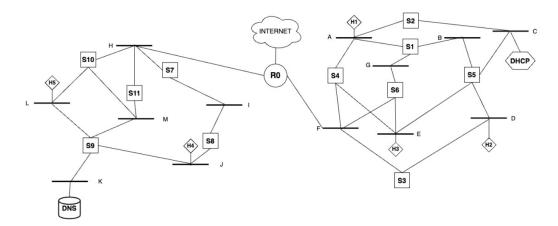
# Ex1 — Introduction to Networks

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## 1 Question 1

Given the following network graph:



- 1.1 The end unit H5 connects to the left network. Within it LAN there is noe DHCP server explain how the end unit H5 can get an IP address automatically.
- 1.1.1 Elaborate on the needed configuration such the end unit H5 will be able to get an IP address automatically.

Firstly we need to configure R0 to transfer DHCP requests to the other network. and vice versa.

- 1.1.2 named the massages that are used when H5 connects and request an IP address.
  - DHCP Discover in the left network.
  - R0 forwards the DHCP Discover to the right network.
  - DHCP Offer in the right network.
  - R0 forwards the DHCP Offer to the left network.
  - DHCP Request in the left network.
  - R0 forwards the DHCP Request to the right network.
  - DHCP Ack in the right network.
  - R0 forwards the DHCP Ack to the left network.
  - DHCP Ack in the left network.

# 1.2 Let's assume that unit H3 activated for the first time, and it want to send one massage to www.huji.ac.il (IP: 123.4.5.6) in the internet. Fill the table with all the massages sends.

The	Source IP	Destination IP	Source	Destination	Pro-	Massage Type	Explain
net-			MAC	MAC	tocol	~ · · ·	-
work							
Right	0.0.0.0	255.255.255.255	Н3	Brodcast	DHCP	DHCP Discover	BC3
Right	DHCP	255.255.255.255	DHCP	Brodcast	DHCP	DHCP Offer	BC3
Right	0.0.0.0	255.255.255.255	Н3	Brodcast	DHCP	DHCP Request	BC3
Right	DHCP	255.255.255.255	DHCP	Brodcast	DHCP	DHCP ACK	BC3
Right	-	-	Н3	R0(1)	ARP	ARP Request -	-
						DNS Server	
Left	-	-	R0(2)	Brodcast	ARP	ARP Request -	transfer the re-
						H3	quest for H3
Left	-	-	DNS	R0(2)	ARP	ARP Response -	R0 will transfer
						DNS Server	this
Right	-	-	R0(1)	H3	ARP	ARP Response -	-
						DNS Server	
Right	Н3	DNS	Н3	R0(1)	DNS	DNS Request -	-
						www.huji.ac.il	
Left	Н3	DNS	R0(2)	DNS	DNS	DNS Request -	-
						www.huji.ac.il	
Left	DNS	Н3	DNS	R0(2)	DNS	DNS Response -	-
						www.huji.ac.il	
Right	DNS	Н3	R0(1)	Н3	DNS	DNS Response -	-
						www.huji.ac.il	
Right	Н3	123.4.5.6	Н3	R0(1)	HTTP	HTTP Request -	-
						www.huji.ac.il	
Right	123.4.5.6	Н3	R0(1)	Н3	HTTP	HTTP Response	-
						- www.huji.ac.il	

# 2 Question 2

The parts in this questions are not depends on each other.

## 2.1 Part 1

## 2.1.1 subquestion 1

- Host send Request to local DNS server.
- Local DNS server send Request to Root DNS server.
- Root DNS server Response to Local DNS server the location of '.com' DNS server.
- Local DNS server send Request to '.com' DNS server.
- '.com' DNS server Response to Local DNS server the location of 'ns1.drekflix.com' DNS server.
- Local DNS server send Request for 'movies.local.drekflix.com' from 'ns1.drekflix.com' DNS server.
- 'ns1.drekflix.com' DNS server Response to Local DNS server the IP address of 'ns1.israel.drekflix.com'.
- Local DNS server send Request for 'movies.local.drekflix.com' from 'ns1.israel.drekflix.com' DNS server.
- 'ns1.israel.drekflix.com' DNS server Response to Local DNS server the IP address of 'movies.local.drekflix.com'.
- Local DNS server send Response to Host with the IP address of 'movies.local.drekflix.com'.

#### 2.1.2 subquestion 2

When one DNS server received a response from another DNS server and update the response in it chache, the TTL of this records define by the response DNS server as the Authorative DNS server.

#### 2.1.3 subquestion 3

'ns1.israel.drekflix.com' wants to be a load-balancing dns server and therefore it crucial to have a short TTL. The reason is that if the IP address of the server changes, the DNS server needs to update the records in the local DNS resolvers. If the TTL is long, the local DNS resolvers will not update the records and the traffic will not be balanced between the servers. the other dns servers can have a long TTL since they are not the load-balancing servers and the IP address of the servers is not changed frequently.

so we will receive the following TTLs:

- Root DNS server: return records with TTL in days.
- '.com' DNS server: return records with TTL in days.
- 'ns1.drekflix.com': return records with TTL in days.
- 'ns1.israel.drekflix.com': return records with TTL in minutes.

#### 2.2 Part 2

## 2.2.1 subquestion 1

Since there were a storm that cause dammage to the main DNS server, the DNS server is not available. The DNS server is the one that responsible for the domain '.mad'. And even the the Server who host the domain 'www.brass-monkey-saloon.mad' in order to resolve this address the Local DNS resolver needs first to resolve the domain '.mad'. Since the main DNS server is not available the Local DNS resolver can't resolve the domain '.mad' and therefore can't resolve the domain 'www.brass-monkey-saloon.mad'.

## 2.2.2 subquestion 2

The reasone why it takes time after the DNS server dammage until the traffic in Madripor failed is because the cached domain in the local DNS resolvers. The TTL of the records in the local DNS resolvers is not expired yet, and therefore the local DNS resolvers can still resolve the domains end with '.mad'. Since the resolvers are probably local and the storme dammage hit far away from the country, the local DNS resolvers can still resolve the domains.

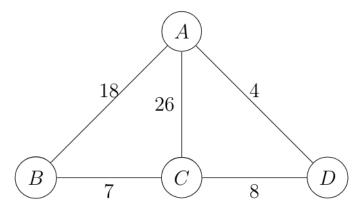
The time it takes until the traffic in Madripor failed is the time it takes until the TTL of the records in the local DNS resolvers expired.

# 3 Question 3

In Distance Vector Protocol we will split the time to synced time units between all vertexes donates as t1, t2, t3, ...

- In each time unit  $t_i$  each vertex that needs do those steps:
  - Send the distance vector to all neighbors.
  - Receive the distance vector that sent to him.
  - Update its distance vector.
- In Addition, when the weight of an edge changes, the connected vertexes will update their distance vector in the next time unit.

Given the following graph:



## 3.1 Subquestion 1

Node A

C D

assume that the net is stable for  $t_0$  and all the distance vectors are updated. we made a change in edge AB from 18 to 1. we will show the distance vectors of all the vertexes in the  $t_1, t_2$ 

This is the distance vectors of all the vertexes in the  $t_0$ :

 $\overline{\mathbf{C}}$ 

D

В

A	0	18	12	4
В	18	0	7	15
$^{\mathrm{C}}$	12	7	0	8
D	4	15	8	0
Node B	A	В	С	D
A	0	18	12	4
В	18	0	7	15
C	12	7	0	8
Node C	A	В	С	D
A	0	18	12	4
В	18	0	7	15

Node D	A	В	С	D
A	0	18	12	4
$^{\mathrm{C}}$	12	7	0	8
D	4	15	8	0

When the weight of the edge AB changes to 1, A,B imidiately update their distance vector and will send them in the next time unit  $t_1$ . Therefore this will be the effect on the changes

Node A	A	В	$\mathbf{C}$	D
A	0	1	8	4
В	18	0	7	15
$\mathbf{C}$	12	7	0	8
D	4	15	8	0
Node B	A	В	С	D
A	0	18	12	4
В	1	0	7	5
$\mathbf{C}$	12	7	0	8
Node C	A	В	С	D
Node C A	A 0	B 18	C 12	D 4
A	0	18	12	4
——————————————————————————————————————	0 18	18 0	12 7	4 15
А В С	0 18 12	18 0 7	12 7 0	4 15 8
A B C D Node D	0 18 12 4	18 0 7 15	12 7 0 8	4 15 8 0
A B C D	0 18 12 4 A	18 0 7 15 B	12 7 0 8	4 15 8 0

Now we will show the before and after with time unit  $\overline{t_1}$ 

After receiving the distance vectors from the neighbors

Node A	A	В	С	D
A	0	1	8	4
В	1	0	7	4 5 8
$\mathbf{C}$	12	7	0	8
D	4	15	8	0
Node B	A	В	С	D
A	0	1	8	4
В	1	0	7	5
$^{\mathrm{C}}$	12	7	0	8
	14	'		
Node C	A	В	С	D
				D 4
Node C A B	A	В	С	D 4 5
Node C A	A 0	B 1	C 8	D 4 5 8
Node C A B	A 0 1	B 1 0	C 8 7	D 4 5
Node C A B C	A 0 1 12	B 1 0 7	C 8 7 0	D 4 5 8
Node C A B C D Node D A	A 0 1 12 4	B 1 0 7 15 B	C 8 7 0 8	D 4 5 8 0 D
Node C A B C D	A 0 1 12 4	B 1 0 7 15 B	C 8 7 0 8 C	D 4 5 8 0

End of  $t_1$ 

Node A				
	A	В	С	D
A	0	1	8	4
В	1	0	7	5
С	12	7	0	8
D	4	15	8	0
Node B	A	В	С	D
A	0	1	8	4
В	1	0	7	5
С	12	7	0	8
Node C	A	В	С	D
A	0	1	8	4
-	1	0	7	l -
В	1	0	1	) Э
$^{\mathrm{B}}$	8	7	0	5 8
				$\begin{bmatrix} 5 \\ 8 \\ 0 \end{bmatrix}$
С	8	7	0 8	8 0 D
C D Node D A	8 4	7 15	0 8	8 0 D 4
C D Node D	8 4 A	7 15 B	0 8	8 0 D

Now we will show the before and after with time unit  $t_2$  After Receiving the distance vectors from the End of  $t_2$  neighbors

Node A	A	В	С	D
A	0	1	8	4
В С	1	0	8 7	$\begin{array}{c c} 4 \\ 5 \end{array}$
$\mathbf{C}$	8	7	0 8	8
D	4	5	8	0
Node B	A	В	С	D
A	0	1	8 7 0	4
В	1	0	7	4 5 8
$\mathbf{C}$	8	7	0	8
Node C	A	В	С	D
A	A 0	1	C 8	
A		B 1 0	C 8 7	D 4 5
— А В С	0	1	C 8 7 0	4 5 8
A	0	1 0	$\begin{bmatrix} 8 \\ 7 \\ 0 \\ 8 \end{bmatrix}$	4 5
A B C D Node D	0 1 8	1 0 7	$\begin{bmatrix} 8 \\ 7 \\ 0 \\ 8 \end{bmatrix}$	4 5 8
A B C D Node D	0 1 8 4 A 0	1 0 7 5 B	8 7 0 8 C	4 5 8 0
A B C D	0 1 8 4	1 0 7 5	$\begin{bmatrix} 8 \\ 7 \\ 0 \\ 8 \end{bmatrix}$	4 5 8 0

 $\Rightarrow$ 

Node A	A	В	С	D
A	0	1	8	4
			7	
$\overline{\mathrm{C}}$	$\begin{vmatrix} 1 \\ 8 \end{vmatrix}$	0 7	0	8
B C D	4	5	8	5 8 0
Node B	A	В	С	D
A	0	1	8	
В	1	0	7	4 5
$^{\mathrm{C}}$	8	7	0	8
	0	'	U	0
Node C	A	В		D
Node C A			С	D 4
Node C A	A 0	В		D 4 5
Node C	A	B 1	C 8 7	D 4 5
Node C A	A 0	B 1 0	C 8	D 4
Node C A B C	A 0 1 8	B 1 0 7	C 8 7 0	D 4 5
Node C A B C D Node D	A 0 1 8 4 A	B 1 0 7 5	C 8 7 0 8	D 4 5 8 0
Node C A B C D	A 0 1 8 4	B 1 0 7 5	C 8 7 0 8 C	D 4 5 8 0

## 3.2 Subquestion 2

Now the edge CD changes from 8 to 32. we will show the distance vectors of all the vertexes in the  $t_1, t_2, t_3$ 

This is the distance vectors of all the vertexes in the  $t_0$ :

Node A	A	В	С	D
A	0	18	12	4
В	18	0	7	15
$\mathbf{C}$	12	7	0	8
D	4	15	8	0
Node B	A	В	С	D
A	0	18	12	4
В	18	0	7	15
С	12	7	0	8
Node C	Α	В	С	D
riode C	A	D		ט
A A	0	18	12	4
A	0	18	12	4
A B	0 18	18 0	12 7	4 15
A B C	0 18 12	18 0 7	12 7 0	4 15 8
A B C D	0 18 12 4	18 0 7 15	12 7 0 8	4 15 8 0
A B C D	0 18 12 4	18 0 7 15 B	12 7 0 8	4 15 8 0

When the weight of the edge DC changes to 32, D,C imidiately update their distance vector and will send them in the next time unit  $t_1$ . Therefore this will be the effect on the changes

changes				
Node A	A	В	С	D
A	0	18	12	4
В	18	0	7	15
$\mathbf{C}$	12	7	0	8
D	4	15	8	0
Node B	A	В	С	D
A	0	18	12	4
В	18	0	7	15
$\mathbf{C}$	12	7	0	8
Node C	A	В	С	D
Node C A	A 0	B 18	C 12	D 4
A	0	18	12	4
A B	0 18	18 0	12 7	4 15
A B C	0 18 25	18 0 7	12 7 0	4 15 22
A B C D	0 18 25 4	18 0 7 15	12 7 0 8	4 15 22 0
A B C D	0 18 25 4	18 0 7 15 B	12 7 0 8	4 15 22 0 D
A B C D Node D	0 18 25 4 A	18 0 7 15 B 18	12 7 0 8 C 12	4 15 22 0 D

Now we will show the before and after with time unit  $\overline{t_1}$ 

After Receiving the distance vectors from the neighbors

11018110010				
Node A	A	В	С	D
A	0	18	12	4
В	18	0	7	15
$\mathbf{C}$	25	7	0	22
D	4	22	16	0
Node B	A	В	С	D
A	0	18	12	4
В	18	0	7	15
C	25	7	0	22
Node C	A	В	С	D
A	0	18	12	4
В	18	0	7	15
$^{\mathrm{C}}$	25	7	0	22
D	4	22	16	0
Node D	A	В	С	D
A	0	18	12	4
$\mathbf{C}$	25	7	0	22
D	4	22	16	0
<del>-</del>				-

End of  $t_1$ 

Node A	A	В	С	D
A	0	18	20	4
В	18	0	7	15
$\mathbf{C}$	25	7	0	22
D	4	22	16	0
Node B	A	В	С	D
A	0	18	12	4
В	18	0	7	22
C	25	7	0	22
Node C	A	В	С	D
A	0	18	12	4
В	18	0	7	15
$\mathbf{C}$	25	7	0	22
D	4	22	16	0
Node D	A	В	С	D
A	0	18	12	4
$\mathbf{C}$	25	7	0	22
C D	$\begin{array}{c} 25 \\ 4 \end{array}$	7 22	0 16	$\begin{array}{c} 22 \\ 0 \end{array}$

Now we will show the before and after with time unit  $\overline{t_2}$ 

After Receiving the distance vectors from the neighbors

Node A	A	В	С	D
A	0	18	20	4
В	18	0	7	22
$\mathbf{C}$	25	7	0	22
D	4	22	16	0
Node B	A	В	С	D
A	0	18	20	4
В	18	0	7	22
$^{\mathrm{C}}$	25	7	0	22
Node C	A	В	С	D
Node C A	A 0	B 18	C 20	
—————————————————————————————————————				D
A	0	18	20	D 4
—————————————————————————————————————	0 18	18 0	20 7	D 4 22
— А В С	0 18 25	18 0 7	20 7 0	D 4 22 22
A B C D	0 18 25 4	18 0 7 22	20 7 0 16	D 4 22 22 0
A B C D Node D	0 18 25 4	18 0 7 22 B	20 7 0 16	D 4 22 22 0 D

End of  $t_2$ 

 $\Rightarrow$ 

Node A	A	В	С	D
A	0	18	20	4
В	18	0	7	22
$\mathbf{C}$	25	7	0	22
D	4	22	16	0
Node B	A	В	С	D
A	0	18	20	4
В	18	0	7	22
С	25	7	0	22
Node C	A	В	С	D
A	0	18	20	4
В	18	0	7	22
~	~	_		
$^{\mathrm{C}}$	25	7	0	29
D D	$\begin{array}{ c c }\hline 25 \\ 4 \end{array}$	7 22	0 16	29 0
	_		_	
D Node D A	4	22	16	0
D Node D	4 A	22 B	16 C	0 D

Now we will show the before and after with time unit  $\overline{t_3}$ 

After Receiving the distance vectors from the neighbors

neignborb				
Node A	A	В	С	D
A	0	18	20	4
В	18	0	7	22
$\mathbf{C}$	25	7	0	29
D	4	22	24	0
Node B	A	В	С	D
A	0	18	20	4
В	18	0	7	22
$\mathbf{C}$	25	7	0	29
Node C	A	В	С	D
Node C A	A 0	B 18	C 20	D 4
A	0	18	20	4
A B	0 18	18 0	20 7	4 22
А В С	0 18 25	18 0 7	20 7 0	4 22 29
A B C D	0 18 25 4	18 0 7 22	20 7 0 24	4 22 29 0
A B C D	0 18 25 4	18 0 7 22 B	20 7 0 24	4 22 29 0
A B C D Node D	0 18 25 4 A 0	18 0 7 22 B 18	20 7 0 24 C 20	4 22 29 0 D 4

End of  $t_3$ 

Node A	A	В	С	D
A	0	18	25	4
В	18	0	7	22
$\mathbf{C}$	25	7	0	29
D	4	22	24	0
Node B	A	В	С	D
A	0	18	20	4
В	18	0	7	22
С	25	7	0	29
Node C	A	В	С	D
A	0	18	20	4
В	18	0	7	22
$\mathbf{C}$	25	7	0	29
D	4	22	24	0
Node D	A	В	С	D
A	0	18	20	4
$\mathbf{C}$	25	7	0	29
D	4	22	24	0

## 3.3 subquestion 3

Now we will show the run using the poisoned reverse technique.

The DV b	oforo	tha a	hane	0	$t_0$ The DV	often t	ho ab	on co	
Node A	A	В	C	D	$t_0 = \frac{ ext{The DV}}{ ext{Node A}}$	A A	В	C	$\Box$
A	0	18	12	4	$\frac{\text{Node A}}{A}$	0	18	12	4
В	18	0	7	15	В	18	$\begin{vmatrix} 10 \\ 0 \end{vmatrix}$	7	15
C	$\frac{10}{12}$	7	0	8	C	12	7	0	8
Ď	4	15	8	0	D	4	15	8	0
Node B	A	В	С	D	Node B	A	В	С	D
A	0	18	12	4	A	0	18	12	4
В	18	0	7	15	В	18	0	7	15
$\mathbf{C}$	12	7	0	8	$\mathbf{C}$	12	7	0	8
Node C	A	В	С	D	$\Rightarrow {\text{Node C}}$	A	В	С	D
A	0	18	12	4	$\overline{A}$	0	18	12	4
В	18	0	7	15	В	18	0	7	$\infty$
$\mathbf{C}$	12	7	0	8	$\mathbf{C}$	25	7	0	30
D	4	15	8	0	D	4	15	8	0
Node D	A	В	С	D	Node D	A	В	С	D
A	0	18	12	4	$\overline{A}$	0	18	$\infty$	4
$\mathbf{C}$	12	7	0	8	$\mathbf{C}$	12	7	0	8
D	4	15	8	0	D	4	22	32	0
The DV at					$t_1$ The DV				
Node A	A	В	С	D	Node A	A	В	С	D
A	0	18	12	4	A	0	18	25	4
В	18	0	7	15	В	18	0	7	15
$\mathbf{C}$	25	7	0	30	$^{ m C}$	25	7	0	30
D	4	22	32	0	D	4	22	32	0
Node B	A	В	С	D	Node B	A	В	С	D
A	0	18	12	4	A	0	18	12	4
В	18	0	7	15	В	18	0	7	22
С	25	7	0	30	⇒ <u>C</u>	25	7	0	30
Node C	A	В	С	D	Node C	A	В	С	D
A	0	18	12	4	$\overline{A}$	0	18	12	4
В	18	0	7	$\infty$	В	18	0	7	$\infty$
$\mathbf{C}$	25	7	0	30	$^{ m C}$	25	7	0	30
D	4	22	32	0	D	4	22	32	0
Node D	A	В	С	D	Node D	A	В	С	D
Α.	0	10	Ι	4	A	0	10	1	1

A C

D

  $\infty$ 

A

 $\mathbf{C}$ 

D

 $\begin{array}{c} 7 \\ 22 \end{array}$ 

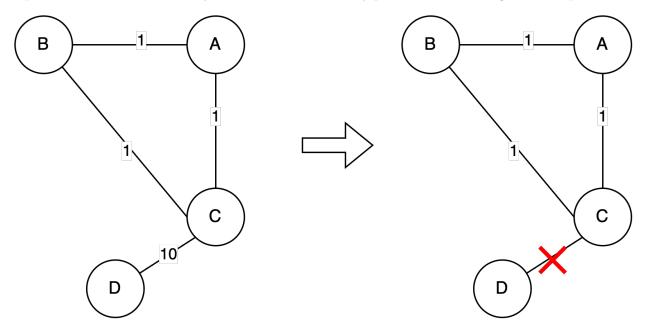
 $\infty$ 

 $\begin{array}{c} 0 \\ 32 \end{array}$ 

The DV aft	ter tl	ne cha	ange		$t_2$ The DV	after t	he ch	ange	
Node A	A	В	$\overline{C}$	D	Node		В	$\overline{C}$	D
A	0	18	25	4	A	0	18	25	4
В	18	0	7	22	В	18	0	7	22
$^{\mathrm{C}}$	25	7	0	30	$^{\mathrm{C}}$	25	7	0	30
D	4	22	32	0	D	4	22	32	0
Node B	A	В	С	D	Node	3 A	В	C	D
A	0	18	25	4	$\frac{1 \cdot 6 \cdot 6 \cdot 1}{A}$	0	18	25	4
В	18	0	7	22	В	18	0	7	22
$\overline{\mathbf{C}}$	25	7	0	30	$\overline{\mathrm{C}}$	25	7	0	30
Node C	A	В	С	D	$\Rightarrow {\text{Node } 0}$		В	C	D
A	0	18	25	4	$\overline{}$ A	0	18	25	4
В	18	0	7	22	В	18	0	7	22
$^{\mathrm{C}}$	25	7	0	30	$^{\mathrm{C}}$	25	7	0	29
D	4	22	32	0	D	4	22	32	0
Node D	A	В	С	D	Node	) A	В	С	D
A	0	18	25	4	$\overline{A}$	0	18	25	4
C	25	7	0	30	$^{\mathrm{C}}$	25	7	0	30
D	4	22	32	0	D	4	22	29	0
The DV aft					$t_3$ The DV				
Node A	A	В	С	D	Node		В	С	D
A	0	18	25	4	A	0	18	25	4
В	18	0	7	22	В	18	0	7	22
С	25	7	0	29	C	25	7	0	29
D	4	22	29	0	D	4	22	29	0
Node B	A	В	С	D	Node		В	С	D
A	0	18	25	4	$\overline{\hspace{1cm}}$ A	0	18	25	4
В	18	0	7	22	В	18	0	7	22
C	25	7	0	29	⇒ <u>C</u>	25	7	0	29
Node C	A	В	С	D	Node	CA	В	С	D
A	0	18	25	4	$\overline{A}$	0	18	25	4
В	18	0	7	22	В	18	0	7	22
C	25	7	0	29	$\mathbf{C}$	25	7	0	29
D	4	22	29	0	D	4	22	29	0
Node D	A	В	С	D	Node		В	С	D
A		4.0	~ =	4	${}$ A	0	18	25	4
	0	18	25	4				23	
C D	$\begin{array}{c} 0 \\ 25 \\ 4 \end{array}$	18 7 22	$ \begin{array}{c} 25 \\ 0 \\ 29 \end{array} $	29	C D	$\begin{bmatrix} 0\\25\\4 \end{bmatrix}$	$\begin{bmatrix} 16 \\ 7 \\ 22 \end{bmatrix}$	$\begin{bmatrix} 25 \\ 0 \\ 29 \end{bmatrix}$	29

## 3.4 subquestion 4

No, poisoned reverse does not always solve the count to infinity problem in networking. For example If



When link breaks, C marks D as unreachable and reports that to A and B.

- Suppose A learns it first
  - A now thinks best path to D is through B
  - A reports D unreachable to B and a route of cost=3 to C
- C thinks D is reachable through A at cost 4 and reports that to B
- B reports a cost 5 to A who reports new cost to C
- $\bullet$  etc...

**Note** that in this case the loop will occur at each step (it won't halt)