SWE3004 Operating Systems, Spring 2023

Project 0. Introduction of xv6

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Project plan

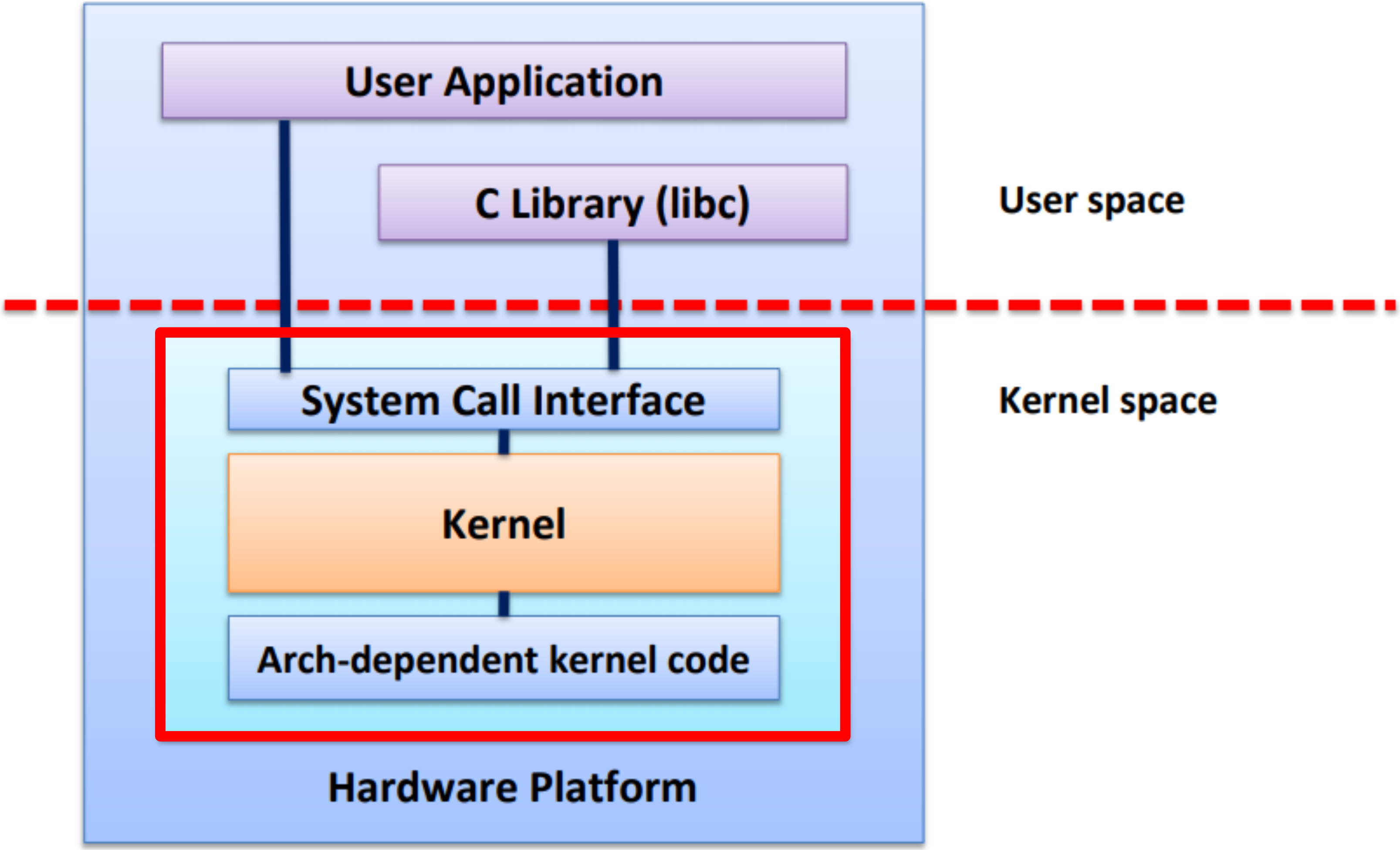
- Schedule and points

	Assignment	Schedule	Point
0	Booting xv6 operating system	3/9 ~ 3/15	10
1	System call	3/16 ~ 3/29	15
2	CPU scheduling	3/30 ~ 4/12	25
3	Virtual memory	4/27 ~ 4/10	25
4	Page replacement	5/11 ~ 5/24	25
5	File systems	5/25 ~ 6/7	0 (optional)

Project plan

- Total 6 projects
  0) Booting xv6 operating system
  1) System call
  2) CPU scheduling
  3) Virtual memory
  4) Page replacement
  5) File systems

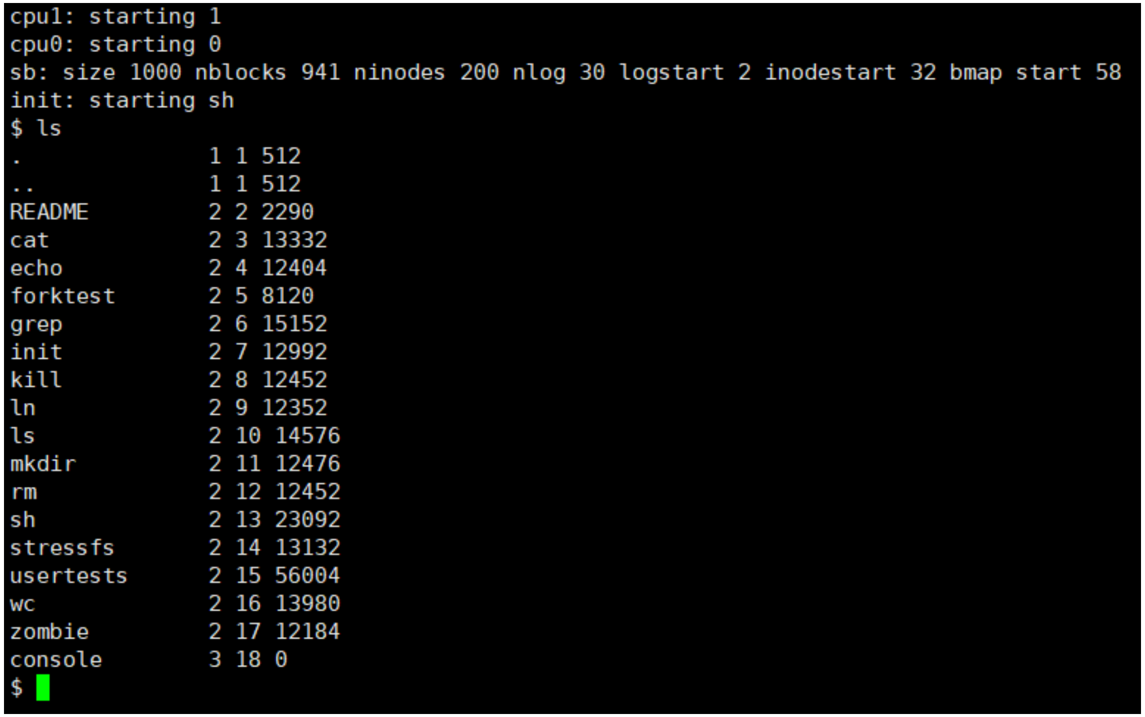
Operating System



xv6 Operating System

- Unix-like teaching operating system developed by MIT

- Based on multiprocessor x86 system



```
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
$ ls
.              1 1 512
..             1 1 512
README         2 2 2290
cat            2 3 13332
echo           2 4 12404
forktest       2 5 8120
grep           2 6 15152
init           2 7 12992
kill           2 8 12452
ln             2 9 12352
ls             2 10 14576
mkdir          2 11 12476
rm             2 12 12452
sh             2 13 23092
stressfs       2 14 13132
usertests      2 15 56004
wc             2 16 13980
zombie         2 17 12184
console        3 18 0
$ 
```

xv6 shell status with ls command

Development Environment

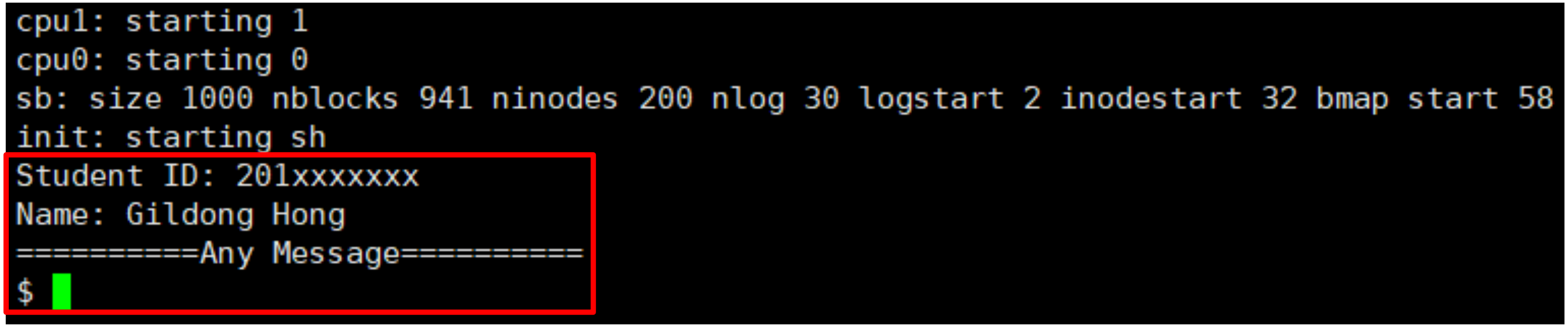
- Ji Server
  - Problems caused by development in other environments will be your own risk.
- Connection method example
  - $ ssh 2023123456@swji.skku.edu –p 1398
  - (If you are new to ji server) Password is pw23123456 (학번 뒤 8 자리)

Clone & booting xv6

- $ git clone https://github.com/mit-pdos/xv6-public.git
- Run xv6
  - $ cd xv6-public
  - $ make qemu-nox
- Terminate xv6
  - ctrl + ‘a’ → ‘x’

Project 0. Booting xv6

- Print your student id, name, and any message(optional) on boot message



```
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
Student ID: 201xxxxxxx
Name: Gildong Hong
==========Any Message==========
$ 
```

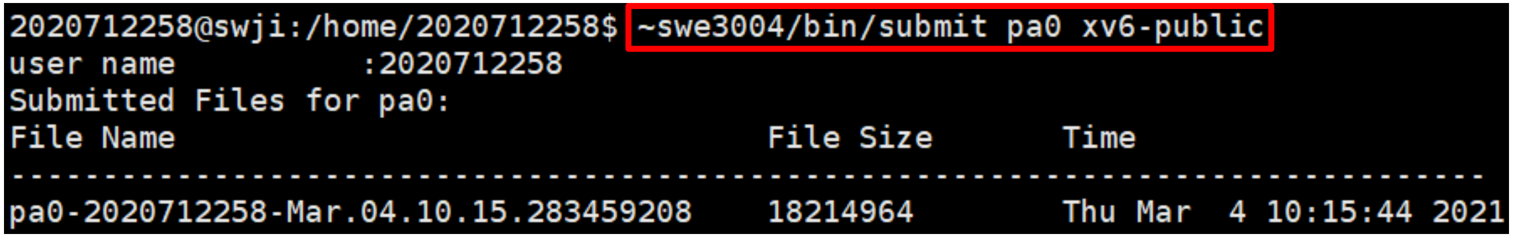
- Hint : Use grep or other analysis tool

Submission

- Report
  - Submit to iCampus
  - Modified code and explanation
  - Free length of the report
  - pa0_202312345.pdf

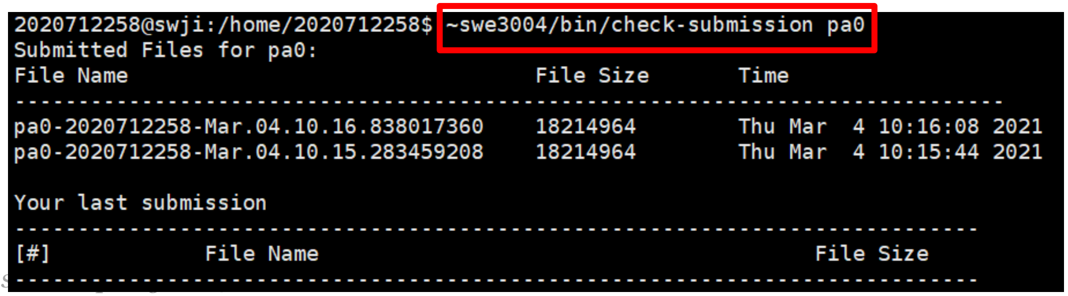
Submission

- Use the *submit* & *check-submission* file in Ji Server
  - $ make clean
  - $ ~swe3004/bin/submit pa0 xv6-public



```
2020712258@swji:/home/2020712258$ ~swe3004/bin/submit pa0 xv6-public
user name          :2020712258
Submitted Files for pa0:
File Name                               File Size       Time
----------------------------------------------------------------------------------------
pa0-2020712258-Mar.04.10.15.283459208    18214964        Thu Mar  4 10:15:44 2021
```

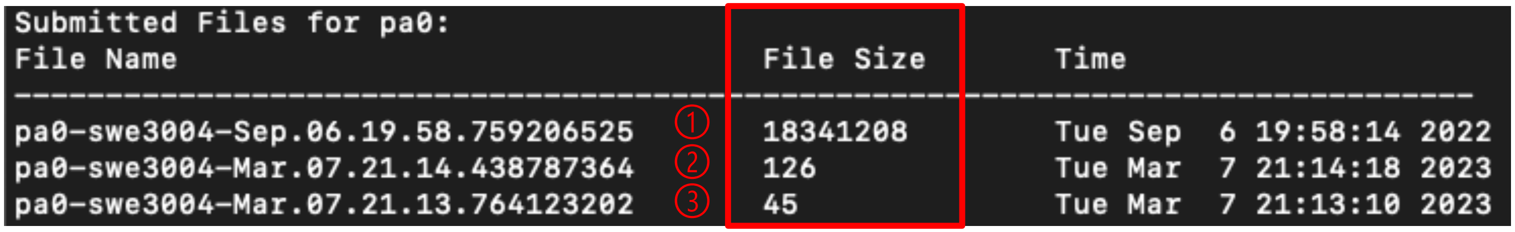
  - you can submit several times, and the submission history can be checked through check-submission
    - Only the last submission will be graded



```
2020712258@swji:/home/2020712258$ ~swe3004/bin/check-submission pa0
Submitted Files for pa0:
File Name                               File Size       Time
----------------------------------------------------------------------------------------
pa0-2020712258-Mar.04.10.16.838017360    18214964        Thu Mar  4 10:16:08 2021
pa0-2020712258-Mar.04.10.15.283459208    18214964        Thu Mar  4 10:15:44 2021

Your last submission
----------------------------------------------------------------------------------------
[#]             File Name                                        File Size
----------------------------------------------------------------------------------------
```

Submission

- Cautions
  – Please check that the submission was successful



```
Submitted Files for pa0:
File Name                                    File Size       Time
-----------------------------------------------------------------------------------------
pa0-swe3004-Sep.06.19.58.759206525   ①   18341208        Tue Sep  6 19:58:14 2022
pa0-swe3004-Mar.07.21.14.438787364   ②   126             Tue Mar  7 21:14:18 2023
pa0-swe3004-Mar.07.21.13.764123202   ③   45              Tue Mar  7 21:13:10 2023
```

① Submitted successful xv6

② Submitted an empty file

③ Submit from the incorrect directory

Submission

- PLEASE DO NOT COPY
  - We will run inspection program on all the submissions
  - Any unannounced penalty can be given to **both students**
    - 0 points / negative points / F grade …

- Due date: 3/15(Wed.), 23:59:59 PM
  - -25% per day for delayed submission

Questions

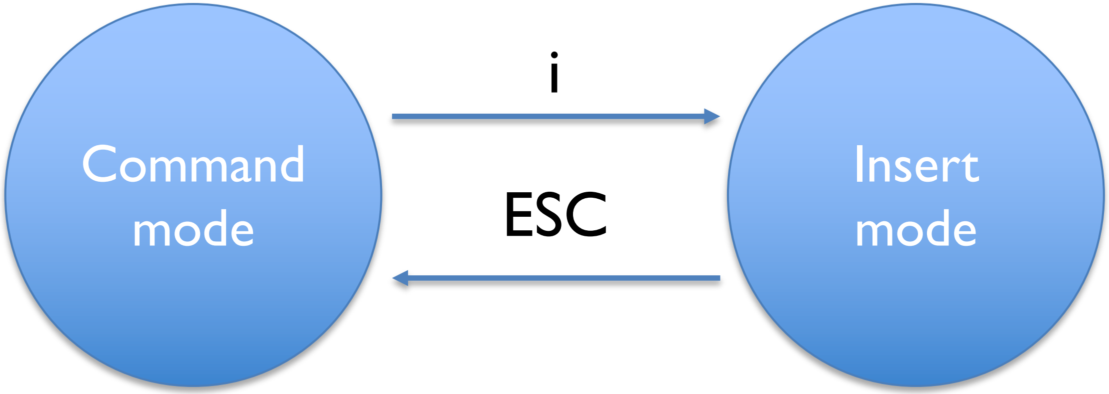
- If you have questions, please ask on icampus
  - Please use the discussion board
  - Discussion board preferred over messages

- You can also visit Corporate Collaboration Center #85533
  - Please iCampus message TA before visiting

- Reading xv6 commentary will help you a lot
  - http://csl.skku.edu/uploads/SSE3044S20/book-rev11.pdf

Appendix. Vim

- Vi Improved
- Text Editor program for Unix
- sudo apt-get install vim



Useful Vim command

- In command mode

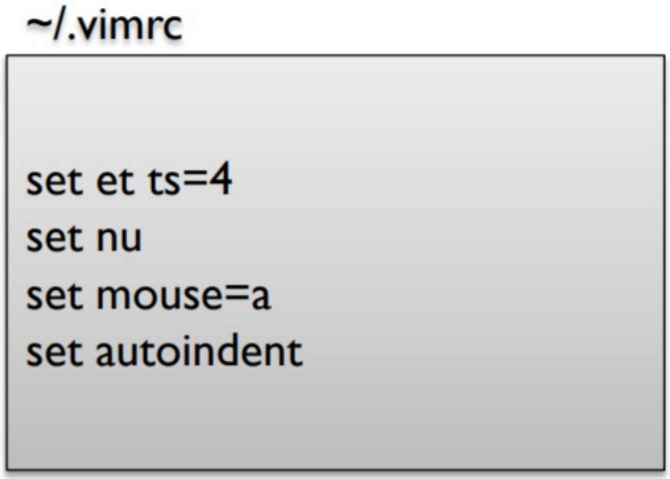
Command	Operation
:w	save changes to a file
:q	quit Vim
:wq	save changes and quit Vim
/[string]	search the string from forward
?[string]	search the string from backward
:sp	Divide the window (horizontal)
:vs	Divide the window (vertical)
ctrl + w -> w	move window-to-window

Command	Operation
dd	delete the line
yy	copy the line
p	paste

Vim Setting

- Vim Preference Setting
  - vimrc : settings file used by Vim

Command	Operation
set nu	display line number
set nonu	hide line number
set mouse=a	enable auto visual mode using mouse
set mouse-=a	disable auto visual mode using mouse
set autoindent	set automatic indentation
set ts=[#]	adjust tap size
set et	expand tap



~/.vimrc

```
set et ts=4
set nu
set mouse=a
set autoindent
```

Source code analysis tool

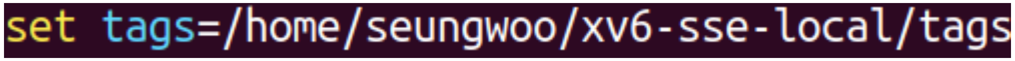
- Ctags, cscope are useful when analyzes source code
  - Also vim editor supports ctags and cscope

- Ctags
  - it recognizes symbols in source code and connects file to each other
  - Allow definitions to be quickly and easily located by a text editor

- Cscope
  - Search for a string or function that calls a function

Ctags

- Vim setting for ctags
  - $ sudo apt-get install ctags
  - $ ctags –R (use in top-level kernel source directory)
  - $ vi ~/.vimrc
  - Add “set tags=[Location of tag file]/tags”
    - Ex)

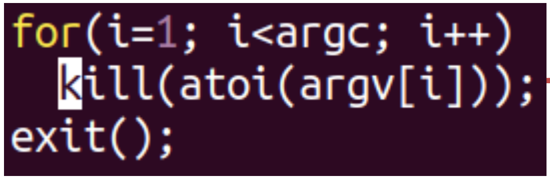


```
set tags=/home/seungwoo/xv6-sse-local/tags
```

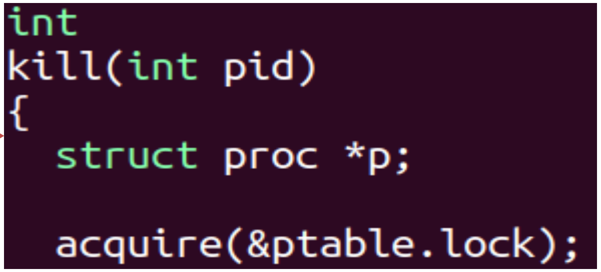
check your path!

Ctags

- Ctags usage (in Vim)
  - Ctrl +] : follow tag

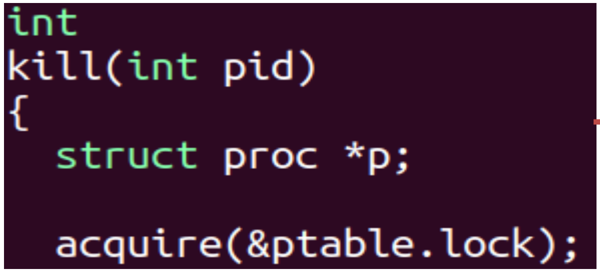


```
for(i=1; i<argc; i++)
  kill(atoi(argv[i]));
exit();
```

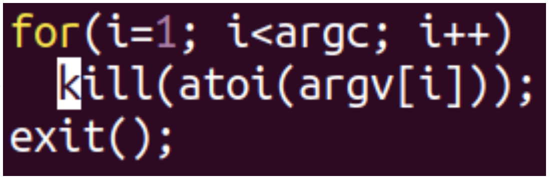


```
int
kill(int pid)
{
  struct proc *p;

  acquire(&ptable.lock);
```

  - Ctrl + T : back to last tag

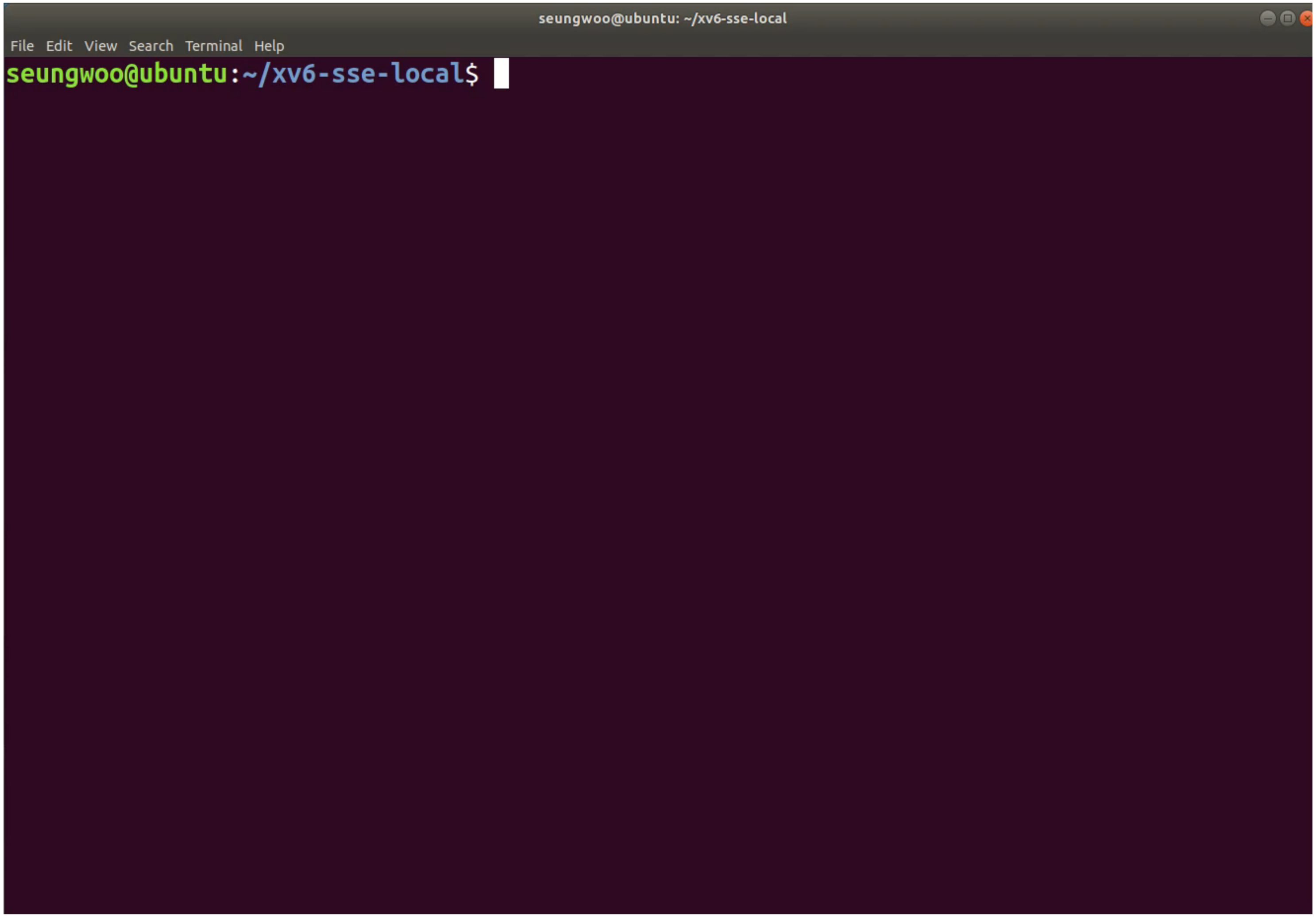


```
int
kill(int pid)
{
  struct proc *p;

  acquire(&ptable.lock);
```



```
for(i=1; i<argc; i++)
  kill(atoi(argv[i]));
exit();
```

Ctags

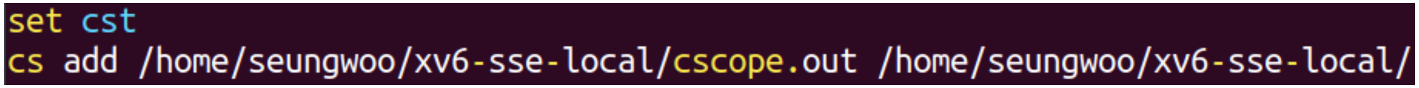


seungwoo@ubuntu: ~/xv6-sse-local
File Edit View Search Terminal Help

```
seungwoo@ubuntu:~/xv6-sse-local$
```

Cscope

- Vim setting for cscope
  - $ sudo apt-get install cscope
  - $ cscope –R (use in top-level kernel source directory)
  - Ctrl + D
  - vi ~/.vimrc
  - Add



```
set cst
cs add /home/seungwoo/xv6-sse-local/cscope.out /home/seungwoo/xv6-sse-local/
```

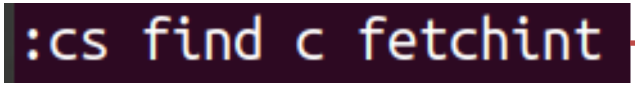
Check your path!

Cscope

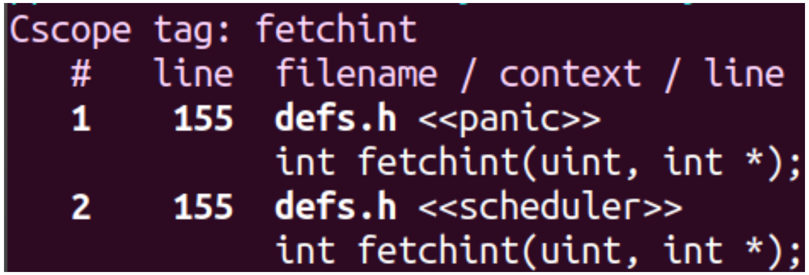
- Cscope usage (in Vim)
  - :cs find [type] [search]

type	Operation
0 or s	Find this C symbol
1 or g	Find this definition
2 or d	Find functions called by this function
3 or c	Find functions calling this function
4 or t	Find assignments to

  - ex) :cs find c [search function]

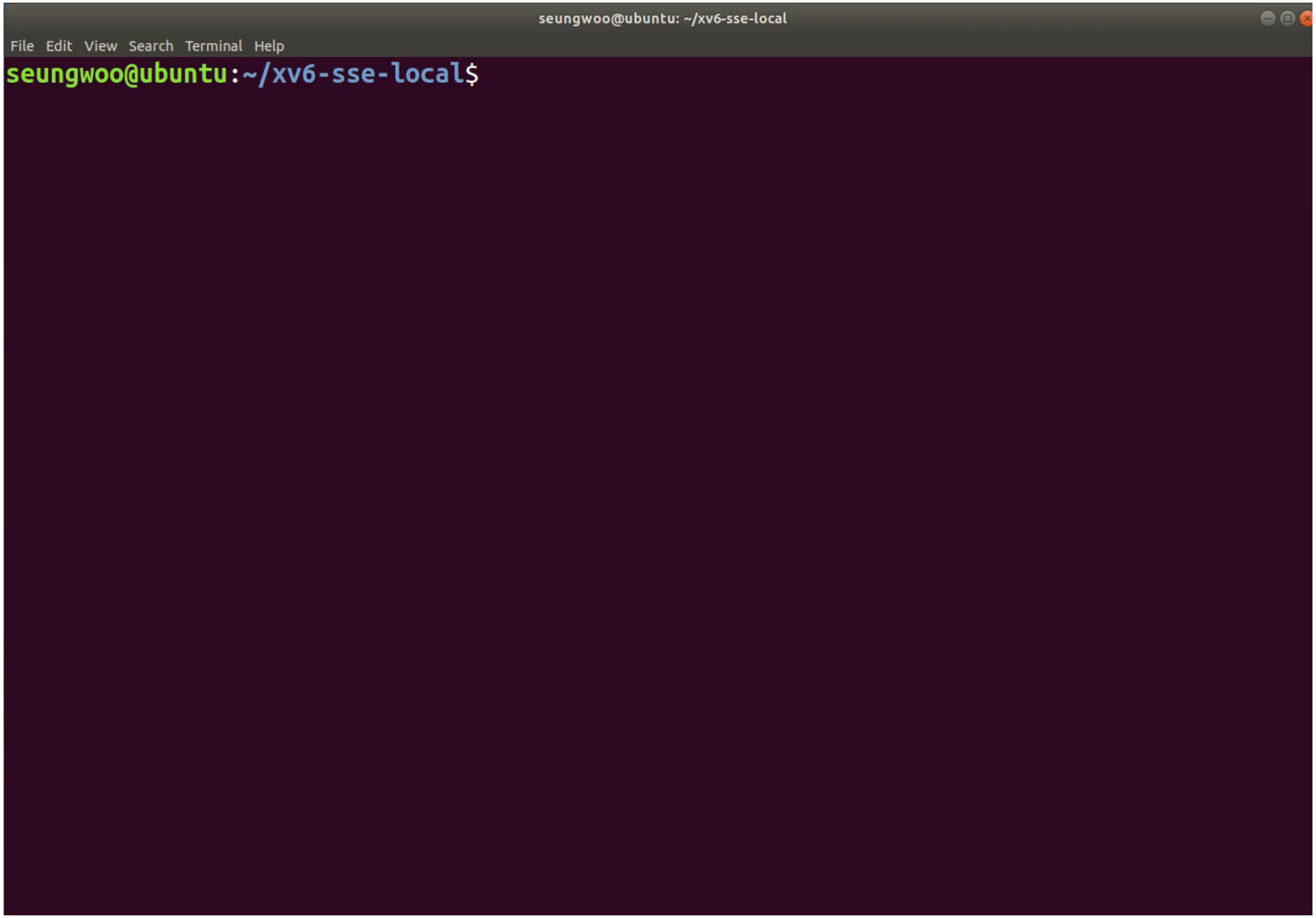


```
:cs find c fetchint
```



```
Cscope tag: fetchint
   #   line  filename / context / line
   1    155  defs.h <<panic>>
             int fetchint(uint, int *);
   2    155  defs.h <<scheduler>>
             int fetchint(uint, int *);
```

Cscope

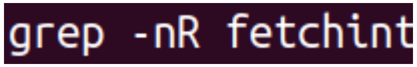


seungwoo@ubuntu: ~/xv6-sse-local
File Edit View Search Terminal Help

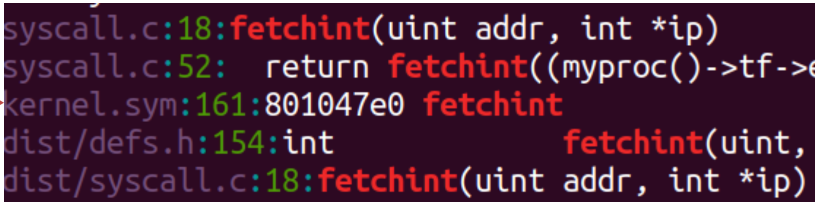
```
seungwoo@ubuntu:~/xv6-sse-local$
```

Any other useful shell command

- Grep usage
  - grep –nR "[string to search]"
    - Find the file where the string exists and also show line number
    - Easier to use than cscope
    - Ex)



```
grep -nR fetchint
```



```
syscall.c:18:fetchint(uint addr, int *ip)
syscall.c:52:  return fetchint((myproc()->tf->e
kernel.sym:161:801047e0 fetchint
dist/defs.h:154:int             fetchint(uint,
dist/syscall.c:18:fetchint(uint addr, int *ip)
```

- Silversearcher-ag usage
  - $ ag [string to search]