

Задание 1

1, 2. Мой компьютер: IP-адрес 10.0.0.100, порт для всех операций передачи и приема TCP-сегментов - 56381.

Сервер gaia.cs.umass.edu: IP-адрес 128.119.245.12, порт 80

ip.addr == 128.119.245.12						
No.	Time	Source	Destination	Protocol	Length	Info
640	2022-04-02 08:54:16,442338	10.0.0.100	128.119.245.12	TCP	54	56381 → 80 [ACK] Seq=135913 Ack=1 Win=131840 Len=0 [TCP segment of a reassembled PDU]
641	2022-04-02 08:54:16,442449	128.119.245.12	10.0.0.100	TCP	54	80 → 56381 [ACK] Seq=1 Ack=63833 Win=165888 Len=0
642	2022-04-02 08:54:16,442480	10.0.0.100	128.119.245.12	TCP	54	56381 → 80 [ACK] Seq=137273 Ack=1 Win=131840 Len=0 [TCP segment of a reassembled PDU]
643	2022-04-02 08:54:16,442480	10.0.0.100	128.119.245.12	TCP	54	56381 → 80 [ACK] Seq=138633 Ack=1 Win=131840 Len=0 [TCP segment of a reassembled PDU]
644	2022-04-02 08:54:16,442543	128.119.245.12	10.0.0.100	TCP	54	80 → 56381 [ACK] Seq=1 Ack=65193 Win=168832 Len=0
645	2022-04-02 08:54:16,442569	10.0.0.100	128.119.245.12	TCP	54	56381 → 80 [ACK] Seq=139993 Ack=1 Win=131840 Len=0 [TCP segment of a reassembled PDU]
646	2022-04-02 08:54:16,442569	10.0.0.100	128.119.245.12	TCP	54	56381 → 80 [ACK] Seq=141353 Ack=1 Win=131840 Len=0 [TCP segment of a reassembled PDU]
647	2022-04-02 08:54:16,442642	128.119.245.12	10.0.0.100	TCP	54	80 → 56381 [ACK] Seq=1 Ack=66553 Win=171776 Len=0
648	2022-04-02 08:54:16,442670	10.0.0.100	128.119.245.12	TCP	54	56381 → 80 [ACK] Seq=142713 Ack=1 Win=131840 Len=0 [TCP segment of a reassembled PDU]
649	2022-04-02 08:54:16,442670	10.0.0.100	128.119.245.12	TCP	54	56381 → 80 [ACK] Seq=144073 Ack=1 Win=131840 Len=0 [TCP segment of a reassembled PDU]
650	2022-04-02 08:54:16,442733	128.119.245.12	10.0.0.100	TCP	54	80 → 56381 [ACK] Seq=1 Ack=67913 Win=174720 Len=0
651	2022-04-02 08:54:16,442758	10.0.0.100	128.119.245.12	TCP	54	56381 → 80 [ACK] Seq=145433 Ack=1 Win=131840 Len=0 [TCP segment of a reassembled PDU]
652	2022-04-02 08:54:16,442758	10.0.0.100	128.119.245.12	TCP	54	56381 → 80 [PSH, ACK] Seq=146793 Ack=1 Win=131840 Len=0 [TCP segment of a reassembled PDU]
653	2022-04-02 08:54:16,442840	128.119.245.12	10.0.0.100	TCP	54	80 → 56381 [ACK] Seq=1 Ack=69273 Win=177664 Len=0
654	2022-04-02 08:54:16,442868	10.0.0.100	128.119.245.12	TCP	54	56381 → 80 [ACK] Seq=148153 Ack=1 Win=131840 Len=0 [TCP segment of a reassembled PDU]
655	2022-04-02 08:54:16,442868	10.0.0.100	128.119.245.12	TCP	54	56381 → 80 [ACK] Seq=149513 Ack=1 Win=131840 Len=0 [TCP segment of a reassembled PDU]
656	2022-04-02 08:54:16,442947	128.119.245.12	10.0.0.100	TCP	54	80 → 56381 [ACK] Seq=1 Ack=70633 Win=180480 Len=0
657	2022-04-02 08:54:16,442973	10.0.0.100	128.119.245.12	TCP	54	56381 → 80 [ACK] Seq=150873 Ack=1 Win=131840 Len=0 [TCP segment of a reassembled PDU]
658	2022-04-02 08:54:16,442973	10.0.0.100	128.119.245.12	HTTP	779	POST /wireshark-labs/lab3-1-reply.htm HTTP/1.1 (text/plain)
659	2022-04-02 08:54:16,443029	128.119.245.12	10.0.0.100	TCP	54	80 → 56381 [ACK] Seq=1 Ack=71993 Win=183296 Len=0
660	2022-04-02 08:54:16,443081	128.119.245.12	10.0.0.100	TCP	54	80 → 56381 [ACK] Seq=1 Ack=73353 Win=183296 Len=0

3. SYN TCP-сегмент, который используется для установления соединения имеет абсолютный порядковый номер 218987891 (относительный номер 0). То, что это именно SYN-сегмент, определяется установкой соответствующего флага SYN:

317	2022-04-02 08:54:14,589445	10.0.0.100	128.119.245.12	TCP	66	56381 → 80 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
> Frame 317: 66 bytes on wire (528 bits), 66 bytes captured (528 bits) on interface \Device\NPF-{72634749-96BF-4B16-ACBE-E152688589CC}, id 0						
> Ethernet II, Src: ac:7d:eb:a7:7d:3e (ac:7d:eb:a7:7d:3e), Dst: 00:d1:e6:e6:e6:e6 (00:d1:e6:e6:e6:e6)						
> Internet Protocol Version 4, Src: 10.0.0.100, Dst: 128.119.245.12						
Transmission Control Protocol, Src Port: 56381, Dst Port: 80, Seq: 0, Len: 0						
Source Port: 56381						
Destination Port: 80						
[Stream index: 41]						
[Conversation completeness: Incomplete, DATA (15)]						
[TCP Segment Len: 0]						
Sequence Number: 0 (relative sequence number)						
Sequence Number (raw): 218987891						
[Next Sequence Number: 1 (relative sequence number)]						
Acknowledgment Number: 0						
Acknowledgment number (raw): 0						
1000 = Header Length: 32 bytes (8)						
Flags: 0x002 (SYN)						
Window: 64240						
[Calculated window size: 64240]						
Checksum: 0x8d29 [unverified]						
[Checksum Status: Unverified]						
Urgent Pointer: 0						
Options: (12 bytes), Maximum segment size, No-Operation (NOP), Window scale, No-Operation (NOP), No-Operation (NOP), SACK permitted						
[Timestamps]						
Flags: 0x002 (SYN)						
000. = Reserved: Not set						
...0 = Nonce: Not set						
.... 0... = Congestion Window Reduced (CWR): Not set						
.... .0.. = ECN-Echo: Not set						
.... .0. = Urgent: Not set						
.... ...0 = Acknowledgment: Not set						
.... 0... = Push: Not set						
....0.. = Reset: Not set						
>1. = Syn: Set						
....0 = Fin: Not set						

4. Абсолютный порядковый номер – 1542129578 (относительный 0). В поле подтверждения хранится значение 218987892. Оно вычисляется на основе как абсолютный порядковый номер соответствующего SYN-пакета + 1, т.е.

номер следующего ожидаемого байта : SYN-пакета имел номер 218987891, $218987891 + 1 = 218987892$. То, что это именно SYNACK-сегмент, определяется установкой соответствующих флагов SYN и ACK:

```
327 2022-04-02 08:54:14,737530 128.119.245.12 10.0.0.100 TCP 66 80 → 56381 [SYN, ACK] Seq=0 Ack=1 Win=29200 Len=0 MSS=1360 SACK_PERM=1 WS=128
> Ethernet II, Src: 00:d1:e6:e6:e6:e6 (00:d1:e6:e6:e6:e6), Dst: ac:7d:eb:a7:7d:3e (ac:7d:eb:a7:7d:3e)
> Internet Protocol Version 4, Src: 128.119.245.12, Dst: 10.0.0.100
> Transmission Control Protocol, Src Port: 80, Dst Port: 56381, Seq: 0, Ack: 1, Len: 0
  Source Port: 80
  Destination Port: 56381
  [Stream index: 41]
  [Conversation completeness: Incomplete, DATA (15)]
  [TCP Segment Len: 0]
  Sequence Number: 0 (relative sequence number)
  Sequence Number (raw): 1542129578
  [Next Sequence Number: 1 (relative sequence number)]
  Acknowledgment Number: 1 (relative ack number)
  Acknowledgment number (raw): 218987892
  1000 .... = Header Length: 32 bytes (8)
  > Flags: 0x012 (SYN, ACK)
  Window: 29200
  [Calculated window size: 29200]
  Checksum: 0xb2c8 [unverified]
  [Checksum Status: Unverified]
  Urgent Pointer: 0
  > Options: (12 bytes), Maximum segment size, No-Operation (NOP), No-Operation (NOP), SACK permitted, No-Operation (NOP), Window scale
  > [Timestamps]
  > [SEQ/ACK analysis]
    [This is an ACK to the segment in frame: 317]
    [The RTT to ACK the segment was: 0.148085000 seconds]
    [RTT: 0.148161000 seconds]
0000 ac 7d eb a7 7d 3e 00 d1 e6 e6 e6 e6 00 45 30 .-.-.-.-E0
0010 00 34 00 00 40 00 2d 06 cd ac 80 77 f5 0c 0a 00 -.-.-.-w...
0020 00 64 00 50 dc 3d 5b eb 07 aa 0d 0d 7d 7d 80 12 -dP-[.-.-.-]t...
0030 72 10 b2 c8 00 00 02 04 05 50 01 01 04 02 01 03 r-----P-----
0040 03 07 ..
```

Активация Windows
Чтобы активировать Windows, перейдите в раздел "Параметры".

5. Сегмент, содержащий POST, имеет абсолютный порядковый номер 218987892 (что соответствует относительному номеру 1):

```
492 2022-04-02 08:54:15,969768 10.0.0.100 128.119.245.12 TCP 690 56381 → 80 [PSH, ACK] Seq=1 Ack=1 Win=131840 Len=636 [TCP segment of a reassembled PDU]
[Conversation completeness: Incomplete, DATA (15)]
[TCP Segment Len: 636]
Sequence Number: 1 (relative sequence number)
Sequence Number (raw): 218987892
[Next Sequence Number: 637 (relative sequence number)]
Acknowledgment Number: 1 (relative ack number)
Acknowledgment number (raw): 1542129579
0101 .... = Header Length: 20 bytes (5)
> Flags: 0x018 (PSH, ACK)
Window: 515
[Calculated window size: 131840]
[Window size scaling factor: 256]
Checksum: 0x4e75 [unverified]
[Checksum Status: Unverified]
Urgent Pointer: 0
> [Timestamps]
> [SEQ/ACK analysis]
  [RTT: 0.148161000 seconds]
  [Bytes in flight: 636]
  [Bytes sent since last PSH flag: 636]
  TCP payload (636 bytes)
  [Reassembled PDU in frame: 658]
  TCP segment data (636 bytes)
0020 f5 0c dc 3d 00 50 bd 0d 7d 7d 5b eb 07 ab 50 18 ...-P...-P-
0030 02 03 4e 75 00 00 50 4f 53 54 20 2f 77 69 72 65 ..Nu..PO ST /wire
0040 73 68 61 72 6b 2d 6c 61 62 73 2f 6c 61 62 33 2d shark-la bs/lab3-
0050 31 2d 72 65 70 6c 79 2e 68 74 6d 20 48 54 54 50 1-reply. htm HTTP
```

Активация Windows
Чтобы активировать Windows, перейдите в раздел "Параметры".

6. Порядковый номер сегмента с POST мы уже выяснили в прошлом задании. Далее за этим сегментом следуют 5 ACK-пакетов с номерами 218988528 (относительный 637), 218989888(относительный 1997), 218991248(относительный 3351), 218992608(относительный 4717), 218993968(относительный 6077). Времена отправки данных пакетов видны на скрине:

```
492 2022-04-02 08:54:15,969768 10.0.0.100 128.119.245.12 TCP 690 56381 → 80 [PSH, ACK] Seq=1 Ack=1 Win=131840 Len=636 [TCP segment of a reassembled PDU]
1414 2022-04-02 08:54:15,970133 10.0.0.100 128.119.245.12 TCP 1414 56381 → 80 [ACK] Seq=637 Ack=1 Win=131840 Len=1360 [TCP segment of a reassembled PDU]
1414 2022-04-02 08:54:15,970133 10.0.0.100 128.119.245.12 TCP 1414 56381 → 80 [ACK] Seq=1997 Ack=1 Win=131840 Len=1360 [TCP segment of a reassembled PDU]
1414 2022-04-02 08:54:15,970133 10.0.0.100 128.119.245.12 TCP 1414 56381 → 80 [ACK] Seq=3357 Ack=1 Win=131840 Len=1360 [TCP segment of a reassembled PDU]
1414 2022-04-02 08:54:15,970133 10.0.0.100 128.119.245.12 TCP 1414 56381 → 80 [ACK] Seq=4717 Ack=1 Win=131840 Len=1360 [TCP segment of a reassembled PDU]
1414 2022-04-02 08:54:15,970133 10.0.0.100 128.119.245.12 TCP 1414 56381 → 80 [ACK] Seq=6077 Ack=1 Win=131840 Len=1360 [TCP segment of a reassembled PDU]
```

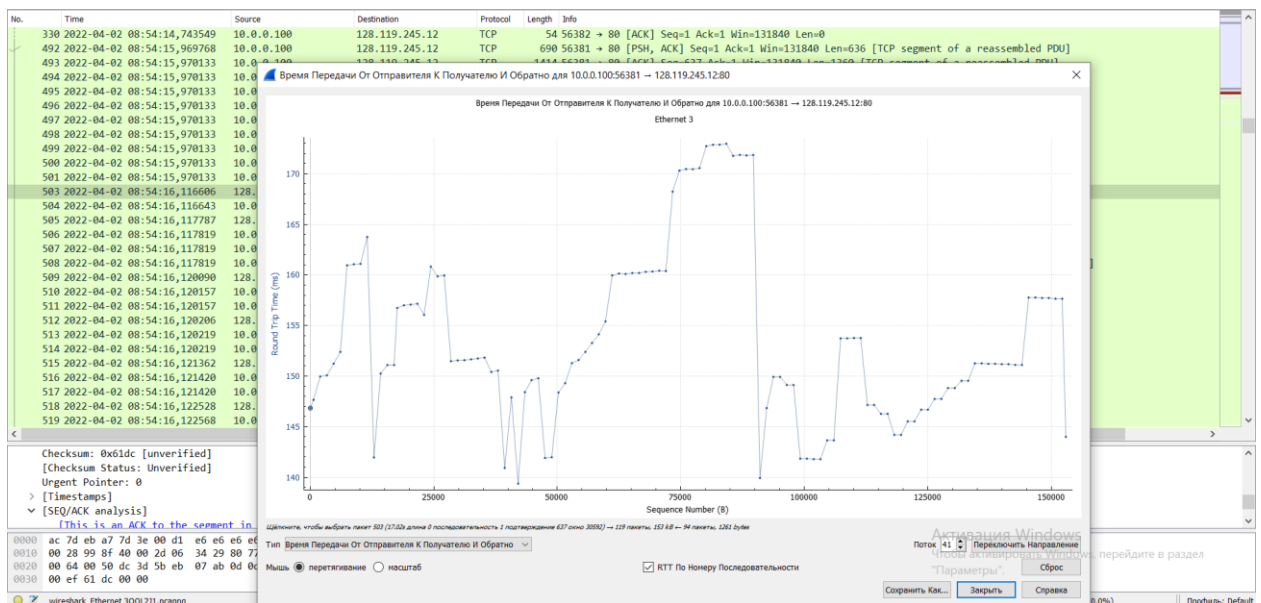
На следующем скрине видны времена получения подтверждений для соответствующих ACK-пакетов:

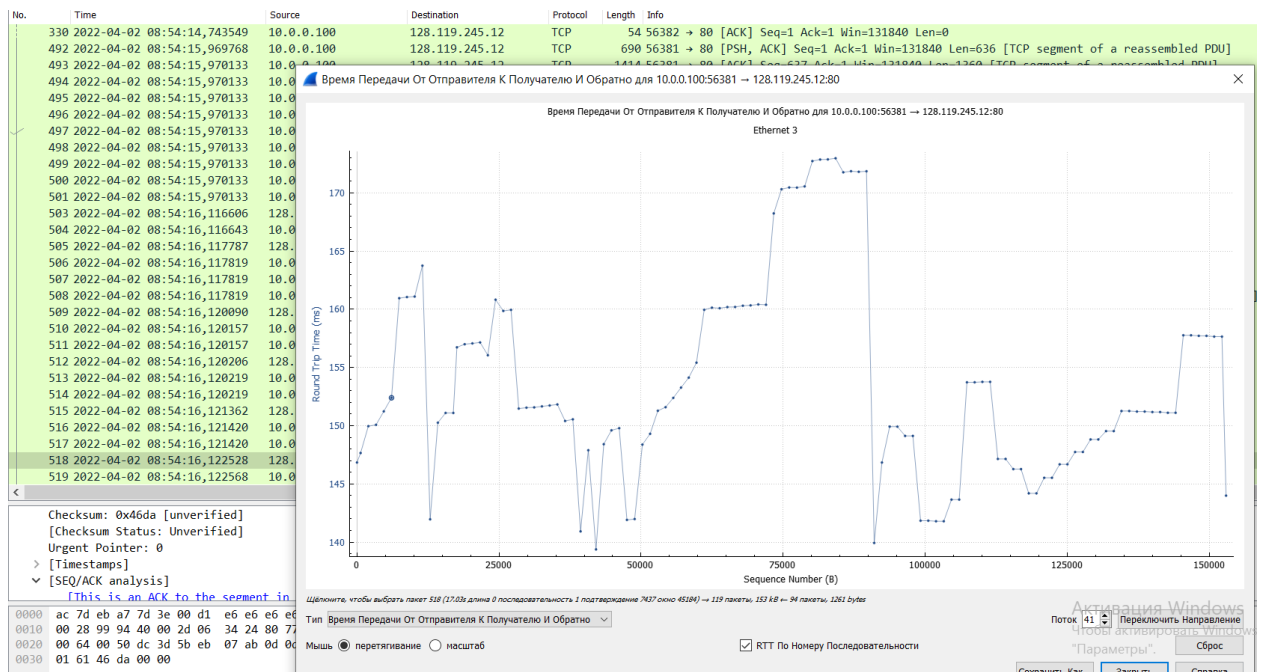
503	2022-04-02 08:54:16,116606	128.119.245.12	10.0.0.100	TCP	54 80 → 56381 [ACK] Seq=1 Ack=637 Win=30592 Len=0
504	2022-04-02 08:54:16,116643	10.0.0.100	128.119.245.12	TCP	1414 56381 → 80 [ACK] Seq=12877 Ack=1 Win=131840 Len=1360 [TCP segment of a reassembled PDU]
505	2022-04-02 08:54:16,117787	128.119.245.12	10.0.0.100	TCP	54 80 → 56381 [ACK] Seq=1 Ack=1997 Win=33408 Len=0
506	2022-04-02 08:54:16,117819	10.0.0.100	128.119.245.12	TCP	1414 56381 → 80 [ACK] Seq=14237 Ack=1 Win=131840 Len=1360 [TCP segment of a reassembled PDU]
507	2022-04-02 08:54:16,117819	128.119.245.12	10.0.0.100	TCP	1414 56381 → 80 [ACK] Seq=15597 Ack=1 Win=131840 Len=1360 [TCP segment of a reassembled PDU]
508	2022-04-02 08:54:16,117819	10.0.0.100	128.119.245.12	TCP	690 56381 → 80 [PSH, ACK] Seq=16957 Ack=1 Win=131840 Len=636 [TCP segment of a reassembled PDU]
509	2022-04-02 08:54:16,120090	128.119.245.12	10.0.0.100	TCP	54 80 → 56381 [ACK] Seq=1 Ack=3357 Win=36352 Len=0
510	2022-04-02 08:54:16,120157	10.0.0.100	128.119.245.12	TCP	1414 56381 → 80 [ACK] Seq=17593 Ack=1 Win=131840 Len=1360 [TCP segment of a reassembled PDU]
511	2022-04-02 08:54:16,120157	10.0.0.100	128.119.245.12	TCP	1414 56381 → 80 [ACK] Seq=18953 Ack=1 Win=131840 Len=1360 [TCP segment of a reassembled PDU]
512	2022-04-02 08:54:16,120206	128.119.245.12	10.0.0.100	TCP	54 80 → 56381 [ACK] Seq=1 Ack=4717 Win=39296 Len=0
513	2022-04-02 08:54:16,120219	10.0.0.100	128.119.245.12	TCP	1414 56381 → 80 [ACK] Seq=20313 Ack=1 Win=131840 Len=1360 [TCP segment of a reassembled PDU]
514	2022-04-02 08:54:16,120219	10.0.0.100	128.119.245.12	TCP	1414 56381 → 80 [ACK] Seq=21673 Ack=1 Win=131840 Len=1360 [TCP segment of a reassembled PDU]
515	2022-04-02 08:54:16,121362	128.119.245.12	10.0.0.100	TCP	54 80 → 56381 [ACK] Seq=1 Ack=6077 Win=42240 Len=0
516	2022-04-02 08:54:16,121420	10.0.0.100	128.119.245.12	TCP	1414 56381 → 80 [ACK] Seq=23033 Ack=1 Win=131840 Len=1360 [TCP segment of a reassembled PDU]
517	2022-04-02 08:54:16,121420	10.0.0.100	128.119.245.12	TCP	1414 56381 → 80 [ACK] Seq=24393 Ack=1 Win=131840 Len=1360 [TCP segment of a reassembled PDU]
518	2022-04-02 08:54:16,122528	128.119.245.12	10.0.0.100	TCP	54 80 → 56381 [ACK] Seq=1 Ack=7437 Win=45184 Len=0

В том, что пакеты нужные, можно убедиться, посмотрев поля [SEQ/ACK analysis]:

```
> Frame 503: 54 bytes on wire (432 bits), 54 bytes captured (432 bits) on interface \Device\NPF_{72634749-96BF-4B16-ACBE-E152688589CC}, id 0
> Ethernet II, Src: 00:d1:e6:e6:e6:e6 (00:d1:e6:e6:e6:e6), Dst: ac:7d:eb:a7:7d:3e (ac:7d:eb:a7:7d:3e)
> Internet Protocol Version 4, Src: 128.119.245.12, Dst: 10.0.0.100
▼ Transmission Control Protocol, Src Port: 80, Dst Port: 56381, Seq: 1, Ack: 637, Len: 0
  Source Port: 80
  Destination Port: 56381
  [Stream index: 41]
  [Conversation completeness: Incomplete, DATA (15)]
  [TCP Segment Len: 0]
  Sequence Number: 1 (relative sequence number)
  Sequence Number (raw): 1542129579
  [Next Sequence Number: 1 (relative sequence number)]
  Acknowledgment Number: 637 (relative ack number)
  Acknowledgment number (raw): 218988528
  0101 .... = Header Length: 20 bytes (5)
  > Flags: 0x010 (ACK)
  Window: 239
  [Calculated window size: 30592]
  [Window size scaling factor: 128]
  Checksum: 0x61dc [unverified]
  [Checksum Status: Unverified]
  Urgent Pointer: 0
  > [Timestamps]
  ▼ [SEQ/ACK analysis]
    [This is an ACK to the segment in frame: 492]
    [The RTT to ACK the segment was: 0.146838000 seconds]
    [iRTT: 0.148161000 seconds]
```

RTT изменяется в диапазоне от 147 до 153 мс (первые 6 точек на графике):





7. Время отправки первого SYN-сегмента: $08:54:14,589445 = 8 * 3600 + 54 * 60 + 14,589445 = 28800 + 3240 + 14,589445 = 32054, 589445$

317/2022-04-02 08:54:14,589445 10.0.0.100 128.119.245.12 TCP 66 56381 → 80 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1

Время получения последнего АСК-сегмента: $08:54:16,860298 = 8 * 3600 + 54 * 60 + 16,860298 = 28800 + 3240 + 16,860298 = 32056, 860298$

698	2022-04-02 08:54:16,600715	128.119.245.12	10.0.0.100	HTTP	831 HTTP/1.1 200 OK (text/html)
699	2022-04-02 08:54:16,654627	10.0.0.100	128.119.245.12	TCP	54 56381 → 80 [ACK] Seq=152958 Ack=778 Win=131072 Len=0
700	2022-04-02 08:54:16,666083	10.0.0.100	128.119.245.12	HTTP	487 GET /favicon.ico HTTP/1.1
701	2022-04-02 08:54:16,810075	128.119.245.12	10.0.0.100	HTTP	538 HTTP/1.1 404 Not Found (text/html)
702	2022-04-02 08:54:16,860298	10.0.0.100	128.119.245.12	TCP	54 56381 → 80 [ACK] Seq=153391 Ack=1262 Win=130560 Len=0

Размер передаваемого файла (alice.txt): 152138 байт

Итого $152138 / (32056, 860298 - 32054, 589445) = 152138 / 2,270853 \sim 66\,996$ байт/сек ~ 65 Кб/сек.

Задание 2

