

UB Datascience

Complex Networks

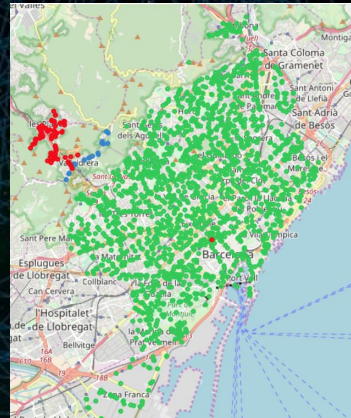
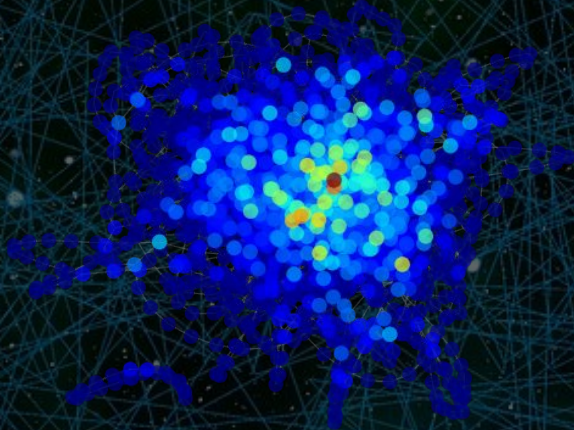
Final delivery

Barcelona bus network

David Solans & Gerard Martinez

Introduction

- 1.- During the course, we have analyzed a bus network extracted from <http://barcelonaapi.marcpous.com> but it contained information from the old network.
- 2.- After requesting access to the data, TMB granted us access to the updated transport dataset.
- 3.- We ended scrapping their web to gather the information presented today.



Data gathering

From the sent dataset to the final data extraction

STATIONS.CSV

	route_id	route_short_name	route_long_name	route_type	route_url	route_color	route_text_color
0	1.1	L1	Hospital de Bellvitge - Fondo	1	https://www.tmb.cat/ca/barcelona/metro/-/linea...	CE1126	FFFFFF
1	1.2	L2	Paral·lel - Badalona Pompeu Fabra	1	https://www.tmb.cat/ca/barcelona/metro/-/linea...	93248F	FFFFFF
2	1.3	L3	Zona Universitària - Trinitat Nova	1	https://www.tmb.cat/ca/barcelona/metro/-/linea...	1EB53A	FFFFFF
3	1.4	L4	La Pau - Trinitat Nova	1	https://www.tmb.cat/ca/barcelona/metro/-/linea...	F7A30E	000000
4	1.5	L5	Cornellà Centre - Vall d'Hebron	1	https://www.tmb.cat/ca/barcelona/metro/-/linea...	005A97	FFFFFF

ROUTES.CSV

	stop_id	stop_code	stop_name	stop_lat	stop_lon	stop_url	location_type	parent_station	wheelchair_boarding
0	1.111	111.0	Hospital de Bellvitge	41.344677	2.107242	NaN	0	P.6660111	1.0
1	E.11101	NaN	Residència sanitària	41.344357	2.106669	NaN	2	P.6660111	1.0
2	P.6660111	NaN	Hospital de Bellvitge	41.344677	2.107242	NaN	1	NaN	NaN
3	1.112	112.0	Bellvitge	41.350975	2.110917	NaN	0	P.6660112	1.0
4	E.11201	NaN	Rambia de la Marina / Avda. Granvia	41.350895	2.111515	NaN	2	P.6660112	1.0

AT THE end, we
SCRAPPED TMB
PORTAL:

Horaris de servei de la línia			
Parada	Enllaç		
Borbó - Serrano	L3 G40 H6 V27 V29		☆
Arnau d'Oms - La Jota	G40 H6 V27 V29		☆
Pi Ferrer - Delà			☆
Pi Ferrer - Pintor Alsamora			☆
Av Rio de Janeiro - Cementiri de Sant Andreu			☆
Av Rio de Janeiro - Pg Valldaura			☆
Pi Àngel Pestaña			☆
Via Júlia - Mas Duran	L4		☆
Via Júlia - Via Favència			☆
Via Favència - Pablo Iglesias			☆

New bus network

Some properties

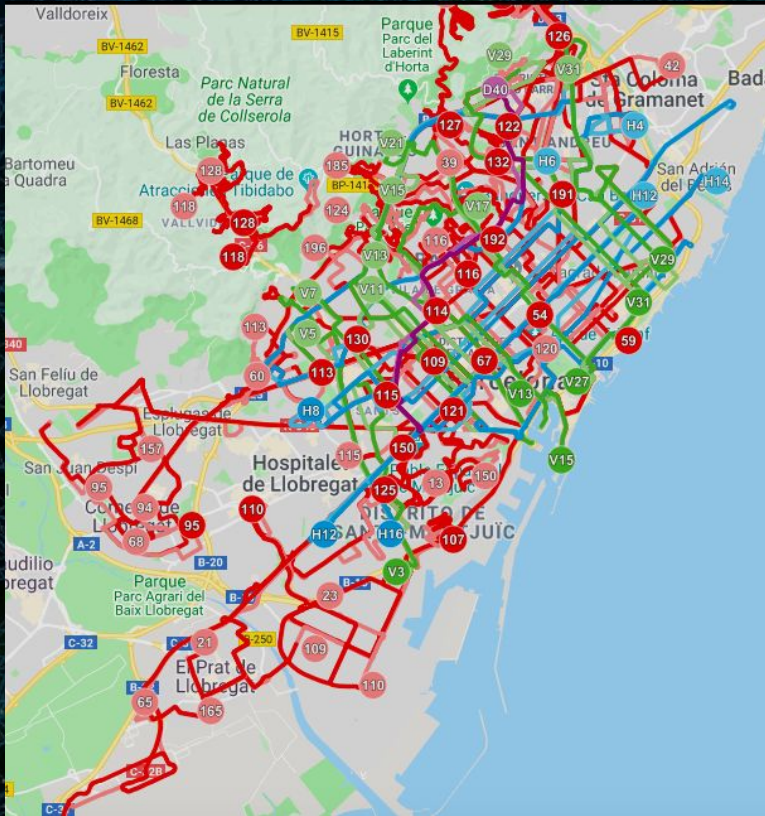
98 bus lines

2374 bus stations

833.17 km length

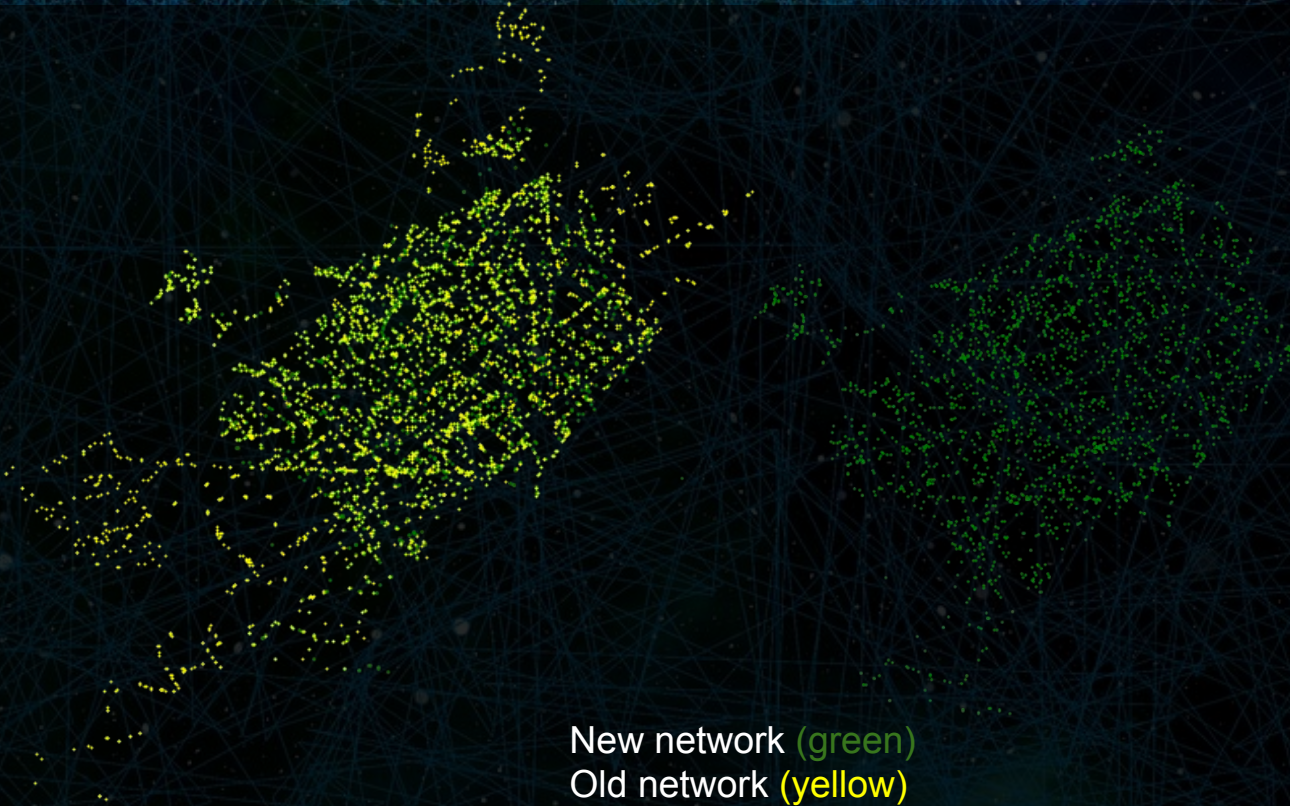
1085 buses in total

12.06 km/h average speed



New network vs old one

Network nodes visualization



New network (green)
Old network (yellow)

New network vs old one

Comparing statistics

Old network

Number of nodes: 2469

Number of edges: 3127

Average degree: 2.533

Nodes per component: 2357, 90, 22

New network

Number of nodes: 2374

Number of edges: 3149

Average degree: 2.6529

Nodes per component: 2260, 91, 23

Old network

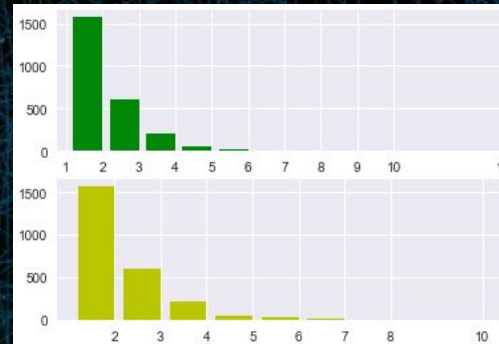
Average: 9.731

Biggest component: 14.307

New network

Average: 13.623

Biggest component: 20.986



degree
DISTRIBUTION

Average
SHORTEST PATH

New network vs old one

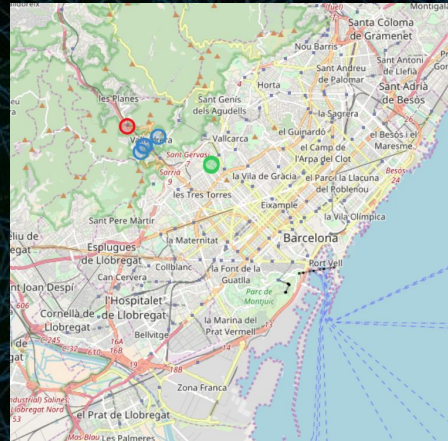
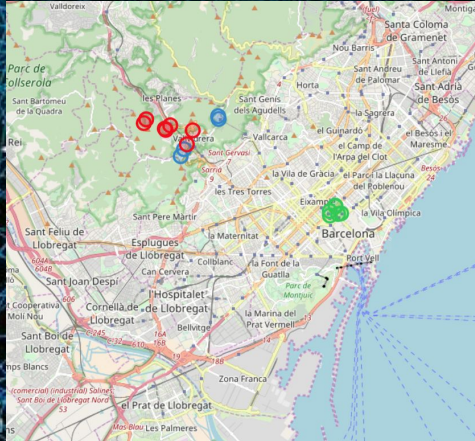
Comparing statistics

Old network

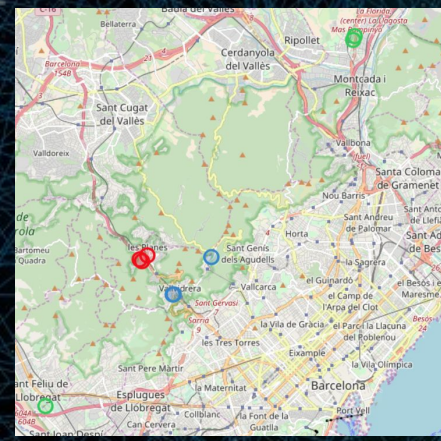
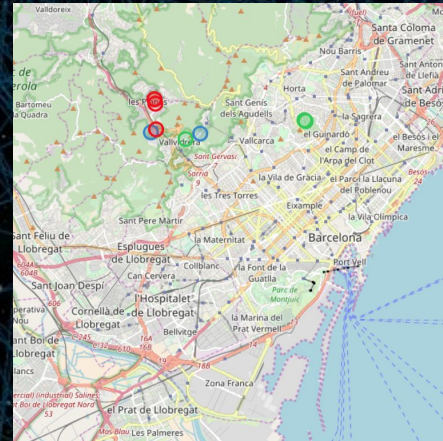
New network

Old network

New network



RADIUS



PERIPHERY

Old network

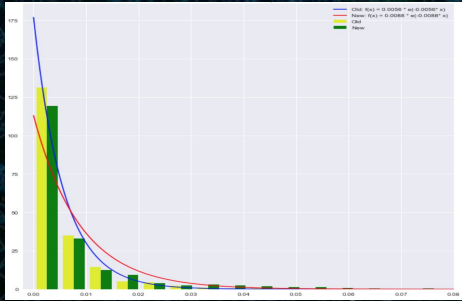
New network

Radius per component: 20 - 14 - 6

Radius per component: 34 - 19 - 11

New network vs old one

Node centrality distributions



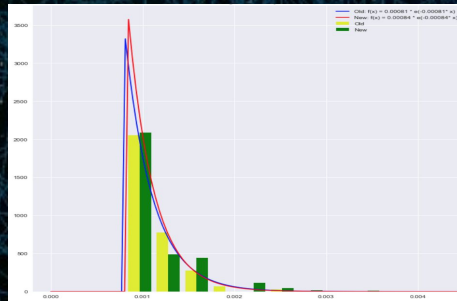
**BETWEENES
CENTRALITY**

Old network

Av.Diagonal-Palau Reial
Gran Via-Rambla Catalunya

New network

Diagonal-Pau Claris
Av. Gaudí



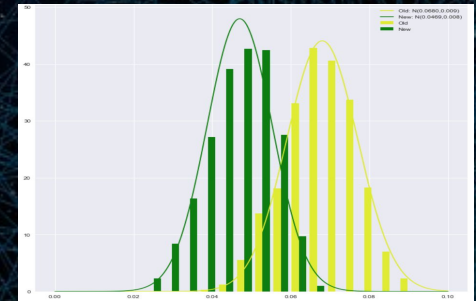
**DEGREE
CENTRALITY**

Old network

Av.Roma-Tarragona
Pl.Espanya - FGC

New network

Pl.Espanya - FGC
Av.Roma-Tarragona



**CLOSENESS
CENTRALITY**

Old network

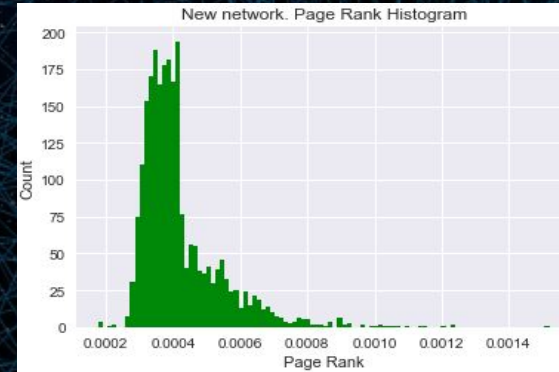
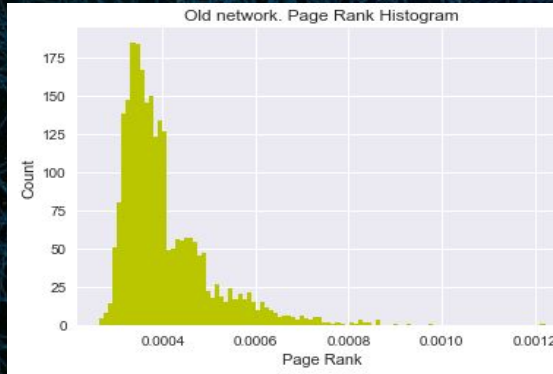
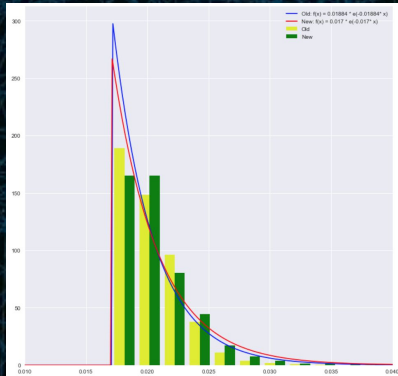
Gran Via-Rambla Catalunya
Pau Claris-Gran Via

New network

Diagonal-Pau Claris
Diagonal-Girona

New network vs old one

Most central node



KATZ CENTRALITY

Old network

Av.Roma-Tarragona
Pau Claris-Gran Via

New network

Pl.Espanya - FGC
Meridiana-La Sagrera

Page rank

Old network

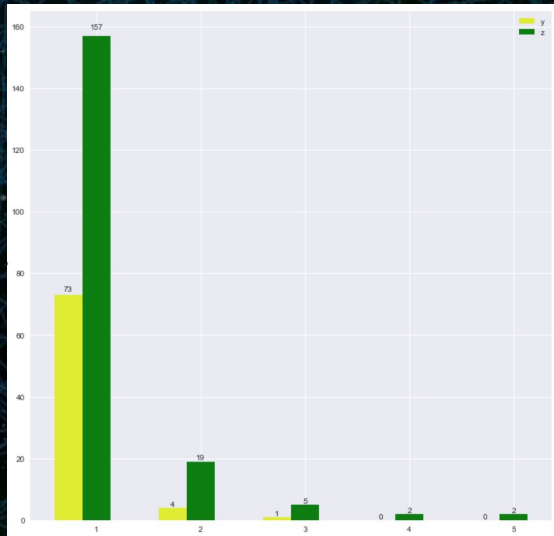
Node with higher rank:
Av.Roma - Tarragona

New network

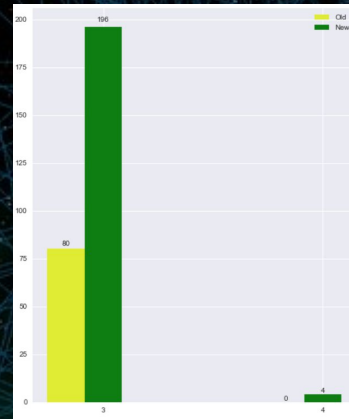
Node with higher rank:
Pl.Espanya - FGC

New network vs old one

Clustering



TRIANGLES



CLIQUEs

Old network

Num nodes part of clickes size 2: 2469

Num nodes part of clickes size 3: 80

Num nodes part of clickes size 4: 0

Num nodes part of clickes size 5: 0

New network

Num nodes part of clickes size 2: 2374

Num nodes part of clickes size 3: 196

Num nodes part of clickes size 4: 4

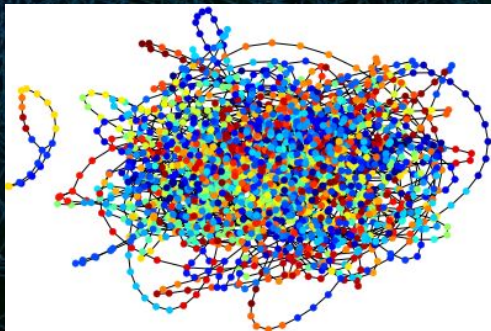
Num nodes part of clickes size 5: 0

New network vs old one

Community detection

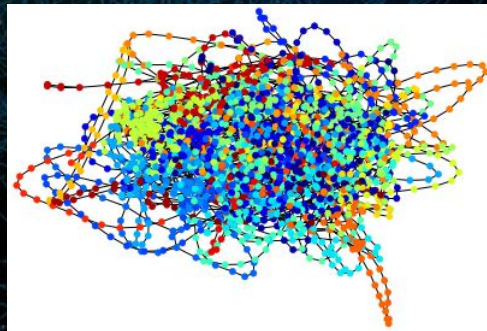
Old network

Louvain



New network

Louvain



Old network

Communities: 753

Modularity: 0.5658

New network

Communities: 729

Modularity: 0.5854

Old network

Communities: 29

Modularity: 0.8574

New network

Communities: 32

Modularity: 0.8866

Old network

Communities: 1112

Modularity: 0.4359

New network

Communities: 114

Modularity: 0.4338

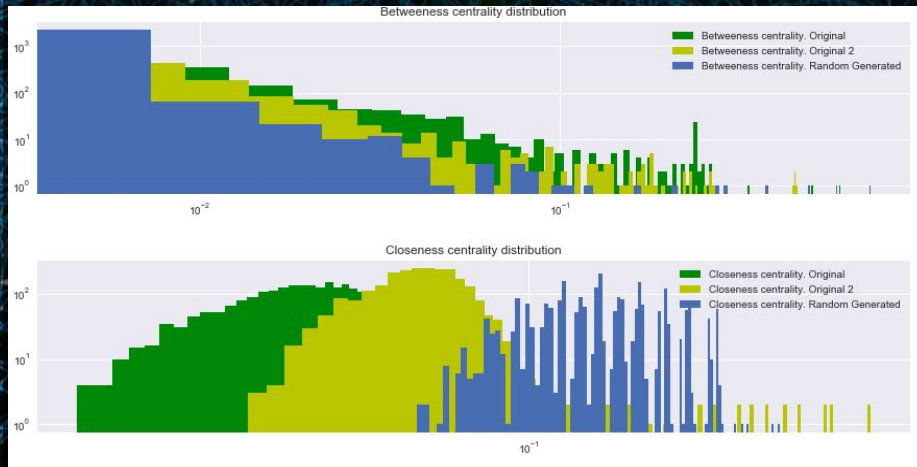
**Label
PROPAGATION**

Louvain

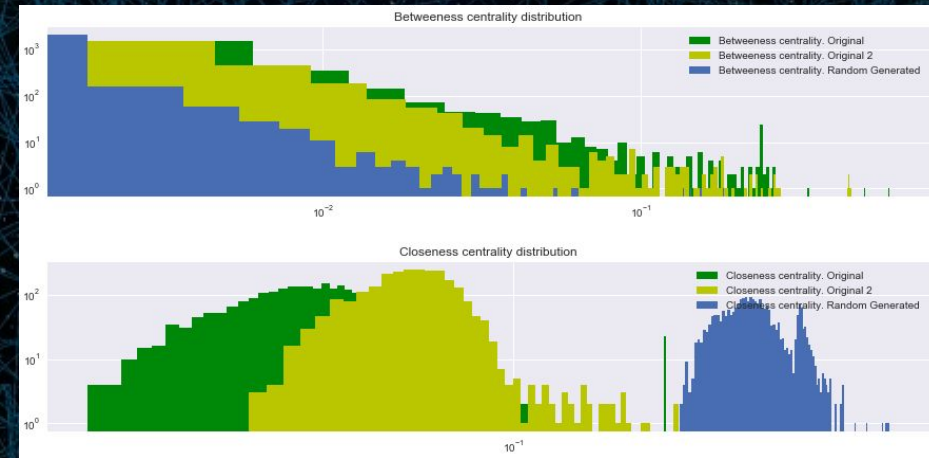
**FLUID
communities**

New network vs old one

Random graphs comparison



$M = 1$



$M = 2$

BARABASI ALBERT
(from new
network, $N=2374$)

New network vs old one

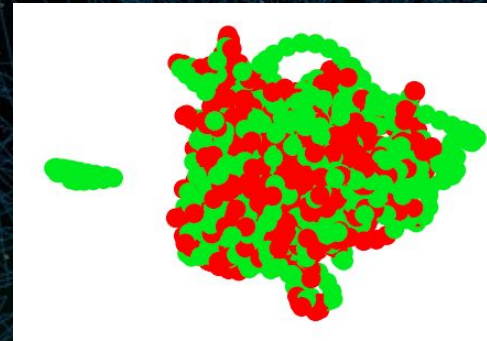
Dynamic model: SIS

$P(\text{get_infected}) = 0.8$
 $P(\text{recuperated}) = 0.5$



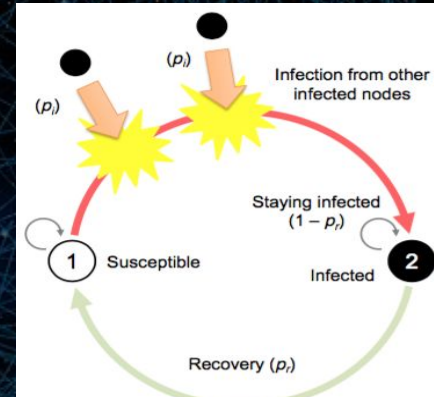
Starting with one infected node

5x
(10000 iterations
of SIS)



Evaluating final number of infected nodes

Nodes infected:



Thank you

For Your Attention