NYU Tandon School of Engineering
Computer Science and Engineering
CS-GY 6233, Fall 2021

Homework #1 (due October 10, 11:55 p.m)

Academic Honesty

Aside from the narrow exception for collaboration on homework, all work submitted in this course must be your own. **Cheating and plagiarism will not be tolerated.** If you have any questions about a specific case, please ask me. We will be checking for this!

NYU Tandon's Policy on Academic Misconduct: http://engineering.nyu.edu/academics/code-of-conduct/academic-misconduct

Homework Notes

General Notes

- Read the assignment carefully, including what files to include.
- Don't assume limitations unless they are explicitly stated.
- Treat provided examples as just that, not exhaustive list of cases that should work.
- When in doubt regarding what needs to be done, ask. Another option is test it in the real UNIX operating system. Does it behave the same way?
- **Test** your solutions, make sure they work. It's obvious when you didn't test the code.

Rubric

Since we had some issues before on homework 1. Here are **some**of the things we know we will test, but these are not the **only** things we will test. Therefore make sure to test your program thoroughly and thoughtfully.

Total: 100 points

- -10: No exit() at the end of hello.c
- -50: uniq does not work
- -10: uniq does not handle long lines (more than 512 characters)
- -10: Debug printf left in code
- -10: cat example.txt | uniq does not work
- -10: uniq -c example.txt does not work

- -10: `uniq -d example.txt` does not work
- -10: `uniq -i example.txt` does not work

Part 0: Intro to xv6

In this assignment, you’ll start getting familiar with xv6 by writing a couple simple programs that run in the xv6 OS.

As a prerequisite, make sure that you have done the hello demo in Anubis to familiarize yourself with Anubis and xv6

A common theme of the homework assignments is that we’ll start off with xv6, and then add something or modify it in some way. This assignment is no exception.

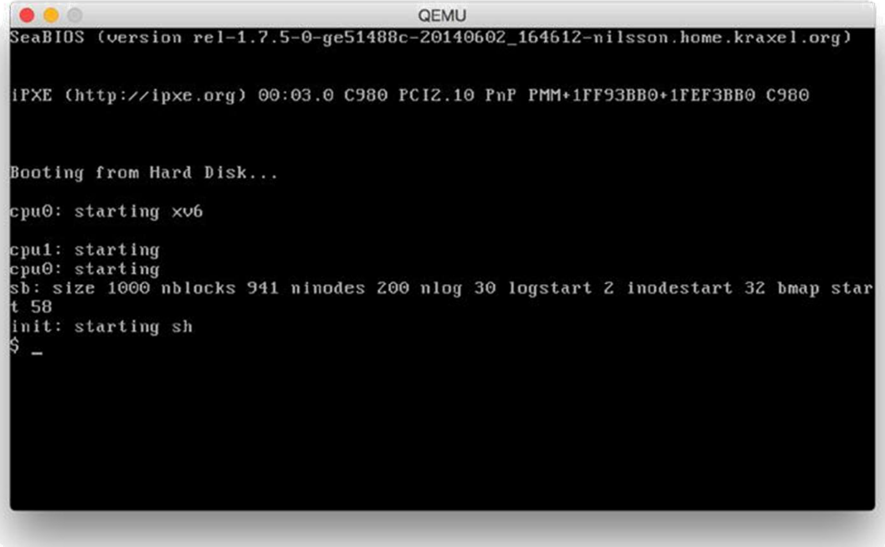
Make sure you can build and run xv6. To build the OS, run make to compile xv6:

```
$ make
```

Then, to run it inside of QEMU, you can do:

```
$ make qemu
```

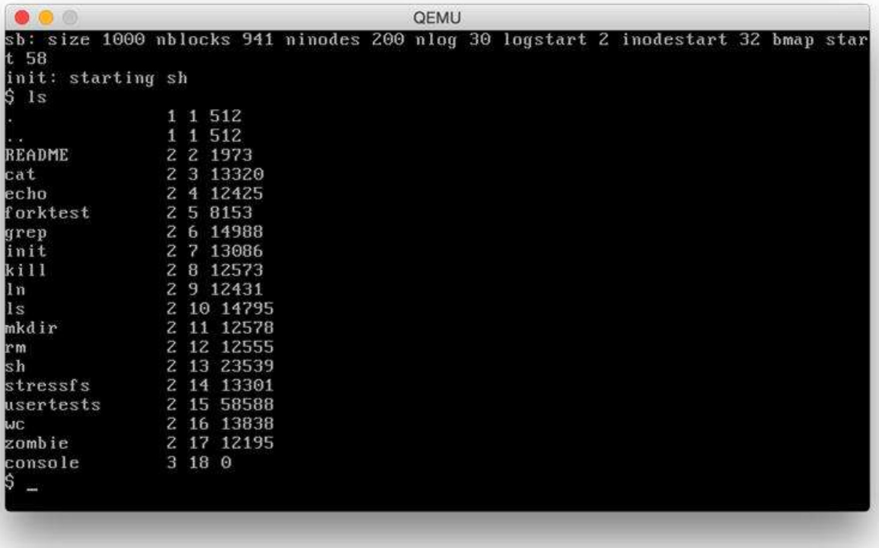
QEMU should appear and show the xv6 command prompt, where you can run programs inside xv6. It will look something like:



```
SeaBIOS (version rel-1.7.5-0-ge51488c-20140602_164612-nilsson.home.kraxel.org)


iPXE (http://ipxe.org) 00:03.0 C980 PCI2.10 PnP PMM+1FF93BB0+1FEF3BB0 C980



Booting from Hard Disk...

cpu0: starting xv6

cpu1: starting
cpu0: starting
sb: size 1000 nblocks 941 ninodes 200 nlog 30 logstart 2 inodestart 32 bmap star
t 58
init: starting sh
$ _
```

Figure 1: Starting xv6 in QEMU

You can play around with running commands such as `ls`, `cat`, etc. by typing them into the QEMU window; for example, this is what it looks like when you run `ls` in xv6:



```
sb: size 1000 nblocks 941 ninodes 200 nlog 30 logstart 2 inodestart 32 bmap star
t 58
init: starting sh
$ ls
.              1 1 512
..             1 1 512
README         2 2 1973
cat            2 3 13320
echo           2 4 12425
forktest       2 5 8153
grep           2 6 14988
init           2 7 13086
kill           2 8 12573
ln             2 9 12431
ls             2 10 14795
mkdir          2 11 12578
rm             2 12 12555
sh             2 13 23539
stressfs       2 14 13301
usertests      2 15 58588
wc             2 16 13838
zombie         2 17 12195
console        3 18 0
$ _
```

Figure 2: Running `ls` in xv6

Part 2: Implementing the `uniq` command (50 points)

For this assignment you will be creating commonly used command line program in Linux called “uniq” but will be implementing this yourself in xv6 to get an idea of how command line programs are written.
uniq is a Unix utility which, when fed a text file, outputs the file with adjacent identical lines collapsed to one. If a filename is provided on the command line (i.e., `uniq FILE`) then `uniq` should open it, read, filter out, print without repeated lines in this file, and then close it. If no filename is provided, `uniq` should read from standard input.

For this assignment you will be running the uniq command on the README.md file included in xv6. Before you begin coding please delete all the text in README file and paste the following lines of text in the README.md file in its place. This is the file and subsequent text you will be running the uniq program on.

Text to copy and paste into xv6 README.md file:

```
No. 1
No. 2
No. 2
No. 2
No. 3
No. 4
No. 5
No. 6
No. 6
No. 2
no. 2
```

Now that you have set up your test file you may begin coding by creating a uniq.c file and coding your program there.

Here’s an example of the basic usage of `uniq`:

```
$ cat README.md
No. 1
No. 2
No. 2
No. 2
No. 3
No. 4
No. 5
No. 6
No. 6
No. 2
no. 2

$ uniq README.md
No. 1
No. 2
No. 3
No. 4
No. 5
No. 6
No. 2
no. 2
```

You should also be able to invoke it without a file, and have it read from standard input. For example, you can use a pipe to direct the output of another xv6 command into `uniq`:

```
$ cat README.md | uniq
No. 1
No. 2
No. 3
No. 4
No. 5
No. 6
No. 2
no. 2
```

Hints

1. Many aspects of this are similar to the `wc.c` program: both can read from standard input if no arguments are passed or read from a file if one is given on the command line. Reading its code will help you if you get stuck.
2. Still confused with `uniq`'s behavior? Use `man uniq` for help.
3. The following link should help give you an idea on how to parse command line arguments and fetch them from the main function : https://dev-notes.eu/2018/03/parse-command-line-arguments-in-c/

Part 3: Extending `uniq` (50 points)

The traditional UNIX `uniq` utility can do lots of things, such as:

- `-c`: count and group prefix lines by the number of occurrences
- `-d`: only print duplicate lines
- `-i`: ignore differences in case when comparing

Here, we are going to implement these three behaviors in your version of `uniq`. The expected output of these commands should be:

```
$ uniq -c README.md
   1 No. 1
   3 No. 2
   1 No. 3
   1 No. 4
   1 No. 5
   2 No. 6
   1 No. 2
   1 no. 2

$ uniq -d README.md
No. 2
No. 6

$ uniq -i README.md
No. 1
No. 2
No. 3
No. 4
No. 5
No. 6
No. 2

$ uniq -c -i README.md
   1 No. 1
   3 No. 2
   1 No. 3
   1 No. 4
   1 No. 5
   2 No. 6
   2 No. 2
```

Notice that ”No. 2” should be the same as ”no. 2” if `uniq` is not case-sensitive. Also, `-c` and `-d` won’t appear at the same time.