



Social Networks

Connecting with others



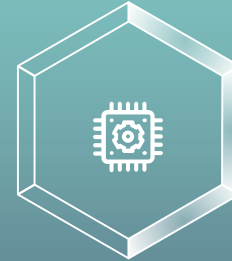
Q1

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

Customer-to-Customer Interactions

WEB 1.0



WEB 2.0





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

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/

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

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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).

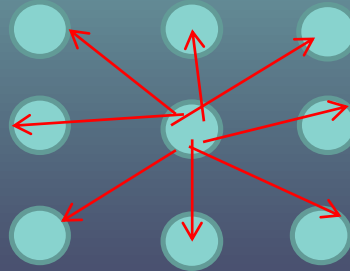
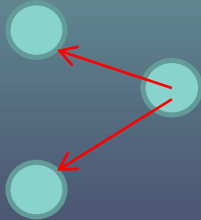
Organic word-of-mouth advertising.

Network can also be used for social advertising.

Amplification Ratio

Amplification ratio

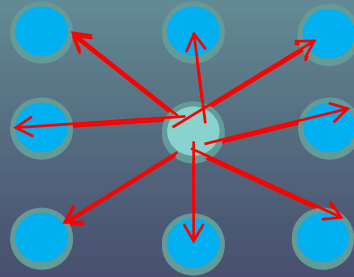
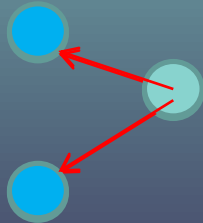
= # Friends of Fans exposed / # Fans exposed



Amplification Ratio

Amplification ratio

= # Friends of Fans exposed / # Fans exposed

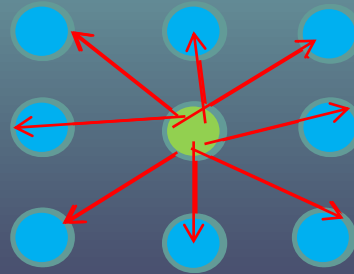
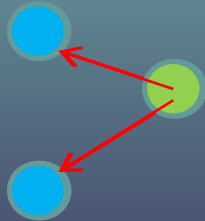


Amplification Ratio

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.

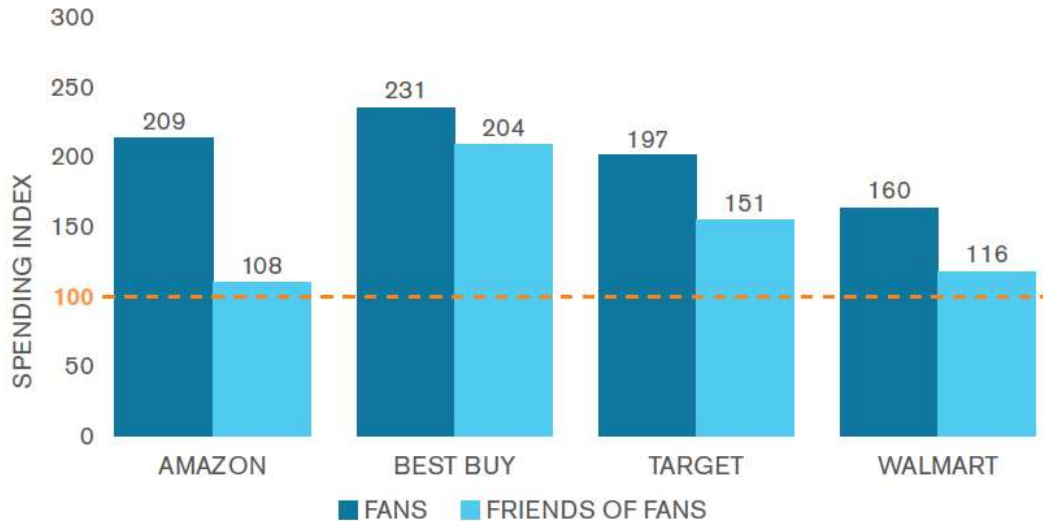
Online and offline purchases of exposed fans and Friends of Fans compared to typical week.



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

The background features a teal-to-blue gradient with a white hexagonal network pattern. The pattern consists of interconnected hexagons and lines, with some nodes highlighted in a light blue color. The overall aesthetic is modern and technological.

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?

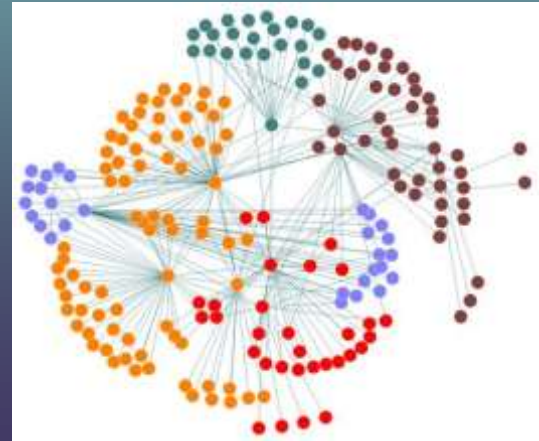
Strength of tie

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

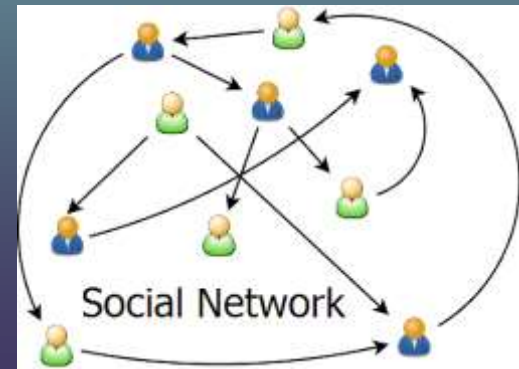
Has meaning independently of social network
You live in Hong Kong island, HK

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)

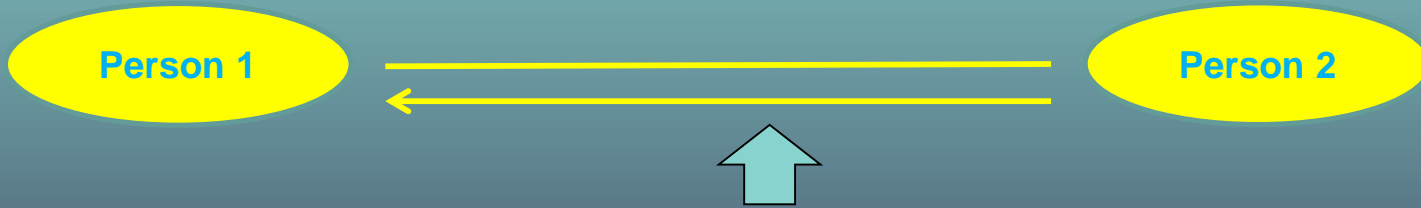


Person 1

Person 2



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

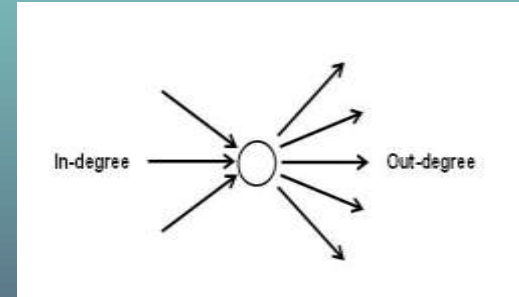
Maximum number of edges in group of size $N(N - 1)/2$.
Where everyone connects to everyone else
If undirected (my friends also have me as a friend)

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.



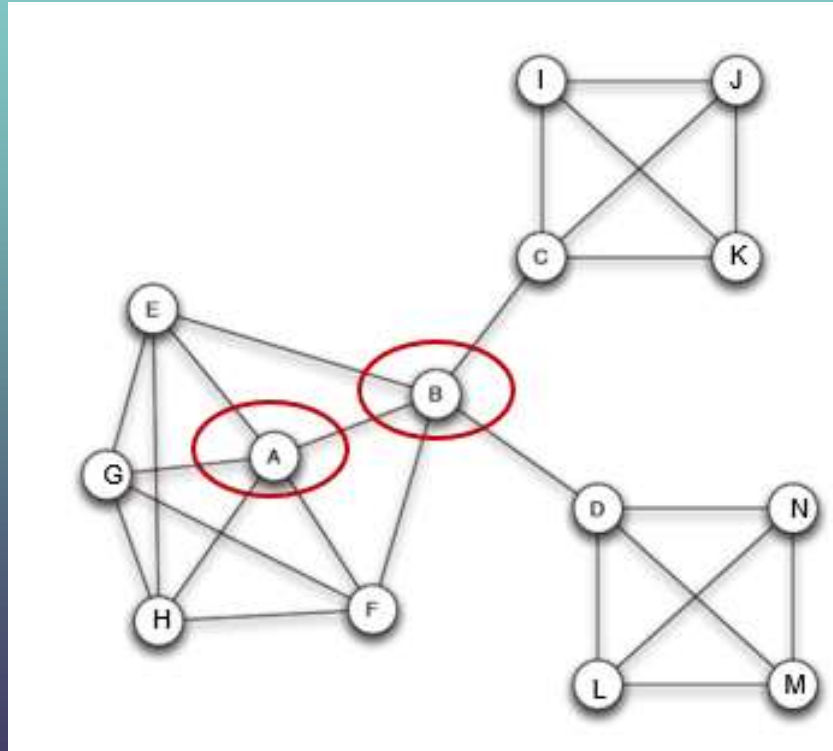


QUESTION

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

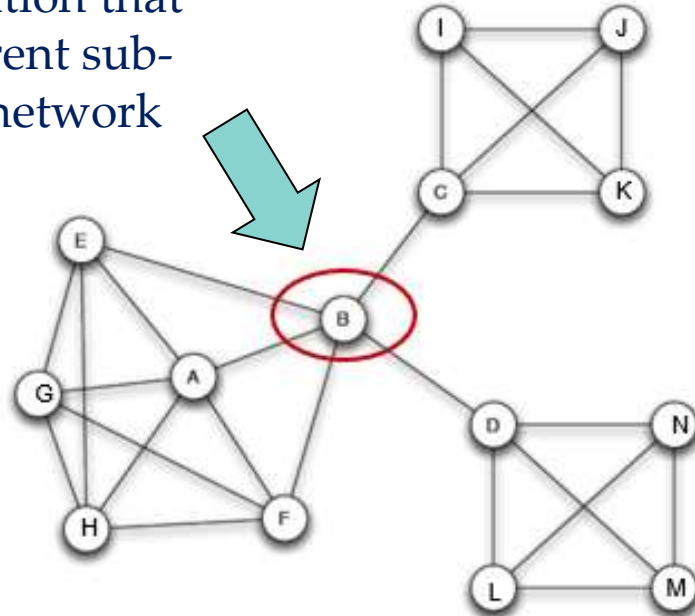


Who is more important? Why?

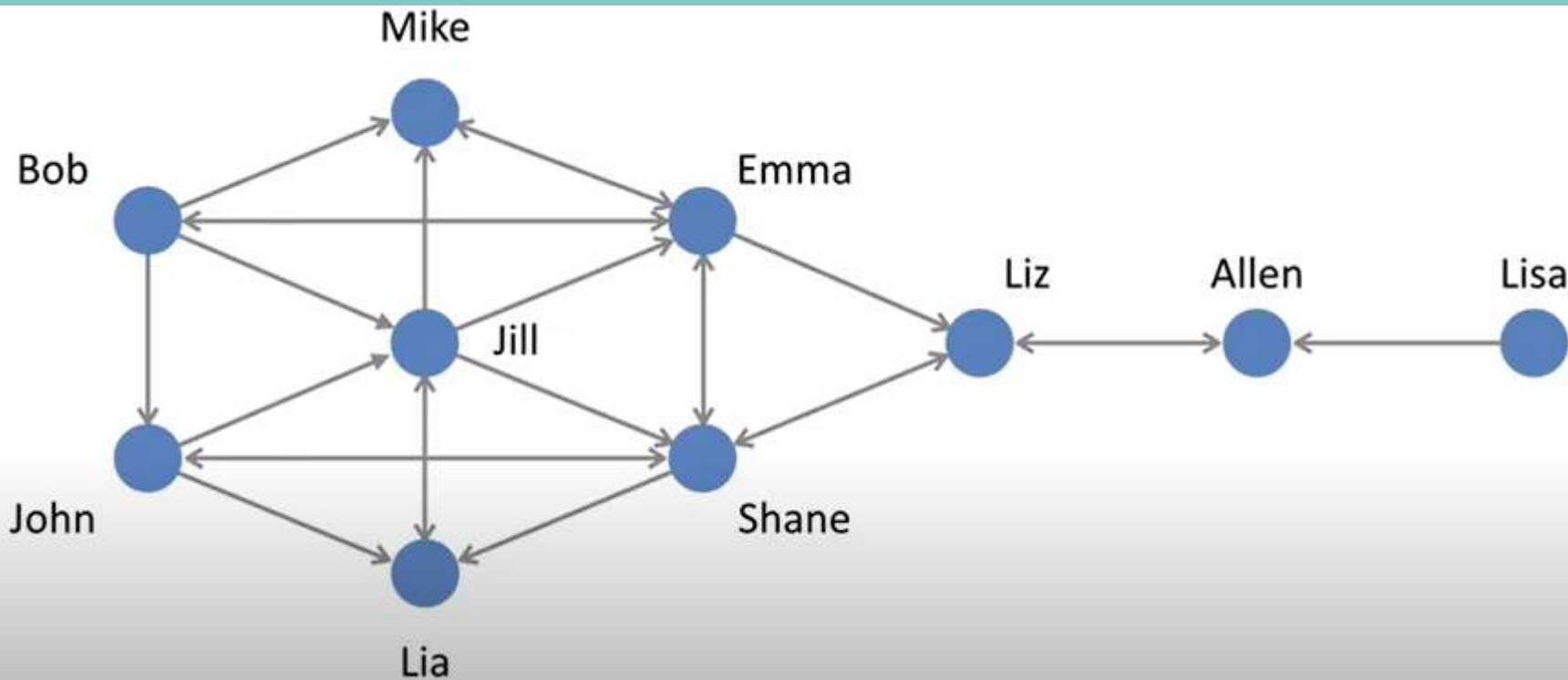


Social Hole

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?



Components



Comp



Comp



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.

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

σ_{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 .



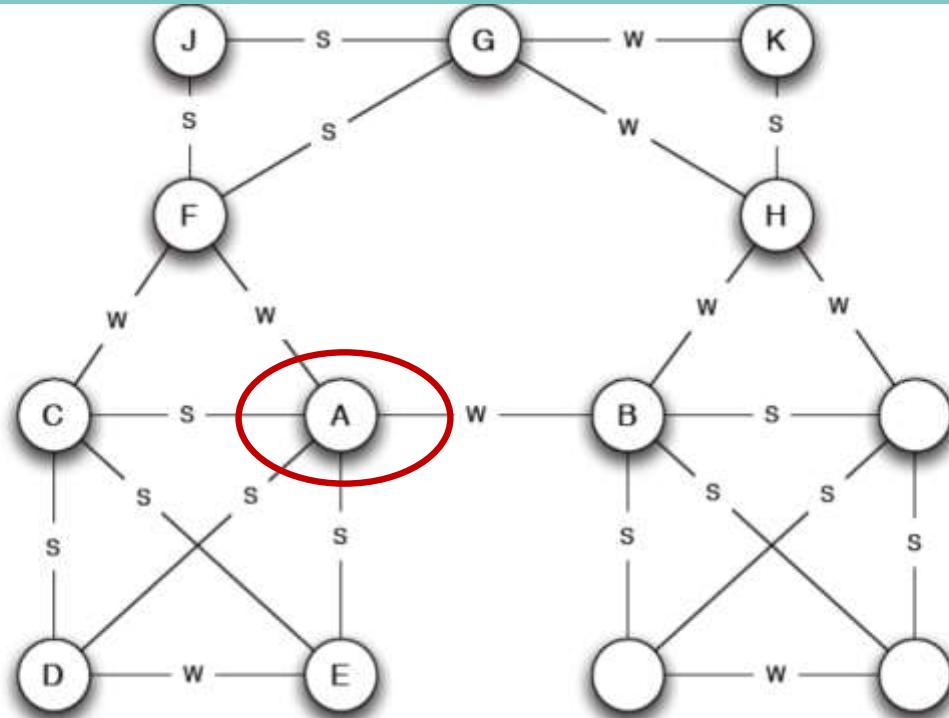
Strong vs. Weak Ties

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.



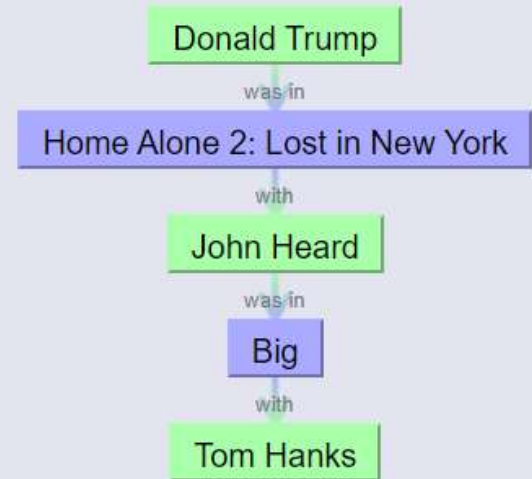
Degrees of Separation

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!

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:

A




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

B



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

C



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
```

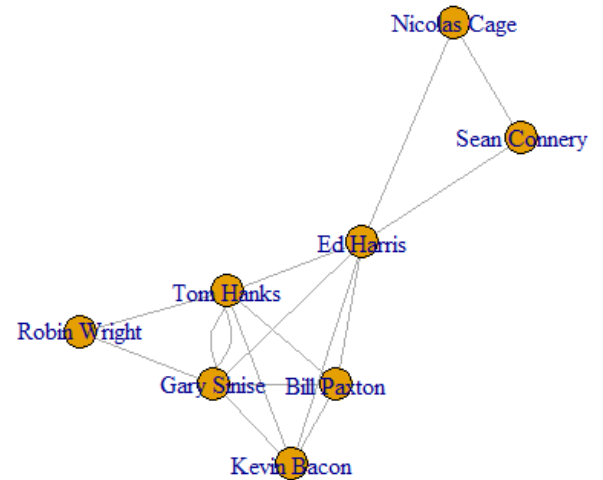
Reading Data

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
```

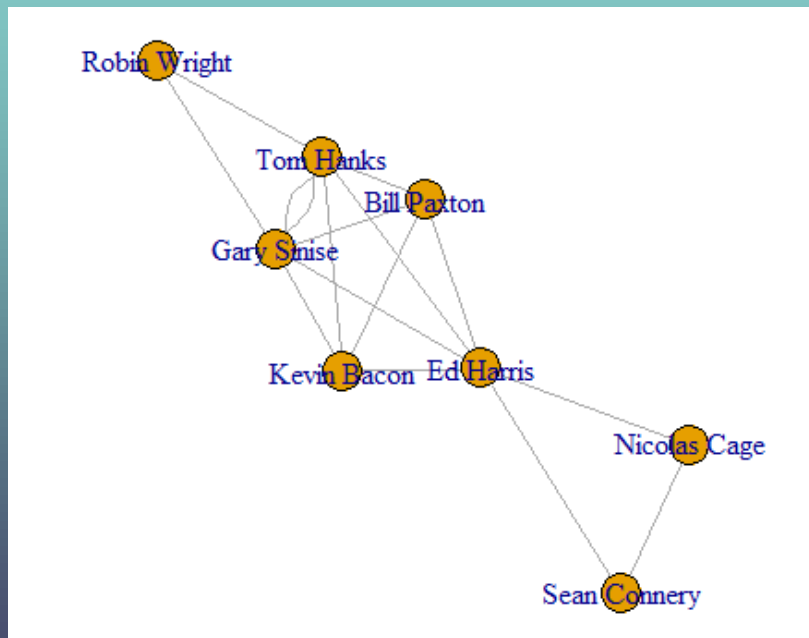
Visualize the Network

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



Visualize the Network

```
plot(actorNetwork)
```

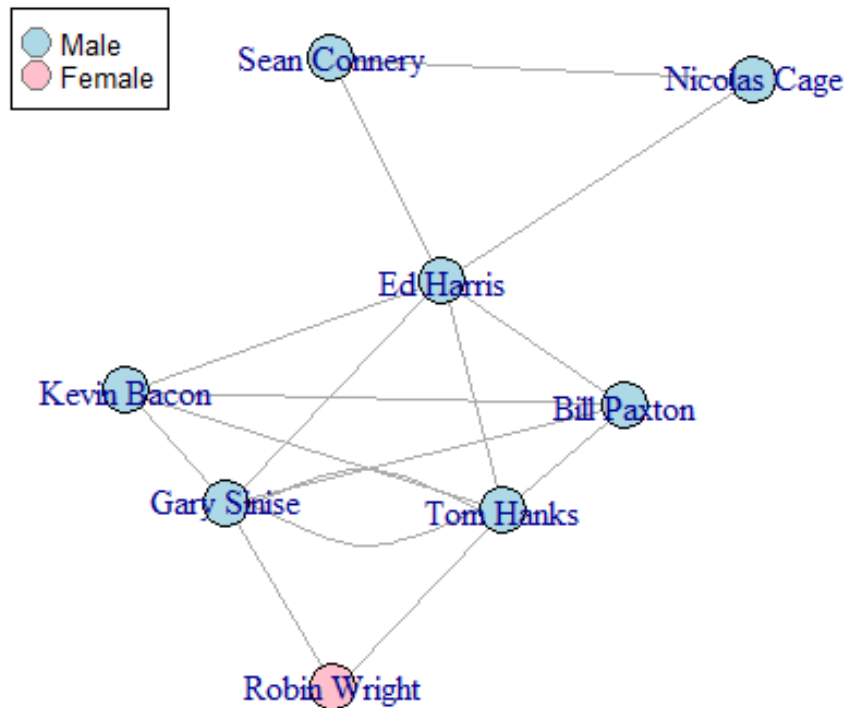


Visualize the Network

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

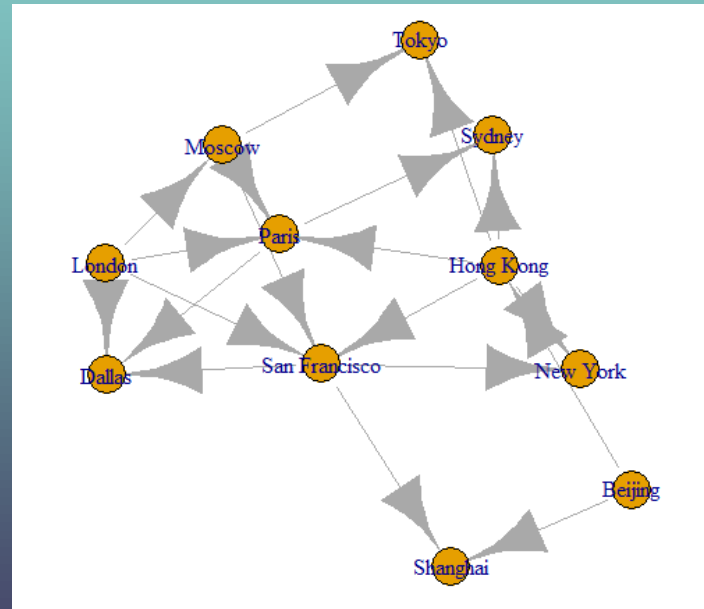
In the following exercise, we play with directed network. This is not much difference.

```
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")
```

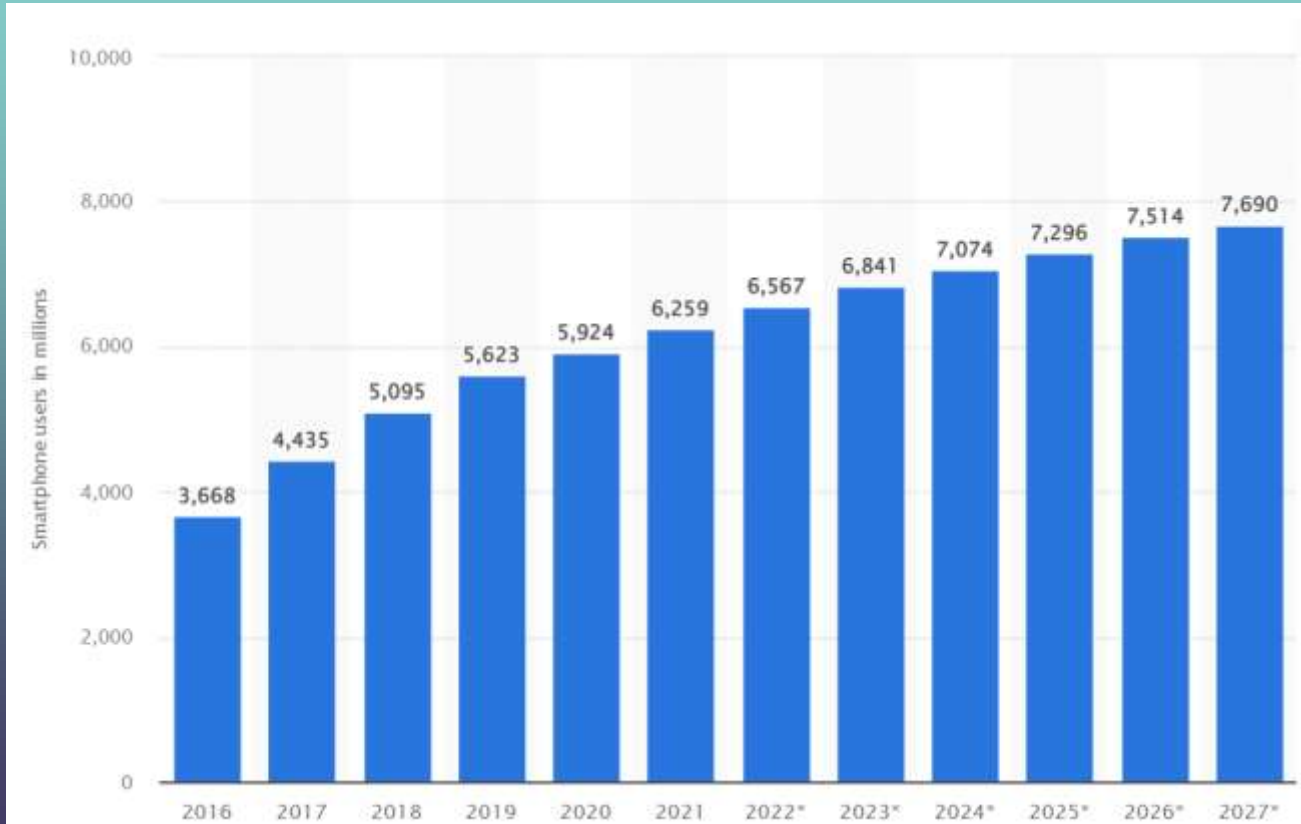
Beijing	Shanghai	Hong Kong	Tokyo	New York	London
2	0	5	0	0	5
Sydney	San Francisco	Paris	Moscow	Dallas	
0	3	2	3	0	



Mobile

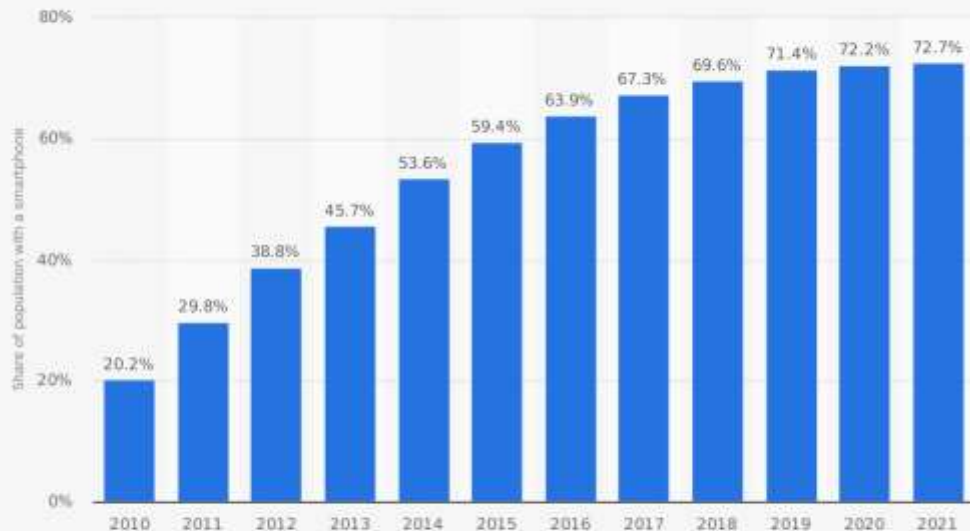
Is mobile different?

The Rise of Mobile



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

Which APPs are most downloaded?




Most Downloaded APPs

Name	Best for	No. of Downloads in 2021 (Forbes)	Rating-Play Store (Google/Apple)
TikTok	Creating and sharing short creative video clips	656 million	4.5/4.9
Instagram	Sharing ideas and thoughts across social media through photos and videos	545 million	4.1/4.7
Facebook	Connecting with friends, families, and people with similar interests	416 million	3.2/2.2
WhatsApp	Communicating seamlessly using internet data	395 million	4.3/4.7
Telegram	Messaging and sending photos, videos, and other documents	329 million	4.5/4.3

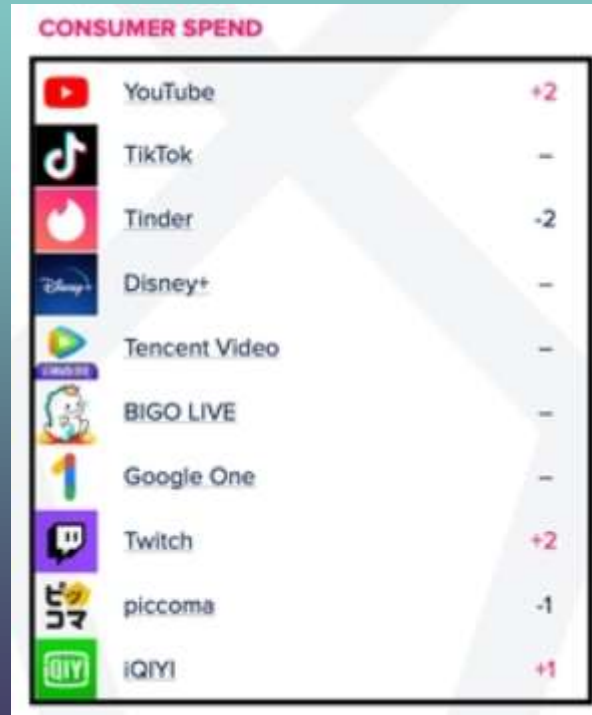


QUESTION

Which APPs do people spend most money on?




People Spend Money on these APPs





QUESTION

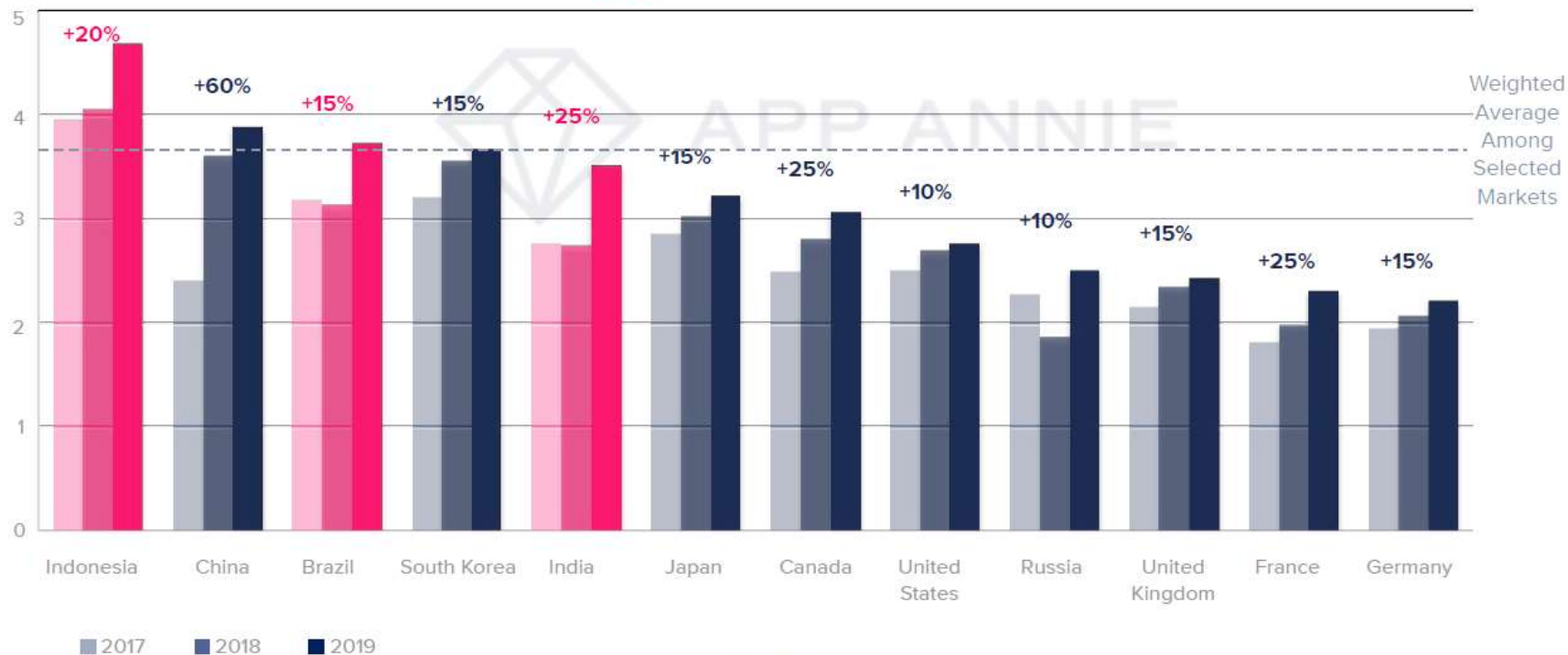
How many hours do people
spend on smartphones
everyday?



Average Daily Hours Spent Per Device on Mobile

Emerging Markets

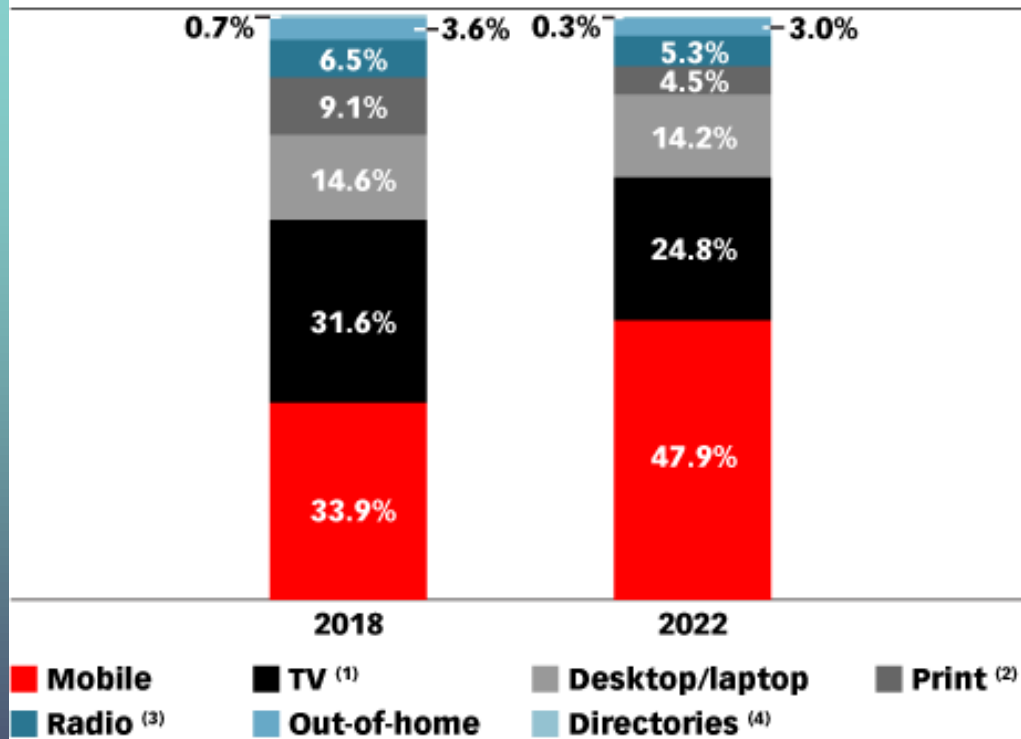
Mature Markets



Note: Android phones

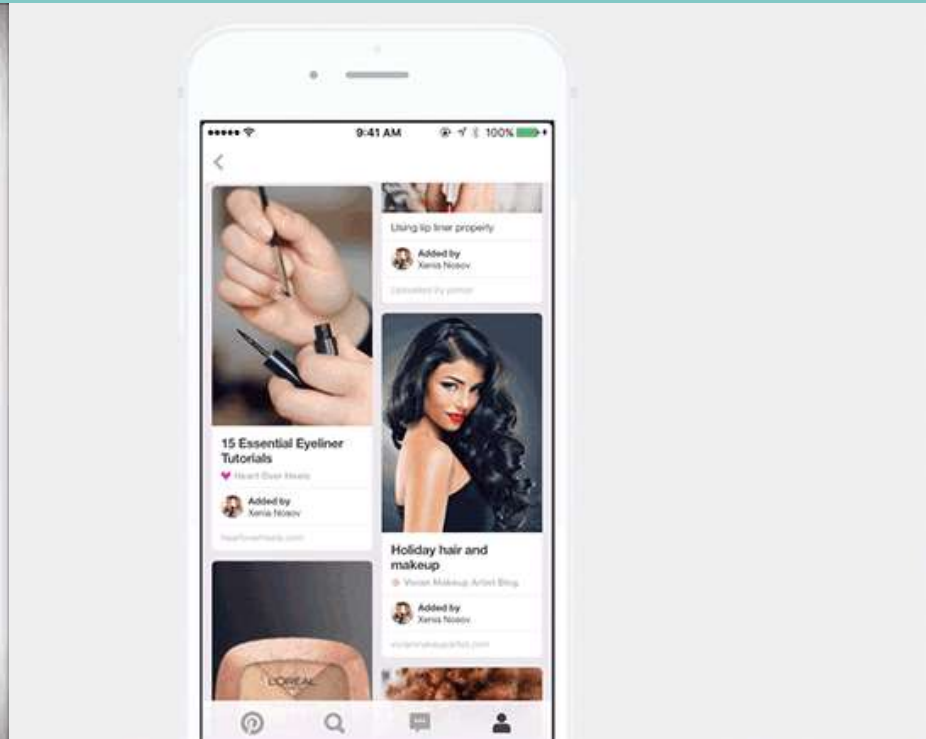
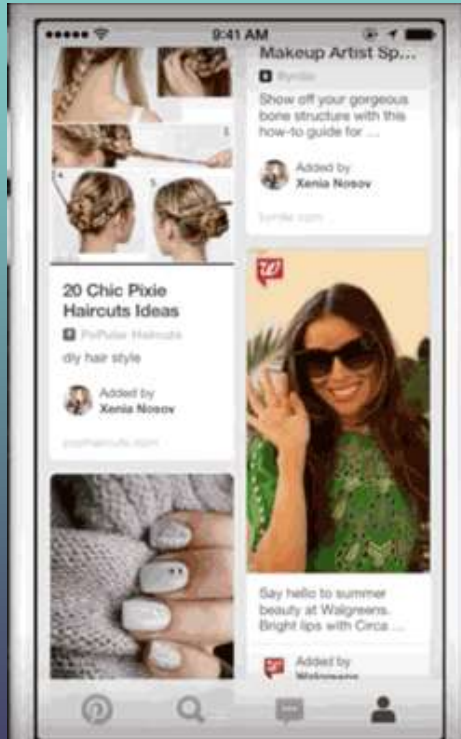
US Total Media Ad Spending Share, by Media, 2018 & 2022

% 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

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





How is Mobile Different

Omnipresence

Always carried and always on.

Reduced targeting errors

Unlike cookies, phone number and device ID cannot be deleted; mobile phones are usually not shared among households.

Location awareness

Location provides both proximity data and contextual information.

Built-in payment system

Easily purchase at offline stores



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.

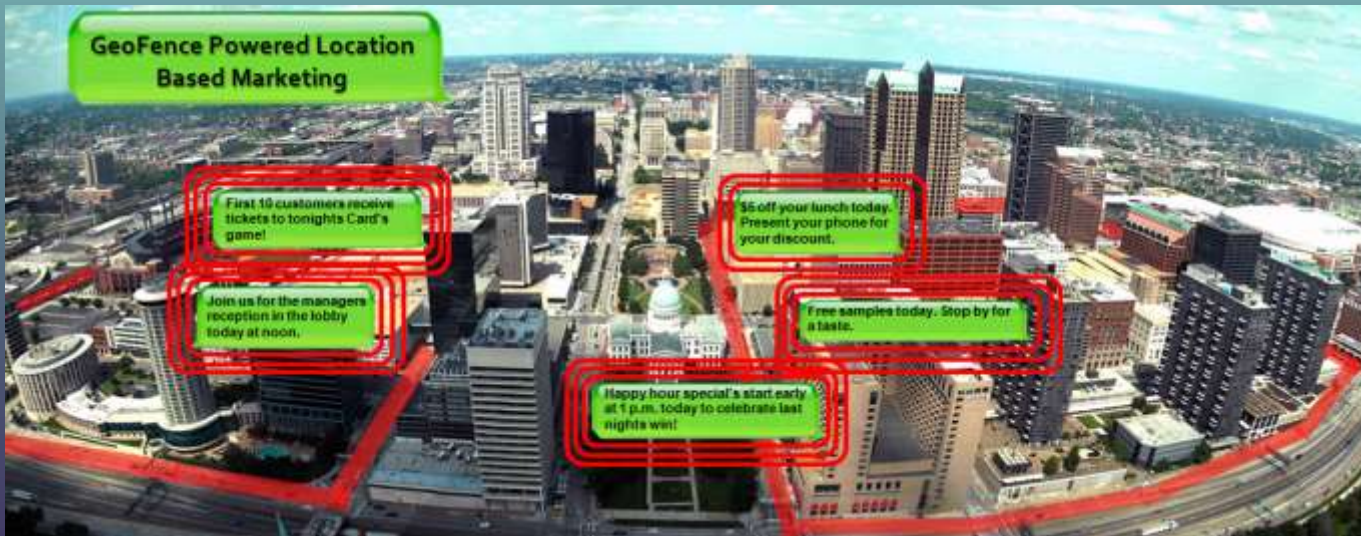
Local searchers are more likely to take actions
50% of consumers who conducted a local search on their smartphone visited a store within a day.

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



Proximity marketing: Geo-fencing

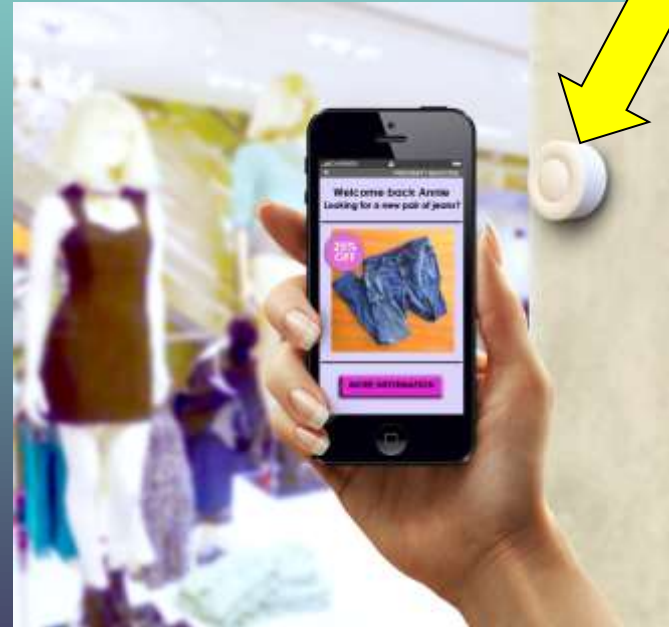
Geofencing is a location-based service that sends promotional messages to smartphone users who enter a defined geographic area such as a hotel, a mall, or a conference center.



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

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



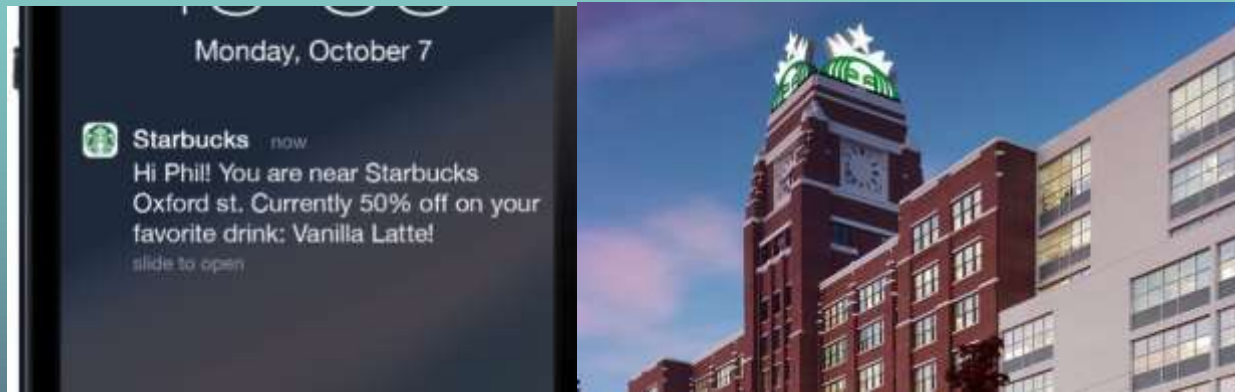


QUESTION

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



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



Personalize user experience

Send mobile coupons

Have high targetability such as demographics, timing, etc

Be non-intrusive by giving users opt-out options

Link with loyalty program