

# HOW DO WE KNOW THAT ONE PERSON USE TWO SIM-CARDS?

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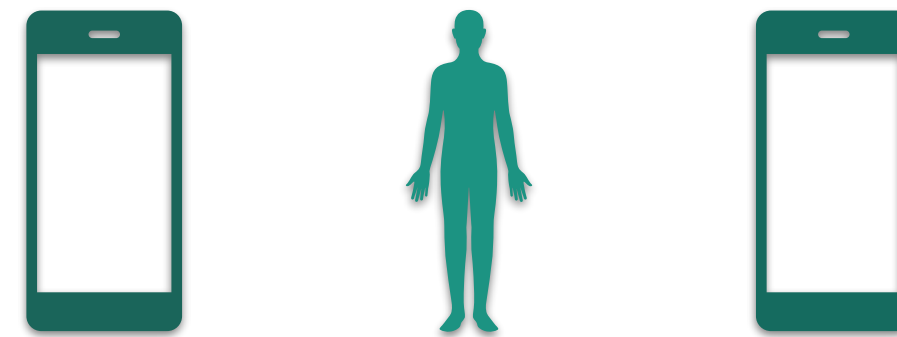
Identifying if two sim-cards belong to one person  
based on geo data over time from cell towers



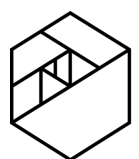
## PROBLEM UNDERSTANDING

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Due to the active expansion of communication services, many people hold more than one SIM card.

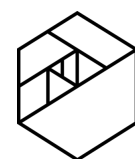
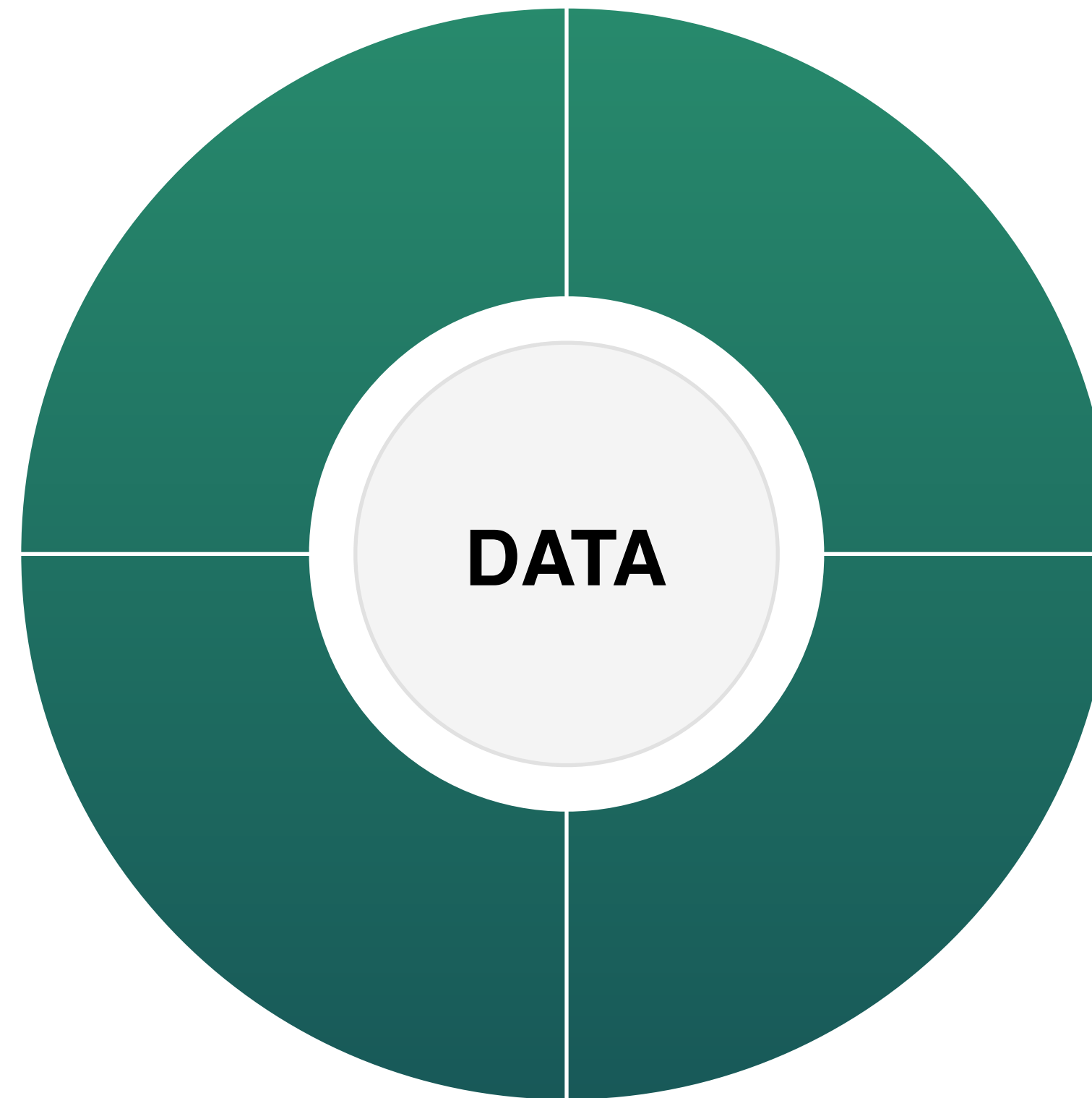


**Business use case:** suggest better plan for customers, which also have a number from another cellular provider.



## LOCATIONS AND TIME

Longitude and latitude of  
base stations, which register  
signal from sim-cards

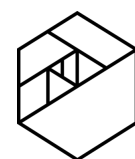
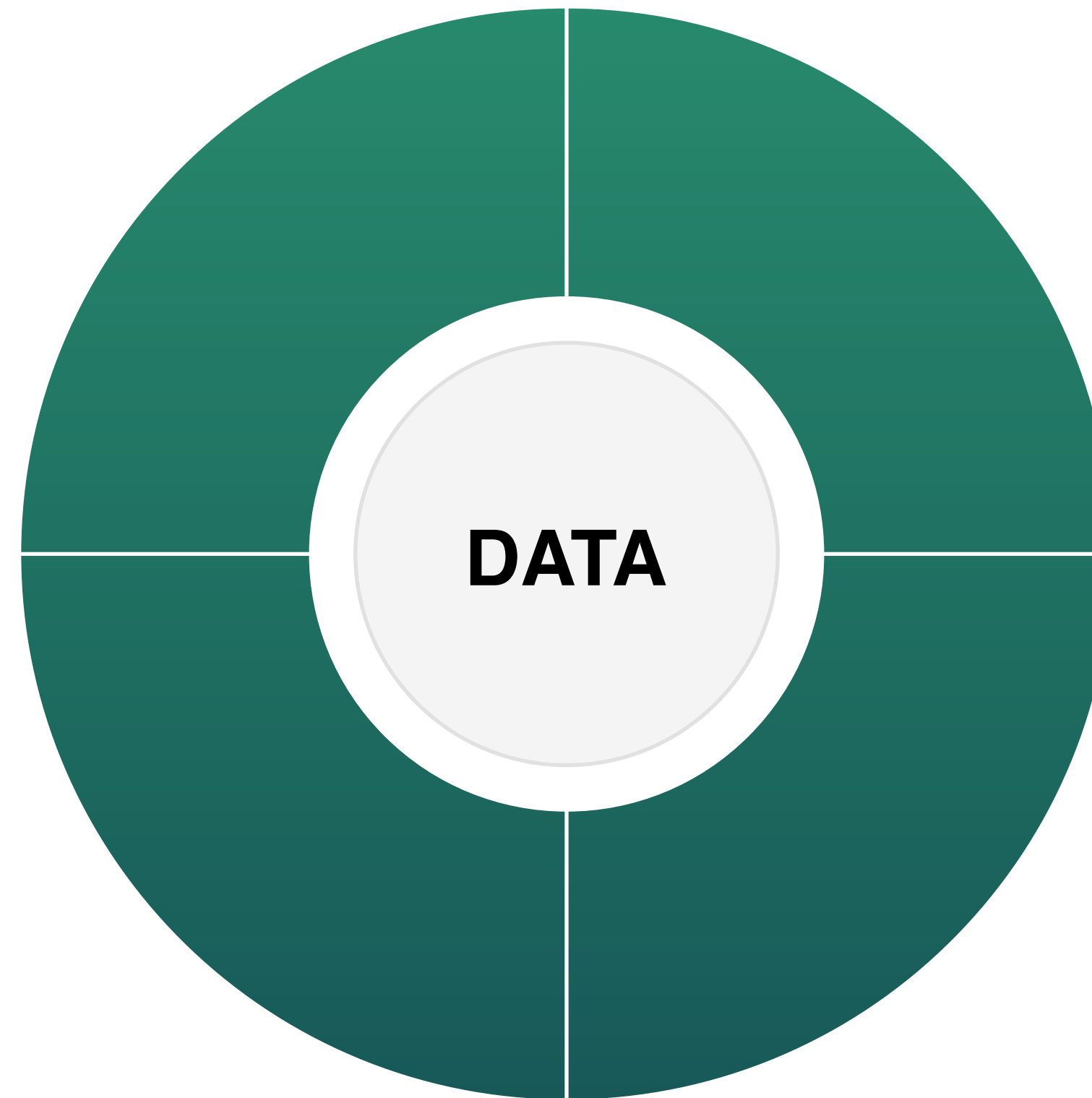


## LOCATIONS AND TIME

Longitude and latitude of base stations, which register signal from sim-cards

## EVENT

There are different event type which base stations can differ: change of locations, switch off the phone, turn on the phone and so on

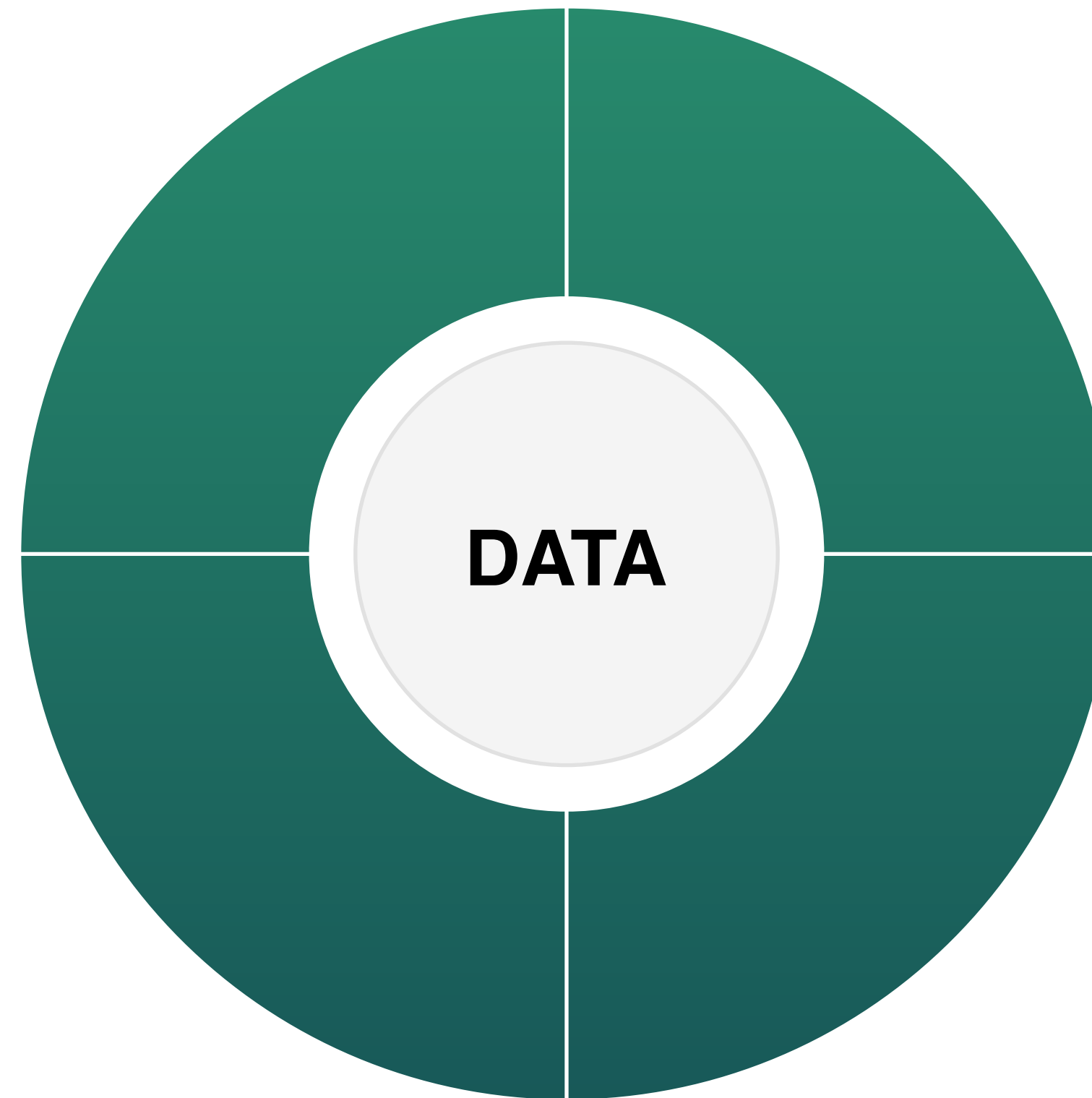


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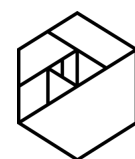
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## ANGLES

Base stations can accept the signals from different angels, depending on the location of sim-card

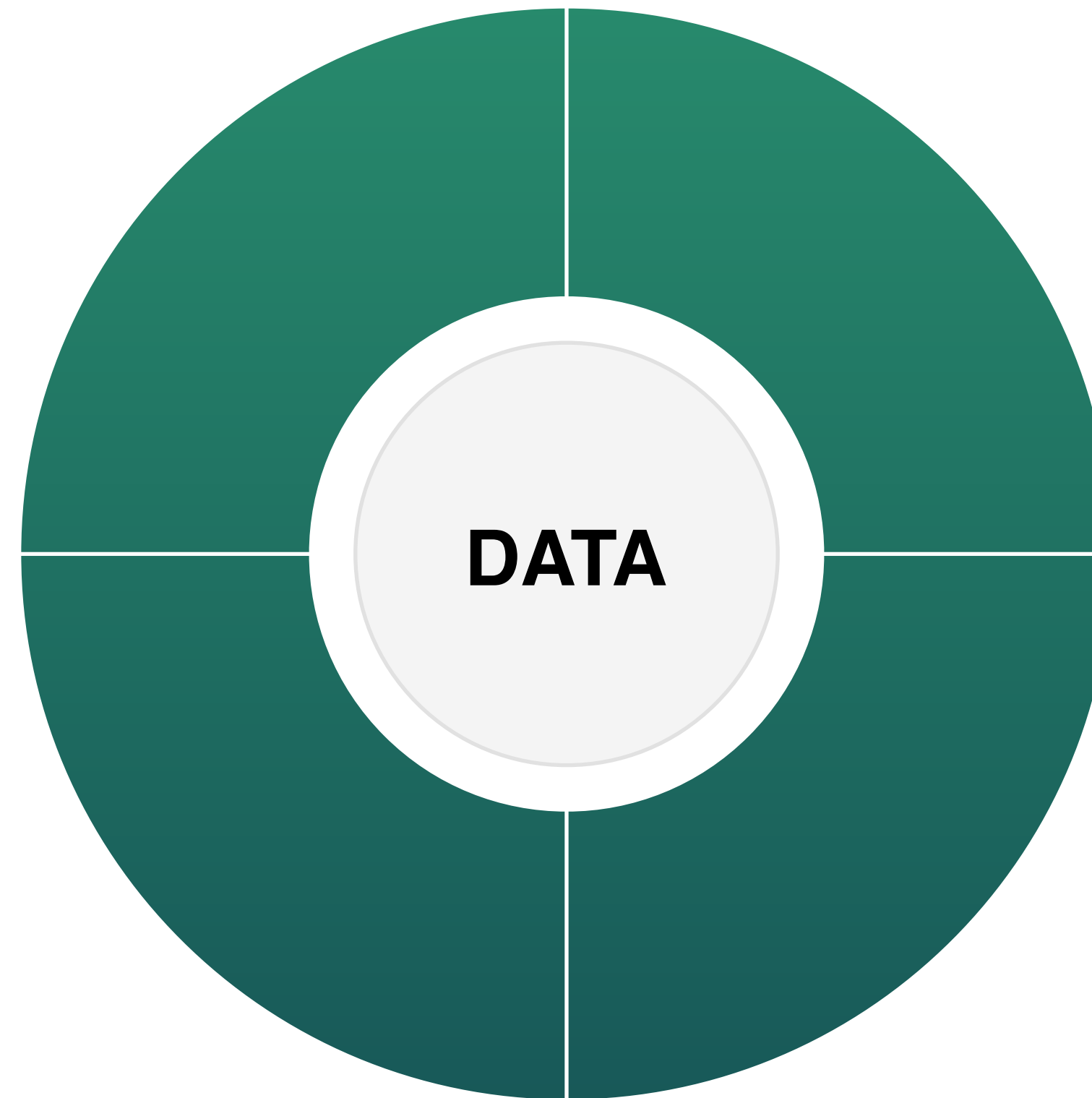


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## IMEI

From IMEI can be extracted information about device type, platform, and phone manufacture

## ASSUMPTION 1

### LOCATION

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Signals from sim-card which belong to one person are registered mainly in the same locations

## ASSUMPTION 2

### LOCATION AND TIME

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Base stations probably register the sim-cards of same person simultaneously

## ASSUMPTION 3

### LOCATION TIME AND ANGELS

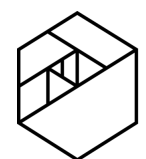
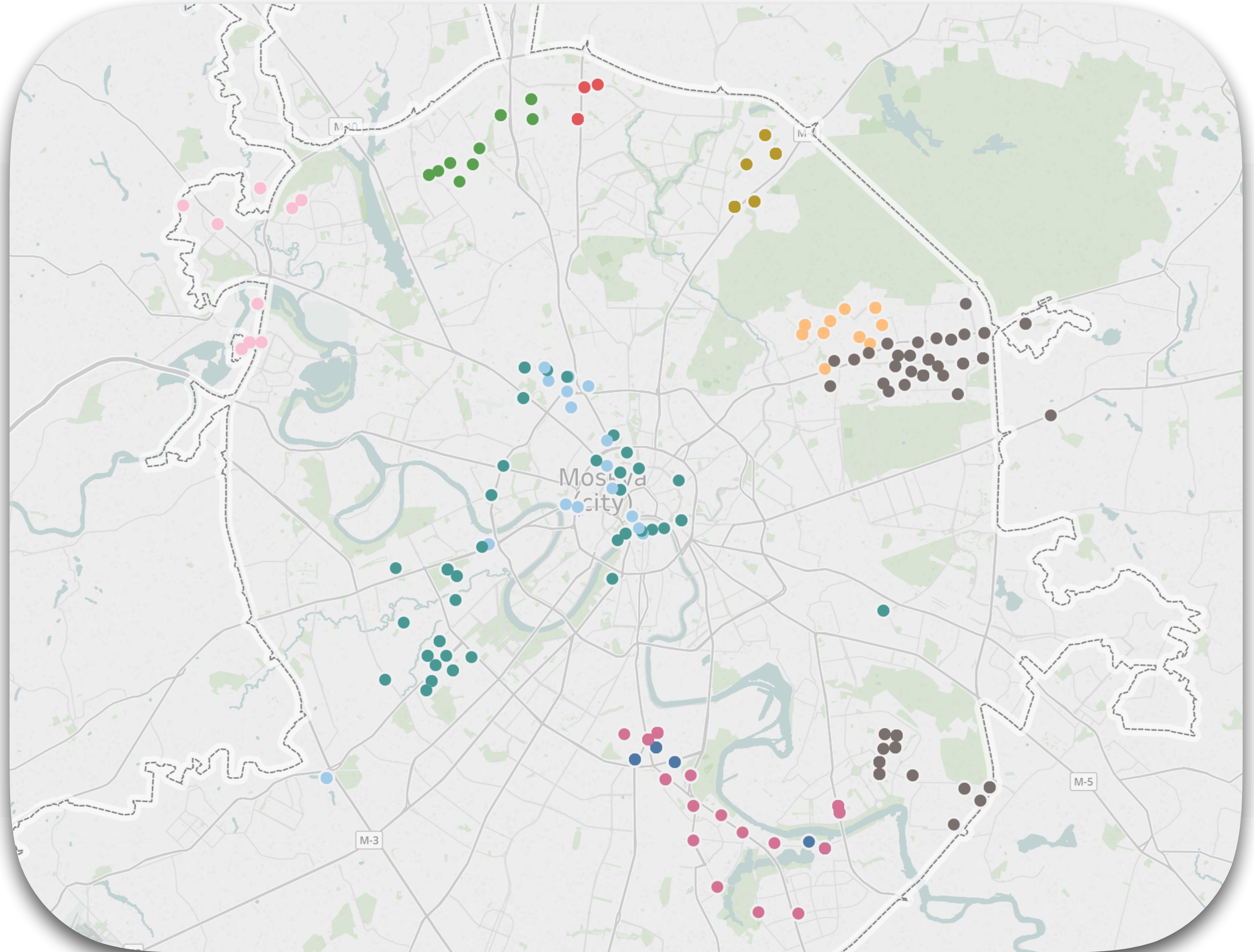
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We can take into consideration angels from base station to differentiate people randomly being at the same time and location





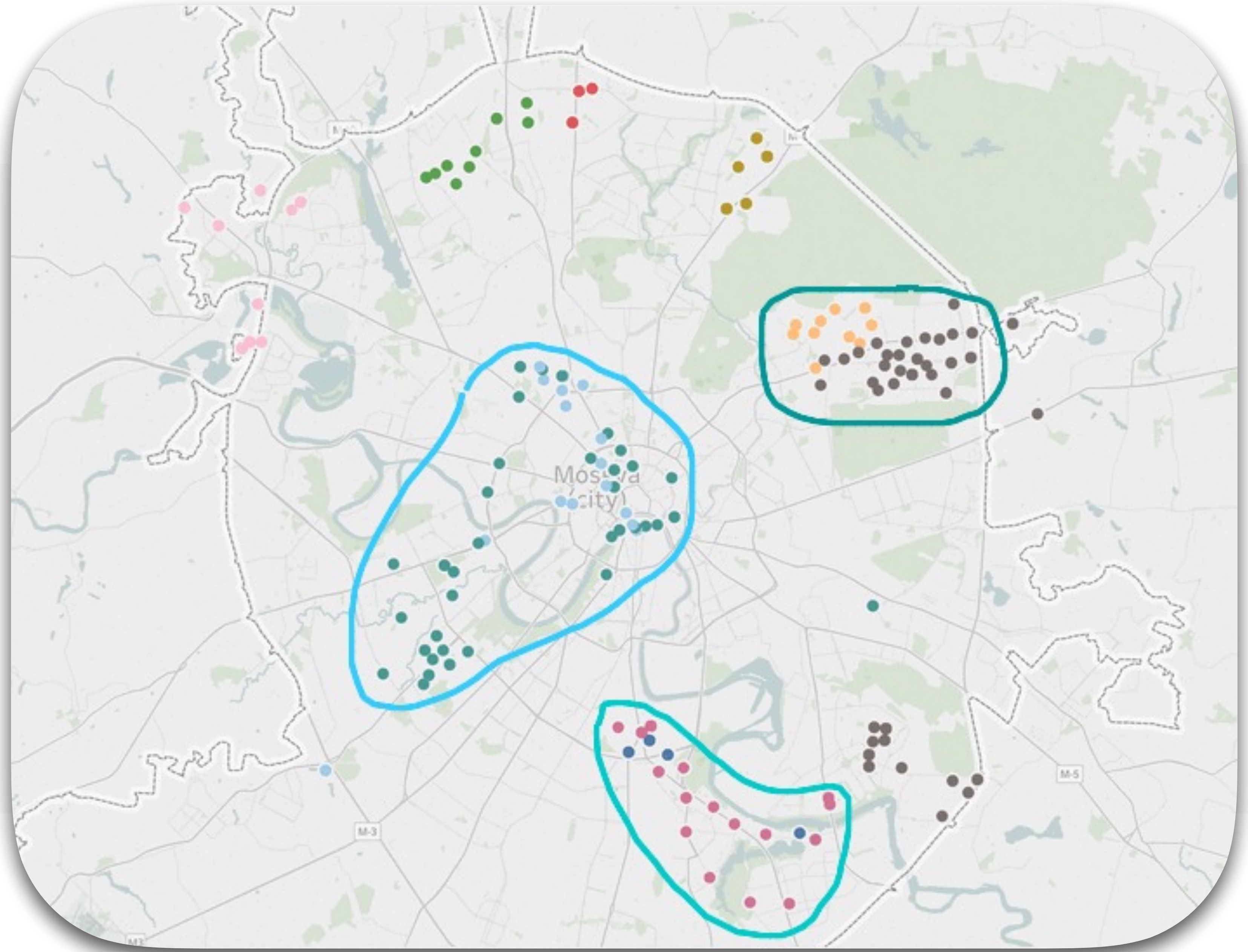
**CAN WE DEFINE  
SUBSCRIBERS  
BY LOCATIONS  
THEY GO?**



**METIS**



**CAN WE DEFINE  
SUBSCRIBERS  
BY LOCATIONS  
THEY GO?**



## ASSUMPTION 1

### LOCATION

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People mainly go in the same locations (from work to home)

## ASSUMPTION 2

### LOCATION AND TIME

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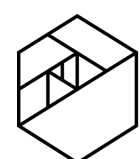
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## ASSUMPTION 3

### LOCATION TIME AND ANGLES

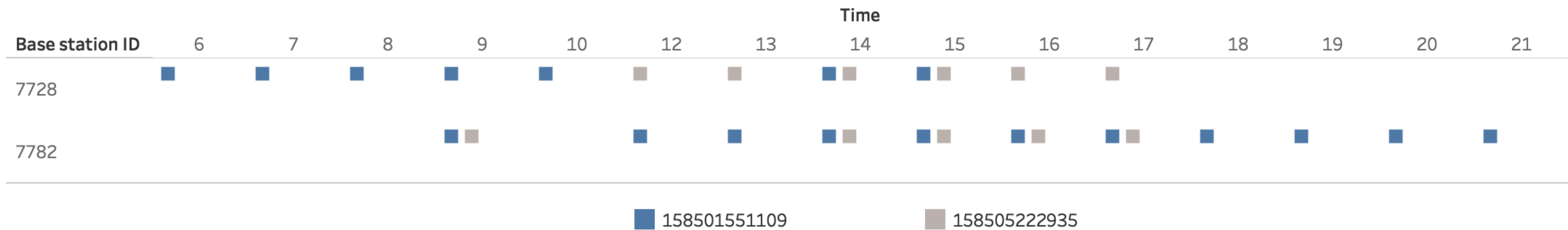
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We can take into consideration angels from base station to differentiate people at the same time and location randomly





# HOW MANY TIMES TWO NUMBERS ARE IN THE SAME LOCATION AND AT THE SAME TIME?



## ASSUMPTION 1

### LOCATION

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People mainly go in the same locations (from work to home)

## ASSUMPTION 2

### LOCATION AND TIME

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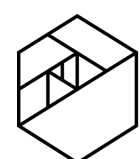
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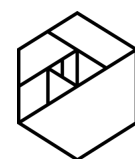
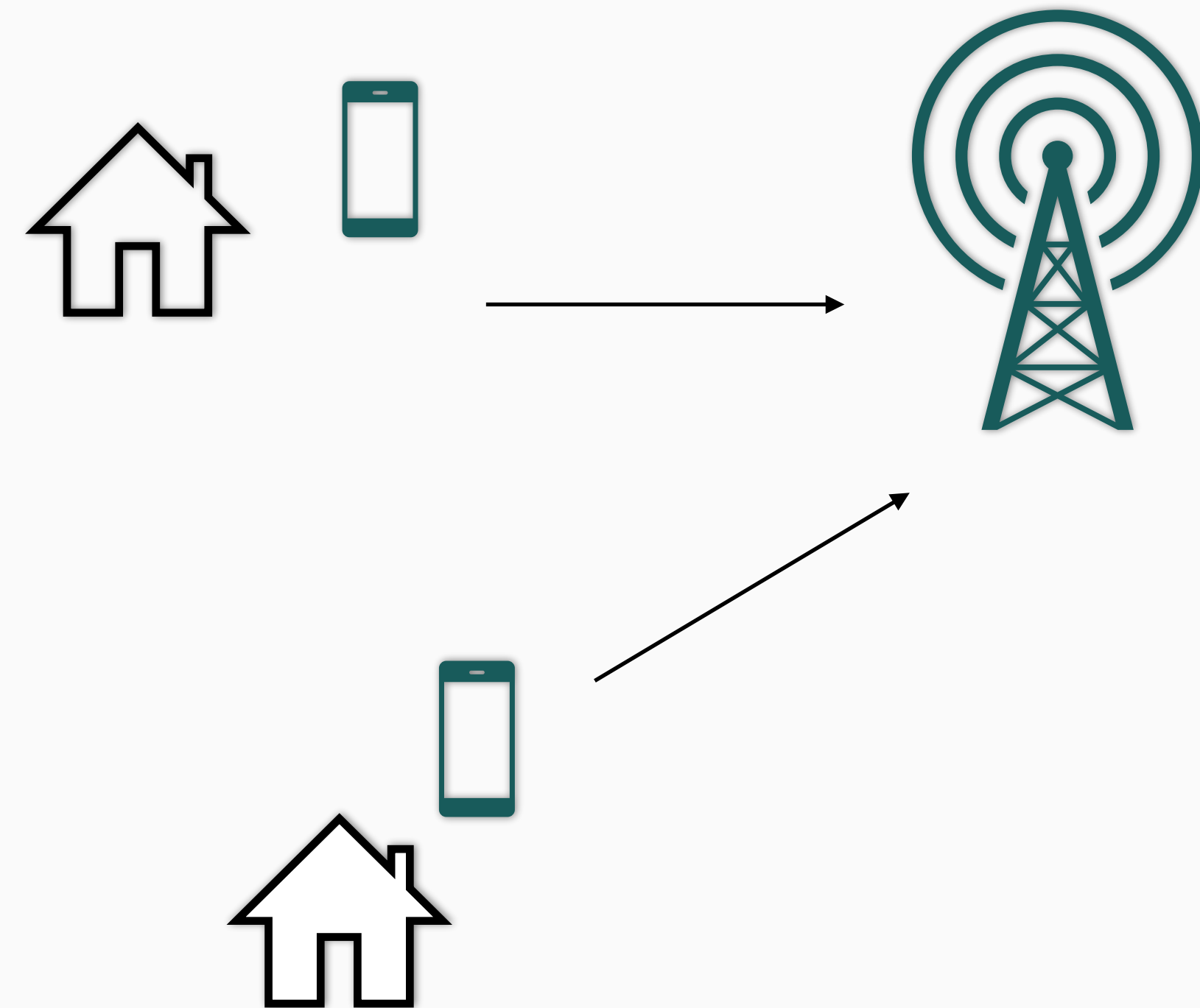


# WHY ANGELS MIGHT BE USEFUL?

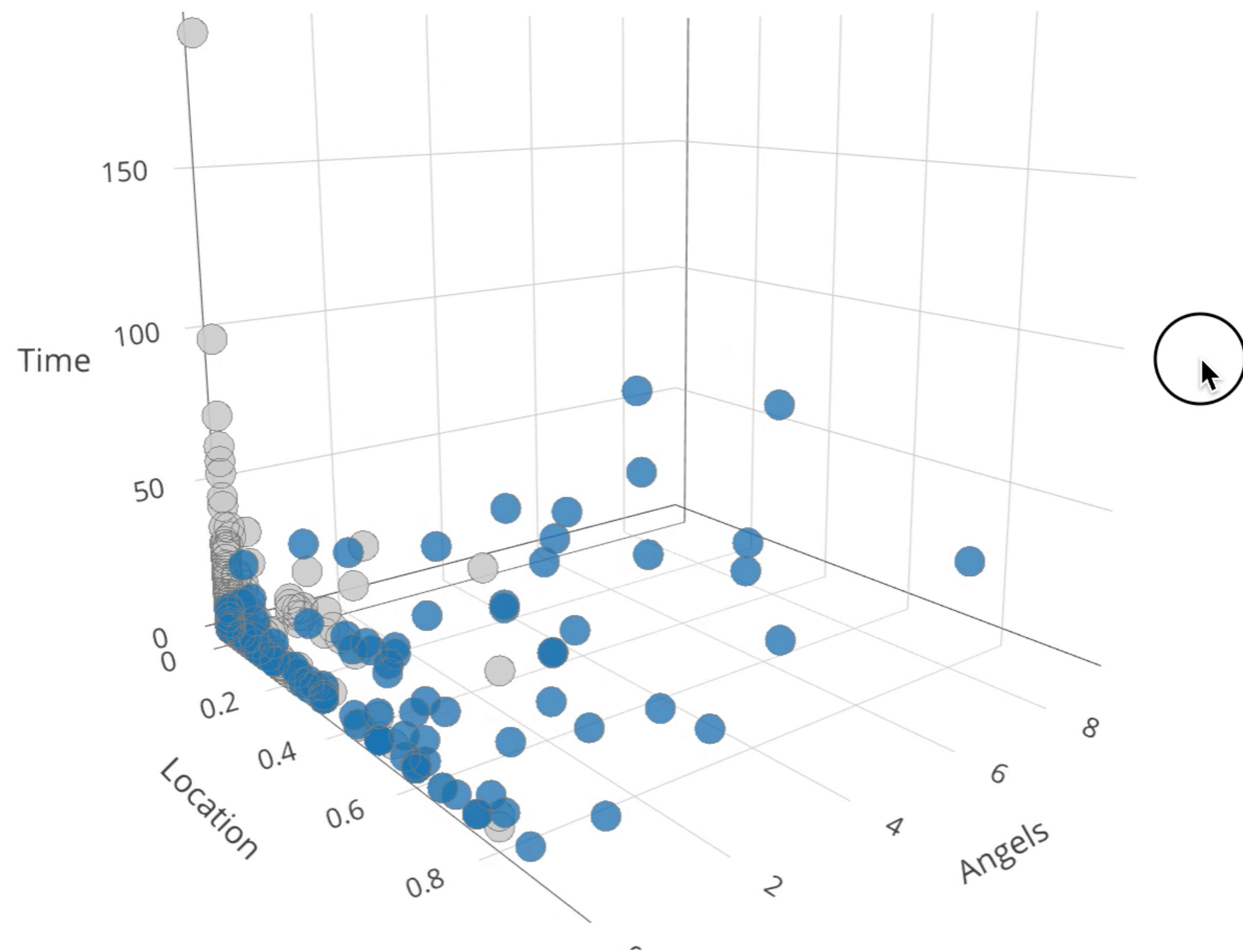
People can live close to each other  
(so they have many intersection in location and time),  
but still they are different people



If all signals from their sim-card are always registered  
from different angels, maybe they are different people?







● Different people    ● Same person

EDIT CHART

# DOES THE SUBSCRIBER DETAILS HELP?



Phone manufacturer

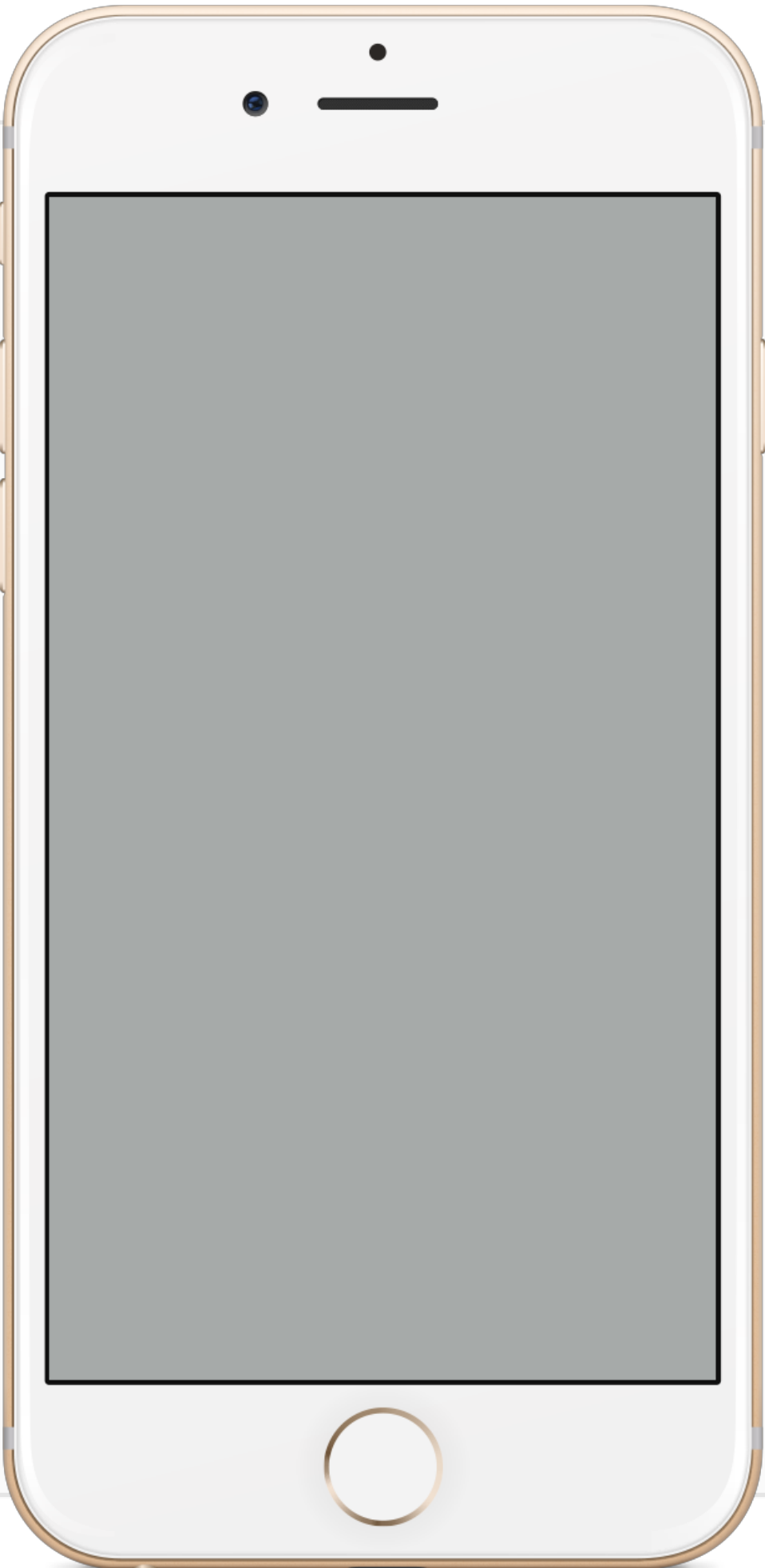


Device type



The operating system on the phone

READ MORE >



## RANDOM FOREST

n\_estimators=200,  
max\_depth=None,  
min\_samples\_leaf=1

Precision 

Recall 

F1 

## KNN

number of neighbours: 2  
distance measure:  
'euclidean'

Precision 

Recall 

F1 

## VOTING CLASSIFIER

estimators:  
KNN, RFC, SVC, XGB  
weights = [1.5, 1, 1, 1.5]

Precision 

Recall 

F1 

## SVC

kernal = 'linear'

Precision 

Recall 

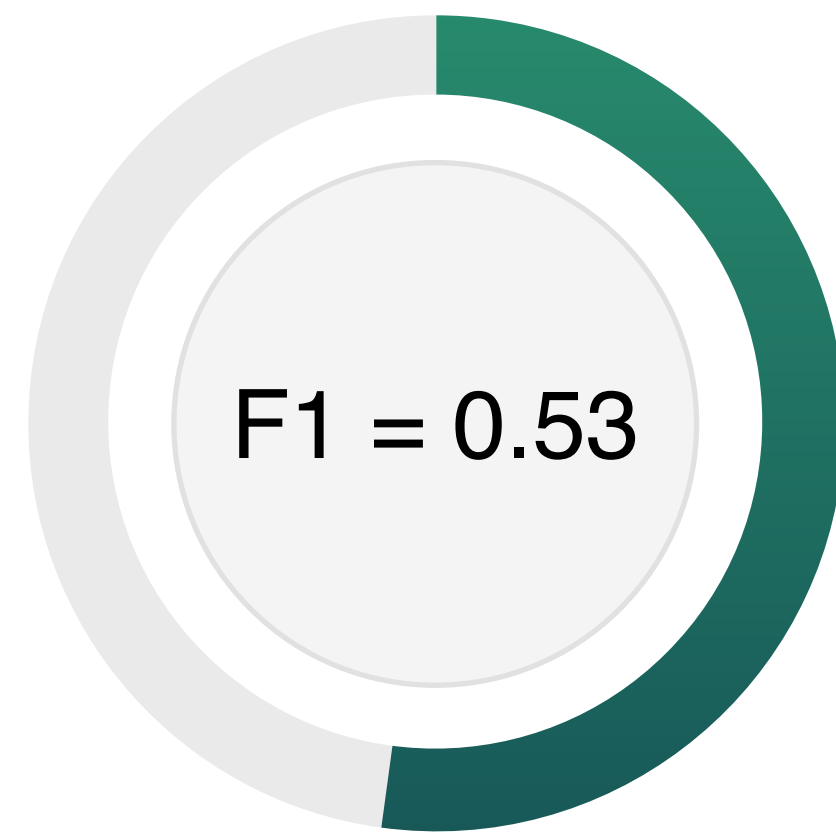
F1 

## XGBOOST

Precision 

Recall 

F1 



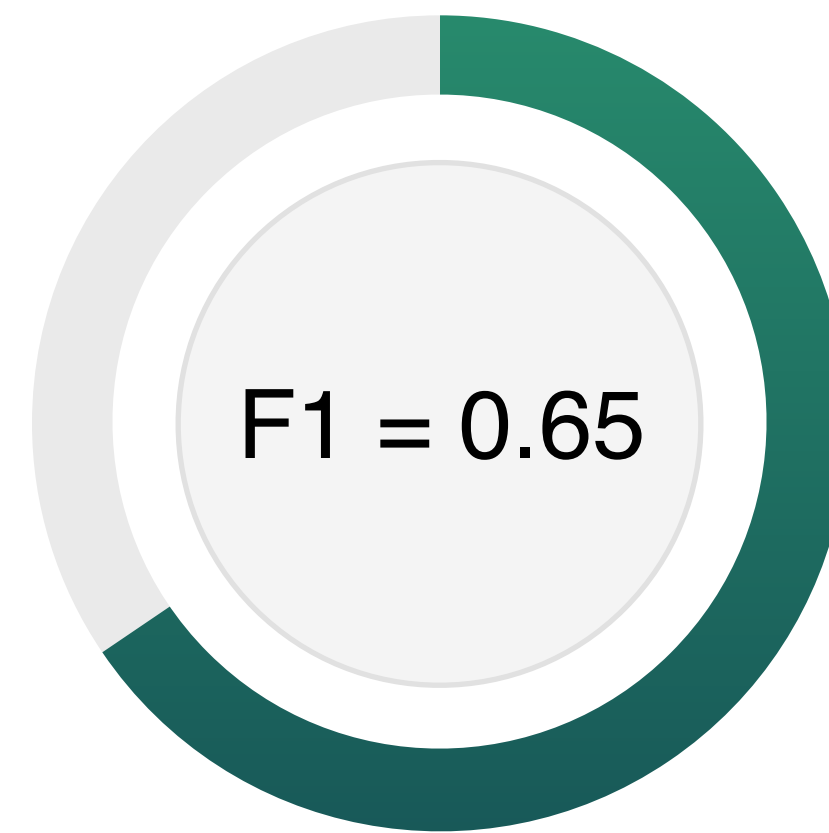
**LOCATION**



Precision

Recall

F1



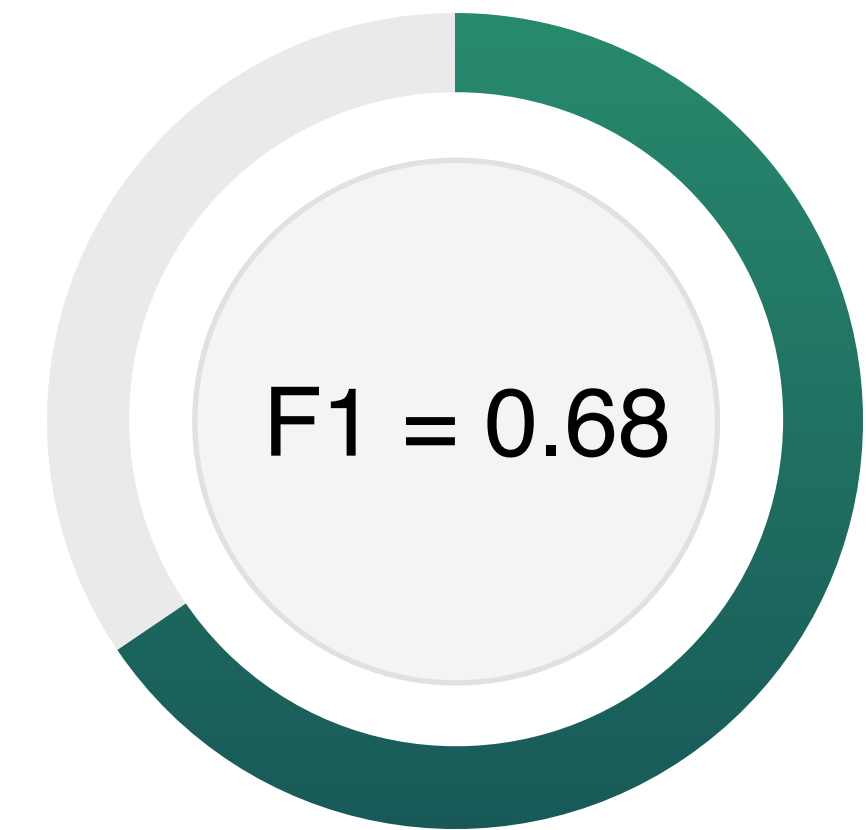
**TIME**



Precision

Recall

F1



**ANGELS**



Precision

Recall

F1

## FURTHER WORK

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To include more observations in data set



To use information about data event





Thank You!