ECE435: Embedded Systems – Homework 5
Internet Protocol

Due: Wednesday, 26 October 2016, 3pm

For this homework short answers will suffice.

To submit, create a document with your answers (text, pdf, libreoffice, MS Office if you must) and e-mail them to *vincent.weaver@maine.edu* by the homework deadline. Title your e-mail "ECE435 Homework 5" and be sure your name is included in the document.

1. Which of the following are valid IPv4 addresses?

   (a) 10.10.10.10

   (b) 3232237569

   (c) 0xc0a80801

   (d) 123.267.67.88

2. What percentage of all IP addresses do early adopters like Ford, IBM, Apple, and MIT have? This xkcd comic might help: `https://xkcd.com/195/`

3. A network is described as 192.168.13.0/24.

   (a) What would be the subnet mask for this subnet?

   (b) What would be the lowest IP address you could assign on this subnet?

   (c) What would be the highest IP addresses on this subnet?

4. You run the "route" command on your Pi and you get an output like the following:

```
pi3:~$ /sbin/route
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
default         192.168.8.2     0.0.0.0         UG    0      0        0 eth0
192.168.8.0     0.0.0.0         255.255.255.0   U     0      0        0 eth0
```

   (a) If a packet is sent to 216.58.192.132, what is its first "hop" on the way?

   (b) If a packet is sent to 192.168.8.50 what is its first "hop" on the way?

5. If you recall from HW3 we looked at a packet similar to this:

```
0x0000:  0013 3b10 667f b827 ebaf 3711 0800 4500   ..;.f..'..7...E.
0x0010:  0038 572a 4000 4006 69cc c0a8 0833 826f   .8W*@.@.i....3.o
0x0020:  2e7f bda5 0050 cdc4 6a49 3c7b 6ca5 8018   .....P..jI<{l...
0x0030:  00e5 79f4 0000 0101 080a 0104 3e58 34a8   ..y.........>X4.
0x0040:  7bc3 4745 540a                            {.GET.
```

```
This decodes as:

BEGIN ETHERNET FRAME HEADER

0x0000:   0013 3b10 667f = destination MAC 00:13:3b:10:66:7f
0x0006:   b827 ebaf 3711 = source MAC b8:27:eb:af:37:11
0x000c:   0800 = type (IPv4)

END ETHERNET FRAME HEADER

BEGIN IPv4 PACKET HEADER

0x000e:   45 =    _____
0x000f:   00 =    _____
0x0010:   0038 = _____
0x0012:   572a = _____
0x0014:   4000 = _____
0x0016:   40 =    _____
0x0017:   06 =    _____
0x0018:   69cc = _____
0x001a:   c0a80833 = _____
0x001e:   826f2e7f = _____

END IPv4 PACKET HEADER

BEGIN TCP PART

0x0022 - 0x0045 = TCP and actual payload

END TCP_PART
```

Fill in the meaning of the various IPv4 fields (what field it is, and what the value means).

6. Use the "ping" command on a network connected machine to `ping www.google.com`.

   (a) What is the round-trip packet time?

   (b) Do you notice anything odd about the hostname that responds?

7. Use the "traceroute" command. It's tracert on Windows.

   (a) `traceroute www.maine.edu`. Do you recognize any of the names in the hops along the way?

   (b) `traceroute www.facebook.com`. How many hops away is it? Do the response times gradually go up for each further hop?