Communication Networks

Spring 2024

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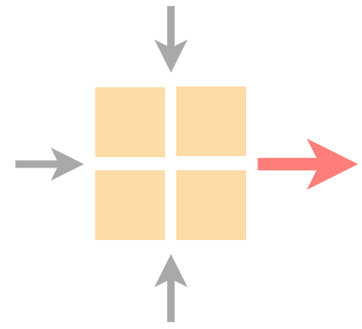
Slides adapted from
Thomas Holterbach and Coralie Busse-Grawitz

Communication Networks

Exercise 5



Avoiding convergence issues in Bellman-Ford

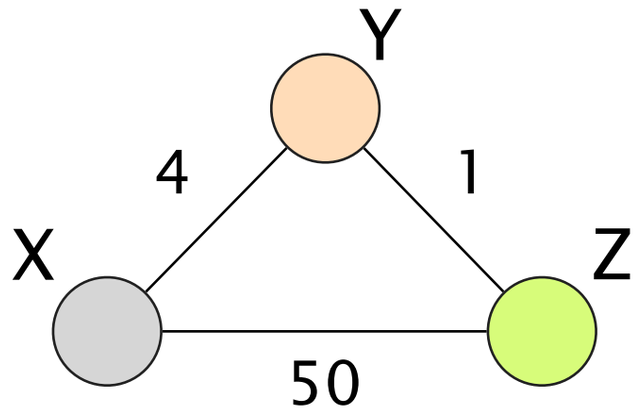
Introduction to this week's exercise

Time to solve the exercise

In the lecture we saw that

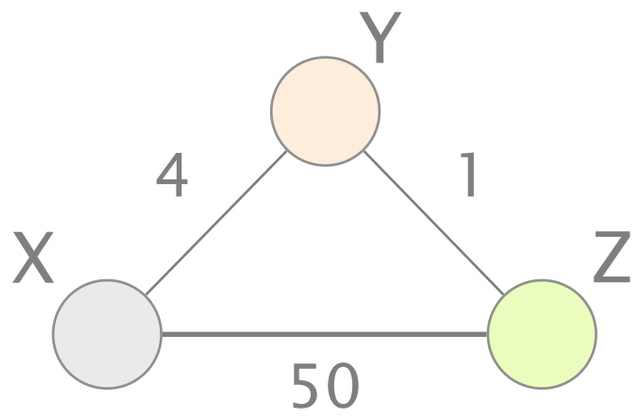
Bellman-Ford may lead to slow convergence

Consider the following network



Consider the following network

leading to the following vectors



Y vector

dest.	via	
	X	Z
X	4	6

Y routes to X directly

Z vector

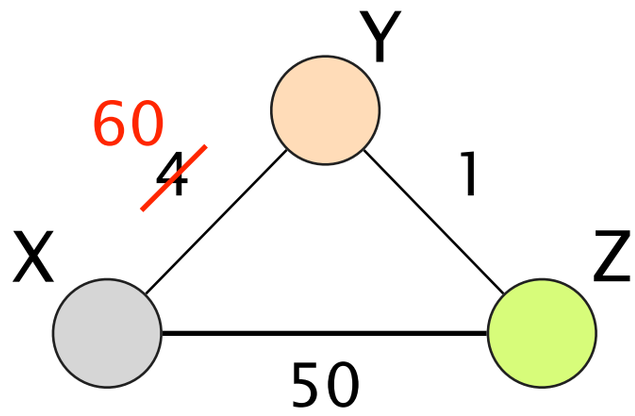
dest.	via	
	X	Y
X	50	5

Z routes to X via Y

t = 0

(X,Y) weight changes

from 4 to 60



time t=0

Y
vector

dest.	via X	via Z
X	4	6

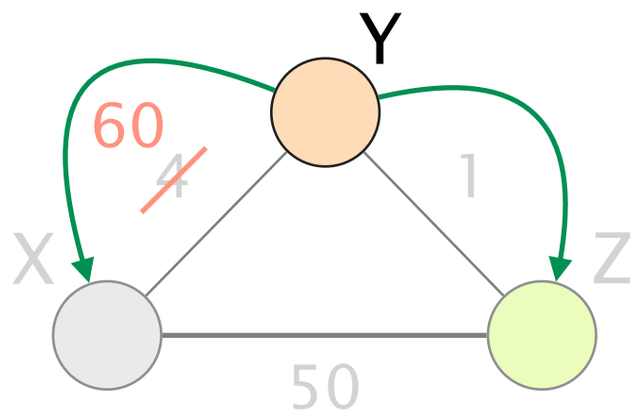
Z
vector

dest.	via X	via Y
X	50	5

t = 1

Y updates its vector,

sends it to X and Z



t=0

Y vector

dest.	via X	via Z
X	4	6

t=1

dest.	via X	via Z
X	60	6

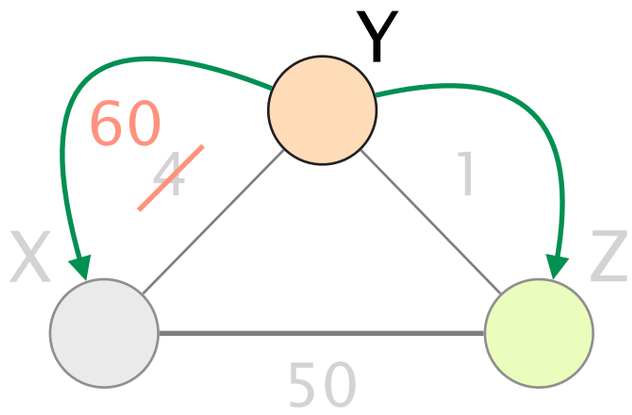
Z vector

dest.	via X	via Y
X	50	5

t = 1

we have a routing loop:

packets to X ping-pong between Y-Z



t=0 t=1

Y vector

dest.	via X	via Z
X	4	6

dest.	via X	via Z
X	60	6

Y routes to X via Z

Z vector

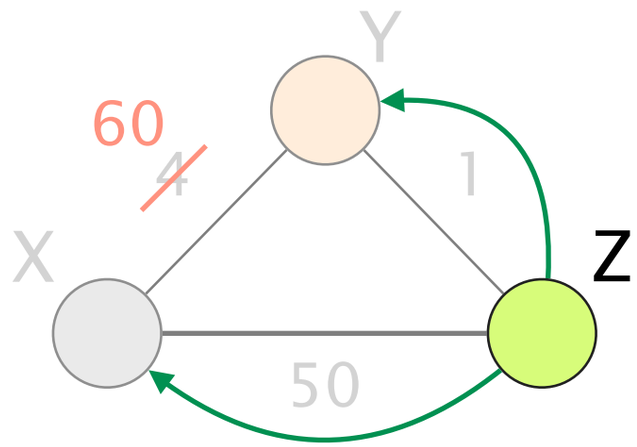
dest.	via X	via Y
X	50	5

Z routes to X via Y

t = 2

Z updates its vector,

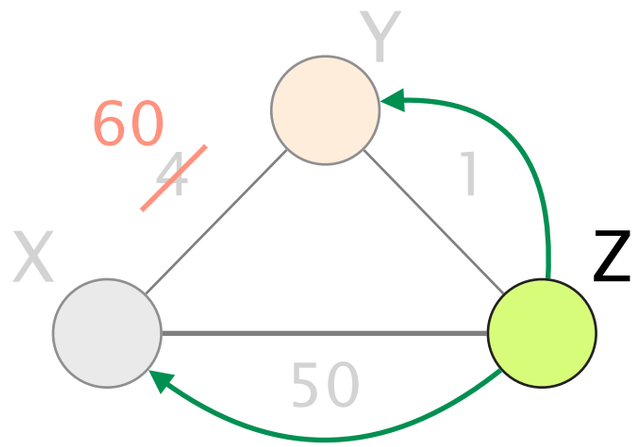
sends it to X and Y



	t=0	t=1	t=2
Y vector	dest. via X Z X 4 6	dest. via X Z X 60 6	
Z vector	dest. via X Y X 50 5		dest. via X Y X 50 7

t = 2

the routing loop continues



t=0 t=1 t=2

Y vector

dest.	via		dest.	via		dest.	via	
	X	Z		X	Z		X	Z
X	4	6	X	60	6			

Y routes to X via Z

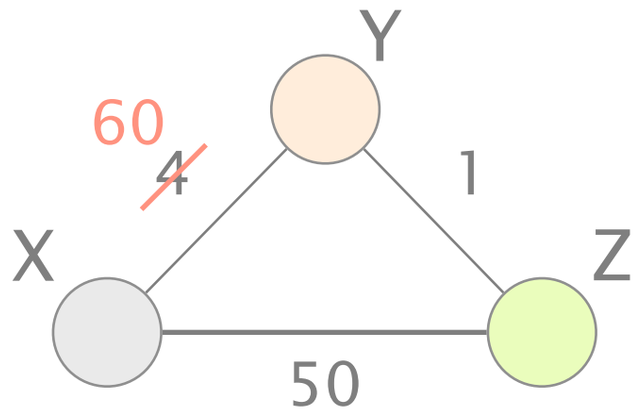
Z vector

dest.	via		dest.	via	
	X	Y		X	Y
X	50	5	X	50	7

Z routes to X via Y

t = 46

the routing loop finishes



t=45

Y
vector

dest.	via	
	X	Z
X	60	50

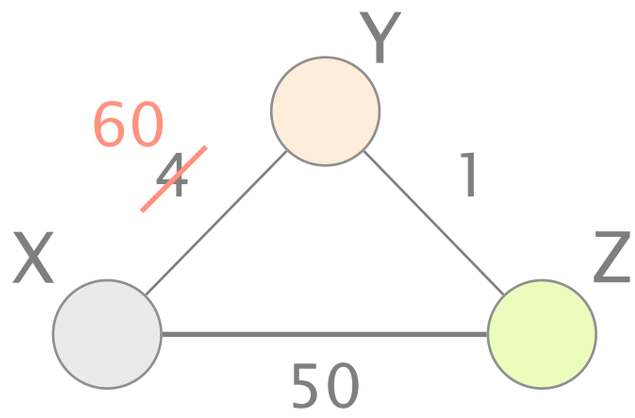
Z
vector

t=46

dest.	via	
	X	Y
X	50	51

t = 48

the network converges



t=45

Y
vector

dest.	via X	via Z
X	60	50

t=46

dest.	via X	via Y
X	50	51

Z
vector

t=47

dest.	via X	via Z
X	60	51

t=48

dest.	via X	via Y
X	50	52

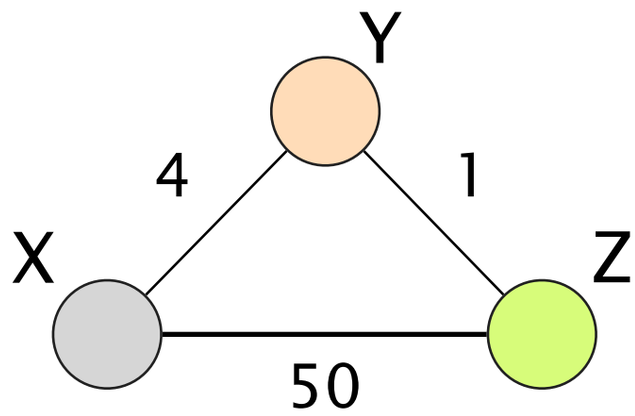
Let’s try to

fix routing loops and slow convergence

Whenever a router (say X) uses another one (say Y),

X will announce to Y an infinite cost

The technique is known as poisoned reverse



Y
vector

dest.	via X	via Z
X	4	∞

As Z routes to X via Y,

Z announces to Y an infinite cost

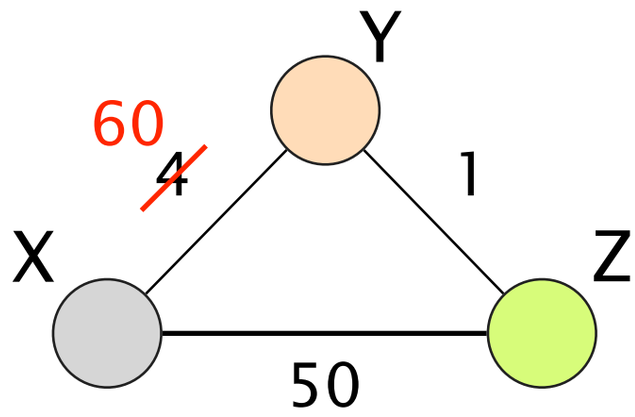
Z
vector

dest.	via X	via Y
X	50	5

t = 0

(X,Y) weight changes

from 4 to 60



t=0

Y
vector

dest.	via X	via Z
X	4	∞

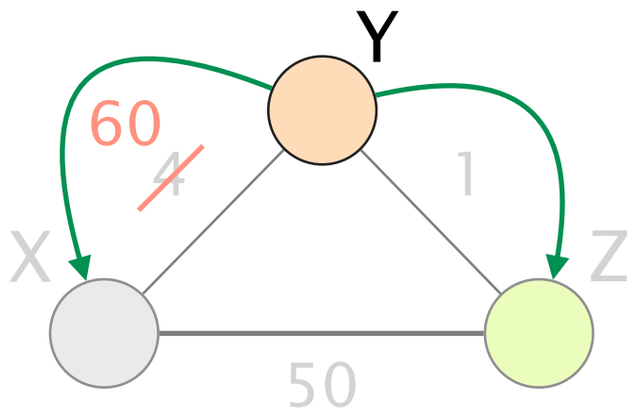
Z
vector

dest.	via X	via Y
X	50	5

t = 1

Y updates its vector,

sends it to X and Z

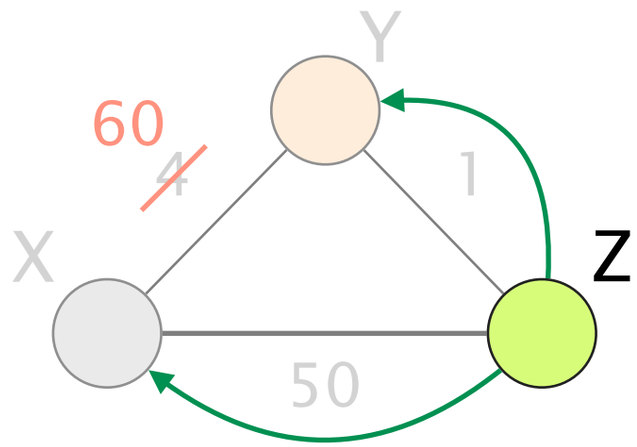


	t=0		t=1	
Y vector	dest.	via X Z	dest.	via X Z
	X	4 ∞	X	60 ∞
Z vector	dest.	via X Y		
	X	50 5		

t = 2

Z updates its vector,

sends it to X and Y

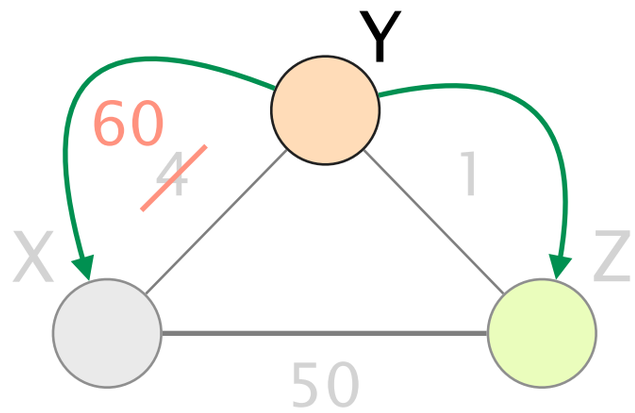


	t=0		t=1		t=2	
Y vector	dest.	via X Z	dest.	via X Z		
	X	4 ∞	X	60 ∞		
Z vector	dest.	via X Y			dest.	via X Y
	X	50 5			X	50 61

t = 3

Y updates its vector,

sends it to X and Z

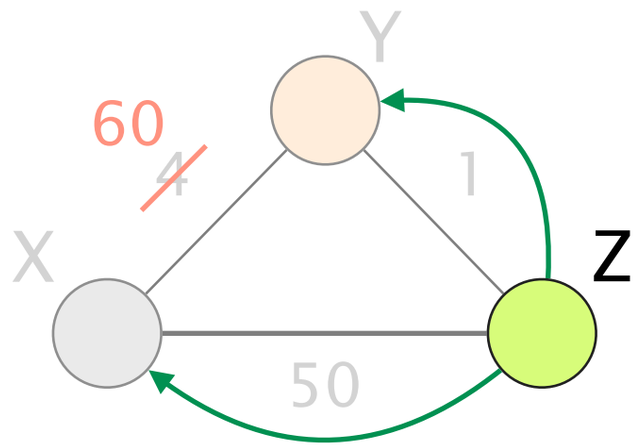


	t=0	t=1	t=2	t=3
Y vector	dest. via X Z	dest. via X Z		dest. via X Z
	X 4 ∞	X 60 ∞		X 60 51
Z vector	dest. via X Y		dest. via X Y	
	X 50 5		X 50 61	

t = 4

Z updates its vector,

sends it to X and Y



t=4

Y
vector

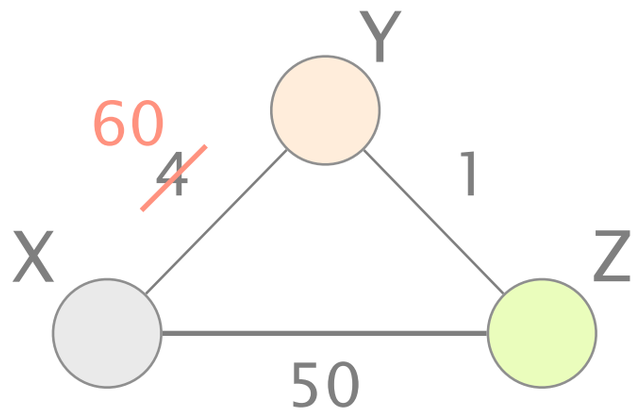
Z
vector

dest.	via	
	X	Y
X	50	∞

t > 4

no one updates its vector

network has converged!



t=4 t>4

Y vector

dest.	via X	via Z
X	60	51

Z vector

dest.	via X	via Y
X	50	∞

dest.	via X	via Y
X	50	∞

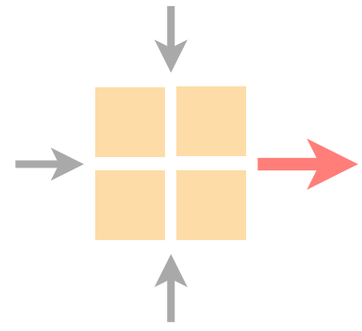
While poisoned reverse solved this case,

it does not solve converge issues in general

see exercise task 1

Communication Networks

Exercise 5

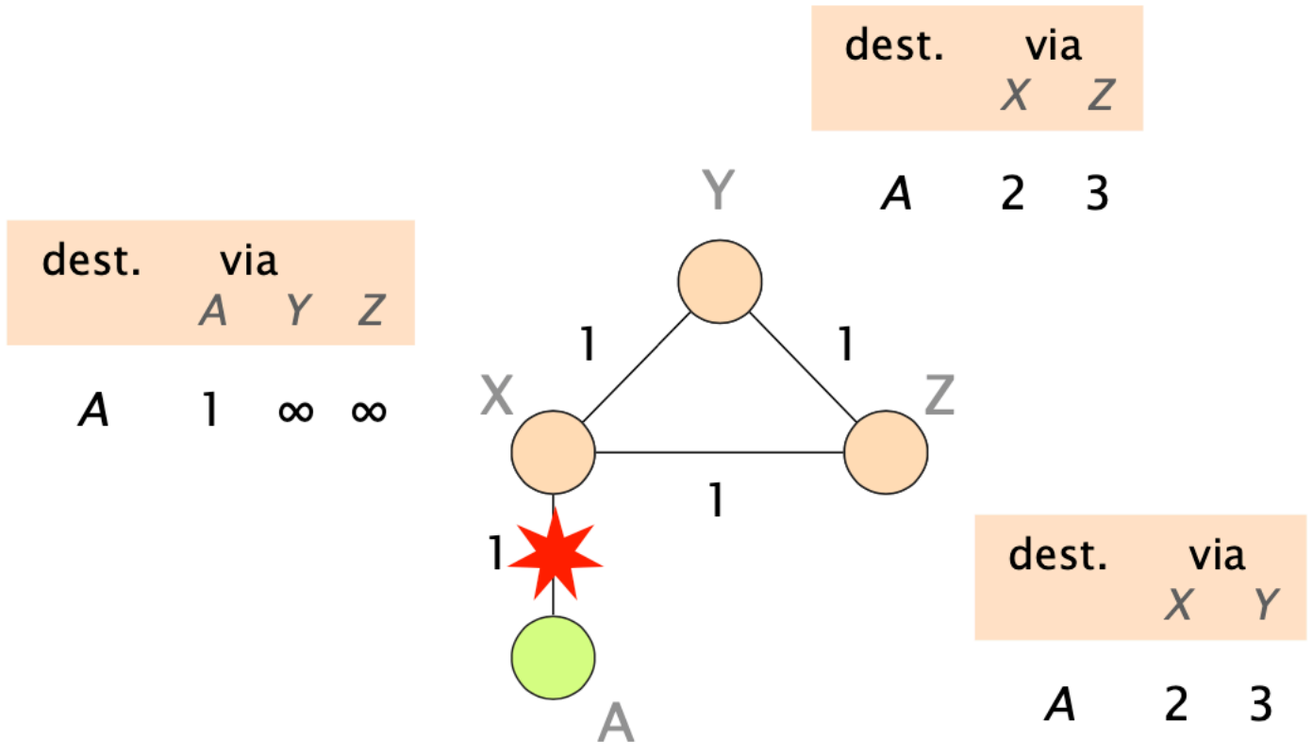


Avoiding convergence issues in Bellman-Ford

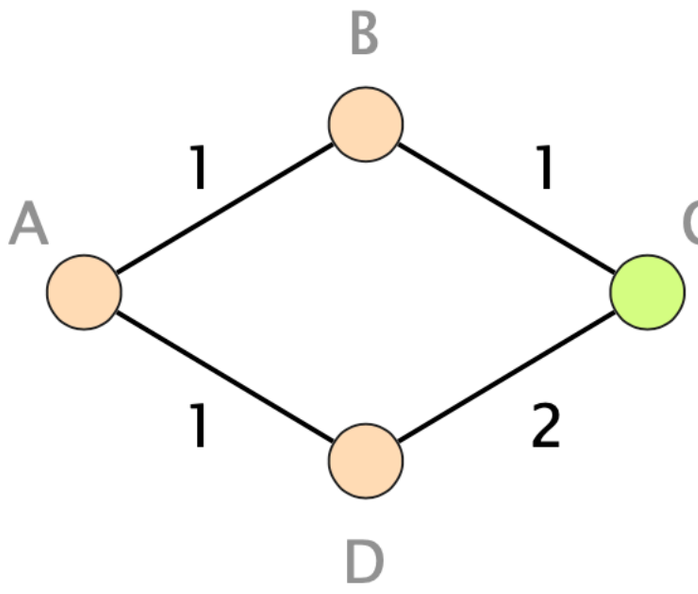
Introduction to this week's exercise

Time to solve the exercise

Task 1: Convergence with Poisoned Reverse



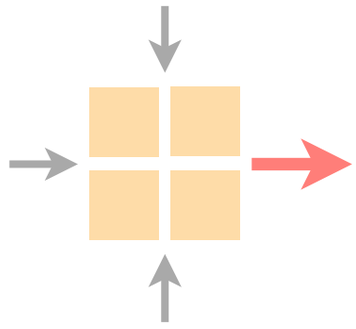
Task 2: Convergence (Exam-Style Question)



Loopy or not?

Communication Networks

Exercise 5



Avoiding convergence issues in Bellman-Ford

Introduction to this week's exercise

Time to solve the exercise