EE309 Assignment 1

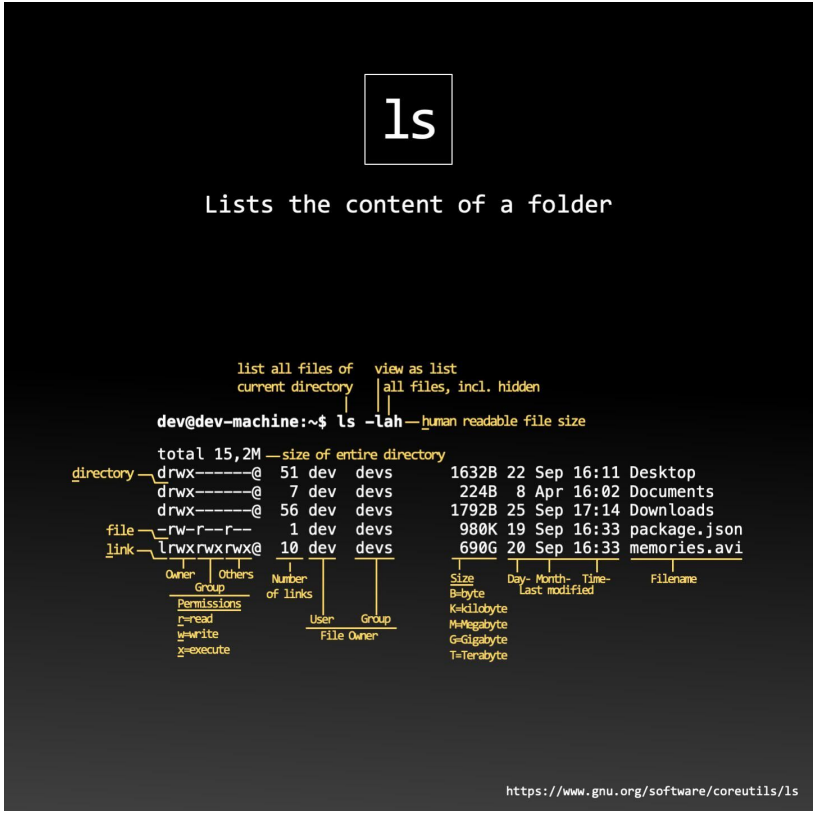
Directory listing - Simplified ls (ls309)

TA: Dongok Kim

Due date: 09/29 23:59:59

KAIST #Hacking Lab

Overview


ls
Lists the content of a folder
list all files of current directory
view as list all files, incl. hidden
dev@dev-machine:~$ ls -lah
human readable file size
total 15,2M
size of entire directory
directory
drwx------@ 51 dev devs 1632B 22 Sep 16:11 Desktop
drwx------@ 7 dev devs 224B 8 Apr 16:02 Documents
drwx------@ 56 dev devs 1792B 25 Sep 17:14 Downloads
file
-rw-r--r-- 1 dev devs 980K 19 Sep 16:33 package.json
link
lrwxrwxrwx@ 10 dev devs 690G 20 Sep 16:33 memories.avi
Owner
Group
Others
Permissions
r=read
w=write
x=execute
Number of links
User
Group
File Owner
Size
B=byte
K=kilobyte
M=Megabyte
G=Gigabyte
T=Terabyte
Day-
Month-
Time-
Last modified
Filename
https://www.gnu.org/software/coreutils/ls

Overview

- ls (**ls**t)
  - Display files & directories in a specified location
  - Providing options for display targets / format
    - Hidden files
    - More informations
    - Subdirectories recursion
    - …

- Goal: Implementing your own simplified ls (ls309)

Getting started

- Download skeleton code into your system (ex. Haedong lounge server)
  - https://teemo.kaist.ac.kr/ee309/2023/assignments/assignment1/ee309_assign1.tar.gz

```
20233083@eelabg1:~$ wget https://teemo.kaist.ac.kr/ee309/2023/assignments/assig
nment1/ee309_assign1.tar.gz
--2023-09-06 17:41:42--  https://teemo.kaist.ac.kr/ee309/2023/assignments/assig
nment1/ee309_assign1.tar.gz
Resolving teemo.kaist.ac.kr (teemo.kaist.ac.kr)... 143.248.55.32
Connecting to teemo.kaist.ac.kr (teemo.kaist.ac.kr)|143.248.55.32|:443... conne
cted.
HTTP request sent, awaiting response... 200 OK
Length: 514039 (502K) [application/octet-stream]
Saving to: 'ee309_assign1.tar.gz'

ee309_assign1.tar.g 100%[==================>] 501.99K  --.-KB/s    in 0.008s

2023-09-06 17:41:42 (61.7 MB/s) - 'ee309_assign1.tar.gz' saved [514039/514039]

20233083@eelabg1:~$ tar -xzvf ee309_assign1.tar.gz > /dev/null
20233083@eelabg1:~$ mv dist/ 20233083_assign1
20233083@eelabg1:~$ ls 20233083_assign1/
Makefile  run_test.py  samples309  src  tests
```

Getting started

- Compile skeleton code

```
20233083@eelabg1:~$ cd 20233083_assign1/
20233083@eelabg1:~/20233083_assign1$ make
mkdir -p obj
gcc209 -Isrc -Isrc/include -Wall -g -D_GNU_SOURCE -o obj/dnode.o -c src/dnode.c
mkdir -p obj
gcc209 -Isrc -Isrc/include -Wall -g -D_GNU_SOURCE -o obj/dir.o -c src/dir.c
mkdir -p obj
gcc209 -Isrc -Isrc/include -Wall -g -D_GNU_SOURCE -o obj/main.o -c src/main.c
gcc209 -o ls309 obj/dnode.o obj/dir.o obj/main.o
20233083@eelabg1:~/20233083_assign1$ ./ls309
.
```

Getting started

- Run test script with sample test cases

```
20233083@eelabg1:~/20233083_assign1$ make grade
./run_test.py
[*] Running test test-basic :
    - Running test cases file-single......O
    - Running test cases file-multiple......X
    - Running test cases dir-single......X
    - Running test cases dir-multiple......X
    - Running test cases dir-cwd......X
    - Running test cases mixed......X
[*] Running test test-a :
    - Running test cases dir-hidden-file......X
    - Running test cases **REDACT**......? (ModuleNotFoundError)
[*] Running test test-l :
    - Running test cases file-single-long......X
    - Running test cases **REDACT**......? (ModuleNotFoundError)
    - Running test cases **REDACT**......? (ModuleNotFoundError)
[*] Running test test-R :
    - Running test cases dir-recursive-one......X
```

```
******************** Grade Result ********************
- test-basic       (3/20)
    - file-single                 : Success (3.0/3.0)
    - file-multiple               : Fail (0.0/3.0)
    - dir-single                  : Fail (0.0/3.0)
    - dir-multiple                : Fail (0.0/4.0)
    - dir-cwd                     : Fail (0.0/3.0)
    - mixed                       : Fail (0.0/4.0)
- test-a           (0/10)
    - dir-hidden-file             : Fail (0.0/5.0)
    - **REDACT**                  : Error (0.0/5.0)
- test-l           (0/15)
    - file-single-long            : Fail (0.0/5.0)
    - **REDACT**                  : Error (0.0/5.0)
    - **REDACT**                  : Error (0.0/5.0)
- test-R           (0/15)
    - dir-recursive-one           : Fail (0.0/5.0)
    - **REDACT**                  : Error (0.0/5.0)
    - **REDACT**                  : Error (0.0/5.1)
- test-advanced    (0/30)
    - **REDACT**                  : Error (0.0/6.0)
    - **REDACT**                  : Error (0.0/6.0)
    - **REDACT**                  : Error (0.0/6.0)
    - **REDACT**                  : Error (0.0/6.0)
    - **REDACT**                  : Error (0.0/6.0)
- test-error       (0/10)
    - error-eexist                : Fail (0.0/3.3)
    - **REDACT**                  : Error (0.0/3.3)
    - **REDACT**                  : Error (0.0/3.4)
---------------------------------
- total                            3/100
```

Specifications

- Inputs
  - Take the (absolute/relative) paths to the file or directory from command-line arguments
    - **$ ./ls309 /home/user/some_abs_path**
    - **$ ./ls309 ./some_rel_path**
    - **$ ./ls309 ./file1 ./file2 ./file2**
    - **$ ./ls309 ./some_file1 ./some_dir/ ./some_file2**
  - Support an empty argument -> use the current directory
    - **$ ./ls309** should give same result with **$ ./ls309 .**
  - Support three options: -a, -l, and -R
    - **$ ./ls309 -a**
    - **$ ./ls309 -a -l**
    - **$ ./ls309 -aR**
    - **$ ./ls309 -alR**
  - the option strings can be located in any position
    - **$ ./ls309 -alR ./file**
    - **$ ./ls309 ./file -alR**
    - **$ ./ls309 ./file1 -a ./file2 -lR**

Specifications

- Outputs
  - Print a list separated by newline("\n") into standard output
  - Should be sorted in **lexicographical order based on ASCII character set**
    - Different behavior from coreutils ls

```
$ ls
alpha  file  samplels309  Zoo
$ ./samplels309
Zoo
alpha
file
samplels309
```

Specifications

- Outputs
  - If multiple display targets are given
    - List the files from targets
    - List the directories with their name and entries.
      - Lists should be separated by newline("\n")
      - Each list and order of directories should be sorted as well.

```
$ ./samplels309 file1 dir1 dir2 file2 dir3
file1
file2

dir1:
dir1-file
dir1-file2

dir2:
dir2-file

dir3:
dir3-file
dir3-file2
dir3-file3
```

Specifications

- Options
  - **-a** option: Display hidden files and directories (start with .)

```
$ ./samplels309
file
samplels309
$ ./samplels309 -a
.
..
.hidden-file
file
samplels309
```

Specifications

- Options
  - **-l** option: Display additional information

```
$ ./samplels309
dir
file
samplels309
symlink
$ ./samplels309 -l
total 1184
drwxrwxr-x    2 20233083 20233083       4096 Sep  7 14:52 dir
-rw-rw-r--    1 20233083 20233083          0 Sep  7 14:52 file
-rwxrwxr-x    1 20233083 20233083    1204960 Sep  7 14:51 samplels309
lrwxrwxrwx    1 20233083 20233083          7 Sep  7 14:53 symlink -> /bin/sh
```

Specifications

- Options
  - **-R** option: Display directories recursively

```
$ ./samplels309
dir
file
samplels309
$ ./samplels309 -R
.:
dir
file
samplels309

./dir:
file1
file2
```

Specifications

- Etc
  - Properly handle errors and print textual error messages
    - ex. **No such file or directory**
  - Should be robust from any kind of input
    - i.e. Should not crash unintendedly
    - Will get 0 points for test case in which unexpected crashes happen
  - Should not have any kind of memory leak.
    - i.e. Should free every memory which returned from malloc

Implementation

- Option parsing & Entries sorting
  - Finish implementation of option parsing routine of **main** function
  - Finish implementation of **sort_dnode_entries** function
    - You may want to use **compare_dnode_name** helper function

```c
int main(int argc, char *argv[]) {
  int opt;

  // parse given options and set proper flags
  while ((opt = getopt(argc, argv, "alR")) != -1) {
    switch (opt) {
    // TODO: Task 1
    //
    //
    //
    default: /* unknown options */
      fprintf(stderr, "Usage: %s [-alR] [file path]\n", argv[0]);
      exit(EXIT_FAILURE);
    }
  }
```

```c
// sort_dnode_entries : sort given dnode linked list into dnode array
// @param head : head pointer of dnode linked list
// @param cnt : count of dnodes
// @return : dnode double pointer that points sorted dnode array
struct dnode **sort_dnode_entries(struct dnode *head, size_t cnt) {
  struct dnode **res, **curr;

  if (!(res = calloc(sizeof(struct dnode *), cnt))) {
    fprintf(stderr, "cannot allocate dnode array : %s\n", strerror(errno));
    return NULL; /* could not allocate dnode array */
  }

  curr = res;
  while (head) {
    *curr++ = head;
    head = head->dn_next;
  }

  // TODO: Task 1
  //
  //
  //

  return res;
}
```

Implementation

- Directory listing and Support **-a** option
  - Implement **parse_dir** function
    - You may need to use…
      - Directory-related library functions (**opendir**, **readdir**, **closedir**)
      - Other helper functions (**concat_path**, **strdup**)
  - Support **-a** option into your implementation of **parse_dir** function.

```c
// parse_dir : parse the directory into dnode linked list
// @param path : path of directory that will be parsed
// @param cnt : size_t pointer which count of dnode entries stored
// @return : head pointer of dnode linked list
struct dnode *parse_dir(const char *path, size_t *cnt) {
  struct dnode *head = NULL;

  // TODO: Task 2
  //
  //
  //

  return head;
}
```

Implementation

- Support **-l** option
  - Finish implementation of **parse_dnode** function.
    - Need to follow or not follow the link based on **follow_link** parameter
    - You may need to use library functions for file information(**stat**, **fstat**, **lstat**)

```
105 // parse_dnode : parse the info about given file into dnode
106 // @param fullname : (full) file path for parsing
107 // @param follow_link : determine wheter follows symlink or not
108 // @return : dnode pointer that stores info about given file
109 struct dnode *parse_dnode(const char *fullname, int follow_link) {
110   struct dnode *res;
111
112   if (!(res = malloc(sizeof(struct dnode)))) {
113     fprintf(stderr, "cannot allocate dnode : %s\n", strerror(errno));
114     return NULL; /* could not allocate dnode */
115   }
116
117   // TODO: Task 3
118   //
119   //
120   //
```

```
122   res->fullname = strdup(fullname);
123   res->dn_next = NULL;
124
125   // TODO: Task 3
126   //
127   //
128   //
129
130   return res;
131 }
```

Implementation

- Support **-l** option
  - Finish implementation of **display_dnode_long** function
    - You may want to use **readlink** function to get link target.

```
84    printf("%s", d->name);
85    if (S_ISLNK(d->dn_mode)) {
86      if (!(lpath = malloc(MAX_PATH_SIZE + 1))) {
87        fprintf(stderr, "cannot allocate lpath : %s\n", strerror(errno));
88        return; /* could not allocate lpath */
89      }
90
91      // TODO: Task 3
92      //
93      //
94      //
95
96      lpath[ret] = '\0';
97
98      printf(" -> ");
99      printf("%s", lpath);
100     free(lpath);
101   }
```

Implementation

- Support **-R** option
  - Finish implementation of **print_dir** function

```
// print_dir : print the entires of given directory with proper flags
// @param path : path of directory that will be printed
void print_dir(const char *path) {
  // TODO for assign
  size_t dnode_cnt;
  struct dnode *dnode_head, **dnode_arr;

  dnode_head = parse_dir(path, &dnode_cnt);
  dnode_arr = sort_dnode_entries(dnode_head, dnode_cnt);

  if (is_print_dir)
    printf("%s:\n", path);
  display_dnode_arr(dnode_arr, dnode_cnt);

  // TODO: Task 4
  //
  //
  //

  free(dnode_arr);
}
```

Implementation

- Error handling & Robustness
  - For error handling…
    - Always check the return values of library functions
    - Print the proper error message into standard error
    - You may want to use the **errno** variable and **perror** / **strerror** functions
  - For the robustness…
    - Always be aware of memory-related bugs
    - You may use Valgrind or Address Sanitizer to check

Submission

- Submit your code as tar.gz archive file
  - Use **KAIST KLMS** to submit your project.
  - File name: **<YourStudentID>_assign1.tar.gz**
  - Make sure to run **make clean** before submitting.

```
20233083@eelabg1:~/20233083_assign1$ make clean
rm -rf ls309  obj ./ee309_test
20233083@eelabg1:~/20233083_assign1$ cd ../
20233083@eelabg1:~$ tar -czvf 20233083_assign1.tar.gz ./20233083_assign1/ > /dev/null
20233083@eelabg1:~$ ls ./20233083_assign1.tar.gz
./20233083_assign1.tar.gz
```

Criteria

- Will test codes on ubuntu 20.04.6 LTS (same with Haedong lounge server)
  - Only provide subset of all test cases as sample

Test categories	Weight
test-basic	20%
test-a	10%
test-l	15%
test-R	15%
test-advanced	30%
test-error	10%

Notes

- Linux man page always helpful
  - ex. man getopt
- Study general guideline and course policy carefully
  - Ethics document, Collaboration Policy…
- Feel free to ask questions on Piazza

Thank you

Any questions?