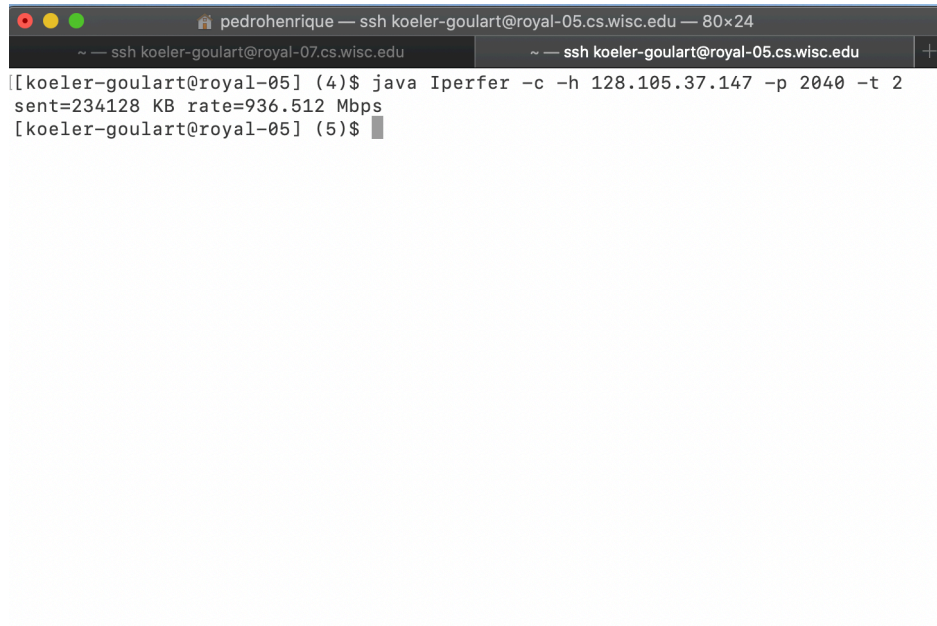


Part 1 - Iperf on Wired Environment

- Client (royal-05): (java Iperf -c -h 128.105.37.147 -p 2040 -t 2)



```
pedrohenrique — ssh koeler-goulart@royal-05.cs.wisc.edu — 80x24
~ — ssh koeler-goulart@royal-07.cs.wisc.edu  ~ — ssh koeler-goulart@royal-05.cs.wisc.edu +
[[koeler-goulart@royal-05] (4)$ java Iperf -c -h 128.105.37.147 -p 2040 -t 2 ]
sent=234128 KB rate=936.512 Mbps
[koeler-goulart@royal-05] (5)$
```

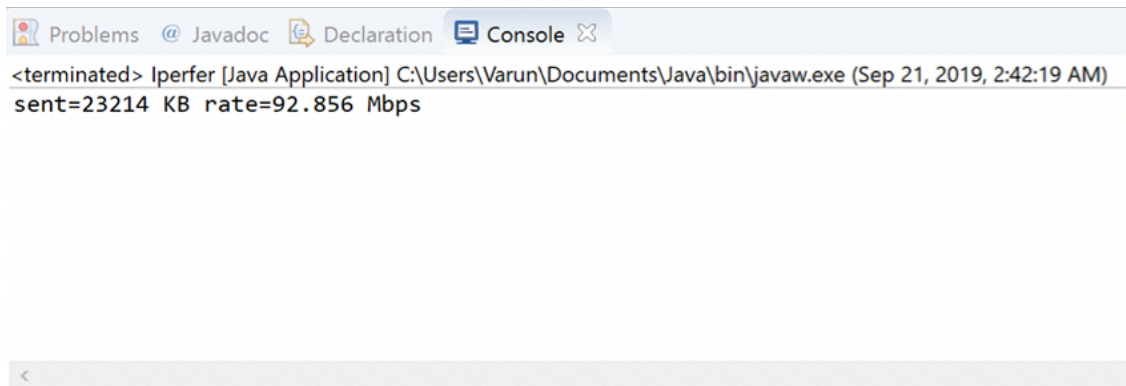
- Server (royal-07): (java Iperf -s -p 2040)



```
pedrohenrique — ssh koeler-goulart@royal-07.cs.wisc.edu — 80x24
~ — ssh koeler-goulart@royal-07.cs.wisc.edu  ~ — ssh koeler-goulart@royal-05.cs.wisc.edu +
[[koeler-goulart@royal-07] (5)$ java Iperf -s -p 2040 ]
received=234128 KB rate=928.159 Mbps
[koeler-goulart@royal-07] (6)$
```

Part 1 - Wireless Environment

- We expect the greater throughput to be on the wired environment.
- Client (Varun): (java Iperfer -c -h 10.141.176.227 -p 2040 -t 2)



```
<terminated> Iperfer [Java Application] C:\Users\Varun\Documents\Java\bin\javaw.exe (Sep 21, 2019, 2:42:19 AM)
sent=23214 KB rate=92.856 Mbps
```

- Server (Pedro): (java Iperfer -s -p 2040)



```
<terminated> Iperfer [Java Application] /Library/Java/JavaVirtualMachines/jdk1.8.0_111.jdk/Contents/Home/bin/java (Sep 21, 2019, 2:41:48 AM)
received=23214 KB rate=88.645 Mbps
|
```

- As expected, the wireless environment had a lower throughput than the wired environment. The wired environment had throughput more than 10 times that of the wireless. This is because wireless signals attenuate fast and are usually shorter in range, moreover, the error rates are higher and the nodes are scarce in energy. All those factors contribute to a lower rate.

Part 3 – Q2

- Our expected average latency would be a sum of L1, L2, and L3, so 140.972 ms. Our expected throughput would be the lowest of the three Ls (L3), so around 20Mbps.
 - $\text{rtt min/avg/max/mdev} = 140.157/140.589/146.247/1.206 \text{ ms}$
 - H1: sent=80352 KB rate=18.744 Mbps
 - H4: received=80352 KB rate=18.083 Mbps
- Our predictions were, therefore, correct. The rate is slightly lower than what is expected. This could be down reasons such as latency added by switches.

Part 3 – Q3

- Our expected average latency would be the same as Q2, so about 140 ms, since propagation (distance) is not affected. Our expected throughput rate would be half of what we got for Q2 for each of the connections, so around 10 Mbps for each, since they need to share the network.
- Pair h1-h10:
 - $\text{rtt min/avg/max/mdev} = 140.227/140.618/145.521/0.992 \text{ ms}$
 - H1: sent=44567 KB rate=11.533 Mbps
 - H10: received=44567 KB rate=9.910 Mbps
- Pair h8-h4:
 - $\text{rtt min/avg/max/mdev} = 140.174/140.362/141.203/0.366 \text{ ms}$
 - H8: sent=40265 KB rate=10.471 Mbps
 - H4: received=40265 KB rate=9.042 Mbps
- Our predictions were almost correct, it seemed that h1-h10 had an advantage over the other connection, but the sum of their rates is still about the rate that was verified for Q2 (single h1-h4 connection).
- Our expected average latency would, again, be the same as Q2, so about 140 ms. Our expected throughput rate would be 1/3 of what we got for Q2 for each of the connections, so around 7.5 Mbps for each.
- Pair h1-h10:
 - $\text{rtt min/avg/max/mdev} = 140.148/140.599/146.236/1.131 \text{ m}$
 - H1: sent=51017 KB rate=12.853 Mbps
 - H10: received=51017 KB rate=12.329 Mbps
- Pair h8-h4:
 - $\text{rtt min/avg/max/mdev} = 140.190/140.630/147.196/1.328 \text{ ms}$
 - H8: sent=21320 KB rate=5.487 Mbps
 - H4: received=21320 KB rate=5.039 Mbps
- Pair h7-h9:
 - $\text{rtt min/avg/max/mdev} = 140.177/140.608/146.069/1.177 \text{ ms}$
 - H7: sent=7967 KB rate=2.059 Mbps
 - H9: received=7967 KB rate=1.947 Mbps
- Our predictions were off by a larger amount than previously, and it seemed that h1-h10 had a priority over the other connections, possibly because it was the first one to be started (by about half a second). The sum of their rates, however, is still about the rate that was verified for Q2 (single h1-h4 connection).

Part 3 – Q4

- Our expected average latency would be the sum of the Ls for each connection (so L1, L2, L3 for h1-h4, and L4, L2, L5 for h5-h6), they would be, respectively, 140.972 ms and 81.092 ms. Our expected throughput rate would be similar to Q2, since the connections are not using the servers at the same time, so we would assume the lowest rates amongst Ls would be the expected throughput rate. Therefore, our expected throughput rate would be around 18.5 Mbps for h1-h4 and around 30.8 Mbps for h5-h6.
- Pair h1-h4:
 - $\text{rtt min/avg/max/mdev} = 140.145/140.677/147.676/1.382 \text{ ms}$
 - H1: sent=80495 KB rate=18.534 Mbps
 - H4: received=80495 KB rate=18.081 Mbps
- Pair h5-h6:
 - $\text{rtt min/avg/max/mdev} = 80.180/80.684/88.750/1.590 \text{ ms}$
 - H5: sent=114873 KB rate=29.605 Mbps
 - H6: received=114873 KB rate=26.786 Mbps
- As expected, the average latency rate was the sums of Ls. For the throughput, we again had a similar estimate for the value.