Network Systems Capstone Homework 3 Report

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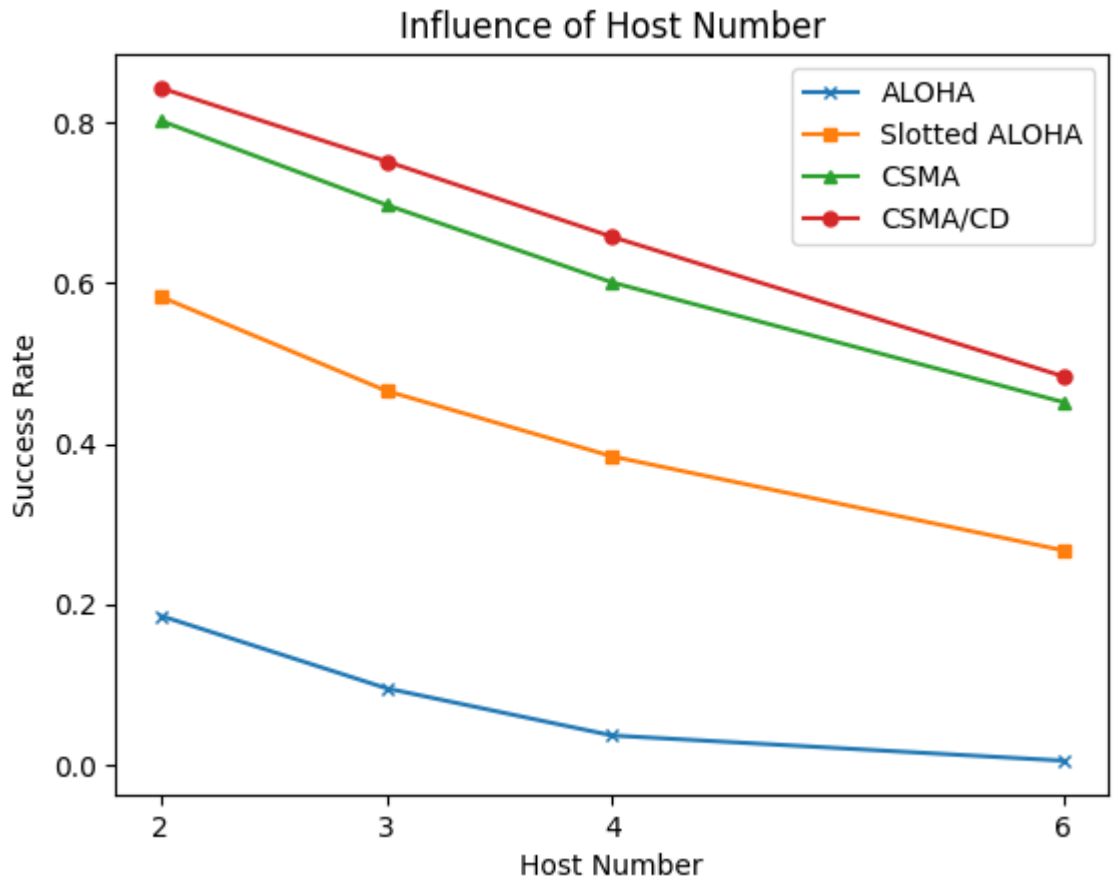
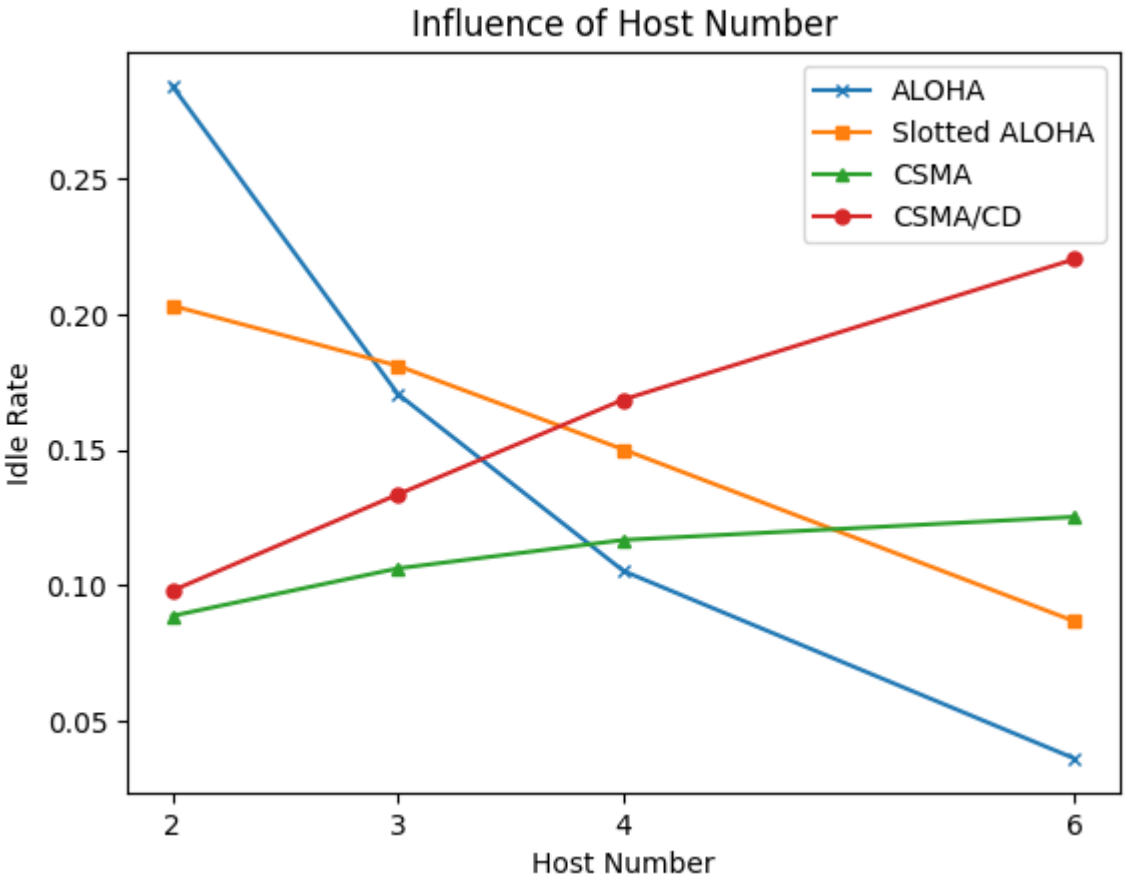
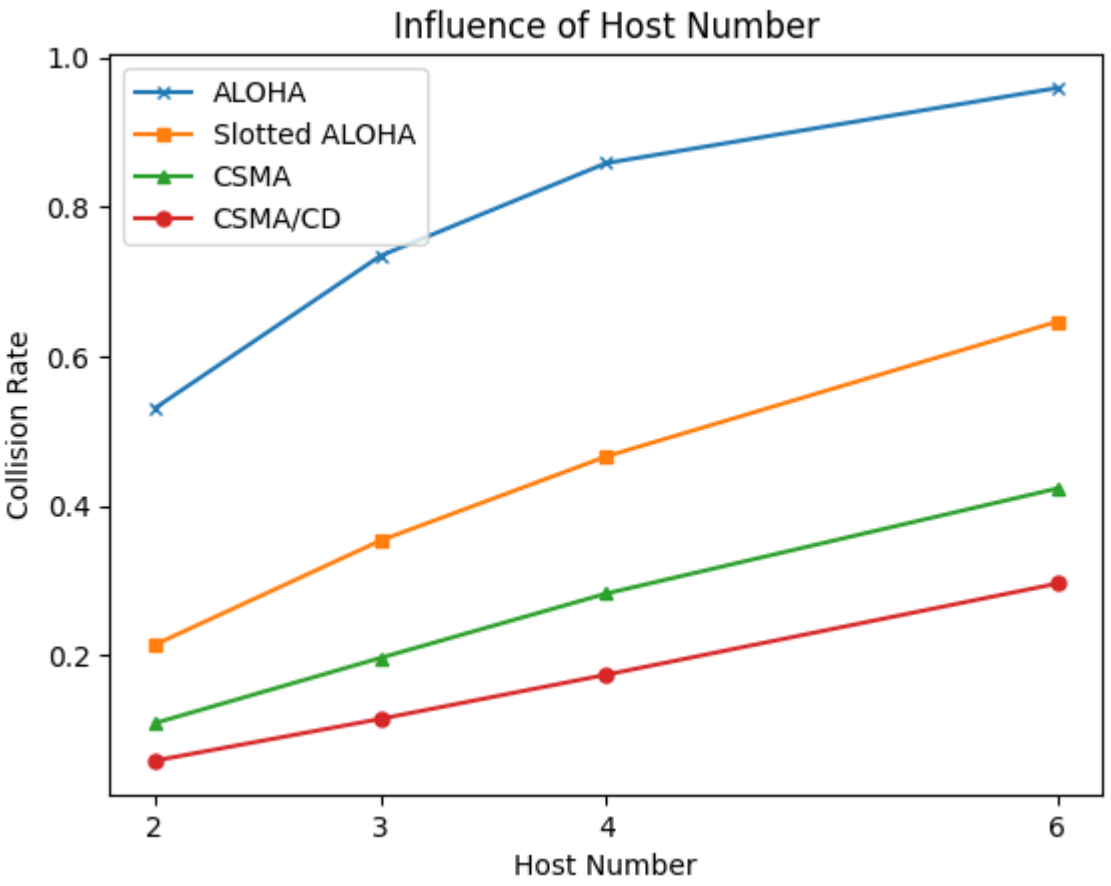
Question 1




Influence of Host Number
ALOHA
Slotted ALOHA
CSMA
CSMA/CD
Idle Rate
0.25
0.20
0.15
0.10
0.05
2
3
4
6
Host Number

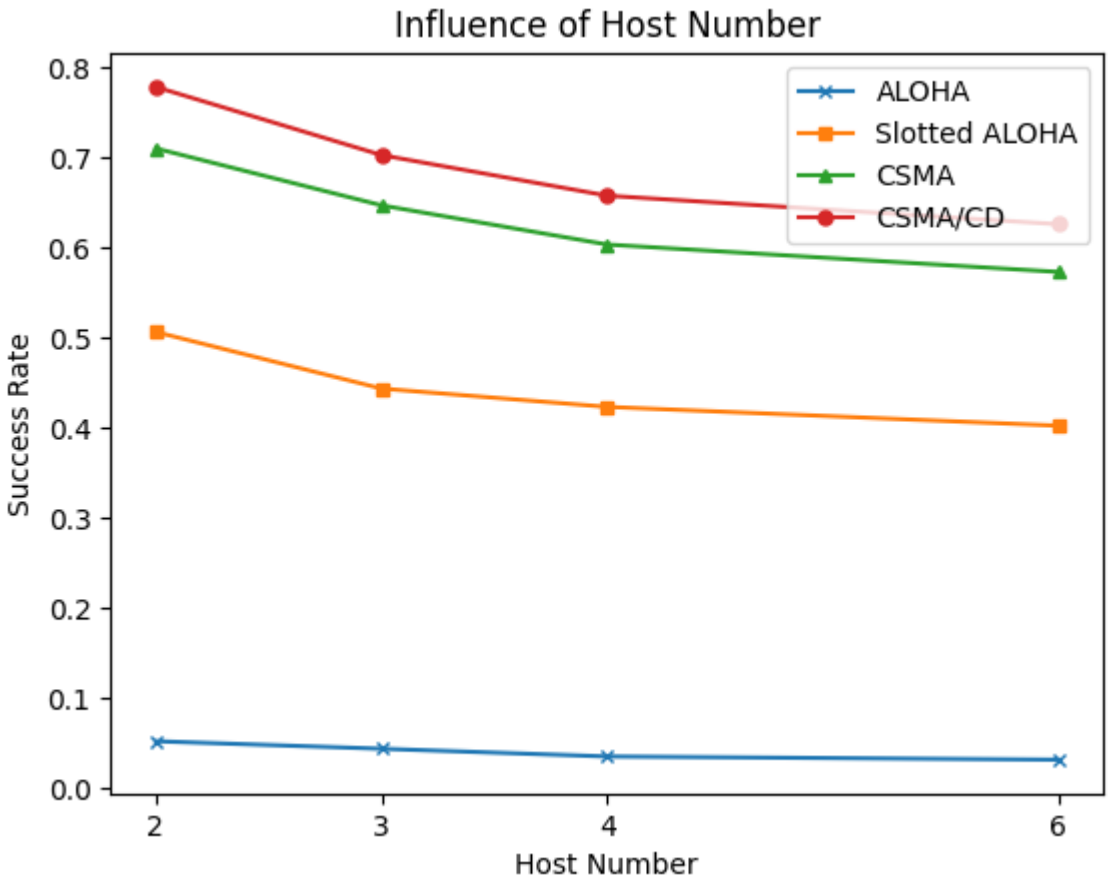

Influence of Host Number
ALOHA
Slotted ALOHA
CSMA
CSMA/CD
Collision Rate
1.0
0.8
0.6
0.4
0.2
2
3
4
6
Host Number

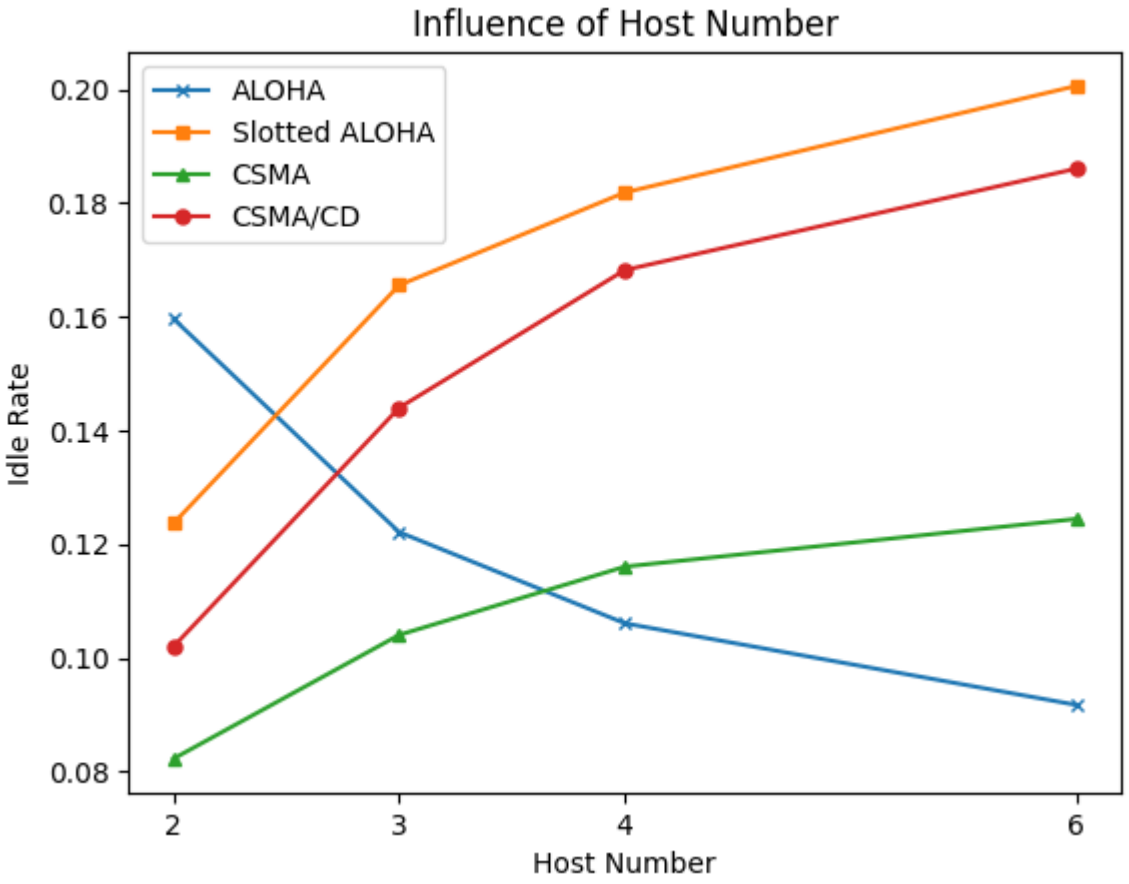
Question 2

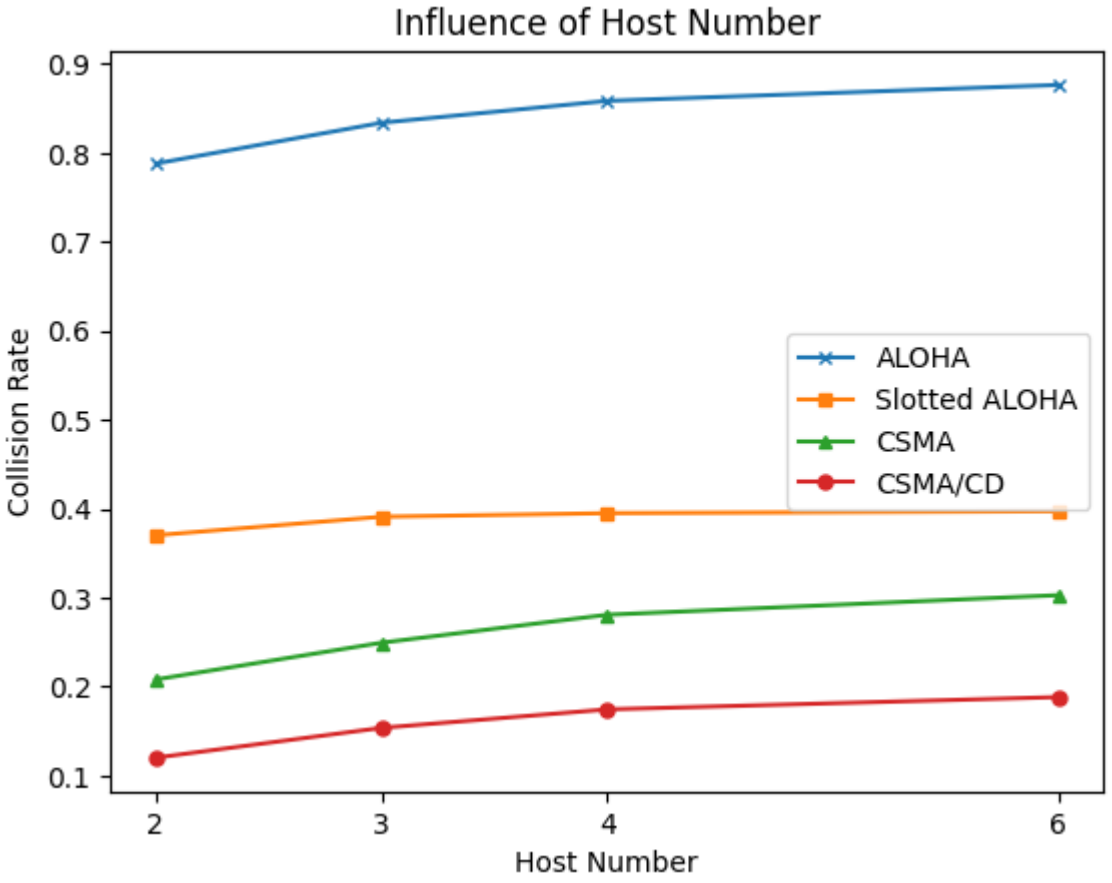
```
max_collision_wait_time = host_num * packet_size * coefficient
p_resend = 1 / (host_num * coefficient)
```

Question 3

Initially, the performance of the network using the expressions was not as good as the performance achieved with the original approach, as it resulted in lower success rates and higher idle and collision rates. However, as the number of hosts increased, the performance of the network with the new expressions improved, and the rate of decline in success rates and growth in idle and collision rates slowed down. These results suggest that the expressions are effective in improving network performance, especially in larger networks where they enable smoother network operation.

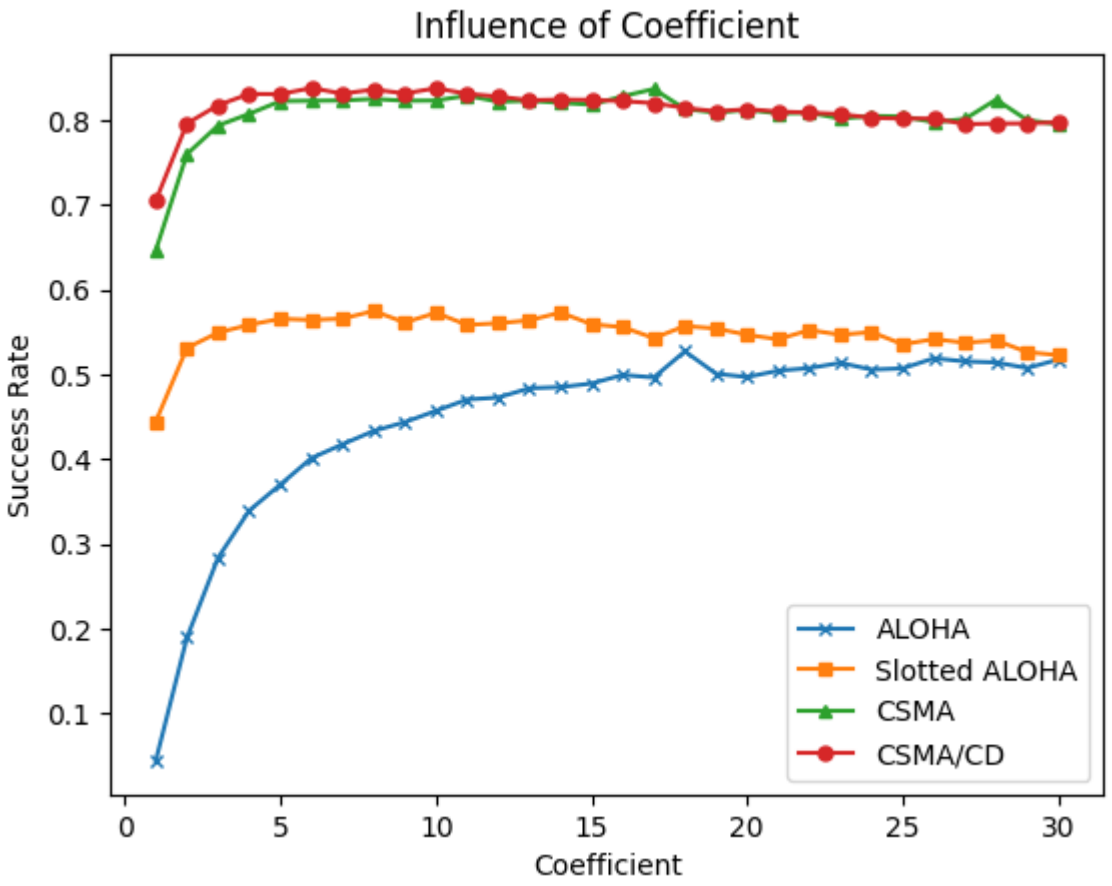


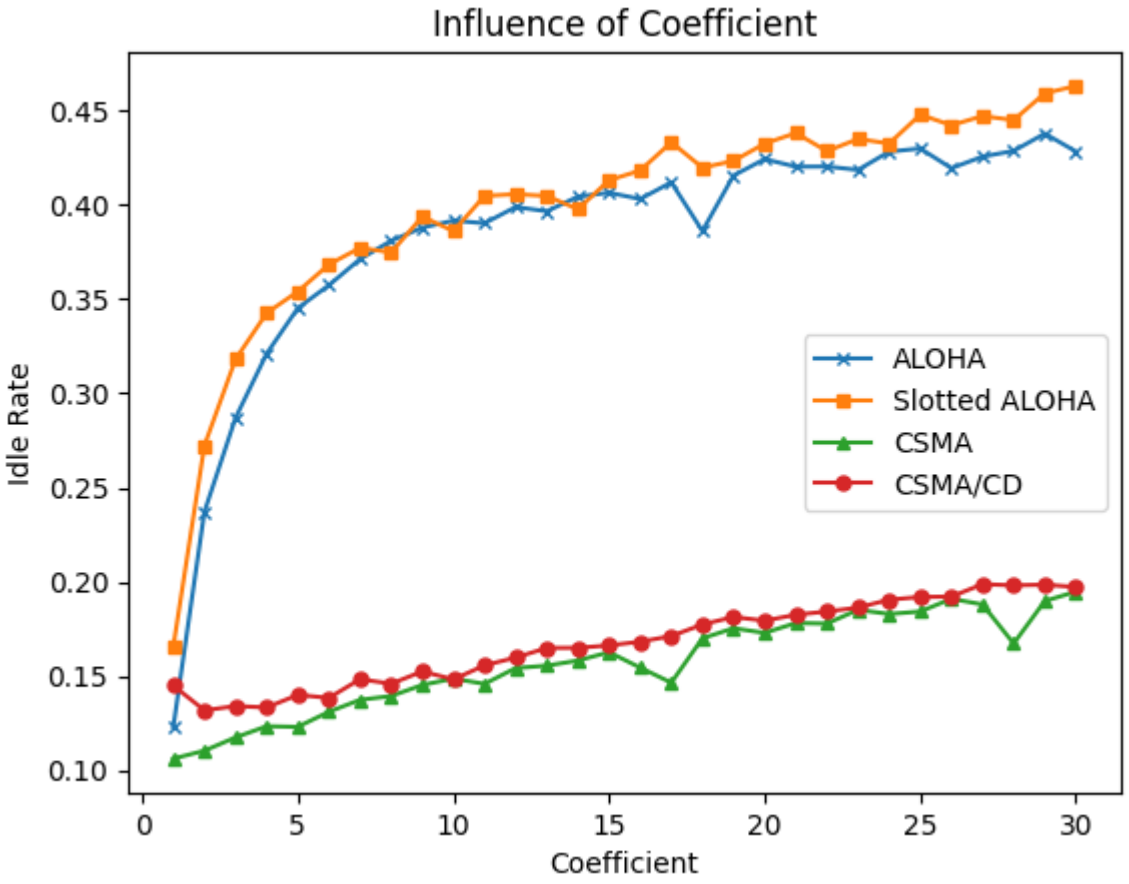

Influence of Host Number
ALOHA
Slotted ALOHA
CSMA
CSMA/CD
Idle Rate
0.20
0.18
0.16
0.14
0.12
0.10
0.08
2
3
4
6
Host Number

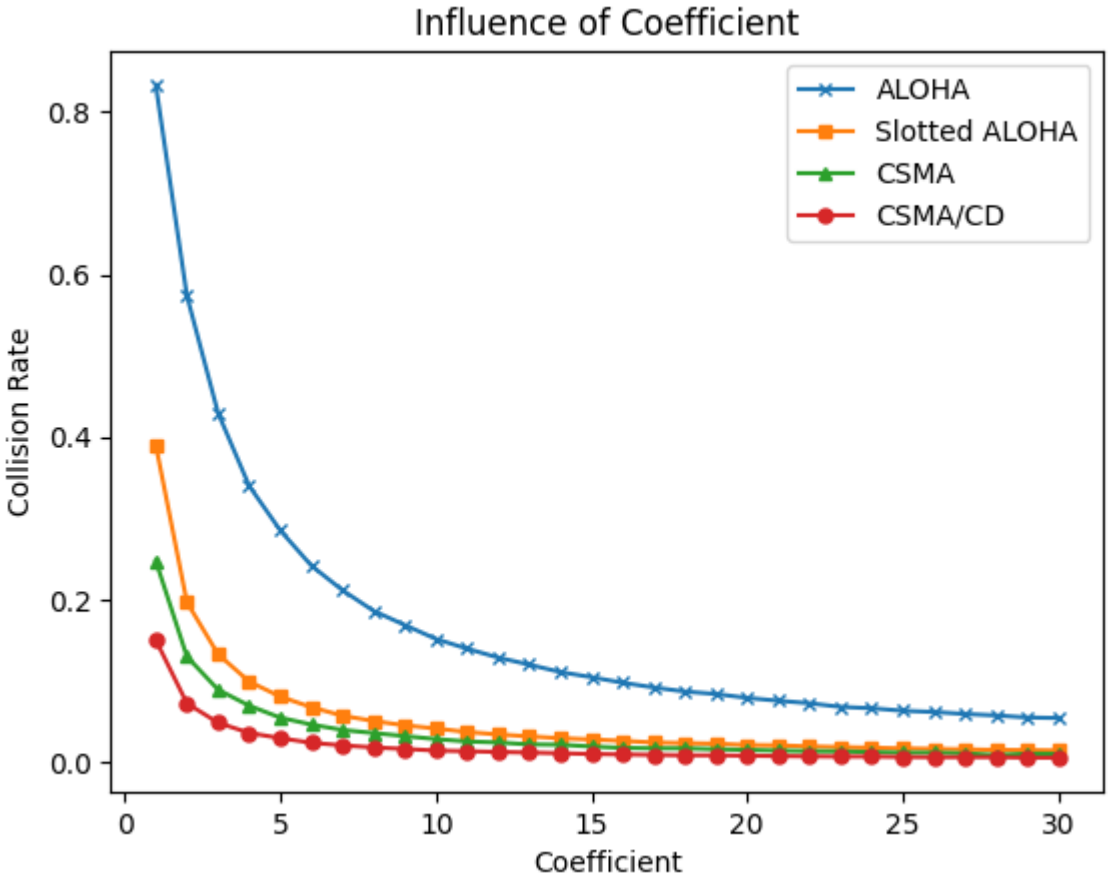

Influence of Host Number
ALOHA
Slotted ALOHA
CSMA
CSMA/CD
Collision Rate
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
2
3
4
6
Host Number

Question 4

According to the expressions mentioned above, the coefficient is proportional to the maximum waiting time when collision occurred and inversely proportional to the resending probability at the beginning of a slot in slotted ALOHA. It is quite obvious that the idle rate would become higher and the collision rate would become lower as the coefficient grows, which fits our plot perfectly. Since the three rates sum up to 1, we can easily get the trend of change in success rate.

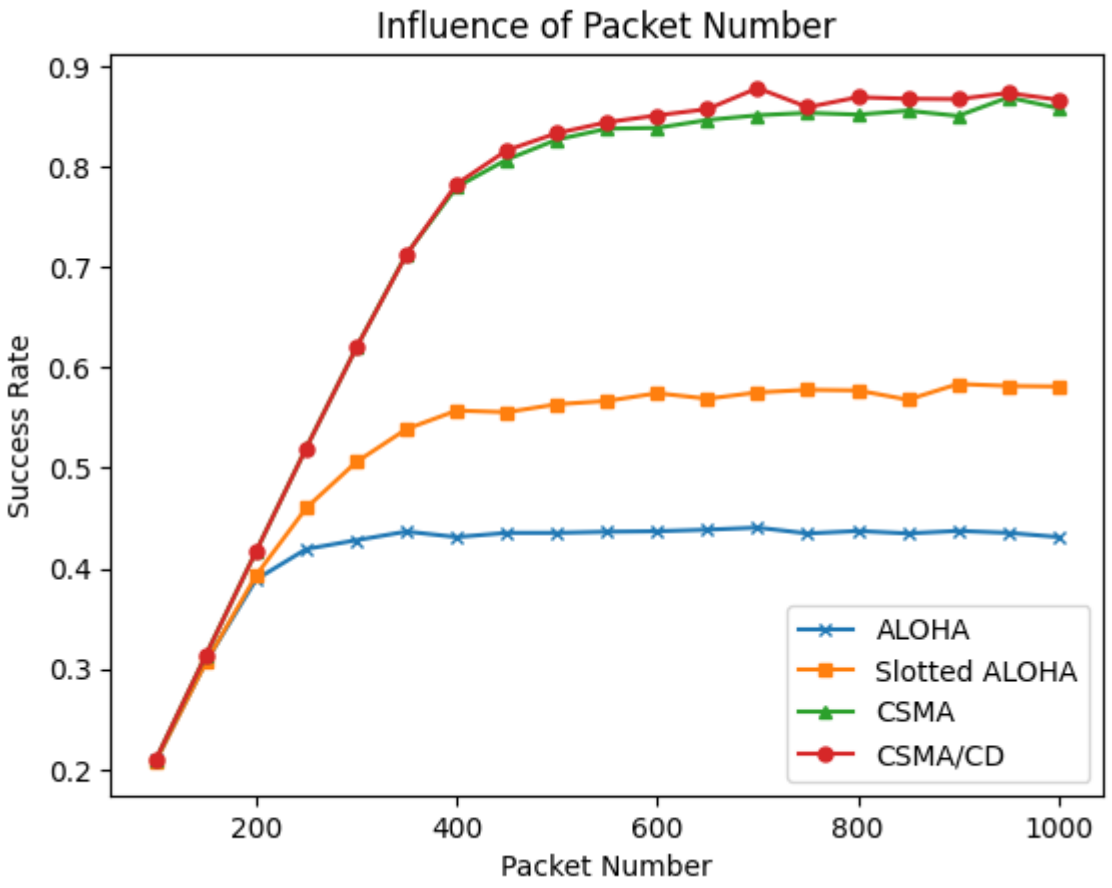


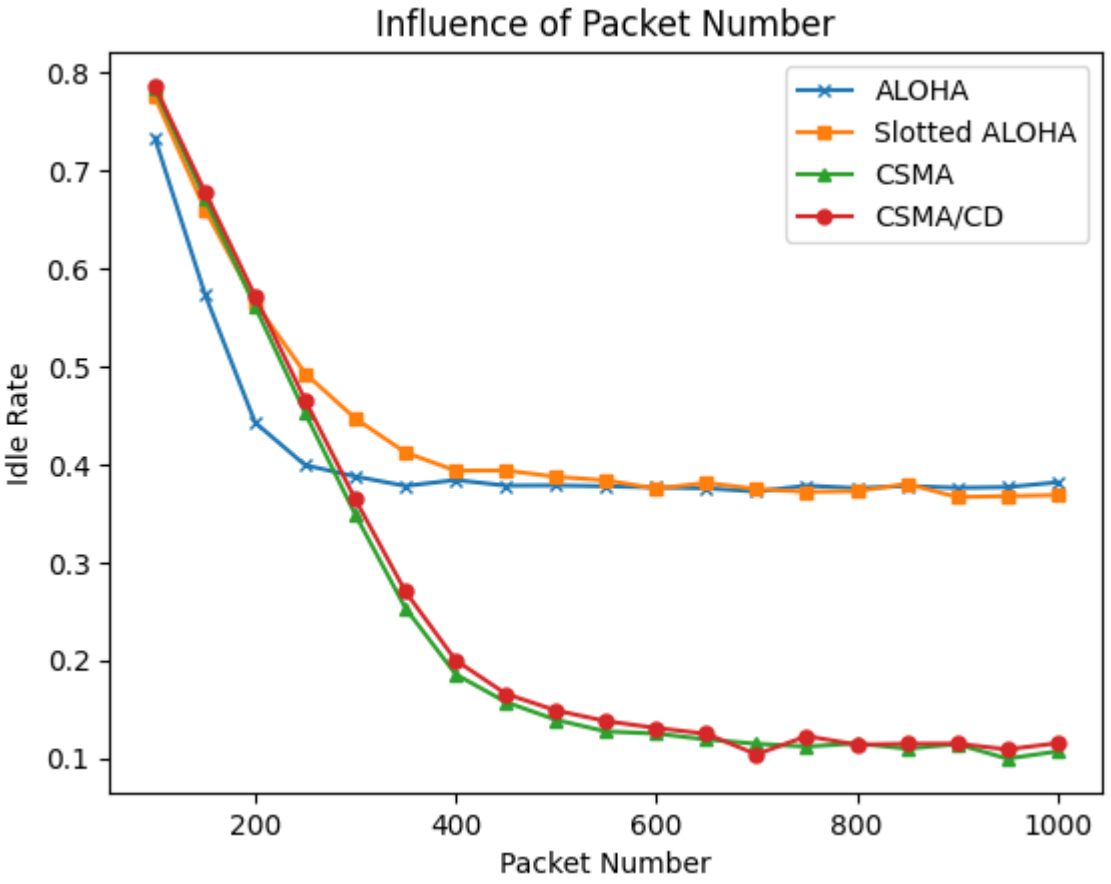

Influence of Coefficient
Idle Rate
Coefficient
ALOHA
Slotted ALOHA
CSMA
CSMA/CD
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0
5
10
15
20
25
30

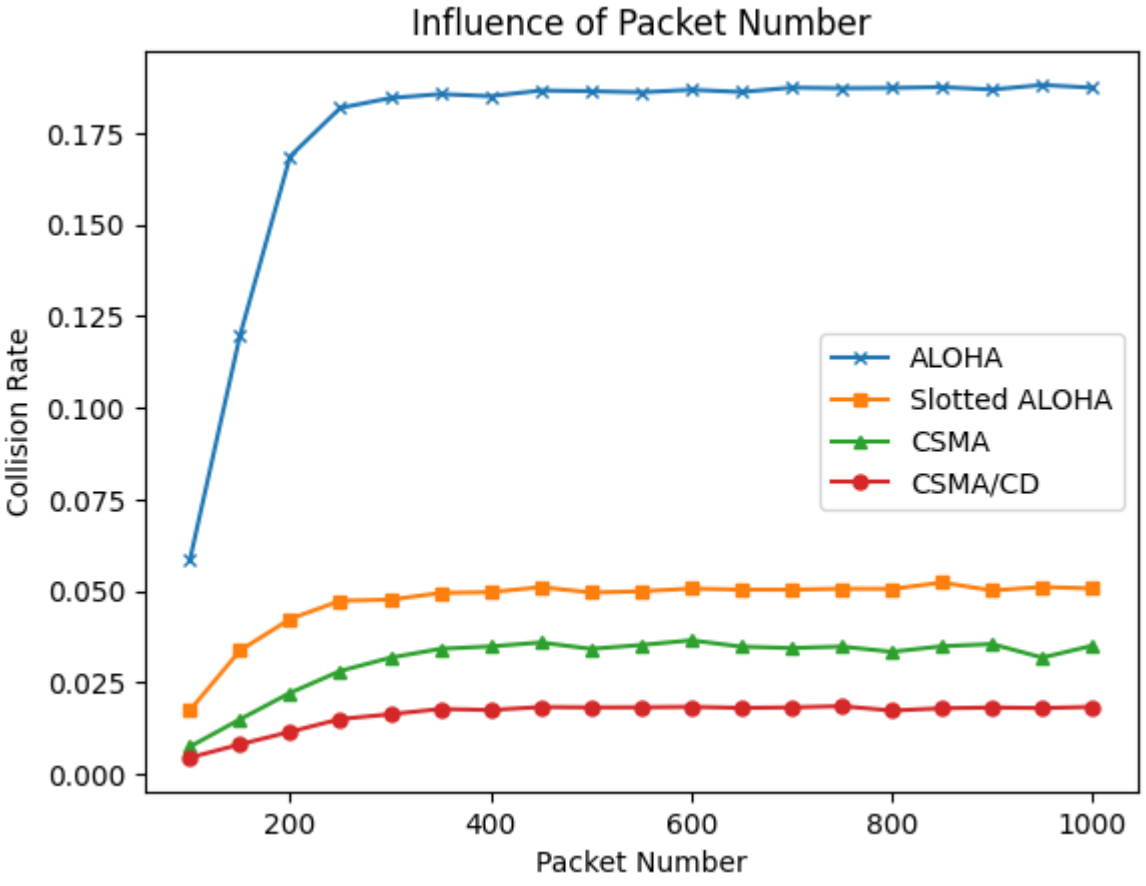

Influence of Coefficient
Collision Rate
Coefficient
ALOHA
Slotted ALOHA
CSMA
CSMA/CD
0.0
0.2
0.4
0.6
0.8
0
5
10
15
20
25
30

Question 5

The packet_num setting denotes the total number of packets that each host will send during the simulation. We can know that the idle rate will decrease and the collision rate will increase as the number of packets per host increases with intuition. However, since the total time needed to transmit all the packets is not even close to the simulation time (~0.7x total time @ p=1000), the collision probability remains low in our simulation. As a result, the success rate could keep at a high point.

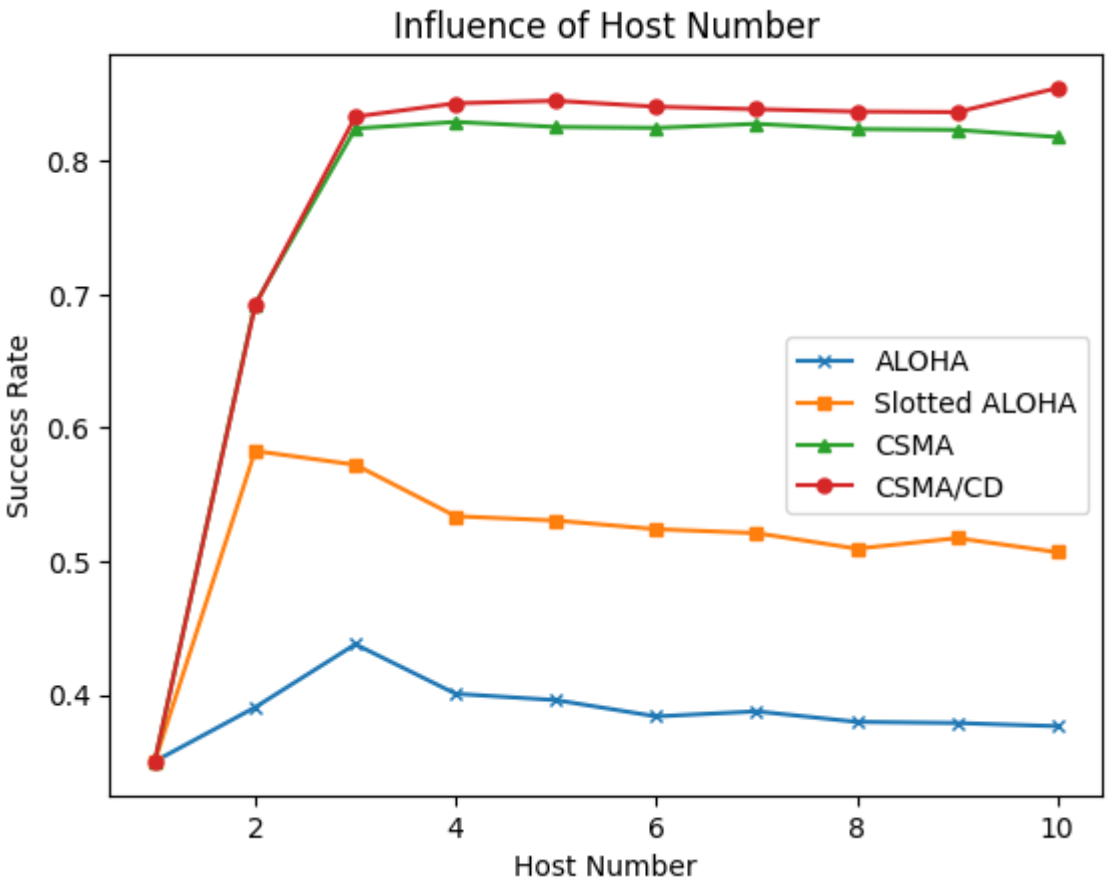


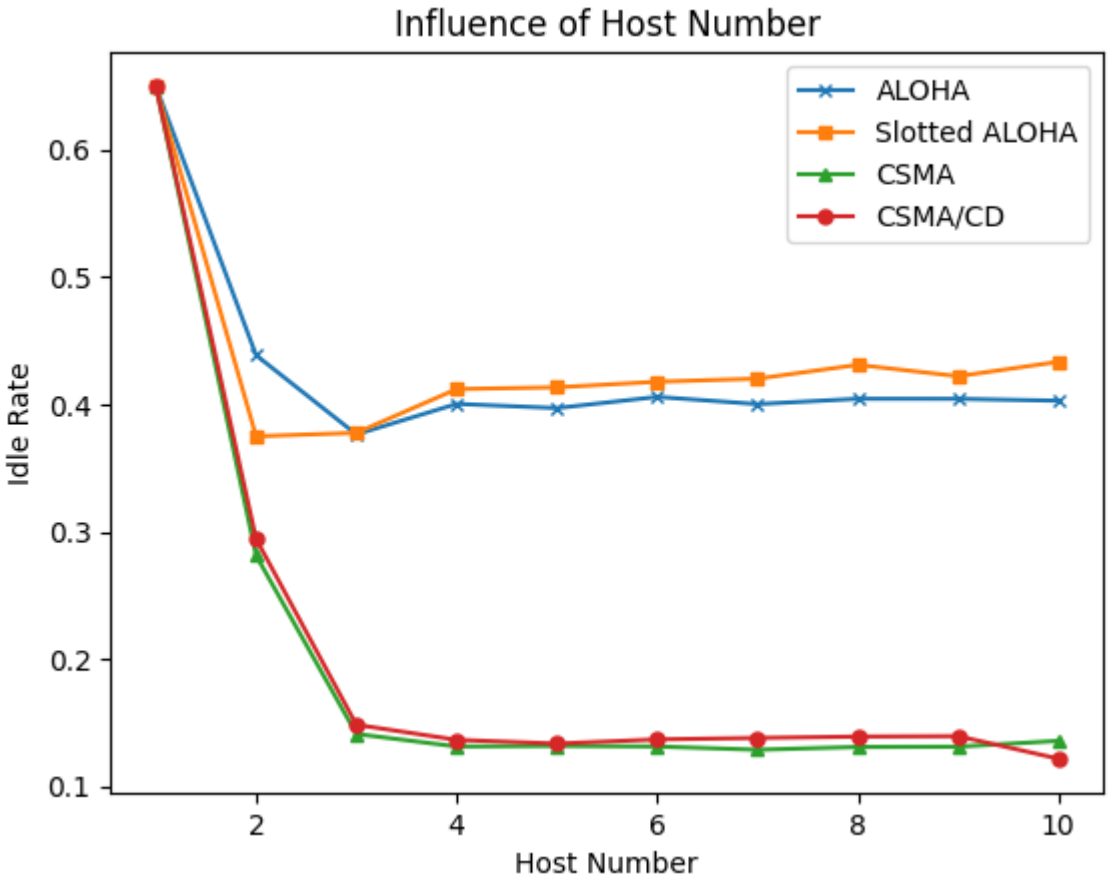

Influence of Packet Number
Idle Rate
Packet Number
ALOHA
Slotted ALOHA
CSMA
CSMA/CD
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
200
400
600
800
1000

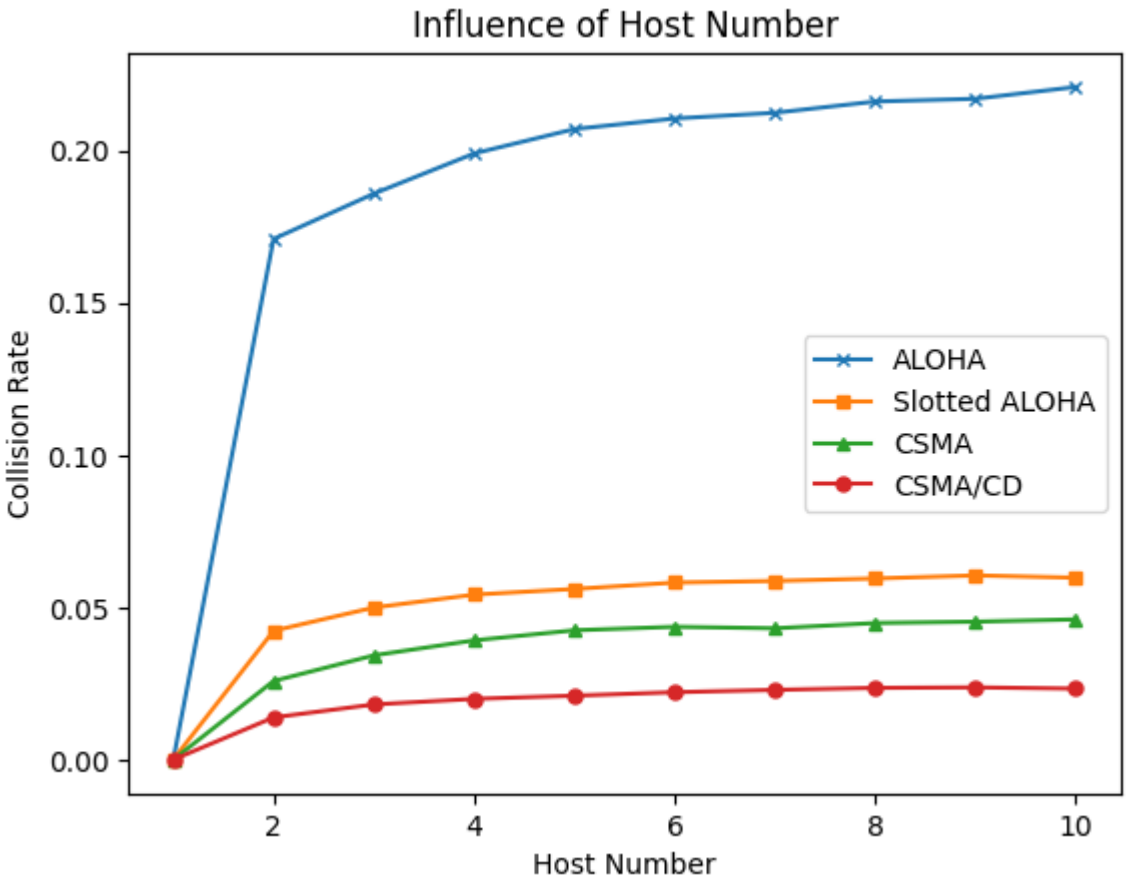

Influence of Packet Number
Collision Rate
Packet Number
ALOHA
Slotted ALOHA
CSMA
CSMA/CD
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.000
200
400
600
800
1000

Question 6

The number of hosts in the simulation affects the idle rate, collision rate, and success rate. As the number of hosts increases, the idle rate decreases and the collision rate increases due to the higher probability of collisions between packets. However, the collision rate does not increase significantly even as the number of hosts increases because the total time needed to transmit all the packets is less than the simulation duration, resulting in a high success rate.

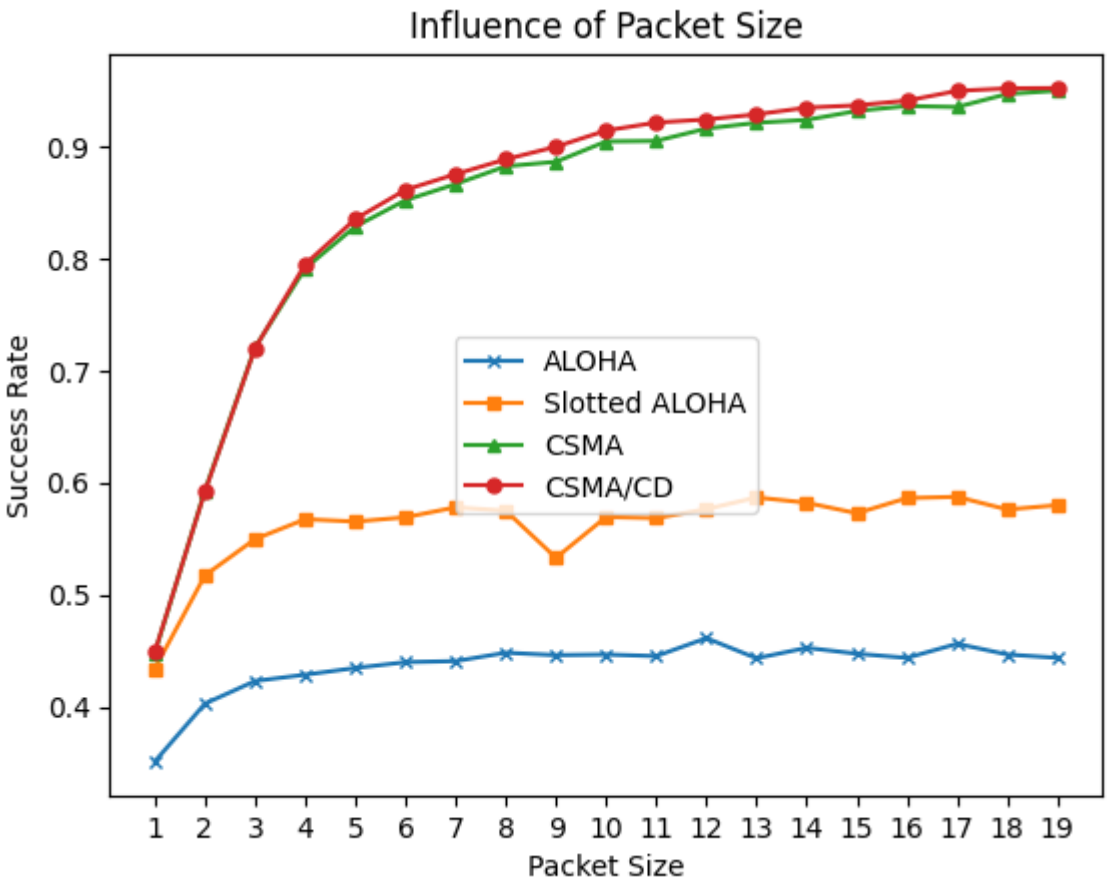


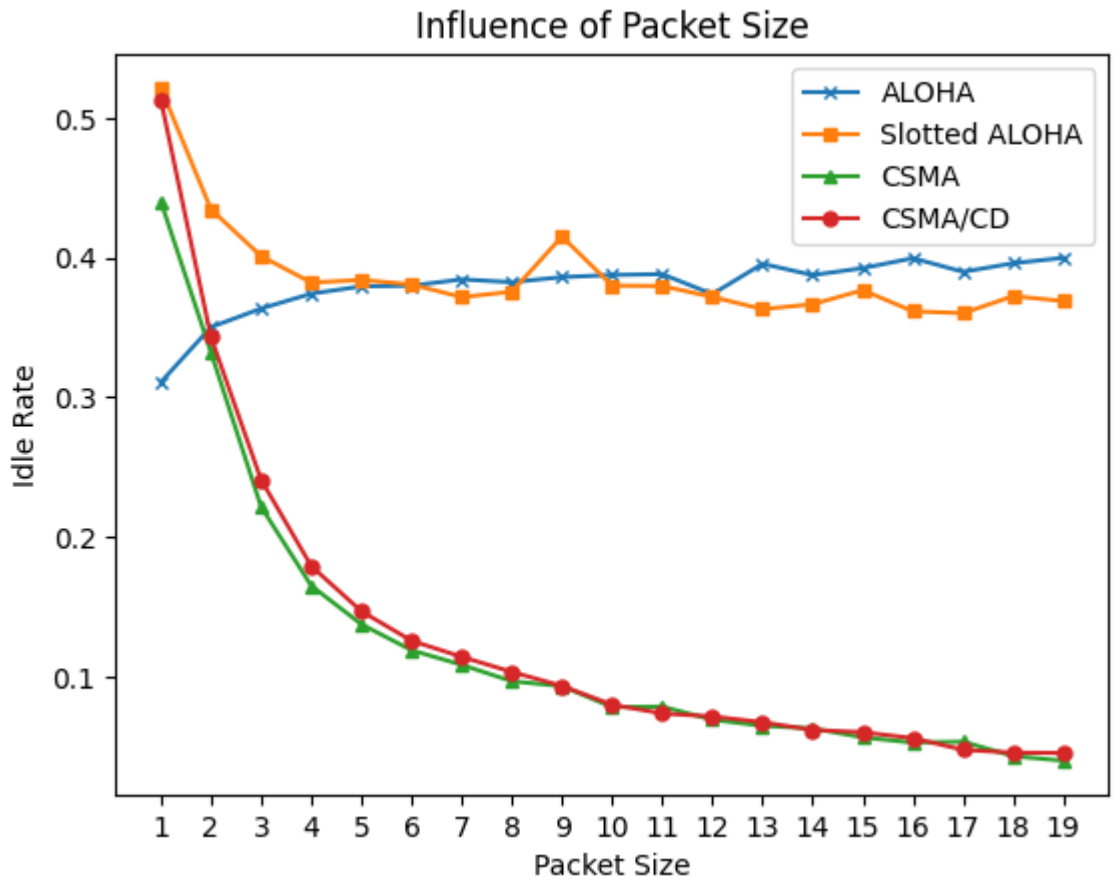

Influence of Host Number
ALOHA
Slotted ALOHA
CSMA
CSMA/CD
Idle Rate
0.6
0.5
0.4
0.3
0.2
0.1
2
4
6
8
10
Host Number

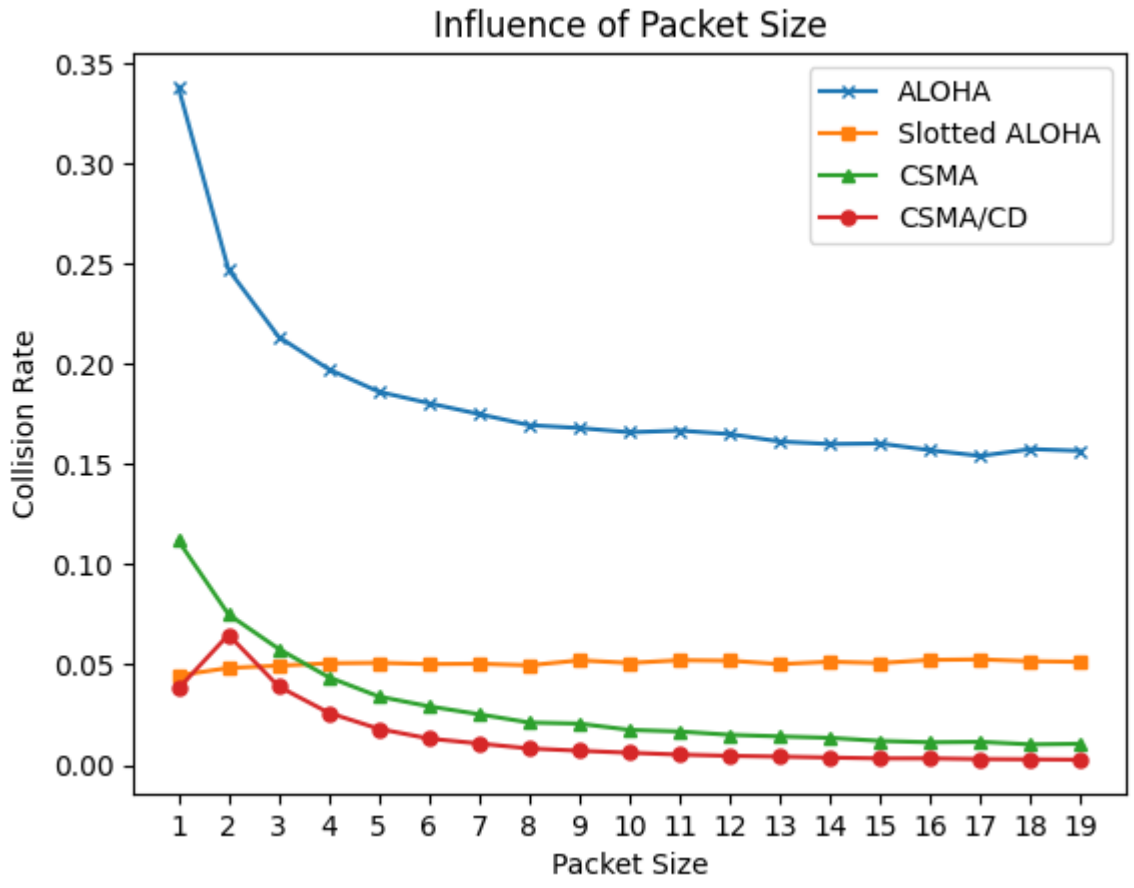

Influence of Host Number
ALOHA
Slotted ALOHA
CSMA
CSMA/CD
Collision Rate
0.20
0.15
0.10
0.05
0.00
2
4
6
8
10
Host Number

Question 7

The size of packets has a direct impact on the time required to send a packet. In CSMA and CSMA/CD, a host that requires a longer time to transmit a whole packet will keep other hosts in a waiting state for a longer period, resulting in a higher success rate and lower idle and collision rates. However, the influence of packet size becomes significantly lower in ALOHA and slotted ALOHA, as they do not perform carrier sense before transmitting a packet, leading to higher collision and idle rates.

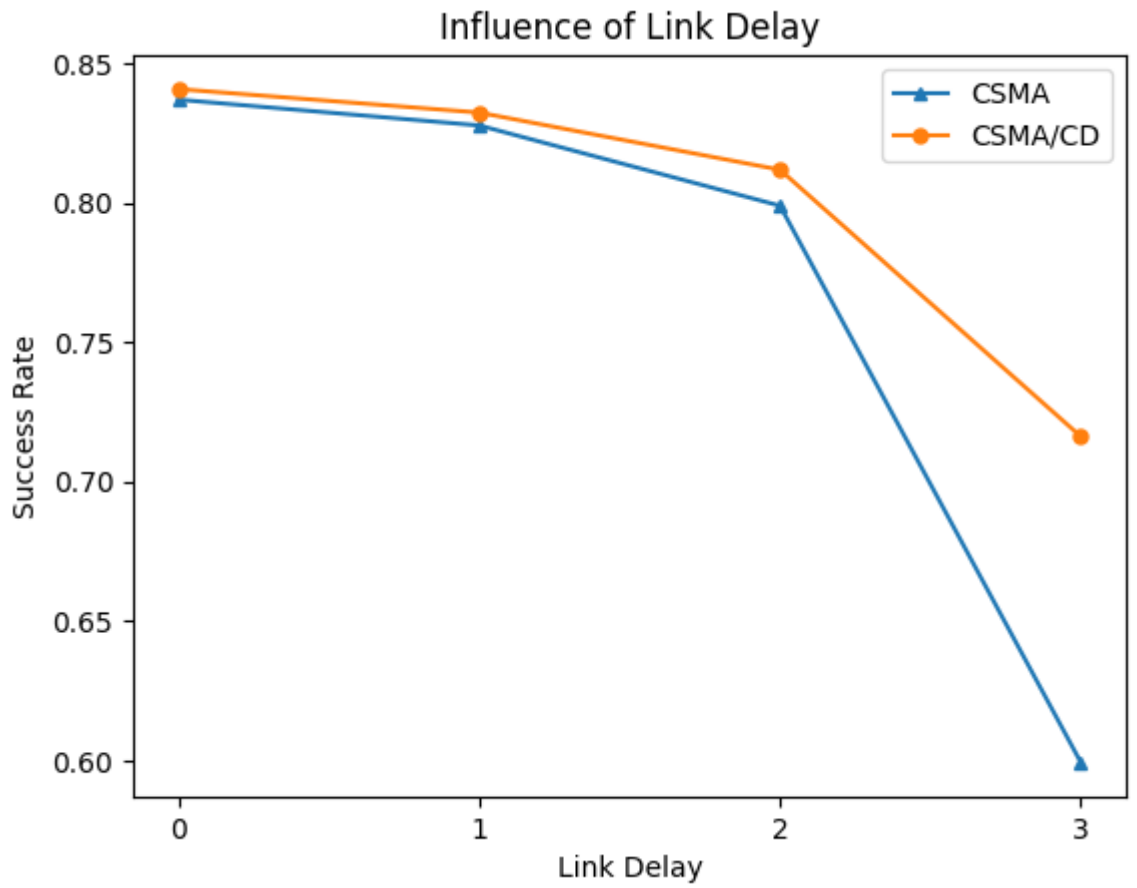


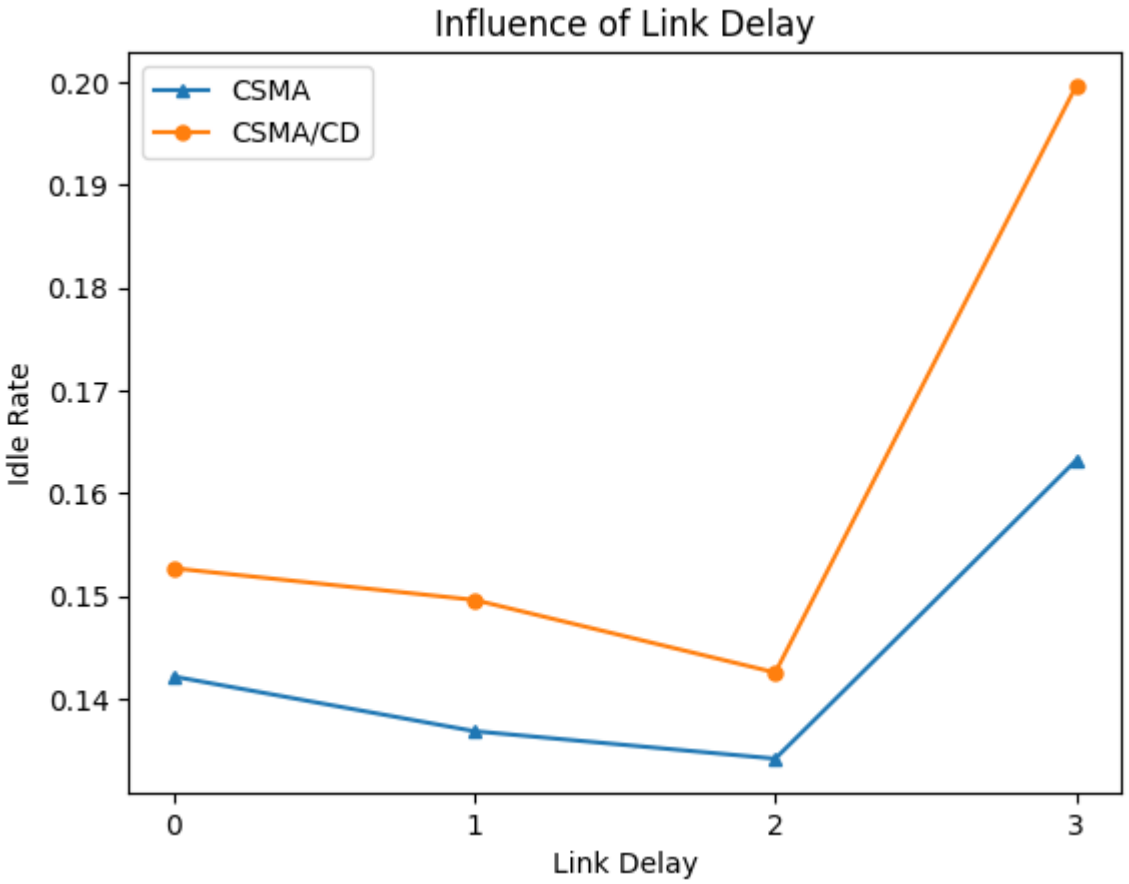

Influence of Packet Size
ALOHA
Slotted ALOHA
CSMA
CSMA/CD
Idle Rate
0.5
0.4
0.3
0.2
0.1
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
Packet Size

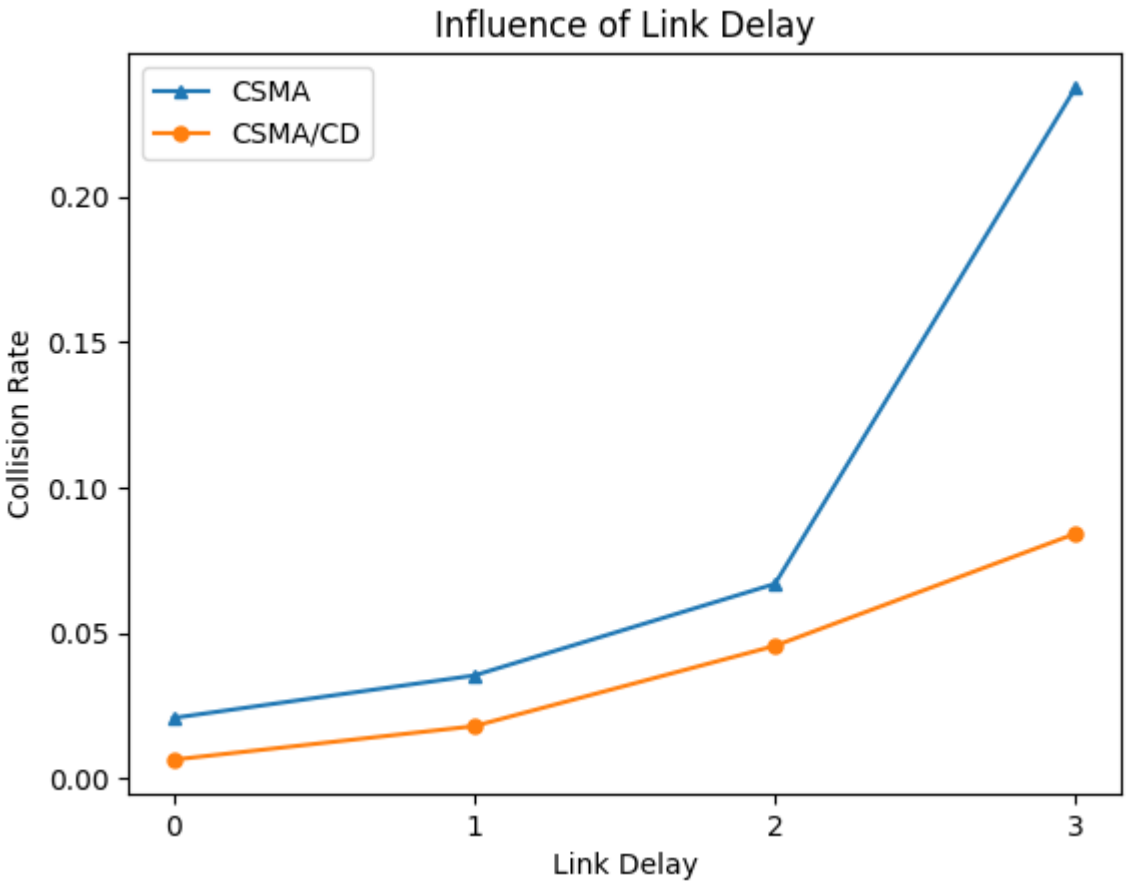

Influence of Packet Size
ALOHA
Slotted ALOHA
CSMA
CSMA/CD
Collision Rate
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
Packet Size

Question 8

The link delay would affect the accuracy of carrier sense in CSMA and CSMA/CD. We can expect that if link delay becomes higher, the effectiveness of carrier sense will be lower, and therefore the success rate will decrease, collision will increase. In addition, with a higher link delay would make hosts think that there is data transmitting on the link, and thus put themselves to idle, resulting in a higher idle rate.




Influence of Link Delay
CSMA
CSMA/CD
Idle Rate
0.20
0.19
0.18
0.17
0.16
0.15
0.14
0
1
2
3
Link Delay


Influence of Link Delay
CSMA
CSMA/CD
Collision Rate
0.20
0.15
0.10
0.05
0.00
0
1
2
3
Link Delay