



# Social Networks

Connecting with others



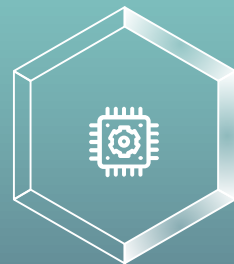
**Q1**

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

Twitter  
Snapchat  
Instagram  
Pinterest  
Reddit  
Wikipedia  
Facebook



# Leveraging Online Social Networks

# Get Fans

STAY CONNECTED

**SIGN UP**

[f](#) [🐦](#) [g+](#) [YouTube](#) [p](#) [🗨️](#) [RSS](#)

[+](#) ABOUT LENOVO      [+](#) PRODUCTS & SERVICES      [+](#) SHOP BY INDUSTRY

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



A screenshot of a Facebook post from the Lenovo page. The post is dated December 11, 2015, and features a video thumbnail showing a woman in a grey hoodie looking at a tablet. The text of the post describes a smart home project called #Goodweird. Below the video, the post has 1.4m views, 17,148 likes (circled in red), and 3,500 shares. The interaction buttons for Like, Comment, and Share are visible.

**Lenovo**  
December 11, 2015 · 🌐

Meet Yolanda and her #Goodweird home. Walls move, rooms change and the house comes to life while adapting to her every need - just like the YOGA 900. Share your #Goodweird at [www.goodweirdproject.com/global/](http://www.goodweirdproject.com/global/)

1.4m Views

👍 Like    💬 Comment    ➦ Share

17,148 people like this.

3,500 shares

Top Comments ▾

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

**Lenovo**  
December 11, 2015 · 🌐

Meet Yolanda and her #Goodweird home. Walls move, rooms change and the house comes to life while adapting to her every need - just like the YOGA 900. Share your #Goodweird at [www.goodweirdproject.com/global/](http://www.goodweirdproject.com/global/)

1.4m Views

👍 Like    💬 Comment    ➦ Share

17,148 people like this.    Top Comments ▾

3,500 shares

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

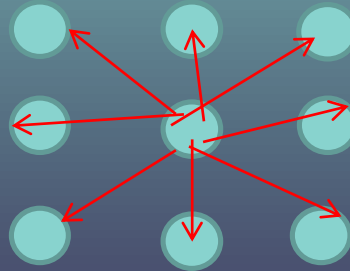
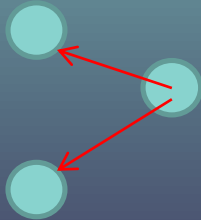
Organic word-of-mouth advertising.

Network can also be used for social advertising.

# Amplification Ratio

Amplification ratio

= # Friends of Fans exposed / # Fans exposed

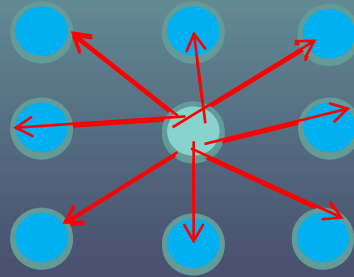
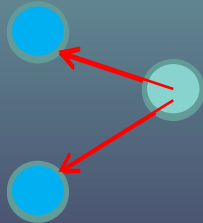




# Amplification Ratio

Amplification ratio

= # Friends of Fans exposed / # Fans exposed

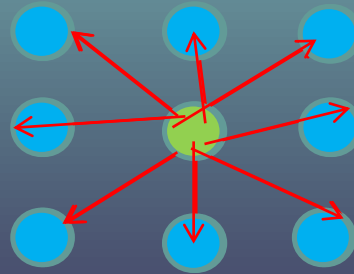
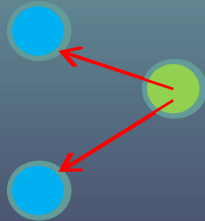


# Amplification Ratio

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.

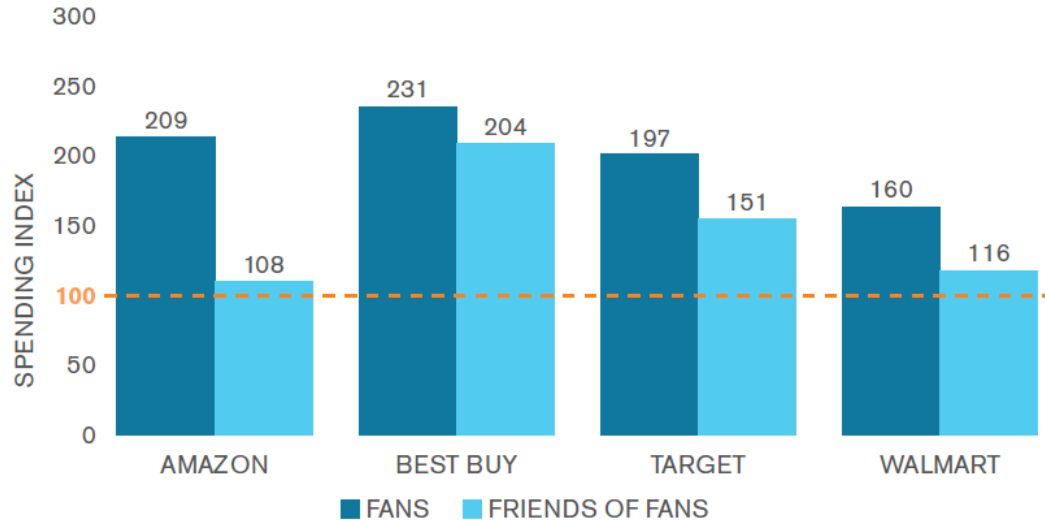
Online and offline purchases of exposed fans and Friends of Fans compared to typical week.



# 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?

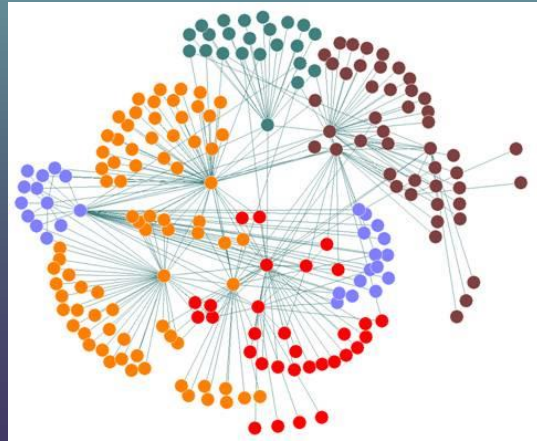
Strength of tie

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

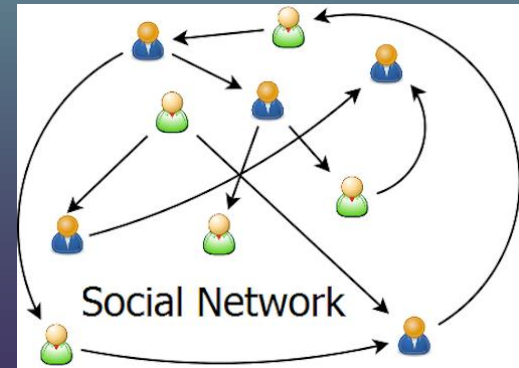
Has meaning independently of social network  
You live in Hong Kong island, HK

## Connection

You are close friends with 10 people at HKU

## Whole Network

On average, students know each other within 4 steps





# Edges

Person 1

# Edges

Person 1

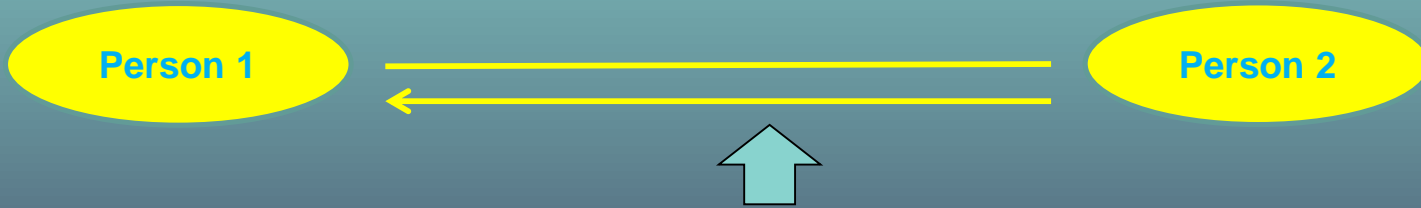
Person 2

# 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

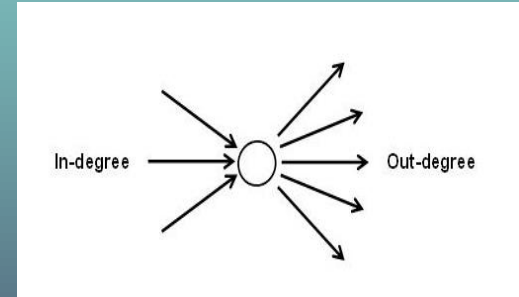
**Maximum number of edges in group of size  $N(N - 1)/2$ .**  
Where everyone connects to everyone else  
If undirected (my friends also have me as a friend)

# 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

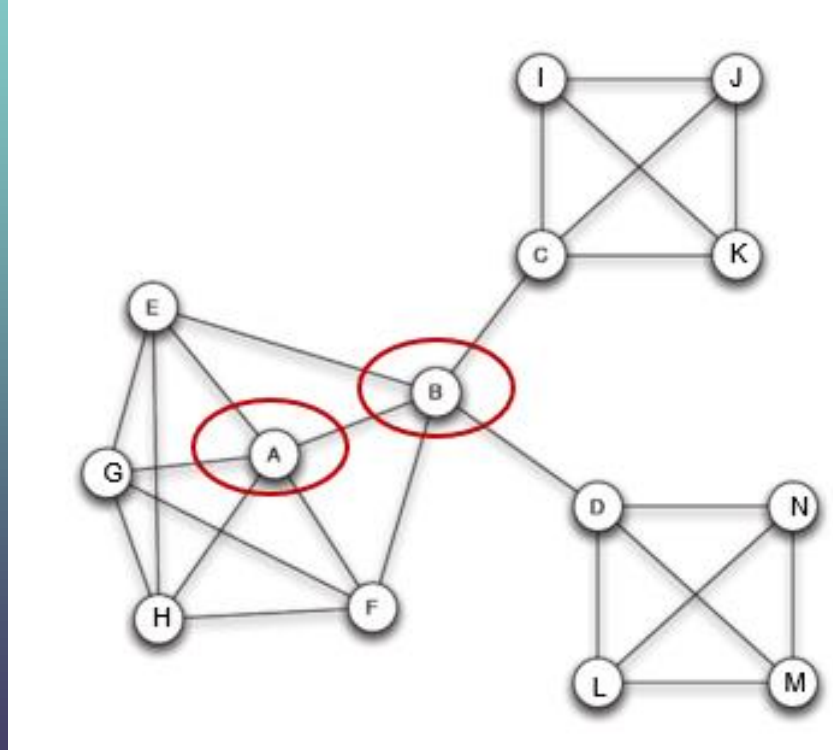
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How to determine the influential person (i.e., node) in a social network?

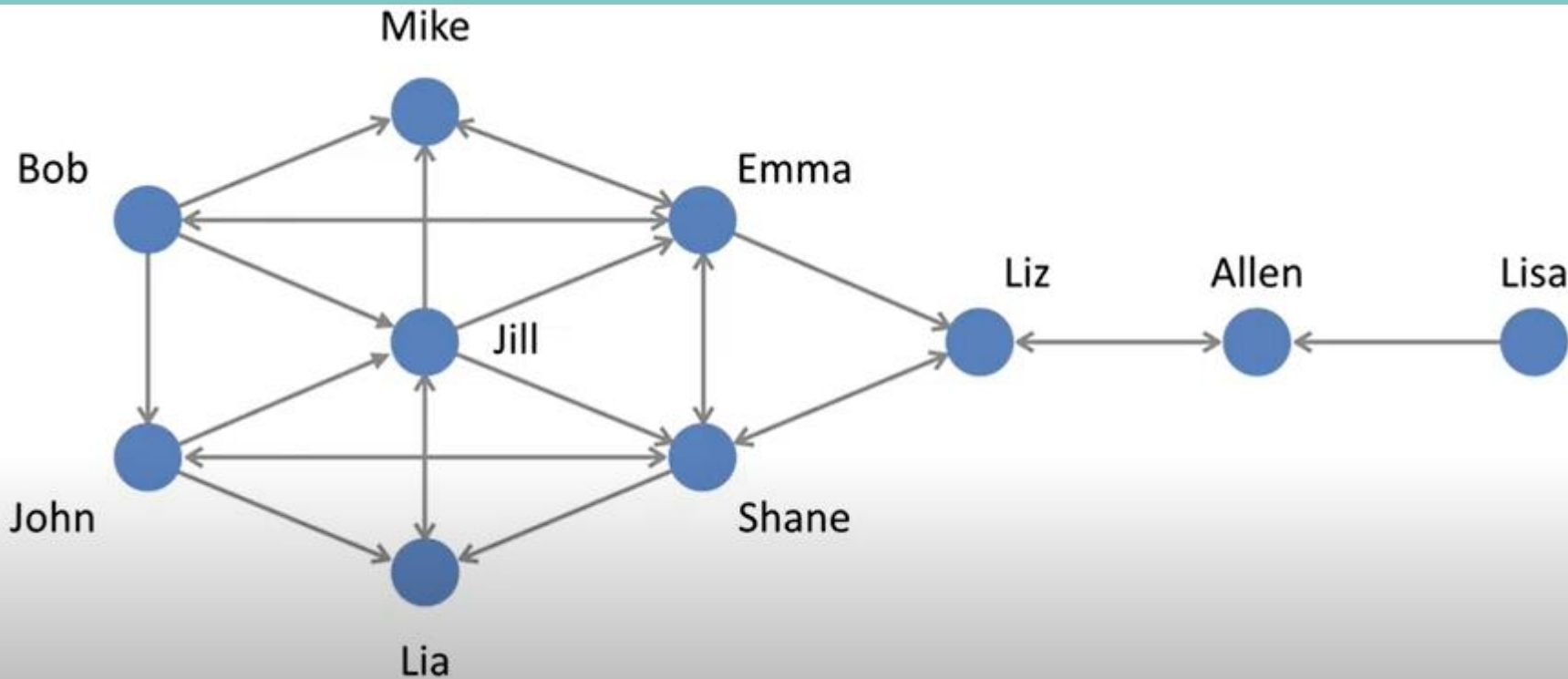




# Who is more important? Why?



# Who is most important? Why?






# QUESTION

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How to define the importance  
of a node?



Network

Component



Component

# Closeness Centrality & Betweenness Centrality

THE BASICS OF SOCIAL NETWORK ANALYSIS

# 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.

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

$\sigma_{yz}$  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  $x$ .



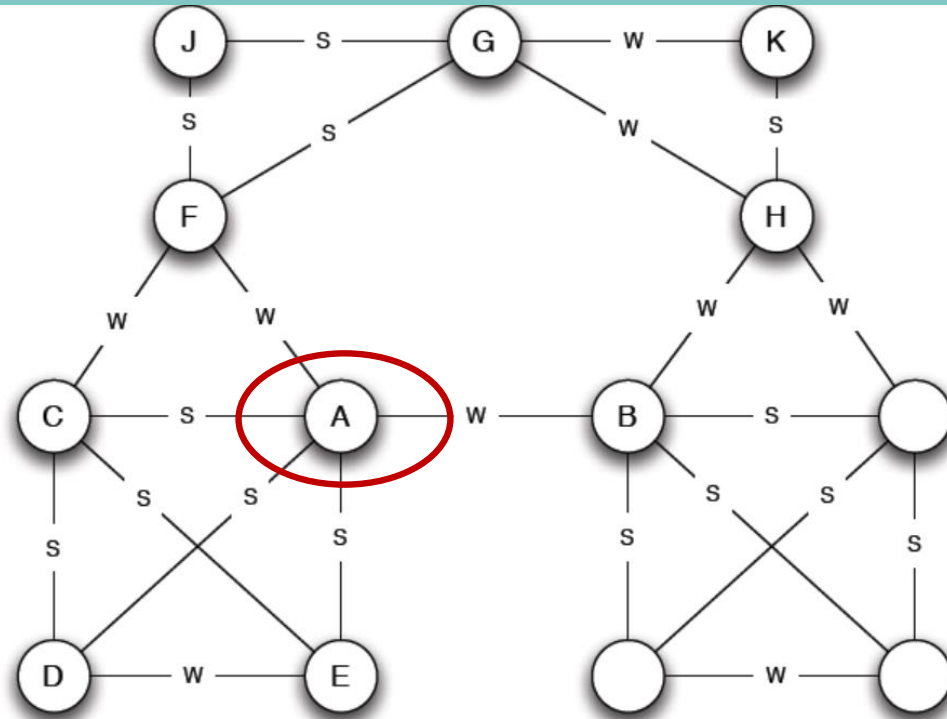
# Strong vs. Weak Ties

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





# 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!

Donald Trump has a Tom Hanks number of 2.



# Is a Network Well-Connected?

Graph/network density

## Network Density

Potential Connections:

$$PC = \frac{n * (n-1)}{2}$$

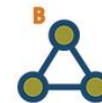
Network Density:

$$\frac{\text{Actual Connections}}{\text{Potential Connections}}$$

Examples:



Nodes (n): 2  
Potential Connections: 1 (2\*1/2)  
Actual Connections: 1  
Network Density: 100% (1/1)



Nodes (n): 3  
Potential Connections: 3 (3\*2/2)  
Actual Connections: 3  
Network Density: 100% (3/3)



Nodes (n): 3  
Potential Connections: 3 (3\*2/2)  
Actual Connections: 2  
Network Density: 66.7% (2/3)



# Networks Analysis in R

# Preparing Packages

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

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

# Reading Data

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

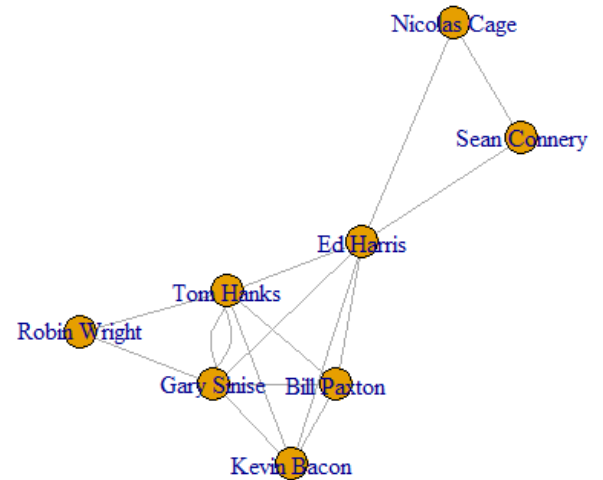
# Reading Data

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

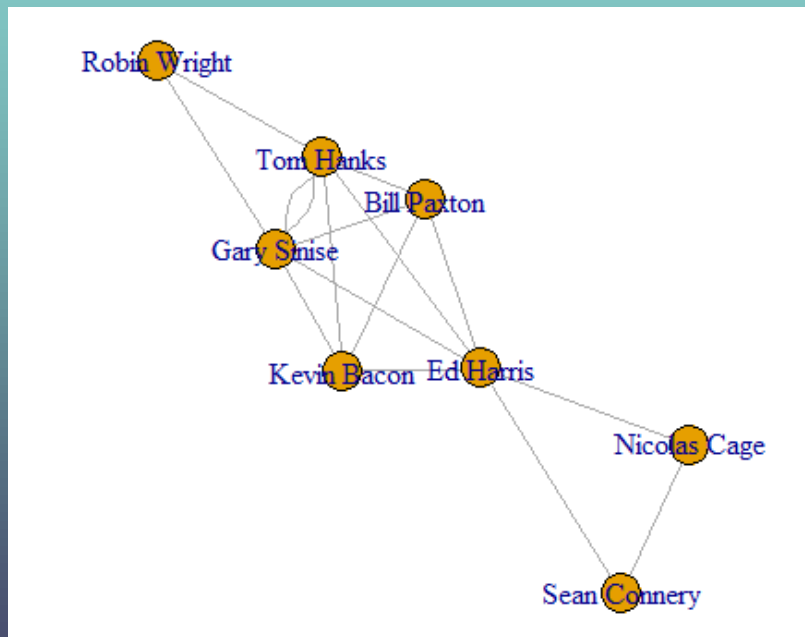
```
actorNetwork <-  
graph_from_data_frame(d=movies,  
vertices=actors, directed=F)  
plot(actorNetwork)
```





# Visualize the Network

```
plot(actorNetwork)
```

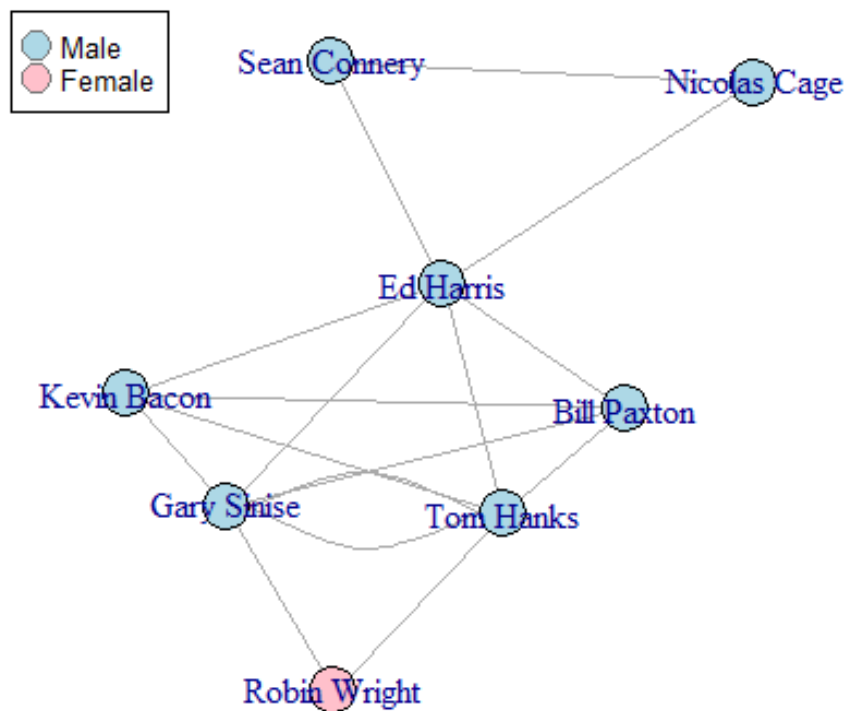


# Visualize the Network

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//ActorsExercise.csv")  
movies <-  
read_csv("https://ximarketing.github.io/class/DM/MoviesExercise.csv")
```

# Directed Network

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

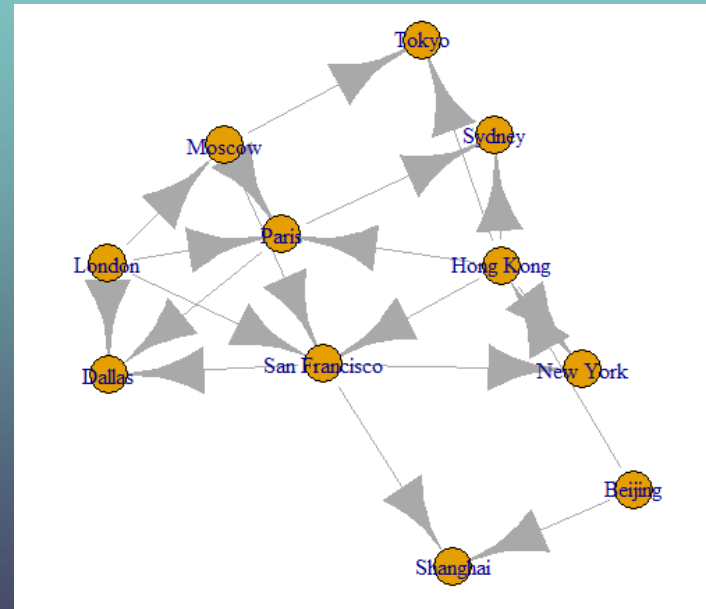
```
cities <-  
read_csv("https://ximarketing.github.io/class/DM/Dir  
ectedNodes.csv")  
routes <-  
read_csv("https://ximarketing.github.io/class/DM/Dir  
ectedEdges.csv")  
flightNetwork <- graph_from_data_frame(d=routes,  
vertices=cities, directed=T)
```



# 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	

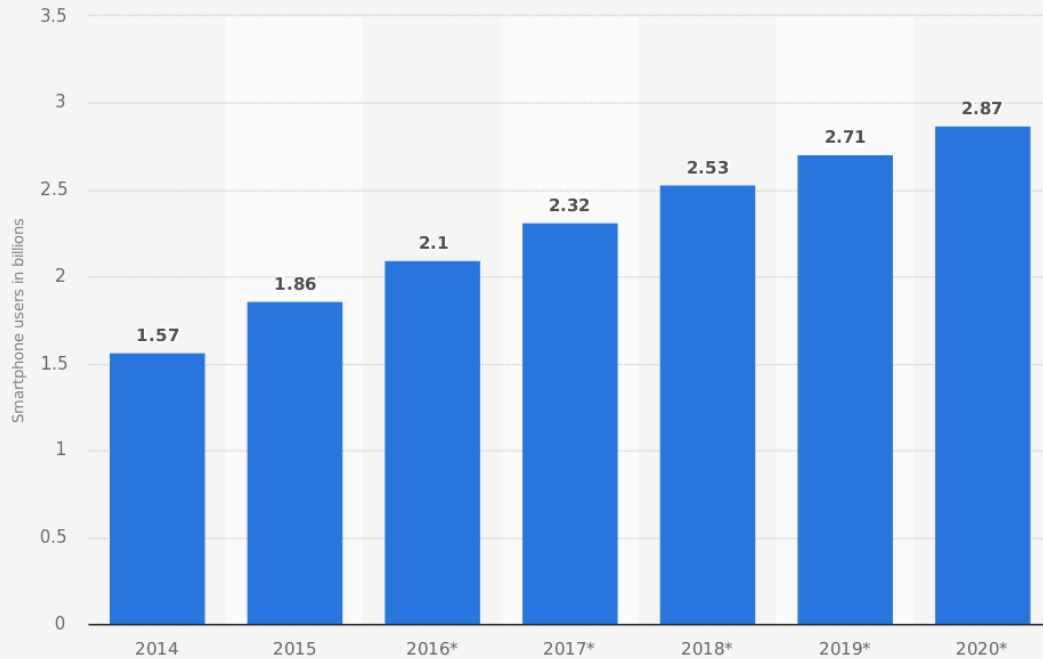


# Mobile

Is mobile different?

# The Rise of Mobile

Number of smartphone users worldwide from 2014 to 2020 (in billions)

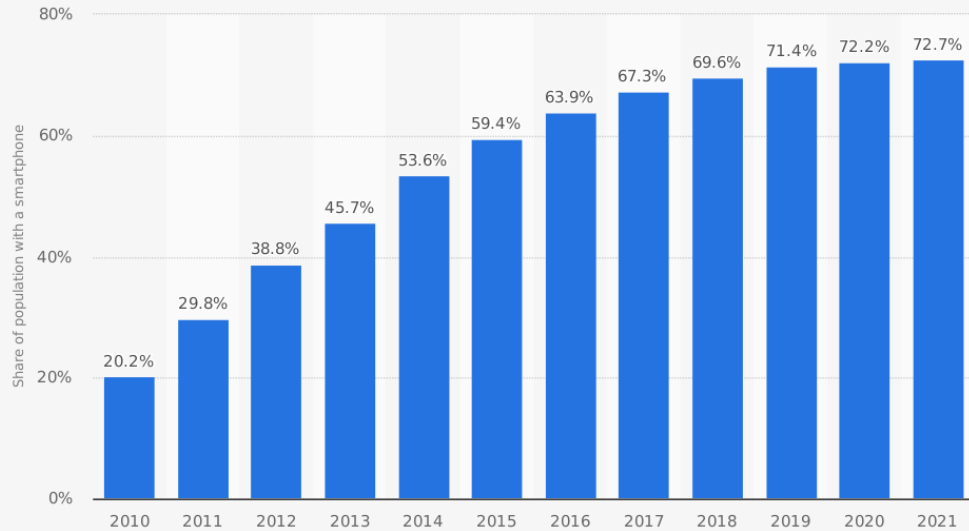


Source  
eMarketer  
© Statista 2017

Additional Information:  
Worldwide; eMarketer; 2014 to 2015

# The Rise of Mobile

**Smartphone penetration rate as share of the population in the United States from 2010 to 2021\***



Source  
eMarketer  
© Statista 2018


Additional Information:  
United States; eMarketer; 2010 to 2017; Individuals of any age who own at least one smartphone per month.



# QUESTION

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Which APPs are most downloaded?






# QUESTION

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Which APPs do people spend most money on?






# QUESTION

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How many hours do people  
spend on smartphones  
everyday?

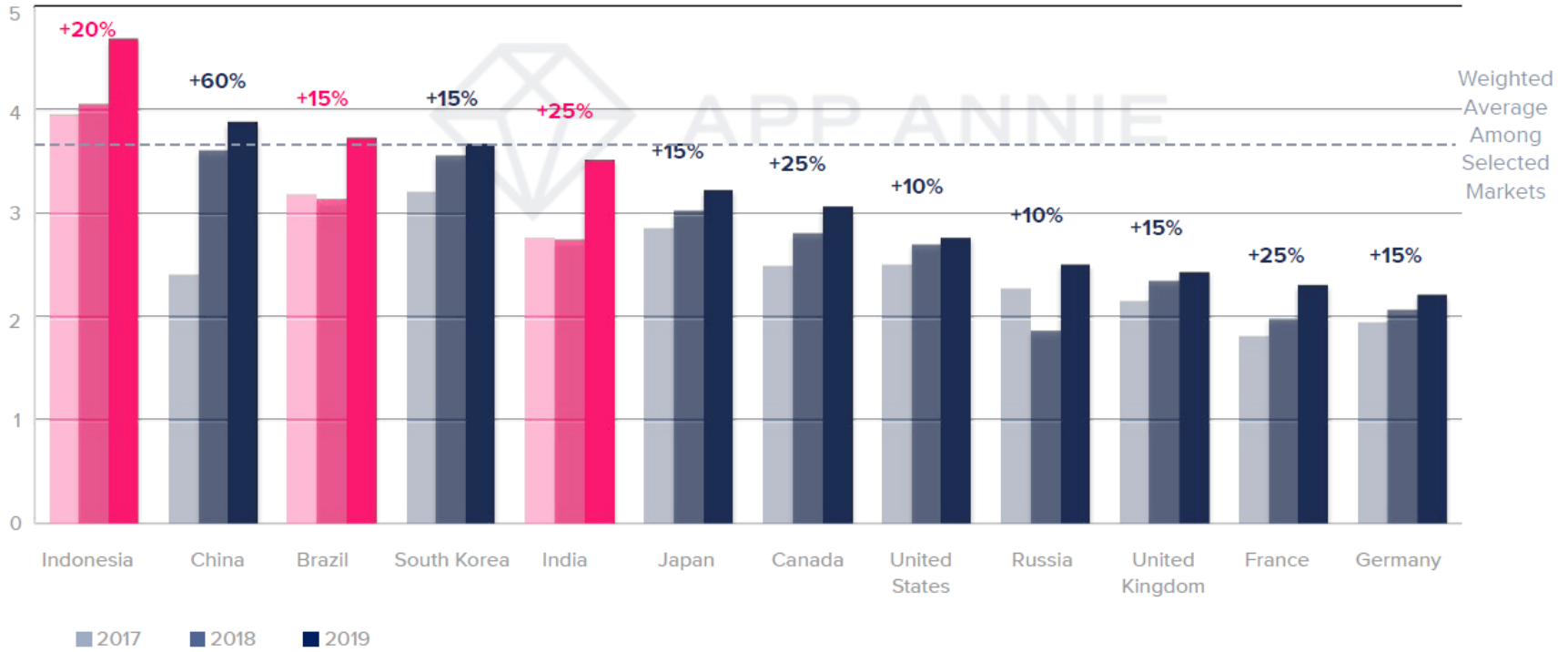




## Average Daily Hours Spent Per Device on Mobile

Emerging Markets

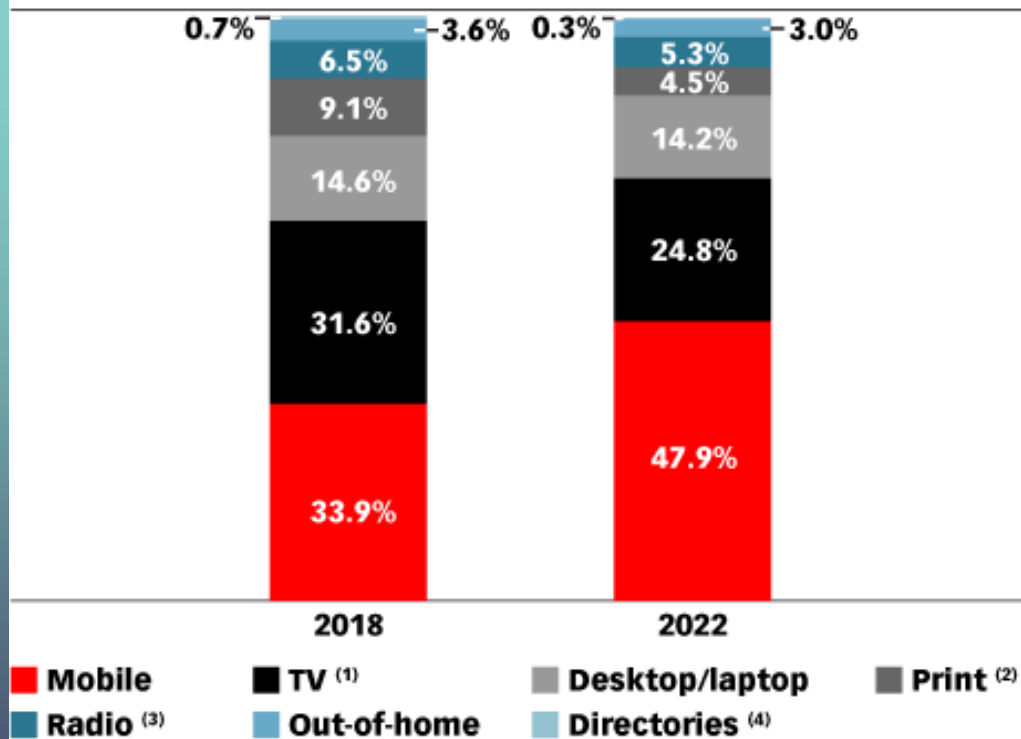
Mature Markets



Note: Android phones

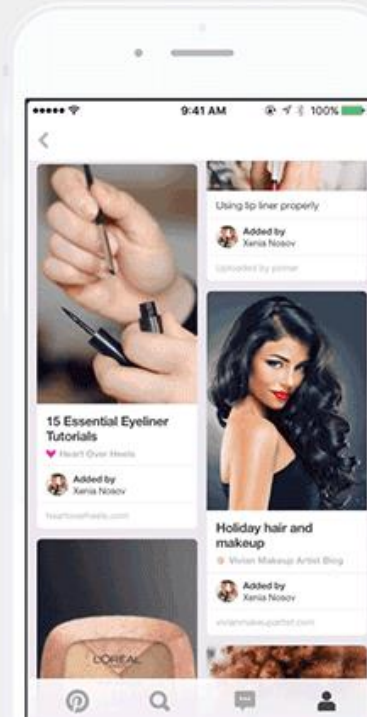
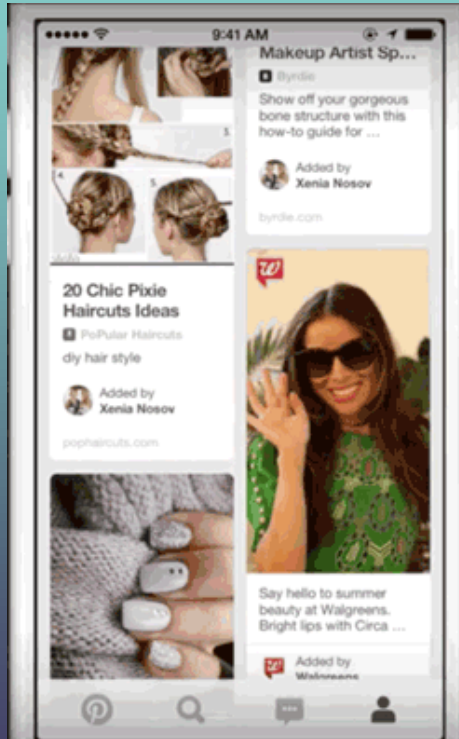
# US Total Media Ad Spending Share, by Media, 2018 & 2022

% of total



Note: numbers may not add up to 100% due to rounding; (1) excludes digital; (2) includes newspapers and magazines; excludes digital; (3) excludes off-air radio and digital; (4) print only; excludes digital  
Source: eMarketer, March 2018

# Motion Based Ads (on Pinterest)






# QUESTION

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How is mobile different from PC? What new marketing opportunities are brought by mobile?



# Mobile is not just your phone



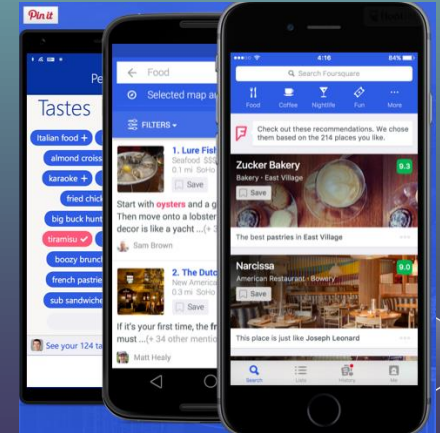
# Location Based Targeting

Consumers search with their **location and proximity** in mind

88% of consumers conduct local searches on smartphones.

Local searchers are more likely to take actions  
50% of consumers who conducted a local search on their smartphone visited a store within a day.

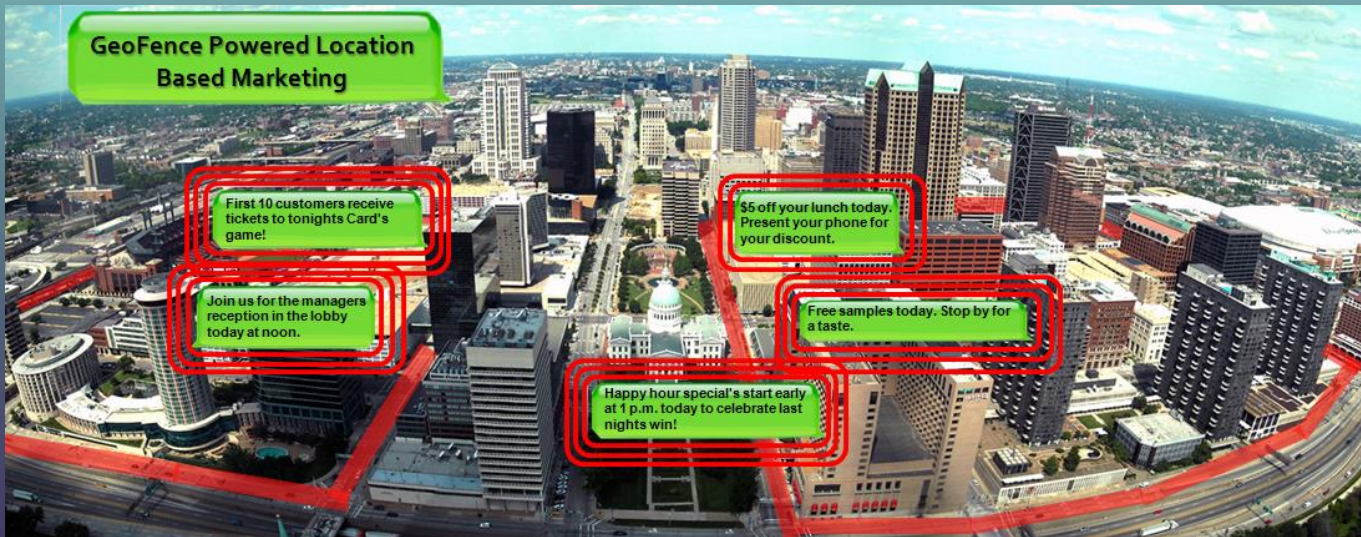
18% of local searches on smartphone lead to a purchase within a day vs. 7% of non-local searches.





# Proximity marketing: Geo-fencing

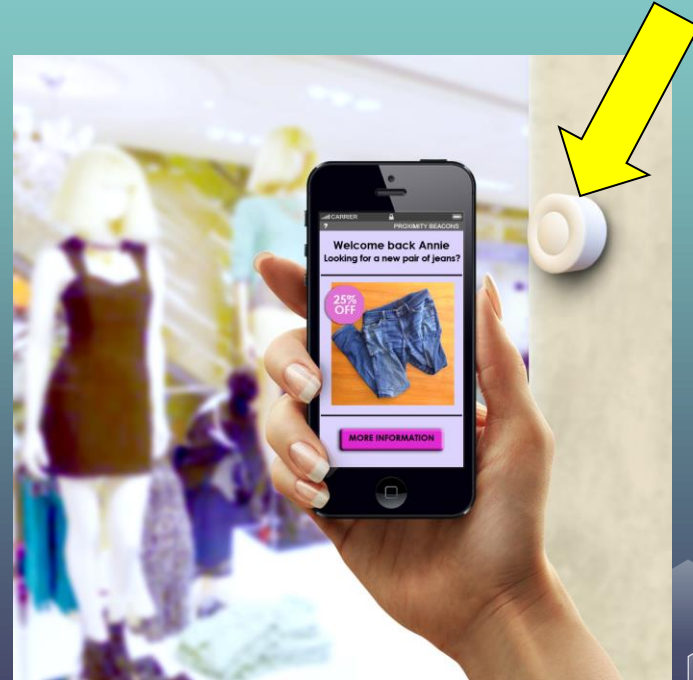
**Geofencing** is a location-based service that sends promotional messages to smartphone users who enter a defined geographic area such as a hotel, a mall, or a conference center.



# Proximity marketing: Beacons

Beacons are small, often inexpensive devices that use Bluetooth to enable more accurate location within a narrow range than GPS, cell tower triangulation and Wi-Fi proximity.

Geo-fencing is optimized for larger and outdoor locations, between 50 and 50,000 meters while beacons have a maximum range of 30 meters and are better used indoors.





# Via mobile apps, Beacons can communicate both behavioral data and social data to create more precise consumer profile

The image shows a large, ornate interior space, likely Grand Central Terminal, with many people walking. Three callout boxes are overlaid on the image, each pointing to a specific area. The first callout box is on the left, the second is in the center, and the third is on the right. Below each callout box is a small inset image of a person, likely representing the target audience for that specific beacon.

Traditional Location Targeting	Mobile Targeting	Mobile Targeting
Works: Unknown	Works: Iowa City, IA	Works: Midtown Manhattan
Lives: Unknown	Lives: Iowa City, IA	Lives: Garden City, NY
Shops: Unknown	Shops: McDonald's, Wal-Mart	Shops at: Costco, Macy's
Age: Unknown	Age: 25-29	Age: 35-44
Income: Unknown	Income: \$50-75k+	Income: \$150k+
Interests: Unknown	Interests: Concerts	Travels for business

# A smart use of beacons by Nivea





# QUESTION

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How are Geo-fencing and Beacons different from traditional outdoor and in-store ads?

