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, \texttt{buffer.c} and \texttt{hack.c}. These are found \url{here} and \url{here}.
- Compile \texttt{buffer.c} \texttt{gcc -o buffer buffer.c}
- Run it and type in a bunch of characters and hit enter. To run it, you just type \texttt{./buffer}. You may have to \texttt{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 \texttt{*** 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
  - \texttt{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 \texttt{buffer}, something like \texttt{buffer = 0xbffdd09c0}.
  - Note that this address changes each time you run the program. Why does that change?
- Disable address space randomization in linux by doing: \texttt{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 \texttt{hack.c} \texttt{gcc -o hack hack.c}
- We are going to feed the output of \texttt{hack.c} (which generates some specially crafted input) into our buffer program.
- First we will recompile \texttt{buffer.c} one more time \texttt{gcc -fno-stack-protector -z execstack -o buffer buffer.c}
  - What do the options \texttt{fno-stack-protector} and \texttt{execstack} do? (See google)(I will ask you this on your submission file)
- You will have to do a \texttt{apt-get install execstack}
- Verify that the execstack is appropriately set by issuing \texttt{execstack -q buffer} (just make sure there aren’t any weird errors)
- Now issue the following:
  - \texttt{./hack [buffer address] [diff] | ./buffer}, where the inputs to buffer address and diff are given by a run of \texttt{./buffer}
  - Ideally now you have a shell, try to type \texttt{ls} and hit \texttt{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 \texttt{fno-stack-protector} and \texttt{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.