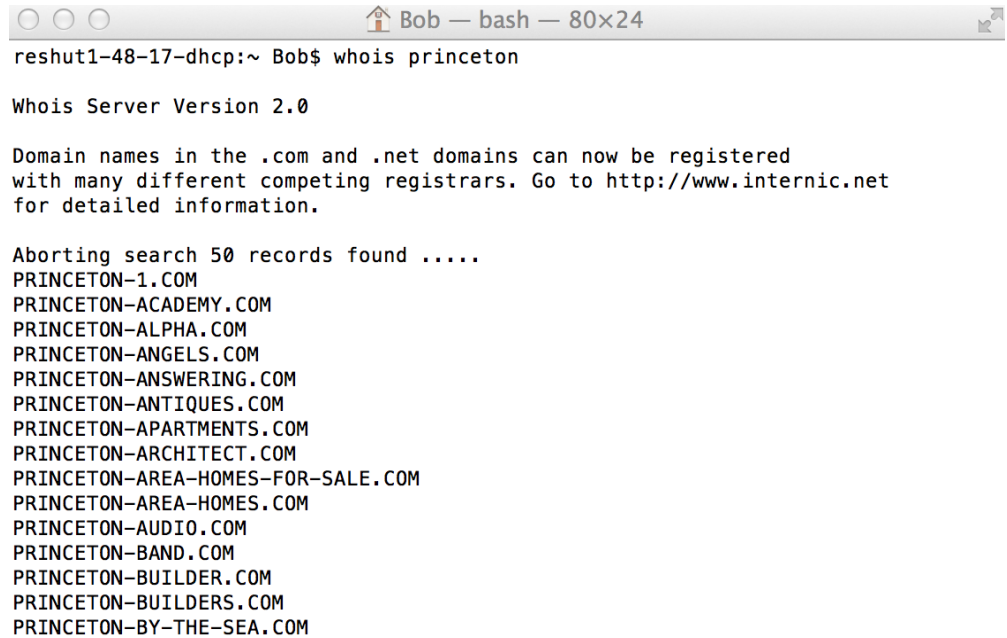


CSCI 4273: Homework One

1. Exercise 2

a. whois princeton

A terminal window titled "Bob — bash — 80x24" showing the output of the command "whois princeton". The output includes a disclaimer about domain registration, a list of 50 records found, and a list of domain names starting with "PRINCETON-".

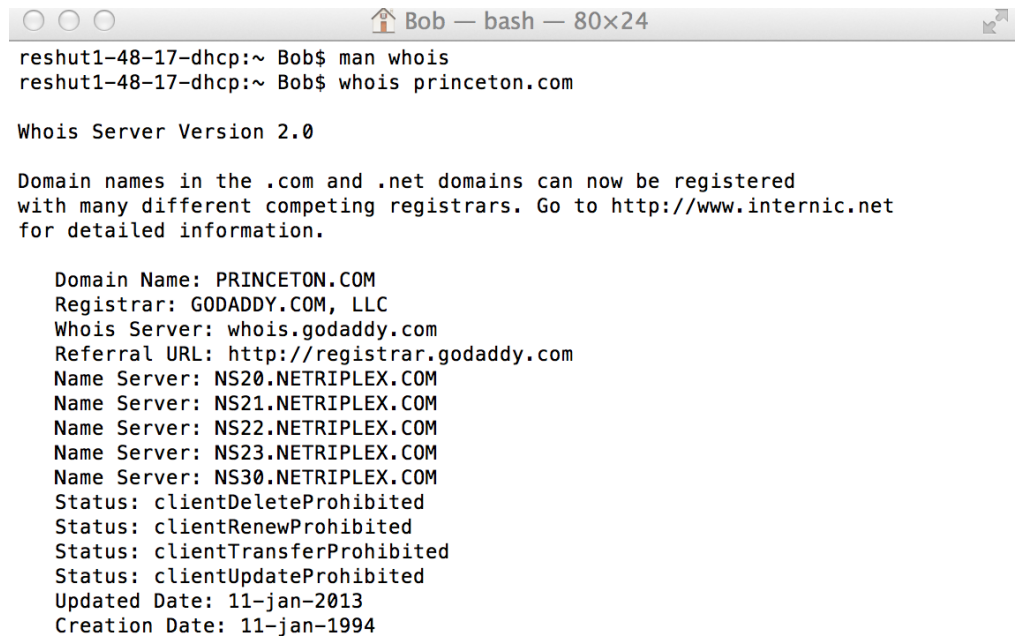
```
Bob$ whois princeton

Whois Server Version 2.0

Domain names in the .com and .net domains can now be registered
with many different competing registrars. Go to http://www.internic.net
for detailed information.

Aborting search 50 records found .....
PRINCETON-1.COM
PRINCETON-ACADEMY.COM
PRINCETON-ALPHA.COM
PRINCETON-ANGELS.COM
PRINCETON-ANSWERING.COM
PRINCETON-ANTIQUES.COM
PRINCETON-APARTMENTS.COM
PRINCETON-ARCHITECT.COM
PRINCETON-AREA-HOMES-FOR-SALE.COM
PRINCETON-AREA-HOMES.COM
PRINCETON-AUDIO.COM
PRINCETON-BAND.COM
PRINCETON-BUILDER.COM
PRINCETON-BUILDERS.COM
PRINCETON-BY-THE-SEA.COM
```

b. whois princeton.com

A terminal window titled "Bob — bash — 80x24" showing the output of the command "whois princeton.com". The output includes a disclaimer about domain registration and detailed information for the domain "PRINCETON.COM".

```
Bob$ man whois
Bob$ whois princeton.com

Whois Server Version 2.0

Domain names in the .com and .net domains can now be registered
with many different competing registrars. Go to http://www.internic.net
for detailed information.

Domain Name: PRINCETON.COM
Registrar: GODADDY.COM, LLC
Whois Server: whois.godaddy.com
Referral URL: http://registrar.godaddy.com
Name Server: NS20.NETRIPLEX.COM
Name Server: NS21.NETRIPLEX.COM
Name Server: NS22.NETRIPLEX.COM
Name Server: NS23.NETRIPLEX.COM
Name Server: NS30.NETRIPLEX.COM
Status: clientDeleteProhibited
Status: clientRenewProhibited
Status: clientTransferProhibited
Status: clientUpdateProhibited
Updated Date: 11-jan-2013
Creation Date: 11-jan-1994
```

2. Exercise 3

- a. Transfer time = RTT + Transfer Size/ Bandwidth
 - i. Bandwidth = 1.5 Mbps, Transfer Size = 1000-KB, RTT = 50 ms
 - ii. $1 \text{ KB} = 2^{10} \text{ bytes} * 8 = 8 * 2^{10} \text{ bits} = 8 \text{ Mb}$
 - iii. $\text{Transfer Size/ Bandwidth} = 8 \text{ Megabits/ } 1.5 \text{ Megabits per second} = 5.3 \text{ s}$
= 5300 ms
 - iv. $\text{Transfer time} = 50 \text{ ms} + 5300 \text{ ms} = 5350 \text{ ms} + 2 * \text{RTT} = 5450 \text{ ms}$
- b. $\text{Transfer time} = 5450 \text{ ms} + 1000 * \text{RTT} = 55450 \text{ ms}$
- c. $\text{Transfer time} = 2 * \text{RTT} (\text{initial handshake}) + 0 (\text{Transmit time}) + 1000/20 * \text{RTT} =$
 $100 \text{ ms} + 50 * 100 = 5100 \text{ ms}$
- d. $\text{Transfer time} = 2 * \text{RTT} (\text{initial handshake}) + 0 (\text{Transmit time}) + 9.5 * \text{RTT} = 100$
 $\text{ms} + 475 \text{ ms} = 575 \text{ ms}$

3. Exercise 9

- a. Multicast addresses might be beneficial when you need to send data to multiple hosts but not all hosts on a network. An example would be podcasts when many people subscribe to one person's service. The podcaster doesn't want to transmit to everybody in the podcast service. He only wants to transmit to those who have subscribed to his podcast so he would need to use multicast.

4. Exercise 10

- a. Each of the mediums is used differently so they require different multiplexing techniques. FDM and STDM are not cost-effective for computer networks because they aren't able to adapt to an unknown number of flows. They operate with a fixed number. Time shared links would be impractical for computer

networks because link idleness can be significant which would hinder the flow of other traffic.

5. Exercise 13

- a. Latency = propagation + transmit = $2 * (385,000 * 10^3 \text{ m}) / (3 * 10^8 \text{ m/s}) + 0 = 2.57 \text{ s} = 2570 \text{ ms}$
- b. delay * bandwidth = $2.57 \text{ s} * 10^9 \text{ bits per second} = 2.57 * 10^9 \text{ bits} = 2.57 \text{ Gb} / 8 = .32 \text{ GB}$
- c. The delay * bandwidth product is the amount of data that can be sent before receiving a response.
- d. Transfer time = RTT + Size/ Bandwidth = $2.57 \text{ s} + 25 \text{ MB} / 1 \text{ Gbps} = 2.57 \text{ s} + (25 * 8 * 2^{20}) \text{ b} / 10^9 \text{ bps} = .21 \text{ s} + 2.57 \text{ s} = 2.78 \text{ s}$

6. Exercise 18

- a. The bandwidth is 100-Mbps.
- b. Packet Latency = $4 * 10 \text{ microseconds (propagation delay)} + 4 * (12000 \text{ bits or } .012 \text{ Mb}) / 100 \text{ Mbps} = 4 * 10 \text{ microseconds} + 480 \text{ microseconds} = 520 \text{ microseconds}$
 - i. ACK Latency = $4 * 10 \text{ microseconds} + .0004 \text{ M bit} / 100 \text{ Mbps} = 40 \text{ microseconds} + 4 \text{ microseconds} = 44 \text{ microseconds}$
 - ii. Total RTT = Packet Delay + Acknowledgement Packet Delay = $520 \text{ microseconds} + 44 \text{ microseconds} = 564 \text{ microseconds}$
 - iii. Bandwidth = Size/ Transmit = $12000 \text{ bits} / .000564 \text{ s} = 21276595 \text{ bits per second} = 21.27 \text{ Mbps}$
- c. $100 * (4.7 * 8 \text{ Gb}) / (12 * 3600 \text{ seconds}) = .087 \text{ Gbps} = 87 \text{ Mbps}$

7. Exercise 21

a. $\text{Transmit} = \text{Size} / \text{Bandwidth}$

i. W/o compression $\text{transmit} = 1 \text{ MB} / \text{Bandwidth}$

ii. W/ compression $\text{transmit} = \text{compression time} + \text{compressed size} / \text{Bandwidth}$

iii. $\text{bandwidth} = \text{compressed size} / \text{time to compress}$

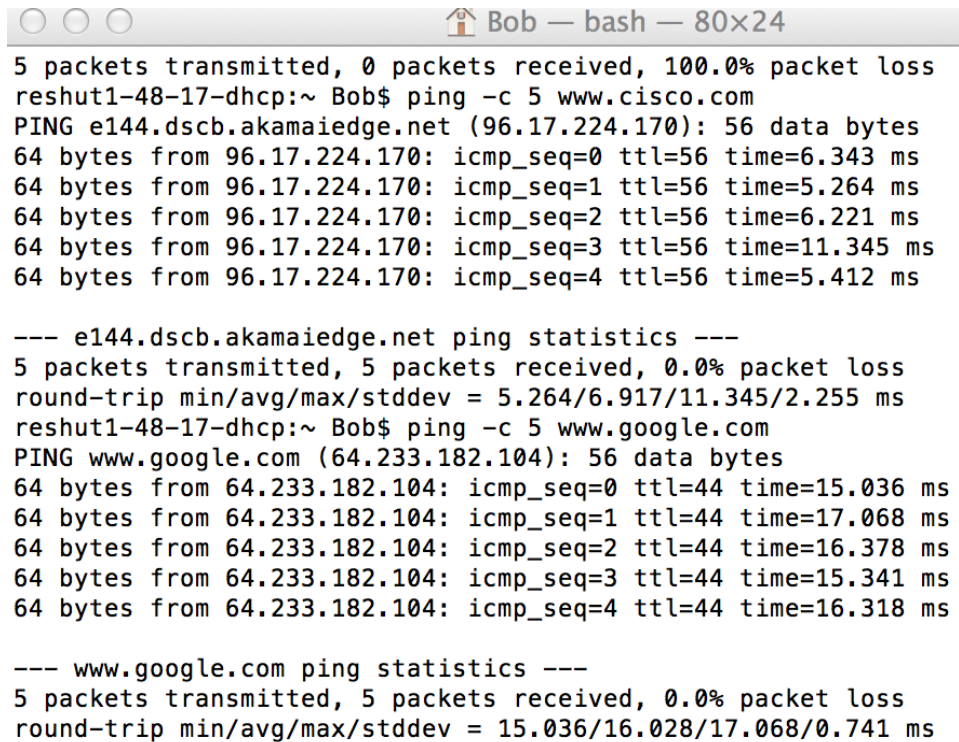
iv. $= .5 \text{ MB} / 1 \text{ sec}$

v. $= .6 \text{ MB} / 2 \text{ sec} = .3 \text{ MB} / 1 \text{ sec}$

b. Latency doesn't affect the answer because it is the same for both compressed and uncompressed files.

8. Exercise 36

a. `ping -c 5 www.google.com`, `ping -c 5 www.cisco.com`



```
Bob — bash — 80x24
5 packets transmitted, 0 packets received, 100.0% packet loss
reshut1-48-17-dhcp:~ Bob$ ping -c 5 www.cisco.com
PING e144.dscb.akamaiedge.net (96.17.224.170): 56 data bytes
64 bytes from 96.17.224.170: icmp_seq=0 ttl=56 time=6.343 ms
64 bytes from 96.17.224.170: icmp_seq=1 ttl=56 time=5.264 ms
64 bytes from 96.17.224.170: icmp_seq=2 ttl=56 time=6.221 ms
64 bytes from 96.17.224.170: icmp_seq=3 ttl=56 time=11.345 ms
64 bytes from 96.17.224.170: icmp_seq=4 ttl=56 time=5.412 ms

--- e144.dscb.akamaiedge.net ping statistics ---
5 packets transmitted, 5 packets received, 0.0% packet loss
round-trip min/avg/max/stddev = 5.264/6.917/11.345/2.255 ms
reshut1-48-17-dhcp:~ Bob$ ping -c 5 www.google.com
PING www.google.com (64.233.182.104): 56 data bytes
64 bytes from 64.233.182.104: icmp_seq=0 ttl=44 time=15.036 ms
64 bytes from 64.233.182.104: icmp_seq=1 ttl=44 time=17.068 ms
64 bytes from 64.233.182.104: icmp_seq=2 ttl=44 time=16.378 ms
64 bytes from 64.233.182.104: icmp_seq=3 ttl=44 time=15.341 ms
64 bytes from 64.233.182.104: icmp_seq=4 ttl=44 time=16.318 ms

--- www.google.com ping statistics ---
5 packets transmitted, 5 packets received, 0.0% packet loss
round-trip min/avg/max/stddev = 15.036/16.028/17.068/0.741 ms
```

i.

ii. RTT icmp packets take longer for google.com than they do for cisco.com.

This might be due to physical distance of the servers of each domain

name, the number of requests being handled by those servers, or the number of requests being handled by the WAN that I'm on.

9. Exercises 37

a. traceroute www.google.com

```
Bob — bash — 80x24
reshut1-48-17-dhcp:~ Bob$ traceroute www.google.com
traceroute: Warning: www.google.com has multiple addresses; using 64.233.182.106
traceroute to www.google.com (64.233.182.106), 64 hops max, 52 byte packets
 1  10.203.48.1 (10.203.48.1)  12.574 ms  44.060 ms  9.830 ms
 2  128.138.81.153 (128.138.81.153)  4.454 ms  2.858 ms  3.975 ms
 3  hut-tcom.colorado.edu (128.138.81.130)  2.635 ms  3.891 ms  2.125 ms
 4  fw-hut.colorado.edu (128.138.81.250)  2.417 ms  3.716 ms  *
 5  juniper-fw.colorado.edu (128.138.81.193)  4.281 ms  3.144 ms  3.395 ms
 6  frgp-i1-ucb.colorado.edu (198.59.55.10)  5.314 ms  4.391 ms  4.404 ms
 7  xe-0-0-1.core-910.frgp.net (192.43.217.170)  5.963 ms  4.679 ms  4.627 ms
 8  72.14.194.239 (72.14.194.239)  5.697 ms  4.936 ms  6.914 ms
 9  72.14.234.59 (72.14.234.59)  5.035 ms  4.556 ms
    72.14.234.57 (72.14.234.57)  6.563 ms
10  216.239.46.146 (216.239.46.146)  5.394 ms
    216.239.46.150 (216.239.46.150)  5.401 ms
    216.239.46.144 (216.239.46.144)  6.222 ms
11  72.14.239.48 (72.14.239.48)  16.110 ms  14.998 ms
    216.239.48.200 (216.239.48.200)  14.597 ms
12  209.85.242.109 (209.85.242.109)  14.634 ms
    216.239.47.180 (216.239.47.180)  15.189 ms
    216.239.49.139 (216.239.49.139)  14.979 ms
13  * * *
i. 14  64.233.182.106 (64.233.182.106)  15.404 ms  14.790 ms  14.513 ms
```

b. traceroute -q 1 www.cisco.com

```
reshut1-48-17-dhcp:~ Bob$ traceroute -q 1 www.cisco.com
traceroute to e144.dscb.akamaiedge.net (23.4.128.211), 64 hops max, 52 byte packets
 1  10.203.48.1 (10.203.48.1)  2.362 ms
 2  128.138.81.153 (128.138.81.153)  3.552 ms
 3  hut-tcom.colorado.edu (128.138.81.130)  2.103 ms
 4  fw-hut.colorado.edu (128.138.81.250)  3.267 ms
 5  juniper-fw.colorado.edu (128.138.81.193)  3.583 ms
 6  tcommx-compmx.colorado.edu (128.138.81.254)  3.841 ms
 7  dvr-edge-13.inet.qwest.net (205.171.45.117)  4.956 ms
 8  72.164.247.150 (72.164.247.150)  5.225 ms
i. 9  *
```

c. Hops don't correlate with RTT times. Cisco had a smaller RTT yet it had more hops than google.com.

d. As geographical distance increases, the number of hops increases.