



湖南大学

HUNAN UNIVERSITY

操作系统实验报告

课 程 名 称： 操作系统

实验项目名称： 操作系统内核编程实验

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实验题目：实验一鲲鹏云 ECS 的构建及内核编译

实验目的：

- 学习掌握如何安装构建 ECS
- 学习掌握如何编译操作系统内核
- 了解内核模块编程

实验环境：

- 华为 ESC 弹性云服务器
- WinScp

实验内容及操作步骤：

1. 创建 ESC 弹性云服务器：



2. 使用 powershell 连接服务器与主机：

```

Welcome to Huawei Cloud Service

Welcome to 4.19.90~2110.8.0.0119.oe1.aarch64

System information as of time: Sun Apr 21 01:58:26 CST 2024

System load: 0.93
Processes: 164
Memory used: 4.9%
Swap used: 0.0%
Usage On: 8%
IP address: 192.168.1.122
Users online: 1

[root@openeuler ~]#
```

3. openEuler 内核编译与安装

1) 安装工具，构建开发环境：

```

[root@openEuler ~]# yum group install -y "Development Tools" --nogpgcheck
[root@openEuler ~]# yum install -y bc --nogpgcheck
[root@openEuler ~]# yum install -y openssl-devel --nogpgcheck
```

2) 备份 boot 目录以防后续步骤更新内核失败

```

[root@openEuler ~]# tar czvf boot.origin.tgz /boot/
```

保存当前内核版本信息

```

[root@openEuler ~]# uname -r > uname_r.log
```

3) 获取内核源代码并解压

```
[root@openEuler ~]# wget
https://gitee.com/openeuler/kernel/repository/archive/openEuler-20.03-LTS-SP3.zip
[root@openEuler ~]# unzip openEuler-20.03-LTS-SP3.zip
```

4) 编译内核

```
[root@openEuler ~]# mv kernel-openEuler-20.03-LTS-SP3/ kernel
[root@openEuler ~]# cd kernel/
```

```
[root@openEuler kernel]# make openeuler_defconfig
```

在这里,我们按源代码文件 kernel/arch/arm64/configs/openeuler_defconfig 的配置配置内核。

```
[root@openEuler kernel]# make help | grep Image
* Image.gz      - Compressed kernel image (arch/arm64/boot/Image.gz)
Image           - Uncompressed kernel image (arch/arm64/boot/Image)
```

这一步查看了可编译的 Image。

```
[root@openEuler kernel]# make -j4 Image modules dtbs
```

5) 安装内核

```
[root@openEuler kernel]# make modules_install
.....
INSTALL sound/soundcore.ko
DEPMOD  4.19.154
[root@openEuler kernel]# make install
/bin/sh ./arch/arm64/boot/install.sh 4.19.154 \
arch/arm64/boot/Image System.map "/boot"
```

6) 以 VNC 登录 ECS



```
Authorized users only. All activities may be monitored and reported.
openeuler login: root
Password:
Last login: Sun Apr 21 01:58:26 from 211.142.244.192

Welcome to Huawei Cloud Service

Welcome to 4.19.90-2110.8.0.0119.oe1.aarch64

System information as of time: Sun Apr 21 02:52:55 CST 2024

System load:  0.06
Processes:    155
Memory used:  5.4%
Swap used:    0.0%
Usage on:     38%
IP address:   192.168.1.122
Users online: 2

[root@openeuler ~]# _
```

7) 重启系统

```
[root@openeuler kernel]# reboot
Connection to 1.92.69.34 closed by remote host.
Connection to 1.92.69.34 closed.
```

8) 登录并验证

```
openEuler (4.19.90) 20.03 (LTS)
openEuler (4.19.90-2110.8.0.0119.oe1.aarch64) 20.03 (LTS)
openEuler (4.19.90-2003.4.0.0036.oe1.aarch64) 20.03 (LTS)
openEuler (0-rescue-838b691167544288a72747f6690d2704) 20.03 (LTS)
System setup

Use the ↑ and ↓ keys to change the selection.
Press 'e' to edit the selected item, or 'c' for a command prompt.
```

9) 登录系统并查看版本

```
Authorized users only. All activities may be monitored and reported.
openeuler login: root
Password:
Last login: Sun Apr 21 03:01:24 on tty1

Welcome to Huawei Cloud Service

Welcome to 4.19.90
System information as of time: Sun Apr 21 03:04:15 CST 2024
System load: 4.49
Processes: 164
Memory used: 5.3%
Swap used: 0.0%
Usage On: 38%
IP address: 192.168.1.122
Users online: 1

[root@openeuler ~]# uname -r
4.19.90
[root@openeuler ~]#
```

4. Hello, world!

1) 正确编写满足功能的源文件，包括.c 源文件和 Makefile 文件

```
[root@openeuler ~]# ls
boot.origin.tgz  kernel  uname_r.log
hello-world     openEuler-20.03-LTS-SP3.zip
[root@openeuler ~]# cd hello-world/
[root@openeuler hello-world]# ls
hello_world.c  Makefile
```

2) 编译源文件

```
[root@openeuler hello-world]# make
make -C /root/kernel M=/root/hello-world modules
make[1]: Entering directory '/root/kernel'
CC [M] /root/hello-world/hello_world.o
Building modules, stage 2.
MODPOST 1 modules
CC /root/hello-world/hello_world.mod.o
LD [M] /root/hello-world/hello_world.ko
make[1]: Leaving directory '/root/kernel'
```

3) 加载编译完成的内核模块，并查看加载结果

```
[root@openeuler hello-world]# insmod hello_world.ko guy="Dinu" year=2013
[root@openeuler hello-world]# lsmod | grep hello_world
hello_world          262144  0
```

4) 卸载内核模块，并查看结果

```
[root@openeuler hello-world]# rmmod hello_world
[root@openeuler hello-world]# dmesg | tail -n5
[ 565.329502] hello_world: loading out-of-tree module taints kernel.
[ 565.329974] hello_world: module verification failed: signature and/or required key missing - tainting kernel
[ 565.331097] Init module.
[ 565.331266] Hello, Dinu, 2013!
[ 621.834976] Exit module.
```

5) 退出登录

实验结果及分析:

5. 实验结果与预期相符，第一次实验主要是了解内核相关操作，难度不高，完成得比较顺利

收获与体会:

1. 第一次执行 ssh 命令时报错

```
PS C:\Users\fenpa> ssh root@1.92.69.34
Bad permissions. Try removing permissions for user: \\Everyone (S-1-1-0) on file C:/Users/fenpa/.ssh/config.
Bad owner or permissions on C:\\Users\\fenpa/.ssh/config
PS C:\Users\fenpa>
```

经上网查询得知是 ssh 权限问题，将所有权限用户删除后单独添加本地用户即可正常运行

2. 做完实验要及时将 ESC 关机以节约经费
3. 掌握了如何安装构建 ECS
4. 掌握了如何编译操作系统内核
5. 了解了内核模块编程

实验
成绩