Assignment 2

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Excercise #2

For this exercise we are investigating the idea of centrality in networks. We will look at what seat or position that we should sit on for the bus ride to Fakebook from downtown San Francisco! We can network with the people in our immediate area but not outside of that.

The Problem

We need to pick an optimal set on the bus. We can talk to people within a fixed range (forward, back, side or diagonal) so we will need to be careful how we pick the seat. Here is an illustration of the problem. seats A-D are open and avaiable to sit in whereas the number seats 1-6 are open. For now we will assume that the other seats will be filled up.

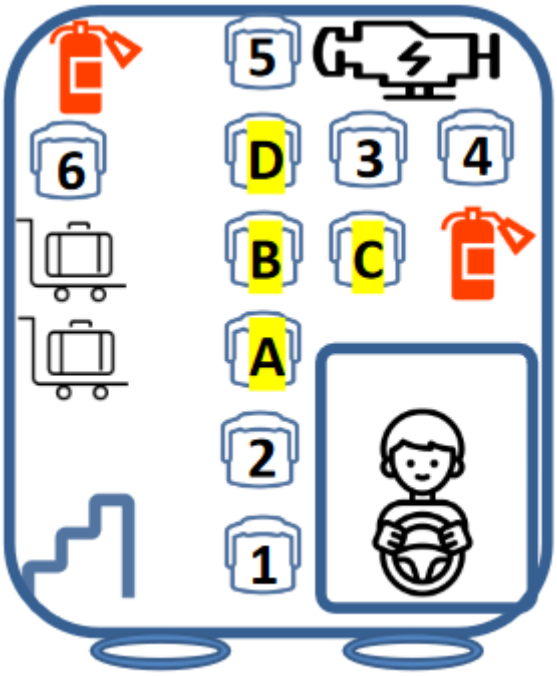


Figure 1: Bus Network Illustartion.

Data acquisition & preprocessing

We can reduce this problem to a set of coordinates and use X- Y Cartesian plane to measure distances and proximity. We will simplify the bus problem slightly by: 1- Ignoring the alley in the bus therefore seat 6 and

D are adjacent in this model.

2- Creating a 4x6 grid where seats are either: taken, available or un-available. The un-available seats do not exist.

3-assume a 100% than all seats will be filled/

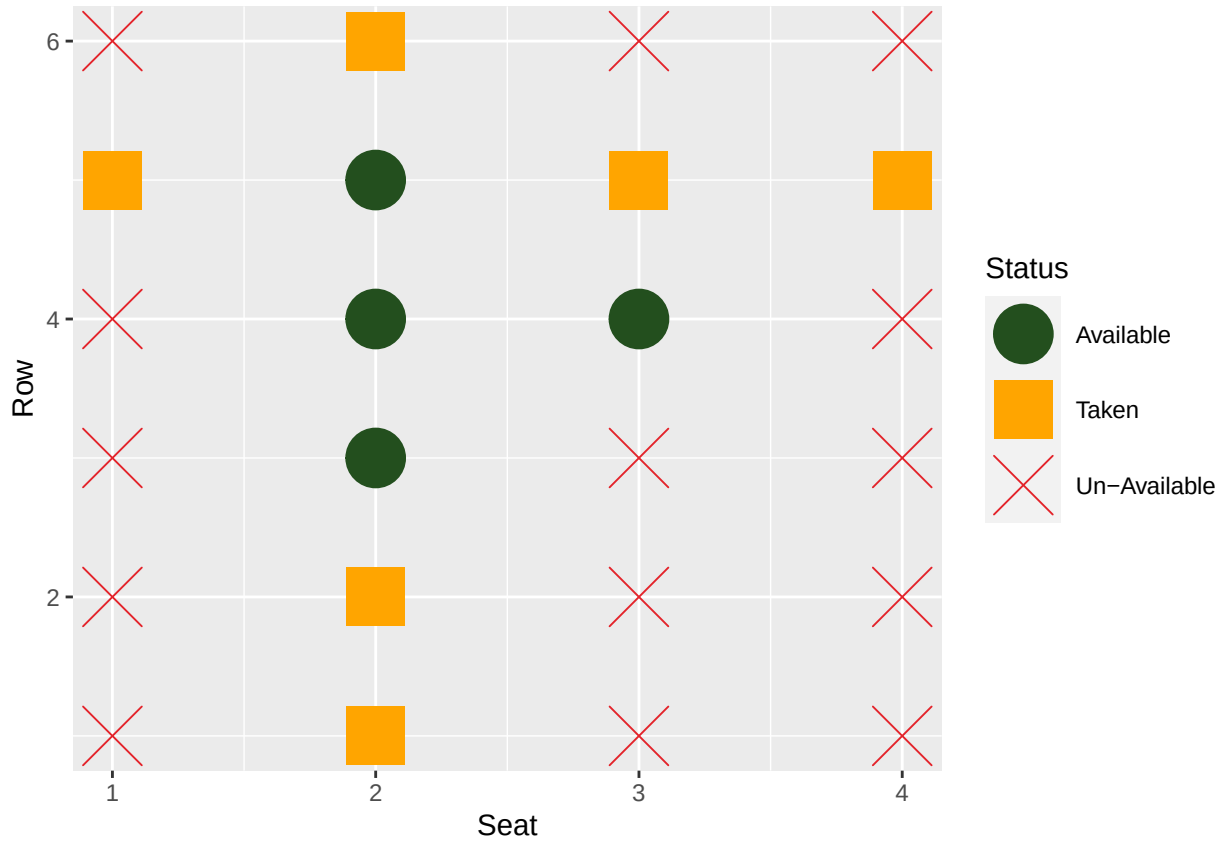
```
##
## Attaching package: 'dplyr'

## The following objects are masked from 'package:stats':
##
##     filter, lag

## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union

## -- Attaching packages --------------------------------------- tidyverse 1.3.2 --
## v tibble  3.1.8     v purrr   0.3.4
## v tidyr   1.2.1     v stringr 1.4.1
## v readr   2.1.3     v forcats 0.5.2
## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
##
## Attaching package: 'igraph'
##
##
## The following objects are masked from 'package:purrr':
##
##     compose, simplify
##
##
## The following object is masked from 'package:tidyr':
##
##     crossing
##
##
## The following object is masked from 'package:tibble':
##
##     as_data_frame
##
##
## The following objects are masked from 'package:dplyr':
##
##     as_data_frame, groups, union
##
##
## The following objects are masked from 'package:stats':
##
##     decompose, spectrum
##
##
## The following object is masked from 'package:base':
##
##     union
```

```
##
##
##
## Attaching package: 'tidygraph'
##
##
## The following object is masked from 'package:igraph':
##
##     groups
##
##
## The following object is masked from 'package:stats':
##
##     filter
```

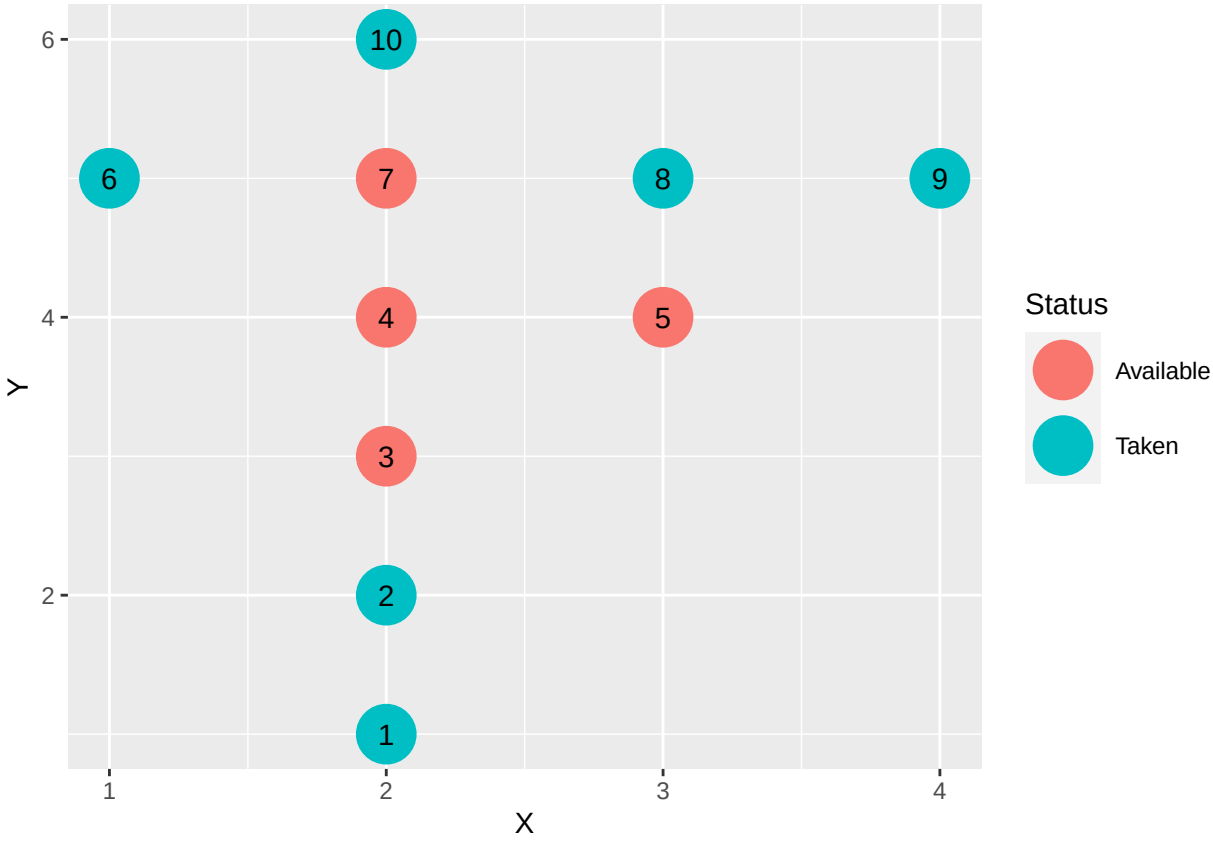
Making a bus coordinate system

Lets Vislualize

Let's take a look at our data!



Looks like we have our bus, the seats available and taken! Now lets filter our data frame to have only the useful coordinates, or seats that exist



We have a simplified coordinate system with the existing seats. We will need all of this information to compute the degree of centrality for each seat, which we can then filter out.

Centrality Measure

Centrality indicates the influence of a node in a network. Higher centrality means higher influence. Therefore for this problem we would want higher centrality.

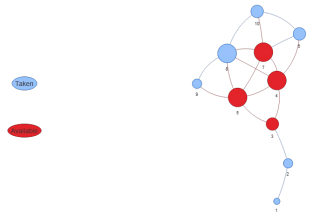
Distance Matrix

We will need to look at the distance between each seat to see which seats can form connection with others. Ultimately we will find the most central in our network.

from_seat_id	X	Y	Status	to_seat_id	Distance
1	2	1	Taken	2	1.000000
1	2	1	Taken	3	2.000000
1	2	1	Taken	4	3.000000
1	2	1	Taken	5	3.162278
1	2	1	Taken	6	4.123106
1	2	1	Taken	7	4.000000

This is just a sample, but the table overall contains all the distances between seats.

Now we have the distance between each of the availabel seats and the taken or occiped seats. We just need to apply the rules of connections (diagonal, front,back, ect) and we will be able to summarize the table to get the stregth of each seat based on the connections. We will filter all of the connections who are further than sqrt 2 away from the current seat



Now let's try to find the measures for each seat ## Centrality Measures

Degree Centrality

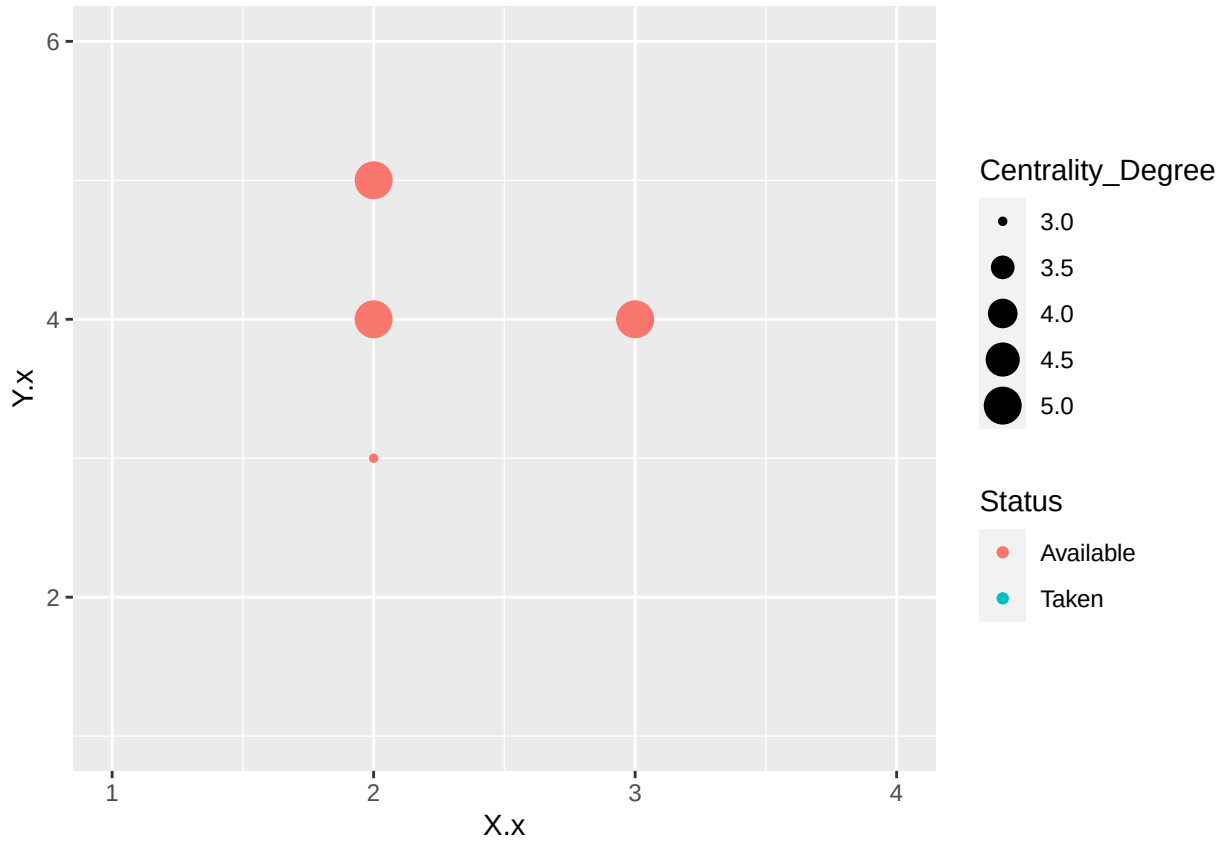
Is the number of links incident upon a node (i.e., the number of ties that a node has).

Seat	Degree_Centrality
B	5
C	5
D	5
A	3

We can validate this with the igraph package wich has a built in functionality for centrality degree

Seat	Centrality_Degree
B	5
C	5
D	5
A	3

```
## Warning: Removed 6 rows containing missing values (`geom_point()`).
```



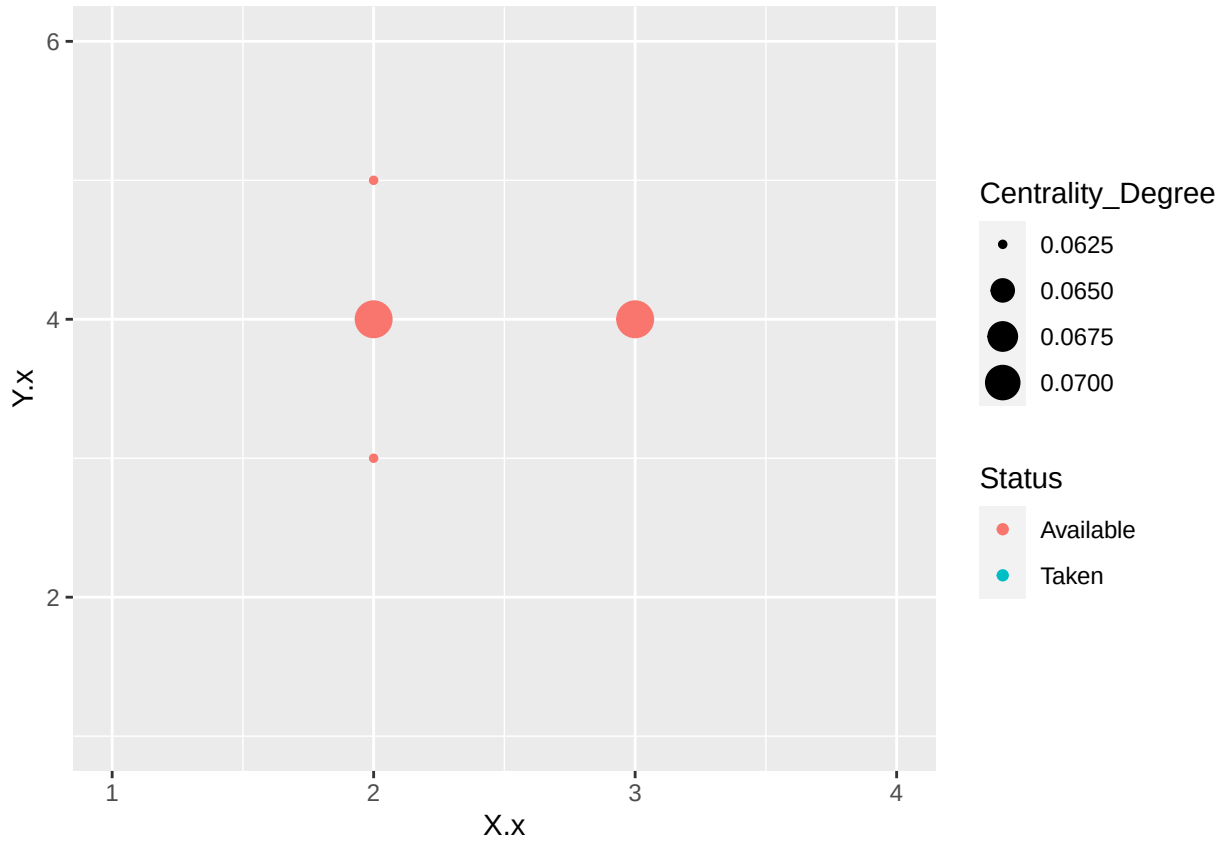
There is agreement between our calculations and the calculations for the package therefore we can use them!

Closeness centrality

is a way of detecting nodes that are able to spread information very efficiently through a graph. The closeness centrality of a node measures its average farness (inverse distance) to all other nodes

Seat	Closeness_Degree
B	0.07142857
C	0.07142857
A	0.06250000
D	0.06250000

```
## Warning: Removed 6 rows containing missing values (`geom_point()`).
```

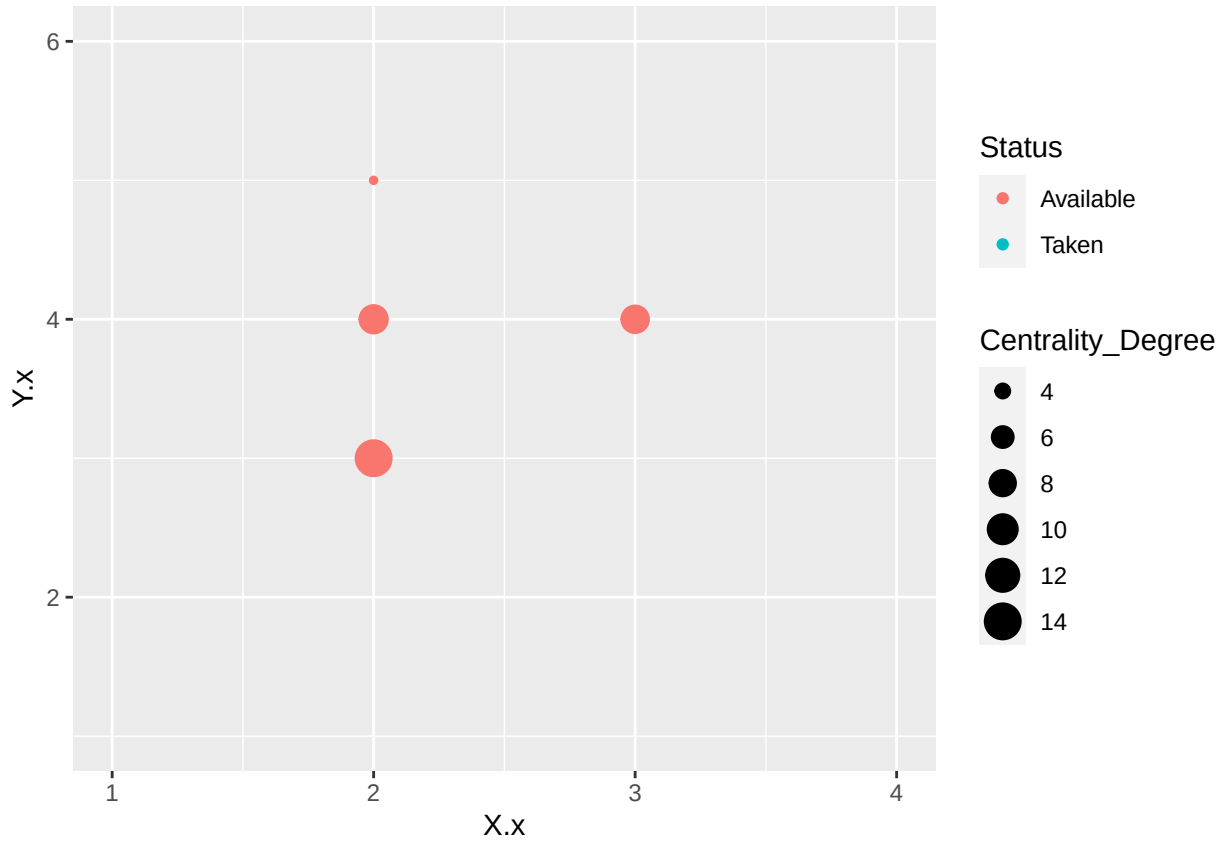


Betweenness centrality

s a way of detecting the amount of influence a node has over the flow of information in a graph.

Seat	Betweenness_Degree
A	14.000000
B	9.033333
C	8.600000
D	3.266667

```
## Warning: Removed 6 rows containing missing values (`geom_point()`).
```



Comparison between all 3!

Seat	Centrality_Degree
Betweeness	
A	14.00000000
B	9.03333333
C	8.60000000
D	3.26666667
Closesness	
B	0.07142857
C	0.07142857
A	0.06250000
D	0.06250000
Centrality Degree	
B	5.00000000
C	5.00000000
D	5.00000000
A	3.00000000