Layer Programming

The program can be divided into three layers, what are they?

- data structure
- sorting functions
- user interface

Split the program into files according to the defined layers.

- Data (list) Structure: `list.c/h`
- Sorting Functions: `sort.c/h`
- User Interface: `ui.c/h`
- main function for cmd user interface: `main_cmd.c`
- main function for menu user interface: `main_menu.c`

I/O File Format for cmd ui

Input:

- `rand_int.txt` : the type of data is `int`
- `rand_char*.txt` : the type of data is `char*`
- `rand_double.txt` : the type of data is `double`

Output:

Format: `<sortingtype>_<datatype>.txt`

sortingtype:

- `rand` : the order of elements is random
- `inc` : the sorting order is increasing
- `dec` : the sorting order is decreasing

datatype:

- `int` : the type of data is `int`
- `char` : the type of data is `char*`
- `double` : the type of data is `double`

Compile the Program

Check `Makefile` for easy compilation.

Libraries

- What are the three stages performed when compiling a file?
  - **Preprocessing**, the preprocessor includes all header files, expands macros (any '#' mark).
  - **Compilation**, the compiler read the source files and then produce the corresponding assembly code.
  - **Linking**, the linker link object files and produce a single binary file.
- Difference between static and dynamic library

  Static libraries, while reusable in multiple programs, are locked into a program at compile time. **Dynamic,** or **shared libraries** on the other hand, exist as separate files outside of the executable file.

static library

use `-c` command to compile the source and header file so as to create a static library file.

create two static library files:

```
gcc -c list.c -o list.o
ar rcs list.a list.o
gcc -c sort.c -o sort.o
ar rcs sort.a sort.o
gcc -c ui.c -o ui.o
ar rcs ui.a ui.o
```

compile the cmd driver program:

```
gcc -c main_cmd.c -o ui_cmd.o
gcc -o ui_cmd ui_cmd.o -L. -lsort -llist -lui
./ui_cmd
```

dynamic library

```
gcc *.c -c -fPIC
gcc *.o -shared -o libmenu.so
gcc -L. -o main_menu main_menu.c -lmenu
export LD_LIBRARY_PATH=./:$LD_LIBRARY_PATH
./main_menu
```

- Difference between a library and the API:

  API refers to a set of tools and protocols prescribed by a computer operating system or another app by which a developer writing a program can make requests, while a library is a collection of functions, pre-compiled routines or reusable components of code, which may not be used as an application.

- Implement the API below for the two libraries.

  Check `./lab5_dlist.c` for implementation.