UCLA (ucla.edu)

```
jwang138@remote05:~/Documents/cs471/HW/jwang138_hw10$ traceroute ucla.edu
traceroute to ucla.edu (128.97.27.37), 30 hops max, 60 byte packets
 1  128.226.180.161 (128.226.180.161)  0.389 ms  0.378 ms  0.433 ms
 2  128.226.3.64 (128.226.3.64)  0.260 ms  0.403 ms 128.226.3.66 (128.226.3.66)  0.386 ms
 3  128.226.102.1 (128.226.102.1)  1.059 ms  1.045 ms  1.141 ms
 4  syr-9208-binghamton.nysernet.net (199.109.9.37)  4.023 ms  3.877 ms  3.981 ms
 5  199.109.7.94 (199.109.7.94)  5.158 ms  4.557 ms  5.123 ms
 6  buf-9208-syr-9208.nysernet.net (199.109.7.194)  7.073 ms  7.117 ms  7.097 ms
 7  I2-CLEV-buf-9208.nysernet.net (199.109.11.34)  12.005 ms  11.592 ms  11.544 ms
 8  ae-1.4079.rtsw.eqch.net.internet2.edu (162.252.70.131)  23.390 ms  21.159 ms  21.151 ms
 9  ae-2.4079.rtsw.chic.net.internet2.edu (162.252.70.132)  21.096 ms  21.028 ms  21.028 ms
10  ae-3.4079.rtsw.kans.net.internet2.edu (162.252.70.141)  32.221 ms  32.169 ms  32.073 ms
11  ae-5.4079.rtsw.salt.net.internet2.edu (162.252.70.145)  53.440 ms  53.423 ms  53.378 ms
12  ae-1.4079.rtsw.losa.net.internet2.edu (162.252.70.114)  63.815 ms  63.957 ms  63.869 ms
13  137.164.26.200 (137.164.26.200)  63.849 ms  63.811 ms  63.746 ms
14  * * *
15  bdl1f1.anderson--cr00f2.csbl.ucla.net (169.232.4.4)  64.681 ms  64.566 ms bdl1f1.anderson--cr001.anderson.ucla.net (169.232.4.6)  64.424 ms
16  cr00f1.anderson--sr02fb.jsei.ucla.net (169.232.8.53)  64.319 ms  64.625 ms  64.644 ms
17  128.97.27.37 (128.97.27.37)  66.462 ms !X  66.371 ms !X  64.575 ms !X
```

```
jwang138@remote00:~$ traceroute ucla.edu
traceroute to ucla.edu (128.97.27.37), 30 hops max, 60 byte packets
 1  128.226.180.161 (128.226.180.161)  0.436 ms  0.555 ms  0.526 ms
 2  128.226.3.64 (128.226.3.64)  0.318 ms  0.286 ms  0.429 ms
 3  128.226.102.1 (128.226.102.1)  1.185 ms  1.139 ms  1.095 ms
 4  syr-9208-binghamton.nysernet.net (199.109.9.37)  3.941 ms  3.944 ms  3.917 ms
 5  199.109.7.94 (199.109.7.94)  4.599 ms  4.580 ms  4.998 ms
 6  buf-9208-syr-9208.nysernet.net (199.109.7.194)  7.095 ms  7.947 ms  7.889 ms
 7  I2-CLEV-buf-9208.nysernet.net (199.109.11.34)  12.039 ms  12.052 ms  11.991 ms
 8  ae-1.4079.rtsw.eqch.net.internet2.edu (162.252.70.131)  20.795 ms  20.601 ms  20.593 ms
 9  ae-2.4079.rtsw.chic.net.internet2.edu (162.252.70.132)  21.462 ms  21.299 ms  21.237 ms
10  ae-3.4079.rtsw.kans.net.internet2.edu (162.252.70.141)  32.234 ms  32.592 ms  32.517 ms
11  ae-5.4079.rtsw.salt.net.internet2.edu (162.252.70.145)  53.249 ms  53.112 ms  51.709 ms
12  ae-1.4079.rtsw.losa.net.internet2.edu (162.252.70.114)  63.966 ms  63.948 ms  63.931 ms
13  137.164.26.200 (137.164.26.200)  63.917 ms  63.964 ms  64.409 ms
14  * * *
15  bdl1f1.anderson--cr00f2.csbl.ucla.net (169.232.4.4)  64.746 ms bdl1f1.anderson--cr001.anderson.ucla.net (169.232.4.6)  74.345 ms  72.609 ms
16  cr00f1.anderson--sr02fb.jsei.ucla.net (169.232.8.53)  65.046 ms cr00f2.csbl--sr02f2.csbl.ucla.net (169.232.8.7)  64.744 ms  64.657 ms
17  128.97.27.37 (128.97.27.37)  64.475 ms !X  64.535 ms !X  64.288 ms !X
```

```
jwang138@remote00:~/Documents/cs471/HW/jwang138_hw11$ traceroute ucla.edu
traceroute to ucla.edu (128.97.27.37), 30 hops max, 60 byte packets
 1  128.226.180.161 (128.226.180.161)  0.323 ms  0.613 ms  0.593 ms
 2  128.226.3.64 (128.226.3.64)  0.358 ms  0.341 ms  0.325 ms
 3  128.226.102.1 (128.226.102.1)  1.191 ms  1.162 ms  1.045 ms
 4  syr-9208-binghamton.nysernet.net (199.109.9.37)  5.489 ms  5.502 ms  5.430 ms
 5  199.109.7.94 (199.109.7.94)  6.207 ms  6.175 ms  10.237 ms
 6  buf-9208-syr-9208.nysernet.net (199.109.7.194)  10.227 ms  8.522 ms  8.938 ms
 7  I2-CLEV-buf-9208.nysernet.net (199.109.11.34)  14.008 ms  13.965 ms  13.957 ms
 8  ae-1.4079.rtsw.eqch.net.internet2.edu (162.252.70.131)  24.139 ms  24.128 ms  24.096 ms
 9  ae-2.4079.rtsw.chic.net.internet2.edu (162.252.70.132)  23.910 ms  21.686 ms  21.537 ms
10  ae-3.4079.rtsw.kans.net.internet2.edu (162.252.70.141)  32.697 ms  32.649 ms  32.578 ms
11  ae-5.4079.rtsw.salt.net.internet2.edu (162.252.70.145)  58.921 ms  58.861 ms  52.066 ms
12  ae-1.4079.rtsw.losa.net.internet2.edu (162.252.70.114)  69.039 ms  68.935 ms  68.897 ms
13  137.164.26.200 (137.164.26.200)  64.077 ms  63.949 ms  63.928 ms
14  * * *
15  bdl1f1.anderson--cr00f2.csbl.ucla.net (169.232.4.4)  64.585 ms  64.573 ms  64.515 ms
16  cr00f2.csbl--sr02f2.csbl.ucla.net (169.232.8.7)  65.362 ms  65.322 ms  65.415 ms
17  128.97.27.37 (128.97.27.37)  64.313 ms !X  64.364 ms !X  64.321 ms !X
```

Cambridge University (cam.ac.uk)

```
jwang138@remote05:~/Documents/cs471/HW/jwang138_hw10$ traceroute cam.ac.uk
traceroute to cam.ac.uk (131.111.150.25), 30 hops max, 60 byte packets
 1  128.226.180.161 (128.226.180.161)  0.456 ms  0.470 ms  0.450 ms
 2  128.226.3.64 (128.226.3.64)  0.252 ms 128.226.3.66 (128.226.3.66)  0.355 ms 128.226.3.64 (128.226.3.64)  0.338 ms
 3  128.226.102.1 (128.226.102.1)  1.036 ms  1.008 ms  0.950 ms
 4  syr-9208-binghamton.nysernet.net (199.109.9.37)  5.440 ms  5.442 ms  5.365 ms
 5  199.109.7.94 (199.109.7.94)  6.920 ms  6.877 ms  6.836 ms
 6  nyc-9208-syr-9208.nysernet.net (199.109.7.162)  11.310 ms  11.057 ms  11.005 ms
 7  I2-NEWY-nyc-9208.nysernet.net (199.109.5.2)  10.052 ms  10.058 ms  10.004 ms
 8  internet2.mx1.ams.nl.geant.net (62.40.124.46)  100.514 ms  100.493 ms  100.382 ms
 9  ae2.mx1.lon.uk.geant.net (62.40.98.80)  94.295 ms  94.144 ms  94.094 ms
10  janet-gw.mx1.lon.uk.geant.net (62.40.124.198)  94.041 ms  93.737 ms  93.642 ms
11  ae28.lowdss-sbr1.ja.net (146.97.33.18)  96.913 ms  96.862 ms  96.832 ms
12  146.97.38.10 (146.97.38.10)  98.317 ms  102.227 ms  99.724 ms
13  146.97.65.106 (146.97.65.106)  101.204 ms  99.397 ms  99.298 ms
14  University-of-Cambridge.cambab-rbr1.eastern.ja.net (146.97.130.2)  99.509 ms  99.533 ms  99.616 ms
15  d-dw.s-dw.net.cam.ac.uk (193.60.88.2)  100.429 ms  100.805 ms  101.511 ms
16  d-dw.s-dw.net.cam.ac.uk (193.60.88.2)  100.774 ms  100.792 ms  100.843 ms
17  outside.fw-srv.net.cam.ac.uk (128.232.128.6)  99.781 ms  99.677 ms  99.693 ms
18  link-srv.uis.fw-srv.net.cam.ac.uk (128.232.129.2)  99.661 ms  99.625 ms  104.267 ms
19  primary.admin.cam.ac.uk (131.111.150.25)  99.914 ms  99.892 ms  100.322 ms
```

```
jwang138@remote00:~$ traceroute cam.ac.uk
traceroute to cam.ac.uk (131.111.150.25), 30 hops max, 60 byte packets
 1  128.226.180.161 (128.226.180.161)  0.405 ms  0.398 ms  0.451 ms
 2  128.226.3.64 (128.226.3.64)  0.192 ms 128.226.3.66 (128.226.3.66)  0.344 ms  0.295 ms
 3  128.226.102.1 (128.226.102.1)  0.964 ms  0.892 ms  0.825 ms
 4  syr-9208-binghamton.nysernet.net (199.109.9.37)  3.756 ms  3.894 ms  3.863 ms
 5  199.109.7.94 (199.109.7.94)  4.610 ms  5.142 ms  5.189 ms
 6  nyc-9208-syr-9208.nysernet.net (199.109.7.162)  10.119 ms  10.034 ms  9.966 ms
 7  I2-NEWY-nyc-9208.nysernet.net (199.109.5.2)  9.821 ms  9.783 ms  9.692 ms
 8  internet2.mx1.ams.nl.geant.net (62.40.124.46)  100.183 ms  100.486 ms  100.331 ms
 9  ae2.mx1.lon.uk.geant.net (62.40.98.80)  93.985 ms  93.862 ms  93.812 ms
10  janet-gw.mx1.lon.uk.geant.net (62.40.124.198)  93.730 ms  94.036 ms  93.943 ms
11  ae28.lowdss-sbr1.ja.net (146.97.33.18)  97.212 ms  97.558 ms  96.865 ms
12  * * *
13  146.97.65.106 (146.97.65.106)  99.270 ms  99.552 ms  99.438 ms
14  University-of-Cambridge.cambab-rbr1.eastern.ja.net (146.97.130.2)  249.628 ms  249.590 ms  249.471 ms
15  d-dw.s-dw.net.cam.ac.uk (193.60.88.2)  100.830 ms  103.079 ms  102.460 ms
16  d-dw.s-dw.net.cam.ac.uk (193.60.88.2)  101.766 ms  101.858 ms  101.922 ms
17  outside.fw-srv.net.cam.ac.uk (128.232.128.6)  102.459 ms  100.318 ms  100.044 ms
18  link-srv.uis.fw-srv.net.cam.ac.uk (128.232.129.2)  99.977 ms  100.741 ms  100.450 ms
19  primary.admin.cam.ac.uk (131.111.150.25)  100.598 ms  101.053 ms  100.028 ms
```

```
jwang138@remote00:~/Documents/cs471/HW/jwang138_hw11$
jwang138@remote00:~/Documents/cs471/HW/jwang138_hw11$ traceroute cam.ac.uk
traceroute to cam.ac.uk (131.111.150.25), 30 hops max, 60 byte packets
 1  128.226.180.161 (128.226.180.161)  0.799 ms  0.887 ms  0.948 ms
 2  128.226.3.64 (128.226.3.64)  0.338 ms  0.288 ms 128.226.3.66 (128.226.3.66)  0.255 ms
 3  128.226.102.1 (128.226.102.1)  1.122 ms  1.100 ms  1.075 ms
 4  syr-9208-binghamton.nysernet.net (199.109.9.37)  4.029 ms  3.972 ms  3.977 ms
 5  199.109.7.94 (199.109.7.94)  4.329 ms  4.735 ms  4.716 ms
 6  nyc-9208-syr-9208.nysernet.net (199.109.7.162)  9.601 ms  9.937 ms  9.568 ms
 7  I2-NEWY-nyc-9208.nysernet.net (199.109.5.2)  9.817 ms  9.680 ms  9.651 ms
 8  internet2.mx1.ams.nl.geant.net (62.40.124.46)  100.519 ms  100.486 ms  100.482 ms
 9  ae2.mx1.lon.uk.geant.net (62.40.98.80)  93.657 ms  93.872 ms  93.797 ms
10  janet-gw.mx1.lon.uk.geant.net (62.40.124.198)  93.909 ms  93.885 ms  93.743 ms
11  ae28.lowdss-sbr1.ja.net (146.97.33.18)  97.657 ms  97.545 ms  97.501 ms
12  146.97.38.10 (146.97.38.10)  98.189 ms  98.512 ms  99.297 ms
13  146.97.65.106 (146.97.65.106)  99.373 ms  99.436 ms  99.223 ms
14  University-of-Cambridge.cambab-rbr1.eastern.ja.net (146.97.130.2)  99.425 ms  99.742 ms  99.798 ms
15  d-dw.s-dw.net.cam.ac.uk (193.60.88.2)  100.705 ms  100.702 ms  100.833 ms
16  d-dw.s-dw.net.cam.ac.uk (193.60.88.2)  100.013 ms  100.040 ms  100.835 ms
17  * outside.fw-srv.net.cam.ac.uk (128.232.128.6)  103.037 ms  99.880 ms
18  link-srv.uis.fw-srv.net.cam.ac.uk (128.232.129.2)  99.850 ms  99.755 ms  99.691 ms
19  primary.admin.cam.ac.uk (131.111.150.25)  99.722 ms  100.040 ms  100.153 ms
```

(a)

UCLA

Day 1

Hops				
1	0.389	0.378	0.433	
2	0.26	0.403	0.386	
3	1.059	1.045	1.141	
4	4.023	3.877	3.981	
5	5.158	4.557	5.123	
6	7.073	7.117	7.097	
7	12.005	11.592	11.544	
8	23.39	21.159	21.151	
9	21.096	21.028	21.028	
10	32.221	32.169	32.073	
11	53.44	53.423	53.378	
12	63.815	63.957	63.869	
13	63.849	63.811	63.746	
15	64.681	64.556	64.424	
16	64.319	64.625	64.644	
17	66.462	66.371	64.575	
Std Dev				26.72886
Average	30.2025	30.00425	29.91206	30.0396

Day 2

Hops				
1	0.436	0.555	0.526	
2	0.318	0.286	0.429	
3	1.185	1.139	1.095	
4	3.941	3.944	3.917	
5	4.599	4.58	4.998	
6	7.095	7.947	7.889	
7	12.039	12.052	11.991	
8	20.795	20.601	20.593	
9	21.462	21.299	21.237	
10	32.234	32.592	32.517	
11	53.249	53.112	51.709	
12	63.966	63.948	63.931	
13	63.917	63.964	64.409	
14	64.746	74.345	72.609	
15	65.046	64.744	64.657	
16	64.475	64.535	64.288	
Std Dev				27.42273
Average				30.3321

Day 3

Hops				
1	0.323	0.613	0.593	
2	0.358	0.341	0.325	
3	1.191	1.162	1.04	
4	5.489	5.502	5.43	
5	6.207	6.175	10.237	
6	10.227	8.522	8.938	
7	14.008	13.965	13.957	
8	24.139	24.128	24.096	
9	23.91	21.686	21.537	
10	32.697	32.649	32.578	
11	58.921	58.861	52.066	
12	69.039	68.935	68.897	
13	64.077	63.949	63.928	
14	64.585	64.573	64.515	
15	65.362	65.322	65.415	
16	64.313	64.364	64.321	
Std Dev				27.05678
Average				31.32221

(b) The path changed on the 15th hop on the 3rd day. There were 16 routers in the path.

(c) The packets pass through 6 ISP networks. The largest delays occur at the peering interfaces between adjacent ISPs.

(d)

Cambridge					Average				64.35791
Day 1									
Hops					Day 2				
1	0.456	0.47	0.45		1	0.405	0.398	0.451	
2	0.252	0.355	0.338		2	0.192	0.344	0.295	
3	1.036	1.008	0.95		3	0.964	0.892	0.825	
4	5.44	5.442	5.365		4	3.756	3.894	3.863	
5	6.92	6.877	6.836		5	4.61	5.142	5.189	
6	11.31	11.057	11.005		6	10.119	10.034	9.966	
7	10.052	10.058	10.004		7	9.821	9.783	9.692	
8	100.514	100.493	100.382		8	100.183	100.486	100.331	
9	94.295	94.144	94.094		9	93.985	93.862	93.812	
10	94.041	93.737	93.642		10	93.73	94.036	93.943	
11	96.913	96.862	96.832		11	97.212	97.558	96.865	
12	98.317	102.227	99.724		12	99.27	99.552	99.438	
13	101.204	99.397	99.298		13	249.628	249.59	249.471	
14	99.509	99.533	99.616		14	100.83	103.079	102.46	
15	100.429	100.805	101.511		15	101.766	101.858	101.922	
16	100.774	100.792	100.843		16	102.459	100.318	100.044	
17	99.781	99.677	99.693		17	99.977	100.741	100.45	
18	99.661	99.625	104.267		18	100.598	101.053	100.028	
19	99.914	99.852	100.322						
Std Dev			45.83402		Std Dev				63.42824
Average			64.35791		Average				70.57722

Day 3				
Hops				
1	0.799	0.887	0.948	
2	0.338	0.288	0.255	
3	1.122	1.1	1.075	
4	4.029	3.972	3.977	
5	4.329	4.735	4.716	
6	9.601	9.937	9.568	
7	9.817	9.68	9.651	
8	100.519	100.486	100.482	
9	93.657	93.872	93.797	
10	93.909	93.885	93.743	
11	97.657	97.545	97.501	
12	98.189	98.512	99.297	
13	99.373	99.436	99.223	
14	99.425	99.742	99.798	
15	100.705	100.702	100.833	
16	100.013	100.04	100.835	
17	103.037	99.88	99.88	
18	99.85	99.755	99.691	
19	99.722	100.04	100.153	
Std Dev				46.05333
Average				63.96505

There are 19 routers in the path to cam.ac.uk.
The path didn't change in the 3 days.
There were 7 ISPs