Code Test

Use Setting(host_num=3, total_time=100, packet_num=4, max_colision_wait_time=20, p_resend=0.3, packet_size=3, link_delay=1, seed=109550031) to simulate in all methods.

- **Aloha**

```
aloha
          V                                          V          V                     V
h0: .......<--->...........................................<---|......<---|...................<---|....
                        V               V                      V        V
h1: ........................<---|.................<---><---|.............<---|..................<---|...
            V     V     V                                                      V
h2: ............<---><--->..<---|.<--->.......................................................<--->........
success_rate: 0.3
idle_rate: 0.4
collision_rate: 0.3
```

- **Slotted Aloha**

```
slotted_aloha
          V                                          V          V                     V
h0: .........<--->.........................................<--->.........<--->..............<--->.....
                        V               V                      V        V
h1: ..............................<--->..........<--->........................<---><--->..............
            V     V     V                                                      V
h2: ...............<---><---><--->....................................................<--->.........
success_rate: 0.6
idle_rate: 0.4
collision_rate: 0.0
```

- **CSMA**

```
csma
          V                                          V          V                     V
h0: .......<--->...........................................<---|.................<---|..........<---><--
                        V               V                      V        V
h1: ..........................<---|.....................<---|.....................<---|...<---|.........
            V     V     V                                                      V
h2: ............<---><--->..<---|...............<--->...................................<---|.........
success_rate: 0.25
idle_rate: 0.48
collision_rate: 0.27
```

- **CSMA/CD**

```
csma_cd
          V                                          V          V                     V
h0: .......<--->...........................................<--->.......<--->...................<--|..
                        V               V                      V        V
h1: ........................<|................<---><--->...........................................<|...
            V     V     V                                                      V
h2: ............<---><--->..<--|.................................................<---><--->.......
success_rate: 0.45
idle_rate: 0.47
collision_rate: 0.08
```

Questions

1. **Apply the following settings in all methods.**

   - host_num_list = [2,3,4,6]

   - packet_num_list = [1200,800,600,400]

   - Setting(host_num=h, packet_num=p, max_colision_wait_time=20, p_resend=0.3) for h,p in zip(host_num_list, packet_num_list)
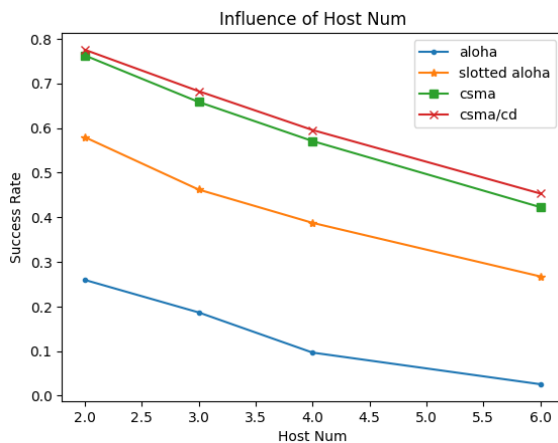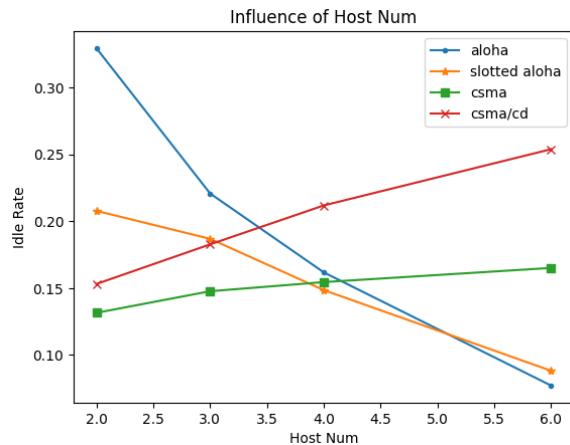

Figure a. success rate

Figure b. idle rate
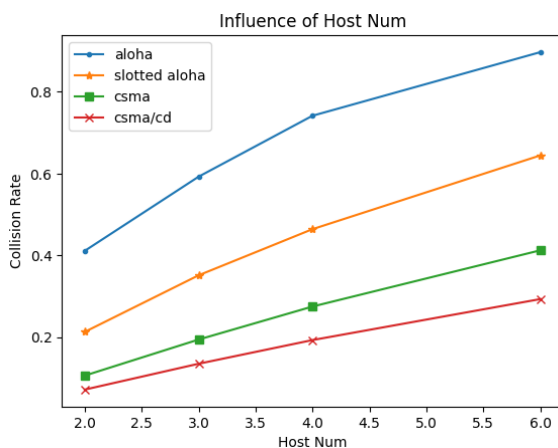

Figure c. collision rate

2. **Define two expressions, one for calculating "max_colision_wait_time" and another for calculating "p_resend", which should both include a coefficient parameter c ≥ 1 and other parameters.**

   - max_collision_wait_time = c * host_num * packet_time

   - p_resend = 1 / (c * host_num)

3. Redo the simulations from question 1 using the updated settings for all methods.

- host_num_list = [2,3,4,6]

- packet_num_list = [1200,800,600,400]

- Setting(host_num=h, packet_num=p, coefficient=1) for h,p in zip(host_num_list, packet_num_list)

In question 1, max_collision_wait_time and p_resend are constants. However, in this question, when host_num increases, max_collision_wait_time gets larger and p_resend gets smaller.

a. The larger the host_num, the higher the collision rate. However, if p_resend and max_collision_wait_time can be adjusted according to host_num, the slope of collision rate will be flattened.

b. For slotted aloha, in question 1, the larger the host_num, the lower the idle rate. But in this question, the larger the host_num, the higher the idle rate. That is because p_resend gets smaller so that the host is less likely to send packets.

c. The larger the host_num, the lower the success rate. However, if p_resend and max_collision_wait_time can be adjusted according to host_num, the decline of success rate will be flattened.
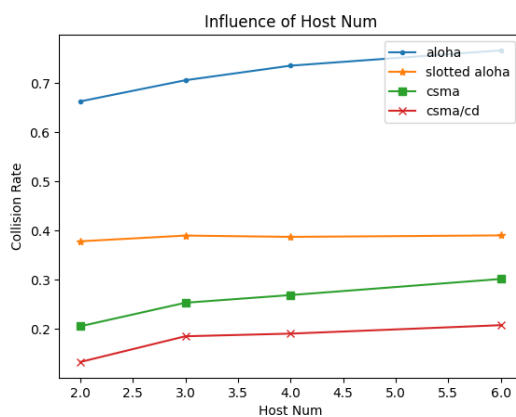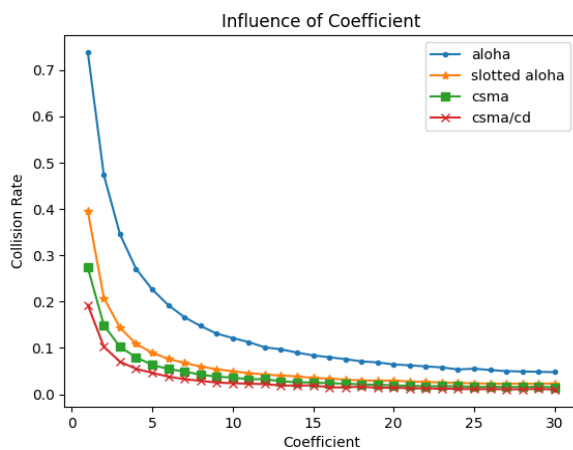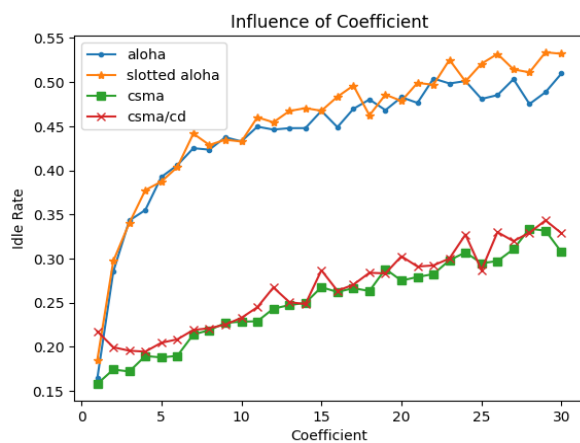

Figure a. collision rate
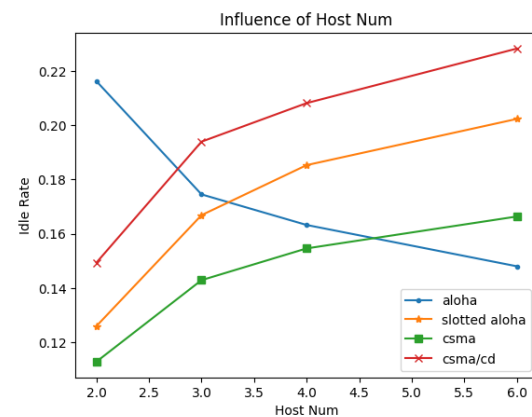
Figure b. idle rate
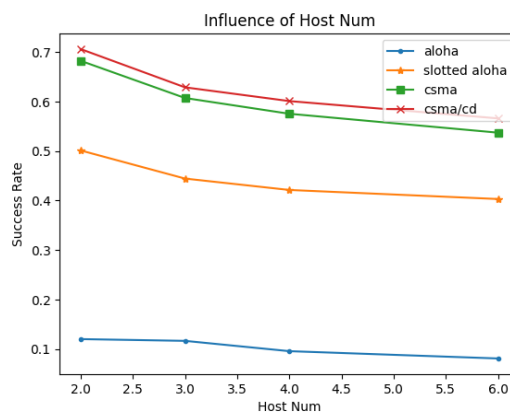
Figure c. success rate

4. What's the influence of "coefficient" in all methods? Apply the following settings.

- Setting(coefficient=c) for c in range(start=1, stop=31, step=1)

When coefficient increases, max_collision_wait_time gets larger and p_resend gets smaller. This means that the host is less likely to send packets, so collisions are less likely to occur and channels have more idle time.

a. The larger the coefficient, the lower the collision rate.

b. The larger the coefficient, the higher the idle rate.

c. The success rate increases initially, but when the coefficient exceeds a certain number, the collision rate begins to converge and the idle rate keeps rising. At this time, the success rate does not continue to increase.

Figure a. collision rate
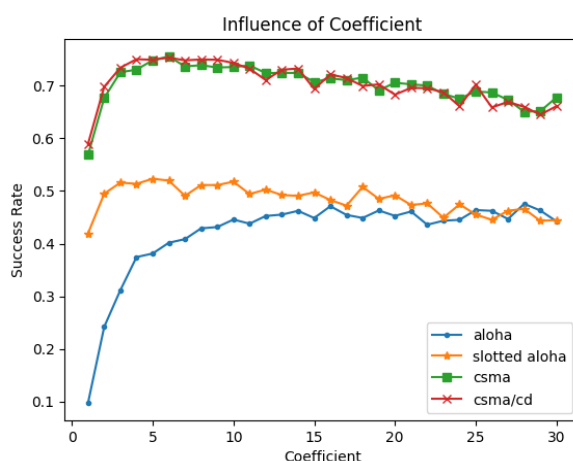
Figure b. idle rate

Figure c. success rate

5. What's the influence of "packet_num" in all methods? Apply the following settings

- Setting(packet_num=p) for p in range(start=100, stop=1050, step=50)

a. The larger the packet_num, the lower the idle rate. Furthermore, aloha and slotted aloha don't detect if someone else is sending before starting to send, so they need to spend more time waiting for retransmit.

b. The larger the packet_num, the higher the success rate. However, when the packet_num exceeds a certain number, the success rate does not continue to increase.

c. The larger the packet_num, the higher the collision rate. In addition, aloha has the highest collision rate.
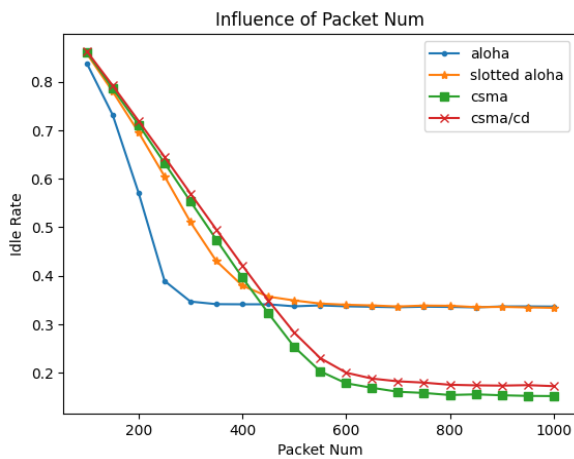
Figure a. idle rate
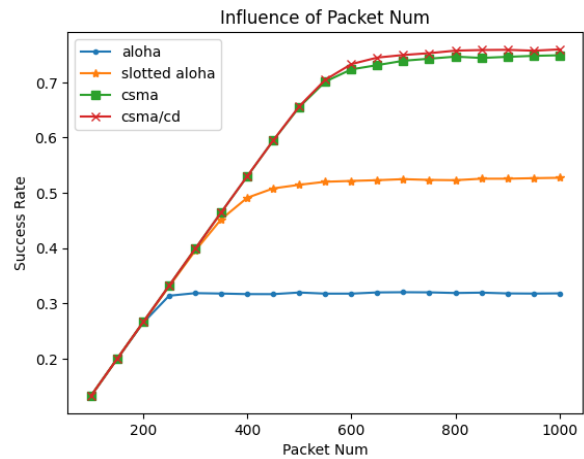
Figure b. success rate
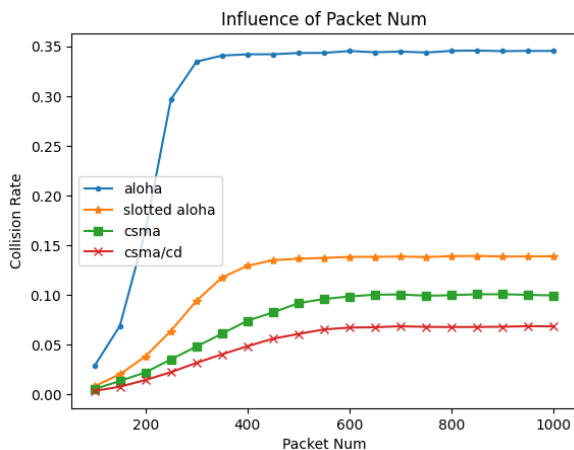
Figure c. collision rate

6. What's the influence of "host_num" in all methods? Apply the following settings.

- Setting(host_num=h) for h in range(start=1, stop=11, step=1)

a. The larger the host_num, the higher the success rate. But when the packet_num exceeds a certain number, the success rate does not continue to increase.

b. The larger the host_num, the higher the collision rate. Furthermore, aloha and slotted aloha don't do carrier sense before sending, so their collision rate is higher than csma and csma/cd.

c. As host_num goes higher, the the idle rate goes lower because there are always hosts occupying the channel.
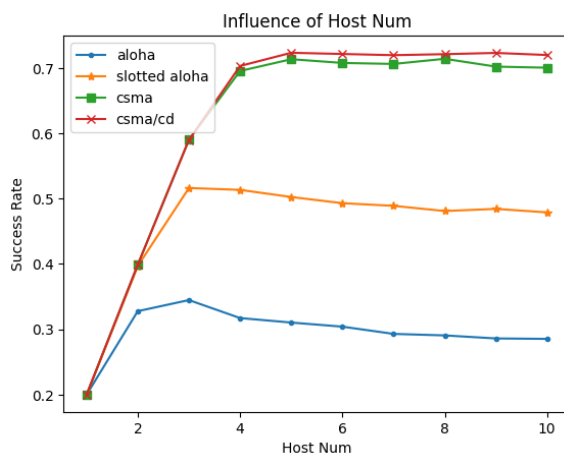
Figure a. success rate
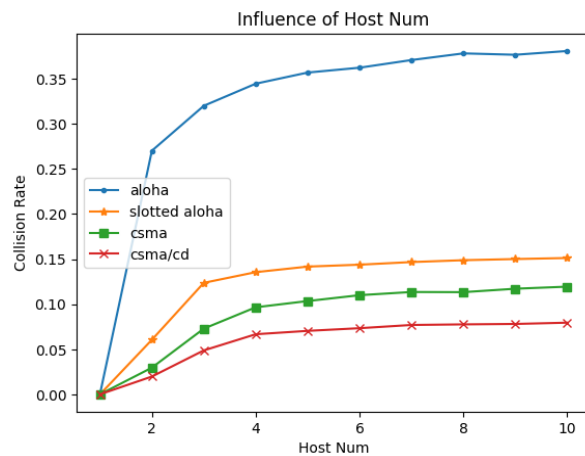
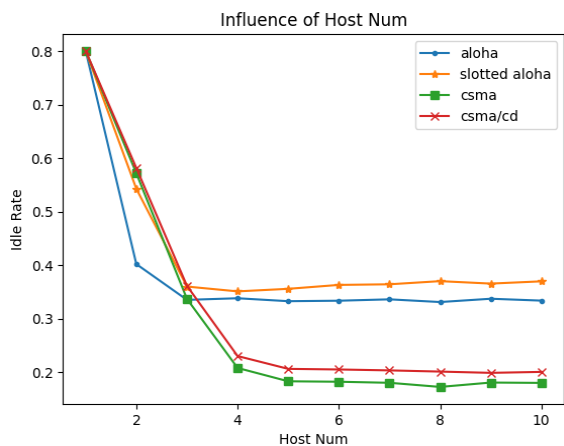**Figure b. collision rate**

Figure c. idle rate

7. What's the influence of "packet_size" in all methods? Apply the following settings.

- Setting(packet_size=p) for p in range(start=1, stop=20, step=1)

When packet_size increases, packet_time gets larger. This means that each packet takes longer to send.

a. The host is more likely to hear other hosts sending packets in csma or csma/cd due to the increase of packet_time. Thus, the larger the packet_size, the lower the collision rate. However, hosts don't detect before sending in aloha and slotted aloha, so the larger the packet_size, the higher the collision rate.

b. The larger the packet_size, the lower the idle rate because each packet takes longer to send.

c. The larger the packet_size, the higher the success rate. Moreover, hosts will do carrier sense in csma and csma/cd, so the slope of success rate will be steep.
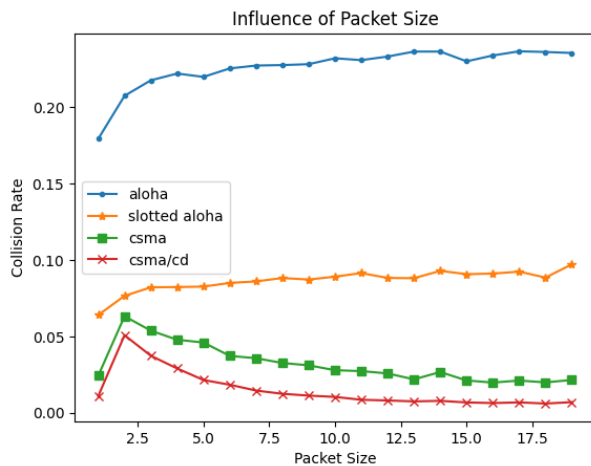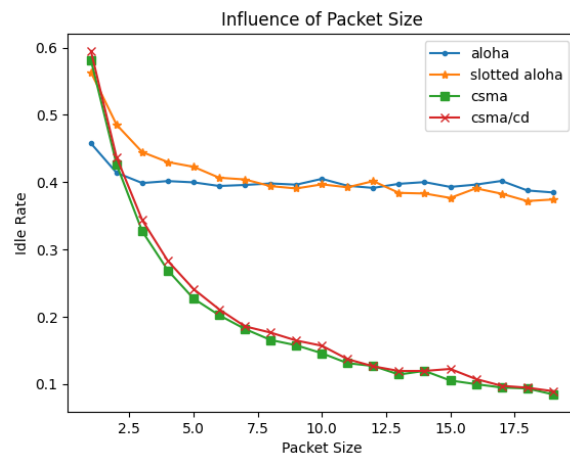

Figure a. collision rate
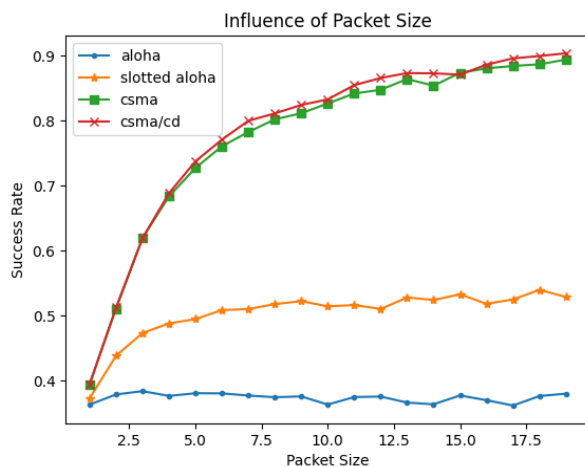

Figure b. idle rate

Figure c. success rate

8. What's the influence of "link_delay" in CSMA and CSMA/CD? Apply the following settings.

- ink_delay= [0,1,2,3]

- packet_size_list= [7,5,3,1]

- Setting(link_delay=l, packet_siz=p) for l,p in zip(link_delay_list, packet_size_list)

When link delay increases, the host will mistakenly think that the channel is empty and send packets. At this time, a collision occurs. Or, the host will mistakenly think that the channel is in use and will not send packets.

a. The larger the link delay, the higher the idle rate.

b. The larger the link delay, the higher the collision rate.

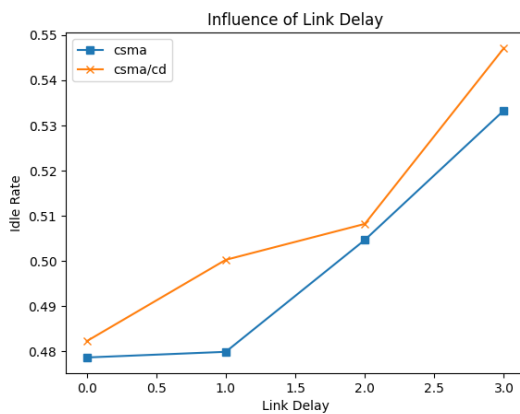c. The larger the link delay, the lower the success rate.
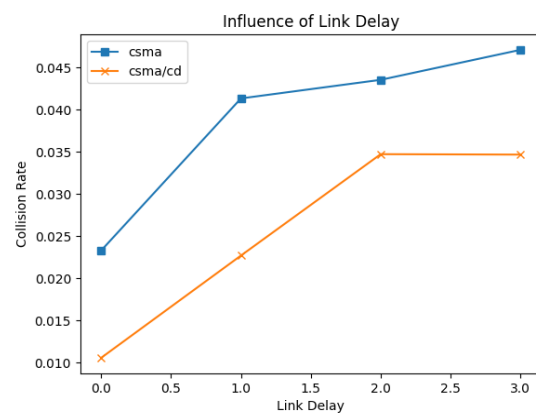

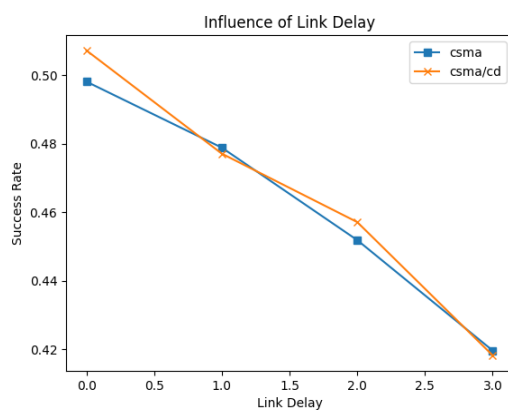**Figure a. idle rate**

Figure b. collision rate

Figure c. success rate