LAB0: INTRODUCTION TO PINTOS

Operating Systems 2015 Spring by Euiseong Seo

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Overview

- Setting up your Pintos
- Project schedule & policies
- Project 0: Warming up

SETTING UP YOUR PINTOS

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Welcome to Pintos!

- Review: What is Pintos?
  - An instructional operating system
  - Developed by Ben Pfaff @ Stanford U.
  - A real, bootable OS for 80x86 architecture
    - Run on a regular IBM-compatible PC
      or an x86 simulator
  - Written in C language with minimal assembly code

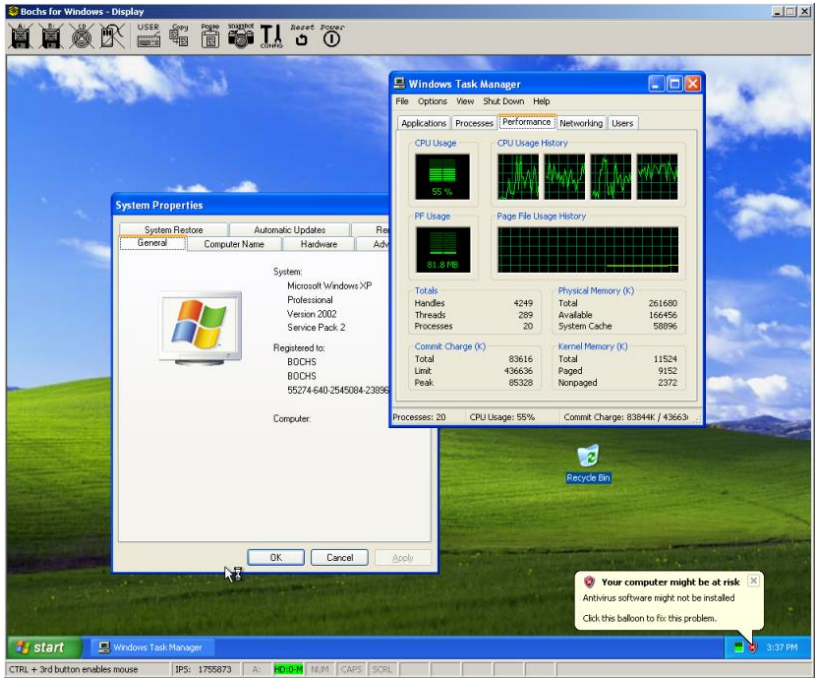
Bochs (1)

- What is Bochs?

  - Open-source IA-32 emulator
  - Simulates a complete Intel x86 computer in software
    - Interprets every instruction from power-up to reboot
    - Has device models for all of the standard PC peripherals: keyboard, mouse, VGA card/monitor, disks, timer, network, …
    - Supports many different host platforms: x86, PowerPC, Alpha, Sun, and MIPS
  - Runs most popular x86 Oses:
    - Windows 95/98/NT/2000/XP/Vista, Linux, BSDs, ...
  - Written in C++
  - Emulation, not virtualization

Bochs (2)

- Linux + Bochs
  - We can run Pintos using Bochs on Linux
  - Bochs makes it easy to develop and debug Pintos projects



Setting Up with Bochs (1)

- Prerequisite of Pintos + Bochs
  - Install Ubuntu on your machine
  - sudo apt-get install
    - patch
    - diff
    - g++
    - xorg-dev
    - ncurses-dev
  - sudo apt-get update
  - There could be additional libraries/tools to install

Setting Up with Bochs (2)

- Install Pintos
  - Download the Pintos package (pintos.tar.gz)
    - Available from http://csl.skku.edu/uploads/SSE3044F14/pintos.tar.gz
    - Use this version only
  - Untar Pintos

```
$ tar xvzf pintos.tar.gz
```

  - Build Pintos

```
$ cd pintos/src/threads
$ make
```

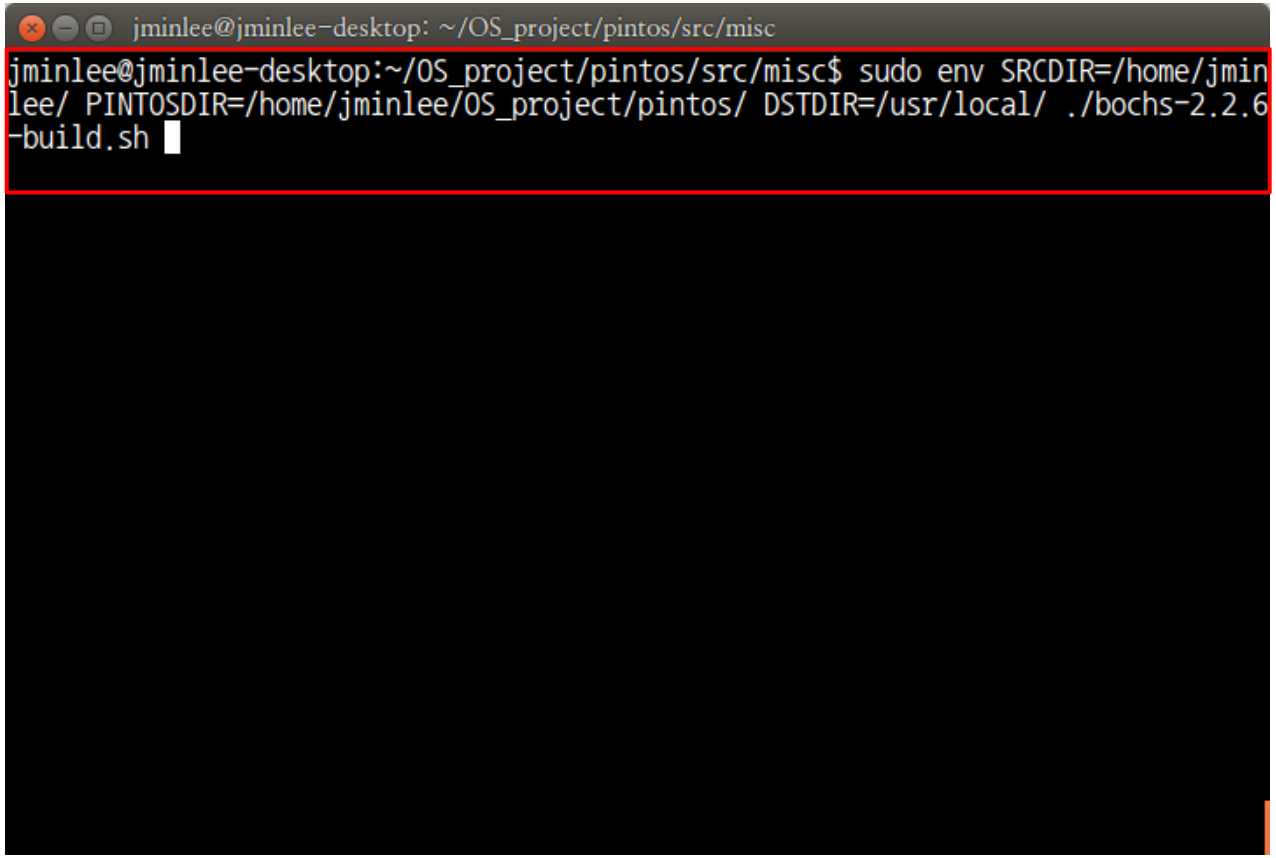
    - This will create the kernel image (kernel.bin) and the final OS disk image (os.dsk = loader.bin + kernel.bin) in ./build

Setting Up with Bochs (3)

- Install Bochs
  - Get the source code from http://bochs.sourceforge.net
    - Make sure you are downloading v2.2.6 (`bochs-2.2.6.tar.gz`)
    - You don't have to untar the source code
  - Install Bochs
    - Must patch the Bochs source code for Pintos (Patches are available in `pintos/src/misc`)
    - Use the installation script provided by Pintos (`pintos/src/misc/bochs-2.2.6-build.sh`)
    - The script will untar, patch, configure, compile, and install Bochs
    - You need to be a superuser (root) to install Bochs in the system directory (e.g., `/usr/local`)

Setting Up with Bochs (4)

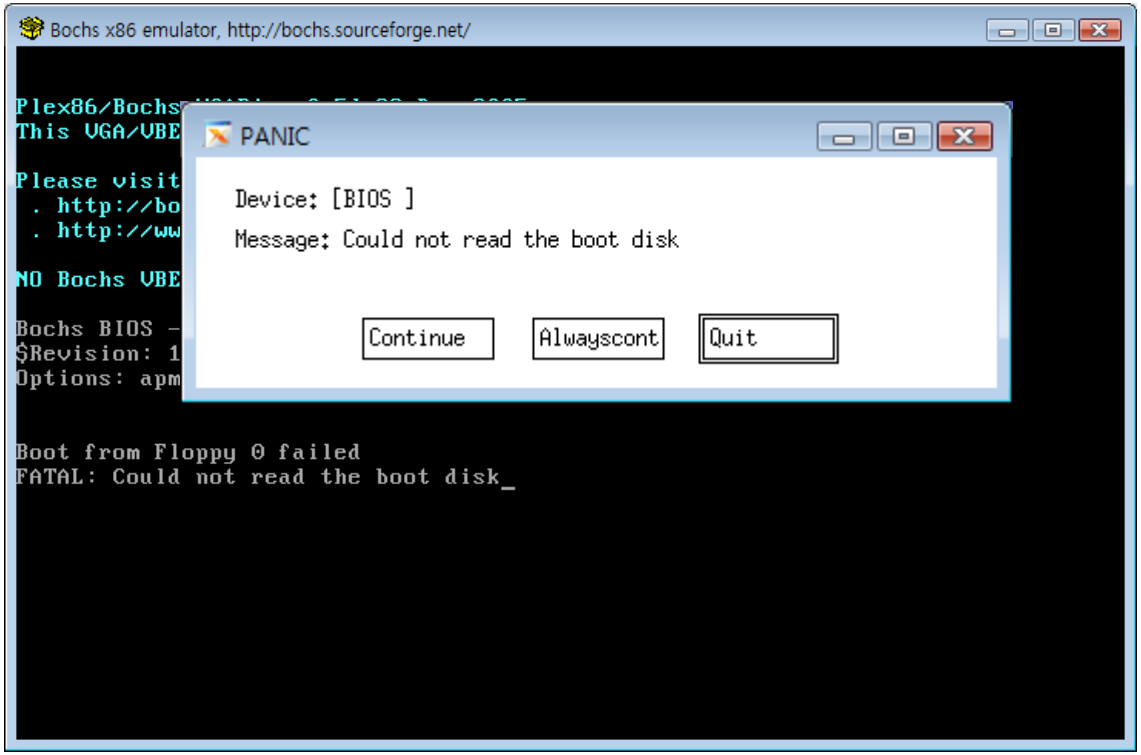
- Install Bochs (cont'd)
  - Running the script:



Setting Up with Bochs (5)

- Test Bochs

  $ bochs ; Put $DSTDIR/bin into your PATH



Setting Up with Bochs (6)

- Setting pintos-gdb

```
$ vi pintos/src/utils/pintos-gdb
```

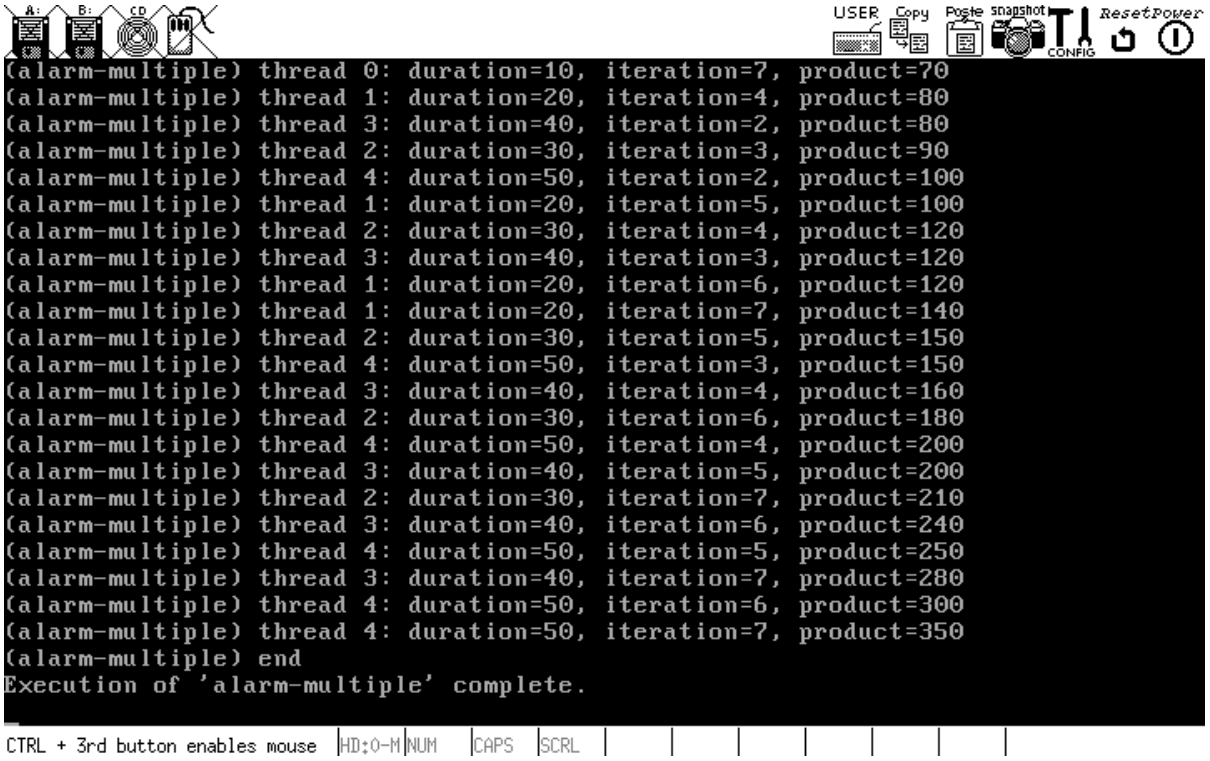
jminlee@jminlee-desktop: ~/OS_project/pintos/src/utils

```
 1 #! /bin/sh
 2
 3 # Path to GDB macros file.  Customize for your site.
 4 GDBMACROS=/home/jminlee/OS_project/pintos/src/misc/gdb-macros
 5
 6 # Choose correct GDB.
 7 if command -v i386-elf-gdb >/dev/null 2>&1; then
 8     GDB=i386-elf-gdb
 9 else
10     GDB=gdb
11 fi
12
13 # Run GDB.
14 if test -f "$GDBMACROS"; then
15     exec $GDB -x "$GDBMACROS" "$@"
16 else
17     echo "*** $GDBMACROS does not exist ***"
18     echo "*** Pintos GDB macros will not be available ***"
19     exec $GDB "$@"
20 fi
~
~
~
                                                    1,10          모두
```

Setting Up with Bochs (7)

- Run Pintos

```
$ cd pintos/src/threads
$ ../utils/pintos run alarm-multiple
```



Qemu

- What is Qemu?
  - Quick EMUlator
  - Written by Fabrice Bellard
  - Supports the emulation of various architectures
    - IA-32, x86-64, MIPS R4000, Sun, ARM, PowerPC, etc..
- Qemu + Linux
  - We can run Pintos using Qemu on Linux
  - Installation of Qemu is very easy!

Setting Up with Qemu (1)

- Install Ubuntu on your machine
- Install QEMU
  - See http://csl.skku.edu/SSE3044F12/QEMU

Setting Up with Qemu (2)

- Install Pintos
  - Download the Pintos package (pintos.tar.gz)
    - Available from http://csl.skku.edu/uploads/SWE3044S14/pintos.tar.gz
    - Use this version only
  - Untar Pintos

```
$ tar xvzf pintos.tar.gz
```

  - Build Pintos

```
$ cd pintos/src/threads
$ make
```

    - This will create the kernel image (kernel.bin) and the final OS disk image (os.dsk = loader.bin + kernel.bin) in ./build

Setting Up with Qemu (3)

- Setting Pintos for QEMU
  - Simulator Setting
    - Check Make.vars at ~/pintos/src/threads
    - 'Simulator = --qemu'
  - Pintos script setting
    - Also see http://csl.skku.edu/SSE3044F12/QEMU
    - Modify ~/pintos/src/utils/pintos
    - You can use any text editor to modify this
  - Run option
    - You have to use --qemu option for pintos
      - Default simulator is bochs
    - ../utils/pintos --qemu -- run alarm-multiple

What is different?

- Difference between Bochs and Qemu
  - "Reproducibility" is important issue for debugging
    - Always same result occurs when you run program in same manner
  - Bochs offers reproducibility
    - Same jitter value causes exactly same result
    - But it also provides real time mode
      - By using –r option
  - Qemu doesn't offer reproducibility
    - Only real time mode is supported
    - Qemu is faster

A Tour of Pintos (1)

- Projects
  - Project 0: Warming up
    - `pintos/src/threads`
  - Project 1: Threads
    - `pintos/src/threads`
  - Project 2: User programs
    - `pintos/src/userprog`
  - Project 3: Virtual memory
    - `pintos/src/vm`
  - ~~Project 4: File system~~
    - ~~`pintos/src/filesys`~~

  - Use “make” command in each of project directories

A Tour of Pintos (2)

- Interesting files in the ./build directory
  - kernel.o:
    - The object file for the entire kernel
    - Used for debugging
  - kernel.bin:
    - The memory image of the kernel
  - loader.bin:
    - The memory image of the kernel loader (512 bytes)
    - Reads the kernel from disk into memory and starts it up
  - os.dsk:
    - Disk image for the kernel (loader.bin + kernel.bin)
    - Used as a “virtual disk” by the simulator

A Tour of Pintos (3)

- Running Pintos
  - Add “pintos/src/utils” to $PATH and run “pintos”

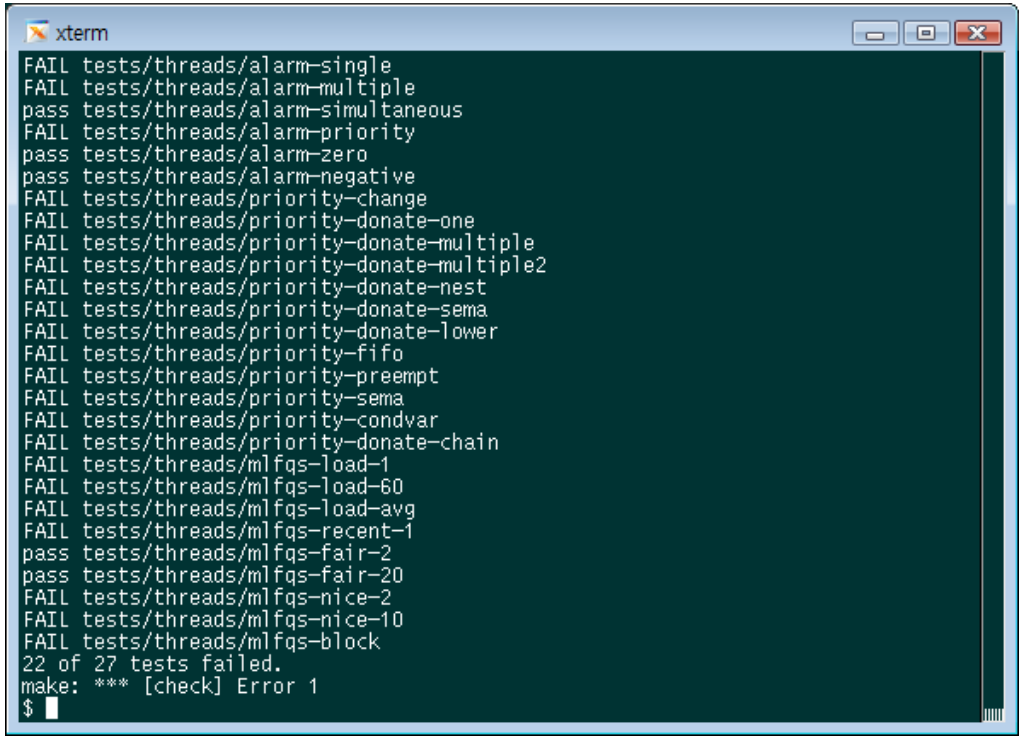
    ```
    $ export PATH=“~/pintos/src/utils:$PATH”
    $ pintos [option] -- [argument]
    ```

  - Option
    - Configure the simulator or the virtual hardware
  - Argument
    - Each argument is passed to the Pintos kernel verbatim
    - ‘pintos run alarm-multiple’ instructs the kernel to run alarm-multiple
  - Pintos script
    - Parse command line, find disks, prepare arguments, run the simulator (Bochs)

A Tour of Pintos (4)

- Project testing

```
$ make check
$ make grade
```



A Tour of Pintos (5)

- Useful tools
  - gdb: The GNU project debugger
    - Allows to see what's going on inside another program while it executes
    - Refer to Appendix E.5: GDB
  - Tags
    - An index to the functions and global variables
    - Powerful when it is combined with vi editor
    - Refer to Appendix F.1: Tags
  - CVS: Version-control system
    - Useful for version controls and concurrent development
    - Refer to Appendix F.3: CVS
    - You can also use SVN or Git

A Tour of Pintos (6)

- Tips
  - Read the project specification carefully
  - Before starting your project, read the document template too!
    - It may give you useful tips
  - Study the test cases in `pintos/src/tests` used by "make check"
    - One C program for each test case (*.c)
    - One Perl script to check whether your implementation is correct or not (*.ck)
    - Study the correct output stored in the perl script
  - Do it incrementally
    - Otherwise, it can be totally messed up

PROJECT SCHEDULE & POLICIES

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Project Schedule

- Project 0
  - Warming up project (3/17~3/23)
- Project 1
  - Threads (3/31~4/13)
- Project 2
  - User programs (4/28~5/18)
- Project 3
  - Virtual memory (5/19~6/10)
- Project 1,2 and 3 are team project (2 students)
- This schedule is subject to change

Project Policy (1)

- Cheating policy
  - "Copying all or part of another person's work, or using reference material not specifically allowed, are forms of cheating and will not be tolerated."
  - For a student involved in an incident of cheating, the following policy will apply:
    - You will get a penalty in the final grade (down to F)
    - For serious offenses, this will be notified to the department chair
  - Share useful information: helping others use systems or tools, helping them with high-level designs or debug their code is NOT cheating!
  - To check cheating, TA see submissions, analyze codes & ask

Project Policy (2)

- Late policy
  - 20% off per day after due date

Project Grading (1)

- Functionality (70%)

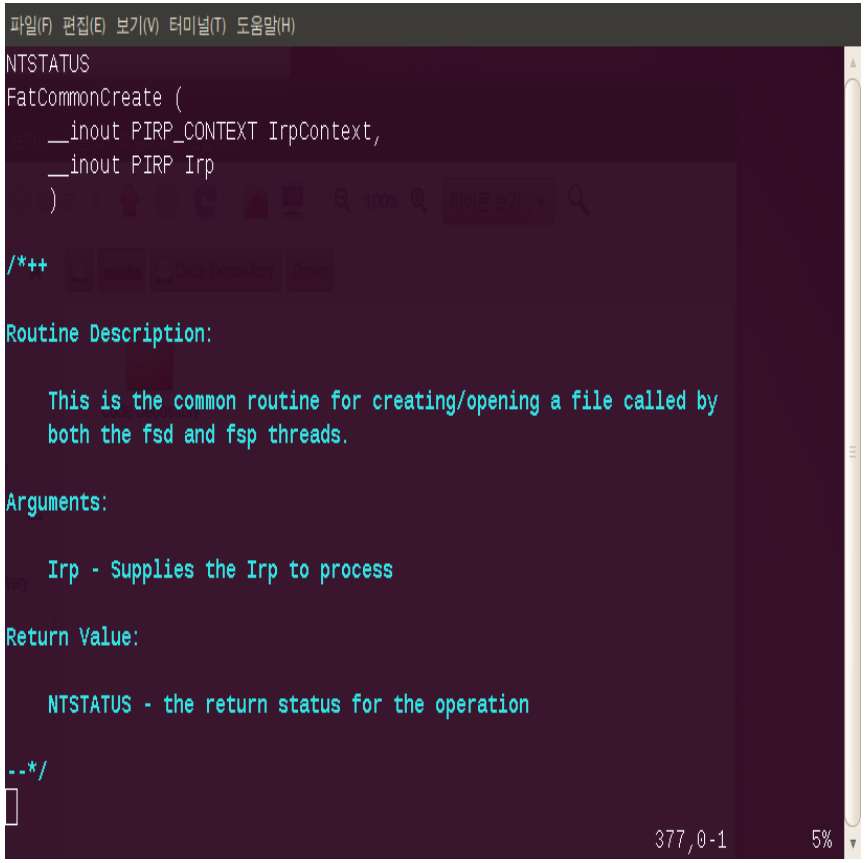
  $ make check

  $ make grade

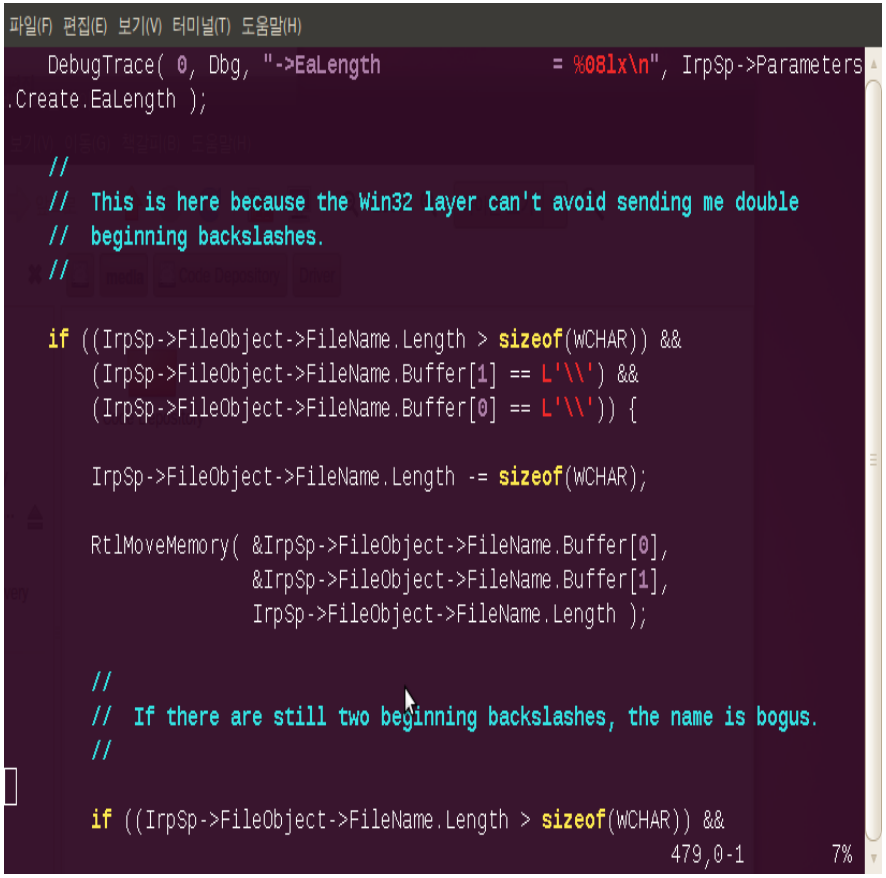
- Design & documentation (30%)
  - Source code
    - variable name, function name, comments
  - Design document
    - Data structure, Algorithm, Synchronization, Rationale
  - Refer to Appendix D: Project Documentation
- Demos & oral tests

Project Grading (2)

- Source code
  - comments



```
파일(F) 편집(E) 보기(V) 터미널(T) 도움말(H)
NTSTATUS
FatCommonCreate (
    __inout PIRP_CONTEXT IrpContext,
    __inout PIRP Irp
    )

/*++

Routine Description:

    This is the common routine for creating/opening a file called by
    both the fsd and fsp threads.

Arguments:

    Irp - Supplies the Irp to process

Return Value:

    NTSTATUS - the return status for the operation

--*/
{
                                                    377,0-1       5%
```



```
파일(F) 편집(E) 보기(V) 터미널(T) 도움말(H)
    DebugTrace( 0, Dbg, "->EaLength                 = %08lx\n", IrpSp->Parameters
.Create.EaLength );

    //
    //  This is here because the Win32 layer can't avoid sending me double
    //  beginning backslashes.
    //

    if ((IrpSp->FileObject->FileName.Length > sizeof(WCHAR)) &&
        (IrpSp->FileObject->FileName.Buffer[1] == L'\\') &&
        (IrpSp->FileObject->FileName.Buffer[0] == L'\\')) {

        IrpSp->FileObject->FileName.Length -= sizeof(WCHAR);

        RtlMoveMemory( &IrpSp->FileObject->FileName.Buffer[0],
                       &IrpSp->FileObject->FileName.Buffer[1],
                       IrpSp->FileObject->FileName.Length );


        //
        //  If there are still two beginning backslashes, the name is bogus.
        //

        if ((IrpSp->FileObject->FileName.Length > sizeof(WCHAR)) &&
                                                    479,0-1       7%
```

Project Grading (3)

- Demos & oral tests
  - Usually done in the next week of the due date
  - Everyone should meet the TA in the office
  - You may bring your notebook as there could be a problem in running your solution in the TA's machine
  - You should be able to answer any questions on
    - Basic system architecture
    - Design decisions
    - Implementation details
    - ...

PROJECT 0: WARMING UP

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Project 0 (1)

- Set up your own project environment
  - Install Linux
  - Install all the required tools
  - Install Pintos

Project 0 (2)

- Add a new test code: print-name
  - Add a new kernel function which prints your name in ASCII text format
  - To run the new function, add a new command "`print-name`"
    - The following command should run your new function

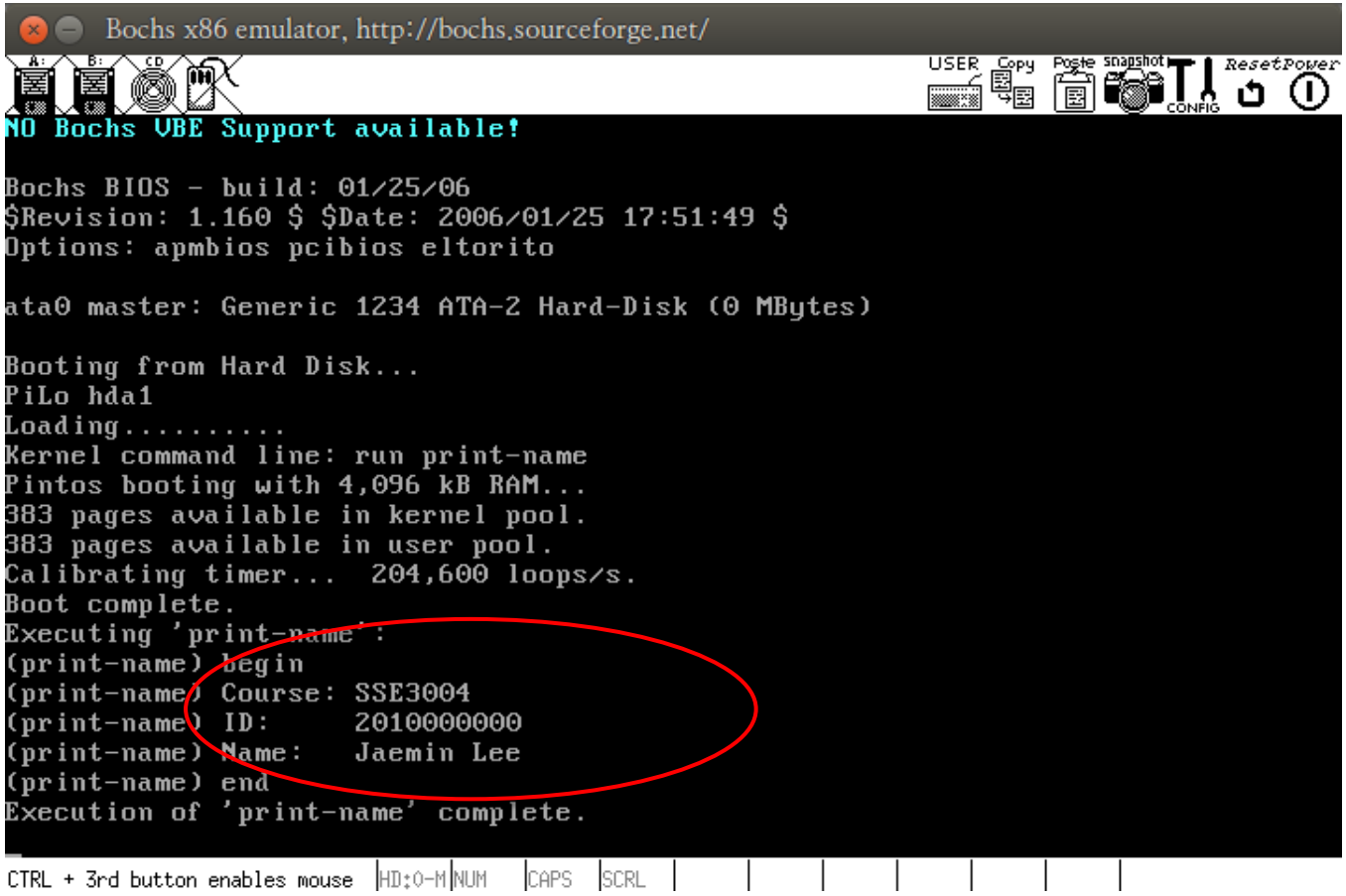
      ```
      $ pintos run print-name
      ```
  - Work in the `pintos/src/threads` and `pintos/src/tests/threads` directories

Project 0 (3)

- Add a new test code: print-name
  - Print format
    - (print-name) Course : SWE3004
    - (print-name) ID : 2010000000
    - (print-name) Name : Jaemin Lee

Project 0 (4)

- Example:



Submission (1)

- Documentation
  - A screen shot of "alarm-multiple"
  - A screen shot of "`print-name`"
  - Detailed explanation of how the "`print-name`" is handled and your name is printed by the kernel
  - File format – PDF format
  - File name – "GDHong_2013123456.pdf"
- Source code
  - Tar and gzip your Pintos source codes

```
$ cd pintos
$ (cd src/threads; make clean)
$ tar cvzf GDHong_2013123456.tar.gz src
```

Submission (2)

- Due
  - Mar. 23, 11:59PM
  - Upload your source code and documentation at iCampus
- Good luck!