You are to complete this project on both a Windows system and a Linux† system. You are to work by yourself. It is OK to ask for help, but you are to complete each step and answer the questions by yourself. Your report should have a separate set of observations (1-4) for Windows and Linux, but you only need to answer the questions once. Submit your report in the text of an email sent to your TA.

In class you studied the ICMP protocol, which provides control messages among IP routers and hosts. This project involves two well-known network utilities that use ICMP: ping and traceroute. (On Windows systems, the command for the latter is tracert.)

**Lab Steps:**

1. Get the documentation for the two commands. On Windows, use Start->Help to find it; on Linux, type “man ping” and “man traceroute”. Use this to complete the actions below.

2. Do a simple ping on the following hosts and report on the results:
   - netlab.gmu.edu
   - osf1.gmu.edu
   - venera.isi.edu (a host at USC/ISI in Marina Del Rey, CA)
   - www.ieee.org (a host on a hosting service supporting the IEEE)
   - www.nps.navy.mil (a host at the Naval Postgraduate School, Monterey, CA)

3. Use ping in repeated mode to ping netlab.gmu.edu 100 times. When you have enough results, type control-C to stop. Report on the ping statistics you get.

4. Run a traceroute to each of the hosts listed in step 2. For each host, report on the number of hops, shortest round trip, and longest round trip.

**Lab Questions:**

1. Explain why minimum, maximum, and average are different in step 3.

2. The first hop for all four traceroutes is the same. What is the role of the machine with this IP address?

3. Explain why the round-trip time for a given hop number is not always the same.

4. Different hosts have different round-trip times. What factors contribute to the round-trip time?

5. What relationship, if any, do you see between the number of hops and the variation in the round-trip time? Provide an explanation for this observation.

6. We saw, in class, that traceroute does not use the ‘record route’ option in the IPv4 header. How does traceroute work, then?

7. www.nps.navy.mil responds to traceroute but not to ping, because of the way it is configured. Provide a likely reason why it was configured that way.

8. Describe a way in which a network support person might use traceroute in troubleshooting.

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† One of the goals of this lab is to have you compare the use of Windows and a UNIX platform. Throughout this lab we refer to Linux, but you can use any UNIX platform to which you have access (e.g., Linux, FreeBSD, Solaris, HP-UX, AIX, OSF). You should clearly indicate in the work you submit for grading exactly which platform (both of UNIX and Windows) that you used.