3a)

Capture

...using this filter: host 34.193.77.105 and dst port 1080

Capture Filter used for wireshark, dst port is changed for generating the necessary files(1080, 1081 and 1082)

```
Request: b'GET / HTTP/1.1\r\nHost: www.sbunetsyslabs.com:1080\r\nConnection: keep-ali
Request Tuple: 9745,1080,526948985,3076023356
Response Tuples:
1080,9745,3076023356,526949424
```

```
Request: b'GET /img/apple.jpeg HTTP/1.1\r\nHost: www.sbunetsyslabs.com:1080\r\nCo
Request Tuple: 7396,1080,107874422,3492923678
Response Tuples:
1080,7396,3492923678,107874819
1080,7396,3492925064,107874819
1080,7396,3492926450,107874819
1080,7396,3492927836,107874819
```

```
Request: b'GET /img/orange.jpeg HTTP/1.1\r\nHost: www.sbunetsyslabs.com:1080\r\nC
Request Tuple: 14710,1080,339963888,1845826783
Response Tuples:
1080,14710,1845826783,339964286
1080,14710,1845828169,339964286
1080,14710,1845829555,339964286
1080,14710,1845830941,339964286
1080,14710,1845832327,339964286
1080,14710,1845833713,339964286
```

```
Request: b'GET /js/hello.js HTTP/1.1\r\nHost: www.sbunetsyslabs.com:1080\r\nConnec
Request Tuple: 2226,1080,4002752586,934975457
Response Tuples:
1080,2226,934975457,4002752919
```

```
Request: b'GET /img/banana.jpeg HTTP/1.1\r\nHost: www.sbunetsyslabs.com:1080\r\nCon
Request Tuple: 5798,1080,1183601180,2642730218
Response Tuples:
1080,5798,2642730218,1183601578
1080,5798,2642731604,1183601578
1080,5798,2642732990,1183601578
```

Trimming a few response tuples, please the run the program for verifying all the tuples

```
Request: b'GET /img/watermelon.jpeg HTTP/1.1\r\nHost: www.sbunetsyslabs.com:1080\r\
Request Tuple: 5606,1080,1653734850,3204558325
Response Tuples:
1080,5606,3204558325,1653735252
1080,5606,3204559711,1653735252
1080,5606,3204561097,1653735252
1080,5606,3204562483,1653735252
1080,5606,3204563869,1653735252
1080,5606,3204565255,1653735252
1080,5606,3204566641,1653735252
1080,5606,3204568027,1653735252
1080,5606,3204569413,1653735252
1080,5606,3204570799,1653735252
1080,5606,3204572185,1653735252
1080,5606,3204573571,1653735252
1080,5606,3204574957,1653735252
1080,5606,3204576343,1653735252
```

```
Request: b'GET /img/cantaloupe-melon.jpeg HTTP/1.1\r\nHost: www.sbunetsyslabs.co
Request Tuple: 12313,1080,1608604278,3797171998
Response Tuples:
1080,12313,3797171998,1608604686
1080,12313,3797173384,1608604686
1080,12313,3797174770,1608604686
1080,12313,3797176156,1608604686
1080,12313,3797177542,1608604686
```

Trimming

```
Request: b'GET /img/honeydew-melon.jpeg HTTP/1.1\r\nHost: www.sbunetsyslabs.com
Request Tuple: 3881,1080,2983751617,830188821
Response Tuples:
1080,3881,830188821,2983752023
1080,3881,830190207,2983752023
1080,3881,830191593,2983752023
1080,3881,830192979,2983752023
1080,3881,830194365,2983752023
1080,3881,830195751,2983752023
1080,3881,830197137,2983752023
1080,3881,830198523,2983752023
1080,3881,830199909,2983752023
1080,3881,830201295,2983752023
1080,3881,830202681,2983752023
1080,3881,830204067,2983752023
1080,3881,830205453,2983752023
1080,3881,830206839,2983752023
```

Trimming

```
Request: b'GET /img/pomegranate.jpeg HTTP/1.1\r\nHost: www.sbunetsyslabs.com:108
Request Tuple: 6345,1080,123998183,2260521726
Response Tuples:
1080,6345,2260521726,123998586
1080,6345,2260523112,123998586
1080,6345,2260524498,123998586
1080,6345,2260525884,123998586
1080,6345,2260527270,123998586
1080,6345,2260528656,123998586
1080,6345,2260530042,123998586
1080,6345,2260531428,123998586
1080,6345,2260532814,123998586
1080,6345,2260534200,123998586
1080,6345,2260535586,123998586
1080,6345,2260536972,123998586
1080,6345,2260538358,123998586
1080,6345,2260539744,123998586
1080,6345,2260541130,123998586
```

```
Request: b'GET /img/raspberry.jpeg HTTP/1.1\r\nHost: www.sbunetsyslabs.com:1080\
Request Tuple: 14422,1080,1185127528,2279501224
Response Tuples:
1080,14422,2279501224,1185127929
1080,14422,2279502610,1185127929
1080,14422,2279503996,1185127929
1080,14422,2279505382,1185127929
1080,14422,2279506768,1185127929
```

```
Request: b'GET /img/raspberrypi.jpeg HTTP/1.1\r\nHost: www.sbunetsyslabs.com:1080
Request Tuple: 11813,1080,2846229924,2491044182
Response Tuples:
1080,11813,2491044182,2846230327
1080,11813,2491045568,2846230327
1080,11813,2491046954,2846230327
1080,11813,2491048340,2846230327
1080,11813,2491049726,2846230327
1080,11813,2491051112,2846230327
```

Trimming

```
Request: b'GET /img/blueberry.jpeg HTTP/1.1\r\nHost: www.sbunetsyslabs.com:1080\r
Request Tuple: 4257,1080,4130993279,2841906458
Response Tuples:
1080,4257,2841906458,4130993680
1080,4257,2841907844,4130993680
1080,4257,2841909230,4130993680
1080,4257,2841910616,4130993680
1080,4257,2841912002,4130993680
1080,4257,2841913388,4130993680
1080,4257,2841914774,4130993680
1080,4257,2841916160,4130993680
1080,4257,2841917546,4130993680
1080,4257,2841918932,4130993680
```

Trimming

```
Request: b'GET /img/strawberry.jpeg HTTP/1.1\r\nHost: www.sbunetsyslabs.com:1080\r'
Request Tuple: 7511,1080,317277024,4197830624
Response Tuples:
1080,7511,4197830624,317277426
1080,7511,4197832010,317277426
1080,7511,4197833396,317277426
1080,7511,4197834782,317277426
1080,7511,4197836168,317277426
1080,7511,4197837554,317277426
1080,7511,4197838940,317277426
1080,7511,4197840326,317277426
1080,7511,4197841712,317277426
1080,7511,4197843098,317277426
1080,7511,4197844484,317277426
1080,7511,4197845870,317277426
1080,7511,4197847256,317277426
```

Trimming

```
Request: b'GET /img/dragonfruit.jpeg HTTP/1.1\r\nHost: www.sbunetsyslabs.com:1080
Request Tuple: 5293,1080,1335441354,400620700
Response Tuples:
1080,5293,400620700,1335441757
1080,5293,400622086,1335441757
1080,5293,400623472,1335441757
1080,5293,400624858,1335441757
1080,5293,400626244,1335441757
1080,5293,400627630,1335441757
1080,5293,400629016,1335441757
1080,5293,400630402,1335441757
1080,5293,400631788,1335441757
1080,5293,400633174,1335441757
1080,5293,400634560,1335441757
```

Trimming

```
Request: b'GET /img/starfruit.jpeg HTTP/1.1\r\nHost: www.sbunetsyslabs.com:1080\r
Request Tuple: 3375,1080,3089110158,3333927766
Response Tuples:
1080,3375,3333927766,3089110559
1080,3375,3333929152,3089110559
1080,3375,3333930538,3089110559
1080,3375,3333931924,3089110559
1080,3375,3333933310,3089110559
1080,3375,3333934696,3089110559
1080,3375,3333936082,3089110559
1080,3375,3333937468,3089110559
1080,3375,3333938854,3089110559
1080,3375,3333940240,3089110559
1080,3375,3333941626,3089110559
1080,3375,3333943012,3089110559
1080,3375,3333944398,3089110559
1080,3375,3333945784,3089110559
1080,3375,3333947170,3089110559
1080,3375,3333948556,3089110559
```

```
Request: b'GET /img/grapes.jpeg HTTP/1.1\r\nHost: www.sbunetsyslabs.com:1080\r\nCo
Request Tuple: 12128,1080,3178957132,3751954418
Response Tuples:
1080,12128,3751954418,3178957530
1080,12128,3751955804,3178957530
1080,12128,3751957190,3178957530
1080,12128,3751958576,3178957530
```

Trimming

```
Request: b'GET /img/tomato.jpeg HTTP/1.1\r\nHost: www.sbunetsyslabs.com:1080\r\nCo
Request Tuple: 9747,1080,1860406171,1884868565
Response Tuples:
1080,9747,1884868565,1860406569
1080,9747,1884869951,1860406569
1080,9747,1884871337,1860406569
1080,9747,1884872723,1860406569
1080,9747,1884874109,1860406569
1080,9747,1884875495,1860406569
1080,9747,1884876881,1860406569
1080,9747,1884878267,1860406569
1080,9747,1884879653,1860406569
1080,9747,1884881039,1860406569
1080,9747,1884882425,1860406569
1080,9747,1884883811,1860406569
1080,9747,1884885197,1860406569
1080,9747,1884886583,1860406569
1080,9747,1884887969,1860406569
1080,9747,1884889355,1860406569
```

3b)

Check the number of flows in captured pcap file (tcp_1081.pcap and tcp_1082.pcap)

If the number of flows is more then one, we can conclude that it is HTTP 1.1, as it can create parallel connections. If the number of Flows is only one, then we can conclude it as HTTP 2.0

```
Number of Flows: 6
tcp_1081.pcap--This Connection is HTTP 1.1
Number of Flows: 1
tcp_1082.pacp--This Connection is HTTP 2.0
```

3c)

```
Under HTTP 1.0
load time: 1.4895548820495605
Total Packets: 1607
Total Bytes: 2138624
Under HTTP 1.1
load time: 5.361763954162598
Total Packets: 1595
Total Bytes: 2149346
Under HTTP 2.0
load time: 5.362007141113281
Total Packets: 1589
Total Bytes: 2176563
```

Every time I generate these files (http_1080, tcp_1081 and tcp_1082), there is considerable amount of variation in the above calculated parameters. (Sometimes it less than 1 sec, sometimes it is coming around 5 sec as shown)

Ideally HTTP 1.0 should be slow, as it closes the TCP connection for every request, so there would be many flows which happen in serial, which will increase the load time.

In HTTP 1.1 and HTTP 2.0, there is TSL handshake, which will also consume additional time, but given that connections are parallel in HTTP 1.1 and there is only one connection in HTTP 2.0, this time should not matter heavily.

As we are dealing with considerably a smaller number of packets in this website when compared to normal sites which we use daily, I think this variation reduces as we deal with larger number of packets and the benefits of HTTP 1.1 and HTTP 2.0 are more visible in similar scenarios(high number of packets)