Operating Systems

Setup & Mini Projects

Juhyung Park

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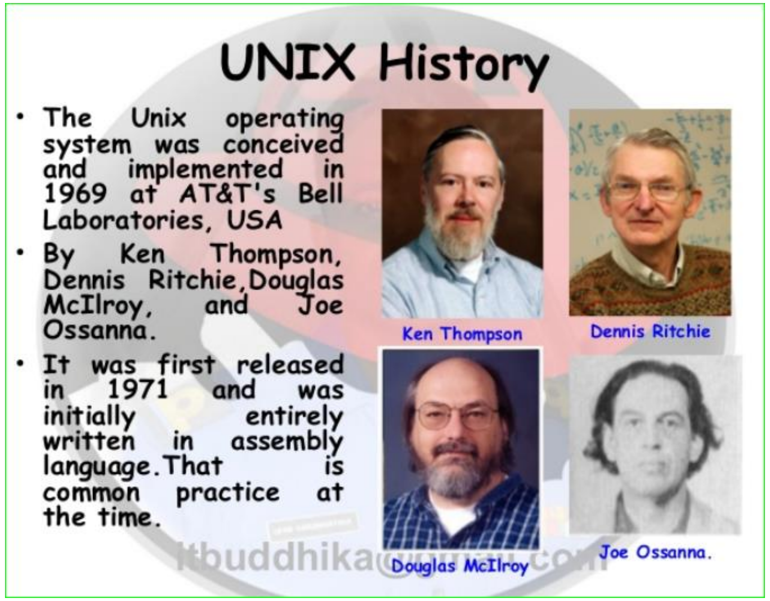
Xv6

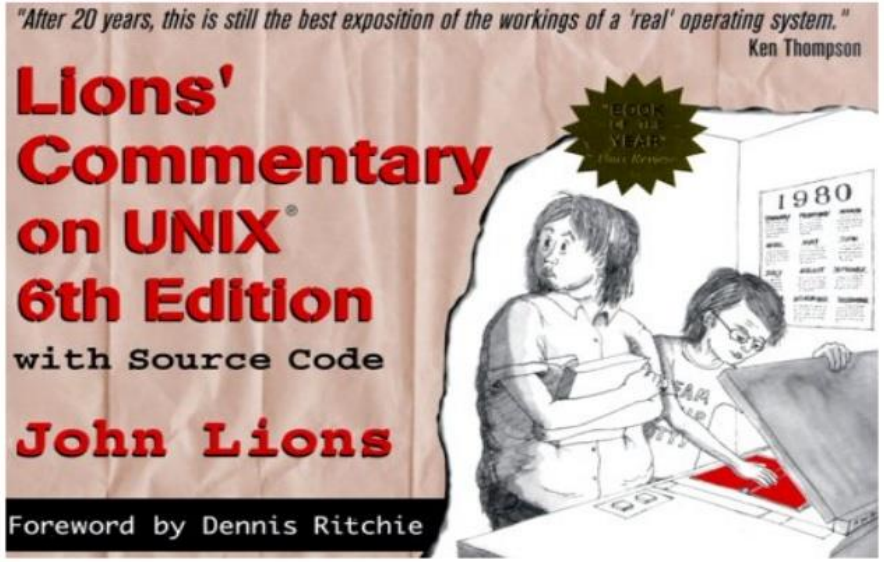
- Unix-like teaching operating system developed by MIT
- Reimplementation of v6 for a modern x86−based multiprocessor using ANSI C.
- Provide basic interface introduced by Ken Thompson and Dennis Ritchie’s Unix operating system, as well as mimicking Unix’s internal design



UNIX History

- The Unix operating system was conceived and implemented in 1969 at AT&T's Bell Laboratories, USA
- By Ken Thompson, Dennis Ritchie, Douglas McIlroy, and Joe Ossanna.
- It was first released in 1971 and was initially entirely written in assembly language. That is common practice at the time.

Ken Thompson
Dennis Ritchie
Douglas McIlroy
Joe Ossanna.



"After 20 years, this is still the best exposition of the workings of a 'real' operating system."
Ken Thompson

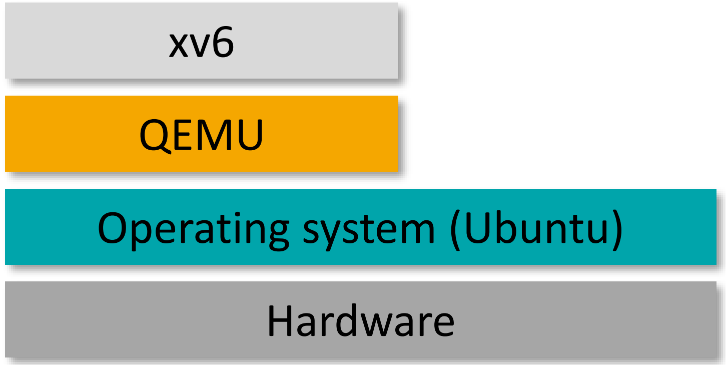
Lions' Commentary on UNIX 6th Edition with Source Code

John Lions

Foreword by Dennis Ritchie

Xv6 operating system (Cont'd)

- Xv6 does boot on real hardware, but typically we run it using the QEMU emulator
  - QEMU
    - Open source machine emulator and virtualizer



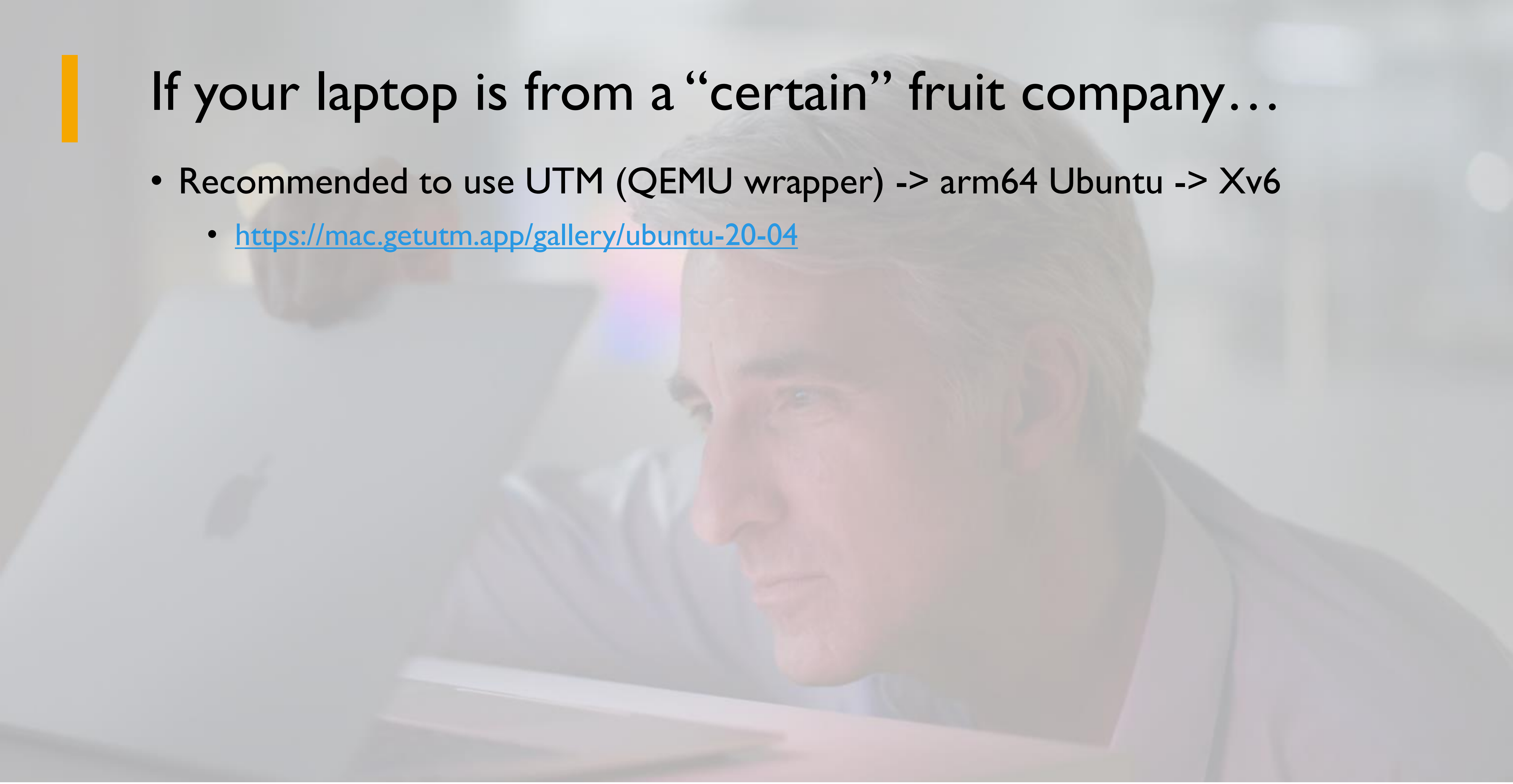
In this course…

- We use WSL2 (Windows Subsystem for Linux), Ubuntu 20.04 LTS and QEMU
  - Windows 10 -> Linux (Hyper-V/WSL2) -> Xv6 (QEMU)
  - Much more light-weight than a full VM (VMware, VirtualBox)

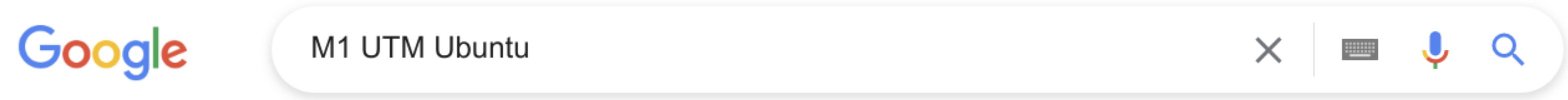
- Students with existing Linux installation (bare-metal or VM) can continue to use it
  - If you were already using WSL1, please remove it and follow the slides

- Feel free to contact TA in case of a setup issue
  - The sooner the better

If your laptop is from a "certain" fruit company…



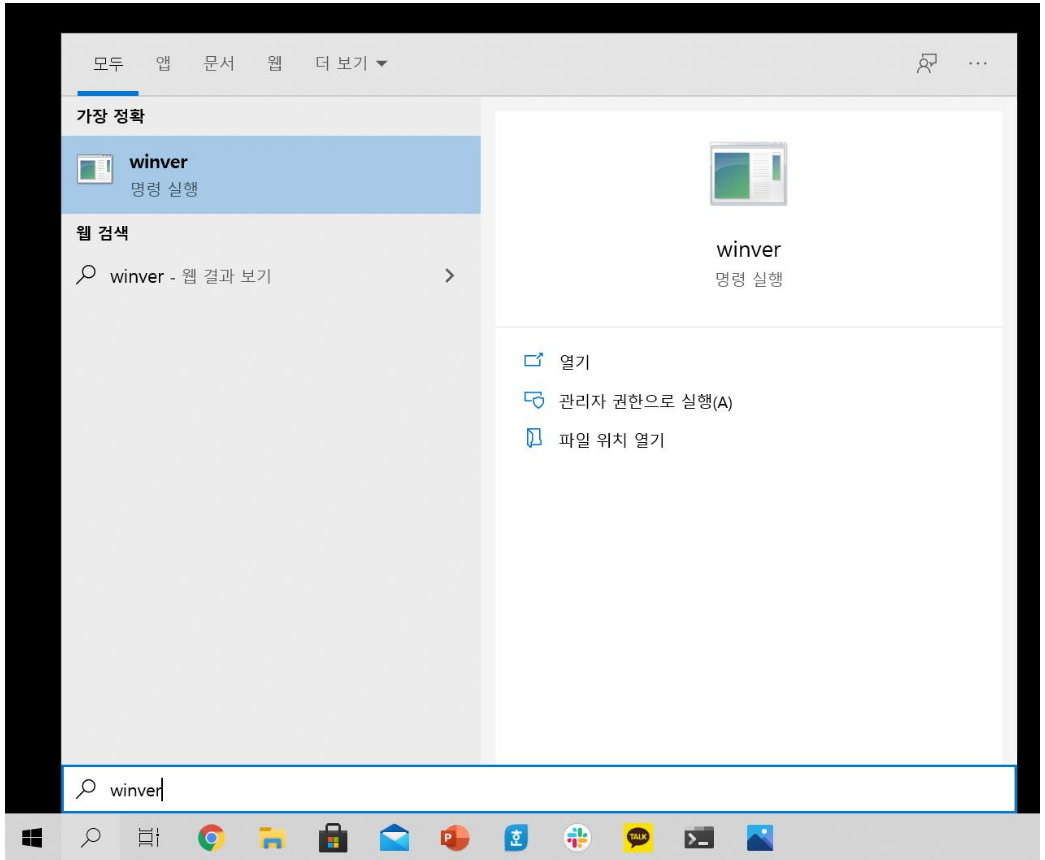
- Recommended to use UTM (QEMU wrapper) -> arm64 Ubuntu -> Xv6
  - https://mac.getutm.app/gallery/ubuntu-20-04

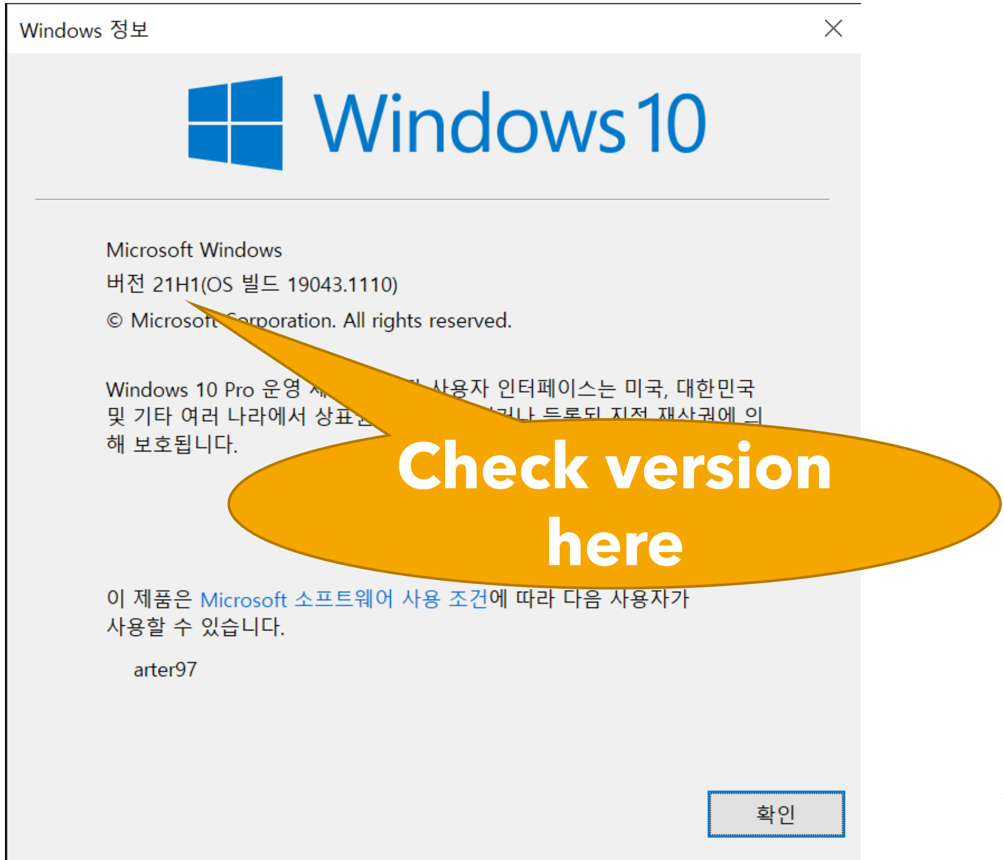


M1 UTM Ubuntu

Prerequisite – Windows 10 (1/4)

- WSL2's minimum requirement is Windows 10 2004 (20H1)
  - We use Windows 10 22H1 (latest) and students are recommended to match the version to avoid possible conflicts
  - Windows 11 users can skip this step





Microsoft Windows
버전 21H1(OS 빌드 19043.1110)
© Microsoft Corporation. All rights reserved.

Windows 10 Pro 운영 체 사용자 인터페이스는 미국, 대한민국
및 기타 여러 나라에서 상표권 거나 드로된 지적 재산권에 의
해 보호됩니다.

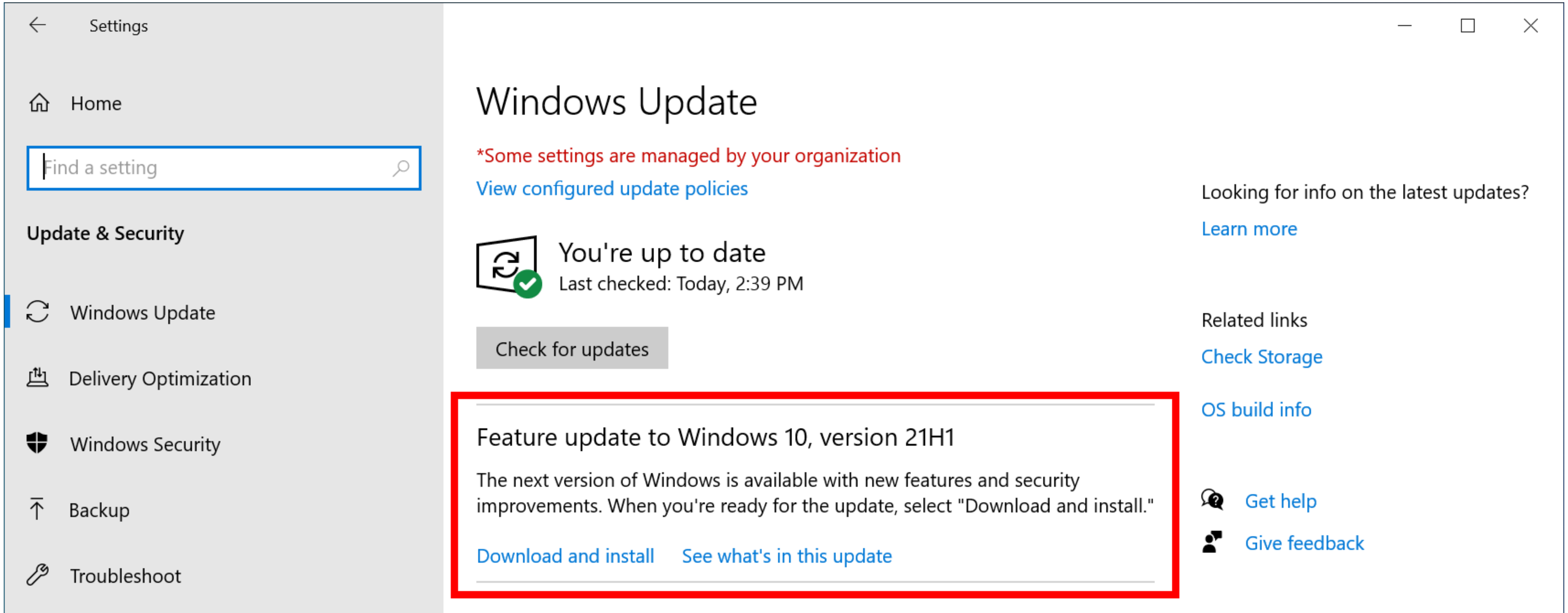
이 제품은 Microsoft 소프트웨어 사용 조건에 따라 다음 사용자가
사용할 수 있습니다.

arter97

Check version here

Prerequisite – Windows 10 (1/4)

- If older than 2004, use Windows Update
  - Tap "Check for updates" and "Download and install"
  - This may take 10-60 minutes



Windows Update

*Some settings are managed by your organization

View configured update policies

You're up to date

Last checked: Today, 2:39 PM

Check for updates

Feature update to Windows 10, version 21H1

The next version of Windows is available with new features and security improvements. When you're ready for the update, select "Download and install."

Download and install   See what's in this update

Looking for info on the latest updates?

Learn more

Related links

Check Storage

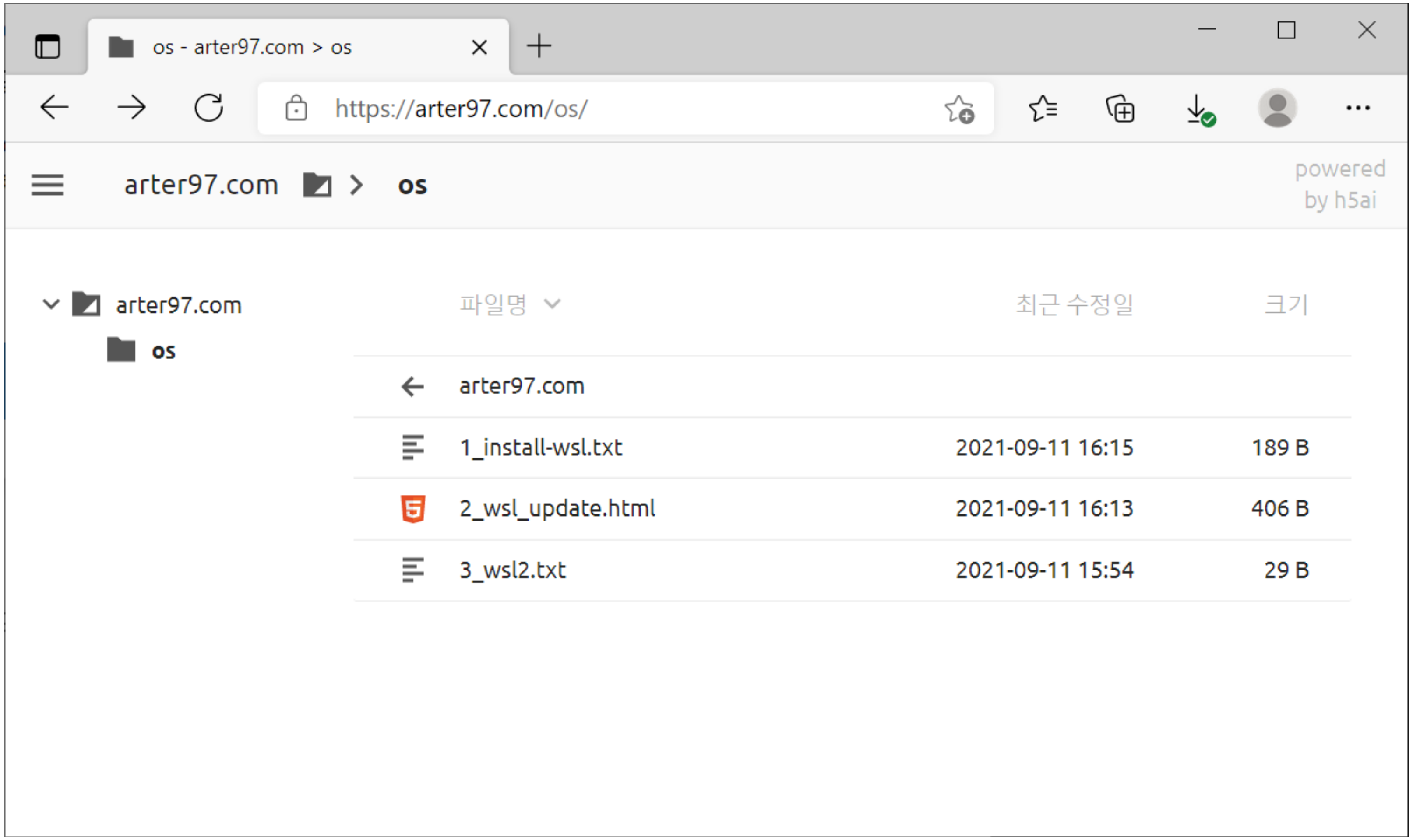
OS build info

Get help

Give feedback

Prerequisite – Install WSL2 (2/4)

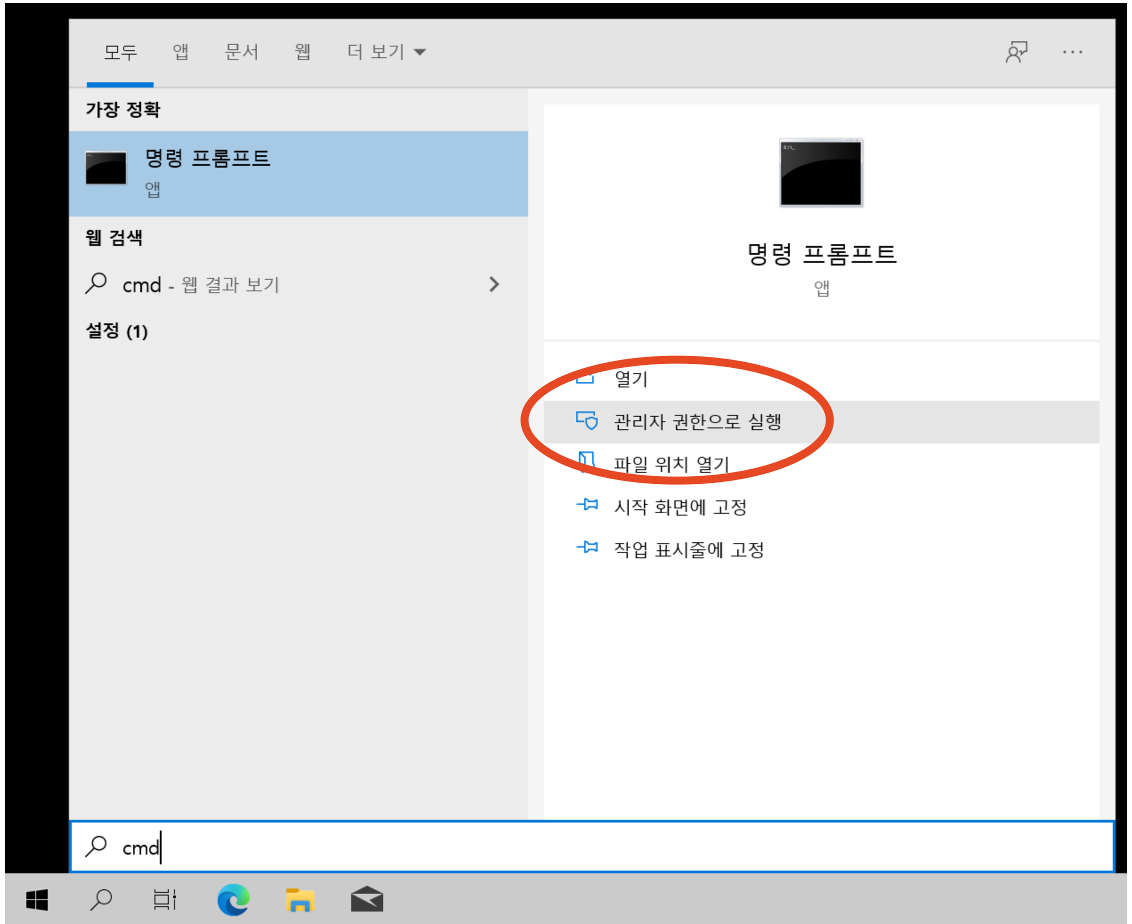
- Visit https://arter97.com/os for easy copy & paste



파일명	최근 수정일	크기
arter97.com		
1_install-wsl.txt	2021-09-11 16:15	189 B
2_wsl_update.html	2021-09-11 16:13	406 B
3_wsl2.txt	2021-09-11 15:54	29 B

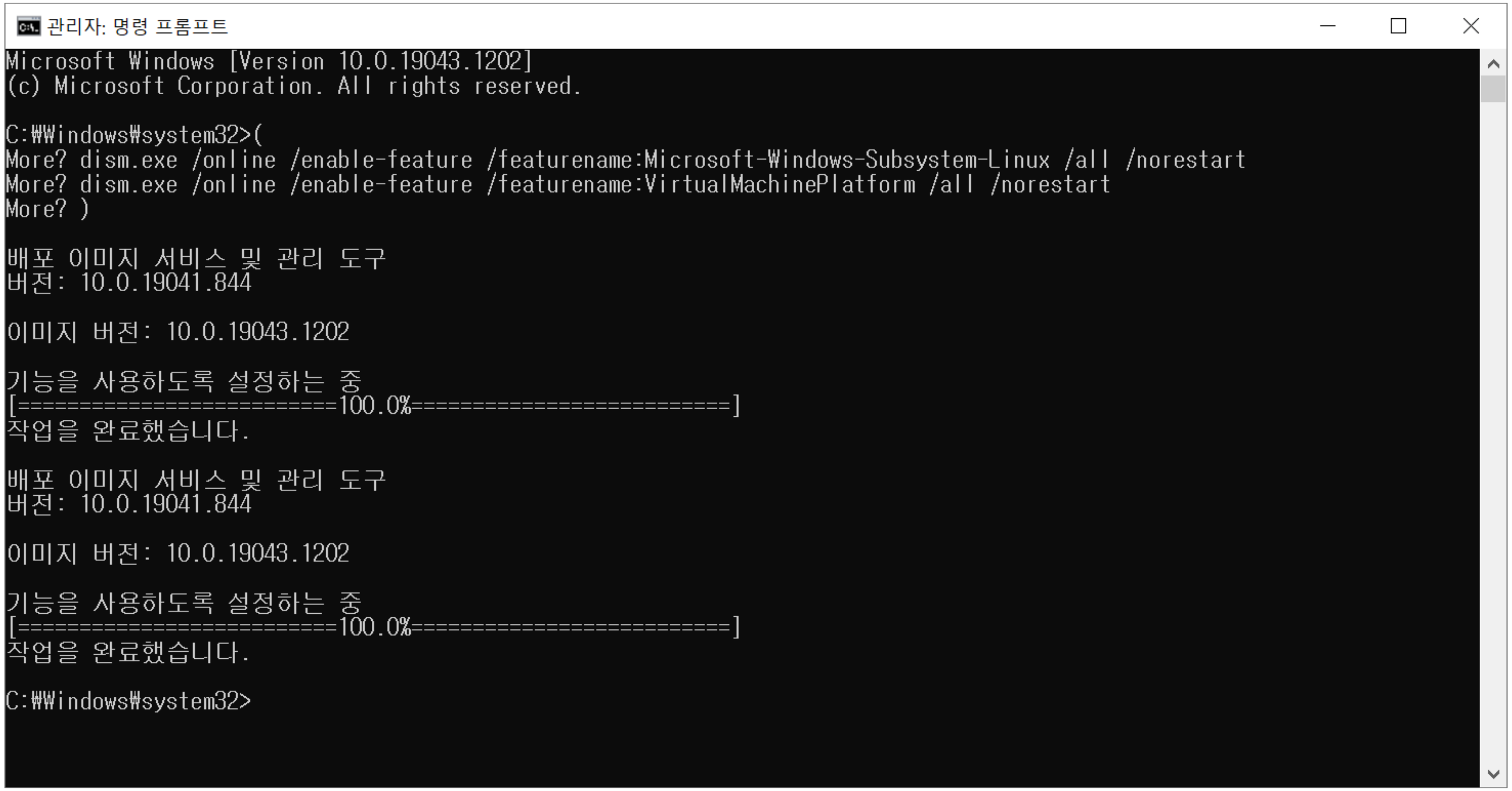
Prerequisite – Install WSL2 (2/4)

- Launch cmd with administrator privileges



Prerequisite – Install WSL2 (2/4)

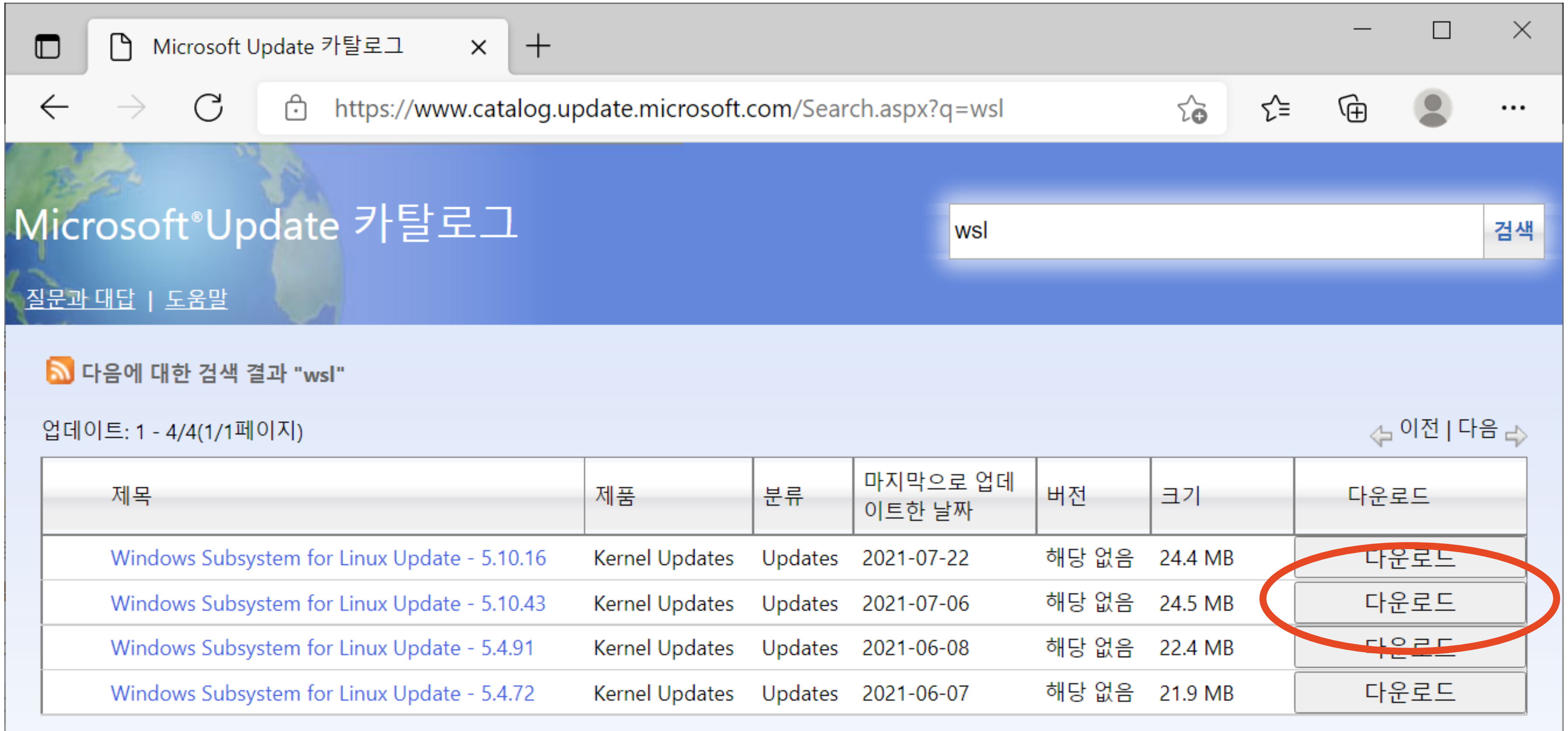
- Launch cmd with administrator privileges
- Type the following commands **and reboot**



```
Microsoft Windows [Version 10.0.19043.1202]
(c) Microsoft Corporation. All rights reserved.

C:₩Windows₩system32>(
More? dism.exe /online /enable-feature /featurename:Microsoft-Windows-Subsystem-Linux /all /norestart
More? dism.exe /online /enable-feature /featurename:VirtualMachinePlatform /all /norestart
More? )

배포 이미지 서비스 및 관리 도구
버전: 10.0.19041.844

이미지 버전: 10.0.19043.1202

기능을 사용하도록 설정하는 중
[==========================100.0%==========================]
작업을 완료했습니다.

배포 이미지 서비스 및 관리 도구
버전: 10.0.19041.844

이미지 버전: 10.0.19043.1202

기능을 사용하도록 설정하는 중
[==========================100.0%==========================]
작업을 완료했습니다.

C:₩Windows₩system32>
```

Prerequisite – Install WSL2 (2/4)

- Install the Linux kernel for WSL2 by visiting https://catalog.update.microsoft.com
  - At the time of writing, 5.10.43 is the latest



Microsoft Update 카탈로그
https://www.catalog.update.microsoft.com/Search.aspx?q=wsl
Microsoft®Update 카탈로그
wsl
검색
질문과 대답 | 도움말
이전 | 다음

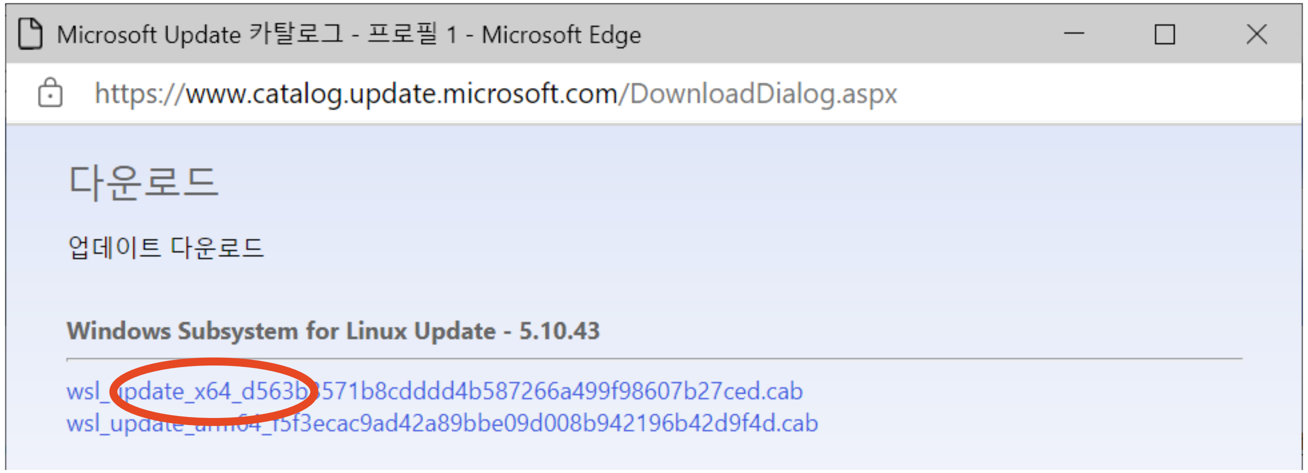
다음에 대한 검색 결과 "wsl"

업데이트: 1 - 4/4(1/1페이지)

제목	제품	분류	마지막으로 업데이트한 날짜	버전	크기	다운로드
Windows Subsystem for Linux Update - 5.10.16	Kernel Updates	Updates	2021-07-22	해당 없음	24.4 MB	다운로드
Windows Subsystem for Linux Update - 5.10.43	Kernel Updates	Updates	2021-07-06	해당 없음	24.5 MB	다운로드
Windows Subsystem for Linux Update - 5.4.91	Kernel Updates	Updates	2021-06-08	해당 없음	22.4 MB	다운로드
Windows Subsystem for Linux Update - 5.4.72	Kernel Updates	Updates	2021-06-07	해당 없음	21.9 MB	다운로드

Prerequisite – Install WSL2 (2/4)

- Install the Linux kernel for WSL2 by visiting https://catalog.update.microsoft.com
  - At the time of writing, 5.10.43 is the latest
- Download the x64 variant



Microsoft Update 카탈로그 - 프로필 1 - Microsoft Edge

https://www.catalog.update.microsoft.com/DownloadDialog.aspx

다운로드

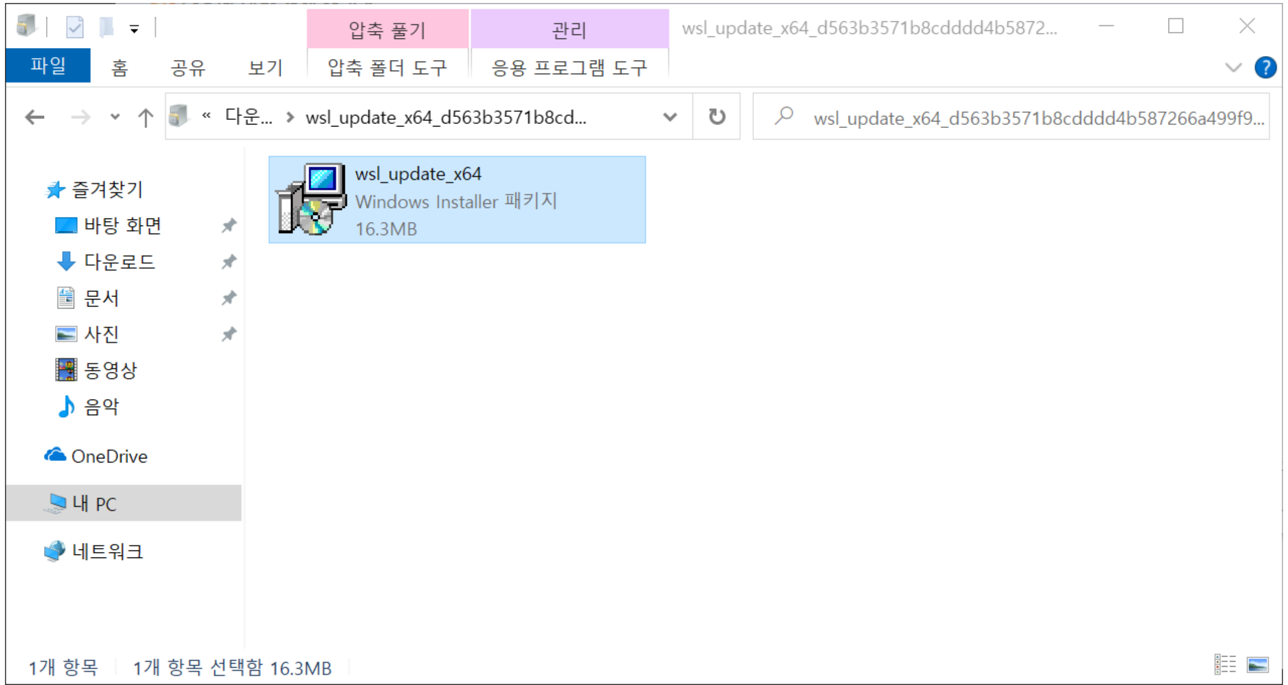
업데이트 다운로드

Windows Subsystem for Linux Update - 5.10.43

wsl_update_x64_d563b8571b8cdddd4b587266a499f98607b27ced.cab
wsl_update_arm64_f5f3ecac9ad42a89bbe09d008b942196b42d9f4d.cab

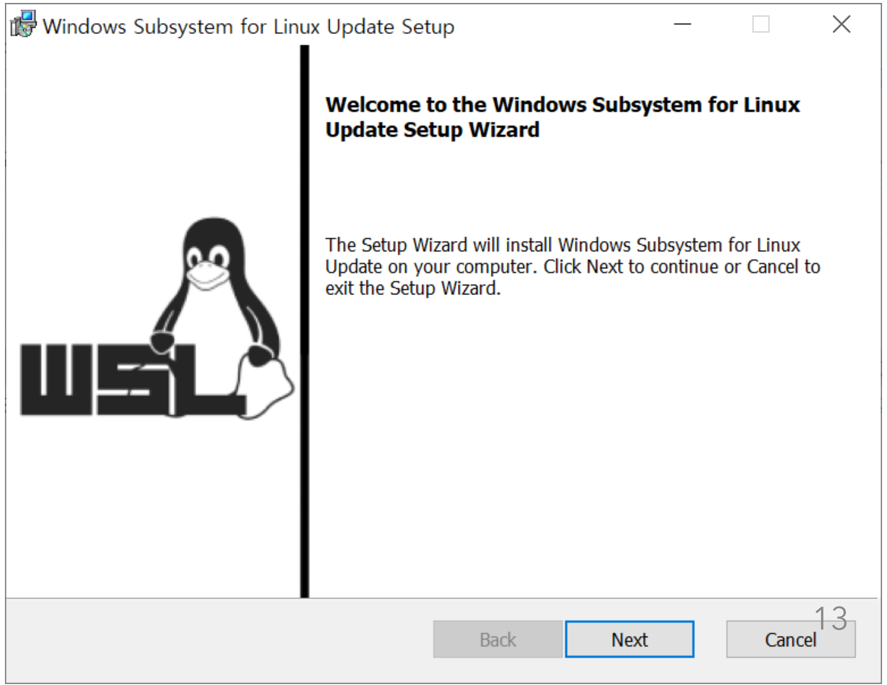
Prerequisite – Install WSL2 (2/4)

- Install the Linux kernel for WSL2 by visiting https://catalog.update.microsoft.com
  - At the time of writing, 5.10.43 is the latest
- Download the x64 variant
- Extract the "cab" file and install


압축 풀기
관리
wsl_update_x64_d563b3571b8cdddd4b5872...
파일
홈
공유
보기
압축 폴더 도구
응용 프로그램 도구
« 다운... › wsl_update_x64_d563b3571b8cd...
wsl_update_x64_d563b3571b8cdddd4b587266a499f9...
즐겨찾기
바탕 화면
다운로드
문서
사진
동영상
음악
OneDrive
내 PC
네트워크

wsl_update_x64
Windows Installer 패키지
16.3MB

1개 항목 1개 항목 선택함 16.3MB

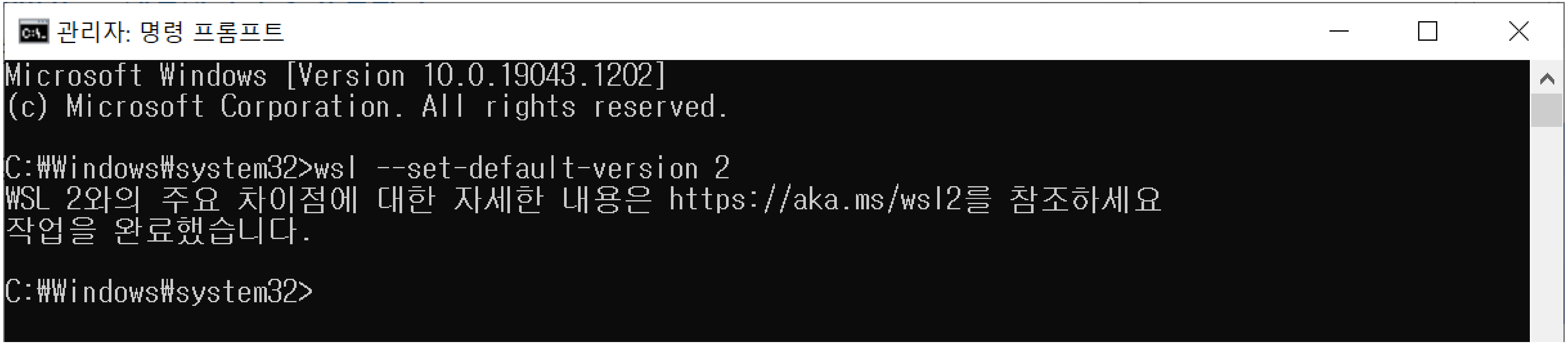


Welcome to the Windows Subsystem for Linux Update Setup Wizard

The Setup Wizard will install Windows Subsystem for Linux Update on your computer. Click Next to continue or Cancel to exit the Setup Wizard.

Prerequisite – Install WSL2 (2/4)

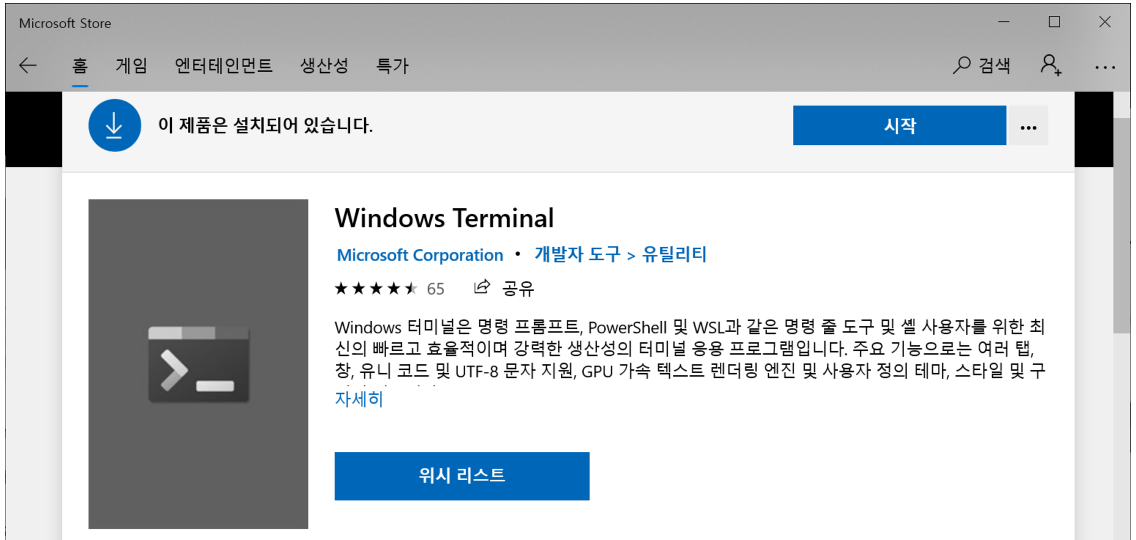
- Launch cmd with administrator privileges again
- Type: `wsl --set-default-version 2`



```
Microsoft Windows [Version 10.0.19043.1202]
(c) Microsoft Corporation. All rights reserved.

C:₩Windows₩system32>wsl --set-default-version 2
WSL 2와의 주요 차이점에 대한 자세한 내용은 https://aka.ms/wsl2를 참조하세요
작업을 완료했습니다.

C:₩Windows₩system32>
```

Prerequisite – Download and install Windows Terminal and Ubuntu (3/4)

- Simply search “Windows Terminal” and “Ubuntu” from the Microsoft Store
  - You’ll see 3 options for Ubuntu
  - **Install “Ubuntu”, not “Ubuntu 20.04 LTS” or “Ubuntu 18.04 LTS”**
- You don’t have to sign-in with a Microsoft Account, click “Not interested” or “X” if prompted



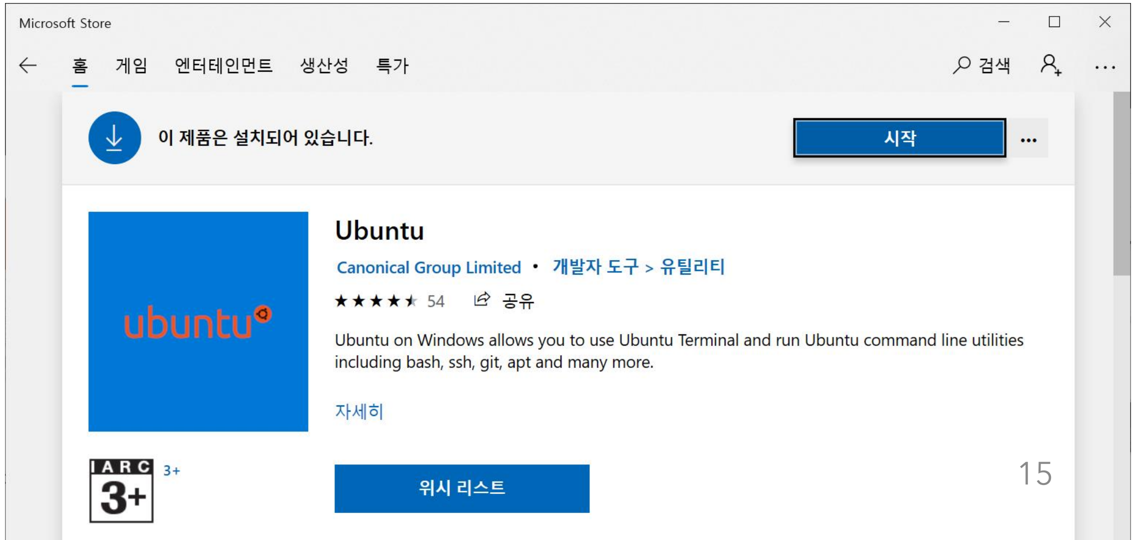
이 제품은 설치되어 있습니다.

Windows Terminal

Microsoft Corporation • 개발자 도구 > 유틸리티

★★★★★ 65

Windows 터미널은 명령 프롬프트, PowerShell 및 WSL과 같은 명령 줄 도구 및 셸 사용자를 위한 최신의 빠르고 효율적이며 강력한 생산성의 터미널 응용 프로그램입니다. 주요 기능으로는 여러 탭, 창, 유니 코드 및 UTF-8 문자 지원, GPU 가속 텍스트 렌더링 엔진 및 사용자 정의 테마, 스타일 및 구



이 제품은 설치되어 있습니다.

Ubuntu

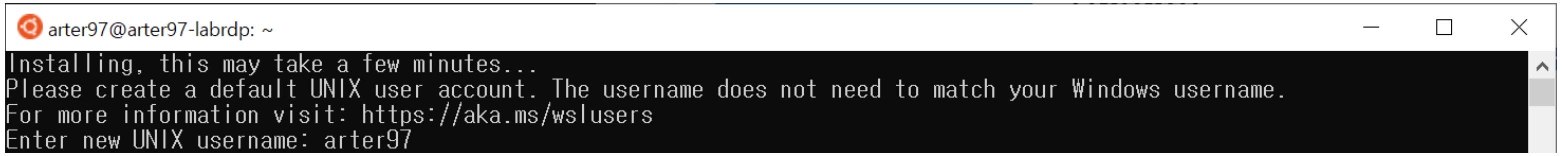
Canonical Group Limited • 개발자 도구 > 유틸리티

★★★★★ 54

Ubuntu on Windows allows you to use Ubuntu Terminal and run Ubuntu command line utilities including bash, ssh, git, apt and many more.

Prerequisite – Setup Ubuntu (4/4)

- Launch Ubuntu

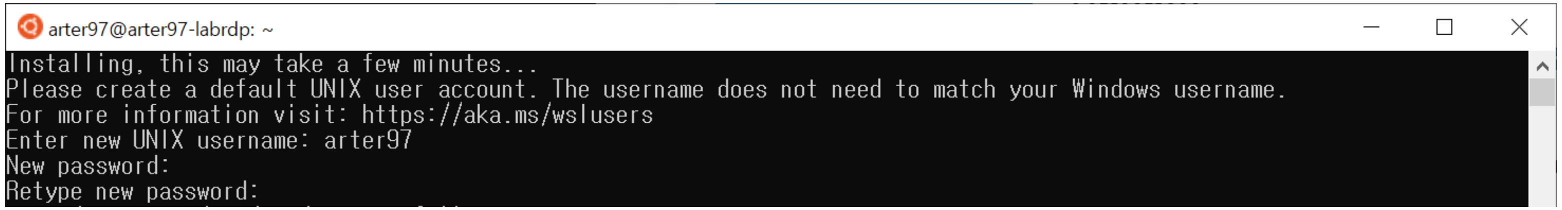


```
Installing, this may take a few minutes...
Please create a default UNIX user account. The username does not need to match your Windows username.
For more information visit: https://aka.ms/wslusers
Enter new UNIX username: arter97
```

Enter username (alphabet and numbers only)

Prerequisite – Setup Ubuntu (4/4)

- Launch Ubuntu

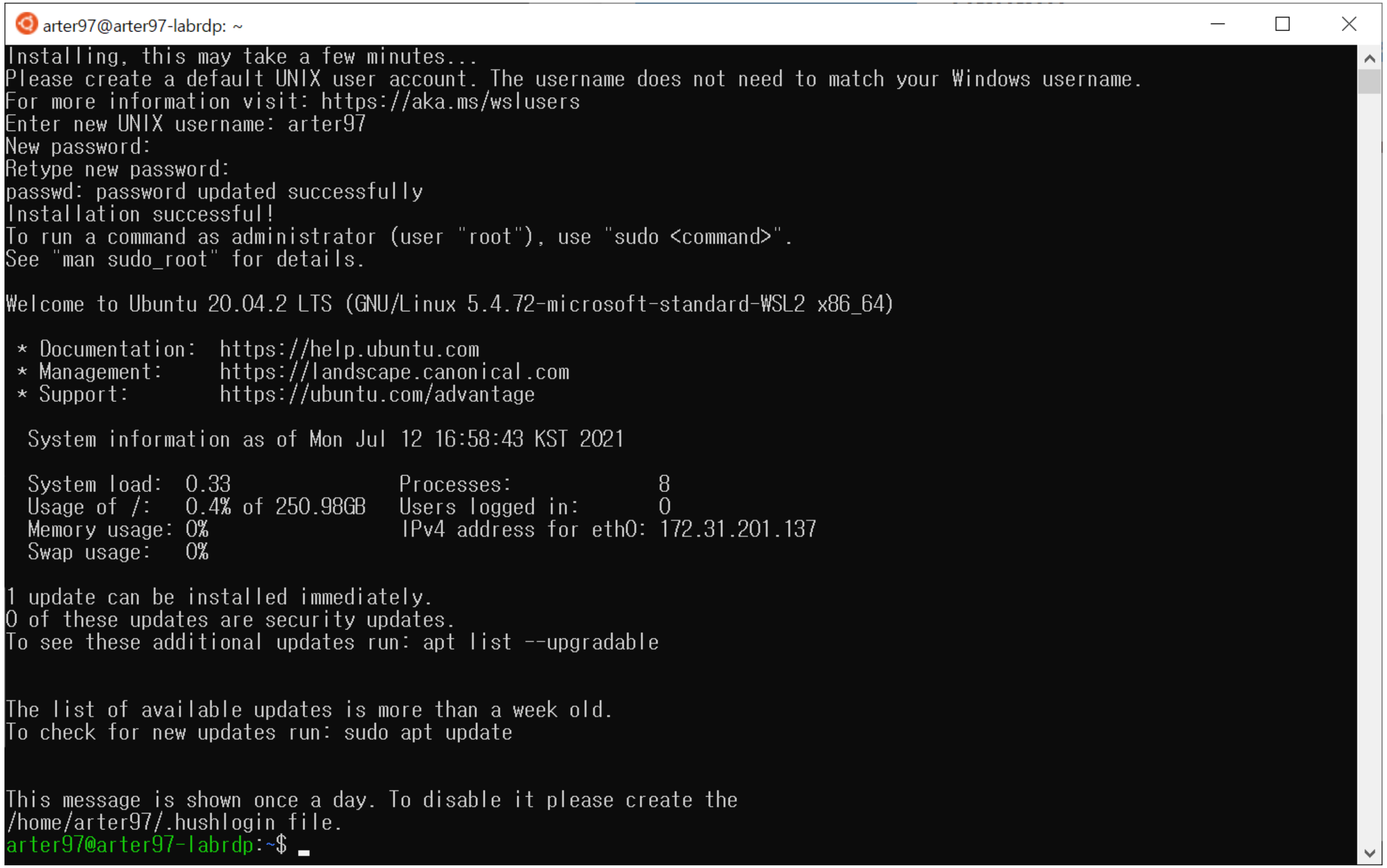


```
Installing, this may take a few minutes...
Please create a default UNIX user account. The username does not need to match your Windows username.
For more information visit: https://aka.ms/wslusers
Enter new UNIX username: arter97
New password:
Retype new password:
```

Type passwords twice (**** won't be displayed on the screen)

Prerequisite – Setup Ubuntu (4/4)

- Launch Ubuntu

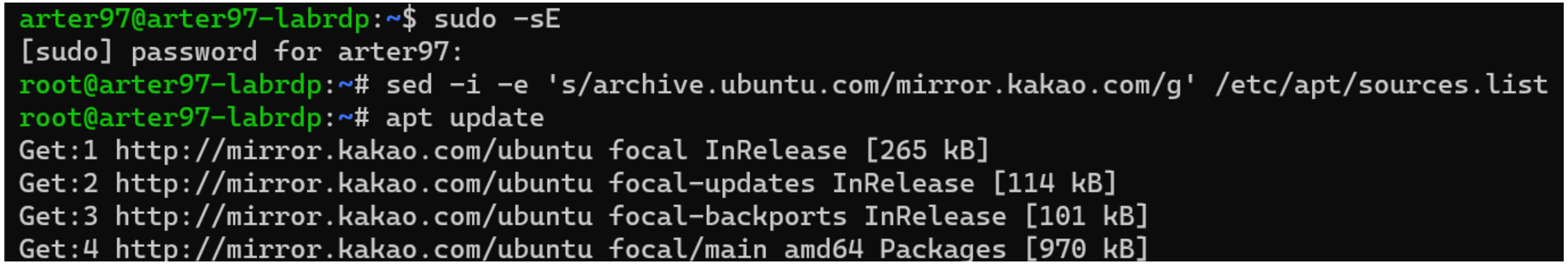


```
Installing, this may take a few minutes...
Please create a default UNIX user account. The username does not need to match your Windows username.
For more information visit: https://aka.ms/wslusers
Enter new UNIX username: arter97
New password:
Retype new password:
passwd: password updated successfully
Installation successful!
To run a command as administrator (user "root"), use "sudo <command>".
See "man sudo_root" for details.

Welcome to Ubuntu 20.04.2 LTS (GNU/Linux 5.4.72-microsoft-standard-WSL2 x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/advantage

  System information as of Mon Jul 12 16:58:43 KST 2021

  System load:  0.33               Processes:             8
  Usage of /:   0.4% of 250.98GB   Users logged in:       0
  Memory usage: 0%                 IPv4 address for eth0: 172.31.201.137
  Swap usage:   0%

1 update can be installed immediately.
0 of these updates are security updates.
To see these additional updates run: apt list --upgradable


The list of available updates is more than a week old.
To check for new updates run: sudo apt update


This message is shown once a day. To disable it please create the
/home/arter97/.hushlogin file.
arter97@arter97-labrdp:~$ _
```

Prerequisite – Setup Ubuntu (4/4)

- Type:

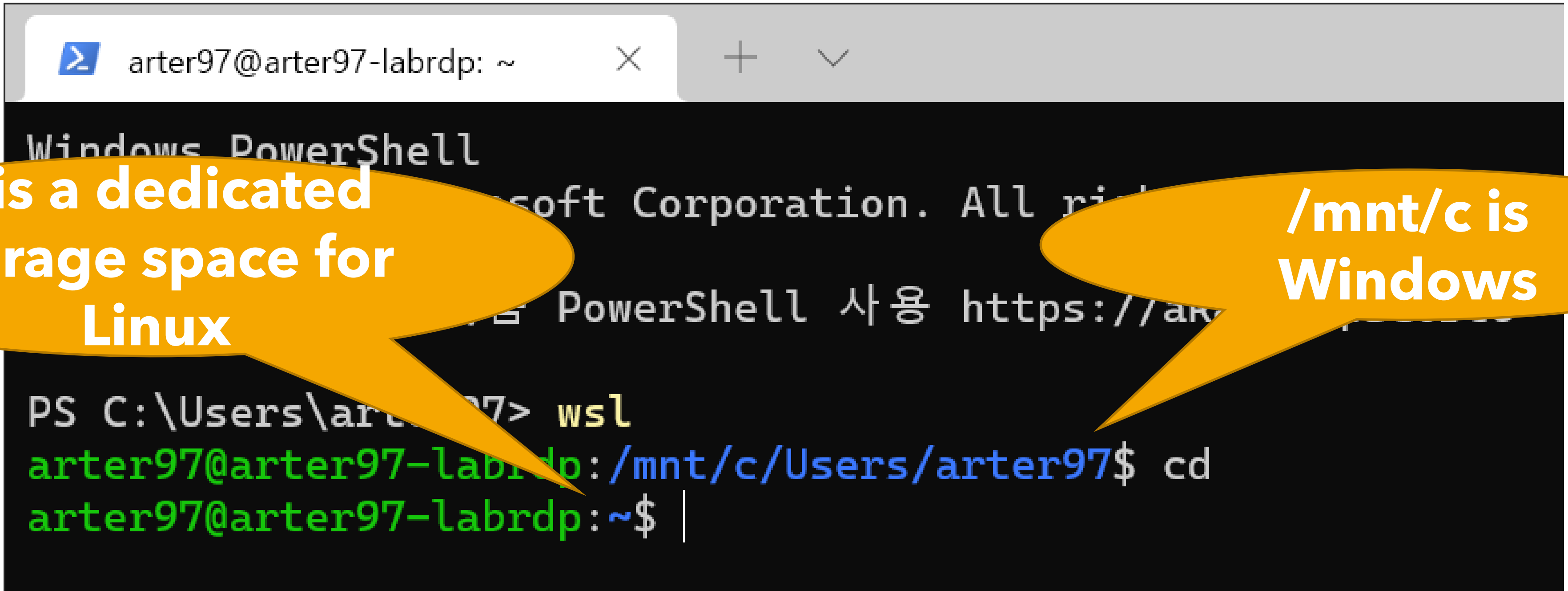
```
sudo -sE # Enter your password next
sed -i -e 's/archive.ubuntu.com/mirror.kakao.com/g' /etc/apt/sources.list
apt update
apt -y dist-upgrade
apt -y install build-essential gcc-multilib git qemu-kvm vim gdb ctags
apt clean
chown -R 1000:1000 ~
exit
exit
```



```
arter97@arter97-labrdp:~$ sudo -sE
[sudo] password for arter97:
root@arter97-labrdp:~# sed -i -e 's/archive.ubuntu.com/mirror.kakao.com/g' /etc/apt/sources.list
root@arter97-labrdp:~# apt update
Get:1 http://mirror.kakao.com/ubuntu focal InRelease [265 kB]
Get:2 http://mirror.kakao.com/ubuntu focal-updates InRelease [114 kB]
Get:3 http://mirror.kakao.com/ubuntu focal-backports InRelease [101 kB]
Get:4 http://mirror.kakao.com/ubuntu focal/main amd64 Packages [970 kB]
```

Using WSL2

- Launch Windows Terminal
- Type `wsl` to use Ubuntu from Windows Terminal
  - We won’t be using the Ubuntu app from now on
  - **Always type ‘cd’** right after launching Ubuntu to prevent touching Windows files
- You can copy Linux files to Windows (e.g., `cp file.txt /mnt/c/Users/arter97/Desktop`)



```
Windows PowerShell
        soft Corporation. All ri

        PowerShell 사용 https://ak

PS C:\Users\arter97> wsl
arter97@arter97-labrdp:/mnt/c/Users/arter97$ cd
arter97@arter97-labrdp:~$
```

~ is a dedicated storage space for Linux

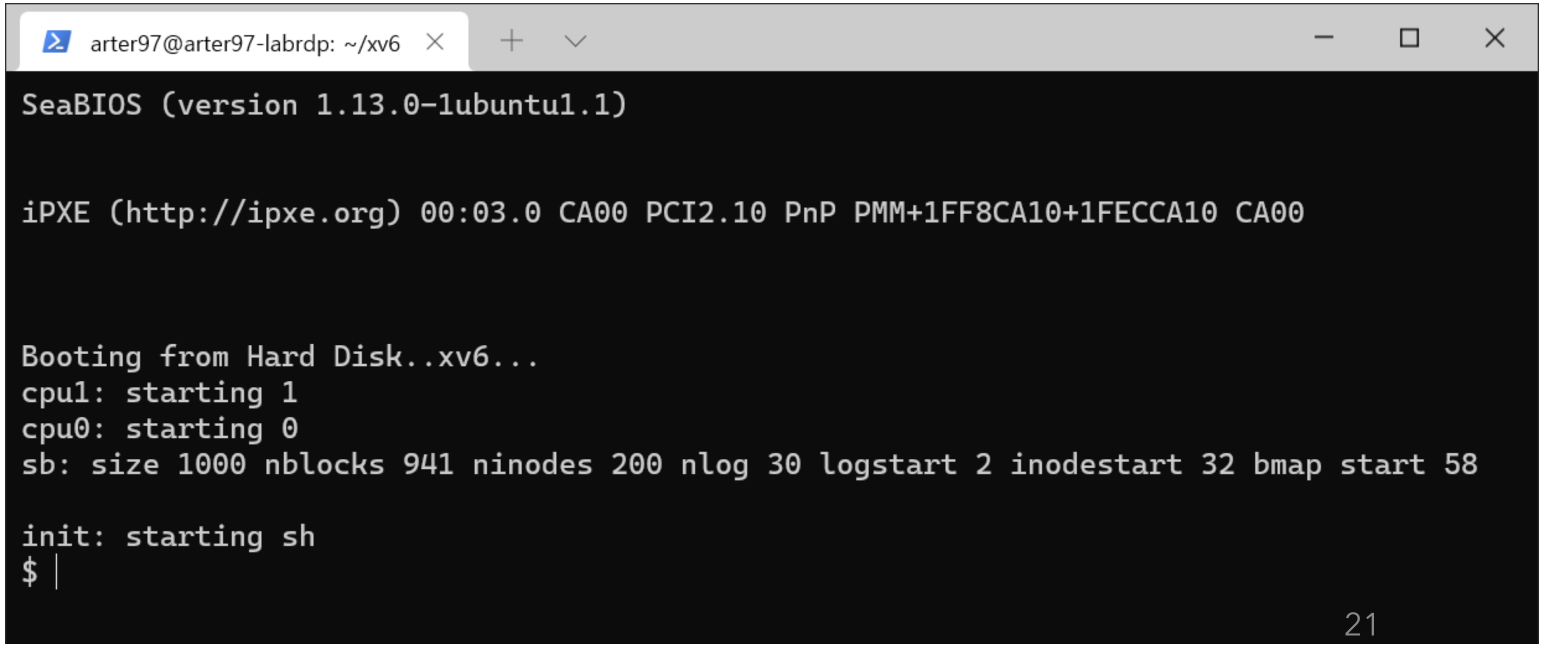
/mnt/c is Windows

Xv6 Installation

- Type:

```
git clone https://github.com/dgist-datalab/xv6
cd xv6
make qemu-nox -j
```

- Uses Git to download Xv6 source code
- Build & run with QEMU



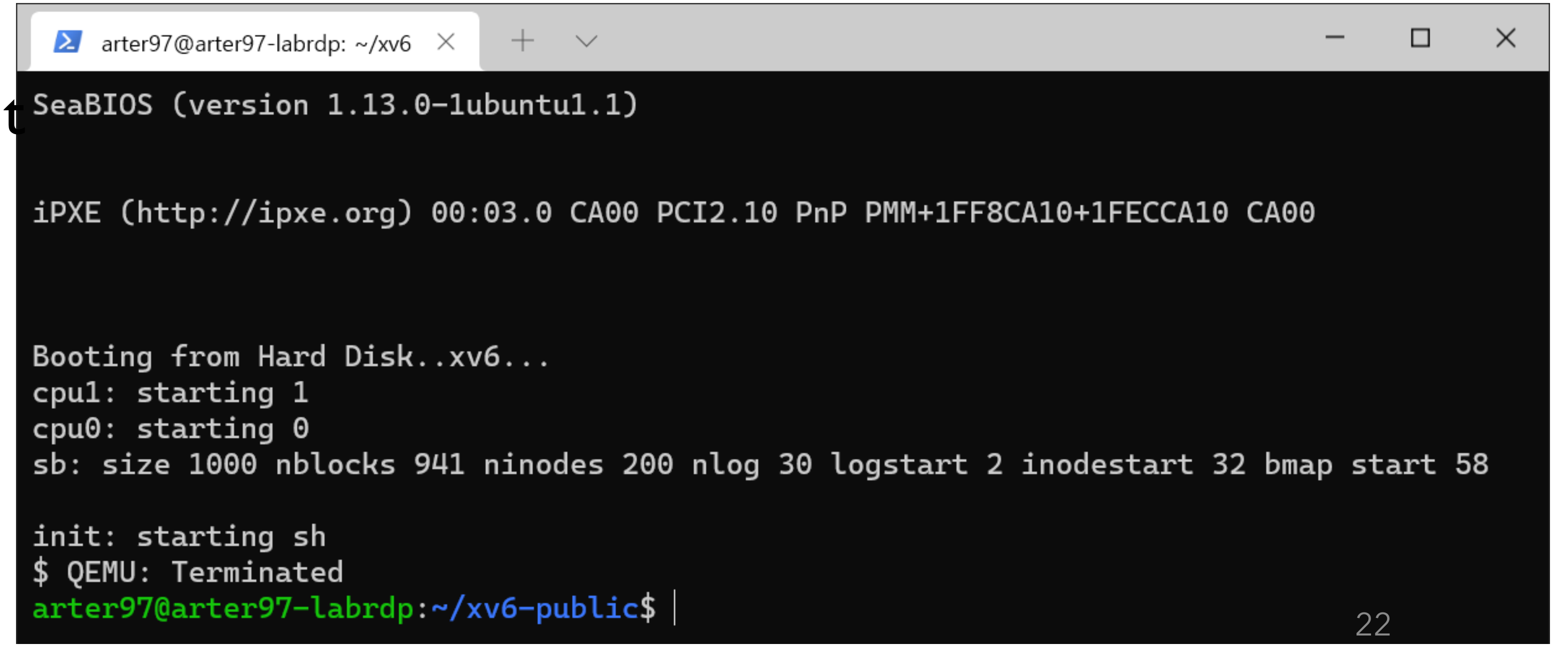
```
SeaBIOS (version 1.13.0-1ubuntu1.1)


iPXE (http://ipxe.org) 00:03.0 CA00 PCI2.10 PnP PMM+1FF8CA10+1FECCA10 CA00



Booting from Hard Disk..xv6...
cpu1: starting 1
cpu0: starting 0
sb: size 1000 nblocks 941 ninodes 200 nlog 30 logstart 2 inodestart 32 bmap start 58

init: starting sh
$
```

Xv6 Installation

- Type:

```
git clone https://github.com/dgist-datalab/xv6
cd xv6
make qemu-nox -j
```

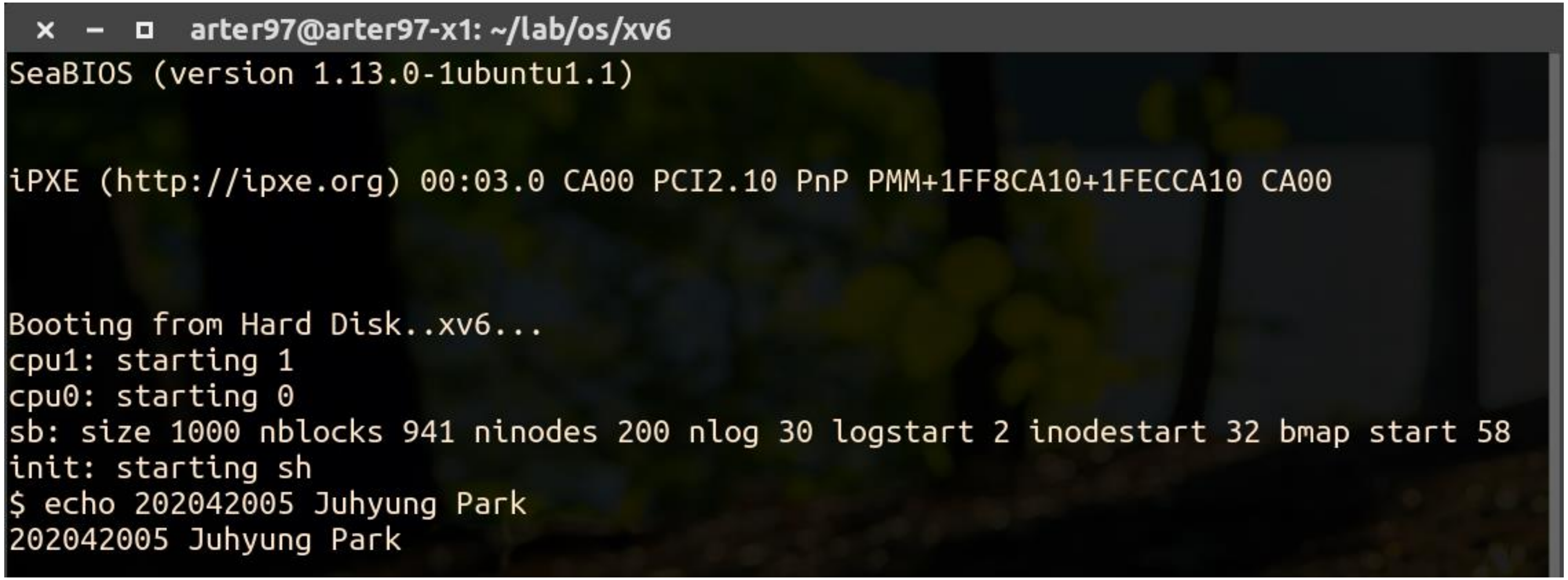
- Uses Git to download Xv6 source code
- Build & run with QEMU
- Press "Ctrl-A + X" to quit
  - It's not "Ctrl-A + Ctrl-X"



```
SeaBIOS (version 1.13.0-1ubuntu1.1)


iPXE (http://ipxe.org) 00:03.0 CA00 PCI2.10 PnP PMM+1FF8CA10+1FECCA10 CA00



Booting from Hard Disk..xv6...
cpu1: starting 1
cpu0: starting 0
sb: size 1000 nblocks 941 ninodes 200 nlog 30 logstart 2 inodestart 32 bmap start 58

init: starting sh
$ QEMU: Terminated
arter97@arter97-labrdp:~/xv6-public$
```

Mini Project #1 - Print the number of context switches on process termination

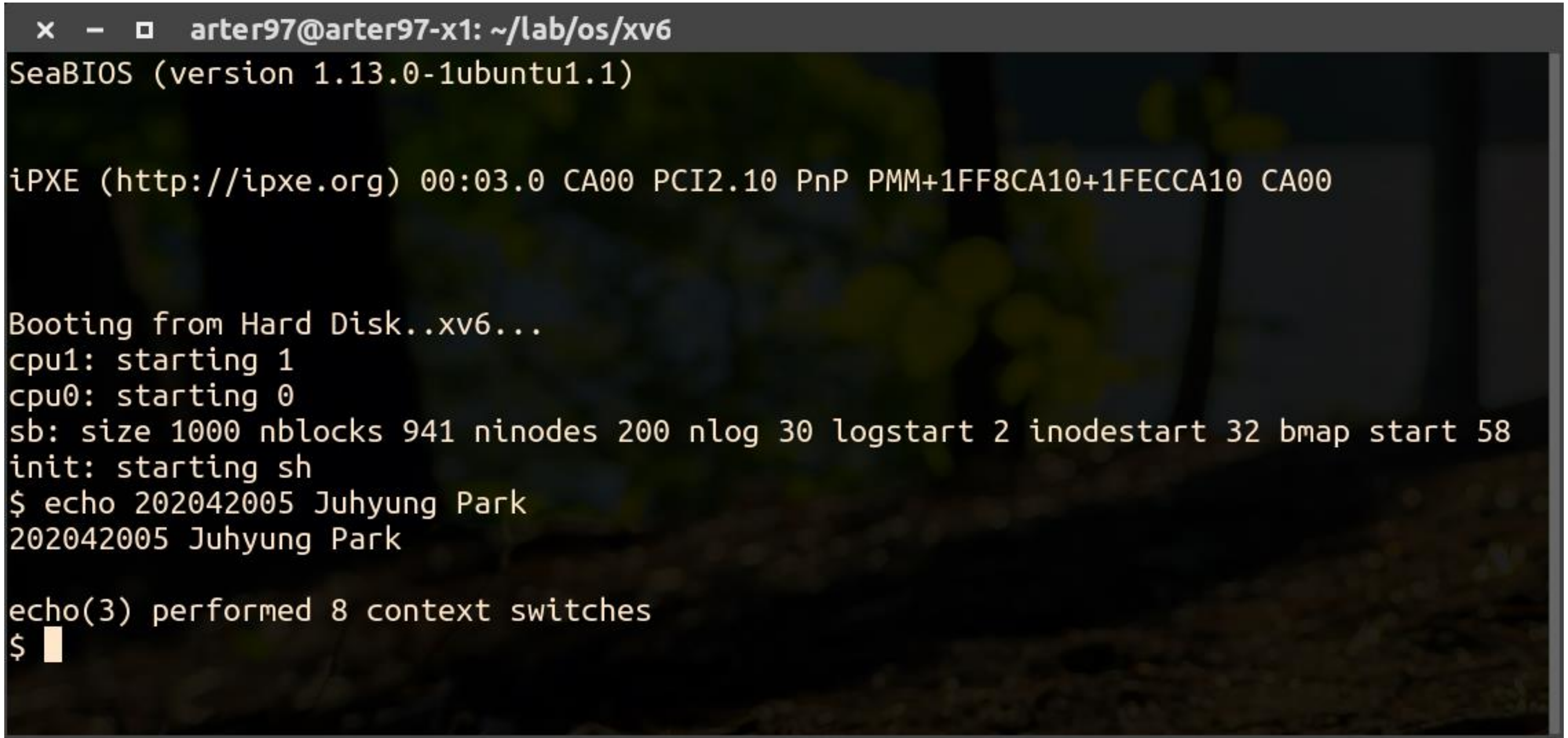
- Print your ID and name with the “echo” command



```
SeaBIOS (version 1.13.0-1ubuntu1.1)


iPXE (http://ipxe.org) 00:03.0 CA00 PCI2.10 PnP PMM+1FF8CA10+1FECCA10 CA00



Booting from Hard Disk..xv6...
cpu1: starting 1
cpu0: starting 0
sb: size 1000 nblocks 941 ninodes 200 nlog 30 logstart 2 inodestart 32 bmap start 58
init: starting sh
$ echo 202042005 Juhyung Park
202042005 Juhyung Park
```

Mini Project #1 - Print the number of context switches on process termination

- Print your ID and name with the "echo" command
- **… and also print the number of context switches**
  - Format: "<Process name>(<PID number>) performed <N of context switches> context switches"



```
SeaBIOS (version 1.13.0-1ubuntu1.1)


iPXE (http://ipxe.org) 00:03.0 CA00 PCI2.10 PnP PMM+1FF8CA10+1FECCA10 CA00



Booting from Hard Disk..xv6...
cpu1: starting 1
cpu0: starting 0
sb: size 1000 nblocks 941 ninodes 200 nlog 30 logstart 2 inodestart 32 bmap start 58
init: starting sh
$ echo 202042005 Juhyung Park
202042005 Juhyung Park

echo(3) performed 8 context switches
$ 
```

Mini Project #1 - Print the number of context switches on process termination

- Objectives of this project
  - Find the termination/exit point of a process from the kernel code and modify it
  - Find the function responsible for context switches from the scheduler code and modify it
  - Find the PCB (Process Control Block) structure in Xv6 and understand it
  - Modify the PCB to keep track of the number of context switches

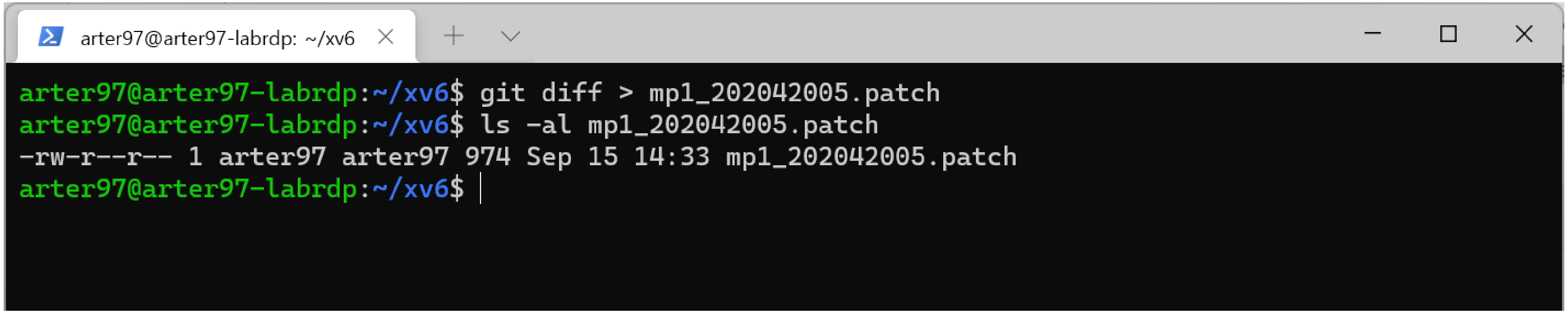
- Where to look and write code:
  - proc.c, proc.h

- How to print:

```
// Print the number of context switches (cswitch)
cprintf("\n%s(%d) performed %d context switches\n", …);
```

Mini Project #1 - Print the number of context switches on process termination

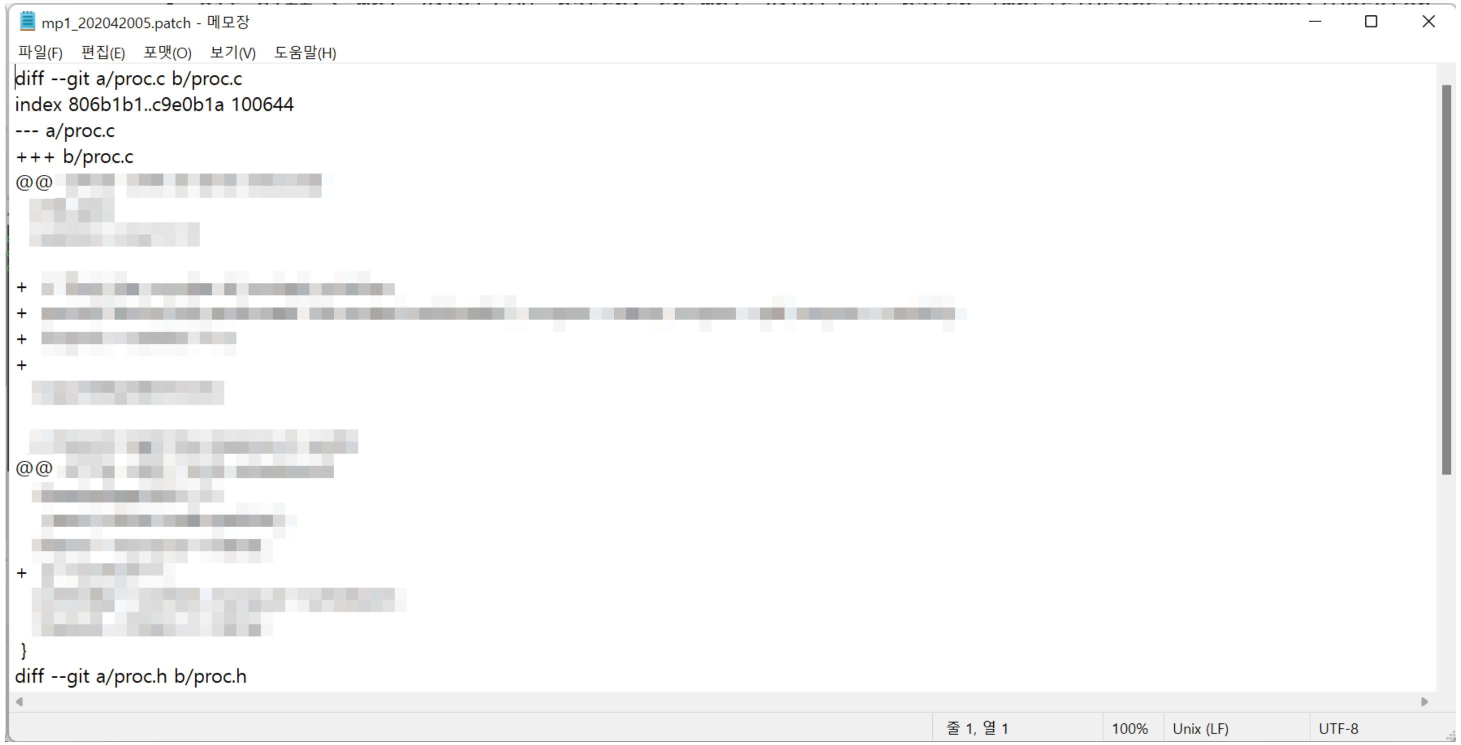
- Hand-in procedure
  - mp1_201812345.patch
    - Run the following command and upload mp1_201812345.patch
      - `git diff > mp1_201812345.patch`



```
arter97@arter97-labrdp:~/xv6$ git diff > mp1_202042005.patch
arter97@arter97-labrdp:~/xv6$ ls -al mp1_202042005.patch
-rw-r--r-- 1 arter97 arter97 974 Sep 15 14:33 mp1_202042005.patch
arter97@arter97-labrdp:~/xv6$
```

Mini Project #1 - Print the number of context switches on process termination

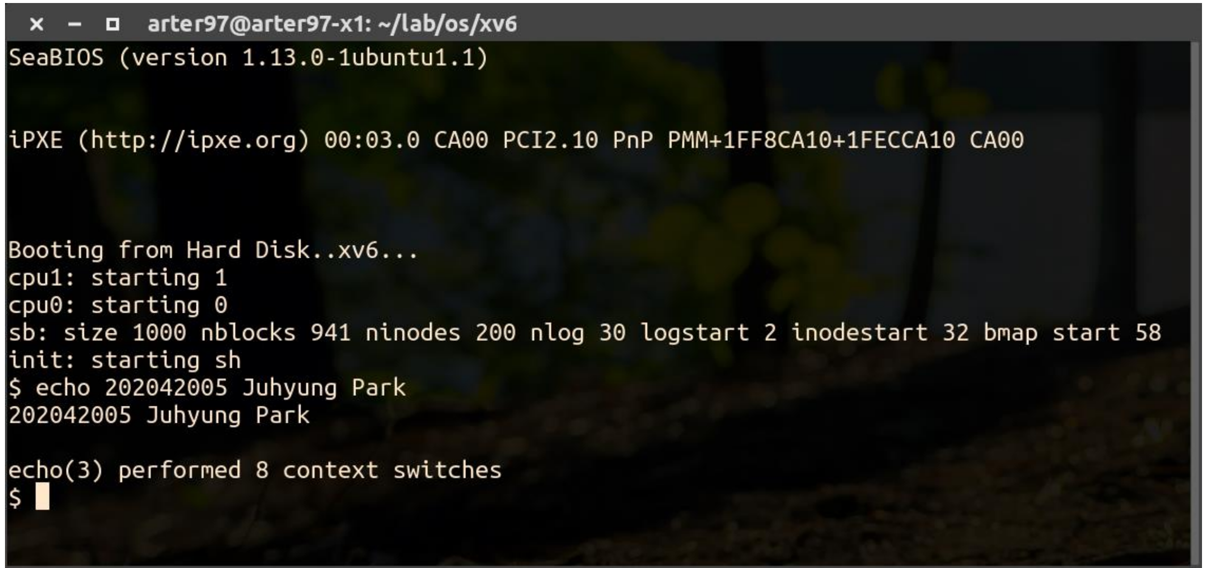
- Hand-in procedure
  - mp1_201812345.patch
    - Run the following command and upload mp1_201812345.patch
      - `git diff > mp1_201812345.patch`
    - Check the patch file with Notepad and confirm your modifications are in the patch file


mp1_202042005.patch - 메모장
파일(F) 편집(E) 포맷(O) 보기(V) 도움말(H)
줄 1, 열 1
100%
Unix (LF)
UTF-8

```
diff --git a/proc.c b/proc.c
index 806b1b1..c9e0b1a 100644
--- a/proc.c
+++ b/proc.c
@@ [redacted]
[redacted]

+ [redacted]
+
+
+
[redacted]

[redacted]
@@ [redacted]
[redacted]
+ [redacted]
[redacted]
}
diff --git a/proc.h b/proc.h
```

Mini Project #1 - Print the number of context switches on process termination

- Hand-in procedure
  - mp1_201812345.patch
    - Run the following command and upload mp1_201812345.patch
      - `git diff > mp1_201812345.patch`
    - Check the patch file with Notepad and confirm your modifications are in the patch file
  - mp1_201812345.jpg (or png)
    - Screenshot of 'echo 201812345 <Your name in English>' command execution



```
SeaBIOS (version 1.13.0-1ubuntu1.1)


iPXE (http://ipxe.org) 00:03.0 CA00 PCI2.10 PnP PMM+1FF8CA10+1FECCA10 CA00



Booting from Hard Disk..xv6...
cpu1: starting 1
cpu0: starting 0
sb: size 1000 nblocks 941 ninodes 200 nlog 30 logstart 2 inodestart 32 bmap start 58
init: starting sh
$ echo 202042005 Juhyung Park
202042005 Juhyung Park

echo(3) performed 8 context switches
$ 
```

Mini Project #1 - Print the number of context switches on process termination

- Hand-in procedure
  - mp1_201812345.patch
    - Run the following command and upload mp1_201812345.patch
      - `git diff > mp1_201812345.patch`
    - Check the patch file with Notepad and confirm your modifications are in the patch file
  - mp1_201812345.jpg (or png)
    - Screenshot of 'echo 201812345 <Your name in English>' command execution
  - Deadline: 2022.09.28 (Wed) 23:59

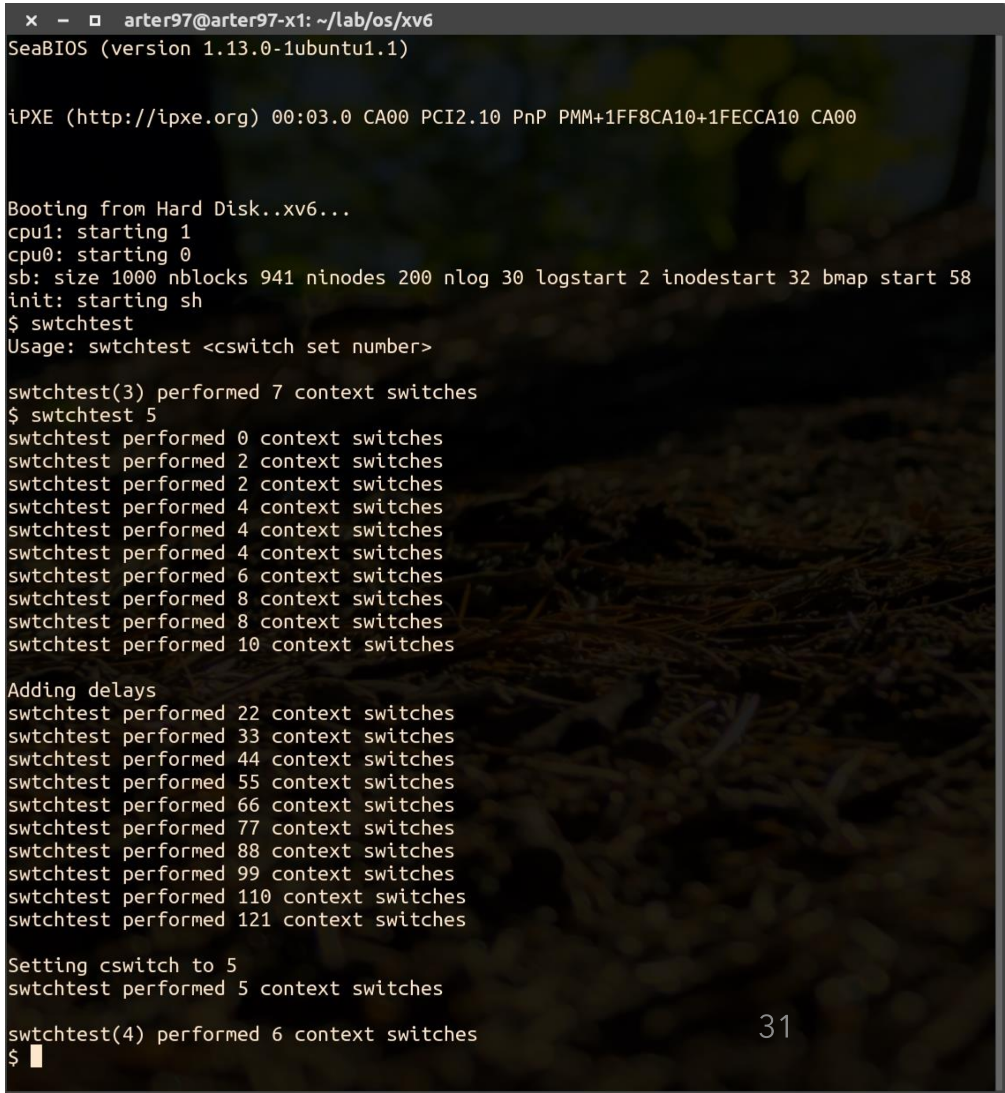
Mini Project #2 - Get/set the number of context switches by system-call

- Objectives of this project
  - Find the system-call table and register your own system-call number
  - Implement your own system-call
  - Understand how the kernel-space and the user-space exchanges data

- Where to look and write code:
  - **proc.c**: myproc() implementation (just for reference, no modifications needed)
  - **syscall.c, syscall.h**: Function prototype declaration, syscall table insertion
    - `extern int sys_getcswitch(void), extern int sys_setcswitch(void)`
  - **sysproc.c**: System-call implementation
    - Hint: Reference sys_kill()/sys_sbrk()/sys_sleep() to find out how to retrieve arguments (argint())
  - **user.h**: Function prototype declaration for user-space programs
    - `int getcswitch(void), int setcswitch(int)`
  - **usys.S**: Entry point of the system-call

Mini Project #2 - Get/set the number of context switches by system-call

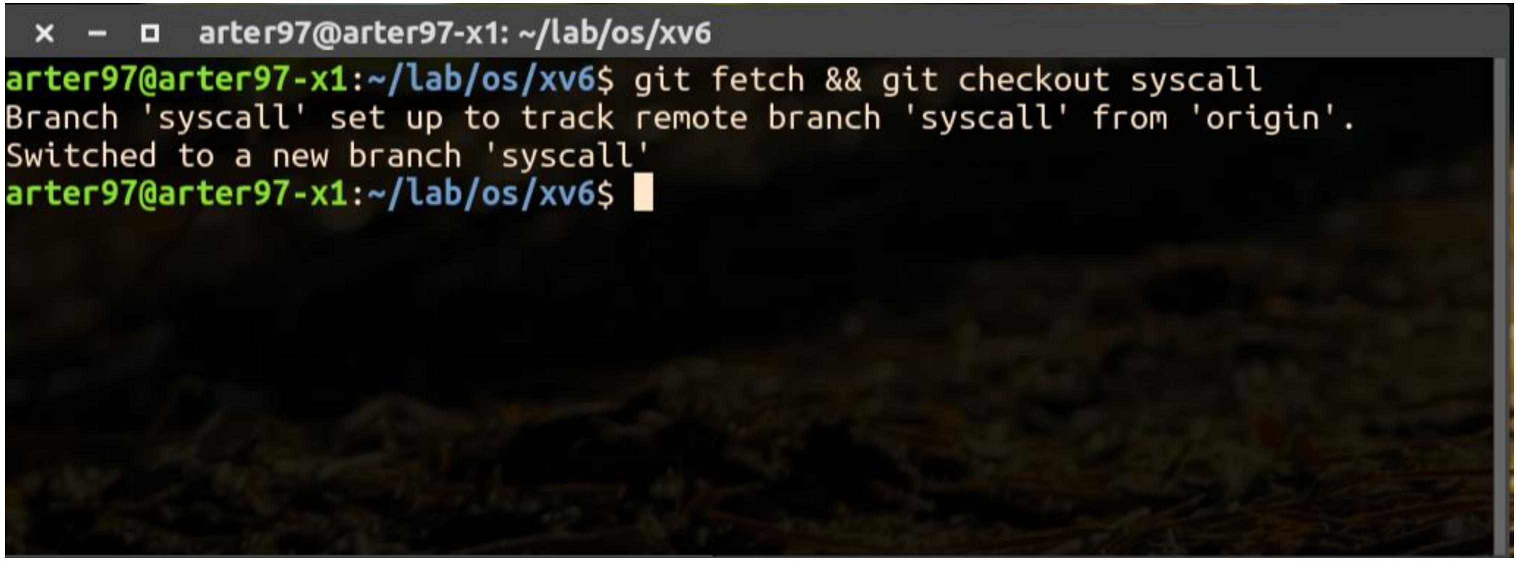
- Running ‘swtchtest’ will print the number of context switches
    - 10 prints without delay
    - 10 prints with 100ms of delay each
    - Final print after manipulating cswitch



```
SeaBIOS (version 1.13.0-1ubuntu1.1)


iPXE (http://ipxe.org) 00:03.0 CA00 PCI2.10 PnP PMM+1FF8CA10+1FECCA10 CA00



Booting from Hard Disk..xv6...
cpu1: starting 1
cpu0: starting 0
sb: size 1000 nblocks 941 ninodes 200 nlog 30 logstart 2 inodestart 32 bmap start 58
init: starting sh
$ swtchtest
Usage: swtchtest <cswitch set number>

swtchtest(3) performed 7 context switches
$ swtchtest 5
swtchtest performed 0 context switches
swtchtest performed 2 context switches
swtchtest performed 2 context switches
swtchtest performed 4 context switches
swtchtest performed 4 context switches
swtchtest performed 4 context switches
swtchtest performed 6 context switches
swtchtest performed 8 context switches
swtchtest performed 8 context switches
swtchtest performed 10 context switches

Adding delays
swtchtest performed 22 context switches
swtchtest performed 33 context switches
swtchtest performed 44 context switches
swtchtest performed 55 context switches
swtchtest performed 66 context switches
swtchtest performed 77 context switches
swtchtest performed 88 context switches
swtchtest performed 99 context switches
swtchtest performed 110 context switches
swtchtest performed 121 context switches

Setting cswitch to 5
swtchtest performed 5 context switches

swtchtest(4) performed 6 context switches
$ █
```

Mini Project #2 - Get/set the number of context switches by system-call

- Running 'swtchtest' will print the number of context switches
- Skeleton code with 'swtchtest' is provided at the 'syscall' branch
  - `git fetch && git checkout syscall`



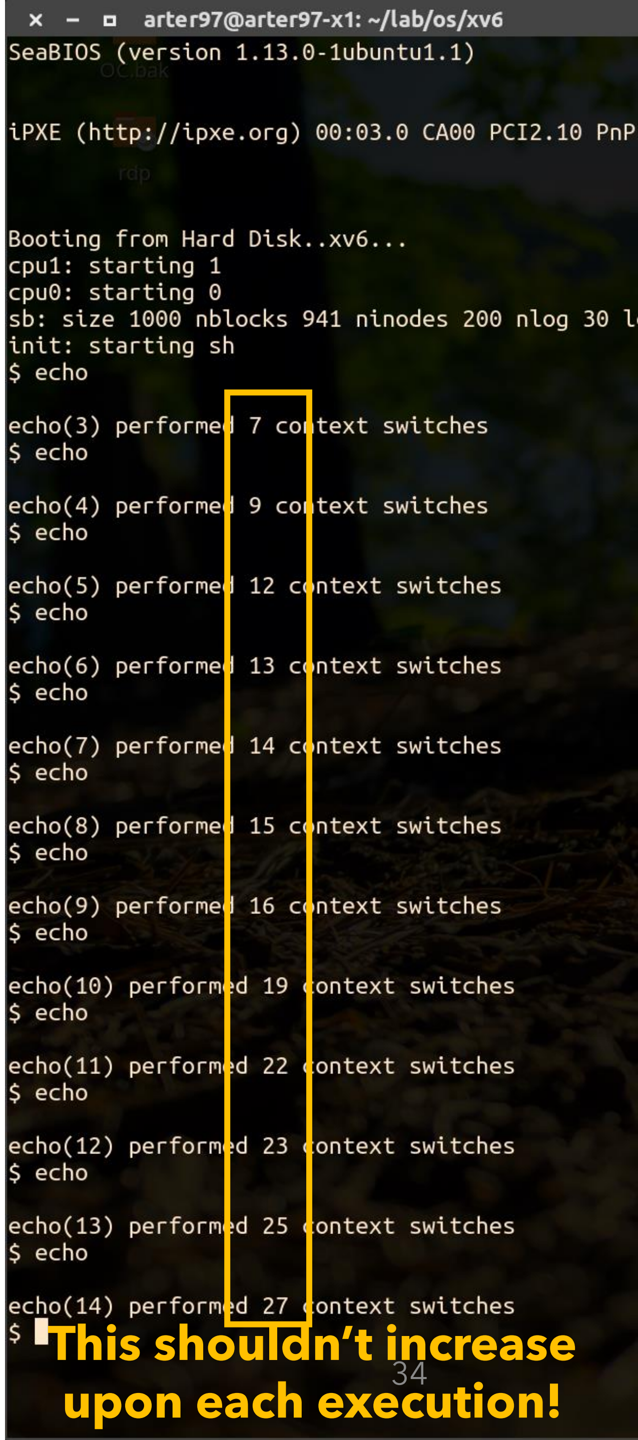
```
arter97@arter97-x1:~/lab/os/xv6$ git fetch && git checkout syscall
Branch 'syscall' set up to track remote branch 'syscall' from 'origin'.
Switched to a new branch 'syscall'
arter97@arter97-x1:~/lab/os/xv6$ 
```

Mini Project #2 - Get/set the number of context switches by system-call

- Hand-in procedure
  - mp2_201812345.patch
  - mp2_201812345.jpg (or png)
    - Screenshot of 'swtchtest N' command execution
    - N: The last 2 digits of your student ID
  - mp2_201812345.txt
    - Explain why the number of context switches increases at a different rate when delays are added in 1-2 sentences (English/Korean)
    - Explain the purpose of myproc() function in relation to the PCB in 1-2 sentences (English/Korean)
  - Deadline: 2022.09.28 (Wed) 23:59

Assignments Warning

- Coding mistakes are still errors
  - Your code may not work properly on TA's computer
  - Initialization errors, undefined behaviors, compiler warnings will be factored into your assignment's scores
    - Typical initialization error
  - Do **<u>NOT</u>** skip compiler warnings
    - You can run '`make clean; make xv6.img fs.img`' to just compile without running QEMU
- TAs will use automation software for grading
  - Please try to match the printed strings to what's shown in the PPT

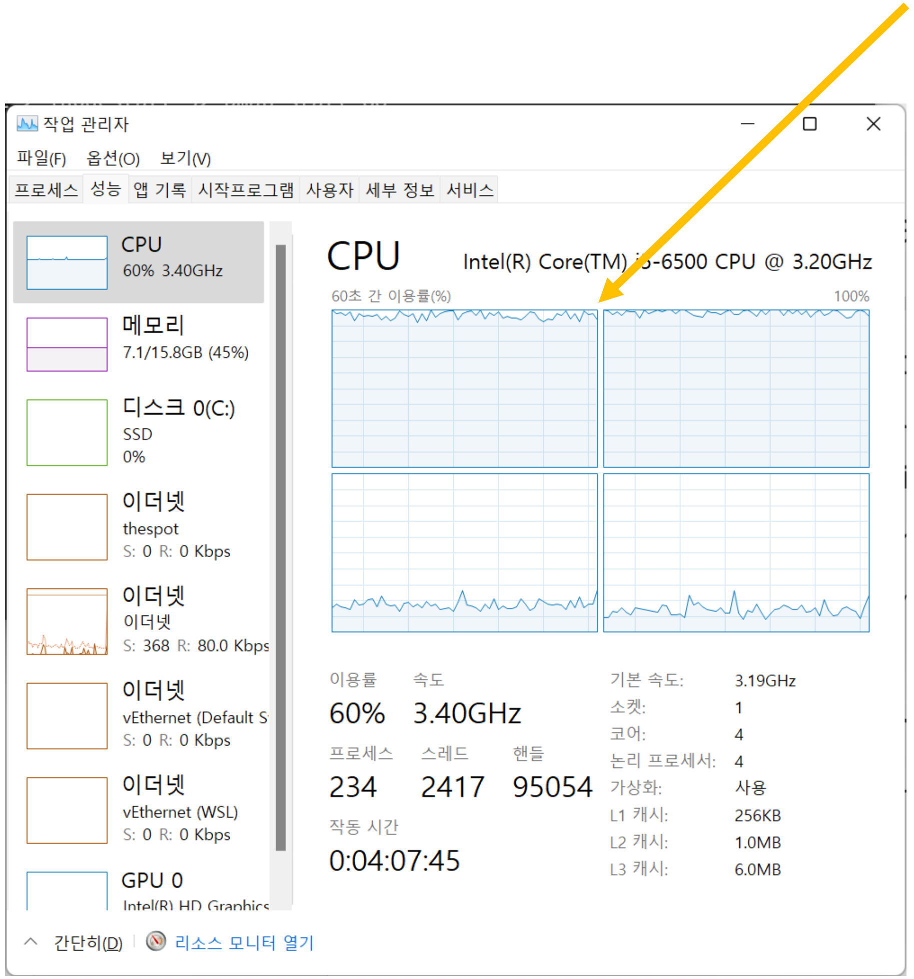


```
SeaBIOS (version 1.13.0-1ubuntu1.1)


iPXE (http://ipxe.org) 00:03.0 CA00 PCI2.10 PnP



Booting from Hard Disk..xv6...
cpu1: starting 1
cpu0: starting 0
sb: size 1000 nblocks 941 ninodes 200 nlog 30 l
init: starting sh
$ echo

echo(3) performed 7 context switches
$ echo

echo(4) performed 9 context switches
$ echo

echo(5) performed 12 context switches
$ echo

echo(6) performed 13 context switches
$ echo

echo(7) performed 14 context switches
$ echo

echo(8) performed 15 context switches
$ echo

echo(9) performed 16 context switches
$ echo

echo(10) performed 19 context switches
$ echo

echo(11) performed 22 context switches
$ echo

echo(12) performed 23 context switches
$ echo

echo(13) performed 25 context switches
$ echo

echo(14) performed 27 context switches
$ 
```

This shouldn't increase upon each execution!

Tips

- Terminate Xv6 when you’re not using it
  - Idle timer is not implemented in Xv6, resulting in high CPU usage



CPU
60% 3.40GHz

메모리
7.1/15.8GB (45%)

디스크 0(C:)
SSD
0%

이더넷
thespot
S: 0 R: 0 Kbps

이더넷
이더넷
S: 368 R: 80.0 Kbps

이더넷
vEthernet (Default S
S: 0 R: 0 Kbps

이더넷
vEthernet (WSL)
S: 0 R: 0 Kbps

GPU 0
Intel(R) HD Graphics

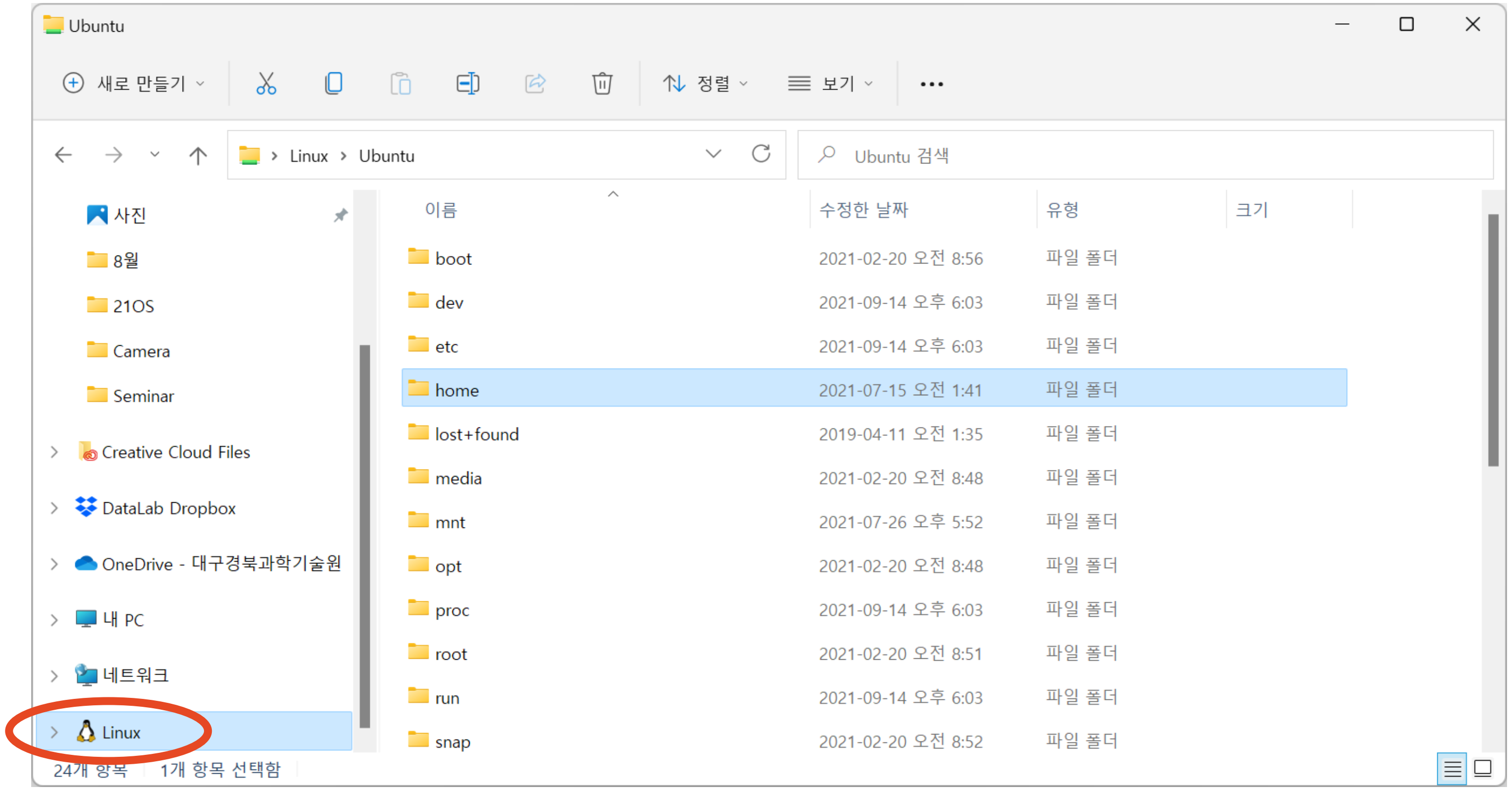
CPU Intel(R) Core(TM) i5-6500 CPU @ 3.20GHz

이용률 60%
속도 3.40GHz
프로세스 234
스레드 2417
핸들 95054
작동 시간 0:04:07:45

기본 속도: 3.19GHz
소켓: 1
코어: 4
논리 프로세서: 4
가상화: 사용
L1 캐시: 256KB
L2 캐시: 1.0MB
L3 캐시: 6.0MB

Tips

- You can access Linux's files from Windows Explorer's sidebar

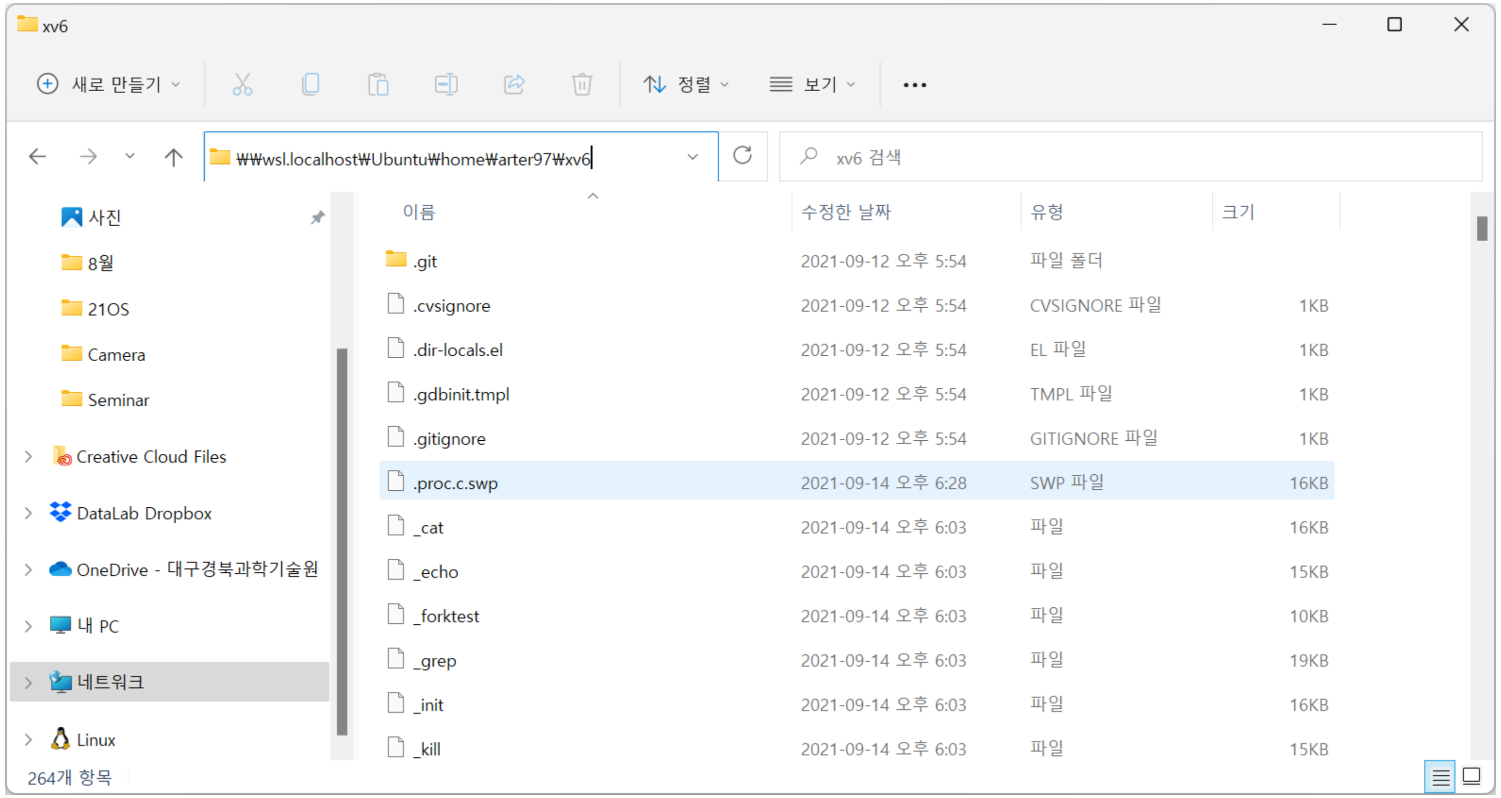


이름	수정한 날짜	유형	크기
boot	2021-02-20 오전 8:56	파일 폴더	
dev	2021-09-14 오후 6:03	파일 폴더	
etc	2021-09-14 오후 6:03	파일 폴더	
home	2021-07-15 오전 1:41	파일 폴더	
lost+found	2019-04-11 오전 1:35	파일 폴더	
media	2021-02-20 오전 8:48	파일 폴더	
mnt	2021-07-26 오후 5:52	파일 폴더	
opt	2021-02-20 오전 8:48	파일 폴더	
proc	2021-09-14 오후 6:03	파일 폴더	
root	2021-02-20 오전 8:51	파일 폴더	
run	2021-09-14 오후 6:03	파일 폴더	
snap	2021-02-20 오전 8:52	파일 폴더	

24개 항목 1개 항목 선택함

Tips

- You can access Linux's files from Windows Explorer's sidebar
  - Or: \\wsl.localhost\Ubuntu



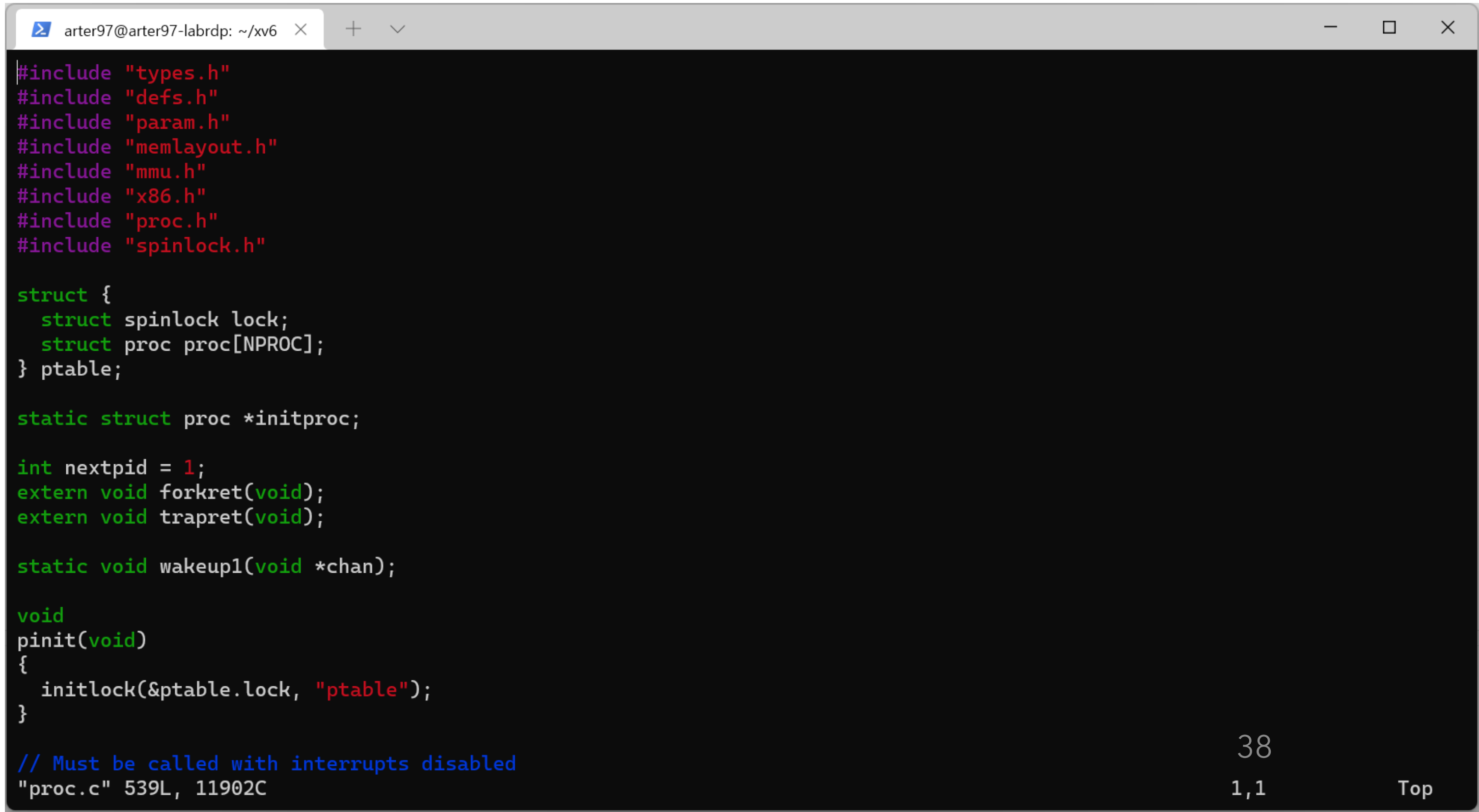
₩₩wsl.localhost₩Ubuntu₩home₩arter97₩xv6

xv6 검색

이름	수정한 날짜	유형	크기
.git	2021-09-12 오후 5:54	파일 폴더	
.cvsignore	2021-09-12 오후 5:54	CVSIGNORE 파일	1KB
.dir-locals.el	2021-09-12 오후 5:54	EL 파일	1KB
.gdbinit.tmpl	2021-09-12 오후 5:54	TMPL 파일	1KB
.gitignore	2021-09-12 오후 5:54	GITIGNORE 파일	1KB
.proc.c.swp	2021-09-14 오후 6:28	SWP 파일	16KB
_cat	2021-09-14 오후 6:03	파일	16KB
_echo	2021-09-14 오후 6:03	파일	15KB
_forktest	2021-09-14 오후 6:03	파일	10KB
_grep	2021-09-14 오후 6:03	파일	19KB
_init	2021-09-14 오후 6:03	파일	16KB
_kill	2021-09-14 오후 6:03	파일	15KB

Tips

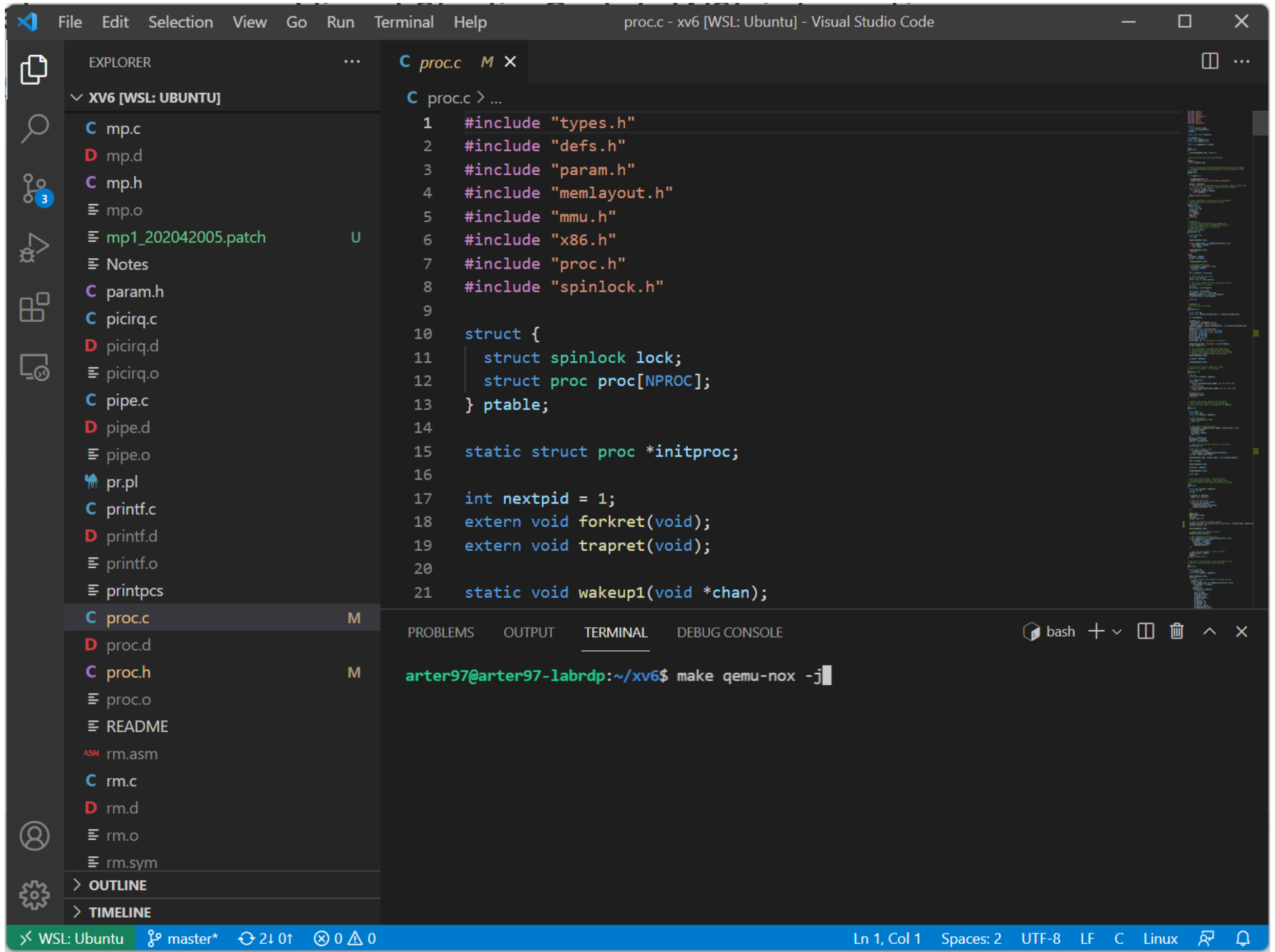
- You can’t use Visual Studio to open Xv6 as a project
- Use vim for modifying source code
  - e.g., vim proc.c



```
#include "types.h"
#include "defs.h"
#include "param.h"
#include "memlayout.h"
#include "mmu.h"
#include "x86.h"
#include "proc.h"
#include "spinlock.h"

struct {
  struct spinlock lock;
  struct proc proc[NPROC];
} ptable;

static struct proc *initproc;

int nextpid = 1;
extern void forkret(void);
extern void trapret(void);

static void wakeup1(void *chan);

void
pinit(void)
{
  initlock(&ptable.lock, "ptable");
}

// Must be called with interrupts disabled
"proc.c" 539L, 11902C                                              1,1           Top
```

Tips

- Alternatively, you can use Visual Studio Code's WSL integration
  - https://code.visualstudio.com/docs/remote/wsl



```c
#include "types.h"
#include "defs.h"
#include "param.h"
#include "memlayout.h"
#include "mmu.h"
#include "x86.h"
#include "proc.h"
#include "spinlock.h"

struct {
  struct spinlock lock;
  struct proc proc[NPROC];
} ptable;

static struct proc *initproc;

int nextpid = 1;
extern void forkret(void);
extern void trapret(void);

static void wakeup1(void *chan);
```

```
arter97@arter97-labrdp:~/xv6$ make qemu-nox -j
```

Finally…

<u>Do NOT hesitate</u> to ask questions!

…but start early