Lab 4 Linker

1. In this lab, we use the following tools:

gcc -c: this will compile object file and compiler stops before the linker stage.

objdump -t: this tool will provide the symbol table.   *UND* means the section is not defined. In the lab, TopSecretGenerateRandomNumber() function is not defined in file lottery.c. This tool can help us to see which function should be provided by other linkers.

gcc -fPIC -shared: create a shared object file.

nm -g: this tool with flag -g displays the external symbols for object files. When we run this tool with libsecret.so file, we can see "00000000000006d5 T TopSecretGenerateRandomNumber". The "T" means that the section is in text and it is global. Therefore we could know that the function is defined in this library (if the section is not defined, it would show "U").

readelf -s: this tool will print symbols table in ELF file. This read could be easily read. For example, it will print out the following for TopSecretGenerateRandomNumber function.
" 45: 00000000000006d5   46 FUNC   GLOBAL DEFAULT   11
TopSecretGenerateRandomNumber"

ldd: this tool will tell you which libraries you need to run the program. In this lab, we will need 4 libraries to run lotto. This could help us know which library is missing in the directory.

LD_LIBRARY_PATH=.: this is not a tool but set the environment variable LD_LIBRARY_PATH to load libraries in the current path.

export LD_PRELOAD=$PWD/: this is preloading an environment variable before we run the program and the environment variable will not be changed later.

echo: this command is to display the variable. In the lab, we use echo to display the environment variable we previously set.

unset: clean up the variables we set.

2. Advantages of linking libraries:
    - We could save memory by linking libraries since other programs may use the same code so we don’t need to repeat them again.
    - Reduce the compile time. When we link the libraries in our program, when need to debug and recompile the program, we do not need to compile the whole program. Instead, we could only compile the libraries we changed.
    - Control the access of file. By linking libraries, we could hide the code that we do not want others to see but allow them to use.

    Disadvantages of linking libraries:
    - May be unsafe because user could preload some libraries and change the function before the programs run.
    - Programs could be unstable since missing one small library could cause the whole program to stop working.