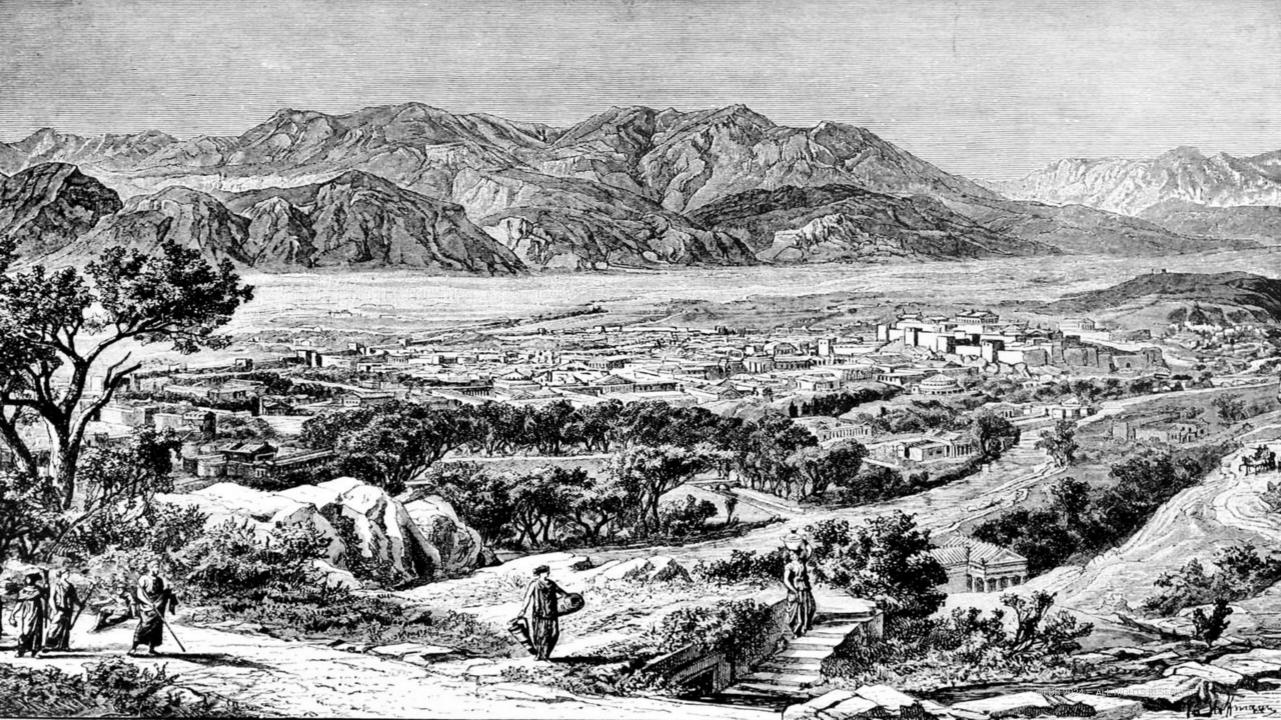
# Sparta's Dual Kingship and PostgreSQL active-active

Boriss Mejías Holistic System Software Engineer Air Guitar Player 23<sup>rd</sup> of October, 2024 – PgConf EU





## Sparta's Dual Kingship and PostgreSQL Active-Active Mirage

image from wikipedia: Sparta

# How can we deploy active-active in PostgreSQL?



## It depends



## It depends You don't need active-active



## It depends



### Why do you need active-active? What is actually the problem?



#### Scale-out

## High Availability

### Geo Redundancy



#### "If you want to do history, you have to be committed to getting it right, rather than being right." *Michael Livingston according to Myke Cole*



#### databases "If you want to do history, you have to be committed to getting it right, rather than being right." *Michael Livingston according to Myke Cole*



computer science active-active PostgreSQL databases "If you want to do history, you have to be committed to getting it right, rather than being right." Michael Livingston according to Myke Cole



#### origin

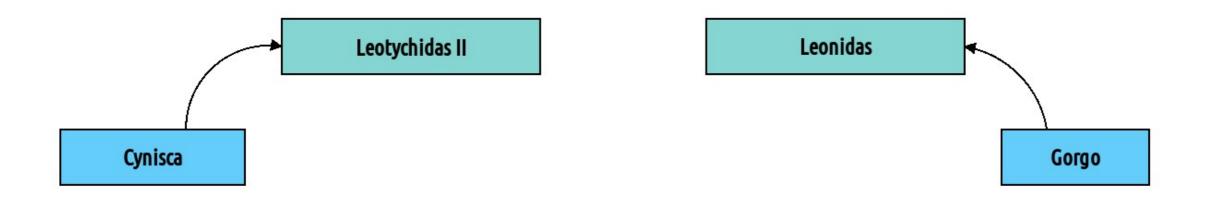


#### origin=none

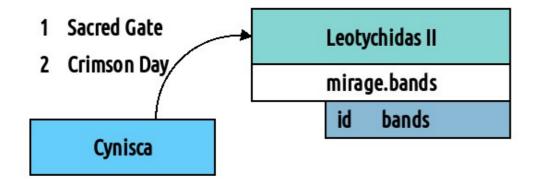


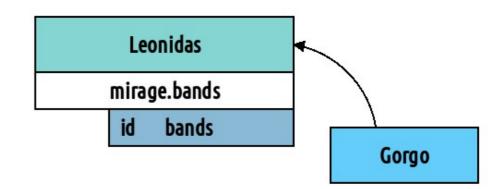
#### CREATE SUBSCRIPTION sub\_eurypontid CONNECTION 'host=agis dbname=sparta user=sparta' PUBLICATION agiad WITH (origin=none);

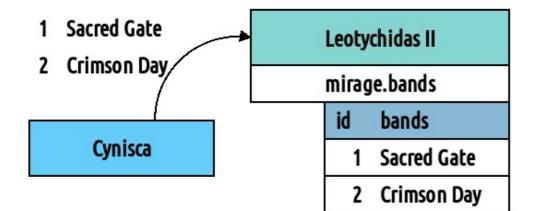


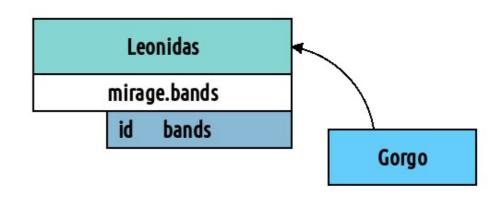


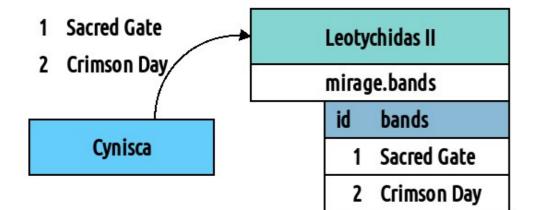


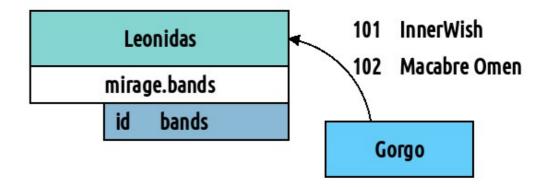


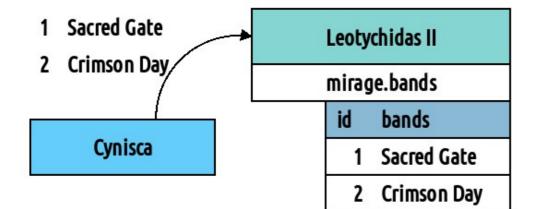


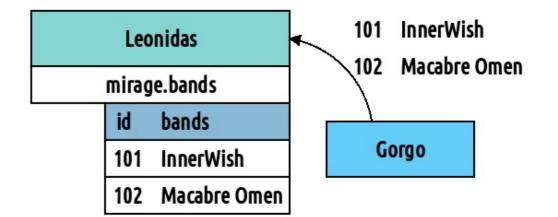


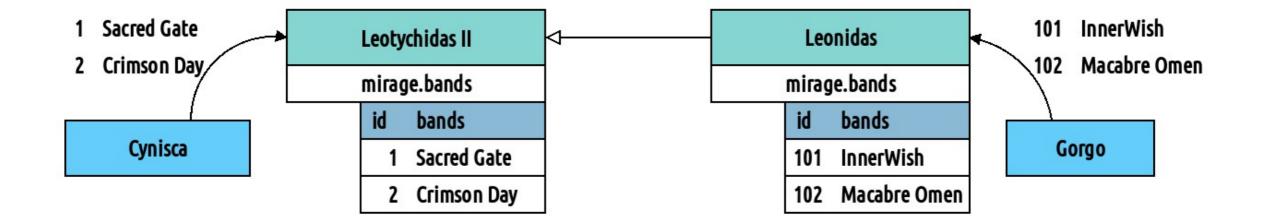


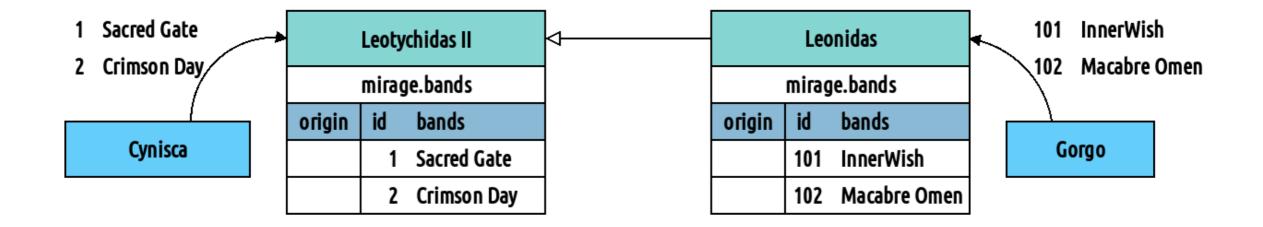


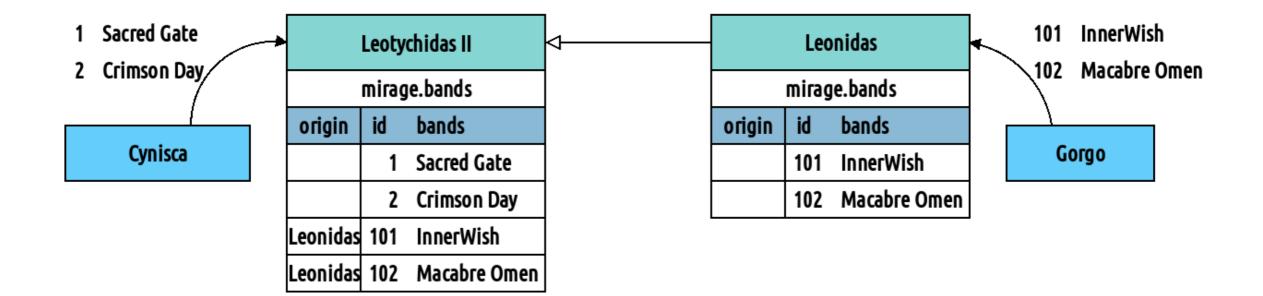


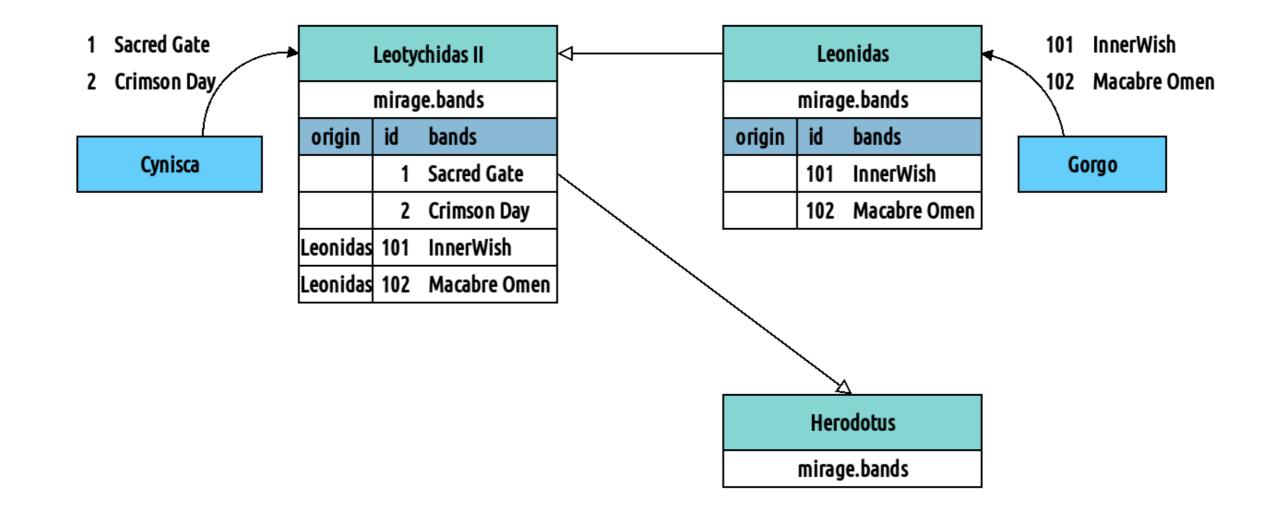


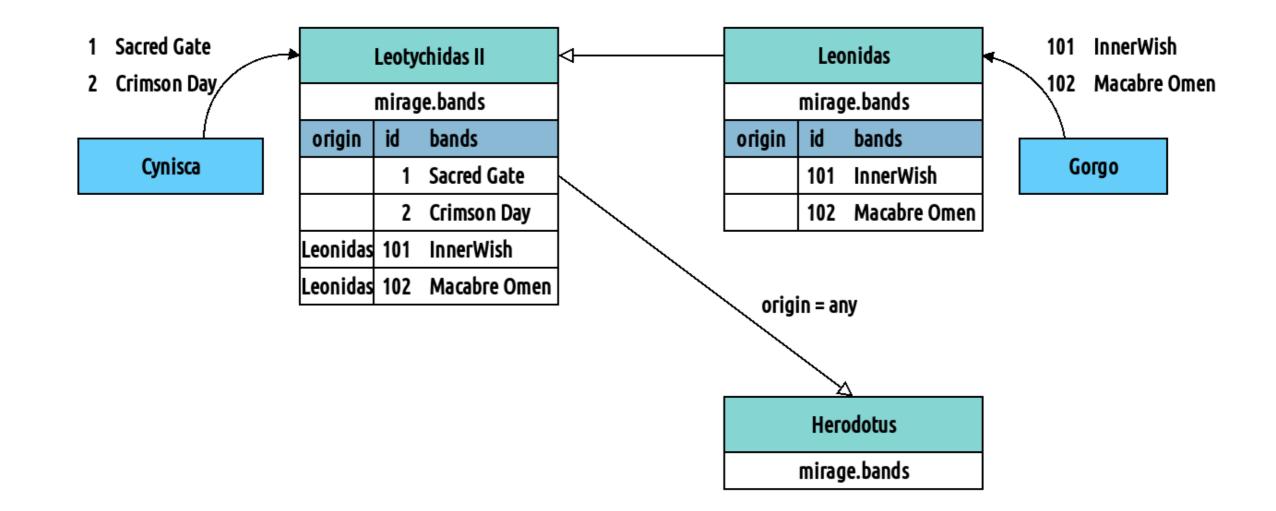


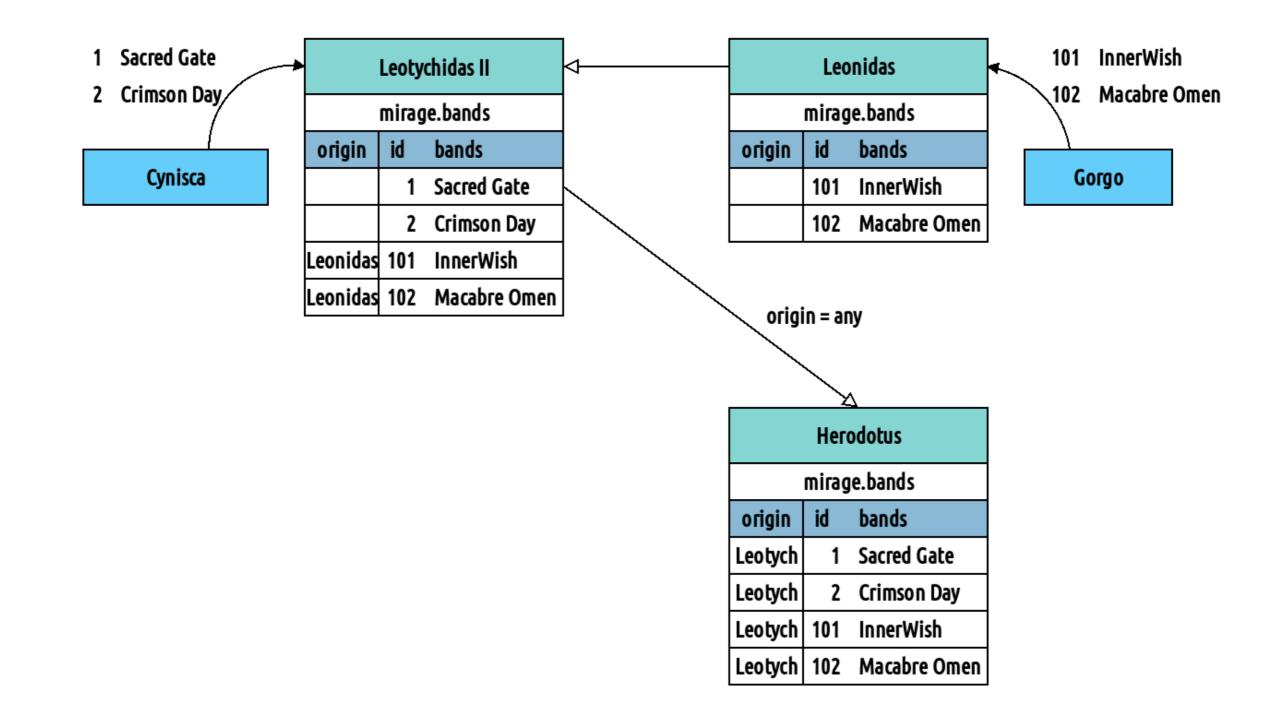


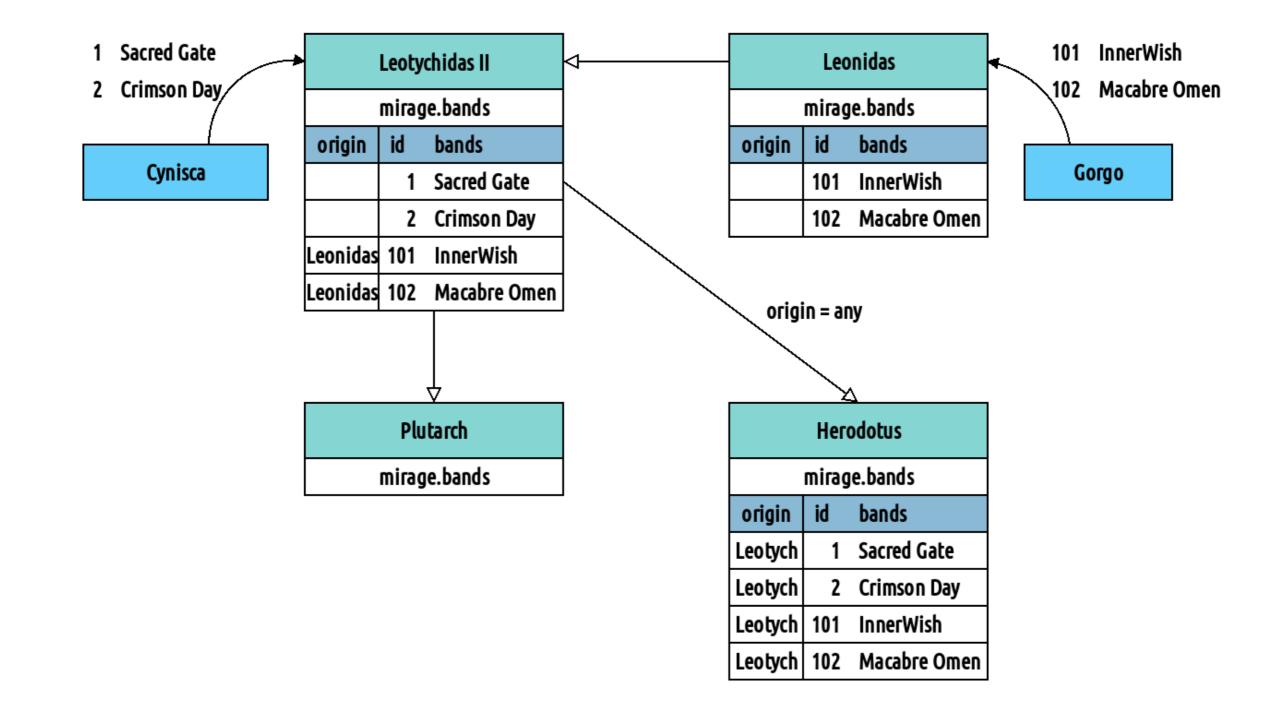


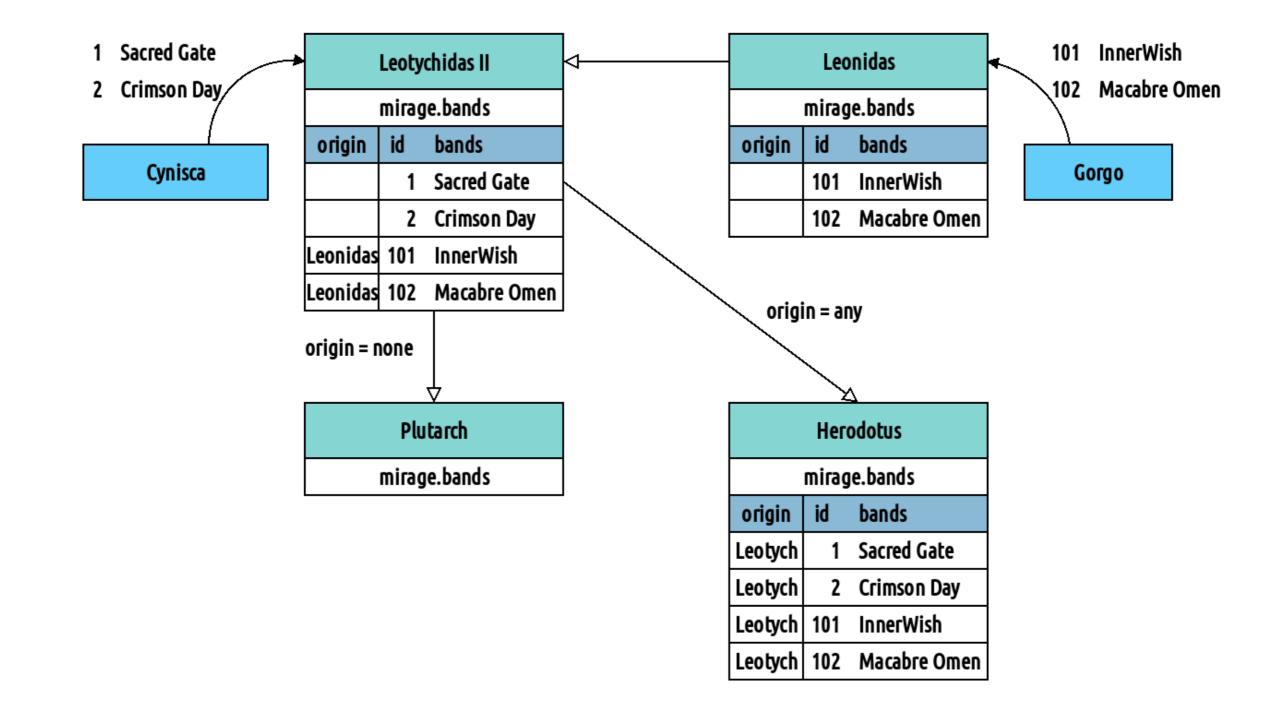


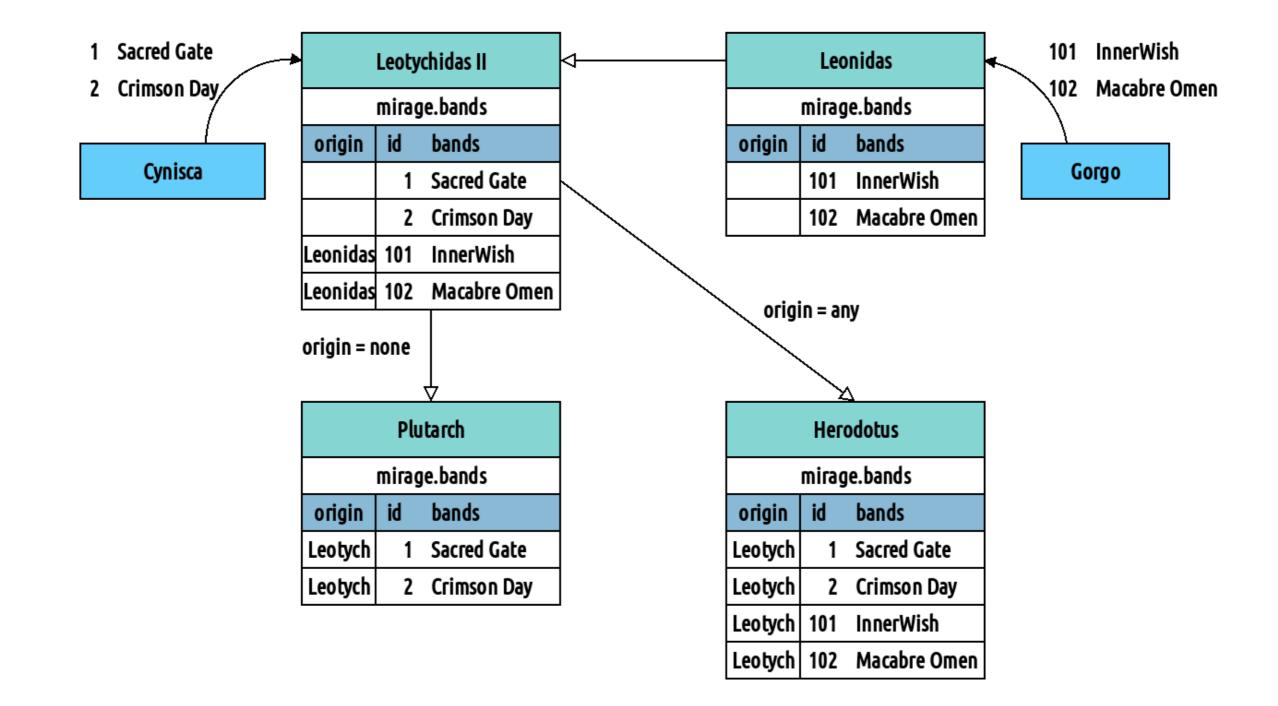


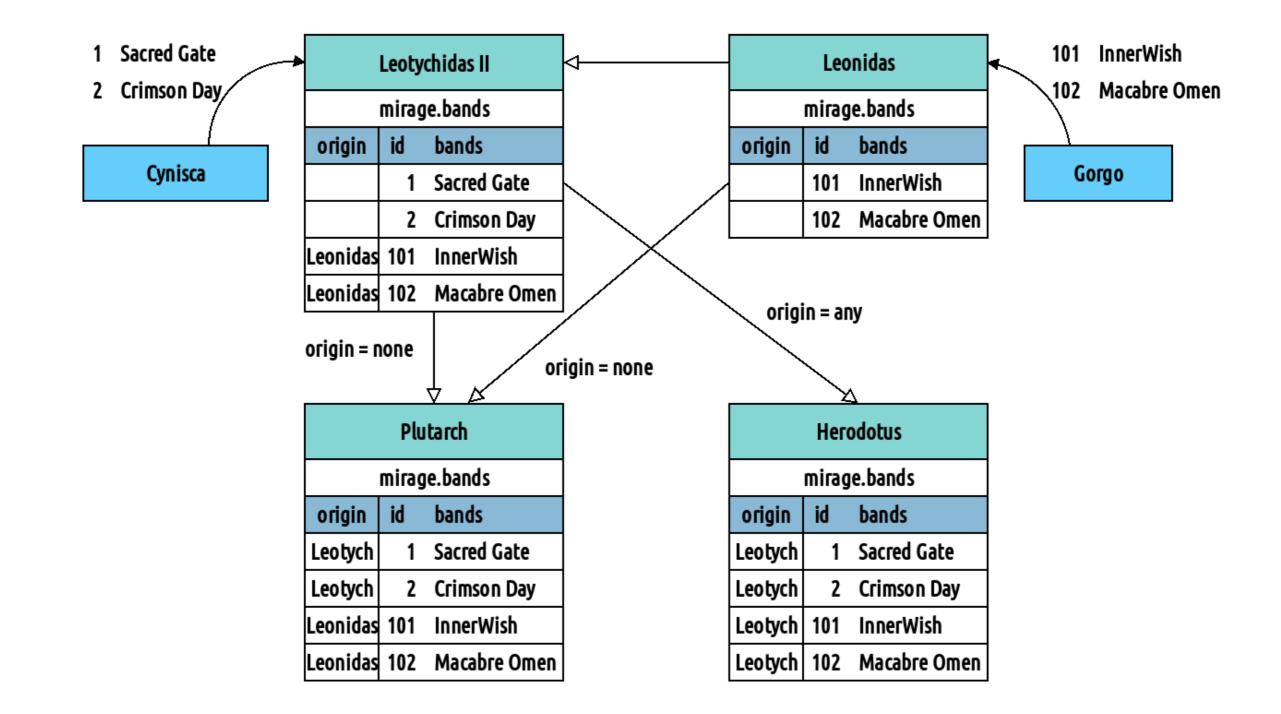










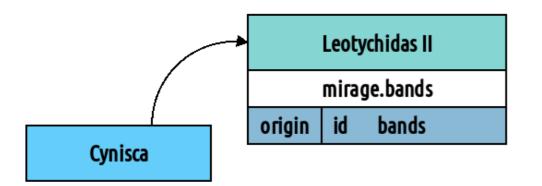


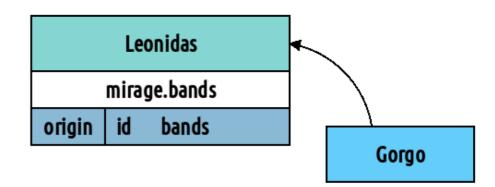
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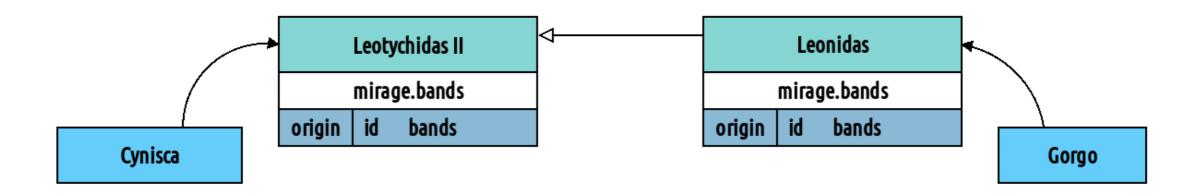


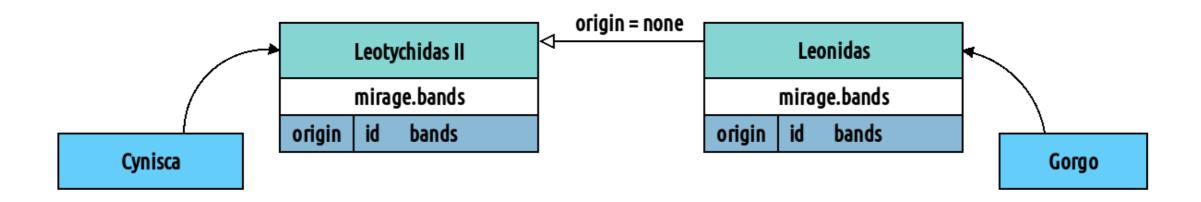
We are here for active-active

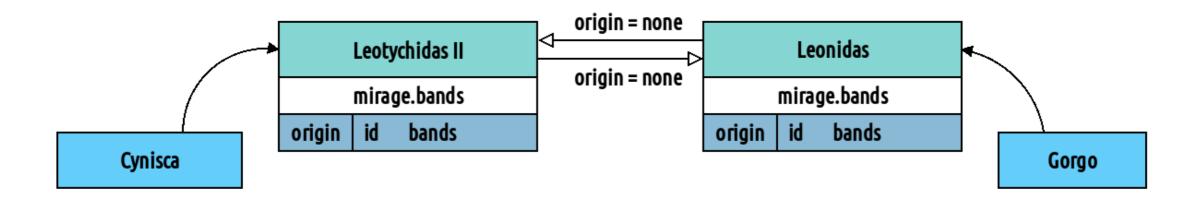


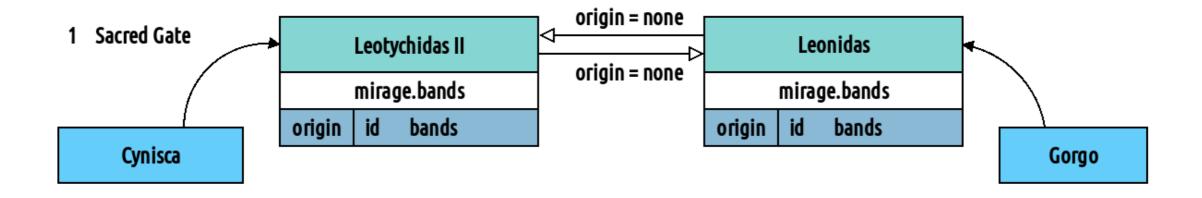


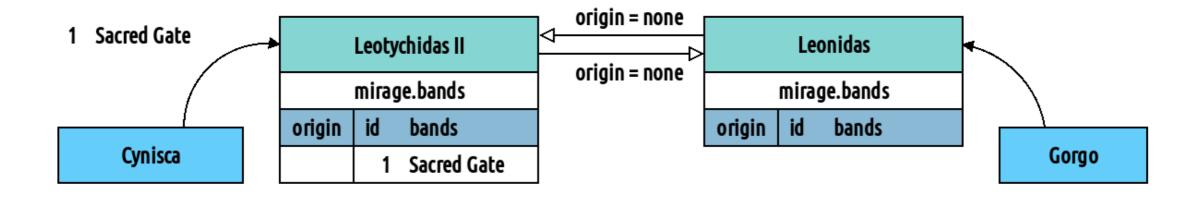


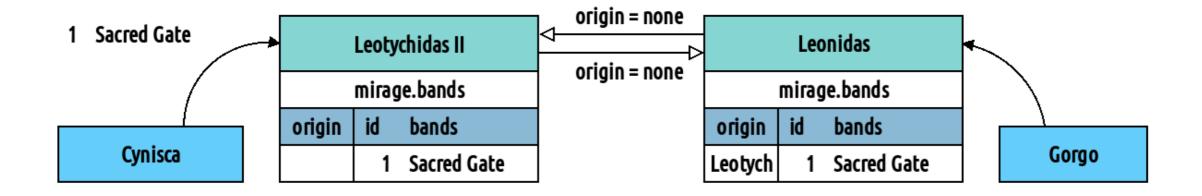


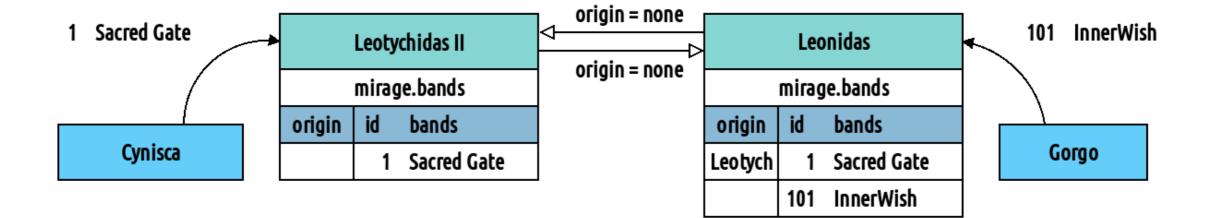


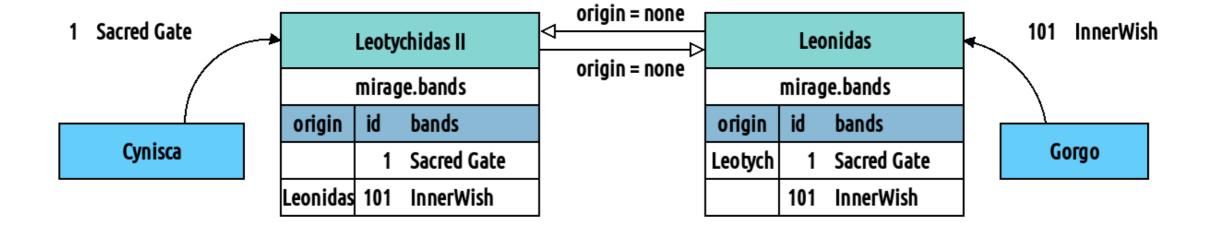


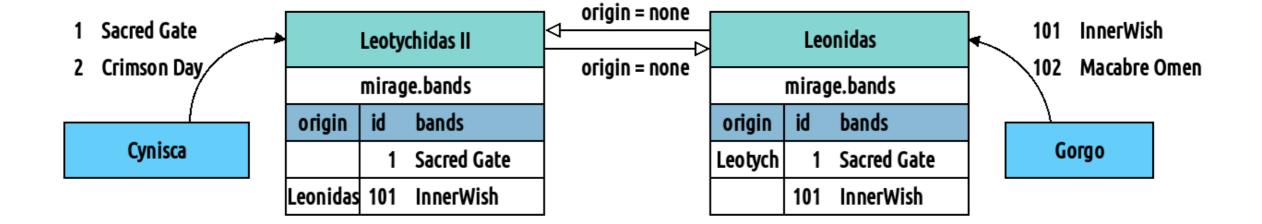


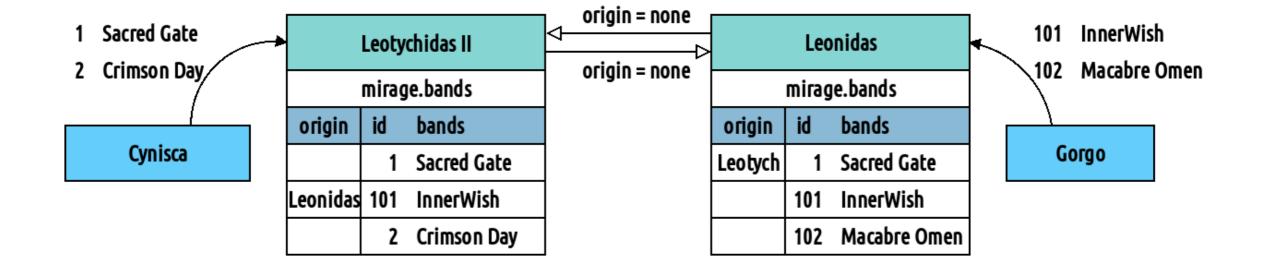


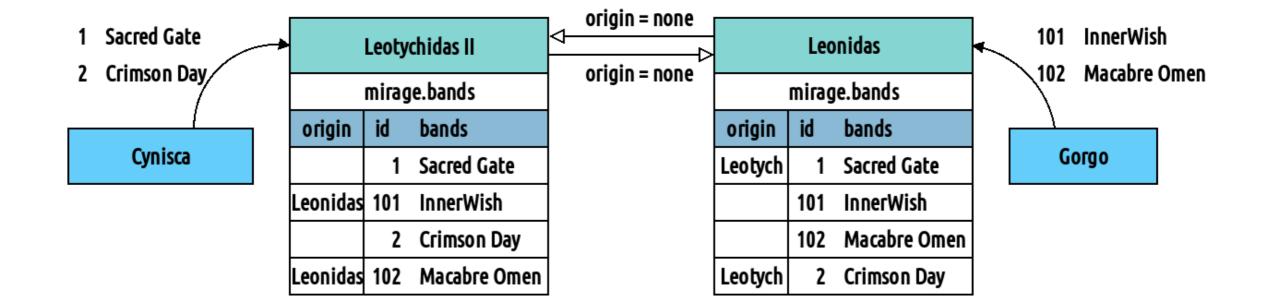












## Conflicts

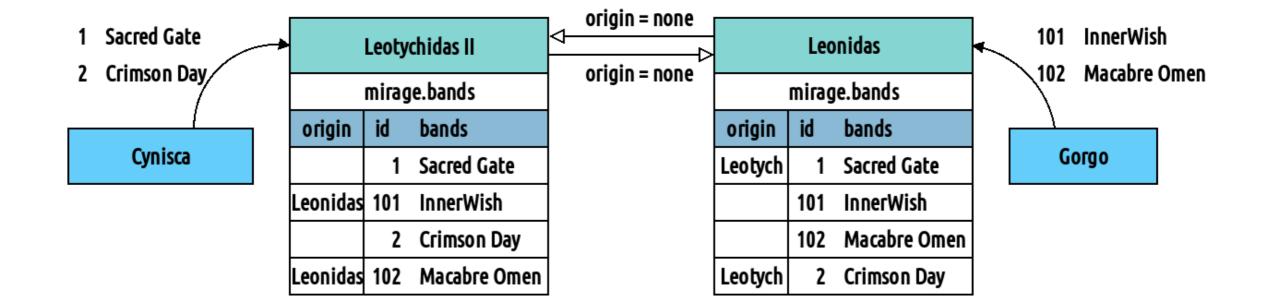


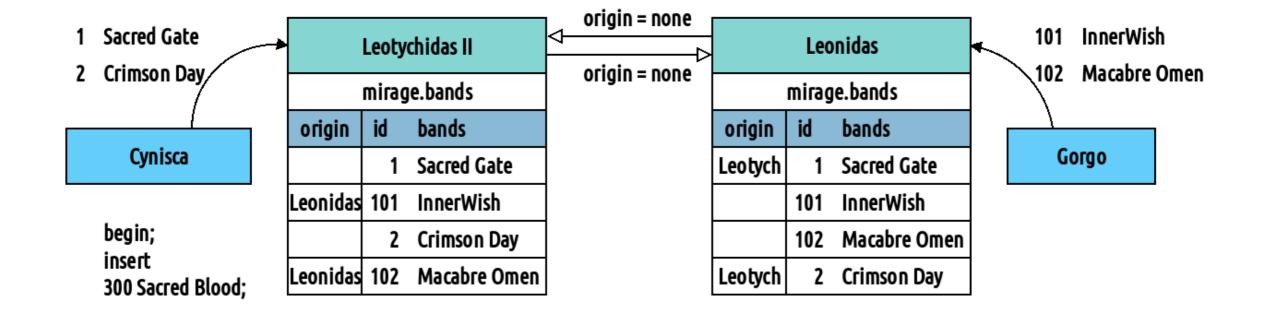
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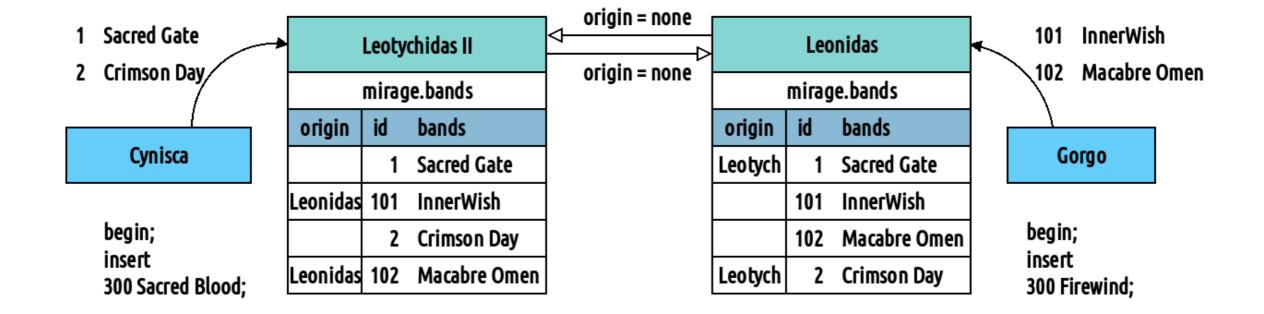
## **Conflicts between Kings of Sparta**

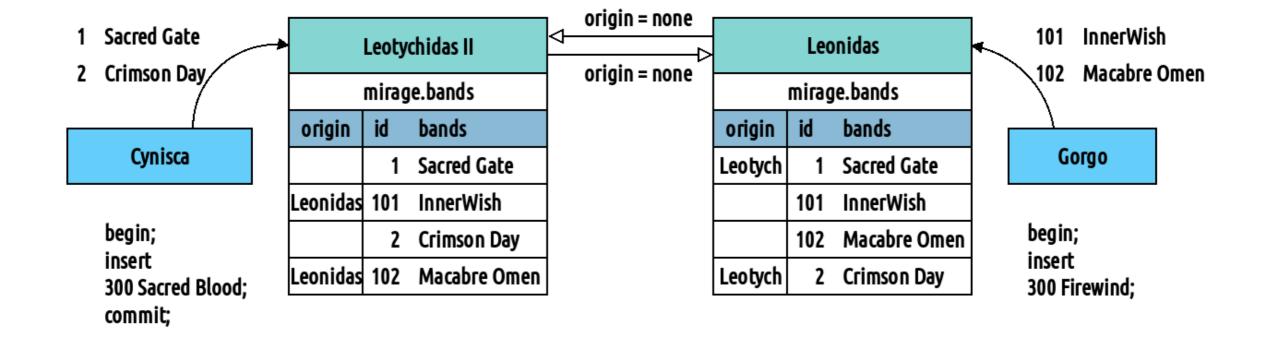
Demaratus and Cleomenes I (late 6<sup>th</sup> early 5<sup>th</sup> cent BCE) Agesilaus and Leotychidas II (4<sup>th</sup> century BCE) Cleombrotus II and Leonidas II (3<sup>rd</sup> century BCE) Archidamus V and Cleomenes III (late 3<sup>rd</sup> cent BCE)

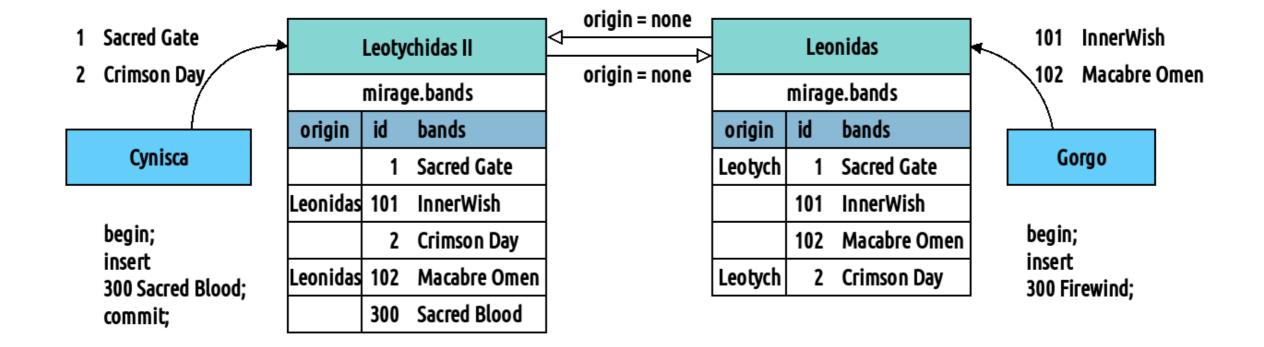


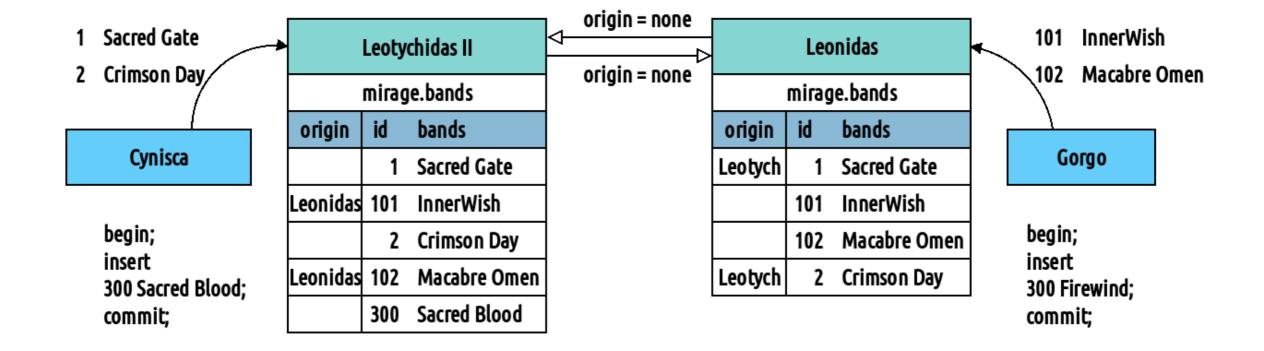






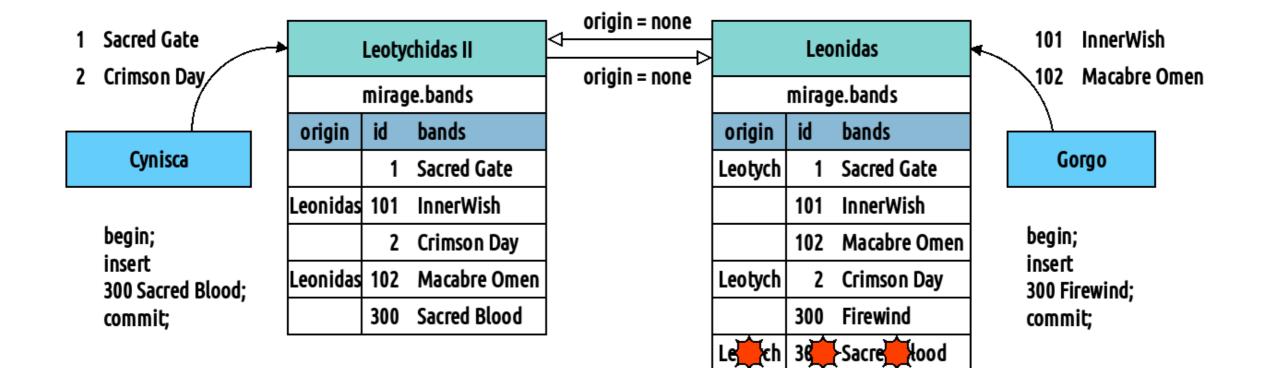


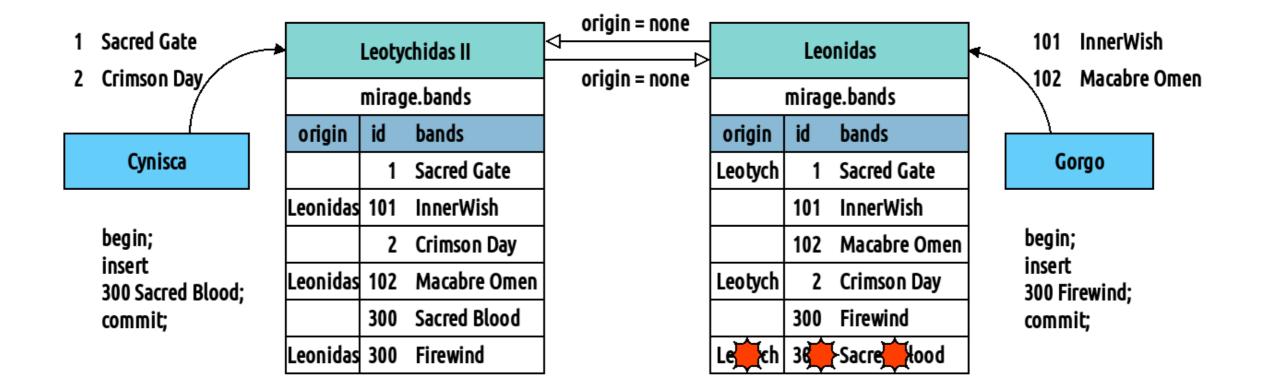


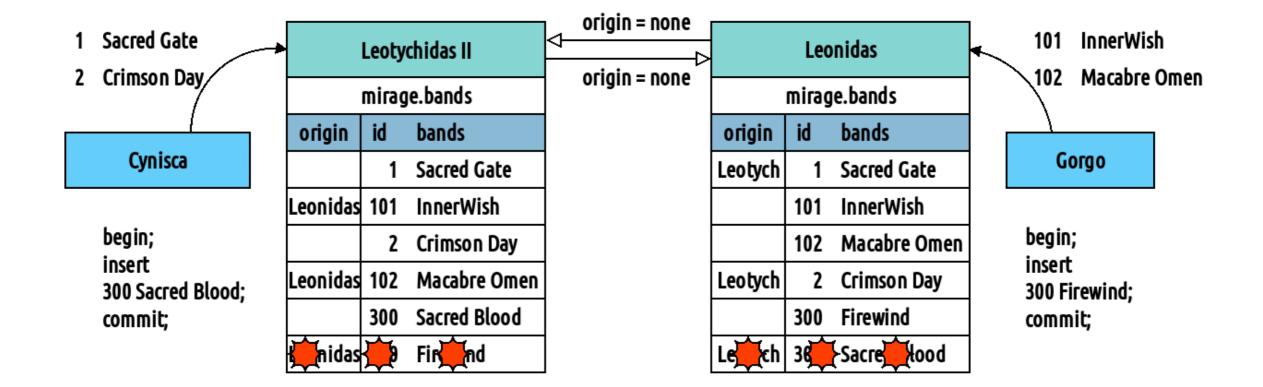


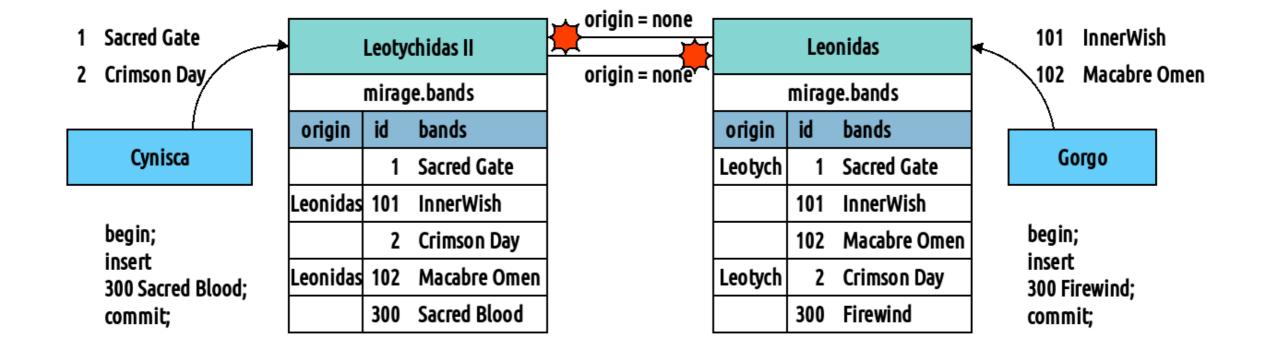
					origin = none				1		
1 Sacred Gate		Leotychidas II				Leonidas		101 InnerWish			
2	2 Crimson Day		-	a baada	origin = none	min ee baade			102 Macabre Omen		
		mirage.bands				mirage.bands					
		origin	id	bands		origin	id	bands			
	Cynisca		1	Sacred Gate		Leotych	1	Sacred Gate		Gorgo	
	begin; insert	Leonidas	101	InnerWish			101	InnerWish			
			2	Crimson Day		102 Macabre Ome	Macabre Omen		begin;		
		Leonidas	102	Macabre Omen		Leotych	2	Crimson Day		insert 300 Firewind;	
			300	Sacred Blood			300	Firewind		commit;	

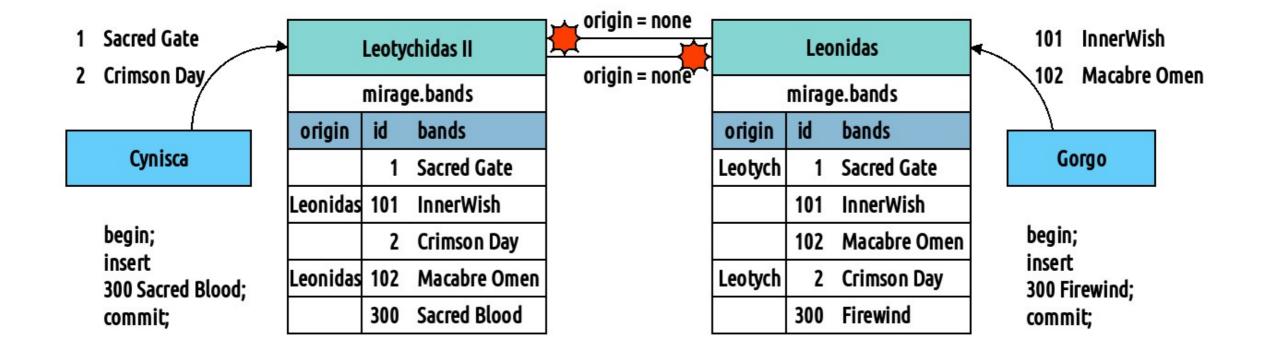
					origin = none				1			
1	Sacred Gate	Leotychidas II				Leonidas		•	101 InnerWish			
2	2 Crimson Day		mirag	e.bands	origin = none	mirage.bands				102 Macabre Omen		
		origin	id	bands		origin	id	bands				
	Cynisca		1	Sacred Gate		Leotych	1	Sacred Gate		Gorgo		
	begin; insert 300 Sacred Blood; commit;	Leonidas	101	InnerWish			101	InnerWish				
			2	Crimson Day		Macabre Omen	begin;					
		Leonidas	102	Macabre Omen		Leotych	2	Crimson Day		insert 300 Firewind;		
			300	Sacred Blood			300	Firewind		commit;		
						Leotych	300	Sacred Blood	]			













## No Spartan King (regent) is above the law



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No Spartan King (regent) is above the law

Pausanias, regent for Pleistarchus (479-478 BCE) Allegations for collaboration with Persia



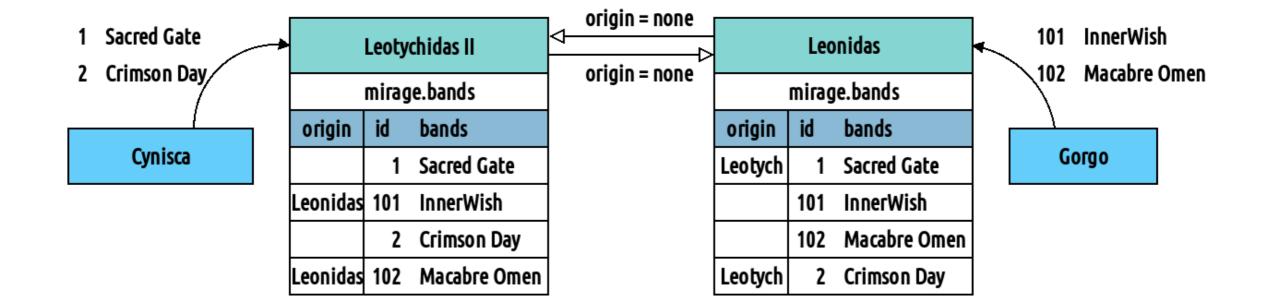
## PostgreSQL cares about the integrity of your data

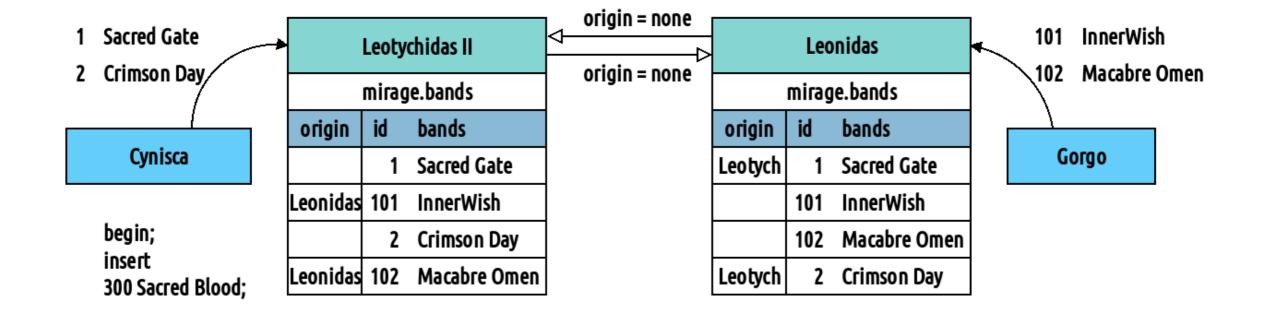


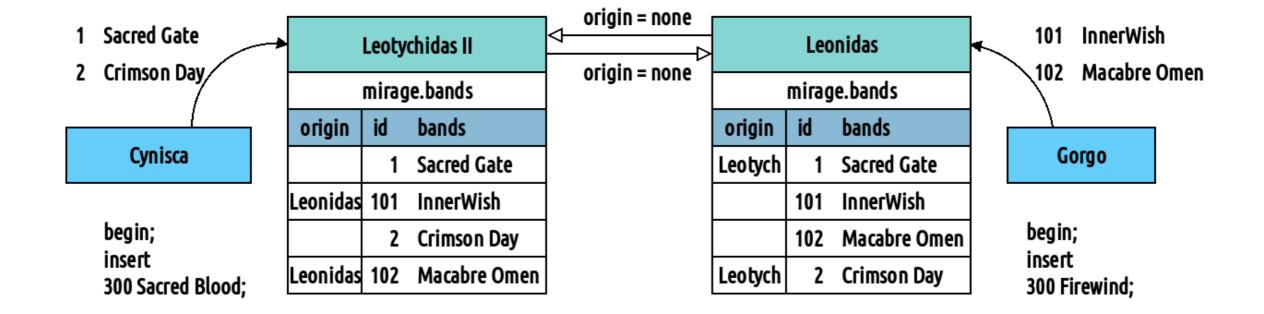
Conflict Resolution

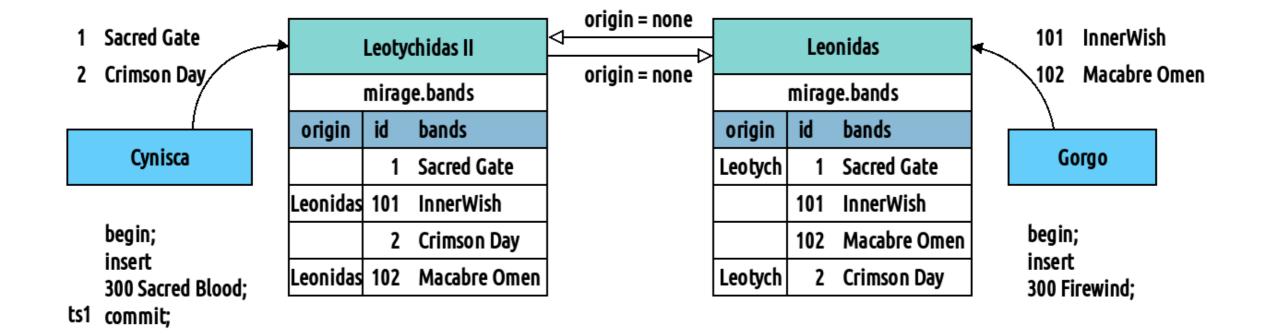


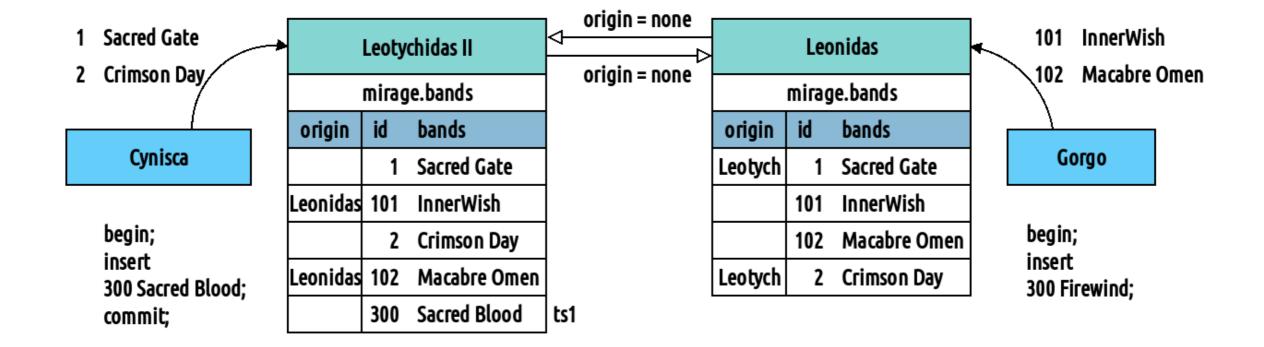
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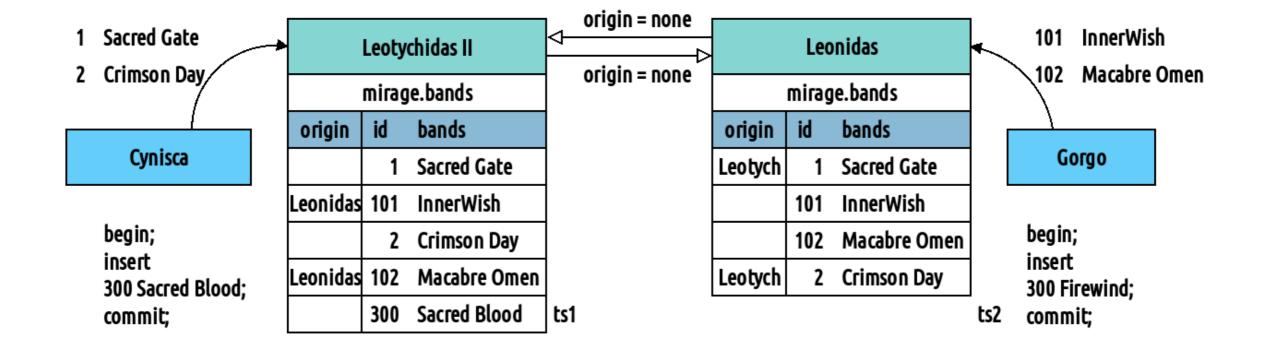










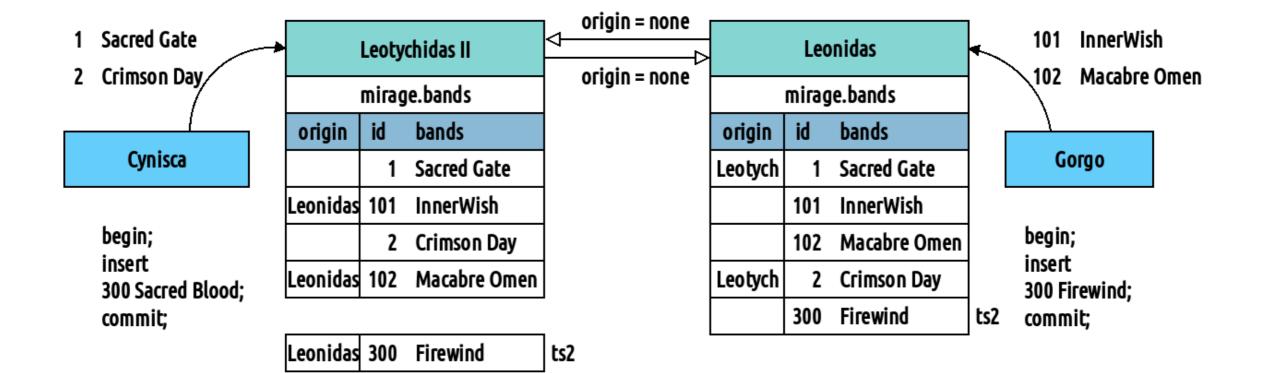


1	Sacred Gate	Leotychidas II			origin = none ⊲	Leonidas			101 InnerWish		
2	2 Crimson Day		-	je.bands	origin = none	mirage.bands			102 Macabre Omen		
		origin	id	bands		origin	id	bands			
	Cynisca		1	Sacred Gate		Leotych	1	Sacred Gate	Gorgo	Gorgo	
	begin; insert	Leonidas	101	InnerWish			101	InnerWish			
			2	Crimson Day			102	Macabre Omen		begin;	
		Leonidas	102	Macabre Omen		Leotych	2	Crimson Day		insert 300 Firewind;	
			300	Sacred Blood	ts1		300	Firewind	ts2	commit;	

					origin = none				1		
1	Sacred Gate	Leotychidas II 🗧				Leonidas			•	101 InnerWish	
2	Crimson Day		mirag	e.bands	origin = none		mirage.bands			102 Macabre Omen	
		origin	id	bands		origin	id	bands			
	Cynisca		1	Sacred Gate		Leotych	1	Sacred Gate		Gorgo	
		Leonidas	101	InnerWish			101	InnerWish			
	begin;		2	Crimson Day			102	Macabre Omen		begin;	
	insert 300 Sacred Blood; commit;	Leonidas	102	Macabre Omen		Leotych	2	Crimson Day		insert 300 Firewind;	
			300	Sacred Blood	ts1		300	Firewind	ts2	commit;	
						Leotych	300	Sacred Blood	ts1		

1	Sacred Gate		lastu	chidas II	origin = none ⊲			nidac		101 InnerWish		
2	Crimson Day	-	Leoty		origin = none	Leonidas				102 Macabre Omen		
-	crimison boy	mirage.bands			ongin none	mirage.bands						
	1	origin	id	bands		origin	id	bands				
	Cynisca		1	Sacred Gate		Leotych	1	Sacred Gate		Gorgo		
		Leonidas	101	InnerWish			101	InnerWish				
	begin;		2	Crimson Day			102	Macabre Omen		begin;		
	insert 300 Sacred Blood; commit;	Leonidas	102	Macabre Omen		Leotych	2	Crimson Day		insert 300 Firewind;		
			300	Sacred Blood	ts1		300	Firewind		commit;		

					origin = none				1	
1	Sacred Gate	Leotychidas II				Leonidas mirage.bands			•	101 InnerWish
2	Crimson Day	mirage.bands			origin = none				102 Macabre Omen	
		origin	id	bands		origin	id	bands		
	Cynisca		1	Sacred Gate	Leotych 1 Sac	Sacred Gate		Gorgo		
		Leonidas	101	InnerWish			101	InnerWish		
	begin; insert 300 Sacred Blood; commit;		2	Crimson Day			102	Macabre Omen		begin; incort
		Leonidas	102	Macabre Omen		Leotych	2	Crimson Day		insert 300 Firewind;
			300	Sacred Blood	ts1		300	Firewind	ts2	commit;
		Leonidas	300	Firewind	ts2					



					origin = none				1			
1	Sacred Gate		Leoty	chidas II			Leo	nidas	•	101 InnerWish		
2	2 Crimson Day				origin = none	mirage.bands			102 Macabre Omen			
-		mirage.bands			<b>.</b>							
		origin	id	bands		origin	id	bands				
	Cynisca		1	Sacred Gate		Leotych	1	Sacred Gate		Gorgo		
		Leonidas	101	InnerWish			101	InnerWish				
	begin;		2	Crimson Day			102	Macabre Omen		begin;		
	insert 300 Sacred Blood; commit;	Leonidas	102	Macabre Omen		Leotych	2	Crimson Day		insert 300 Firewind;		
		Leonidas	300	Firewind	ts2		300	Firewind		commit;		

300 Sacred Blood ts1

## EICDD



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Et omicity Consistency Isolation Jurability

Consistency **Evailabity** Partition Tolcrance



#### Consistency

## Every read receives the most recent write or an error



					origin = none				1			
1	Sacred Gate		Leoty	chidas II			Leo	nidas	•	101 InnerWish		
2	2 Crimson Day				origin = none	mirage.bands			102 Macabre Omen			
-		mirage.bands			<b>.</b>							
		origin	id	bands		origin	id	bands				
	Cynisca		1	Sacred Gate		Leotych	1	Sacred Gate		Gorgo		
		Leonidas	101	InnerWish			101	InnerWish				
	begin;		2	Crimson Day			102	Macabre Omen		begin;		
	insert 300 Sacred Blood; commit;	Leonidas	102	Macabre Omen		Leotych	2	Crimson Day		insert 300 Firewind;		
		Leonidas	300	Firewind	ts2		300	Firewind		commit;		

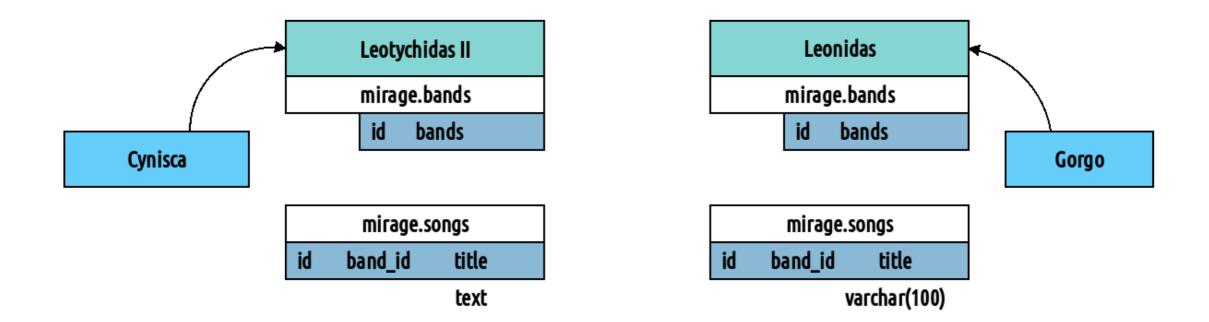
300 Sacred Blood ts1

## DDL Data Definition Language



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## DDL Based on Consensus



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## Dual Kingship and the Gerousia



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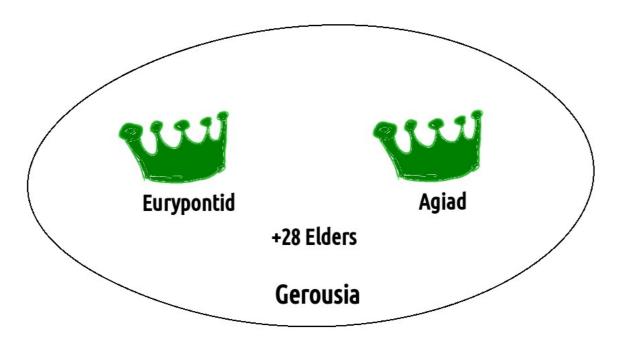
#### Dual Kingship and the Gerousia





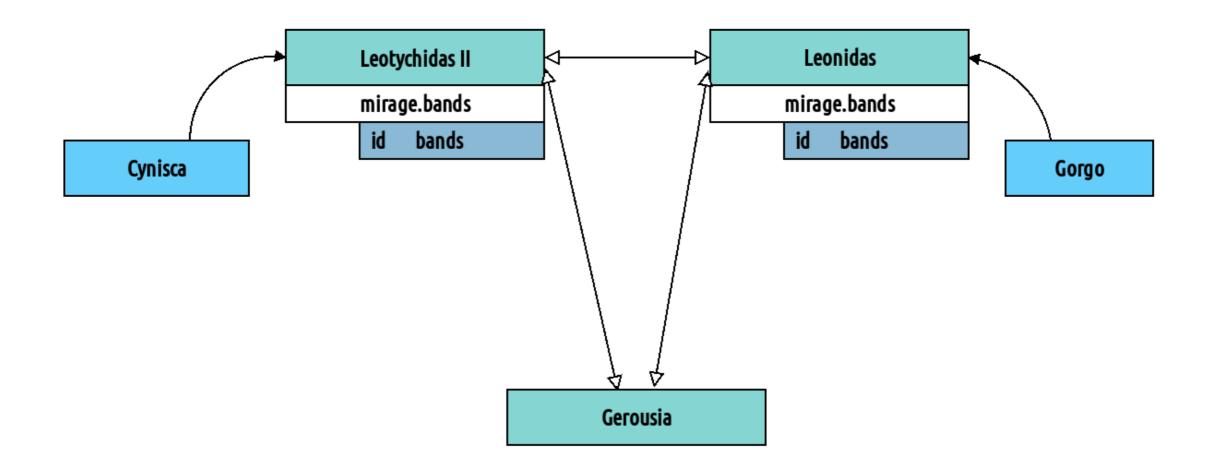


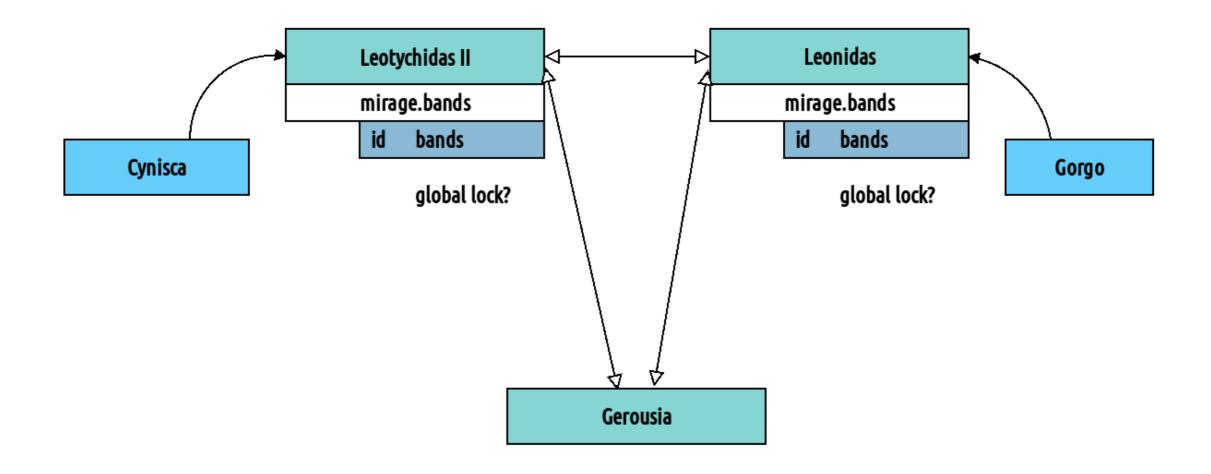
## Dual Kingship and the Gerousia

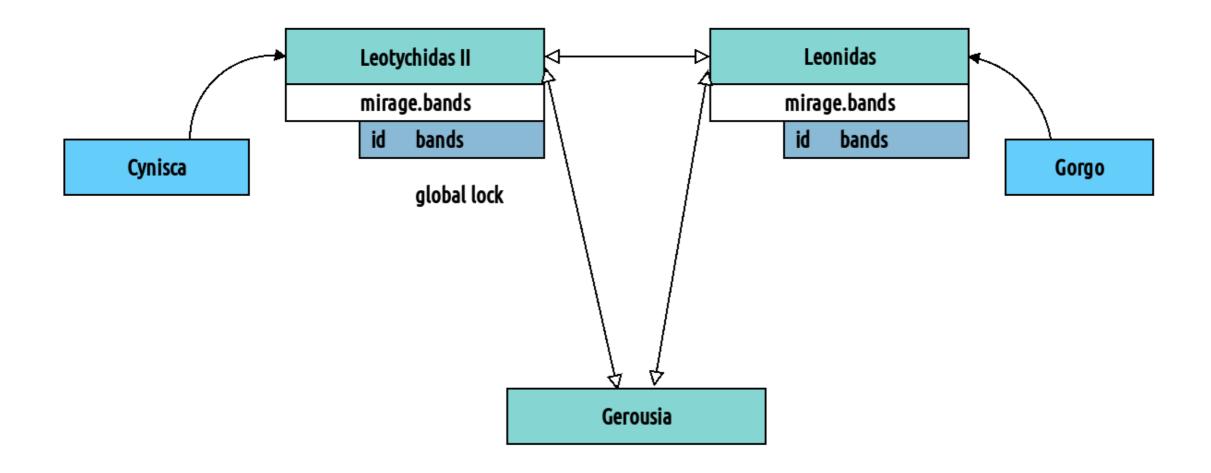


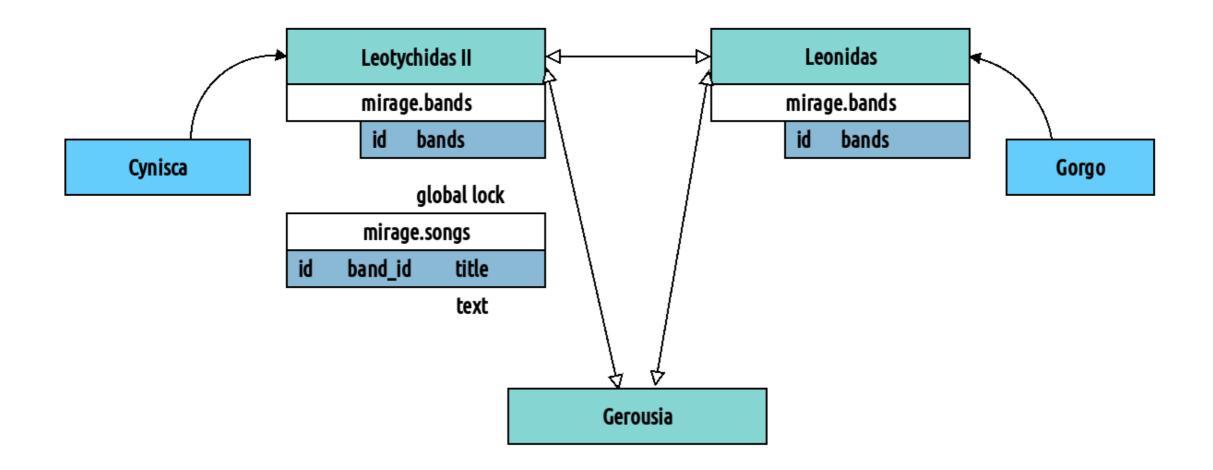


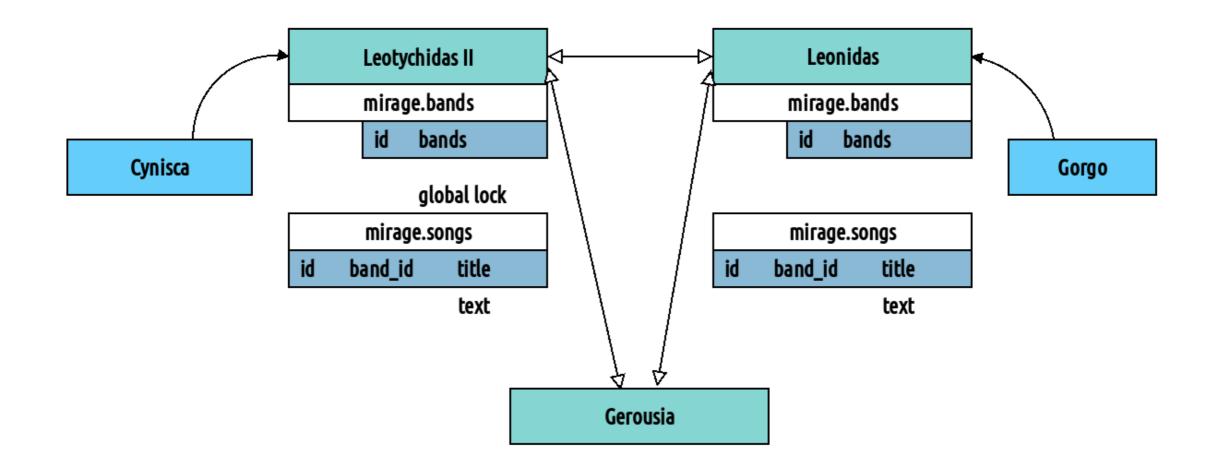


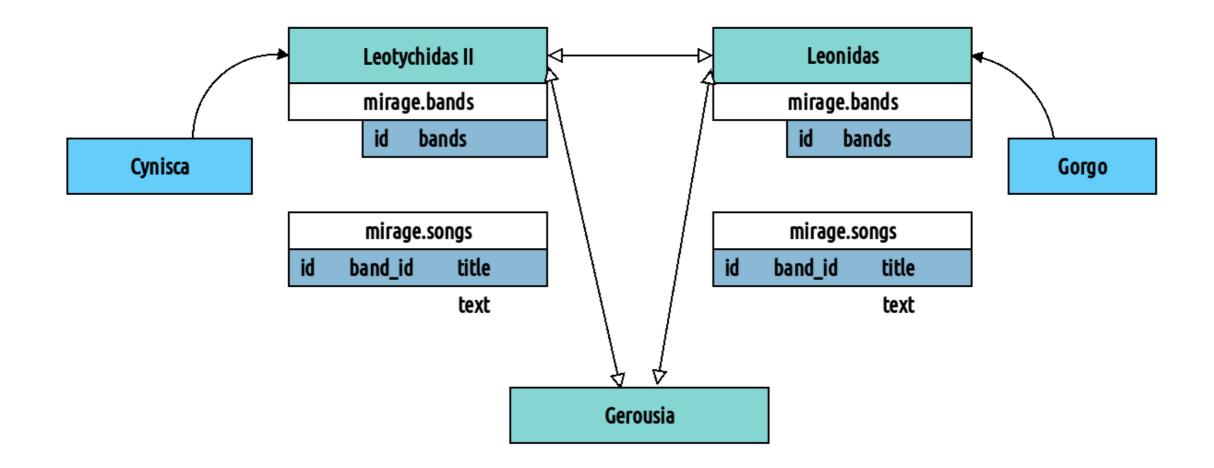












# Can we use the Gerousia for something else?



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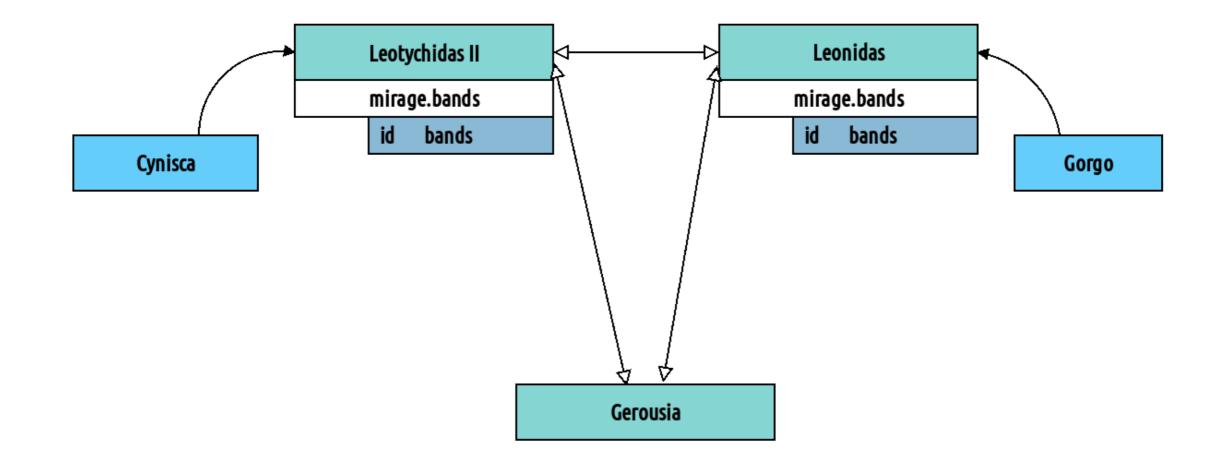


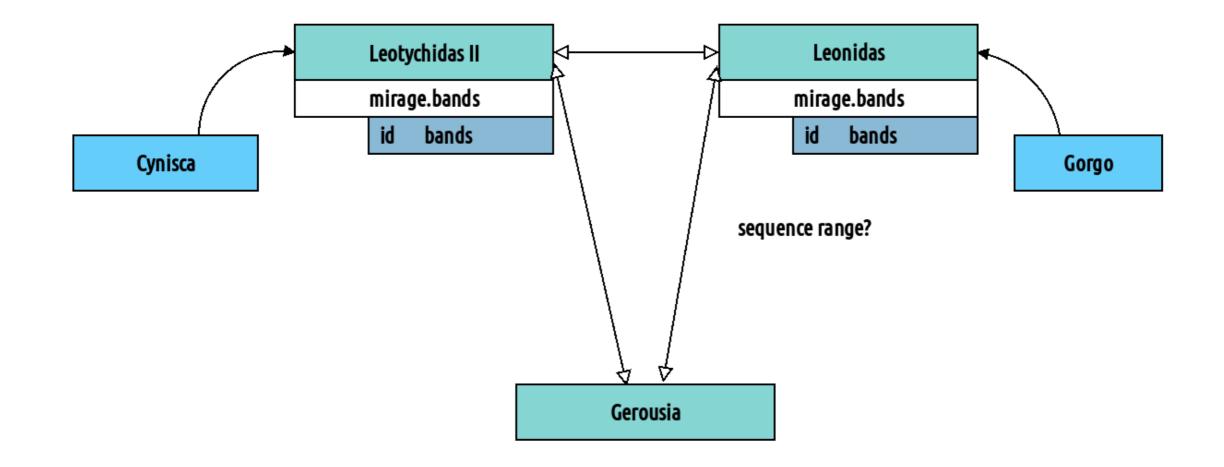
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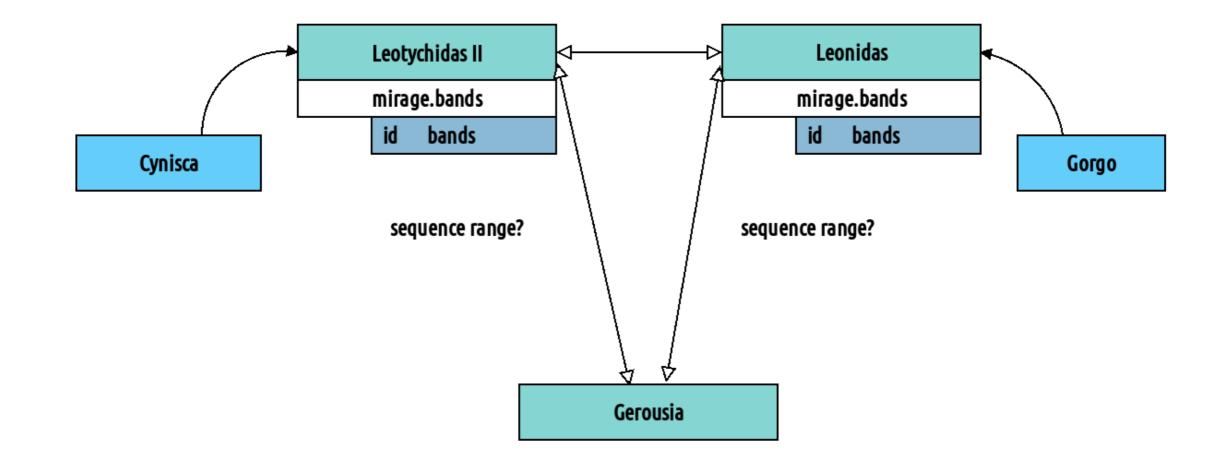


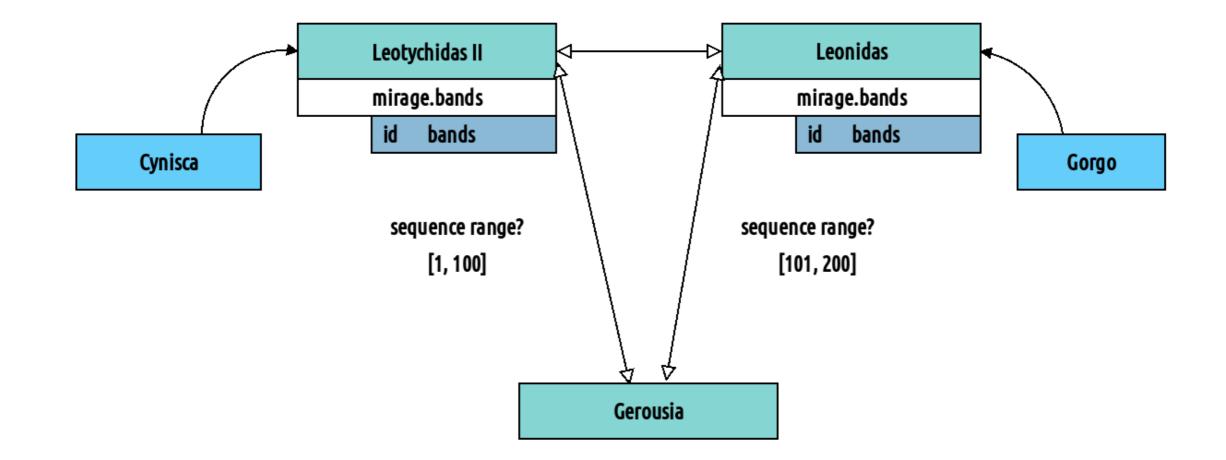


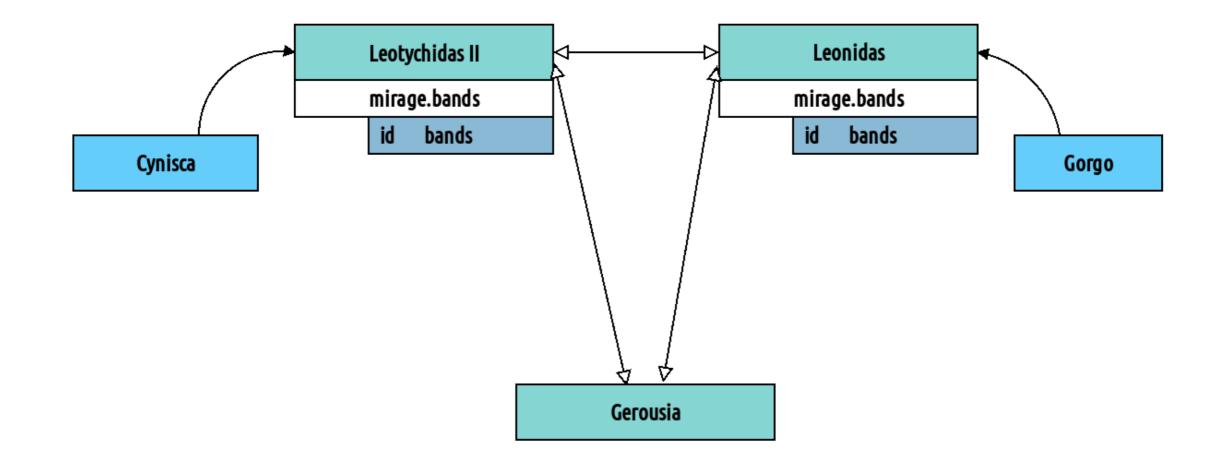
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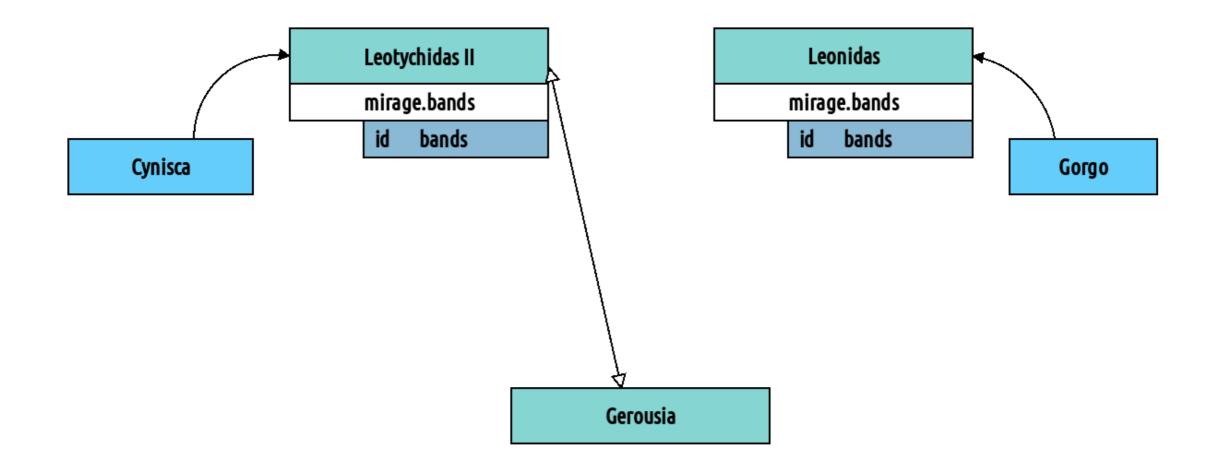


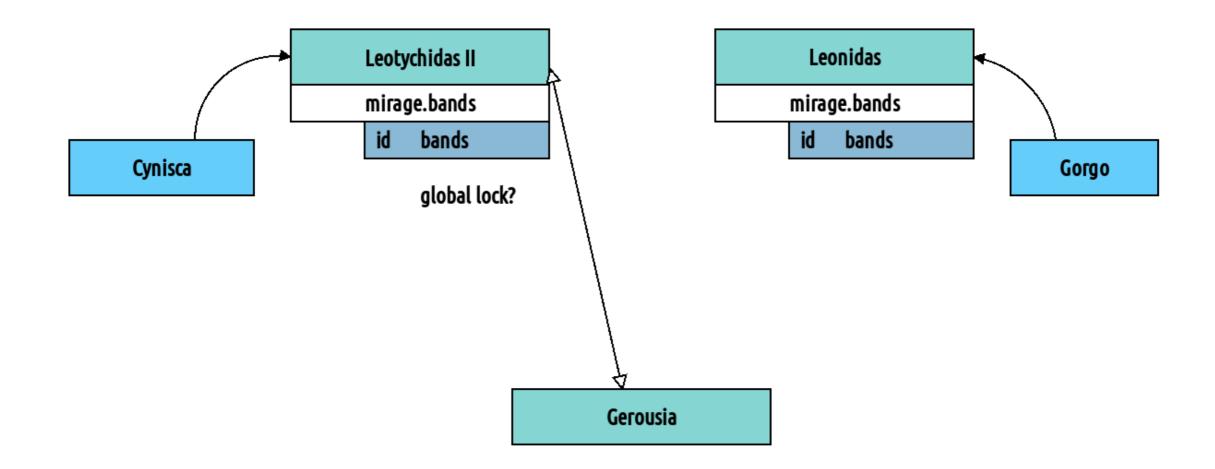


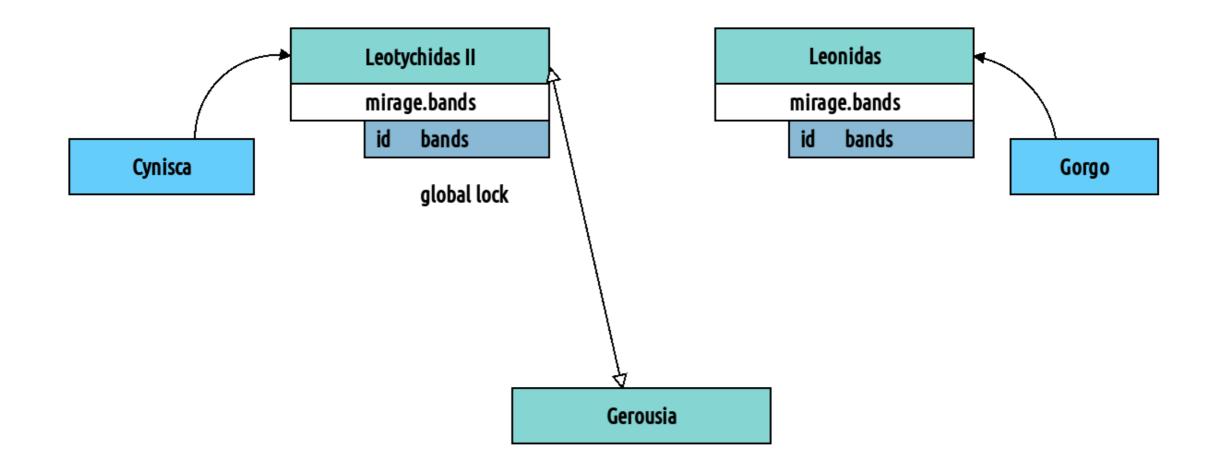


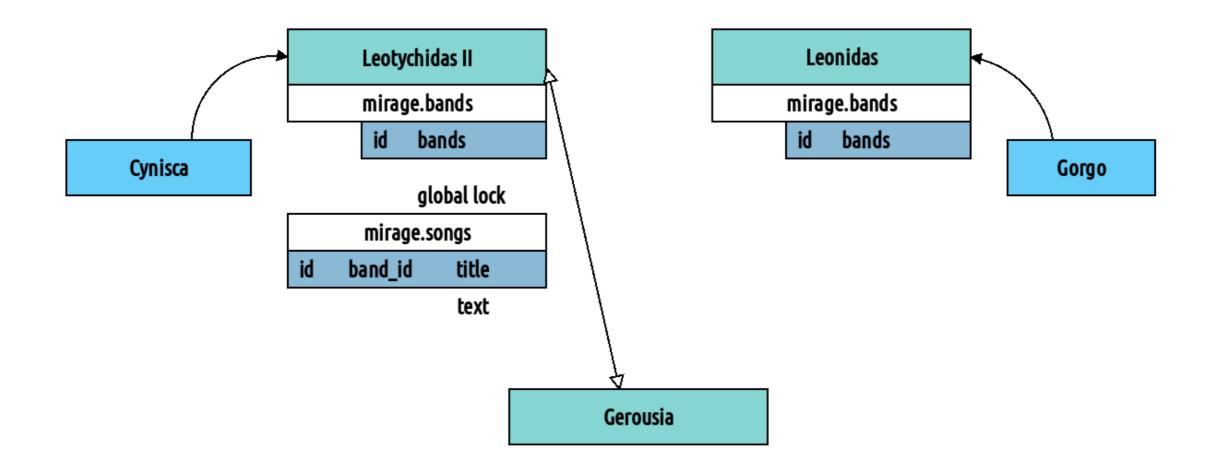


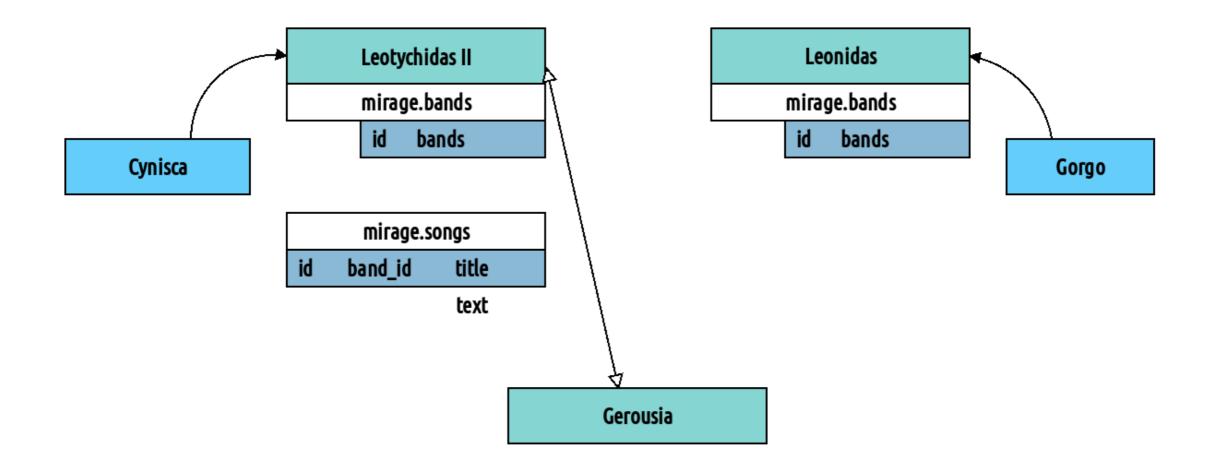


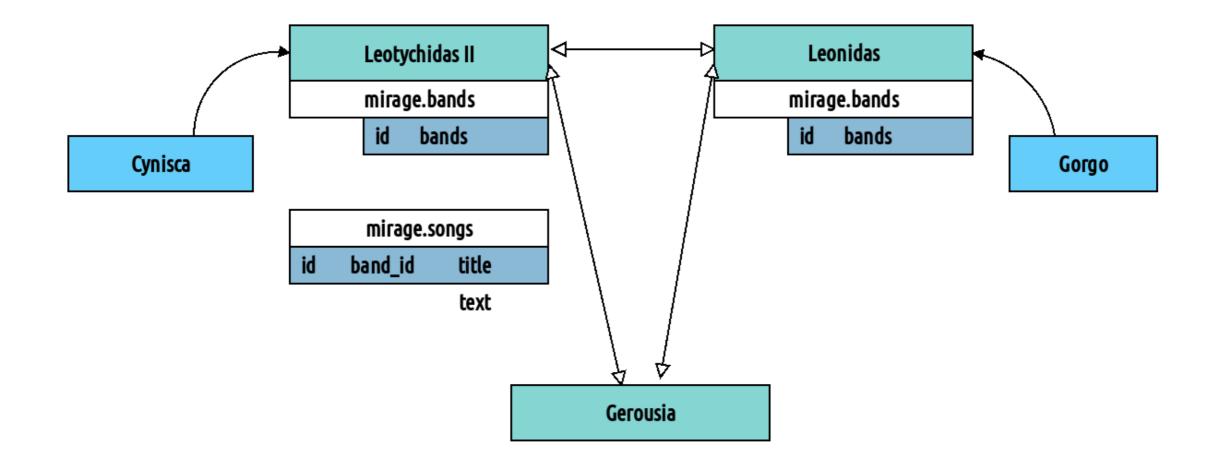


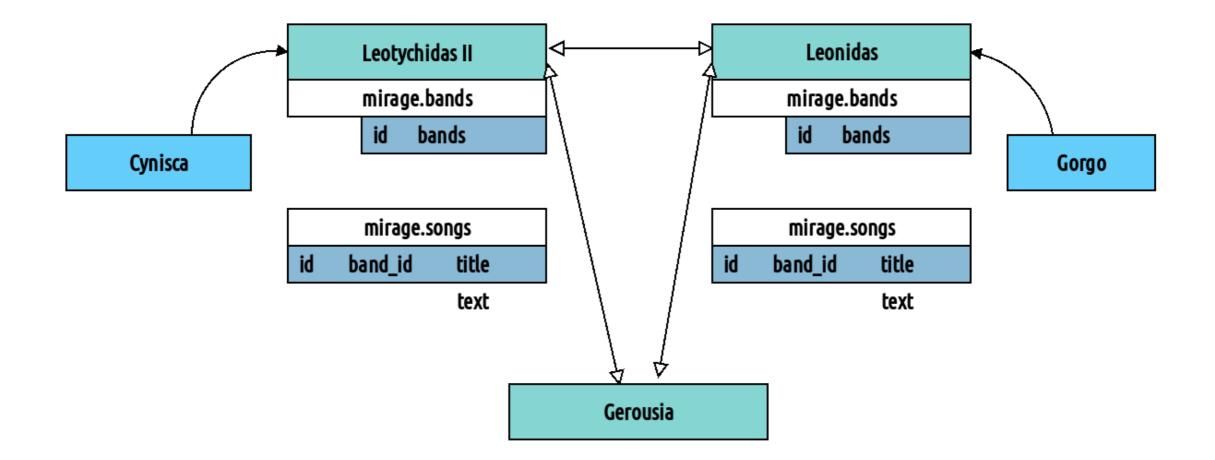






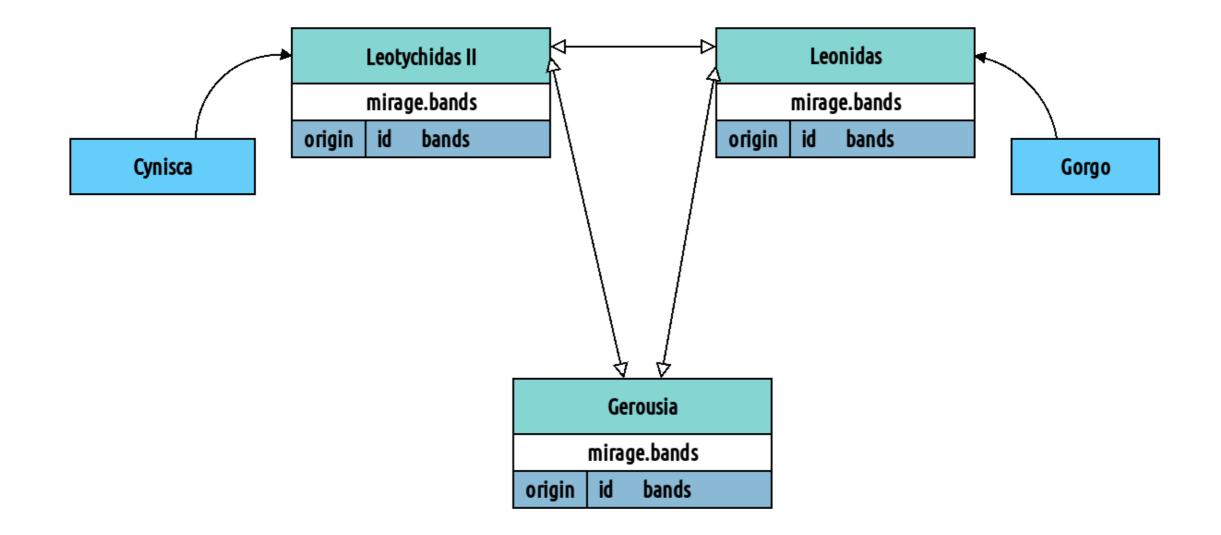


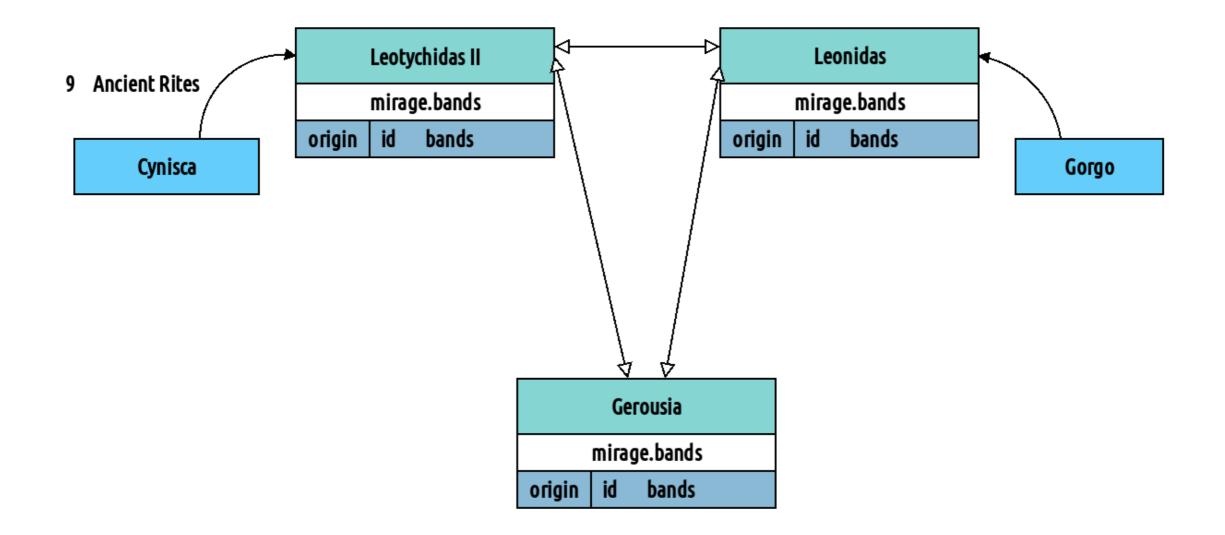


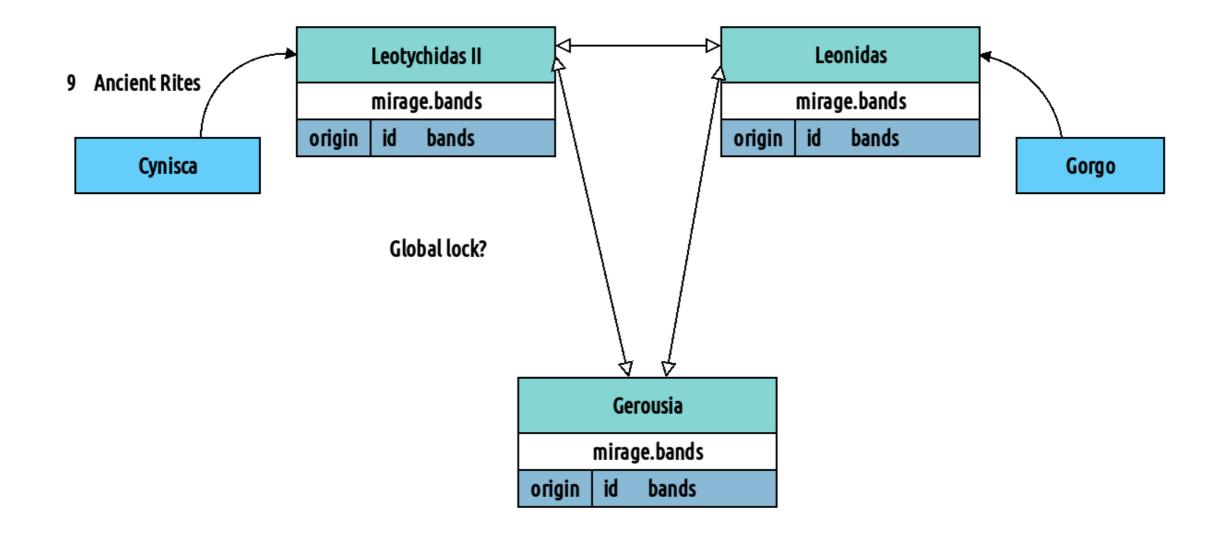


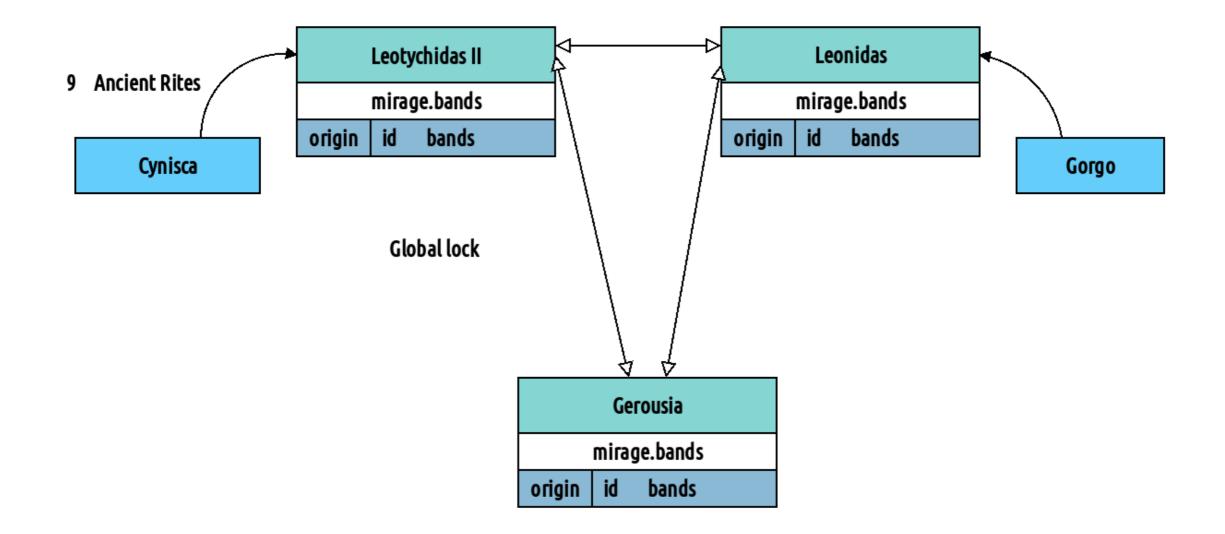
Deal with Conflicts using Consensus

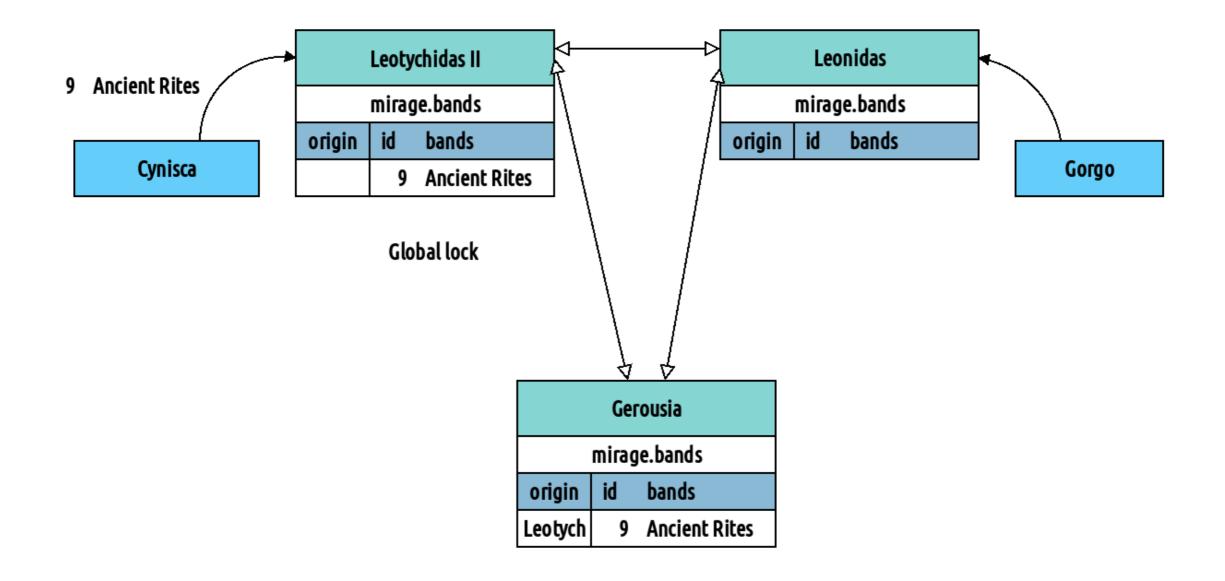


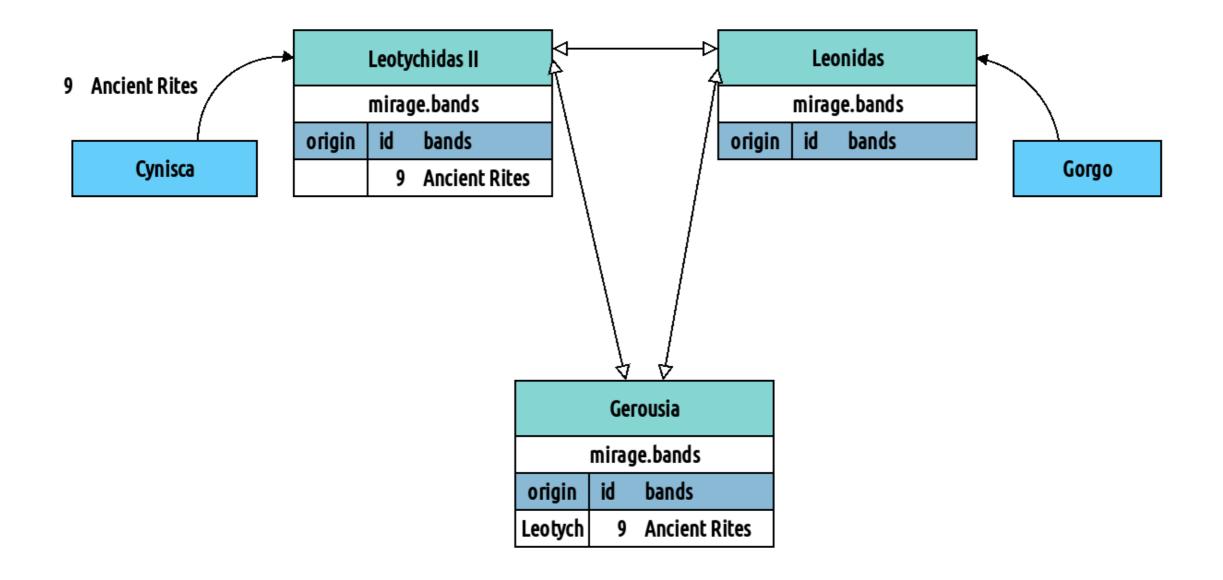












# Write in the majority



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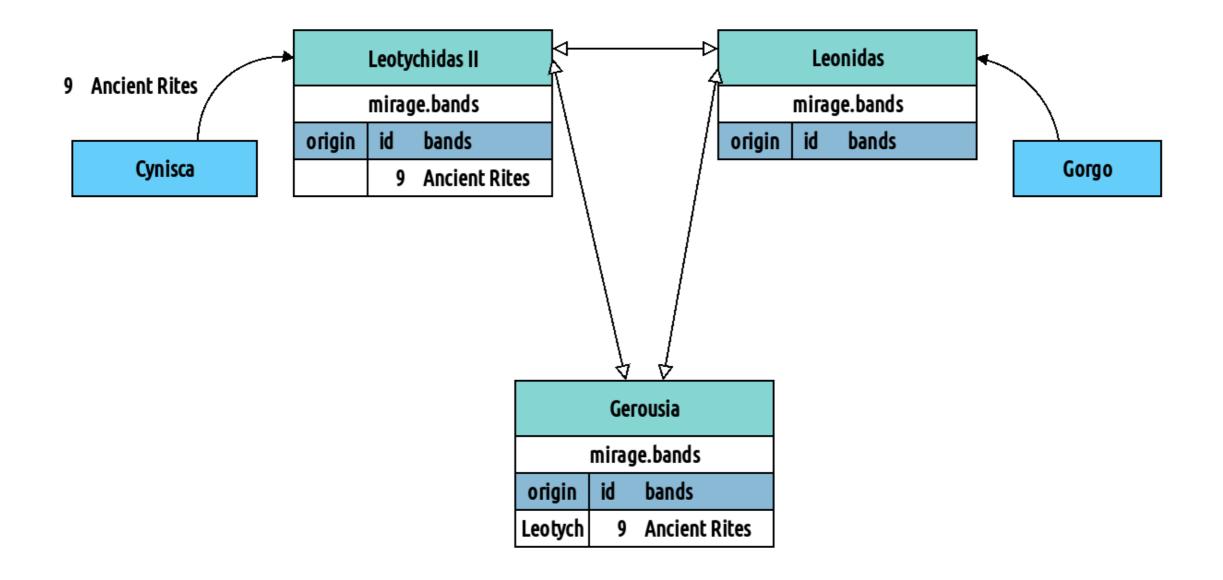
## Write in the majority Read from one node?

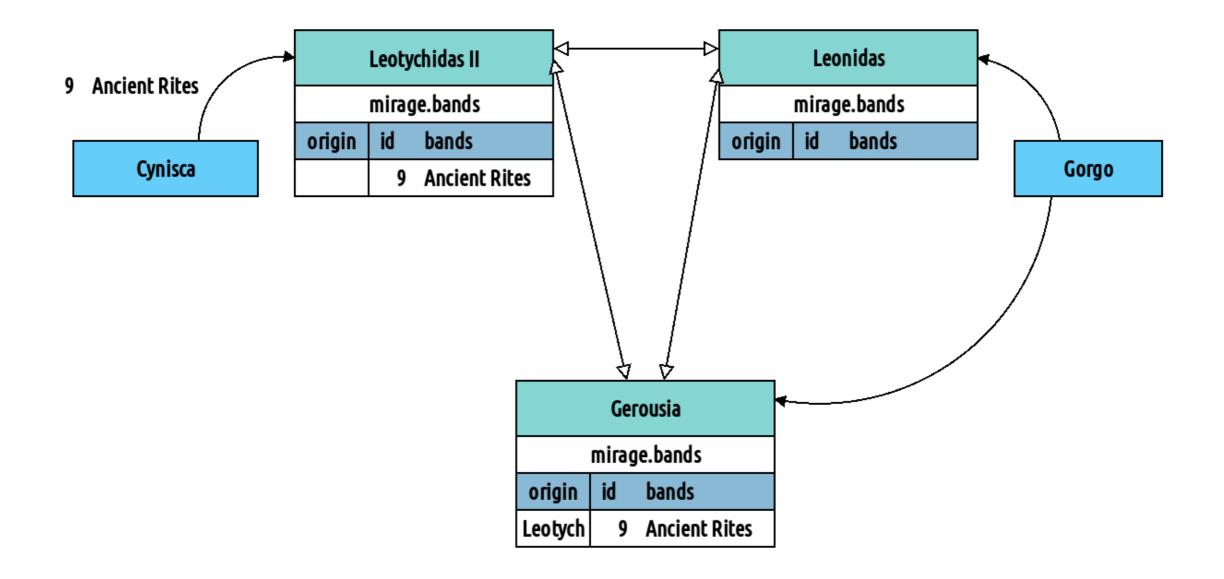


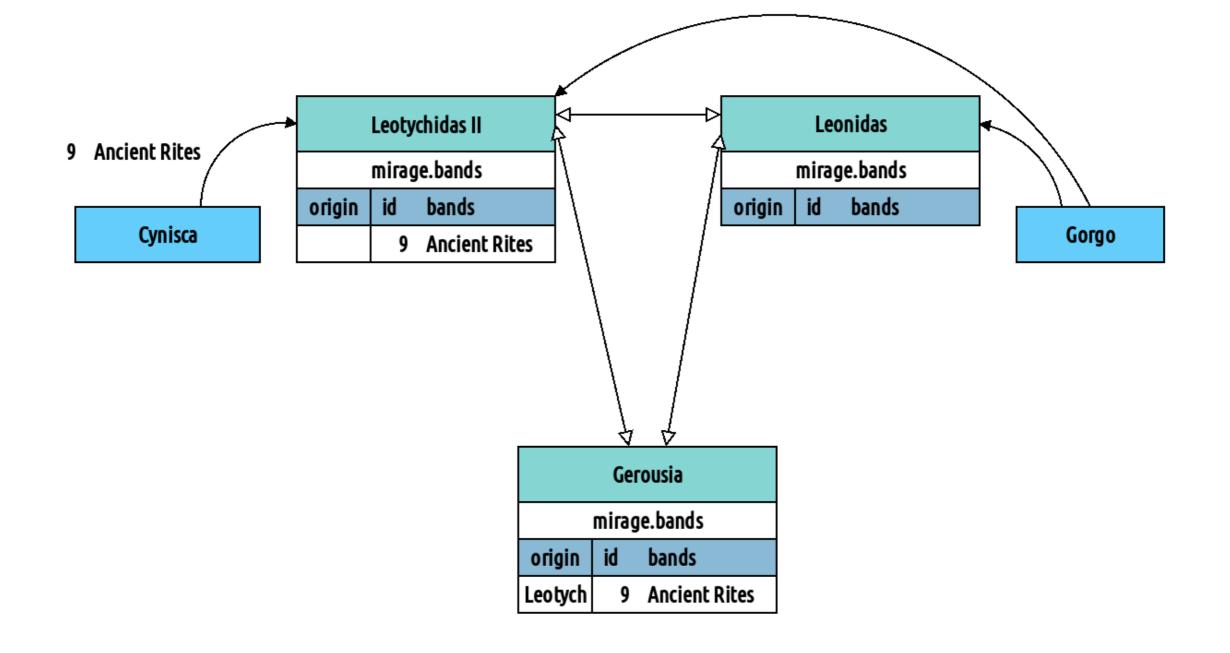
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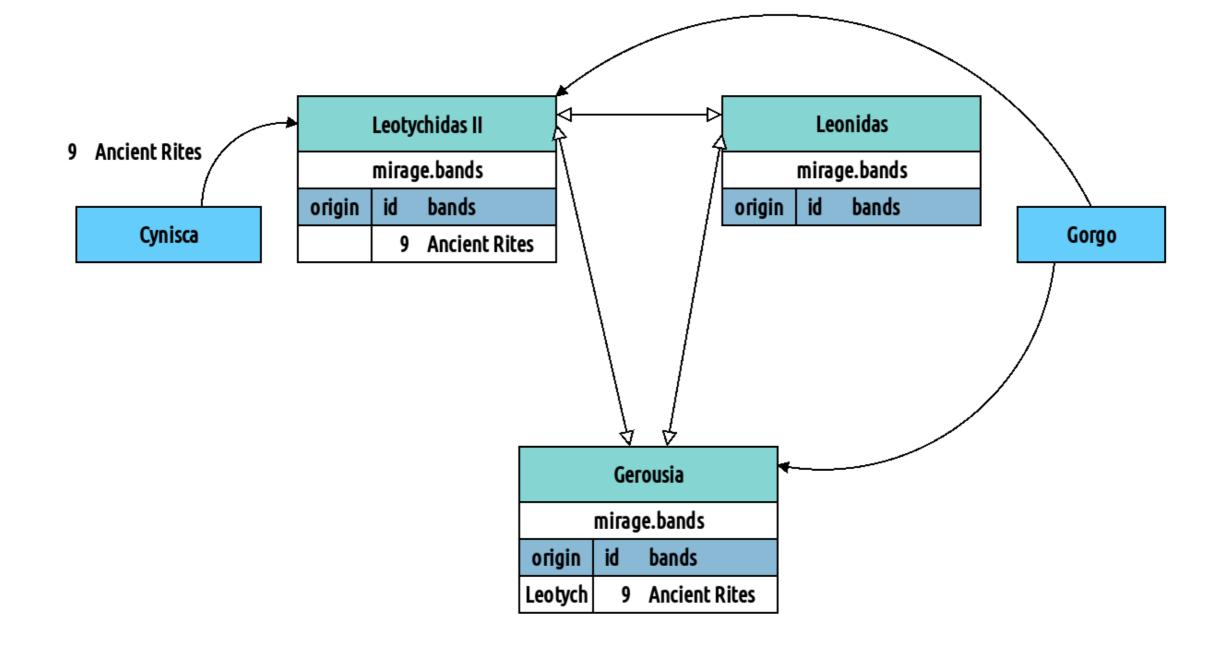
Write in the majority Read from one node? Read from majority?

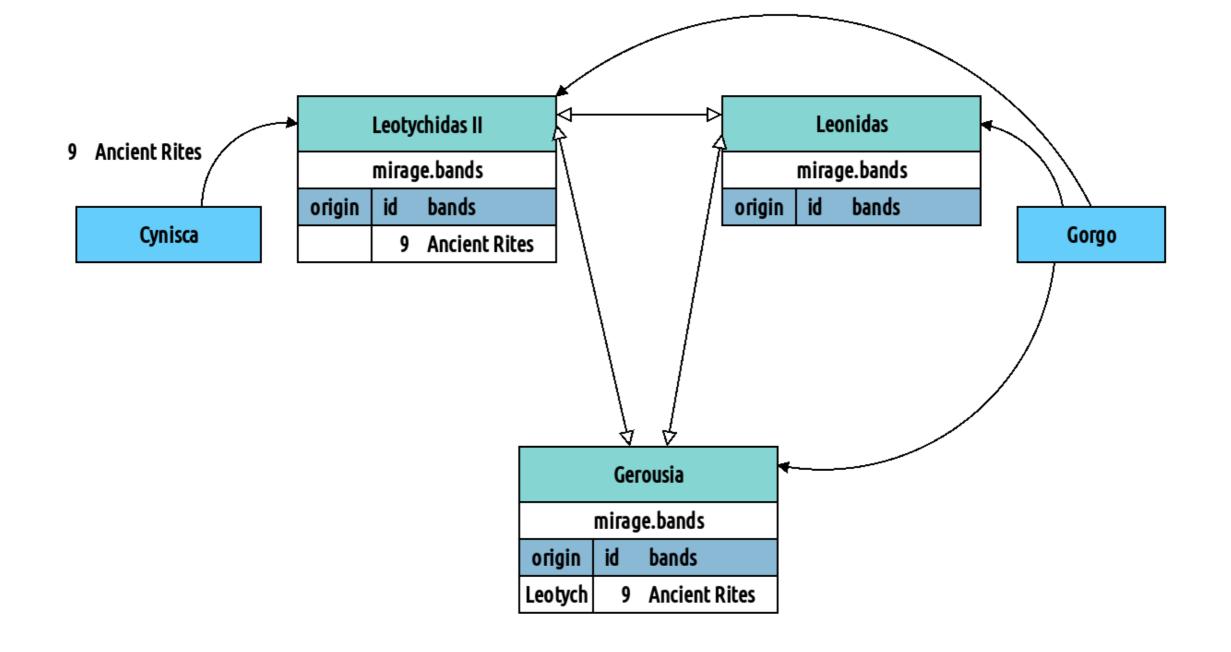


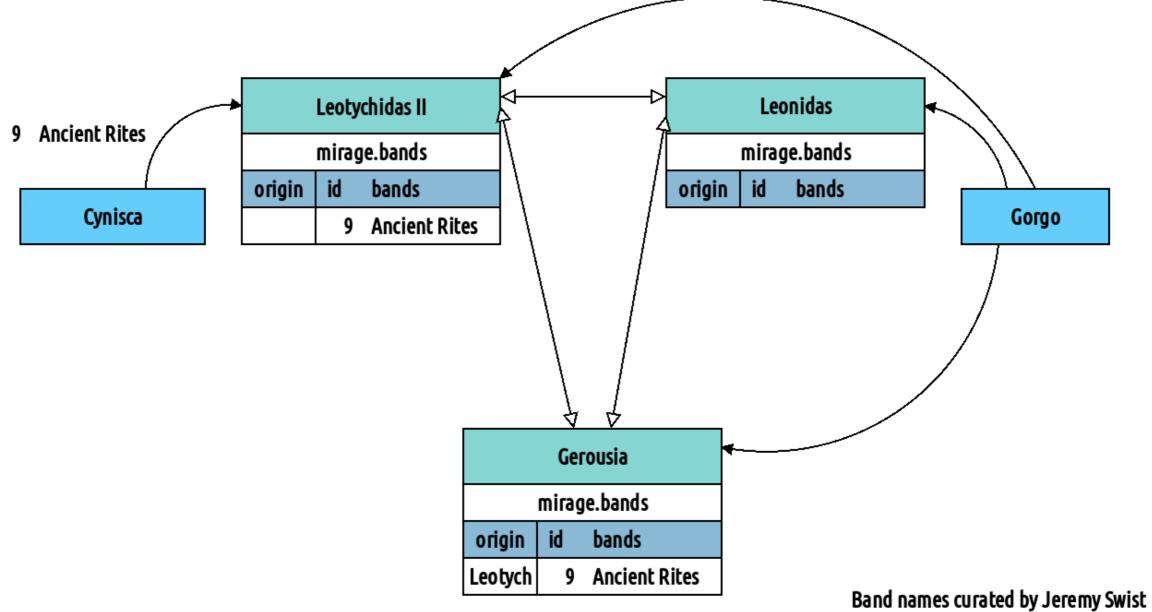












The Spartan Metal Mirage



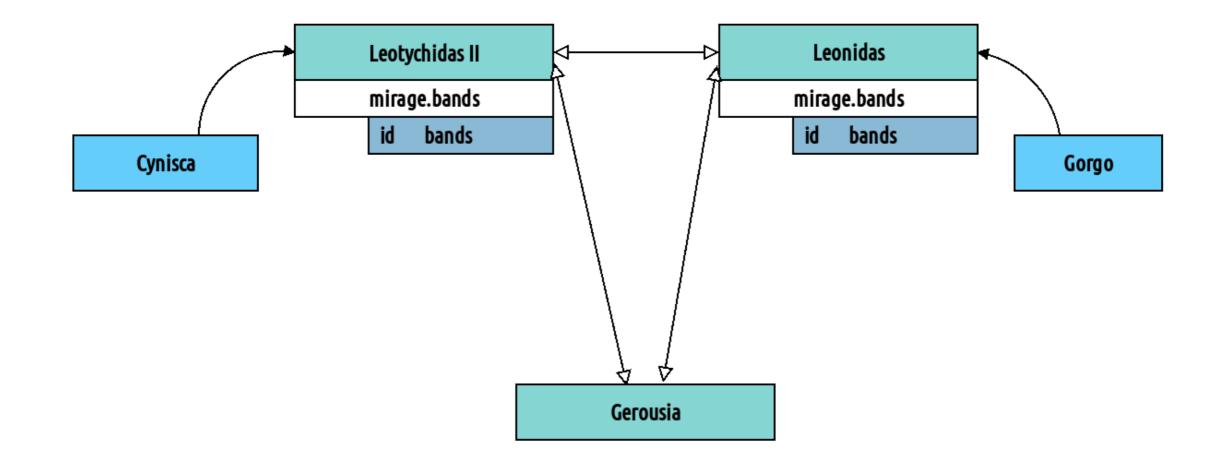


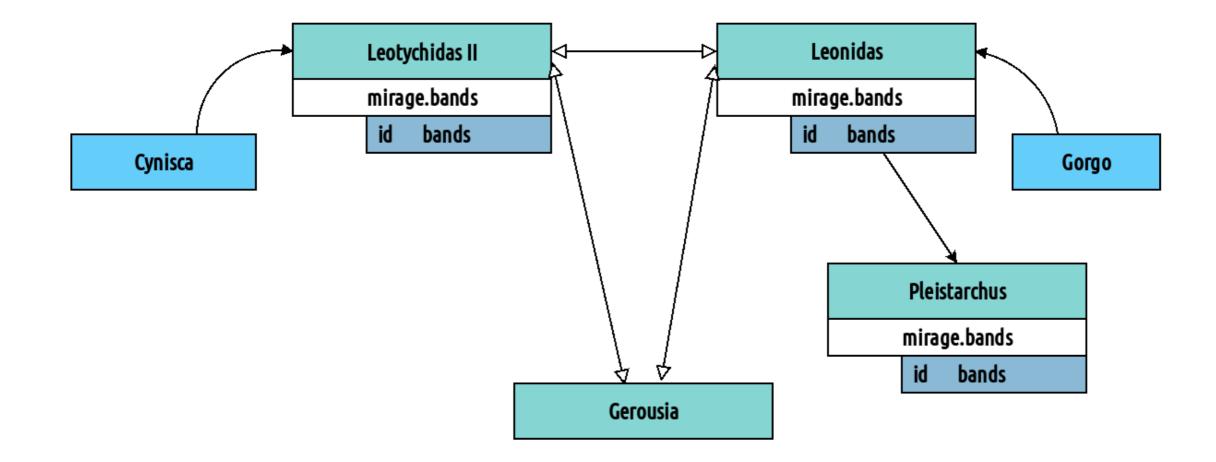
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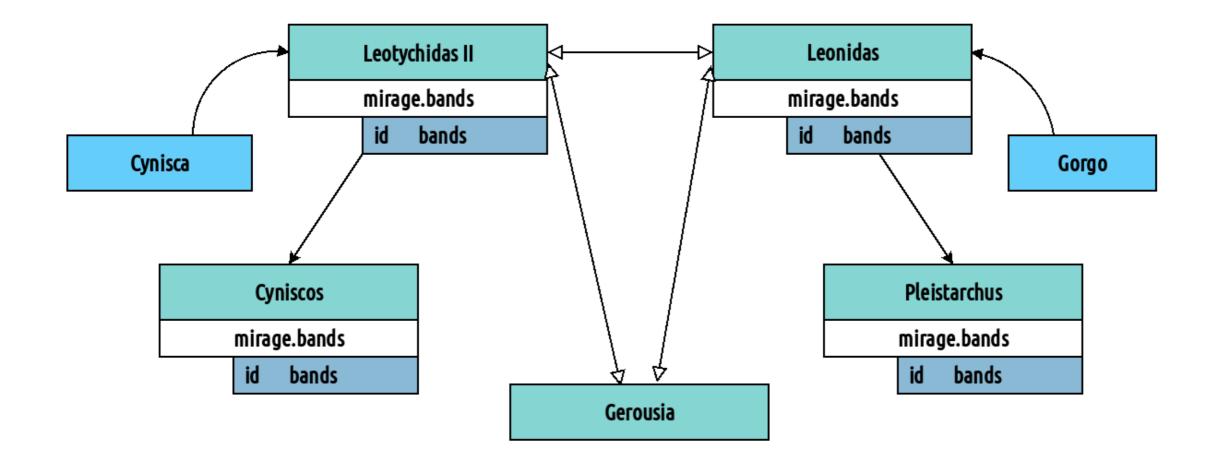
## **Disaster Recovery**

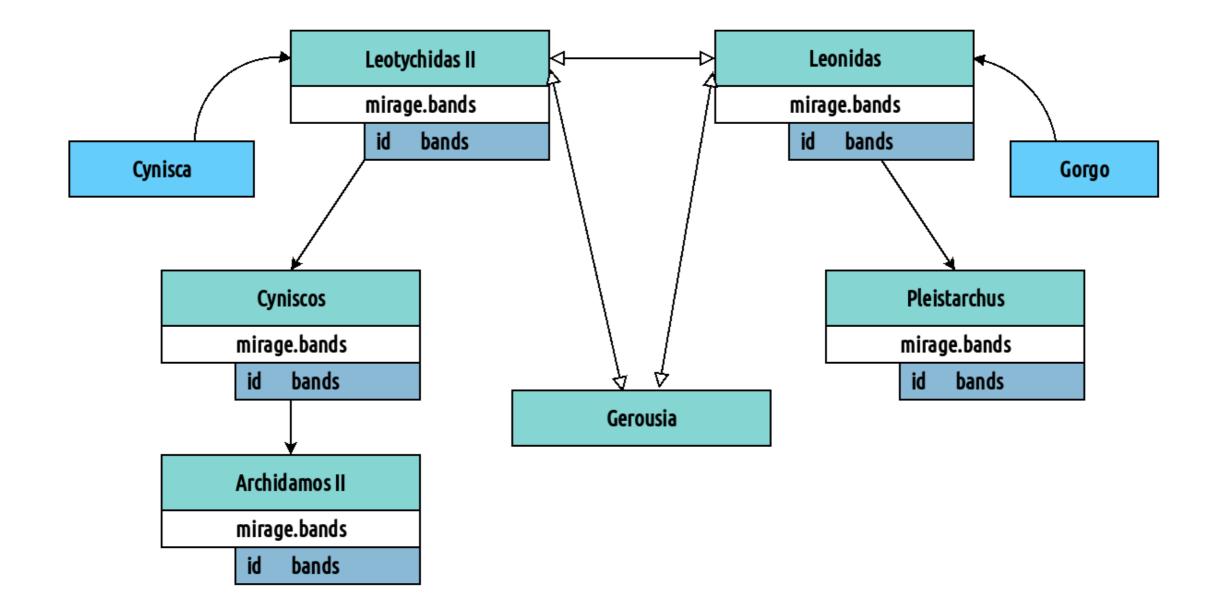


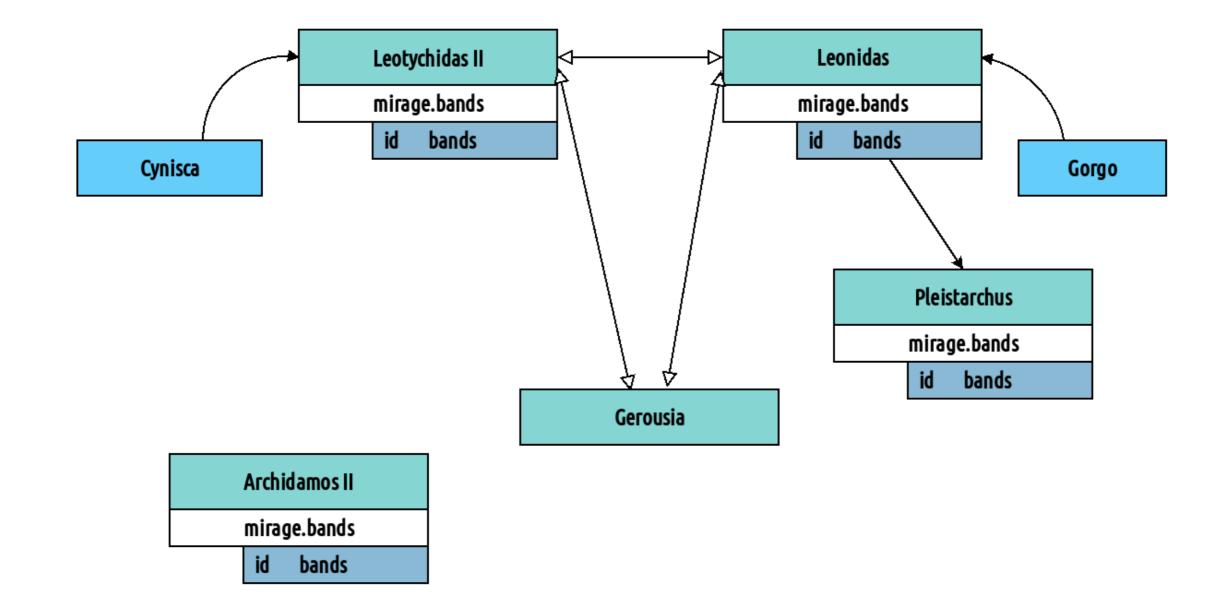
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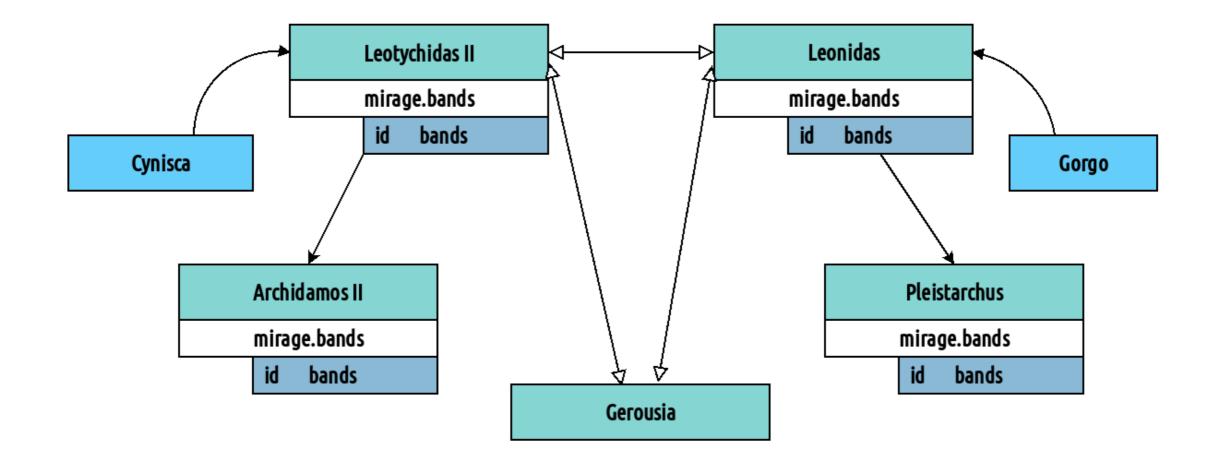


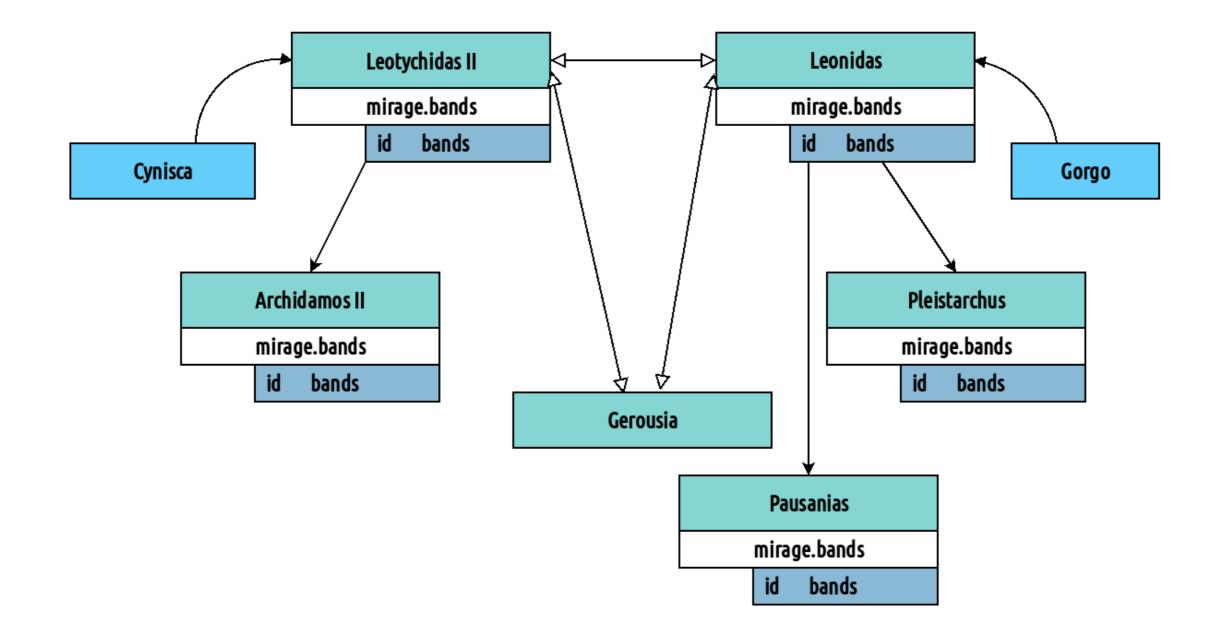


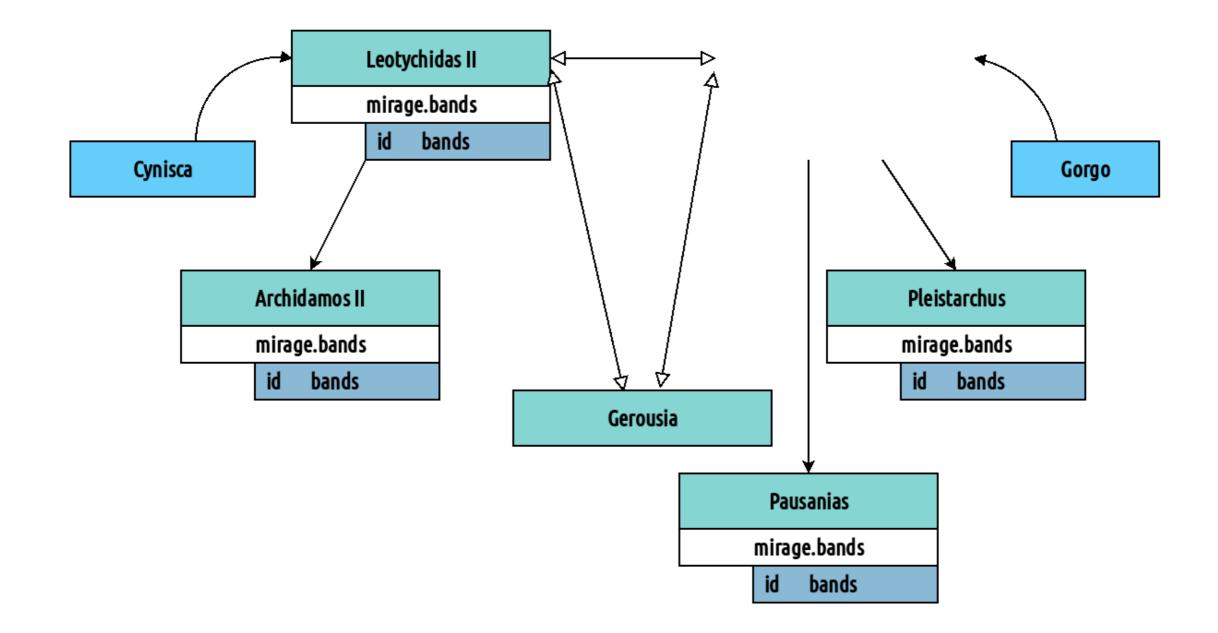


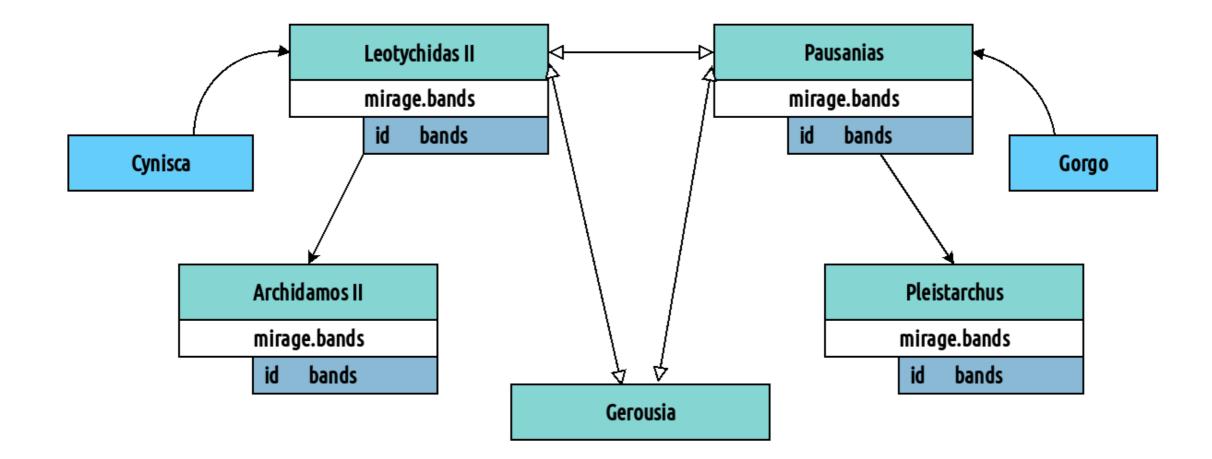


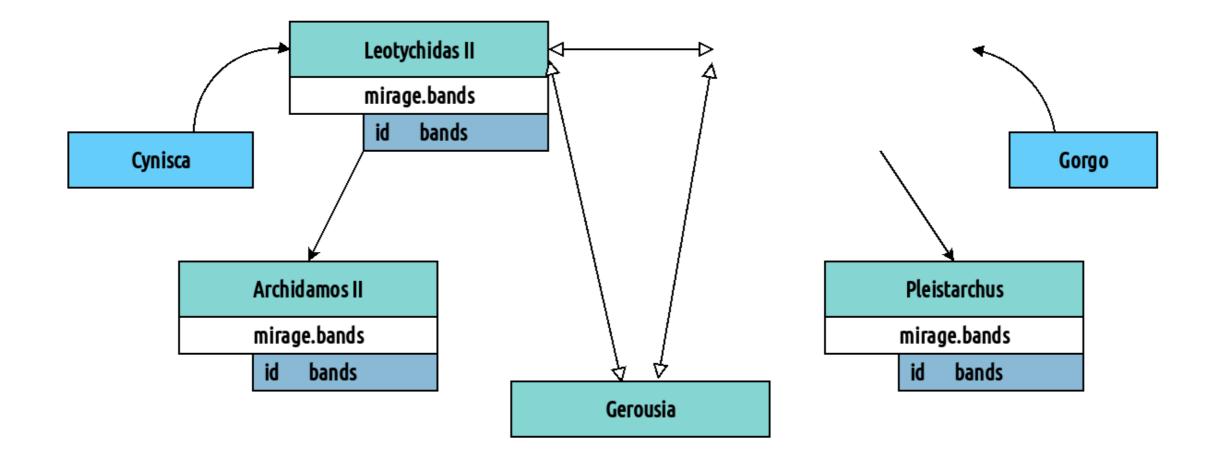


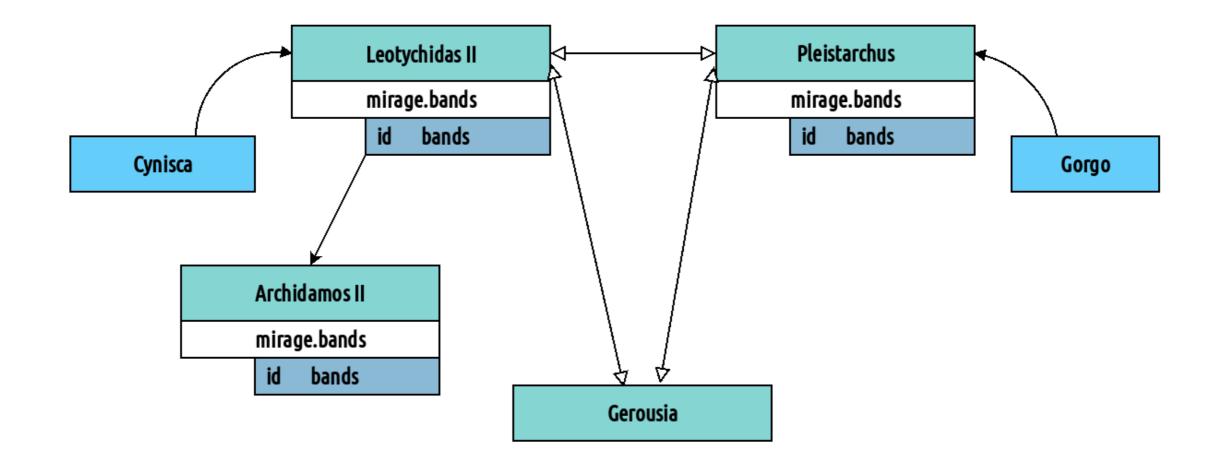


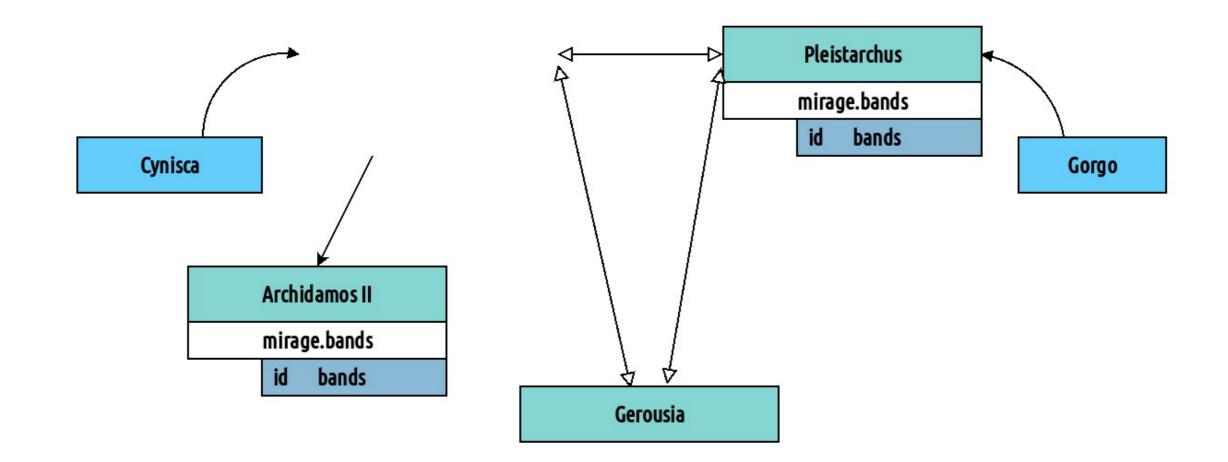


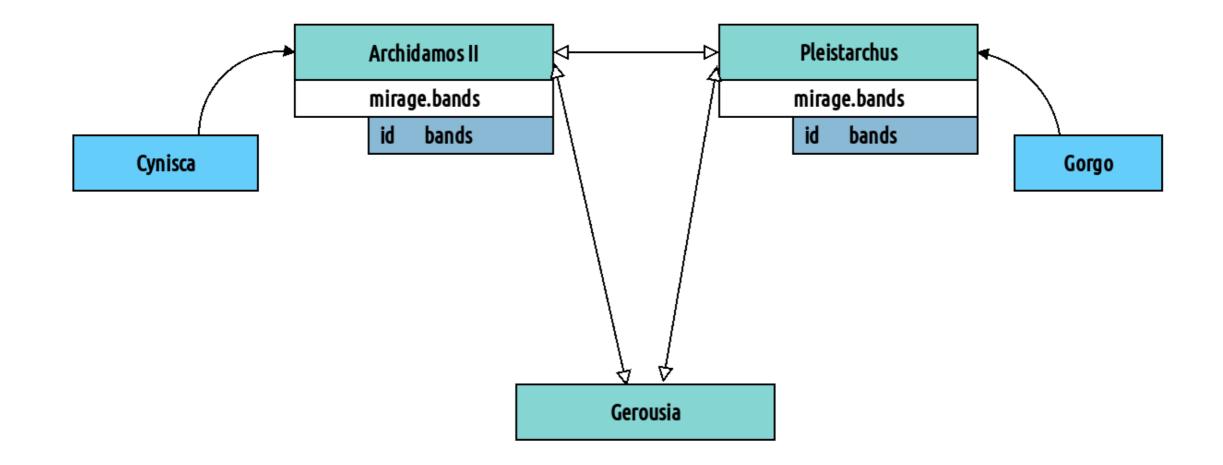












#### The Battle of Thermopylae

### No chance of success There was a disaster recovery plan



#### The Battle of Thermopylae

### No chance of success There was a disaster recovery plan It was a moral victory that has last for many years



480 BCE Greco-Persian



## 480 BCE Greco-Persian Gallic, Roman, Balkan, Byzantine, Bulgarian...

## 480 BCE Greco-Persian Gallic, Roman, Balkan, Byzantine, Bulgarian... 1821 Greek Independence – 48 against 8000



## 480 BCE Greco-Persian Gallic, Roman, Balkan, Byzantine, Bulgarian... 1821 Greek Independence – 48 against 8000 1941 WWII – Sabotage of the viaduct



## Disaster Recovery Plan is not only about the servers



# High Availability is not only about the servers



Wrapping up



## Scale-out

## High Availability

## Geo Redundancy



Et omicity Consistency Isolation Jurability

Consistency **Evailabity** Partition Tolcrance

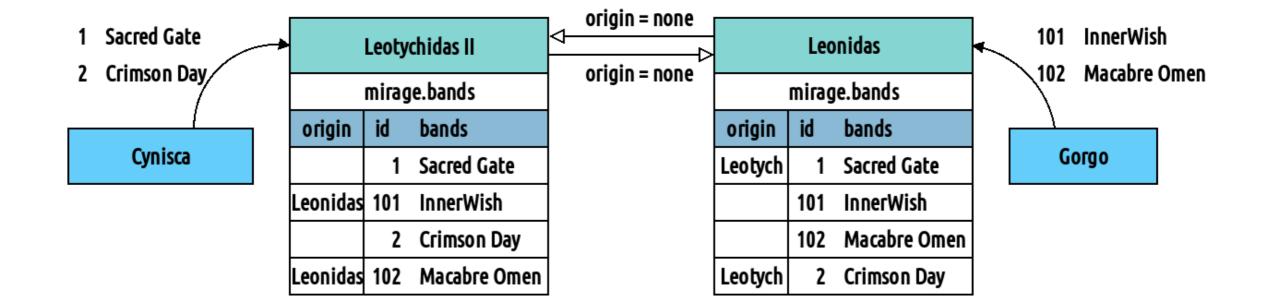


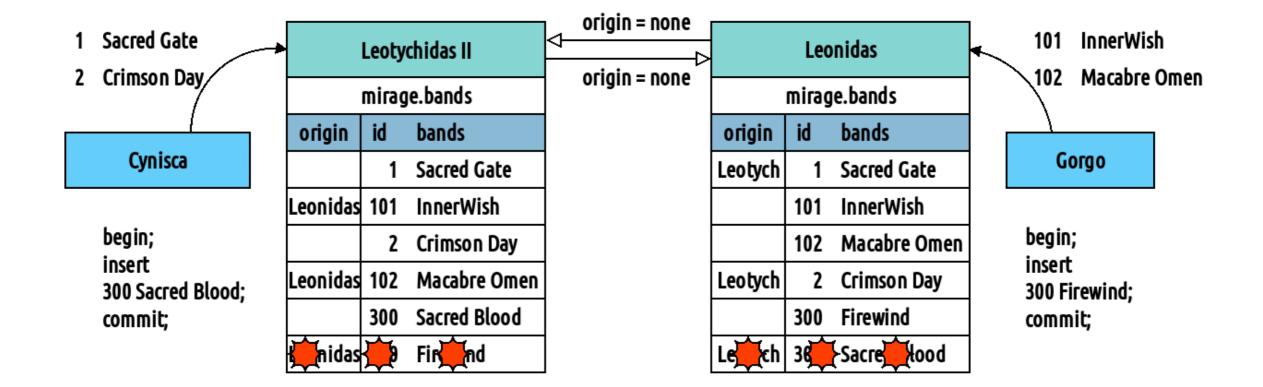
## Spartan's Dual Kingship

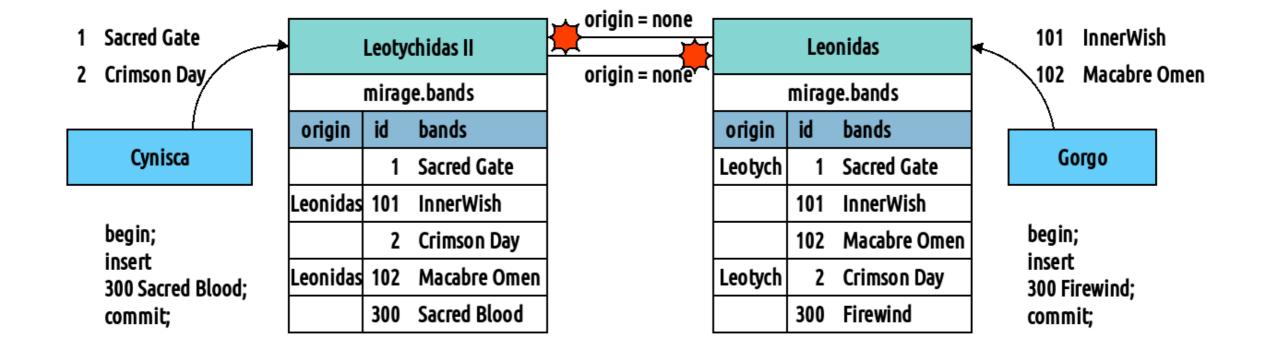












#### Consistency

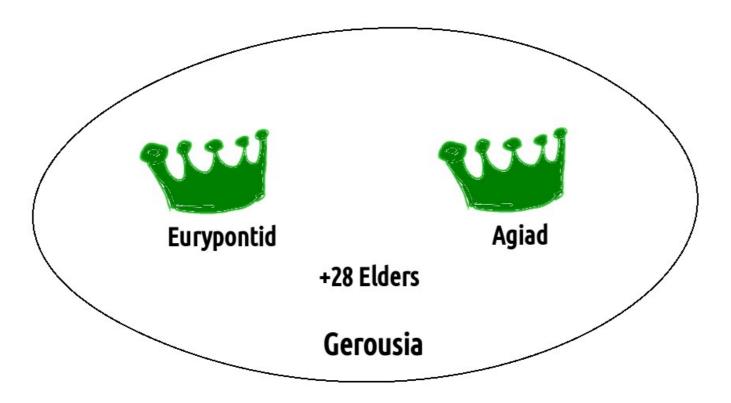
## Every read receives the most recent write or an error



					origin = none				1	
1	1 Sacred Gate		Leoty	chidas II		Leonidas		•	101 InnerWish	
2 Crim	Crimson Day				origin = none			102 Macabre Omen		
		mirage.bands				mirage.bands				
		origin	id	bands		origin	id	bands		
	Cynisca		1	Sacred Gate		Leotych	1	Sacred Gate		Gorgo
	begin; insert 300 Sacred Blood;	Leonidas	101	InnerWish			101	InnerWish		begin;
			2	Crimson Day			102	Macabre Omen		
		Leonidas	102	Macabre Omen		Leotych	2	Crimson Day		insert 300 Firewind;
		Leonidas	300	Firewind	ts2		300	Firewind	ts2 commit;	•

300 Sacred Blood ts1

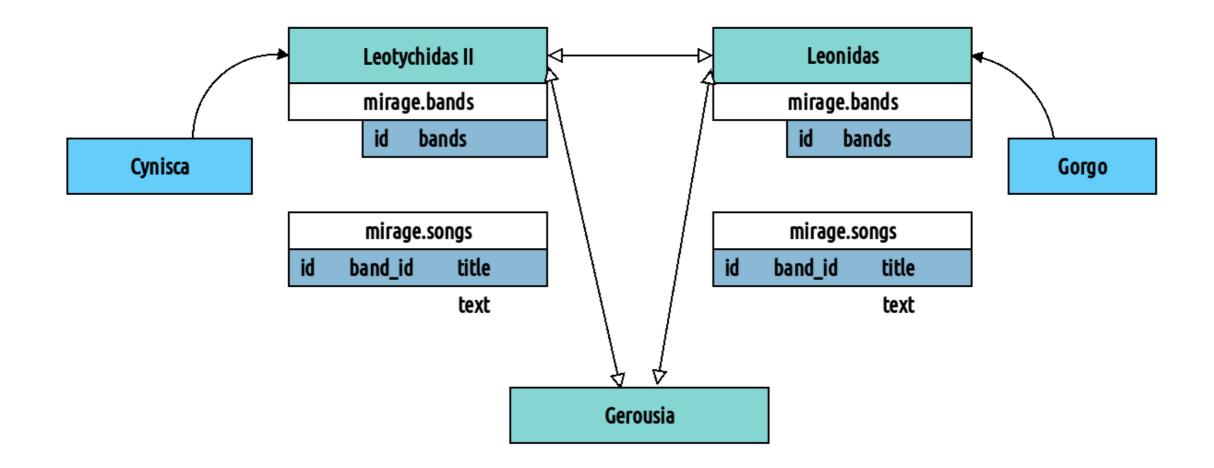
#### Spartan's Dual Kingship and the Gerousia

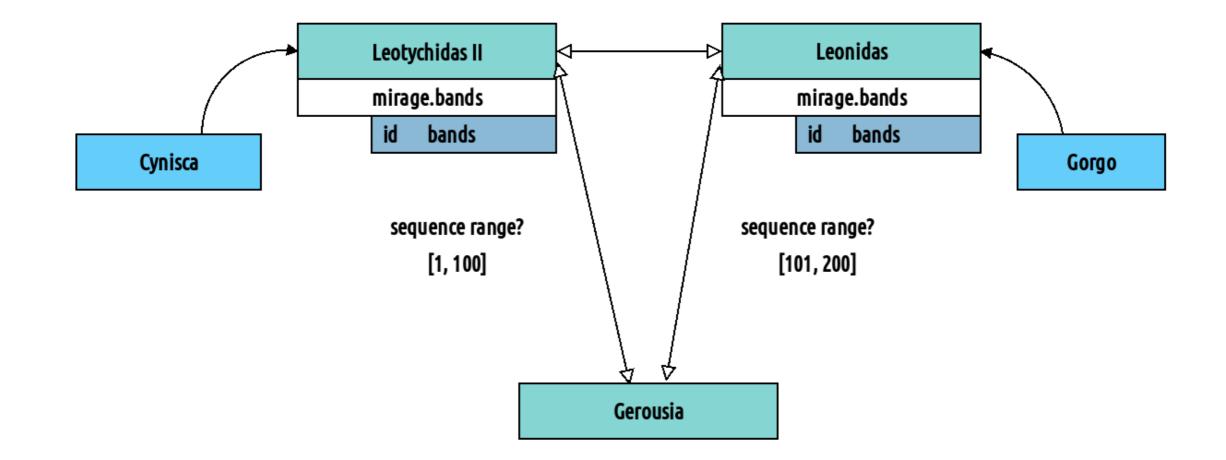




## Having consensus is very useful

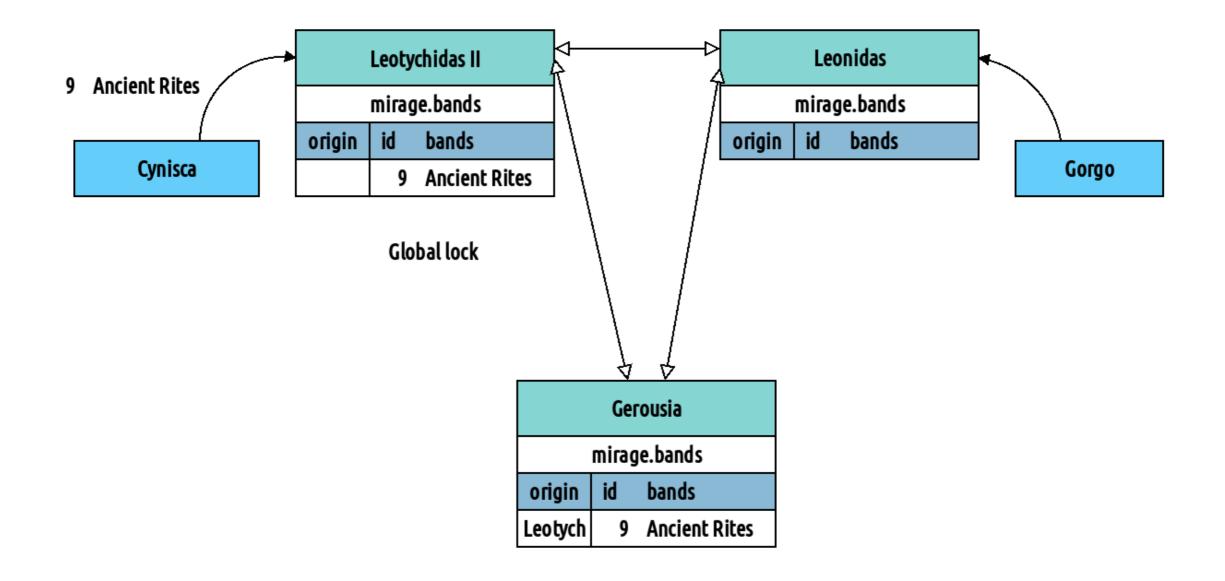


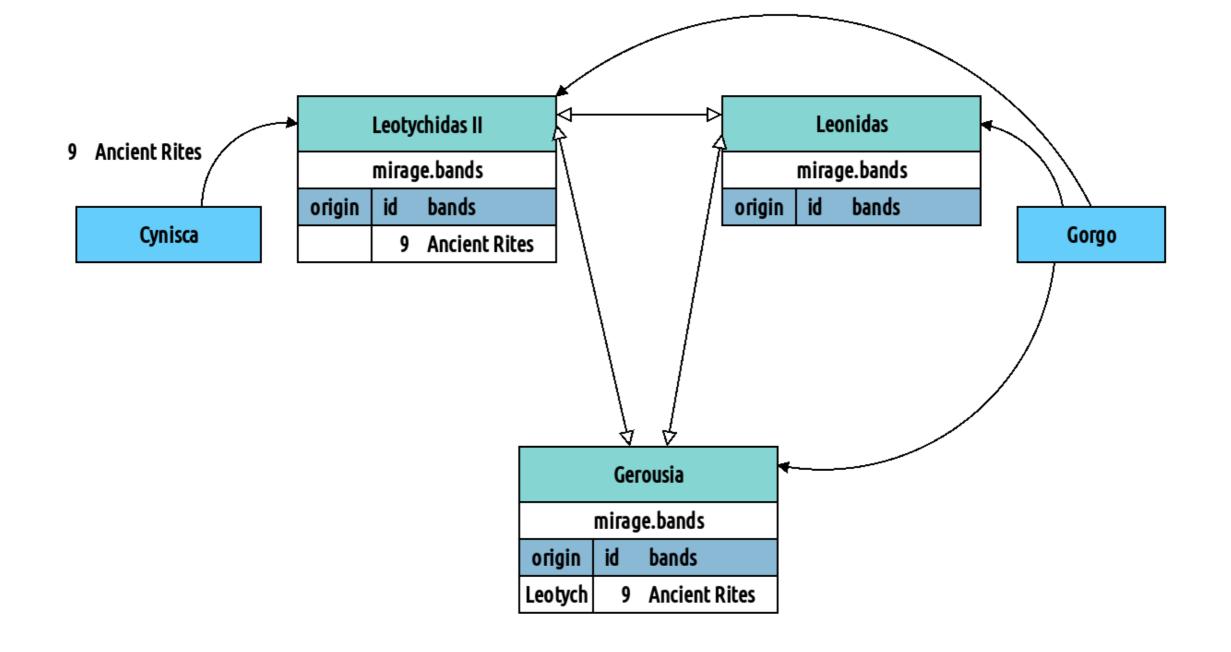




## Reduce remote locking

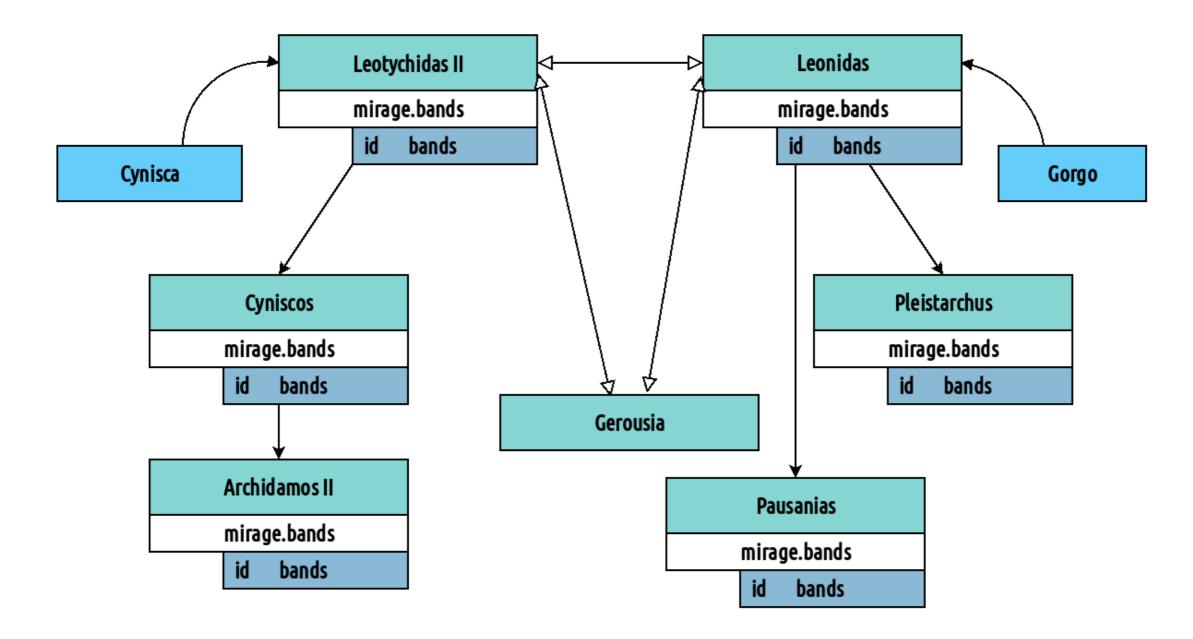






Disaster Recovery Mixing Logical and Physical Replication





## Beware of the Mirage of Active-Active



# Test your assumptions



# Design with Active-Active in mind





