:warning: override: reassigning to symbol STAGING
#
# configuration written to .config
#
[root@yya-hzj-ky kernel-openEuler-20.03-LTS-SP3]#
```

然后就 build 内核，以 8 个线程来创建内核

make -j16 Image

```
  INSTALL net/tipc/tipc.ko
  INSTALL net/tls/tls.ko
  INSTALL net/unix/unix_diag.ko
  INSTALL net/vmw_vsock/vmw_vsock_virtio_transport.ko
  INSTALL net/vmw_vsock/vmw_vsock_virtio_transport_common.ko
  INSTALL net/vmw_vsock/vsock.ko
  INSTALL net/vmw_vsock/vsock_diag.ko
  INSTALL net/wireless/cfg80211.ko
  INSTALL net/xfrm/xfrm_ipcomp.ko
  INSTALL security/keys/encrypted-keys/encrypted-keys.ko
  INSTALL security/keys/trusted.ko
  INSTALL sound/soundcore.ko
  DEPMOD  4.19.90
[root@yya-hzj-ky kernel-openEuler-20.03-LTS-SP3]#
[root@yya-hzj-ky kernel-openEuler-20.03-LTS-SP3]#
[root@yya-hzj-ky kernel-openEuler-20.03-LTS-SP3]#
[root@yya-hzj-ky kernel-openEuler-20.03-LTS-SP3]#
[root@yya-hzj-ky kernel-openEuler-20.03-LTS-SP3]#
[root@yya-hzj-ky kernel-openEuler-20.03-LTS-SP3]#
[root@yya-hzj-ky kernel-openEuler-20.03-LTS-SP3]#
```

创建内核模块

```
make -j16 modules
```

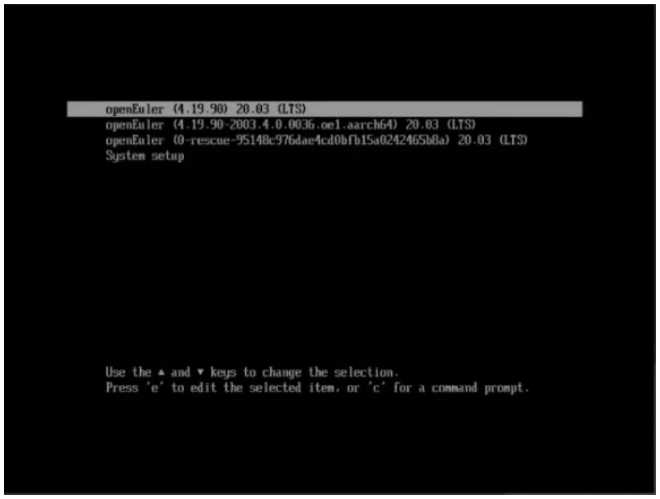
安装到 boot 目录下

```
Make install
```

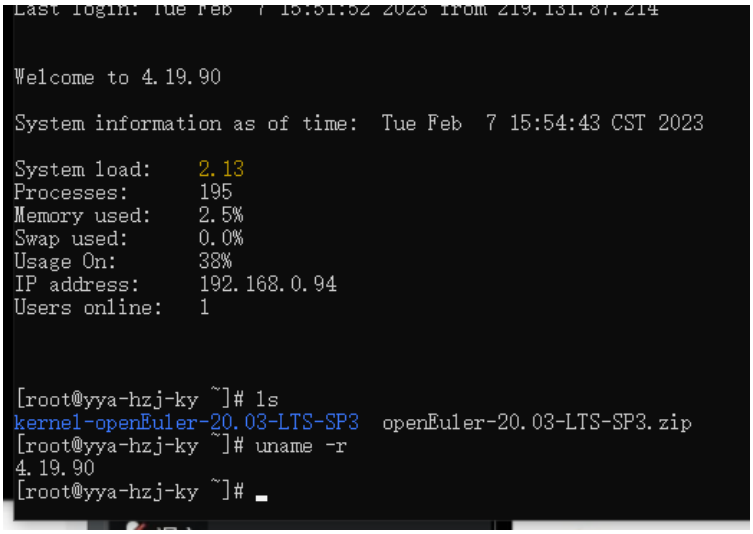
```
[root@yya-hzj-ky kernel-openEuler-20.03-LTS-SP3]#
[root@yya-hzj-ky kernel-openEuler-20.03-LTS-SP3]#
[root@yya-hzj-ky kernel-openEuler-20.03-LTS-SP3]#
[root@yya-hzj-ky kernel-openEuler-20.03-LTS-SP3]#
[root@yya-hzj-ky kernel-openEuler-20.03-LTS-SP3]#
[root@yya-hzj-ky kernel-openEuler-20.03-LTS-SP3]# ls /boot
config-4.19.90-2003.4.0.0036.oe1.aarch64                  initramfs-4.19.90-2110.8.0.0119.oe1.aarch64.img
config-4.19.90-2110.8.0.0119.oe1.aarch64                  initramfs-4.19.90-2110.8.0.0119.oe1.aarch64kdump.img
dracut                                                    loader
dtb-4.19.90-2003.4.0.0036.oe1.aarch64                     symvers-4.19.90-2003.4.0.0036.oe1.aarch64.gz
dtb-4.19.90-2110.8.0.0119.oe1.aarch64                     symvers-4.19.90-2110.8.0.0119.oe1.aarch64.gz
efi                                                       System.map-4.19.90-2003.4.0.0036.oe1.aarch64
grub2                                                     System.map-4.19.90-2110.8.0.0119.oe1.aarch64
initramfs-0-rescue-838b891167544288a72747f6690d2704.img   vmlinuz-0-rescue-838b891167544288a72747f6690d2704
initramfs-4.19.90-2003.4.0.0036.oe1.aarch64.img           vmlinuz-4.19.90-2003.4.0.0036.oe1.aarch64
initramfs-4.19.90-2003.4.0.0036.oe1.aarch64kdump.img      vmlinuz-4.19.90-2110.8.0.0119.oe1.aarch64
[root@yya-hzj-ky kernel-openEuler-20.03-LTS-SP3]# make install
/bin/sh ./arch/arm64/boot/install.sh 4.19.90 \
arch/arm64/boot/Image System.map "/boot"
[root@yya-hzj-ky kernel-openEuler-20.03-LTS-SP3]#
[root@yya-hzj-ky kernel-openEuler-20.03-LTS-SP3]# ls /boot
config-4.19.90-2003.4.0.0036.oe1.aarch64                  loader
config-4.19.90-2110.8.0.0119.oe1.aarch64                  symvers-4.19.90-2003.4.0.0036.oe1.aarch64.gz
dracut                                                    symvers-4.19.90-2110.8.0.0119.oe1.aarch64.gz
dtb-4.19.90-2003.4.0.0036.oe1.aarch64                     System.map
dtb-4.19.90-2110.8.0.0119.oe1.aarch64                     System.map-4.19.90
efi                                                       System.map-4.19.90-2003.4.0.0036.oe1.aarch64
grub2                                                     System.map-4.19.90-2110.8.0.0119.oe1.aarch64
initramfs-0-rescue-838b891167544288a72747f6690d2704.img   vmlinuz
initramfs-4.19.90-2003.4.0.0036.oe1.aarch64.img           vmlinuz-0-rescue-838b891167544288a72747f6690d2704
initramfs-4.19.90-2003.4.0.0036.oe1.aarch64kdump.img      vmlinuz-4.19.90
initramfs-4.19.90-2110.8.0.0119.oe1.aarch64.img           vmlinuz-4.19.90-2003.4.0.0036.oe1.aarch64
initramfs-4.19.90-2110.8.0.0119.oe1.aarch64kdump.img      vmlinuz-4.19.90-2110.8.0.0119.oe1.aarch64
initramfs-4.19.90.img
[root@yya-hzj-ky kernel-openEuler-20.03-LTS-SP3]#
```

可以看到有新的内核 vmlinuz-4.19.90 已经安装

Reboot 重启，以新的内核引导

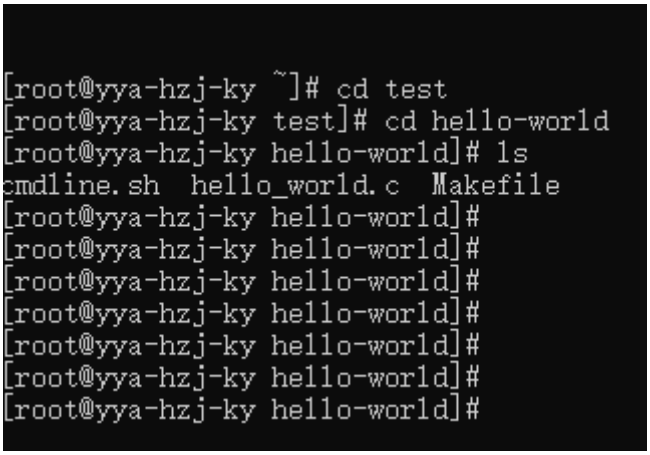


可以看到，重启后内核变了



3.2.2 Hello, world!

将 test 文件夹上传到服务器



将编译并执行 hello-world.c

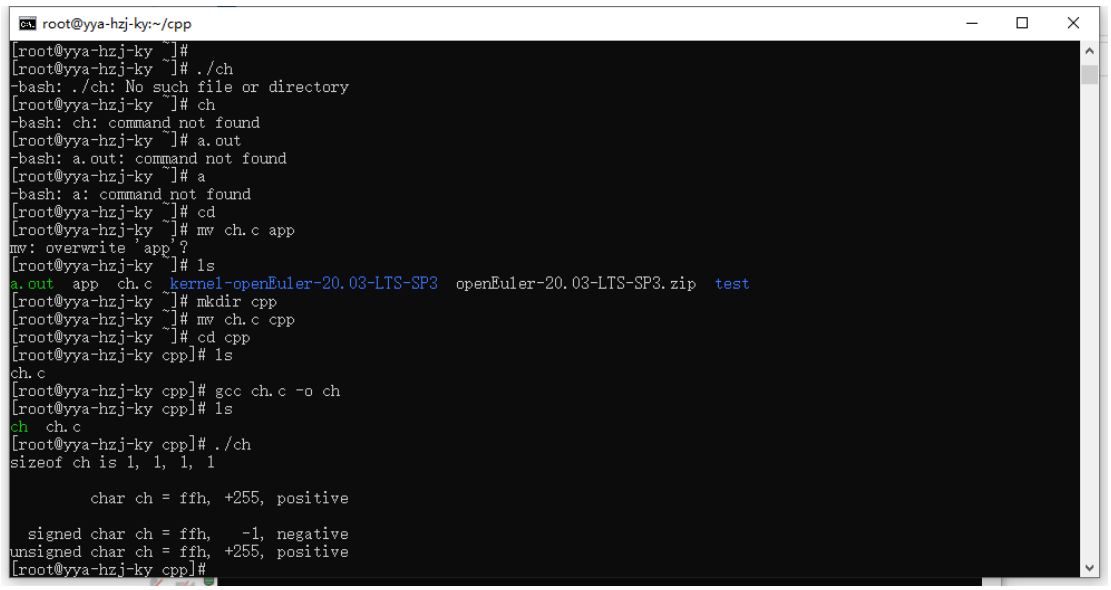
装载到内核运行， 在装载时会打印 hello，Yya，2023

使用 rmmod 指令卸载模块，在退出时打印了 Exit module.

```
[root@yya-hzj-ky ~]# cd test
[root@yya-hzj-ky test]# cd hello-world
[root@yya-hzj-ky hello-world]# ls
cmdline.sh  hello_world.c  Makefile
[root@yya-hzj-ky hello-world]#
[root@yya-hzj-ky hello-world]#
[root@yya-hzj-ky hello-world]#
[root@yya-hzj-ky hello-world]#
[root@yya-hzj-ky hello-world]#
[root@yya-hzj-ky hello-world]#
[root@yya-hzj-ky hello-world]# make
make -C /usr/lib/modules/4.19.90/build M=/root/test/hello-world modules
make[1]: Entering directory '/root/kernel-openEuler-20.03-LTS-SP3'
  CC [M]  /root/test/hello-world/hello_world.o
  Building modules, stage 2.
  MODPOST 1 modules
  CC      /root/test/hello-world/hello_world.mod.o
  LD [M]  /root/test/hello-world/hello_world.ko
make[1]: Leaving directory '/root/kernel-openEuler-20.03-LTS-SP3'
[root@yya-hzj-ky hello-world]# insmod hello_world.ko guy="Yya Hzj & Ky" year=2023
[root@yya-hzj-ky hello-world]# insmod hello_world.ko guy="YyaKy" year=2023
insmod: ERROR: could not insert module hello_world.ko: File exists
[root@yya-hzj-ky hello-world]# lsmod | grep hello
hello_world            262144  0
[root@yya-hzj-ky hello-world]# rmmod hello_world
[root@yya-hzj-ky hello-world]# dmesg | tail -n3
[ 1082.420678] Init module.
[ 1082.420886] Hello, Yya, 2023!
[ 1173.000035] Exit module.
[root@yya-hzj-ky hello-world]#
```

3.2.3 char 数据类型

将 ch.c 文件上传到服务器，并用 gcc 编译执行，可以看到执行结果，如下图。



ch.c 做的工作是创建一个值为-1 的 char 值，

分别打印在 openeuler 操作系统下，char 的长度，ch 的长度，signedchar 的长度，unsigned char 的长度。

从图中可以看出均为 1.

然后打印 ch 以本身输出，以 signedchar 格式输出，以 unsignedchar 格式输出的值

可以看到分别为 255，-1，和 255。所以在鲲鹏平台，默认 char 是无符号的数。

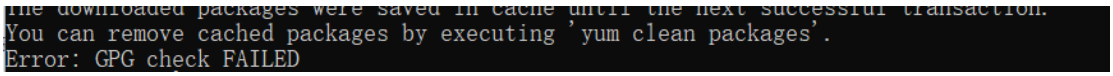
4 实验遇到的问题

4.1 问题一

4.1.1 问题描述

在执行以下命令时，遇到下图报错

```
yum install -y openssl-devel
```



4.1.2 解决方法

将上述命令该成下面的

```
yum install -y openssl-devel --nogpgcheck
```

5 小组分工

我们小组共同购买了一个华为云服务器，然后各自在自己电脑上完成全部实验，由于实验内容一样，本报告只粘贴了一份实验结果截图。