Project 2: Android scheduler

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Objectives

- Compile the Android kernel.
- Familiarize Android scheduler
- Implement a random policy in round robin scheduler.
- Get experience with software engineering techniques.

Enviroment

- Implementation
  - AVD(Android Virtual Devices)
    - SDK version r24.4.1
- Development
  - Linux（64-bits）
    - Ubuntu (recommended)
    - Debian
    - Fedora

What to Submit

- A“tar” file of your DIRECTORY, containing:
  - All *.c, *.h files you have changed in Linux kernel.
  - Any “readme” or “.pdf” files asked for in the project
  - Screen captures of the scheduler test
    - If you cannot get your program to work, submit a run of whatever you can get to work as you can get partial credit

- DO NOT SUBMIT your object or executable files, REMOVE them before you pack your directory.

How to Submit

- Pack your code in a project directory

  tar –cvf Prj2+StudentID.tar project1

- Send your Prj2+StudentID.tar file to cs356.sjtu@gmail.com

For Help?

- Teaching Assistant
  - Bo Wang
    - Email: wangbo0727@outlook.com, wangbo0727@126.com
    - WeChat：hadesghost727
  - Jiapeng Xie
    - Email: jsxiejp@163.com
    - WeChat: xjp18248794518

Compile the Linux Kernel

- Make sure that your environment variable is correct.

```
export JAVA_HOME=/usr/lib/jdk1.8.0_73
export JRE_HOME=/usr/lib/jdk1.8.0_73/jre
export CLASSPATH=.:$CLASSPATH:$JAVA_HOME/lib:$JRE_HOME/lib
export PATH=$PATH:$JAVA_HOME/bin:$JRE_HOME/bin
export PATH=~/Kit/android-sdk-linux/platform-tools:$PATH
export PATH=~/Kit/android-sdk-linux/tools:$PATH
export PATH=~/Kit/android-ndk-linux:$PATH
export PATH=~/Kit/android-ndk-linux/toolchains/arm-linux-androideabi-4.9/prebuilt/linux-x86_64/bin:$PATH
```

Compile the Linux Kernel (cont.)

- Modify Makefile in the kernel
  - Change
    - ARCH ?= $(SUBARCH)
    - CROSS_COMPILE ?=
  - To

```
export KBUILD_BUILDHOST := $(SUBARCH)
ARCH          ?= arm
CROSS_COMPILE   ?= arm-linux-androideabi-

# Architecture as present in compile.h
```

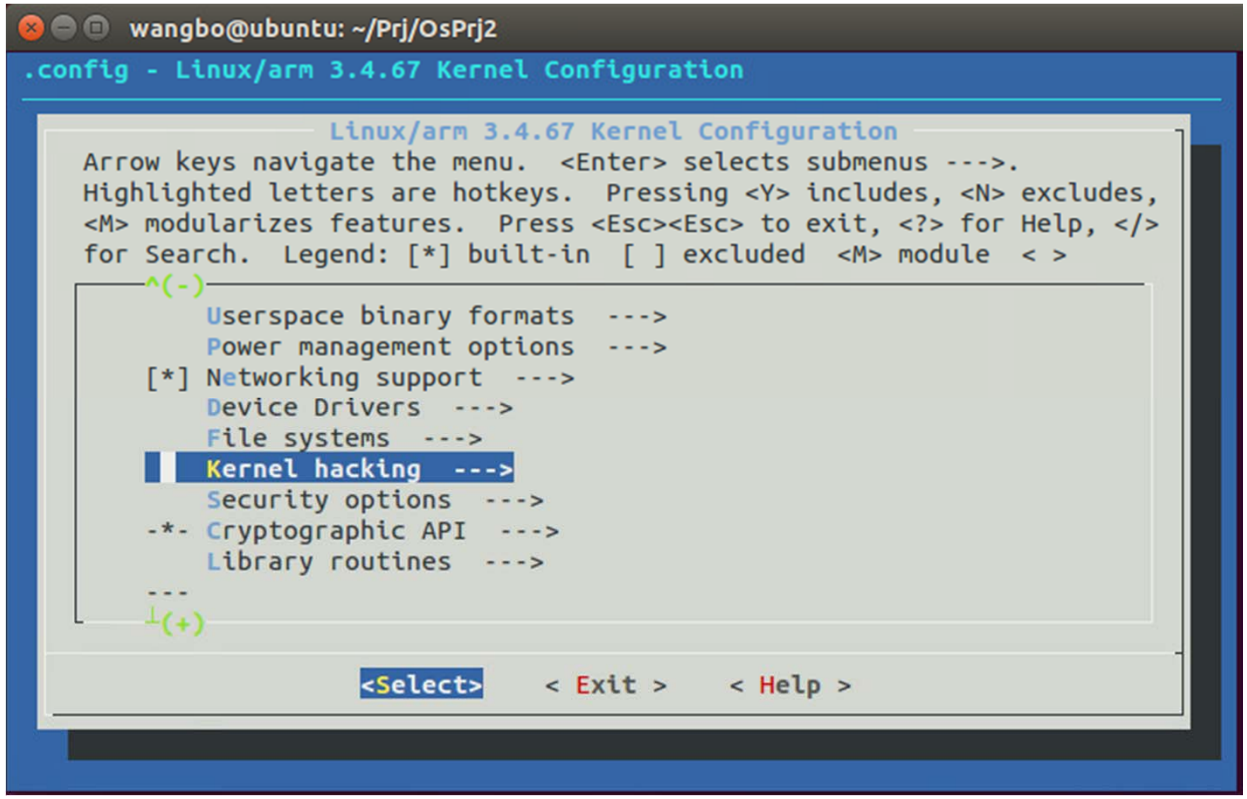
Compile the Linux Kernel (cont.)

- Execute the following command:

```
wangbo@ubuntu:~/Prj/OsPrj2$ make goldfish_armv7_defconfig
#
# configuration written to .config
#
wangbo@ubuntu:~/Prj/OsPrj2$ sudo apt-get install ncurses-dev
wangbo@ubuntu:~/Prj/OsPrj2$ make menuconfig
```

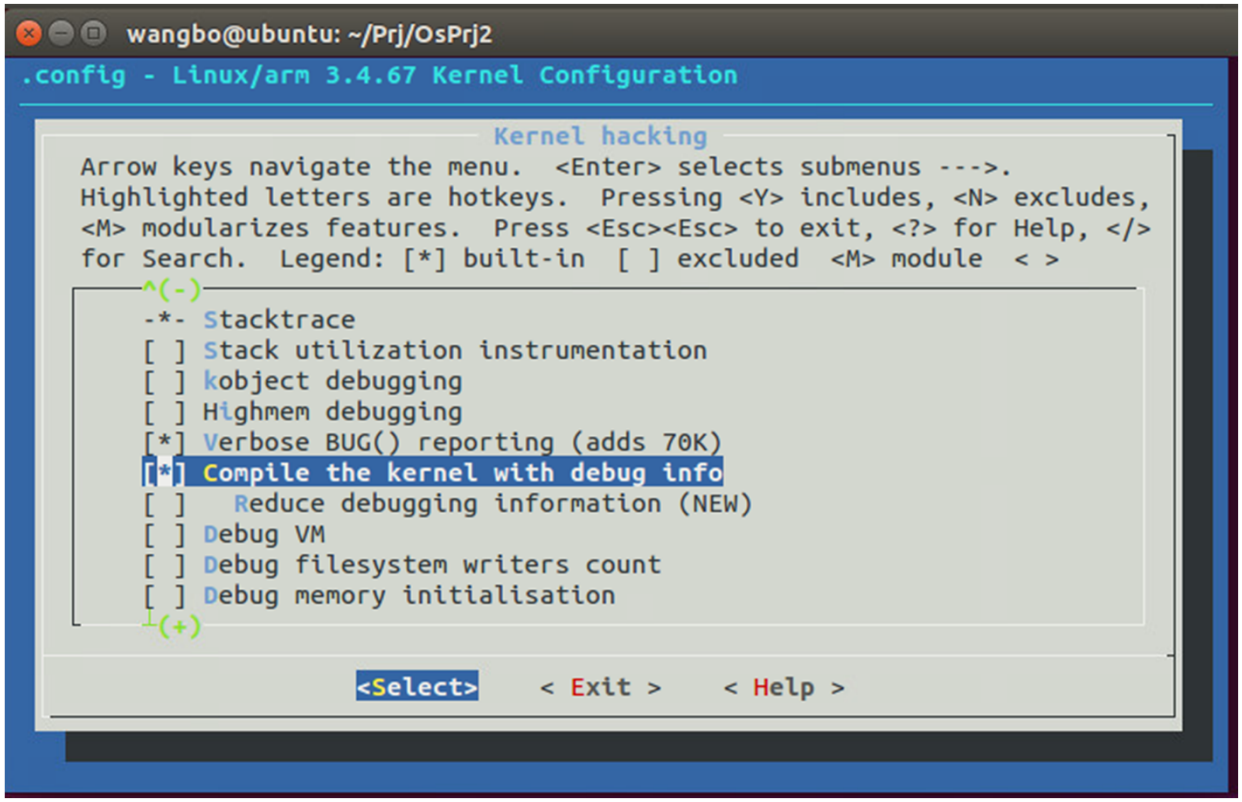
Compile the Linux Kernel (cont.)

- Then you can see:



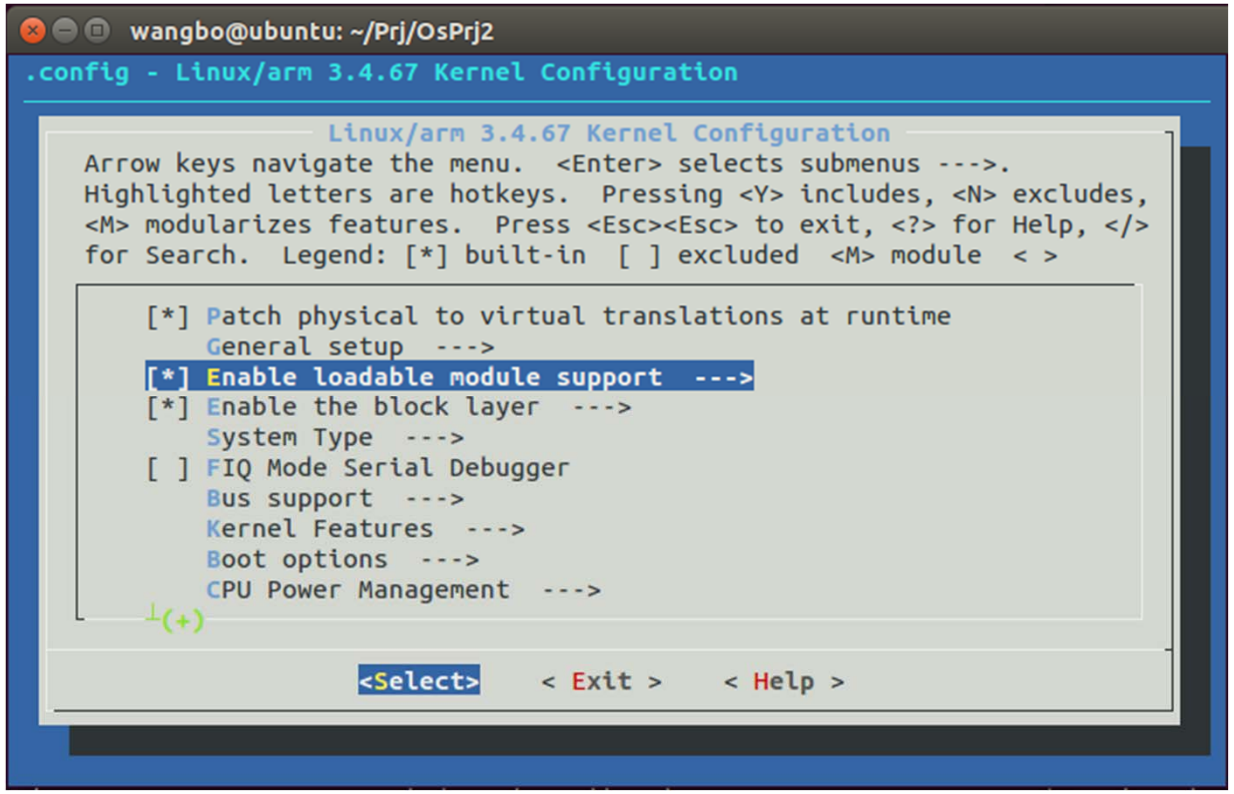
Compile the Linux Kernel (cont.)

- Then you can see:



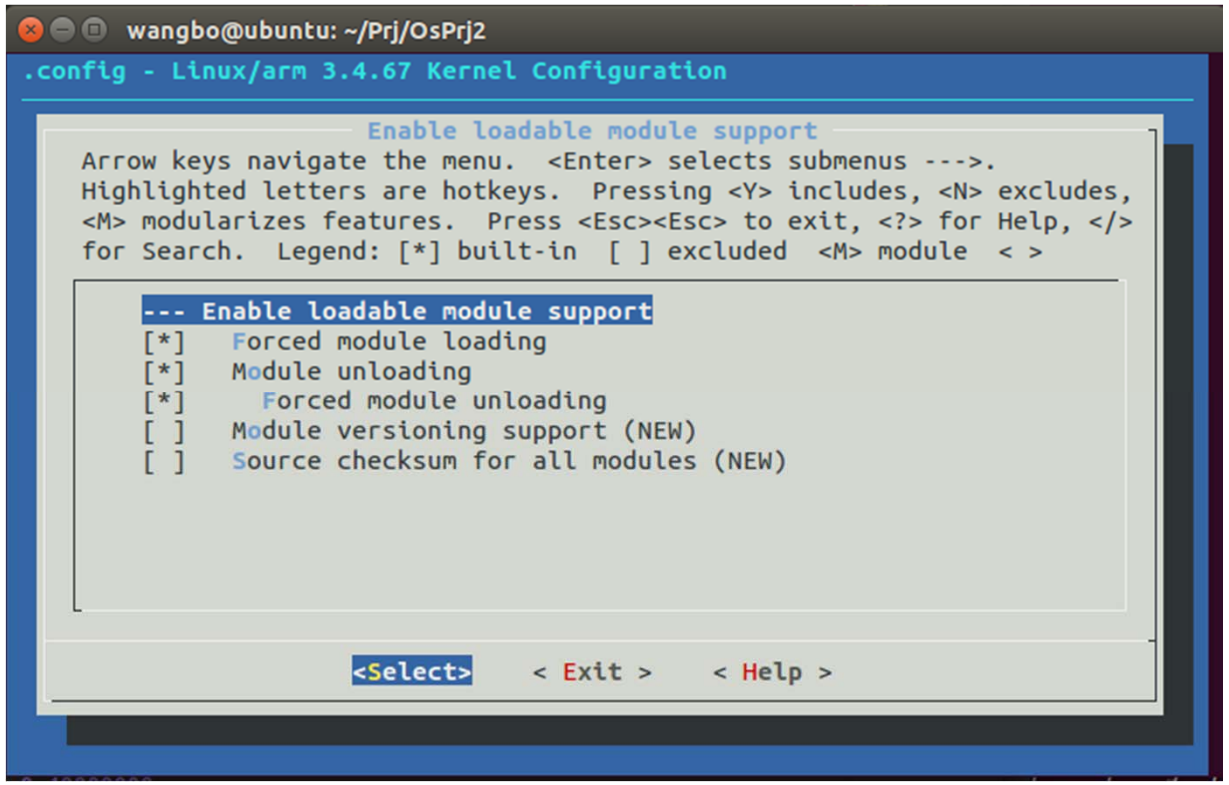
Compile the Linux Kernel (cont.)

- Then you can see:



Compile the Linux Kernel (cont.)

- Then you can see:



Compile the Linux Kernel (cont.)

- Compile it

```
wangbo@ubuntu:~/Prj/OsPrj2$ make -j4
  SYSMAP  System.map
  SYSMAP  .tmp_System.map
  OBJCOPY arch/arm/boot/Image
  Kernel: arch/arm/boot/Image is ready
  GZIP    arch/arm/boot/compressed/piggy.gzip
  AS      arch/arm/boot/compressed/piggy.gzip.o
  LD      arch/arm/boot/compressed/vmlinux
  OBJCOPY arch/arm/boot/zImage
  Kernel: arch/arm/boot/zImage is ready
wangbo@ubuntu:~/Prj/OsPrj2$
```

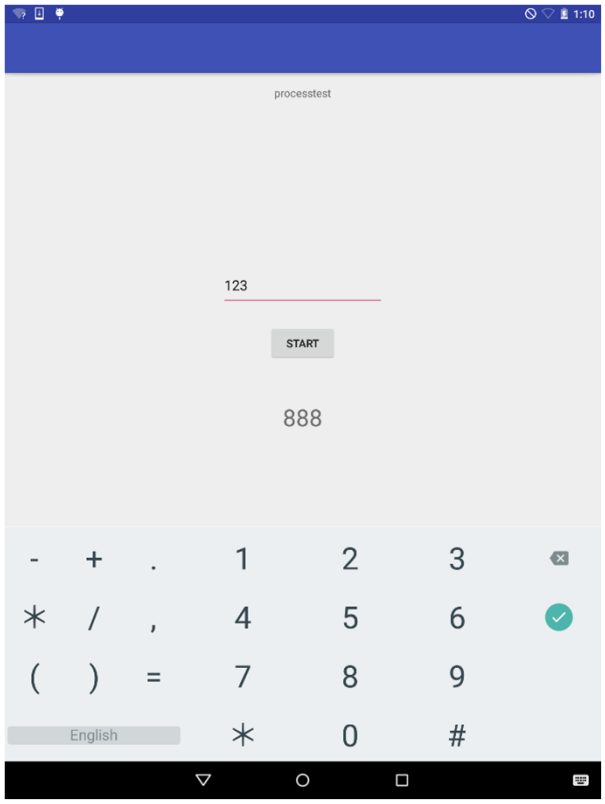
Scheduler in Android

- Android system has three kind of scheduler:
  - SCHED_NORMAL
  - SCHED_RR
  - SCHED_FIFO

Scheduler in Android (cont.)

- You should finish the following task in this problem:
  - Change the scheduler of test applications to SCHED_FIFO, and compare the executing time of them with the time using SCHED_NORMAL. The priorities of them should be same.
  - Change the scheduler of test applications to SCHED_RR, and compare the executing time of them with the time using SCHED_NORMAL. The priorities of them should be same.
  - Change the scheduler of all descendants of process zygote to SCHED_RR, and compare the executing time of them with the time using SCHED_NORMAL. The priority of any process exclude test application should be same.
- sched_getscheduler() / sched_setscheduler()

Scheduler in Android (cont.)



To install:

adb install processtest.apk

To show information:

ps -P

Modify Scheduler

- Change the schedule policy in kernel:
  - Default scheduler of all descendants of process zygote should be SCHED_RR. The priority of process should be $\frac{max\ priority\ of\ SCHED\_RR}{5} \times (PID\ mod\ 5) + 1$.
  - Change the policy of SCHED_RR to pick the next process randomly

Modify Scheduler (cont.)

- Scheduler in kernel
  - You can find the scheduling class of SCHED_RR in kernel/sched/rt.c
  - You can learn how the Linux scheduler works in kernel/sched/core.c and include/linux/sched.h

Modify Scheduler (cont.)

```
const struct sched_class rt_sched_class = {
    .next           = &fair_sched_class,
    .enqueue_task       = enqueue_task_rt,
    .dequeue_task       = dequeue_task_rt,
    .yield_task     = yield_task_rt,

    .check_preempt_curr = check_preempt_curr_rt,

    .pick_next_task     = pick_next_task_rt,
    .put_prev_task      = put_prev_task_rt,

#ifdef CONFIG_SMP
    .select_task_rq     = select_task_rq_rt,

    .set_cpus_allowed       = set_cpus_allowed_rt,
    .rq_online              = rq_online_rt,
    .rq_offline             = rq_offline_rt,
    .pre_schedule       = pre_schedule_rt,
    .post_schedule      = post_schedule_rt,
    .task_woken     = task_woken_rt,
    .switched_from      = switched_from_rt,
#endif

    .set_curr_task          = set_curr_task_rt,
    .task_tick      = task_tick_rt,

    .get_rr_interval    = get_rr_interval_rt,

    .prio_changed       = prio_changed_rt,
    .switched_to        = switched_to_rt,
};
```

Modify Scheduler (cont.)

- Test the performance of new scheduler
  - Set the priority of the android application as a certain number (>,=,<).
  - Execute the two applications repeatedly to observe the difference.

Report

- Compare and figure out the difference between three scheduling class.
- Explain how you programs work.
- Analysis the result of your test.

Demo & Presentation

- Demo:
  - **June 25-26, 2016**. Demo slots will be posted on the door of East 3-309 SEIEE Building. Please sign your name in one of the available slots.
- Presentation:
  - You are encouraged to present your design of the project optionally. The presentation date is Jun. 26, 2016.

For Help?

- Teaching Assistant
  - Bo Wang
    - Email: wangbo0727@outlook.com, wangbo0727@126.com
    - WeChat：hadesghost727
  - Jiapeng Xie
    - Email: jsxiejp@163.com
    - WeChat: xjp18248794518

- Some useful website
  - http://www.csdn.net/
  - http://stackoverflow.com/
  - http://developer.android.com/

For Help?

Mid-night, June. 24, 2016

Q&A