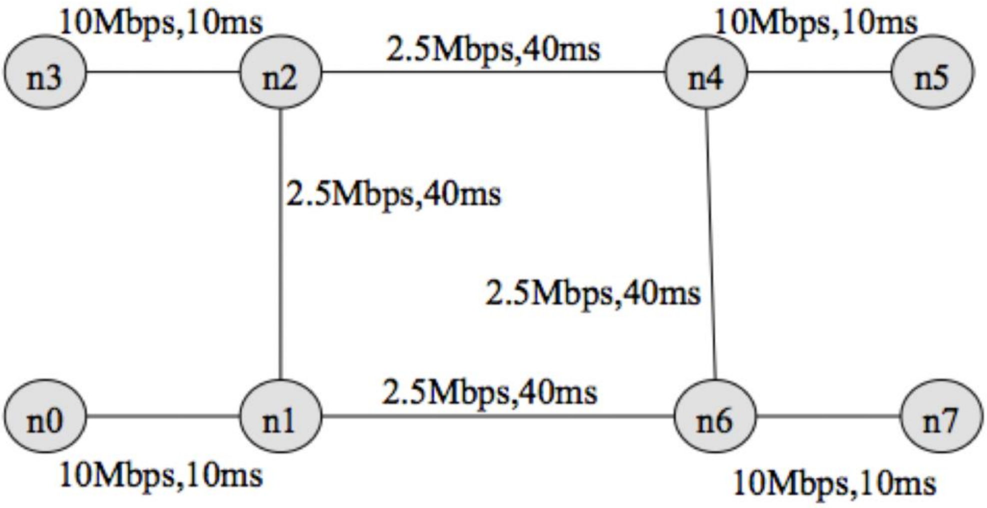
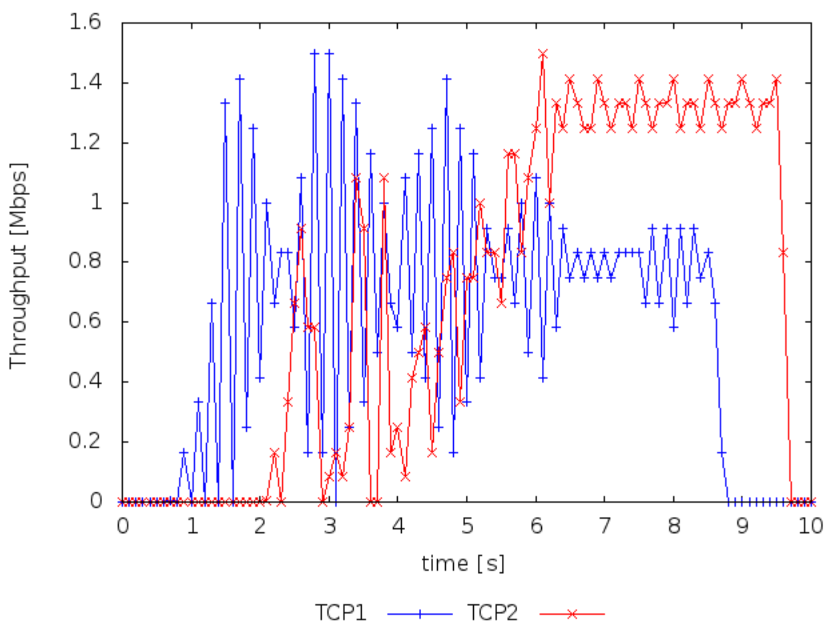
COMP3331 Lab06 Report

Exercise 1.



Question 1.



The throughput achieved by flow tcp2 higher than tcp1 between 6 sec and 8 sec is because $[n_3 \rightarrow n_2](10Mbps)$ has a larger bandwidth than $[n_0 \rightarrow n_1 \rightarrow n_2](2.5Mbps)$.

Question 2.

Between the time span 0.5 sec and 2 sec, the throughput of the tcp1 flows is in the slow-start phase because of the congestion control.

Question 3.

Between the time span 0.5 sec and 2 sec, there is only tcp1 in slow-start phase and did not achieve the maximum bandwidth. After tcp2 join at the time 2 sec, tcp1 and tcp2 will share the link bandwidth, which cause tcp1 not able to get higher throughput.

Exercise 2.

Question 1.

The data size 2000 and 3500 have caused the fragmentation because by default, the maximum segment size is 1500 bytes.
The IP address 192.168.1.103 has fragmented the original datagram.
2 fragments have been created when the data size is 2000 bytes.

Question 2.

The reply from the destination 8.8.8.8 for 3500-byte data size also get fragmented because the reply of the pings echoes the input which the data size is required to be fragmented to a smaller segment.

Question 3.

```
39 19.395869   192.168.1.103   8.8.8.8   IPv4   1514 Fragmented IP prot
40 19.395870   192.168.1.103   8.8.8.8   IPv4   1514 Fragmented IP prot
41 19.395871   192.168.1.103   8.8.8.8   ICMP    582 Echo (ping) reques
▸ Frame 39: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits) on interface 0
▸ Ethernet II, Src: Apple_64:20:54 (e0:ac:cb:64:20:54), Dst: Tp-LinkT_4d:a1:40 (e8:de:27:4d:a1:40)
▾ Internet Protocol Version 4, Src: 192.168.1.103, Dst: 8.8.8.8
    0100 .... = Version: 4
    .... 0101 = Header Length: 20 bytes (5)
  ▸ Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
    Total Length: 1500
    Identification: 0x7a7b (31355)
  ▸ Flags: 0x2000, More fragments
    Fragment offset: 0
    Time to live: 64
    Protocol: ICMP (1)
    Header checksum: 0x0887 [validation disabled]
    [Header checksum status: Unverified]
    Source: 192.168.1.103
    Destination: 8.8.8.8
```

```
40 19.395870   192.168.1.103   8.8.8.8   IPv4   1514 Fragmented IP prot
41 19.395871   192.168.1.103   8.8.8.8   ICMP    582 Echo (ping) reques
▸ Frame 40: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits) on interface 0
▸ Ethernet II, Src: Apple_64:20:54 (e0:ac:cb:64:20:54), Dst: Tp-LinkT_4d:a1:40 (e8:de:27:4d:a1:40)
▾ Internet Protocol Version 4, Src: 192.168.1.103, Dst: 8.8.8.8
    0100 .... = Version: 4
    .... 0101 = Header Length: 20 bytes (5)
  ▸ Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
    Total Length: 1500
    Identification: 0x7a7b (31355)
  ▸ Flags: 0x20b9, More fragments
    Fragment offset: 1480
    Time to live: 64
    Protocol: ICMP (1)
    Header checksum: 0x07ce [validation disabled]
    [Header checksum status: Unverified]
    Source: 192.168.1.103
    Destination: 8.8.8.8
```

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  41 19.395871   192.168.1.103          8.8.8.8                ICMP         582 Echo (ping) request
▸ Frame 41: 582 bytes on wire (4656 bits), 582 bytes captured (4656 bits) on interface 0
▸ Ethernet II, Src: Apple_64:20:54 (e0:ac:cb:64:20:54), Dst: Tp-LinkT_4d:a1:40 (e8:de:27:4d:a1:40)
▾ Internet Protocol Version 4, Src: 192.168.1.103, Dst: 8.8.8.8
    0100 .... = Version: 4
    .... 0101 = Header Length: 20 bytes (5)
  ▸ Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
    Total Length: 568
    Identification: 0x7a7b (31355)
  ▸ Flags: 0x0172
    Fragment offset: 2960
    Time to live: 64
    Protocol: ICMP (1)
    Header checksum: 0x2ab9 [validation disabled]
    [Header checksum status: Unverified]
    Source: 192.168.1.103
    Destination: 8.8.8.8
```

ID	Length	Flag	Offset
0x7a7b	1500	0x2000	0
0x7a7b	1500	0x20b9	1480
0x7a7b	568	0x0172	2960

Question 4.

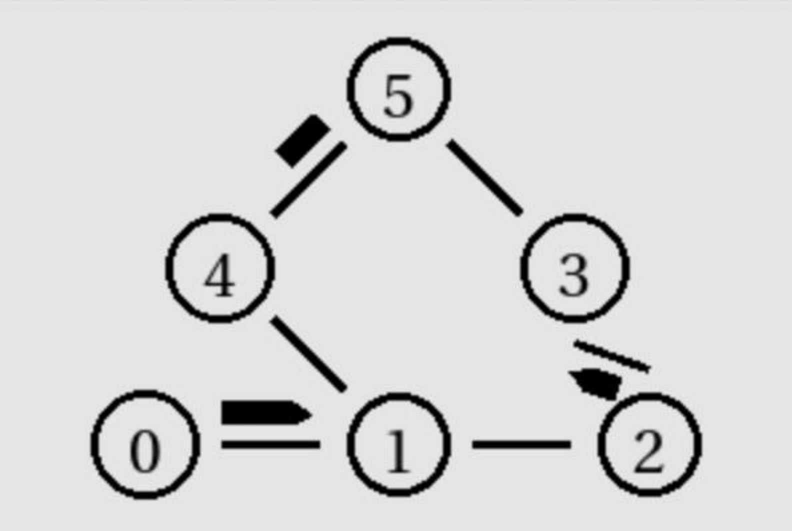
The fragmentation of fragments occurred when 3500-byte data size has been used because the maximum transmission unit is smaller than the given data size.

Question 5.

If one or more fragments from the IP datagrams are lost, the whole IP datagram will be discarded after the timeout period. The whole TCP packages will have to be retransmitted by which side sent previously.

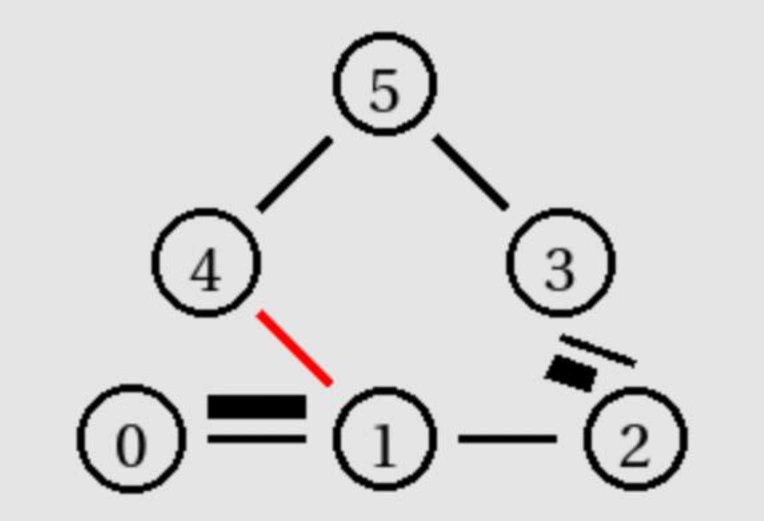
Exercise 3.

Question 1.



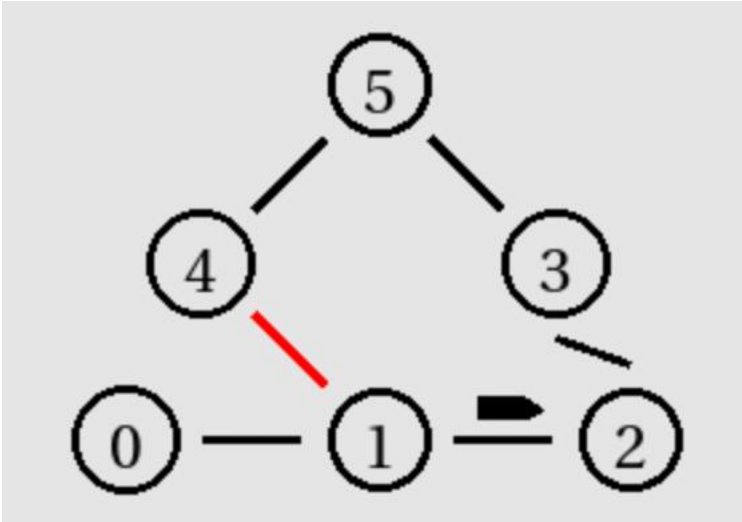
UDP0: $n_0 \rightarrow n_5 (0 \rightarrow 1 \rightarrow 4 \rightarrow 5)$
UDP1: $n_2 \rightarrow n_5 (2 \rightarrow 3 \rightarrow 5)$
The route does not change over time.

Question 2.



The link between n_1 and n_4 is blocked. It affects the route of $n_0 \rightarrow n_5 (0 \rightarrow 1 \rightarrow 4 \rightarrow 5)$ but it does not affect $n_2 \rightarrow n_5 (2 \rightarrow 3 \rightarrow 5)$.
The route between communicating nodes does not change.
The UDP0 experienced a package loss.

Question 3.



When the link between n_1 and n_4 is blocked, the route will go from n_1 to n_2 to reach to n_5, which $n_0 \rightarrow n_5(0 \rightarrow 1 \rightarrow 2 \rightarrow 3 \rightarrow 5)$. When the link is unblocked, the route will go back from $n_0 \rightarrow n_5(0 \rightarrow 1 \rightarrow 4 \rightarrow 5)$.

Question 4.

The cost of the link between n_1 and n_4 has increased to 3.
The total cost of the route $n_0 \rightarrow n_5(0 \rightarrow 1 \rightarrow 4 \rightarrow 5)$ will be 4 after the step 3 change, while the total cost of the route $n_1 \rightarrow n_5(1 \rightarrow 2 \rightarrow 3 \rightarrow 5)$ is 3. Therefore, it is cheaper to take the second route for package transmission.
The $n_2 \rightarrow n_5(2 \rightarrow 3 \rightarrow 5)$ remain the same.

Question 5.

For UDP0
Route 1: $n_0 \rightarrow n_5(0 \rightarrow 1 \rightarrow 4 \rightarrow 5)$ Cost = 4
Route 2: $n_0 \rightarrow n_5(0 \rightarrow 1 \rightarrow 2 \rightarrow 3 \rightarrow 5)$ Cost = 5
For UDP1
Route 1: $n_2 \rightarrow n_5(2 \rightarrow 3 \rightarrow 5)$ Cost = 4
Route 2: $n_2 \rightarrow n_5(2 \rightarrow 1 \rightarrow 4 \rightarrow 5)$ Cost = 4
For UDP1, it will use both routes to reach n_5 since it has the same cost. For UDP0, it will use route 1 to reach n_5 instead of route 2 because route 1 has a cheaper cost than route 2.