Flight network and airline alliances

Flight route

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Introduction

STAR ALLIANCE

26 airlines

for example :

- Swiss
- Air China
- Lufthansa
- United Airlines

oneworld

14 airlines

for example :

- American Airline
- Japan Airline

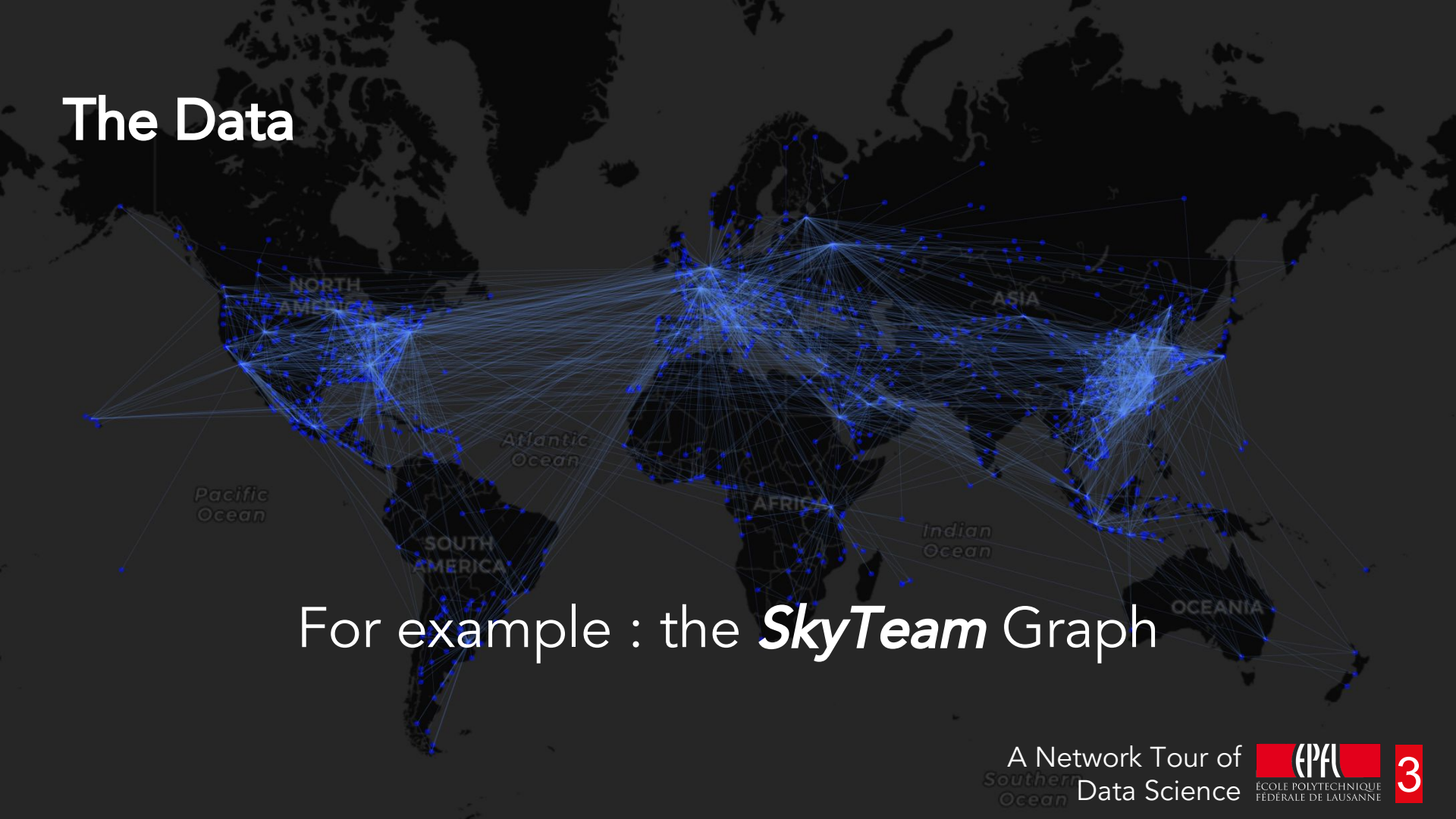
SKYTEAM

20 airlines

for example :

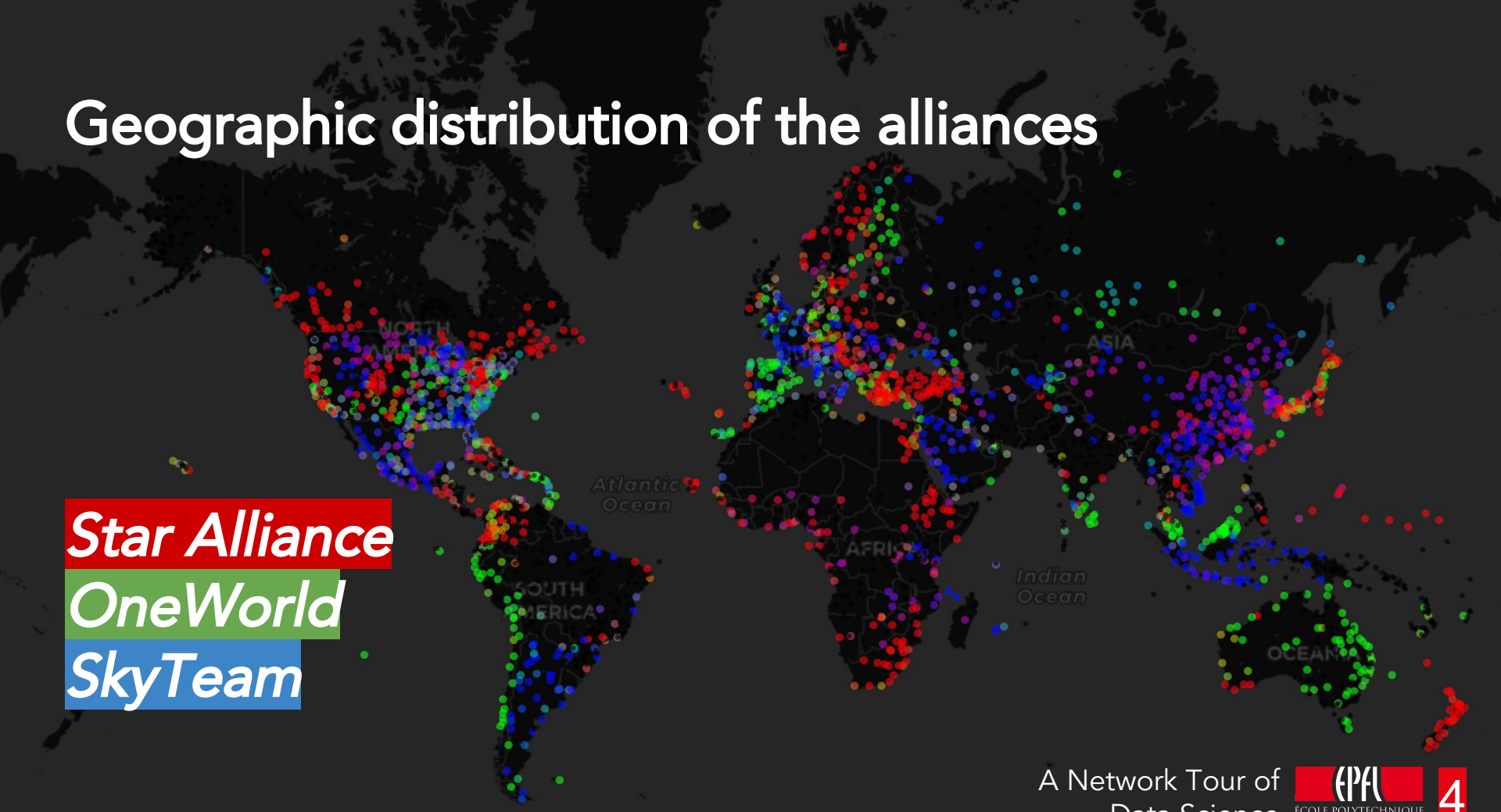
- Air France
- KLM Royal Dutch Airline

The Data



For example : the ***SkyTeam*** Graph

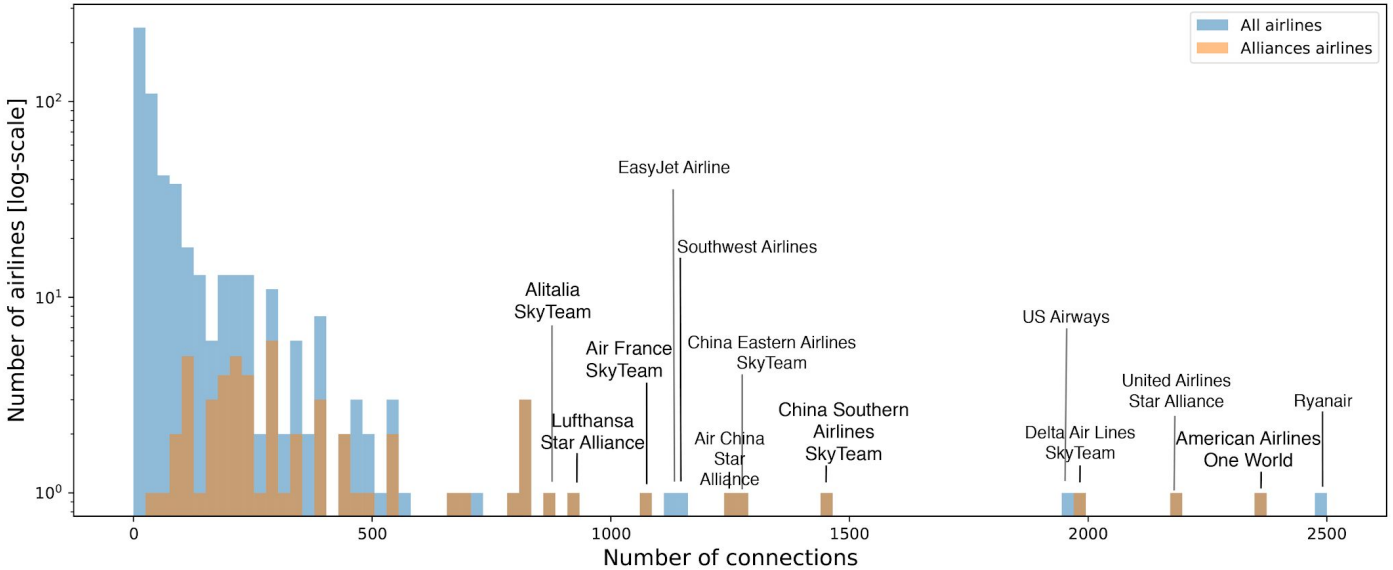
Geographic distribution of the alliances



1 -

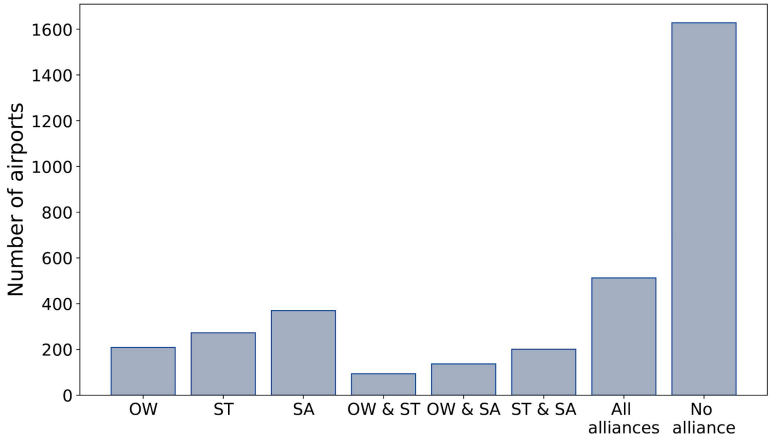
How prevalent are the alliances in the global flight route network ?

Airlines distribution

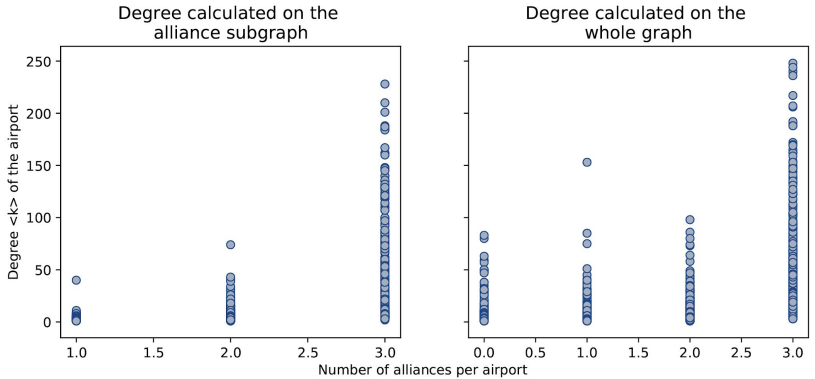


Alliance airlines: 11% of all the airlines
Almost half the connecting edges are operated by alliance airlines

Alliances and big hub



852, 432 and 513 are served by 1, 2, and 3 alliances respectively



Airports with a degree >100 are served by the 3 alliances

2 -

Prediction of the alliance expansion

Airport expansion of the alliances predicted through label propagation

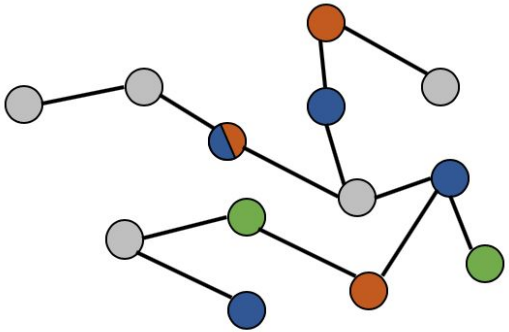
1. Randomly select an unlabeled node

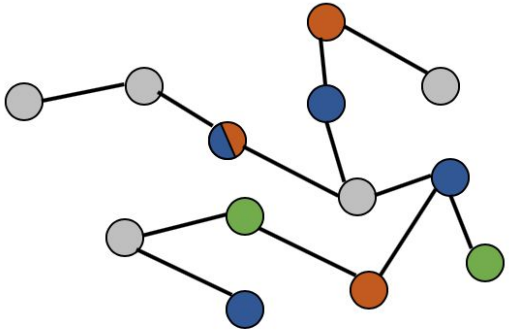
2. Sum up the labels of the neighbors

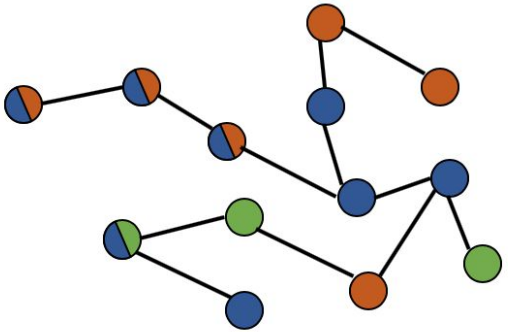
3. If all the neighbors are unlabeled go back to 1

4. Assign majority label

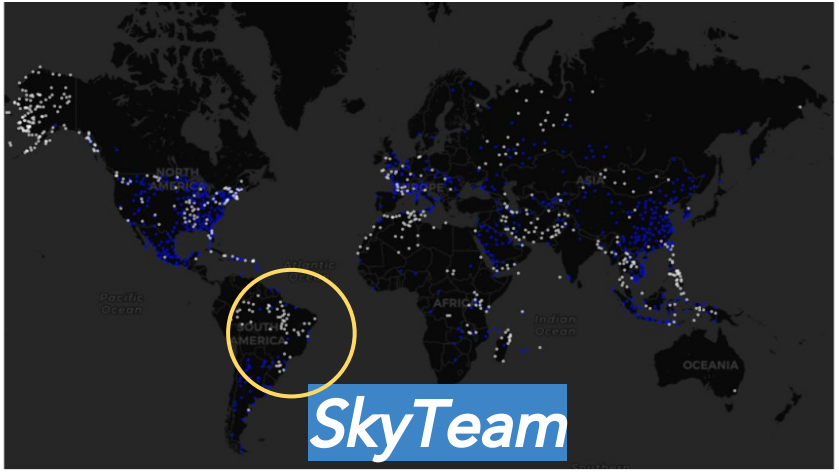
5. Repeat until all the nodes are labeled



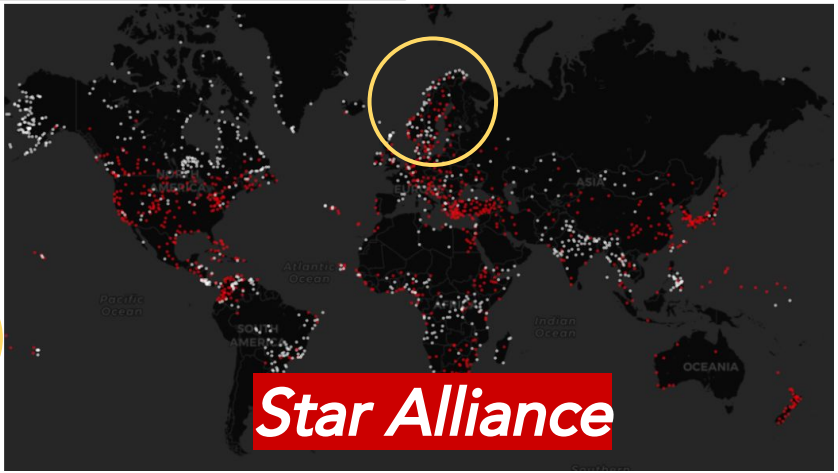




Network expansion's map

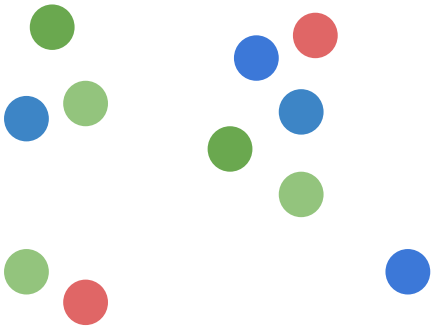


Example of predicted controlled area



Attribution of airline alliance from airport alliance distribution

1. **Found all airport where the airline operates**



Airports where *Example Airline* operates

2. **Count the weight of each alliance**

Star Alliance : 2

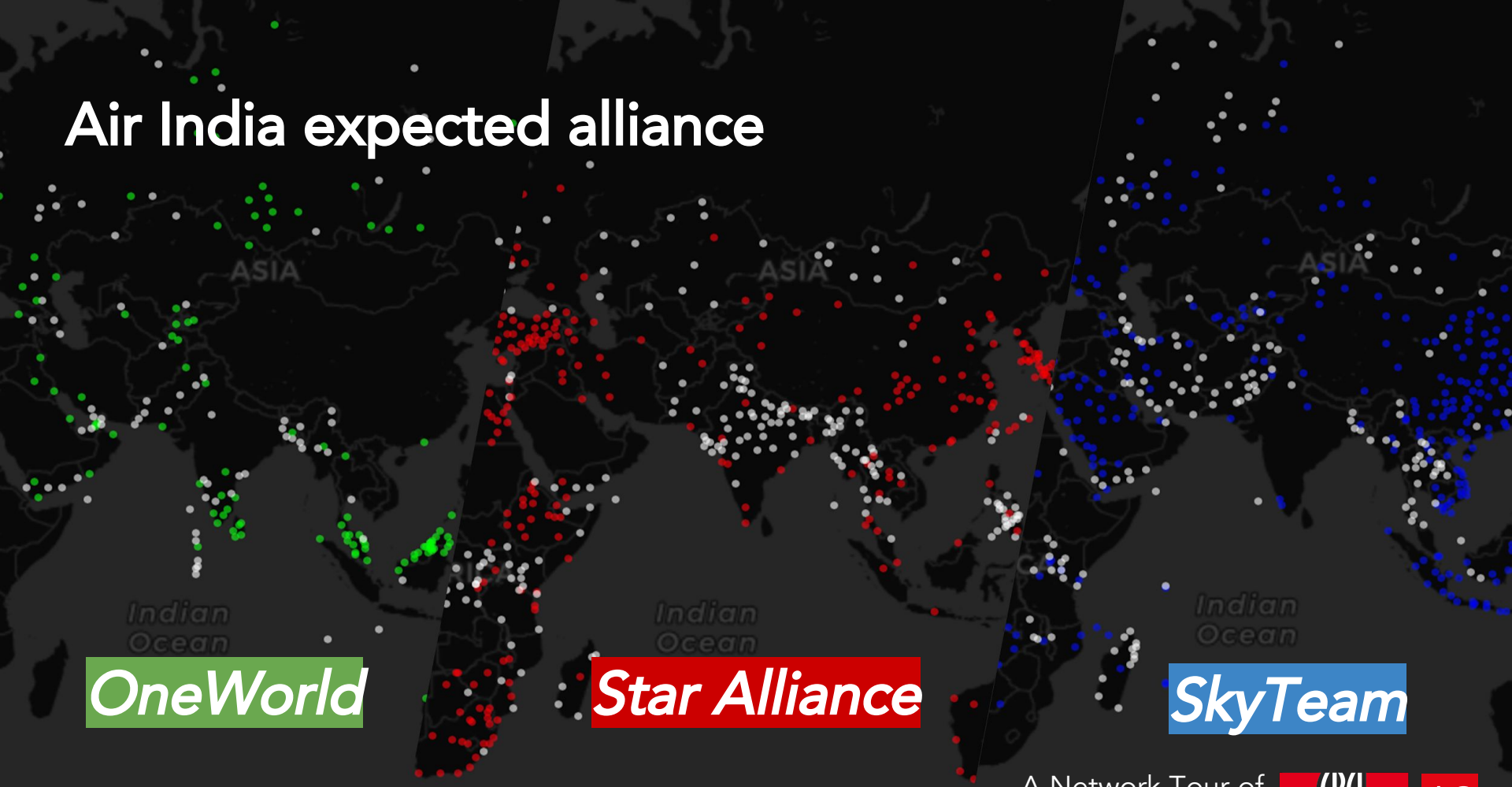
One World : 5

SkyTeam : 4

3. **Attribute the most appearing one**

One World

Air India expected alliance

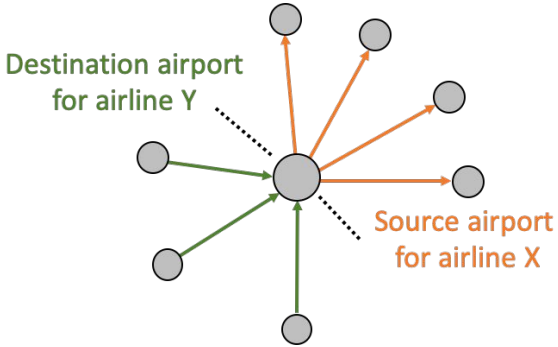


3 -

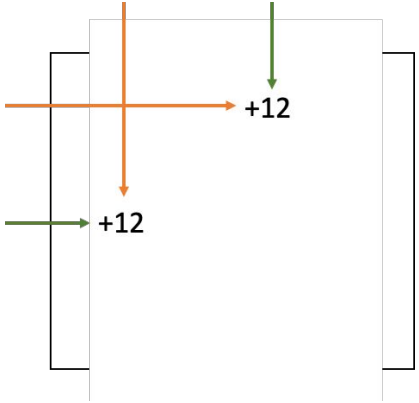
Can the alliances be predicted from an airline network ?

Building an airline network

1. For each airport check pairwise incoming and outgoing airline flights



12 possible connections



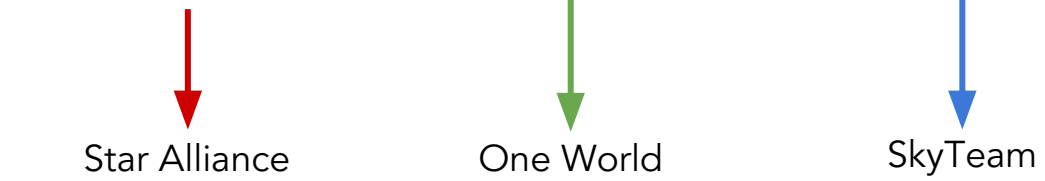
Airline adjacency matrix

2. Set weights between airlines operating in the same region (Europe, North America, …) to zero

3. Normalize the adjacency matrix

Cluster analysis

	Cluster 1	Cluster 2	Cluster 3
One World	3 (21% of OW)	11 (79% of OW)	0 (0% of OW)
Skyteam	7 (35% of ST)	2 (10% of ST)	11 (55% of ST)
Star Alliance	14 (54% of SA)	11 (42% of SA)	1 (4% of SA)



Misclassification occurred mainly for *small* airlines

4 -

Which alliances are the *independent* airlines likely to join ?

Prediction with our two methods

Airlines	Spectral clustering	Label Propagation
JetBlue Airways	OW	ST
Ryanair	OW	OW
US Airways	OW	ST
Emirates	SA	SA
Etihad Airways	SA	SA
easyJet	SA	SA
Wizz Air	SA	SA
AirAsia	ST	ST
Virgin Atlantic Airways	ST	ST
Southwest Airlines	ST	ST

Similar results, because of similar assumption:

Label propagation: Alliance expansions to neighbouring airports are the most likely

Spectral clustering: Airlines doing neighbouring connections are most likely to be inside a cluster

Conclusion

- Big hubs (degree > 100) are served by all the alliances
- Alliances are globally present, but there are also geographic differences
- Label propagation predicted the likely expansion of the alliances
- Spectral clustering revealed that there is an underlying network property which makes the alliances appear ‘naturally’
- Coherent airline attributions to alliances were predicted with two algorithms

Thanks for your attention !