**Buffer Overflows**

**Description**

You should use your ubuntu instance to complete the following.

We are going to take a look at how to overflow a simple buffer of some c code to gain terminal access. Answer the following questions where indicated.

Here is a simple video to get you started.

- In your home directory you should install two c programs, `buffer.c` and `hack.c`. These are found [here](#) and [here](#).
- Compile `buffer.c` with: `gcc -o buffer buffer.c`
- Run it and type in a bunch of characters and hit enter. To run it, you just type `./buffer`. You may have to `chmod +x` to make it executable. It then waits for you to type in a string. Type one in and see what happens.
- Type a very long string in, you should see something like `*** stack smashing detected ***: ./buffer terminated.

  - Make a note of the maximum number of characters that you can type in without getting the above error?
- Now, recompile the above code without stack smashing protection.
  - `gcc -fno-stack-protector -U_FORTIFY_SOURCE -o buffer buffer.c`

- Run the code again with lots of characters.
  - What does the new error message say?
- Run the code 3 or 4 times
  - Record the address of where that is trying to run each time. The address is indicated by the value of buffer, something like `buffer = 0xbffd09c0`.
  - Note that this address changes each time you run the program. Why does that change?
- Disable address space randomization in linux by doing: `sudo /bin/sh -c "echo 0 > /proc/sys/kernel/randomize_va_space"`. (If you need to re-enable it, you can change the 0 to a 1)
  - Run your code again 3 or 4 more times.
    - What happens to the address now.
    - Why does it not change?
- Compile `hack.c` with: `gcc -o hack hack.c`

- We are going to feed the output of `hack.c` (which generates some specially crafted input) into our buffer program.
- First we will recompile `buffer.c` one more time with: `gcc -fno-stack-protector -z execstack -o buffer buffer.c`
  - What do the options fno-stack-protector and execstack do? (See google)(I will ask you this on your submission file)
- You will have to do a `apt-get install execstack`
  - Verify that the execstack is appropriately set by issuing `execstack -q buffer` (just make sure there aren't any weird errors)
- Now issue the following:
  - `./hack [buffer address] [diff] | ./buffer`, where the inputs to buffer address and diff are given by a run of `./buffer`
  - Ideally now you have a shell, try to type `ls` and hit `enter`. (Ctrl-D to exit the shell)
  - Take a print screen of your buffer overflow.

**To submit**

A single pdf with the answers to the following questions. Many of these answers will require you to do some research on your part.

- What is a buffer overflow?
- How does address space randomization mitigate buffer overflows?
- How else can you prevent buffer overflows?
- What do the options fno-stack-protector and execstack do? (See google)
- Find a recent vulnerability of a buffer overflow and report what program it affects and anything else interesting about it.
- Include a screenshot of your above buffer overflow working.