v1.5.3_MiniOS使用qemu运行和调试

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>
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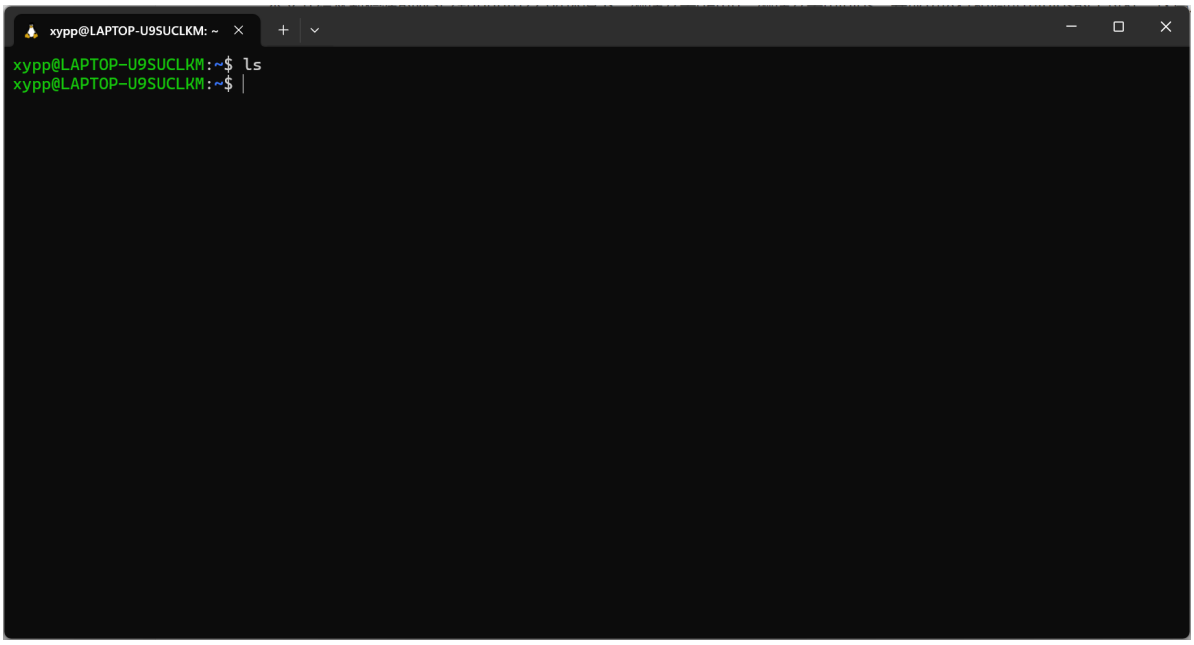
本文介绍从新搭建的WSL2+ubuntu22.04环境下，编译安装qemu，编译安装minios，并成功运行和调试minios的全过程。这篇文章适合刚刚接触qemu和minios的小白，为保证实践过程中尽量少的出现错误，请尽量严格按照本文的步骤进行操作。

1 起始环境

起始环境为使用WSL2刚刚安装成功ubuntu22.04

1.1 安装WSL2+ubuntu22.04

具体可以参考 [安装WSL2和Ubuntu22.04版本]() 这篇文章进行安装



1.2 更换镜像源

> 建议使用本文列出的镜像源，使用其他镜像源在后续安装工具包可能会出现依赖错误

- 备份 `sources.list` 文件

```
sudo cp /etc/apt/sources.list /etc/apt/sources.list.bak
```

- 换源

```
sudo vim /etc/apt/sources.list
```

将sources.list清空后，将下列代码粘贴到sources.list后保存退出

```
deb http://mirrors.aliyun.com/ubuntu/ jammy main restricted universe multiverse
deb-src http://mirrors.aliyun.com/ubuntu/ jammy main restricted universe
multiverse
deb http://mirrors.aliyun.com/ubuntu/ jammy-security main restricted universe
multiverse
deb-src http://mirrors.aliyun.com/ubuntu/ jammy-security main restricted universe
multiverse
deb http://mirrors.aliyun.com/ubuntu/ jammy-updates main restricted universe
multiverse
deb-src http://mirrors.aliyun.com/ubuntu/ jammy-updates main restricted universe
multiverse
deb http://mirrors.aliyun.com/ubuntu/ jammy-proposed main restricted universe
multiverse
deb-src http://mirrors.aliyun.com/ubuntu/ jammy-proposed main restricted universe
multiverse
deb http://mirrors.aliyun.com/ubuntu/ jammy-backports main restricted universe
multiverse
deb-src http://mirrors.aliyun.com/ubuntu/ jammy-backports main restricted
universe multiverse
```

- 更新软件列表

```
sudo apt-get update
sudo apt-get upgrade
```

2 安装工具包

2.1 安装编译和调试工具

```
sudo apt-get install net-tools make build-essential gdb nasm
```

2.2 安装qemu所需依赖

以下命令摘自qemu官网https://wiki.qemu.org/Hosts/Linux

```
sudo apt-get install git libglib2.0-dev libfdt-dev libpixman-1-dev zlib1g-dev
ninja-build
```

为避免后续使用qemu启动minios后，只输出一行提示信息: `VNC server running on 127.0.0.1:5900` 的问题，还要安装下面依赖用来支持 `SDL`

```
sudo apt-get install libsdl1.2-dev libsdl2-dev
```

还要安装对应的gcc 32位的库，使用`multilib`这个库可以在64位的机器上产生32位的程序或者库文件

```
sudo apt-get install gcc-multilib
```

3 qemu

安装的版本是qemu6.2.0

进入用户根目录，创建并进入qemu文件夹

```
cd ~
mkdir qemu
cd qemu
```

3.1 源码方式下载qemu

- 下载源码

```
wget https://download.qemu.org/qemu-6.2.0.tar.xz
```

- 解压缩

```
tar xvJf qemu-6.2.0.tar.xz
```

- 进入qemu-6.2.0目录

```
cd qemu-6.2.0
```

```
xypp@LAPTOP-U9SUCLKM:~/qemu/qemu-6.2.0$ ls
COPYING         blockjob.c      fsdev                   meson.build             qemu-edid.c         scsi
COPYING.LIB     bsd-user        gdb-xml                 meson_options.txt       qemu-img-cmds.hx    semihosting
Kconfig         capstone        gdbstub.c               migration               qemu-img.c          slirp
Kconfig.host    chardev         gitdm.config            module-common.c         qemu-io-cmds.c      softmmu
LICENSE         configs         hmp-commands-info.hx    monitor                 qemu-io.c           storage-daemon
MAINTAINERS     configure       hmp-commands.hx         nbd                     qemu-keymap.c       stubs
Makefile        contrib         hw                      net                     qemu-nbd.c          subprojects
README.rst      cpu.c           include                 os-posix.c              qemu-options.hx     target
VERSION         cpus-common.c   io                      os-win32.c              qemu.nsi            tcg
accel           crypto          iothread.c              page-vary-common.c      qemu.sasl           tests
audio           disas           job-qmp.c               page-vary.c             qga                 thunk.c
authz           disas.c         job.c                   pc-bios                 qobject             tools
backends        docs            libdecnumber            plugins                 qom                 trace
block           dtc             linux-headers           po                      replay              trace-events
block.c         dump            linux-user              python                  replication.c       ui
blockdev-nbd.c  ebpf            memory_ldst.c.inc       qapi                    roms                util
blockdev.c      fpu             meson                   qemu-bridge-helper.c    scripts             version.rc
```

3.2 configure

进入qemu-6.2.0目录后执行以下命令

```
./configure
```

确保SDL support开启

```
xypp@LAPTOP-U9SUCLKM: ~

Dependencies
  SDL support                   : YES
  SDL image support             : NO
  GTK support                   : NO
  pixman                        : YES 0.40.0
  VTE support                   : NO
  slirp support                 : internal
  libtasn1                      : NO
  PAM                           : NO
  iconv support                 : YES
  curses support                : NO
  virgl support                 : NO
  curl support                  : NO
  Multipath support             : YES
  VNC support                   : YES
  VNC SASL support              : NO
  VNC JPEG support              : NO
  VNC PNG support               : YES 1.6.37
  OSS support                   : YES
  ALSA support                  : YES 1.2.6.1
  PulseAudio support            : YES 15.99.1
  JACK support                  : NO
  brlapi support                : NO
  vde support                   : NO
  netmap support                : NO
  l2tpv3 support                : YES
  Linux AIO support             : NO
  Linux io_uring support        : NO
  ATTR/XATTR support            : YES
```

3.3 编译

执行 `make` 就可以进行编译了

```
make
```

编译时间会很长，可以添加参数进行多核编译，`nproc` 表示系统cpu核心的数量

```
xypp@LAPTOP-U9SUCLKM:~/qemu/qemu-6.2.0$ nproc
12
xypp@LAPTOP-U9SUCLKM:~/qemu/qemu-6.2.0$
```

以下命令使用 `make` 工具并行编译项目，并行作业的数量等于系统中可用的处理器数量。这样可以充分利用多核处理器的性能，加快编译速度。

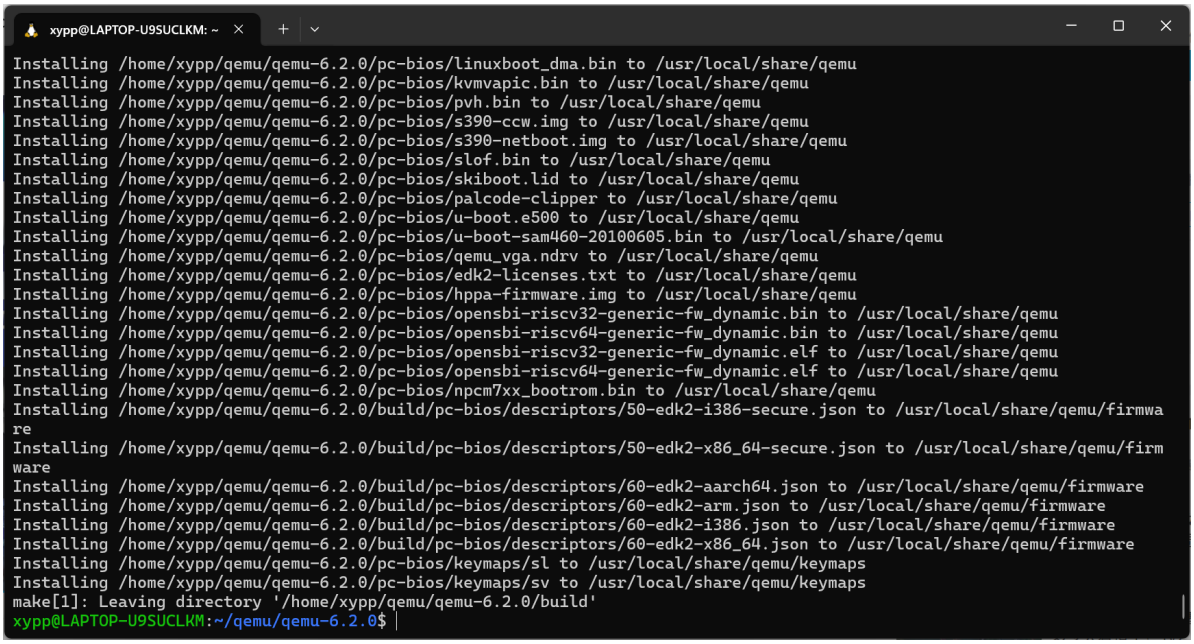
```
make -j`nproc`
```

```
xypp@LAPTOP-U9SUCLKM: ~
[9585/9607] Linking target tests/qtest/device-plug-test
[9586/9607] Compiling C object tests/qtest/rtc-test.p/rtc-test.c.o
[9587/9607] Linking target tests/qtest/fw_cfg-test
[9588/9607] Linking target tests/qtest/hd-geo-test
[9589/9607] Compiling C object tests/qtest/cpu-plug-test.p/cpu-plug-test.c.o
[9590/9607] Compiling C object tests/qtest/vmgenid-test.p/boot-sector.c.o
[9591/9607] Linking target tests/qtest/drive_del-test
[9592/9607] Compiling C object tests/qtest/vmgenid-test.p/vmgenid-test.c.o
[9593/9607] Compiling C object tests/qtest/tco-test.p/tco-test.c.o
[9594/9607] Compiling C object tests/qtest/vmgenid-test.p/acpi-utils.c.o
[9595/9607] Compiling C object tests/qtest/q35-test.p/q35-test.c.o
[9596/9607] Compiling C object tests/qtest/prom-env-test.p/prom-env-test.c.o
[9597/9607] Compiling C object tests/qtest/pnv-xscom-test.p/pnv-xscom-test.c.o
[9598/9607] Linking target tests/qtest/rtc-test
[9599/9607] Linking target tests/qtest/cpu-plug-test
[9600/9607] Linking target tests/qtest/m48t59-test
[9601/9607] Linking target tests/qtest/tco-test
[9602/9607] Linking target tests/qtest/vmgenid-test
[9603/9607] Linking target tests/qtest/q35-test
[9604/9607] Linking target tests/qtest/prom-env-test
[9605/9607] Linking target tests/qtest/pnv-xscom-test
[9606/9607] Linking target tests/qtest/rtas-test
[9607/9607] Linking target tests/qtest/virtio-ccw-test
make[1]: Leaving directory '/home/xypp/qemu/qemu-6.2.0/build'
changing dir to build for make ""...
make[1]: Entering directory '/home/xypp/qemu/qemu-6.2.0/build'
[1/177] Generating QAPI test (include) with a custom command
[2/144] Generating qemu-version.h with a custom command (wrapped by meson to capture output)
make[1]: Leaving directory '/home/xypp/qemu/qemu-6.2.0/build'
xypp@LAPTOP-U9SUCLKM:~/qemu/qemu-6.2.0$
```

3.4 安装

安装qemu使用 `make install` 命令，但直接 `make install` 会出现错误，请使用以下命令

```
sudo make install
```



4 minios

- 创建并进入code目录

```
cd ~
mkdir code
cd code
```

- 从gitee下载minios源码到code目录后，进入minios目录

```
cd minios
```

4.1 创建一些空文件夹

- 创建 `hd` 目录用于存放镜像

```
mkdir hd
```

- 创建 `root` 目录用于挂载 `/dev/loop1p2`

```
mkdir root
```

- 创建 `iso` 目录用于挂载 `/dev/loop0p1`

```
mkdir iso
```

4.2 制作启动镜像文件

使用 `dd` 创建一个镜像文件，为了与makefile对应，镜像文件名称为 `fat32_boot.img`，具体命令如下

```
dd if=/dev/zero of=hd/fat32_boot.img bs=512 count=204800
```

```
xypp@LAPTOP-U9SUCLKM:~/code$ cd minios/
xypp@LAPTOP-U9SUCLKM:~/code/minios$ ls
Makefile    doc                       launch-qemu-init-gdb.sh     launch-qemu.sh  umount_fat0.sh
README.md   generate-test-script.sh   launch-qemu-shell_0-gdb.sh  mount_fat0.sh   user
bochsrc     launch-qemu-gdb.sh        launch-qemu-test_1-gdb.sh   os              utils
xypp@LAPTOP-U9SUCLKM:~/code/minios$ mkdir hd
xypp@LAPTOP-U9SUCLKM:~/code/minios$ mkdir root
xypp@LAPTOP-U9SUCLKM:~/code/minios$ mkdir iso
xypp@LAPTOP-U9SUCLKM:~/code/minios$ dd if=/dev/zero of=hd/fat32_boot.img bs=512 count=20480
20480+0 records in
20480+0 records out
10485760 bytes (10 MB, 10 MiB) copied, 0.100701 s, 104 MB/s
xypp@LAPTOP-U9SUCLKM:~/code/minios$
```

4.3 使用fdisk对镜像进行分区

使用 `fdisk` 对硬镜像进行分区

```
fdisk hd/fat32_boot.img
```

1. **创建第一个分区**：
   - 输入 `n` 创建新分区。
   - 选择 `p` 创建主分区。
   - 输入分区号 `1`。
   - 输入起始扇区 `2048`。
   - 输入结束扇区 `4095`。
   - 输入 `a` 将该分区设置为可启动分区。
2. **创建第二个分区**：
   - 输入 `n` 创建新分区。
   - 选择 `p` 创建主分区。
   - 输入分区号 `2`。
   - 输入起始扇区 `4096`。
   - 输入结束扇区 `106495`。
3. **创建扩展分区**：
   - 输入 `n` 创建新分区。
   - 选择 `e` 创建扩展分区。
   - 输入分区号 `3`。
   - 输入起始扇区 `106496`。
   - 输入结束扇区 `204799`。
4. **在扩展分区内创建逻辑分区**：
   - 输入 `n` 创建新分区。
   - 输入起始扇区 `108544`。
   - 输入结束扇区 `204799`。
5. **保存分区表并退出**：
   - 输入 `w` 保存分区表并退出 `fdisk`。

使用以下命令查看分区结果

```
fdisk -l hd/fat32_boot.img
```

```
xypp@LAPTOP-U9SUCLKM:~/code/minios$ fdisk -l hd/fat32_boot.img
Disk hd/fat32_boot.img: 100 MiB, 104857600 bytes, 204800 sectors
Units: sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disklabel type: dos
Disk identifier: 0x5bb2a6ab

Device             Boot  Start    End Sectors Size Id Type
hd/fat32_boot.img1 *      2048   4095    2048   1M 83 Linux
hd/fat32_boot.img2        4096 106495  102400  50M 83 Linux
hd/fat32_boot.img3      106496 204799   98304  48M  5 Extended
hd/fat32_boot.img5      108544 204799   96256  47M 83 Linux
xypp@LAPTOP-U9SUCLKM:~/code/minios$
```

4.4 编译

- 分区后就可以执行 `make all` 命令编译minios了

```
make all
```

4.5 安装

- 安装成功后执行 `make install` 命令安装minios

```
sudo make install
```

下图说明安装成功

```
user/user/test/4_ipc/shmat/run.sh => /test/4_ipc/shmat/run.sh
user/user/test/4_ipc/shmctl/run.sh => /test/4_ipc/shmctl/run.sh
user/user/test/2_fs/read/run.sh => /test/2_fs/read/run.sh
user/user/test/2_fs/open/run.sh => /test/2_fs/open/run.sh
user/user/test/2_fs/opendir/run.sh => /test/2_fs/opendir/run.sh
user/user/test/2_fs/run.sh => /test/2_fs/run.sh
user/user/test/2_fs/rmdir/run.sh => /test/2_fs/rmdir/run.sh
user/user/test/2_fs/getcwd/run.sh => /test/2_fs/getcwd/run.sh
user/user/test/2_fs/write/run.sh => /test/2_fs/write/run.sh
user/user/test/2_fs/mkdir/run.sh => /test/2_fs/mkdir/run.sh
user/user/test/2_fs/lseek/run.sh => /test/2_fs/lseek/run.sh
user/user/test/2_fs/unlink/run.sh => /test/2_fs/unlink/run.sh
user/user/test/2_fs/mount/run.sh => /test/2_fs/mount/run.sh
user/user/test/2_fs/close/run.sh => /test/2_fs/close/run.sh
user/user/test/3_pthread/run.sh => /test/3_pthread/run.sh
user/user/test/3_pthread/pthread_self/run.sh => /test/3_pthread/pthread_self/run.sh
user/user/test/3_pthread/pthread_cond_broadcast/run.sh => /test/3_pthread/pthread_cond_broadcast/run.sh
user/user/test/3_pthread/pthread_exit/run.sh => /test/3_pthread/pthread_exit/run.sh
user/user/test/3_pthread/pthread_mutex_unlock/run.sh => /test/3_pthread/pthread_mutex_unlock/run.sh
user/user/test/3_pthread/pthread_join/run.sh => /test/3_pthread/pthread_join/run.sh
user/user/test/3_pthread/pthread_mutex_destroy/run.sh => /test/3_pthread/pthread_mutex_destroy/run.sh
user/user/test/3_pthread/pthread_cond_wait/run.sh => /test/3_pthread/pthread_cond_wait/run.sh
user/user/test/3_pthread/pthread_cond_timewait/run.sh => /test/3_pthread/pthread_cond_timewait/run.sh
user/user/test/3_pthread/pthread_mutex_lock/run.sh => /test/3_pthread/pthread_mutex_lock/run.sh
user/user/test/3_pthread/pthread_create/run.sh => /test/3_pthread/pthread_create/run.sh
user/user/test/3_pthread/pthread_cond_destroy/run.sh => /test/3_pthread/pthread_cond_destroy/run.sh
user/user/test/3_pthread/pthread_cond_init/run.sh => /test/3_pthread/pthread_cond_init/run.sh
user/user/test/3_pthread/pthread_mutex_trylock/run.sh => /test/3_pthread/pthread_mutex_trylock/run.sh
user/user/test/3_pthread/pthread_mutex_init/run.sh => /test/3_pthread/pthread_mutex_init/run.sh
user/user/test/3_pthread/pthread_cond_signal/run.sh => /test/3_pthread/pthread_cond_signal/run.sh
user/user/t_mnt.sh => /t_mnt.sh
sudo umount root
xypp@LAPTOP-U9SUCLKM:~/code/minios$
```

安装成功后会多一些文件

```
xypp@LAPTOP-U9SUCLKM:~/code/minios$ ls
Makefile   bochsrc                 hd          kernel.gdb.bin          launch-qemu-shell_0-gdb.sh  mount_fat0.sh  umount_fat0.sh
README.md  doc                     iso         launch-qemu-gdb.sh      launch-qemu-test_1-gdb.sh   os             user
b.img      generate-test-script.sh kernel.bin  launch-qemu-init-gdb.sh launch-qemu.sh             root           utils
```

4.6 拷贝镜像文件

minios的启动脚本 `launch-qemu.sh` 中需要两块硬盘镜像，需要将安装后新生成的 `b.img` 文件拷贝一份，新镜像名称为 `test2.img`

launch-qemu.sh

home > xypp > code > minios > launch-qemu.sh

```
# deleted by mingxuan 2019-5-17
# qemu-system-i386 -fda a.img -hda 80m.img -boot order=a -ctrl-grab \
# -monitor stdio

# modified by mingxuan 2019-5-17
# qemu-system-i386 -m 2048 -hda b.img -boot order=a -ctrl-grab \
# -monitor stdio -usbdevice tablet

# qemu-system-i386 -drive id=disk,file=b.img,if=none -device ich9-ahci,id=ahci \
# -device ide-hd,drive=disk,bus=ahci.0 -monitor stdio
# cp b.img a.img
# cp b.img c.img
# cp b.img d.img
# cp b.img e.img

# qemu-system-i386 \
# -drive id=disk,file=b.img,if=none -device ich9-ahci,id=ahci -device ide-hd,drive=disk,bus=ahci.0 \
# -drive id=disk1,file=c.img,if=none -device ide-hd,drive=disk1,bus=ahci.1 \
# -drive id=disk2,file=d.img,if=none -device ide-hd,drive=disk2,bus=ahci.2 \
# -hda a.img -hdb e.img
#cp b.img c.img
qemu-system-i386 \
-device ich9-ahci,id=xiaofeng \
-device ide-hd,drive=disk,bus=xiaofeng.0 -drive id=disk,file=b.img,if=none,media=disk \
-device ide-hd,drive=disk2,bus=xiaofeng.1 -drive id=disk2,file=test2.img,if=none,media=disk \
-rtc base=utc \
-boot menu=on \
-serial file:minios.log \
-monitor stdio
```

执行以下命令进行拷贝操作

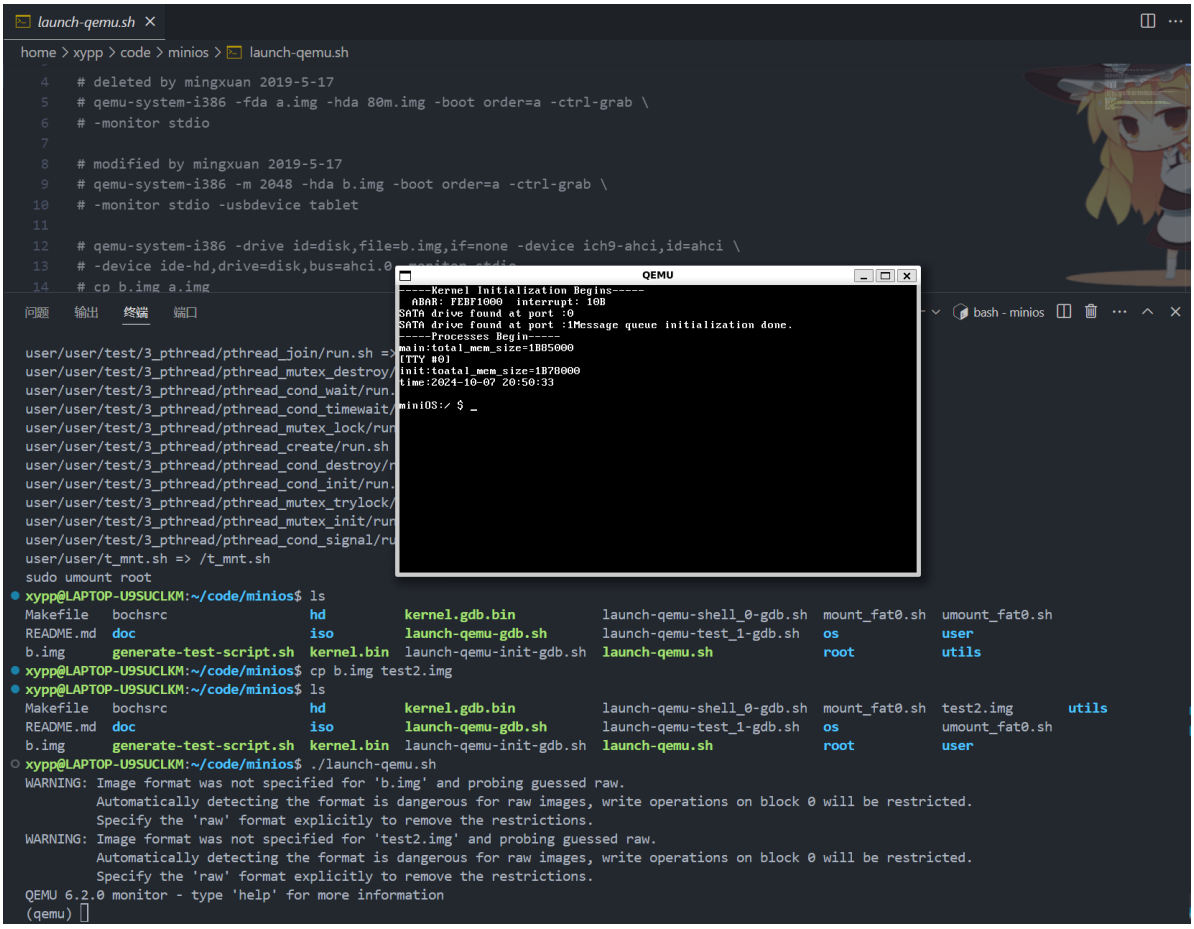
```
cp b.img test2.img
```

4.7 启动minios

完成以上所有步骤并且没有报错的话，就可以运行minios的启动脚本 `launch-qemu.sh` 了

```
sudo ./launch-qemu.sh
```

运行以上命令之后，会弹出minios的启动界面



如果出现上图的启动界面，说明minios启动成功。

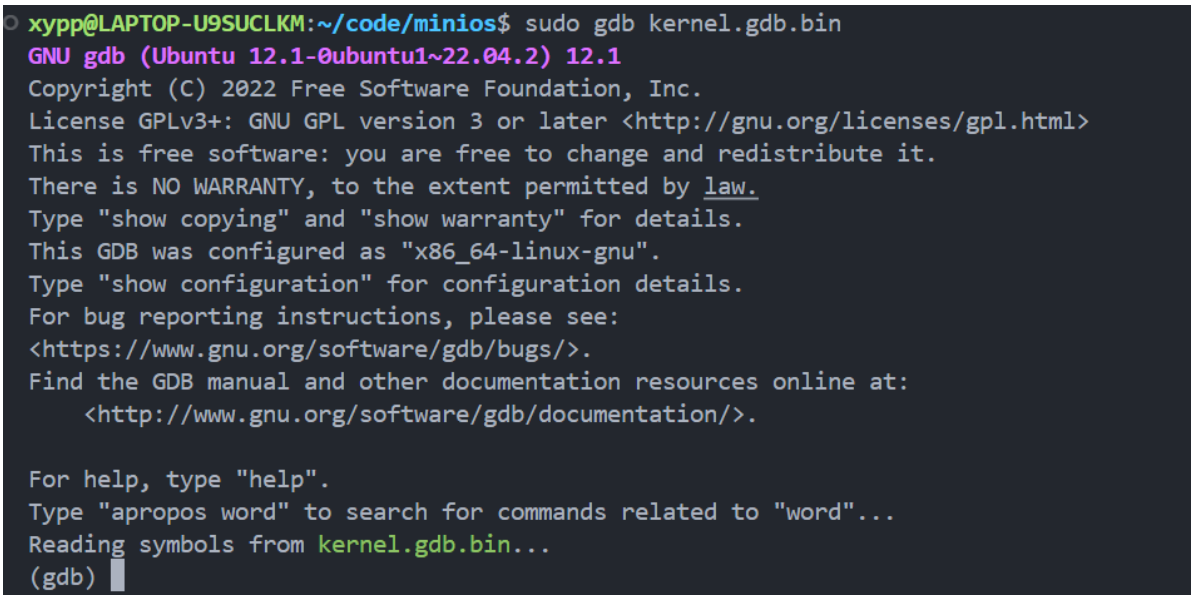
4.8 调试minios

调试minios需要运行调试脚本 `launch-qemu-gdb.sh`

```
sudo ./launch-qemu-gdb.sh
```

运行以上命令后，需要开启另一个终端进行调试，执行以下命令进入gdb环境

```
cd ~/code/minios
sudo gdb kernel.gdb.bin
```



在gdb命令界面执行命令`target remote :1234`和qemu建立连接

```
target remote :1234
```

连接成功后，就可以顺利调试了