# Social Networks

Connecting with others

# Review Questions

1. How are display ads bought and sold?
2. How to combat click/impression fraud?

Lenddo, a Singaporean start-up, helps financial institutions collect users' social network data. But why?

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# Credit Scoring with Social Network Data

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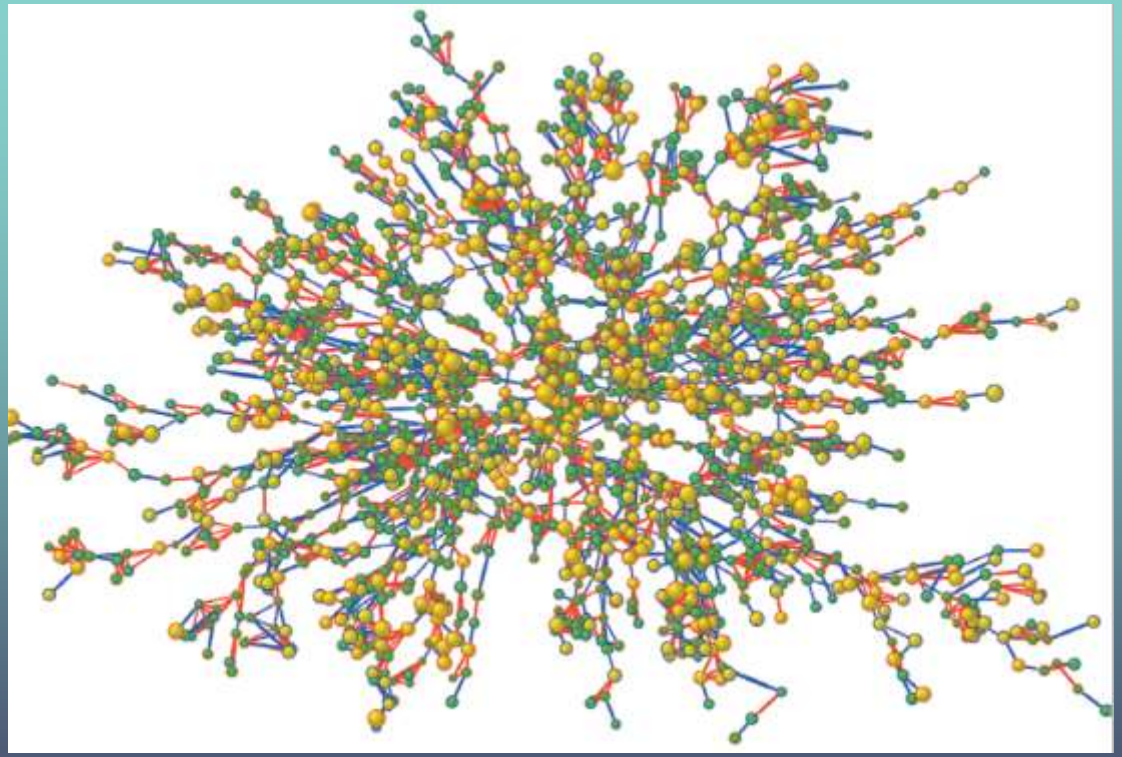
# Obesity is an epidemic.

The NEW ENGLAND JOURNAL of MEDICINE

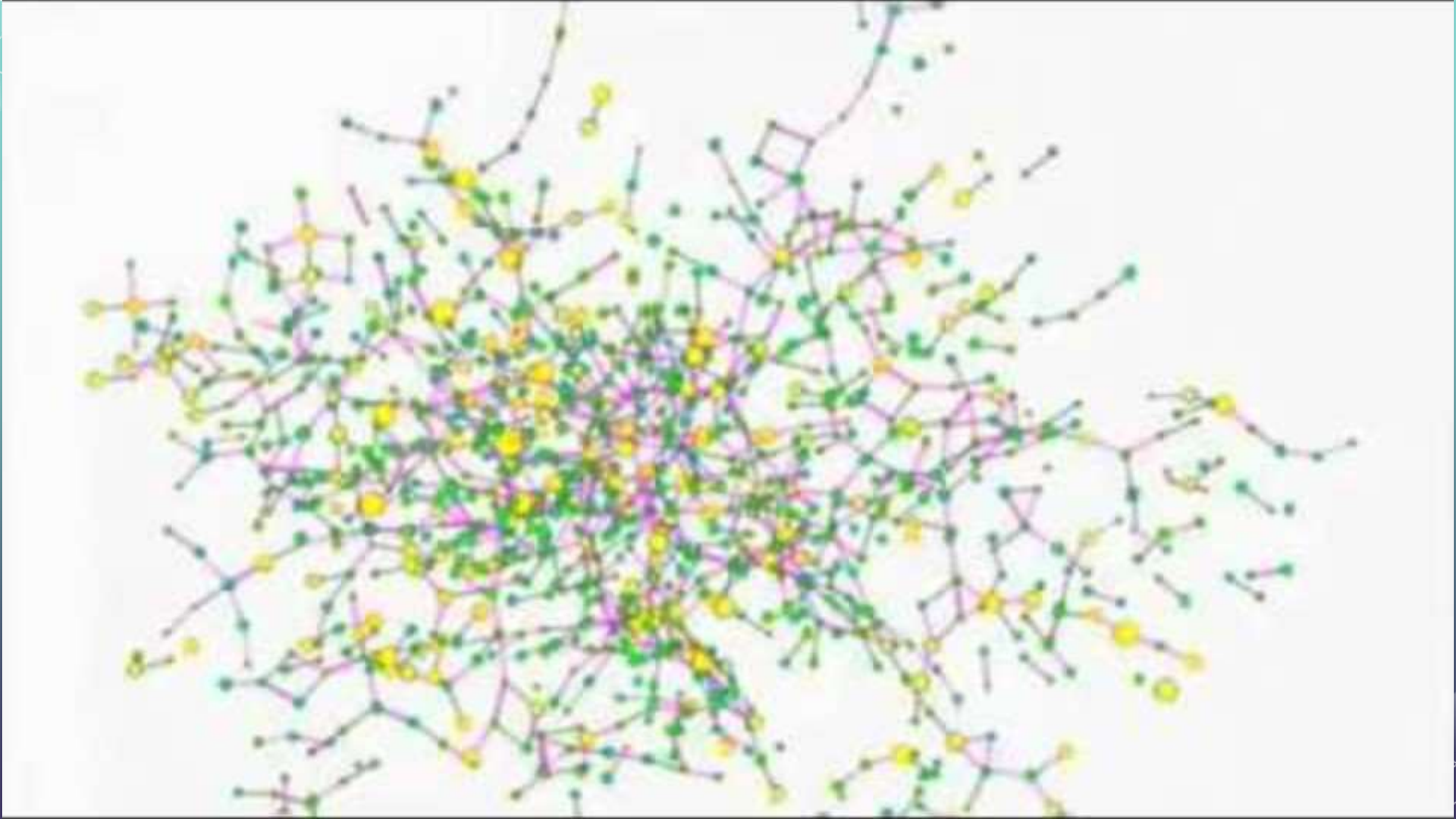
SPECIAL ARTICLE

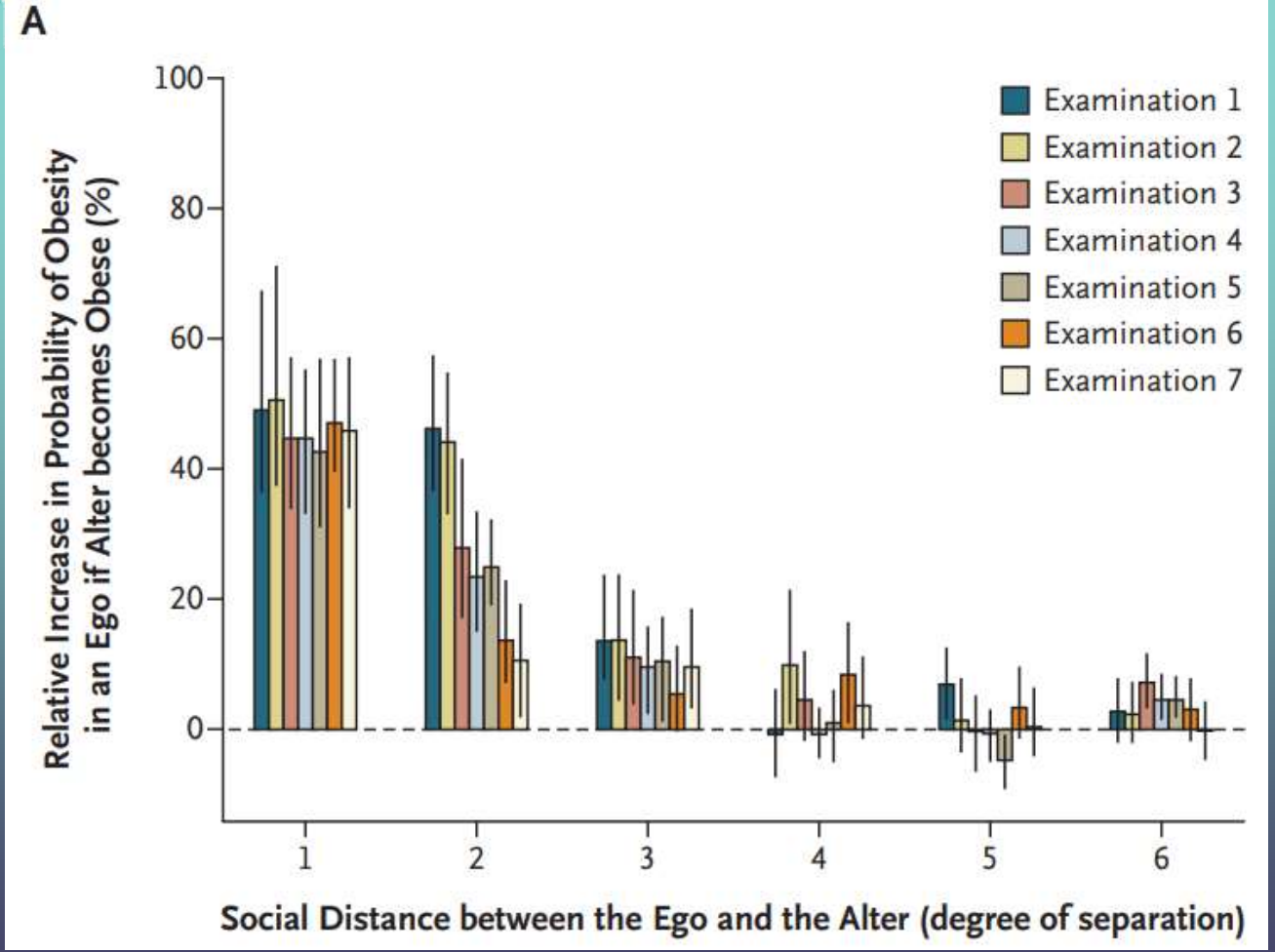
## The Spread of Obesity in a Large Social Network over 32 Years

Nicholas A. Christakis, M.D., Ph.D., M.P.H., and James H. Fowler, Ph.D.



Node: individual; edge: connections; size of node: body mass index; yellow: obesity (i.e., BMI > 30)




A
Relative Increase in Probability of Obesity in an Ego if Alter becomes Obese (%)
100
80
60
40
20
0
Examination 1
Examination 2
Examination 3
Examination 4
Examination 5
Examination 6
Examination 7
1
2
3
4
5
6
Social Distance between the Ego and the Alter (degree of separation)

45%, 25%, and 10%

# But Why?

## #1: Induction

“Hey, let’s go and have muffins and beer!”

“Comparing with my friends, my weight sounds good.”

## #2: Homophily

I make friends with you because we share the same body size.

## #3: Confounding

We share a common exposure to something, e.g., we are both visiting the same gym.

**Q1**

What are the benefits of leveraging online social networks?

**Q2**

How to describe the structure of social networks?

**Q3**

How to find important influencers in a social network?

# What is the difference?

## Web 1.0

Expedia
Google
eBay
Amazon.com
CNN.com
WSJ.com

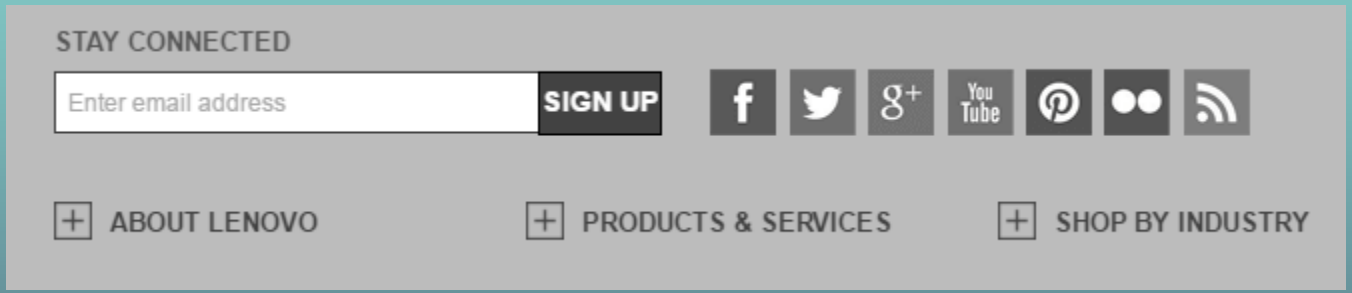
## Web 2.0 and beyond

X (Twitter)
Snapchat
Instagram
Pinterest
Reddit
Wikipedia
Facebook

# Customer-to-Customer Interactions


# Leveraging Online Social Networks

# Get Fans




The vast majority of large brands today have an active social media presence, such as FB fan page. For brands to resonate on Facebook, the first step is to accumulate your fan base.

# Engage


Brand messages only reach subset of fans.

Users that engage in fan page more likely to receive messages on news feed.

Users can engage by *liking, sharing, posting, commenting and checking in*.

# Amplify

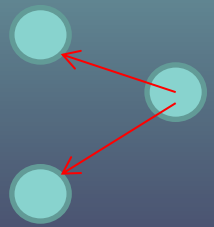

Spread brand message across social network (i.e., newsfeed).

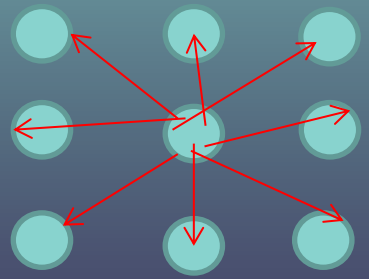
Organic word-of-mouth advertising.

Network can also be used for social advertising.

# Amplification Ratio

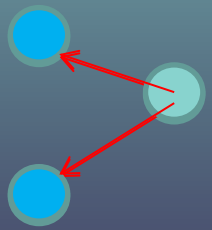
Amplification ratio
= # Friends of Fans exposed / # Fans exposed

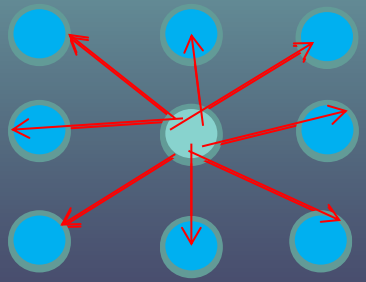




# Amplification Ratio

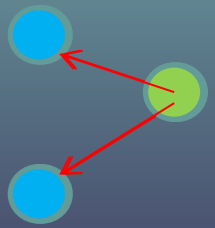
Amplification ratio
= # Friends of Fans exposed / # Fans exposed

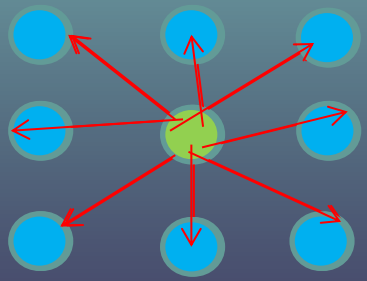




# Amplification Ratio

Amplification ratio
= # Friends of Fans exposed / # Fans exposed
= 10/2 = 5.





# AMPLIFICATION RATIO

Here are some facts. According to FB:

The top ten corporate brands had an average Amplification Ratio average of 1.05 (Range: 0.42 to 2.18).

The top 100 brands (excluding Celebrities & Entertainment) had an average Amplification Ratio of 0.84 (Range: 0.06 to 2.87).

# CASE STUDY: Holiday Sales

Case study focused on Amazon, Best Buy, Target and Walmart.

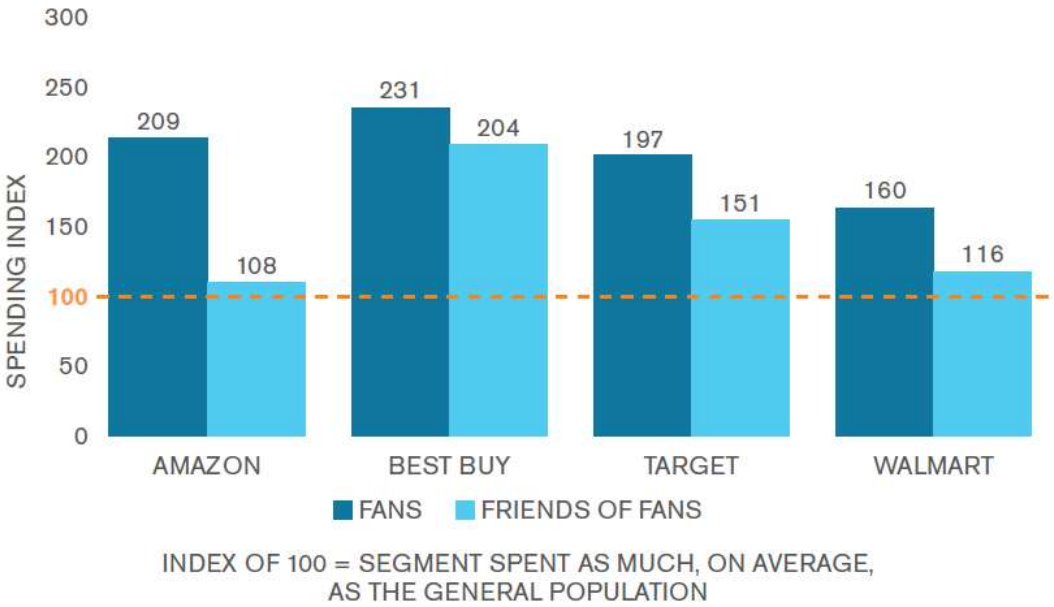
Retailers offered Facebook fans Black Friday deals.

Friends of Fans received notifications about their friends becoming fans, which lead to increased amplification.

Online and offline purchases of exposed fans and Friends of Fans compared to typical week.

# CASE STUDY: Holiday Sales

**Figure 3** Fans & Friends of Fans: Spending Index for Leading Retail Brands
Online & In-Store Purchase Behavior
*Source: comScore Social Essentials, U.S., November-December 2011*



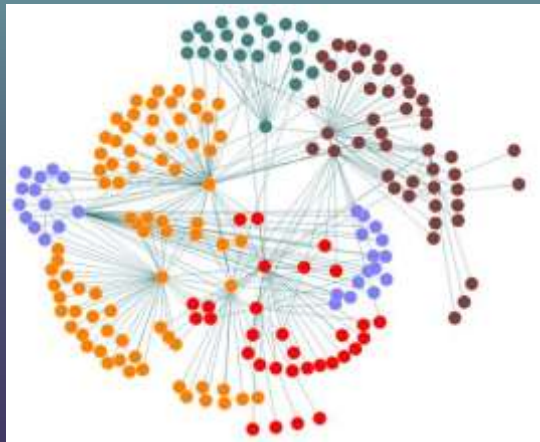

INDEX OF 100 = SEGMENT SPENT AS MUCH, ON AVERAGE,
AS THE GENERAL POPULATION

# Social Networks Analysis: Theory

# Social Network Analysis Useful for…

Spotting influential people
- Who has a lot of linkages?
- Who is vital at linking people up?
- Why not just looking at no. of friends/followers?
  - Strength of tie

Understanding how connected the network is
- How many people are connected?
- What is the longest path between people?
- How to measure the density of a network?



# Metrics

## Individual

Has meaning independently of social network

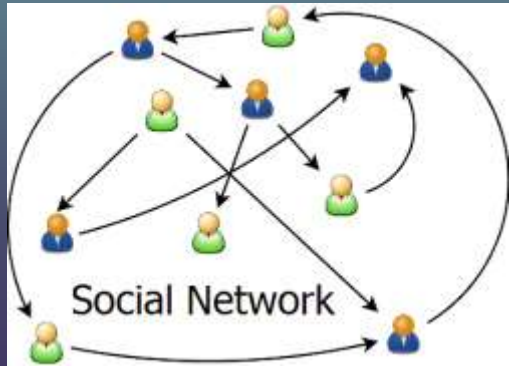
You live in Hong Kong island, HK

## Connection

You are close friends with 10 people at HKU

## Whole Network

On average, students know each other within 4 steps

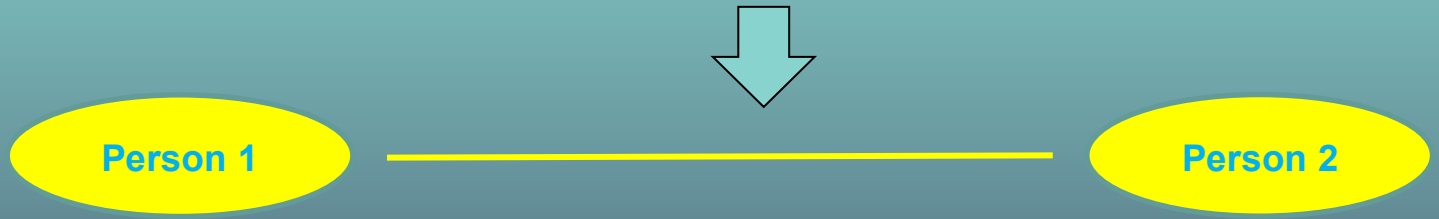


# Edges

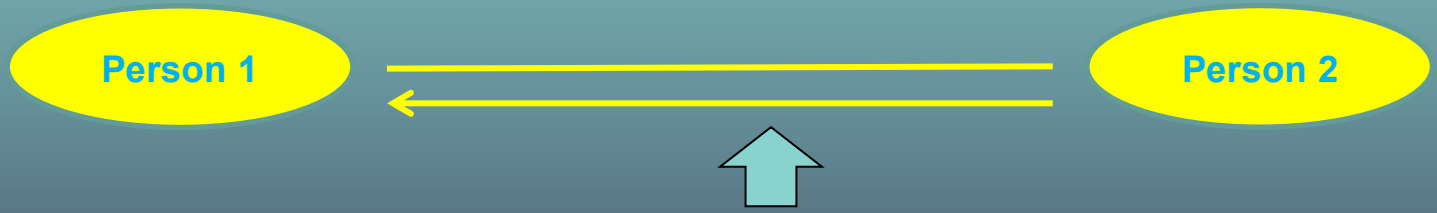
# Edges

# Edges

Undirected (e.g., study at HKU)



# Edges




Directed (e.g., 2 follows 1)

# Edges


Edges are also called links or ties.

# Nodes and Edges

Vertex/Node: an end point
    Often a person

Edge/Link: What connects up the Nodes
    A relationship

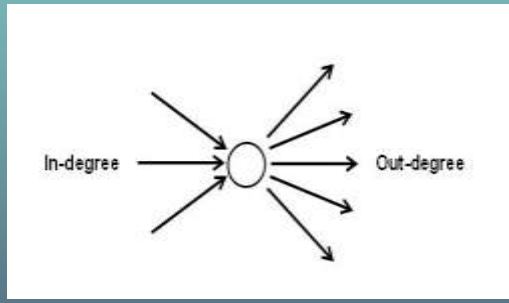
Maximum number of edges in group of size $N(N-1)/2$.
    Where everyone connects to everyone else
    If undirected (my friends also have me as a friend)

# Who is well-connected?

Degree (centrality): The number of linkages you have.

"In-degree", e.g., someone that follows me.

"Out-degree", e.g., I follow someone else.




Edge Weight

Sometimes edge can also carry weight

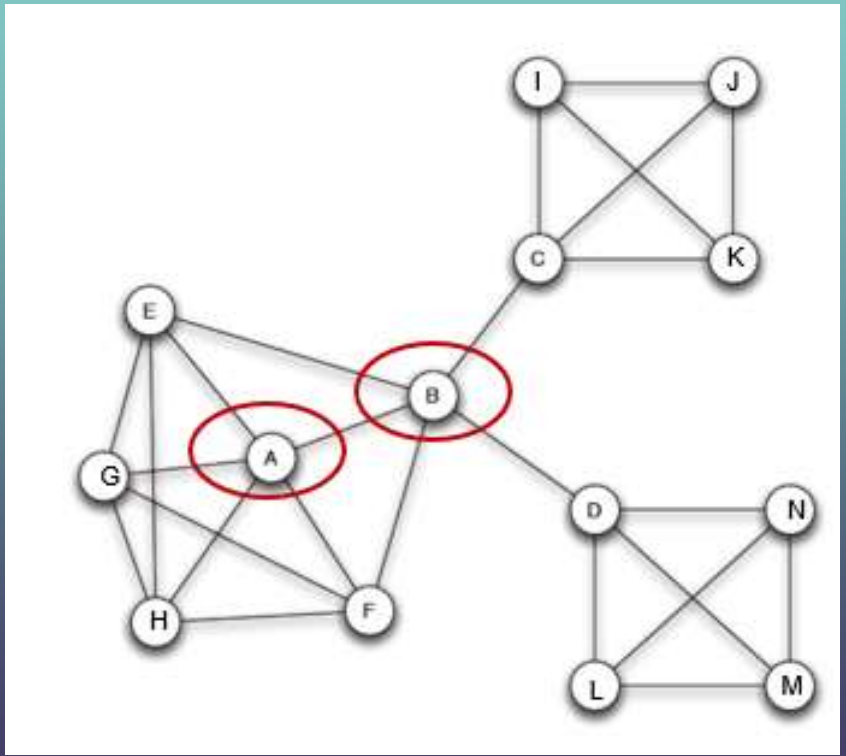
Can capture how deep the relationships are

E.g., frequency of interactions between two nodes.

# QUESTION

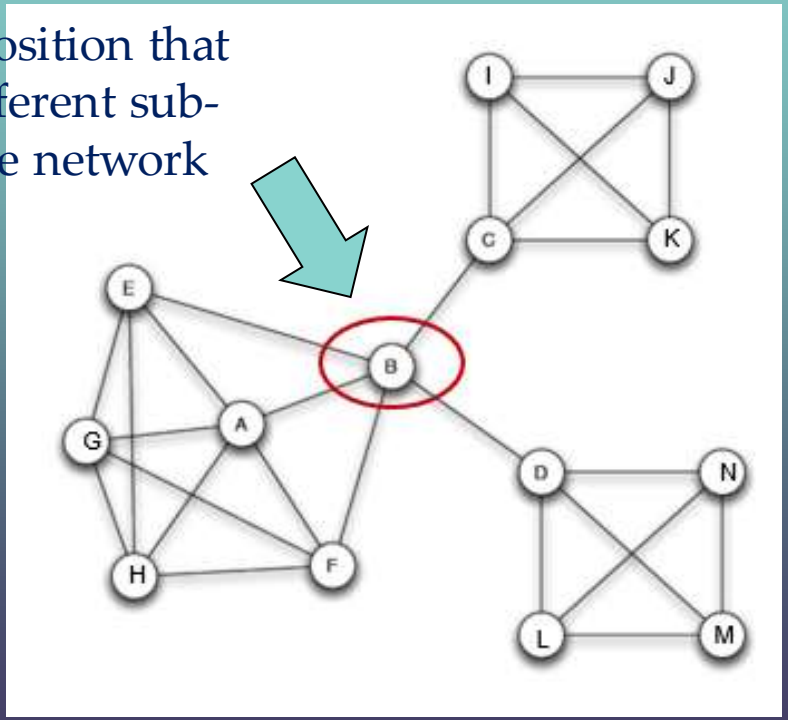
How to determine the influential person (i.e., node) in a social network?

# Who is more important? Why?

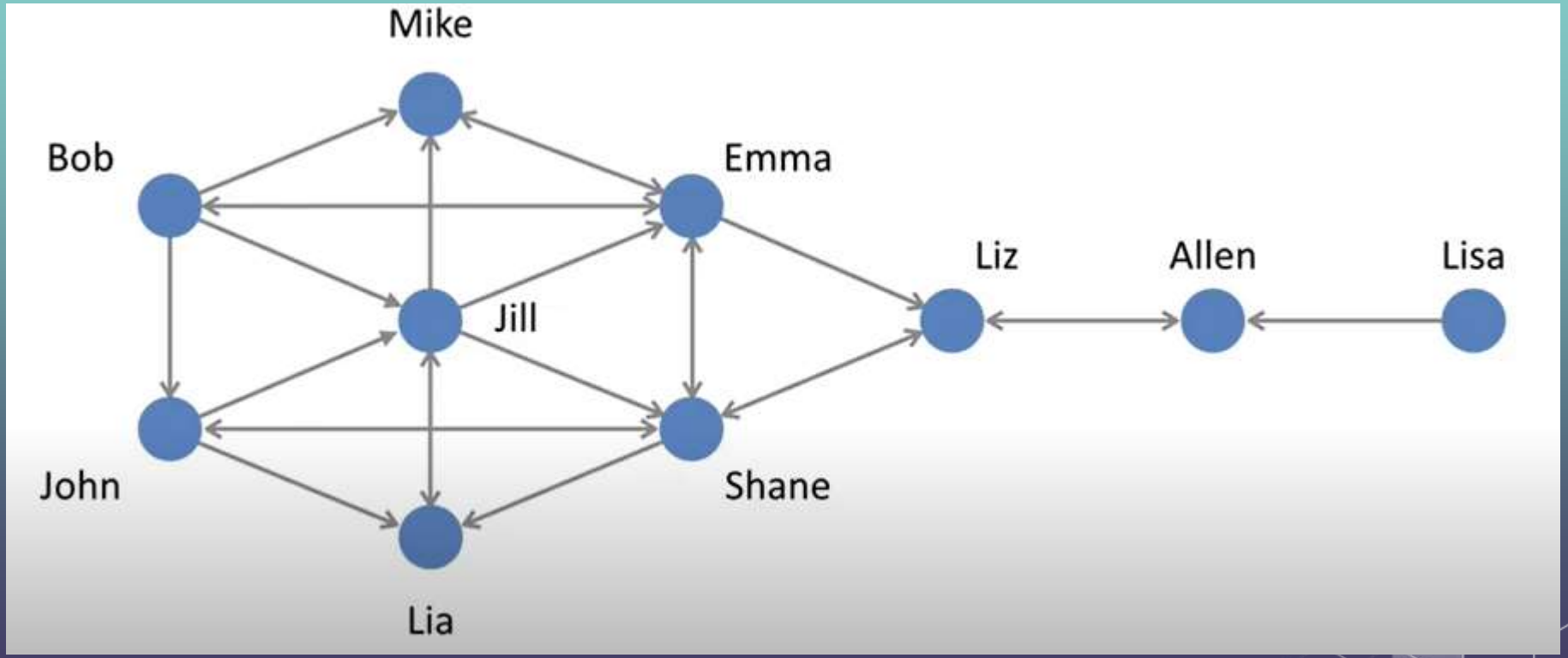


# Social Hole

A node or position that connects different sub-groups of the network



# Who is most important? Why?



# QUESTION

How to define the importance of a node?


Closeness Centrality
& Betweeness Centrality

# Closeness Centrality

Only applies to a fully connected network (i.e., a path exists between any pair of nodes).

$$\text{Closeness Centrality}(x) = \frac{N - 1}{\sum_y d(x, y)}$$

N: number of nodes in the network
d(x, y): the shortest distance between nodes x and y.

# Betweenness Centrality

Applies to disconnected networks as well.

$$\text{Betweenness Centrality(x)} = \sum_{y,z} \frac{\sigma_{yz}(x)}{\sigma_{yz}}$$

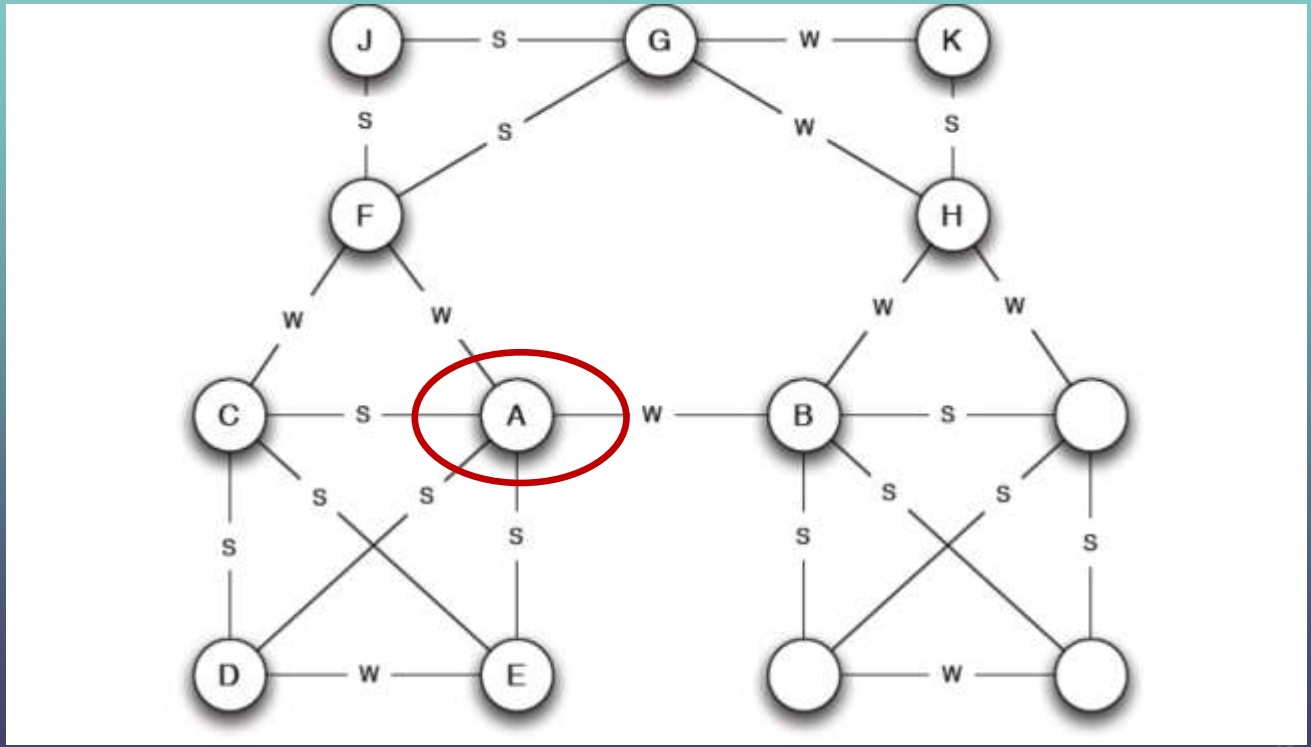
$\sigma_{yz}$ is the total number of shortest paths from y to z.
$\sigma_{yz}(x)$ is the number of shortest paths from y to z that go through x.

# Strong vs. Weak Ties

Suppose that two individuals are connected in a social network (i.e., they know each other).

However, the strength of their connection may differ: It may be a strong tie (i.e., they are friends) or a weak tie (they are acquaintances).

# Strong vs. Weak Ties



# Strong vs. Weak Ties

A, B and C are currently iPhone users.

C has recently switched to Android system, and B still uses iPhone.

A is more likely to switch or stay, follow your friend or acquaintance?

Strength of strong ties.

# Strong vs. Weak Ties

A has recently changed job.

Is A more likely getting a lead from friend C or acquaintance B?

Strength of weak ties (Mark Granovetter's famous example in 1960).

# Strong vs. Weak Ties

Although strong ties generally exert more normative influence, weak ties often have more informational influence.

Why?

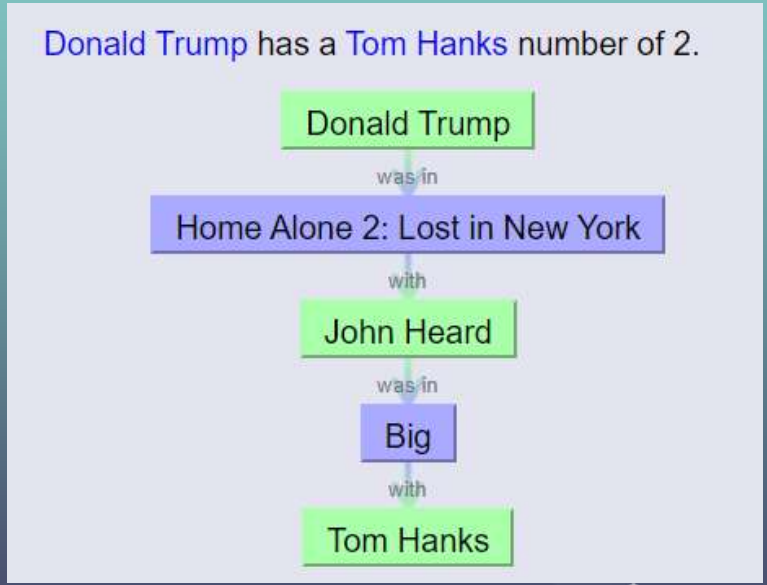
Because different social circles have different info, i.e., you probably know what your good friends know. Most jobs are found through weak connections.

# Degrees of Separation

Path of how many people are needed to connect people up
Technical name: Geodesic distance

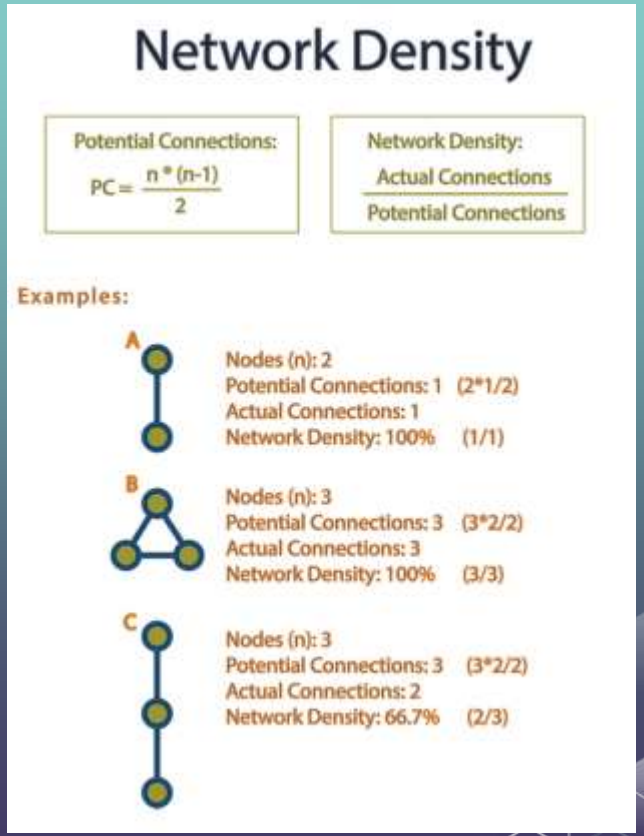
6 is the magical number: Kevin Bacon game (Link)

Don't fixate on 6! It does not apply to all networks!



# Is a Network Well-Connected?

Graph/network density



# Networks Analysis in R

# Preparing Packages

```
library(igraph)
library(readr)
```

The “igragh” package provides you tools for network analysis while the “readr” facilitates reading data.

# Reading Data

```
actors <-
read_csv("https://ximarketing.github.io/class/DM//Actors.csv")
movies <-
read_csv("https://ximarketing.github.io/class/DM/Movies.csv")
```

Here, the first file contains the nodes information, whereas the second file contains the edge information. Each actor/actress is a node, and if two actors/actresses appear in a same movie, there is an edge between them.

# Reading Data

Actor Information (nodes):

```
> head(actors)
# A tibble: 6 x 3
  Actor         Gender BestActorActress
  <chr>         <chr>  <chr>
1 Tom Hanks     Male   Winner
2 Gary Sinise   Male   None
3 Robin Wright  Female None
4 Bill Paxton   Male   None
5 Kevin Bacon   Male   None
6 Ed Harris     Male   Nominated
```

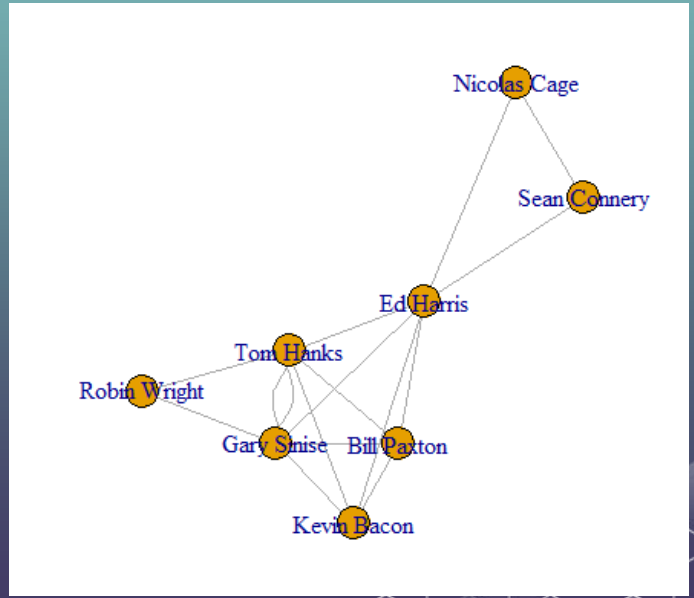
# Reading Data

Movie Information (edges):

```
> head(movies)
# A tibble: 6 x 3
  `Actor 1`    `Actor 2`     Movie
  <chr>        <chr>         <chr>
1 Tom Hanks    Gary Sinise   Forest Gump
2 Tom Hanks    Robin Wright  Forest Gump
3 Gary Sinise  Robin Wright  Forest Gump
4 Tom Hanks    Gary Sinise   Apollo 13
5 Tom Hanks    Bill Paxton   Apollo 13
6 Tom Hanks    Kevin Bacon   Apollo 13
```

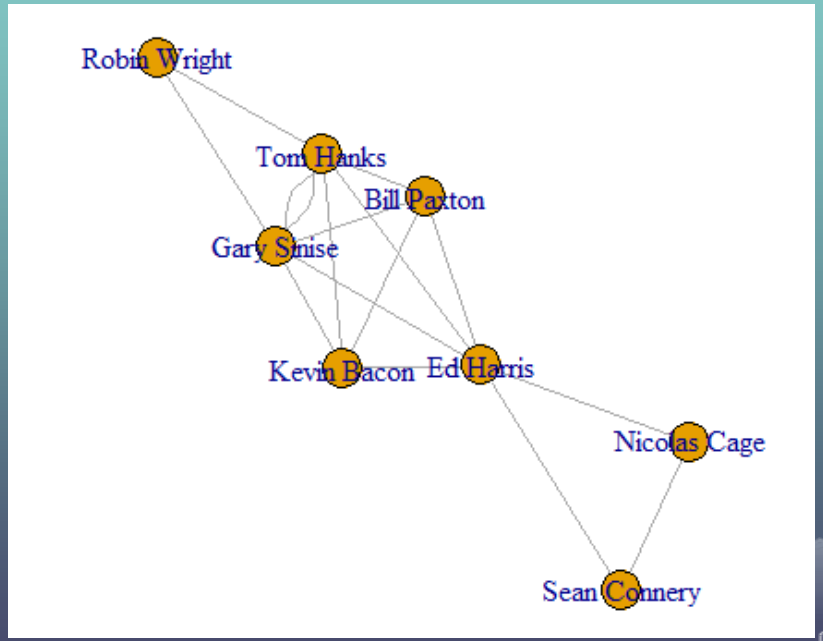
# Visualize the Network

```
actorNetwork <-
graph_from_data_frame(d=movies,
vertices=actors, directed=F)
plot(actorNetwork)
```



# Visualize the Network

```
plot(actorNetwork)
```

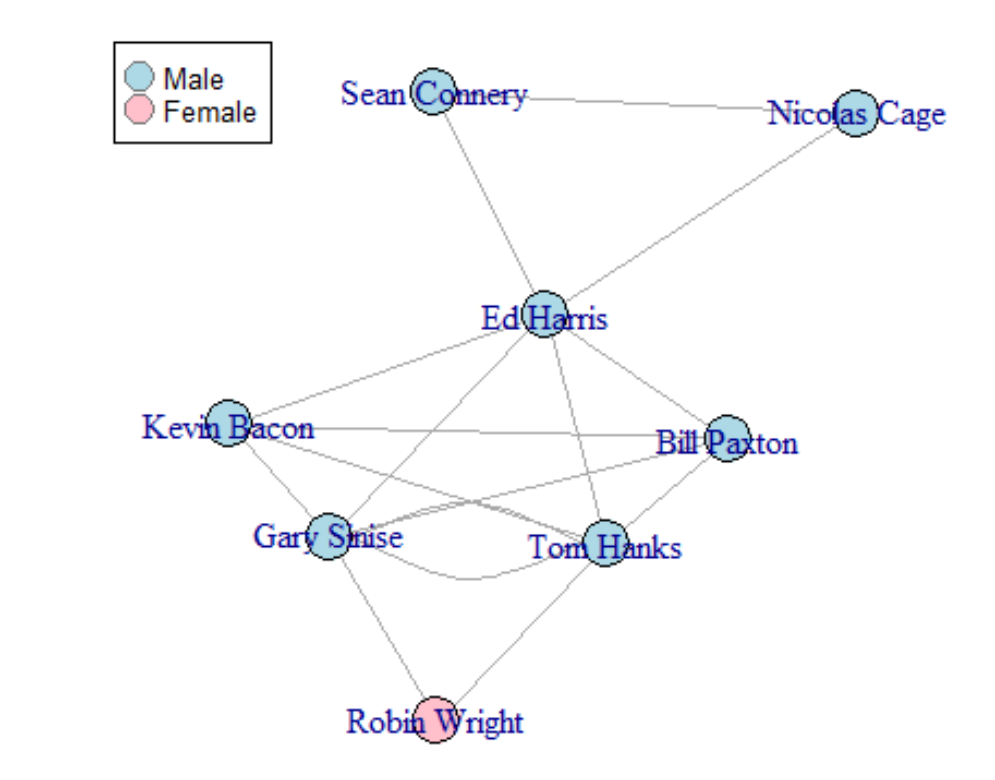


# Visualize the Network

You can also add colors to your nodes:

```
V(actorNetwork)$color <-
ifelse(V(actorNetwork)$Gender == "Male",
"lightblue", "pink")
plot(actorNetwork)
legend("topleft", c("Male","Female"),
pch=21,
  col="#777777",
pt.bg=c("lightblue","pink"), pt.cex=2,
cex=.8)
```

# Visualize the Network



# Degree of the nodes

To check the degree of nodes in the network:

```
degree(actorNetwork, mode="all")
```

```
   Tom Hanks  Gary Sinise Robin Wright  Bill Paxton  Kevin Bacon     Ed Harris
           6            6            2            4            4             6
Sean Connery Nicolas Cage
           2            2
```

# Closeness/Betweenness Centrality

```
closeness(actorNetwork, mode="all",
weights=NA, normalized=T)
```

```
   Tom Hanks  Gary Sinise Robin Wright  Bill Paxton  Kevin Bacon     Ed Harris
   0.7777778    0.7777778    0.5000000    0.7000000    0.7000000    0.8750000
Sean Connery Nicolas Cage
   0.5384615    0.5384615
```

```
betweenness(actorNetwork, directed=F,
weights=NA, normalized = T)
```

```
   Tom Hanks  Gary Sinise Robin Wright  Bill Paxton  Kevin Bacon     Ed Harris
   0.1190476    0.1190476    0.0000000    0.0000000    0.0000000    0.4761905
Sean Connery Nicolas Cage
   0.0000000    0.0000000
```

# Network Density

```
edge_density(actorNetwork)
```

# Exercise

There are another two files containing social networks of movie actors and actress. Play with these files yourselves! The files are downloadable here:

```
actors <-
read_csv("https://ximarketing.github.io/class/DM//Ac
torsExercise.csv")
movies <-
read_csv("https://ximarketing.github.io/class/DM/Mov
iesExercise.csv")
```

# Directed Network

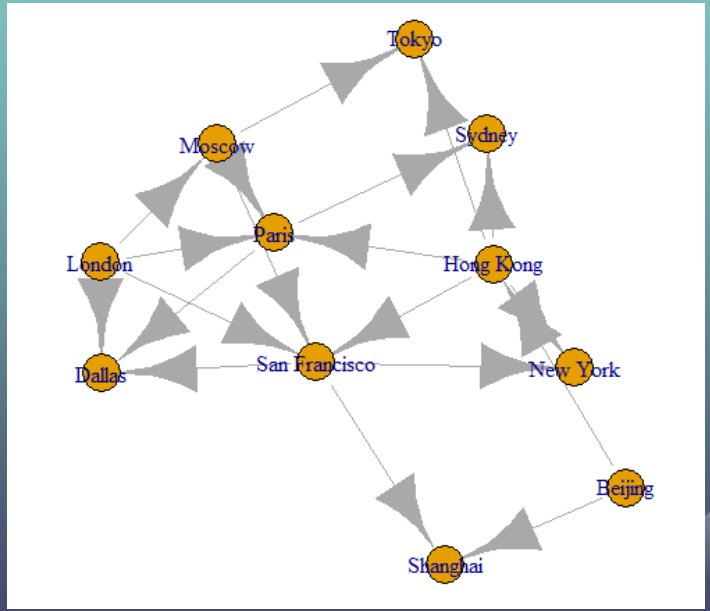
In the following exercise, we play with directed network. This is not much difference.

```
cities <-
read_csv("https://ximarketing.github.io/class/DM/Dir
ectedNodes.csv")
routes <-
read_csv("https://ximarketing.github.io/class/DM/Dir
ectedEdges.csv")
flightNetwork <- graph_from_data_frame(d=routes,
vertices=cities, directed=T)
```

# Directed Network

Plot the directed network:

```
plot(flightNetwork)
```



# Directed Network

We can distinguish between in-degrees and out-degrees:

```
degree(flightNetwork, mode="in")
```

```
    Beijing     Shanghai    Hong Kong        Tokyo     New York       London
          0            2            1            2            2            0
     Sydney San Francisco        Paris       Moscow       Dallas
          2            3            4            1            3
```

```
degree(flightNetwork, mode="out")
```

```
    Beijing     Shanghai    Hong Kong        Tokyo     New York       London
          2            0            5            0            0            5
     Sydney San Francisco        Paris       Moscow       Dallas
          0            3            2            3            0
```

# Mobile

Is mobile different?

Mobile is the closest a brand can get to its customer.

# QUESTION

What are the advantages of mobile marketing?

# Advantages of mobile marketing

Mass Reach

Do you know anybody who does not own a mobile phone anymore? Even your grandparents text and check their Facebook accounts on their mobile phones.

Always Reachable

Mobile users are said to be “always on,” meaning that they can be reached 24 hours a day, seven days a week, 365 days a year.

Always Shopping

With mobile, consumers are always shopping.

# Advantages of mobile marketing

Personal

The mobile phone is a very personal device. Borrow somebody else's phone and change something on it, and you'll feel their ire. Marketers can customize their mobile messages to each individual.

More Data

One of the greatest benefits of mobile marketing is that every lead or opt-in that it generates becomes a part of your business's database.

# Advantages of mobile marketing

Geotargeting

If there is just one feature that makes mobile such an outstanding marketing medium, it is geotargeting. With geotargeting, a business can reach only those consumers who are within the range of their retail store. That means no waste!

# APP Marketing

# APP Pricing

Almost 94 percent of all apps are free to the consumer.

Some do charge for the initial download, but there is significant price resistance with apps, even when they are sold for less than a dollar.

# APP Pricing

Almost 94 percent of all apps are free to the consumer.

Some do charge for the initial download, but there is significant price resistance with apps, even when they are sold for less than a dollar.

Guess: What is the most expensive app developed for?

CyberTuner, a piano tuning software, is the most expensive app at a $999.99 price.

# APP Pricing

Getting people to pay for apps is not an easy task since consumers are used to getting apps for no charge. Therefore, there are also freemium apps. A freemium app is free to download, but users may need to pay a la carte for enhancements to the app.

In other cases, such as with the game Angry Birds, the app is free to download but comes with advertising included. If the user wants to eliminate the advertisements that come up between levels of the game, he needs to pay for the upgrade.

# Acquisitions

It is hard to get noticed on the app stores when there are over 4.5 million apps residing there. The best way to get noticed, stand out from the horde, and gain ground in app store rankings is to generate a lot of downloads.

App installs that come from the app stores are known as *organic installs*. Users find the app after doing a keyword search in the app store or by entering the app name in the search box based on a word-of-mouth recommendation.

# ASO

Apple has frequently referenced how many app downloads come directly from searches. Apple has stated in the past that 50–63 percent of all downloads come from searches, but that amount has increased to a solid 65 percent.

Organic installs can be most affected by outstanding app store optimization (ASO).

Question: How does ASO differ from SEO?

# ASO

ASO is similar to SEO, but with one major difference—the number of app downloads is a major factor in ASO.

It is so important to do some initial marketing for the app outside of the app store itself, especially shortly after release. Also, get your friends and family to download and review the app immediately to increase your early download numbers.

There are also paid installs! You pay others to install your app.

# ASO

A website can have many different pages on it, with each page targeting specific keywords. An app has only one page, so it needs to align all of those keywords within a single app. App stores allow an app owner to put 4,000 characters in the app description, so there is plenty of space for long-tail keywords.

Like SEO, it is good to have a primary keyword for the app in the title of the app.