HW3

Question 1

Answer 1:

```
r0 = 1
a = 0.7
realrtt = 0.5
finalrtt = r0
for i in range(20):
    finalrtt = a * finalrtt + (1 - a) * realrtt
finalrtt
```

With this python simulation code, we can get the RTT-timeout(20) = 0.5004

Answer 2:

After changing $\alpha = 0.5$, RTT-timeout(20) = 0.5000

After changing $\alpha = 0.95$, RTT-timeout(20) = 0.679242961204271

We can find out when α is bigger, then the convergence is slower, when it is smaller, the convergence is faster, with the assumption that the real rtt never changes.

Question 2

1.

Time	**FIFO**		**Highest Priority**		**Round Robin**		**WFQ**	
	Packet	Delay	Packet	Delay	Packet	Delay	Packet	Delay
1	1	1	1	1	1	1	1	1
2	2	2	3	1	2	2	4	1
3	3	2	2	3	4	2	2	3
4	4	3	5	1	3	3	3	3
5	6	3	7	2	6	3	6	3
6	5	3	9	1	5	3	9	1
7	7	4	4	6	7	4	7	4
8	9	3	6	6	8	3	10	1

Time	FIFO		Highest Priority		Round Robin		WFQ	
9	8	4	11	1	11	1	5	6
10	10	3	8	5	9	5	12	2
11	11	3	10	4	12	3	8	6
12	12	4	12	4	10	5	11	4

2. Delay
   FIFO: 2.9167
   HP: 2.9167 (low priority: 1.167 high priority: 4.667) RR: 2.9167 (class 1: 3.289 class 2: 2.4) WFQ: 2.9167 (class 0: 2.25 class 1: 1.75 class 2: 4.75)
3. The average delays for them are the same. Class in HP with higher priority will have smaller delay and class in WFQ with higher weight tend to have smaller delay.

Question 3

Answer 1:

For subnet A, 128 addresses suffice;

For subnet B, 32 addresses suffice;

For subnet C, 32 addresses suffice;

So,

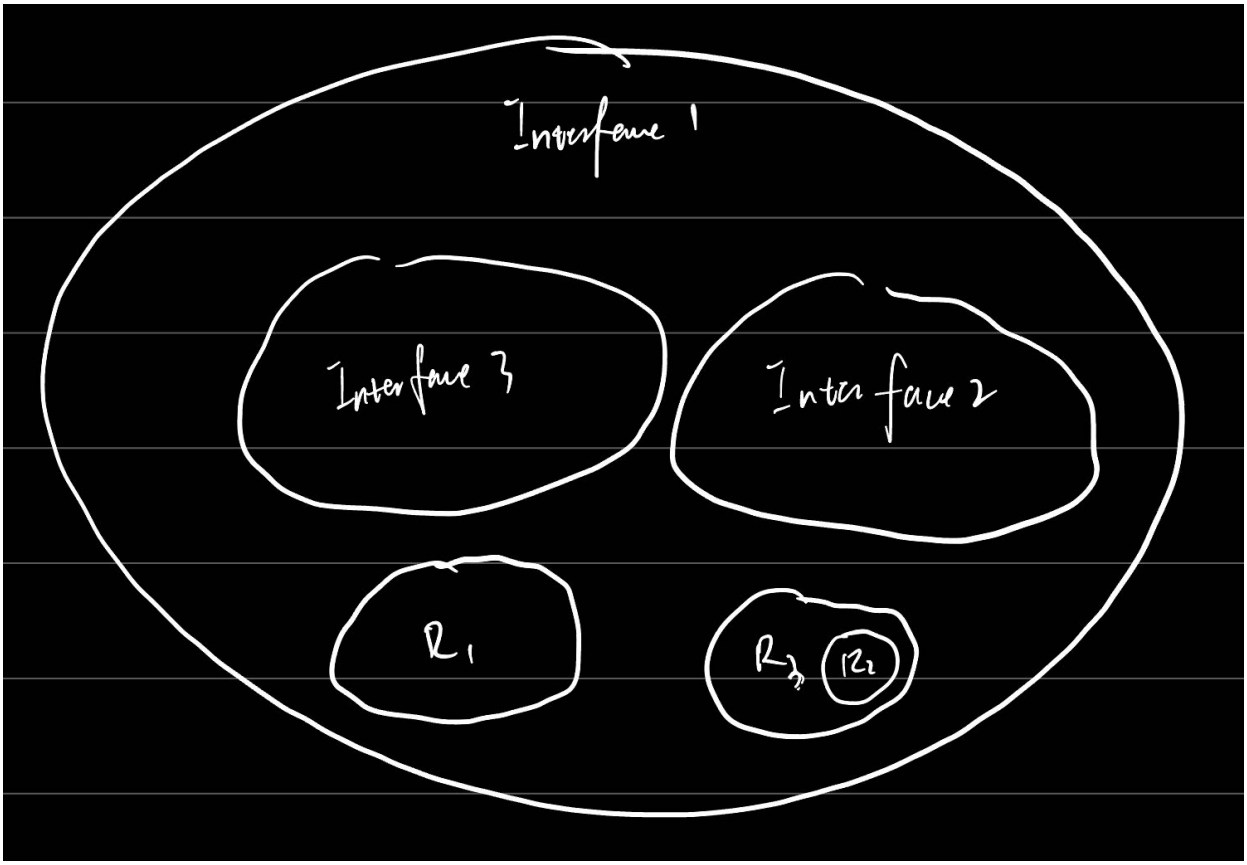
A: **200.20.15.0**0000000/25 = 200.20.15.0/25

B: **200.20.15.100**00000/27 = 200.20.15.128/27

C: **200.20.15.101**00000/27 = 200.20.15.160/27

Answer 2:

Here is the subnet relation:



Interface 1 128.174.240.0/20: **128.174.1111**0000.0/20, so $2^{12} - 2^{10} - 2^{10} - 2^7 - 2^3 = 1912$ address in total

R1 128.174.240.128/25: **128.174.240.1**0000000/25, so $2^7 = 128$ addresses in total

R2 128.174.240.17: 1 address in total

Interface 3 128.174.252.0/22: **128.174.111111**00.0/22, so $2^{10} = 1024$ addresses in total

R3 128.174.240.16/29: **128.174.240.00010**000, so $2^3 - 1 = 7$ addresses in total

Interface 2 128.174.248.0/22: **128.174.111110**00.0/22, so $2^{10} = 1024$ addresses in total

Answer 3:

(a) R2

(b) Interface 1

(c) Interface 2

(d) Interface 3

(e) Interface 4

(f) R3

Question 4

1. (1)Process runing on the host computer join the network and find a server by sending DHCP discover packet.

(2)The sever reponds with DHCP offer packet.
(3)Then host sends DHCP request
(4)Sever send DHCP ACK back.
Host gets the IP address from sever.

2. Yes, it's possible. Their private address can be translated to the same IP using NAT.
3. IPv6 is 128 bits long and will provide larger IP address space. IPv6 can be global dedicated so it can get rid of NAT.
4. IPv6 can still be converted to IPv4 using tunneling and continue using NAT service. NAT provides security, devices inside local net not explicitly addressable, visible by outside world (a security plus).

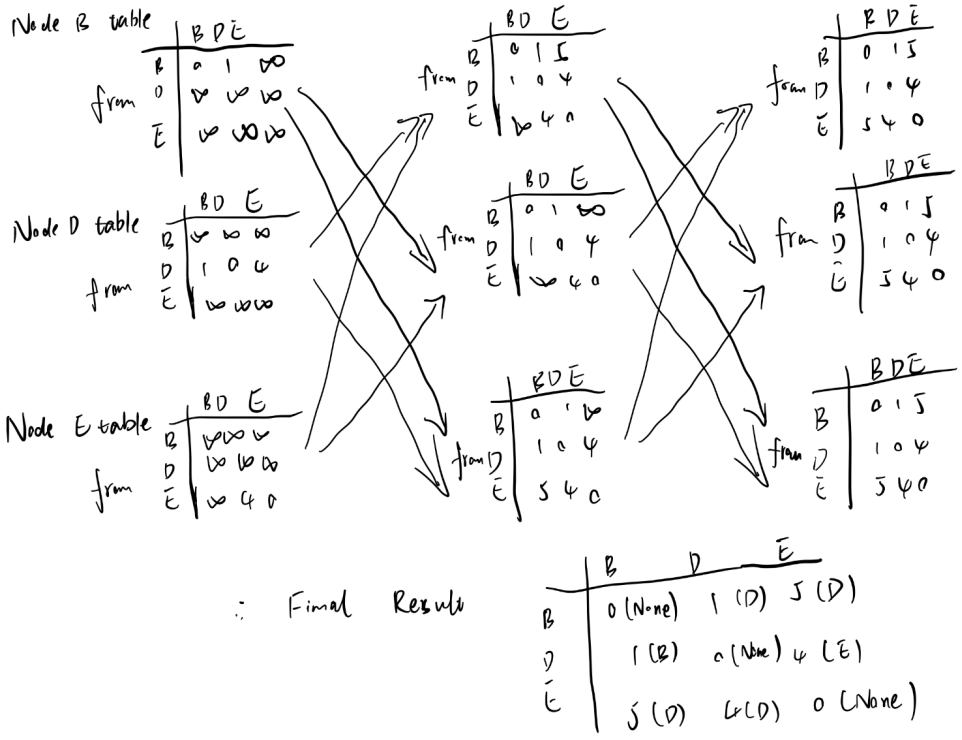
Question 5

Answer 1

Step	N	D(A)	D(B)	D(C)	D(D)	D(F)	D(G)
0	E	INF	INF	6, E	4, E	3, E	INF
1	EF	INF	INF	6, E	4, E		5, F
2	EFD	INF	5, D	6, E			5, F
3	EFDB	17, B		6, E			5, F
4	EFDBG	17, B		6, E			
6	EFDBGC	14, C					
7	EFDBGCA						

Answer 2

I only consider the route among B, D, E.



Answer 3

In each iteration, each row in the table means the distance between the destination node and that node in each of the node routing table; the first table is the distance table and the second table is the next hop table. I don't print all the entries in the routing table for the reason of making the homework clean, other wise I have to print 7 * 7×7 tables in one iteration.

Before Change

_	A	B	C	D	E	F	G
A	0.0	12.0	8.0	11.0	14.0	14.0	15.0
B	12.0	0.0	4.0	1.0	5.0	4.0	5.0
C	8.0	4.0	0.0	3.0	6.0	6.0	7.0
D	11.0	1.0	3.0	0.0	4.0	3.0	4.0
E	14.0	5.0	6.0	4.0	0.0	3.0	5.0
F	14.0	4.0	6.0	3.0	3.0	0.0	2.0
G	15.0	5.0	7.0	4.0	5.0	2.0	0.0

_	A	B	C	D	E	F	G
A	None	C	C	C	C	C	C
B	A	None	D	D	D	D	D
C	A	D	None	D	E	D	D

_	A	B	C	D	E	F	G
D	C	B	C	None	E	F	G
E	C	D	C	D	None	F	F
F	D	D	D	D	E	None	G
G	D	D	D	D	F	F	None

After Change (C to D increase to 30)

iteration 1

_	A	B	C	D	E	F	G
A	0.0	12.0	8.0	11.0	14.0	14.0	15.0
B	12.0	0.0	4.0	1.0	5.0	4.0	5.0
C	8.0	9.0	0.0	10.0	6.0	9.0	11.0
D	13.0	1.0	5.0	0.0	4.0	3.0	4.0
E	14.0	5.0	6.0	4.0	0.0	3.0	5.0
F	14.0	4.0	6.0	3.0	3.0	0.0	2.0
G	15.0	5.0	7.0	4.0	5.0	2.0	0.0

_	A	B	C	D	E	F	G
A	NA	C	C	C	C	C	C
B	A	NA	D	D	D	D	D
C	A	B	NA	B	E	E	E
D	B	B	B	NA	E	F	G
E	C	D	C	D	NA	F	F
F	D	D	D	D	E	NA	G
G	D	D	D	D	F	F	NA

iteration 2

_	A	B	C	D	E	F	G
A	0.0	12.0	8.0	13.0	14.0	16.0	17.0
B	12.0	0.0	6.0	1.0	5.0	4.0	5.0
C	8.0	9.0	0.0	10.0	6.0	9.0	11.0

_	A	B	C	D	E	F	G
D	13.0	1.0	5.0	0.0	4.0	3.0	4.0
E	14.0	5.0	6.0	4.0	0.0	3.0	5.0
F	16.0	4.0	8.0	3.0	3.0	0.0	2.0
G	16.0	5.0	8.0	4.0	5.0	2.0	0.0

_	A	B	C	D	E	F	G
A	NA	B	C	B	C	B	B
B	A	NA	D	D	D	D	D
C	A	B	NA	B	E	E	E
D	B	B	B	NA	E	F	G
E	C	D	C	D	NA	F	F
F	D	D	D	D	E	NA	G
G	F	D	F	D	F	F	NA

iteration 3

_	A	B	C	D	E	F	G
A	0.0	12.0	8.0	13.0	14.0	16.0	17.0
B	12.0	0.0	6.0	1.0	5.0	4.0	5.0
C	8.0	9.0	0.0	10.0	6.0	9.0	11.0
D	13.0	1.0	7.0	0.0	4.0	3.0	4.0
E	14.0	5.0	6.0	4.0	0.0	3.0	5.0
F	16.0	4.0	8.0	3.0	3.0	0.0	2.0
G	17.0	5.0	9.0	4.0	5.0	2.0	0.0

_	A	B	C	D	E	F	G
A	NA	B	C	B	C	B	B
B	A	NA	D	D	D	D	D
C	A	B	NA	B	E	E	E
D	B	B	B	NA	E	F	G
E	C	D	C	D	NA	F	F

_	A	B	C	D	E	F	G
F	D	D	D	D	E	NA	G
G	D	D	D	D	F	F	NA

iteration 4

_	A	B	C	D	E	F	G
A	0.0	12.0	8.0	13.0	14.0	16.0	17.0
B	12.0	0.0	8.0	1.0	5.0	4.0	5.0
C	8.0	9.0	0.0	10.0	6.0	9.0	11.0
D	13.0	1.0	7.0	0.0	4.0	3.0	4.0
E	14.0	5.0	6.0	4.0	0.0	3.0	5.0
F	16.0	4.0	9.0	3.0	3.0	0.0	2.0
G	17.0	5.0	10.0	4.0	5.0	2.0	0.0

_	A	B	C	D	E	F	G
A	NA	B	C	B	C	B	B
B	A	NA	D	D	D	D	D
C	A	B	NA	B	E	E	E
D	B	B	B	NA	E	F	G
E	C	D	C	D	NA	F	F
F	D	D	E	D	E	NA	G
G	D	D	F	D	F	F	NA

iteration 5

_	A	B	C	D	E	F	G
A	0.0	12.0	8.0	13.0	14.0	16.0	17.0
B	12.0	0.0	8.0	1.0	5.0	4.0	5.0
C	8.0	9.0	0.0	10.0	6.0	9.0	11.0
D	13.0	1.0	9.0	0.0	4.0	3.0	4.0
E	14.0	5.0	6.0	4.0	0.0	3.0	5.0
F	16.0	4.0	9.0	3.0	3.0	0.0	2.0

_	A	B	C	D	E	F	G
G	17.0	5.0	11.0	4.0	5.0	2.0	0.0

_	A	B	C	D	E	F	G
A	NA	B	C	B	C	B	B
B	A	NA	D	D	D	D	D
C	A	B	NA	B	E	E	E
D	B	B	B	NA	E	F	G
E	C	D	C	D	NA	F	F
F	D	D	E	D	E	NA	G
G	D	D	D	D	F	F	NA

iteration 6

_	A	B	C	D	E	F	G
A	0.0	12.0	8.0	13.0	14.0	16.0	17.0
B	12.0	0.0	9.0	1.0	5.0	4.0	5.0
C	8.0	9.0	0.0	10.0	6.0	9.0	11.0
D	13.0	1.0	9.0	0.0	4.0	3.0	4.0
E	14.0	5.0	6.0	4.0	0.0	3.0	5.0
F	16.0	4.0	9.0	3.0	3.0	0.0	2.0
G	17.0	5.0	11.0	4.0	5.0	2.0	0.0

_	A	B	C	D	E	F	G
A	NA	B	C	B	C	B	B
B	A	NA	C	D	D	D	D
C	A	B	NA	B	E	E	E
D	B	B	B	NA	E	F	G
E	C	D	C	D	NA	F	F
F	D	D	E	D	E	NA	G
G	D	D	F	D	F	F	NA

iteration 7

_	A	B	C	D	E	F	G
A	0.0	12.0	8.0	13.0	14.0	16.0	17.0
B	12.0	0.0	9.0	1.0	5.0	4.0	5.0
C	8.0	9.0	0.0	10.0	6.0	9.0	11.0
D	13.0	1.0	10.0	0.0	4.0	3.0	4.0
E	14.0	5.0	6.0	4.0	0.0	3.0	5.0
F	16.0	4.0	9.0	3.0	3.0	0.0	2.0
G	17.0	5.0	11.0	4.0	5.0	2.0	0.0

_	A	B	C	D	E	F	G
A	NA	B	C	B	C	B	B
B	A	NA	C	D	D	D	D
C	A	B	NA	B	E	E	E
D	B	B	B	NA	E	F	G
E	C	D	C	D	NA	F	F
F	D	D	E	D	E	NA	G
G	D	D	F	D	F	F	NA

Question 6

1. (a)
   d->a->c->e
   d->c->e
   d->b->e
   d->e
   (b) The path could be any path from d to a because it is controlled by a center plane, and it will give an optimal path. Note all path means simple path, without cycle.

2. Link State: In link state algorithms, each node maintains more state than distance vector algorithms. Each node has a local view of the network topology by maintaining a database containing information about the links and their costs for all other nodes in the network. The node uses this information to build a shortest path tree and calculate the optimal path to every other node. The link state algorithm uses Dijkstra's algorithm for routing, and Open Shortest Path First (OSPF) is a popular example. Nodes exchange link state advertisements (LSAs) to share information about their directly connected links and their costs, allowing them to build and update their local view of the network topology.

Distance Vector: In distance vector algorithms, each node maintains a routing table containing the distance (cost) to reach every other node in the network, along with the next hop information. The node does not maintain any knowledge about the entire network topology. The distance vector algorithm uses the Bellman-Ford algorithm for routing, and Routing Information Protocol (RIP) is a popular example. Nodes periodically exchange routing table updates with their direct neighbors, allowing them to learn about changes in the network.

Path Vector: In path vector algorithms, each node maintains even more state than link state algorithms. Each node maintains a routing table containing the complete path (list of nodes traversed) to reach every other node in the network. The path vector algorithm is designed to prevent routing loops and can be seen as an extension of the distance vector algorithm with additional information. Border Gateway Protocol (BGP) is a popular example of a path vector protocol. Nodes exchange path information with their neighbors, including the sequence of autonomous systems (ASes) traversed to reach a specific destination. This approach allows nodes to apply complex policies and filtering based on the AS path information, which contributes to the increased state maintained by each node.

stored states: Distance Vector < Link State < Path Vector