Designing engaging social sites and the engagement lifecycle

Ifeoma Adaji

Learning objectives

- At the end of the class, students should be able to:
  - Describe social design and list the challenges of social design for social software
  - Describe the framework for social design and why it is important to have one
  - Describe the AOF framework for social design
  - Explain the usage lifecycle
  - Describe design strategies for sign-up, return visits, ongoing engagement, collective intelligence and sharing
  - Explain funnel analysis

Social Design

- Social design is the conception, planning, and production of web sites and applications that support social interaction
- Ongoing, and will likely keep evolving
- Important because
  - Humans are innately social creatures
    - We exhibit social behaviour

Key aspects of social behaviour

- Humans are complex social animals who interact with each other for almost every need: food and water, shelter, technology, friendship, learning, fun, ritual, sport
- Humans organize themselves into groups, often belonging to multiple groups at the same time
- Groups can be as small as two people or as large as a religion, and can be for any purpose
- Groups can be made up of family, friends, acquaintances, or any set of people with something in common
- Humans act as both group members and individuals at the same time
- Humans behave differently in groups than they do individually, and vice-versa
- Humans play different roles in different parts and periods of their lives
- When humans are uncertain, they rely on social connections to help them out
- People usually compare themselves to those in their social group, not to society at large
- The people we know greatly influence how we act

Social Design

- Social design is the conception, planning, and production of web sites and applications that support social
- Ongoing, and will likely keep evolving
- Important because
  - Humans are naturally social creatures
    - We exhibit social behaviour
  - Social software is a *"forced move"*
    - We rely on social networks when making decisions making it *forced*
    - *Think of the last time you shopped online, did you rely on the reviews to make a decision?*
  - Social software is *"accelerating"*
    - Social software is trending upward: it is already the fastest growing and most widely used software on the web.
    - Social software has evolved from one-way conversations (read only) in the early nineties to two-way conversations (read-write) and finally to a many-way conversation (social)

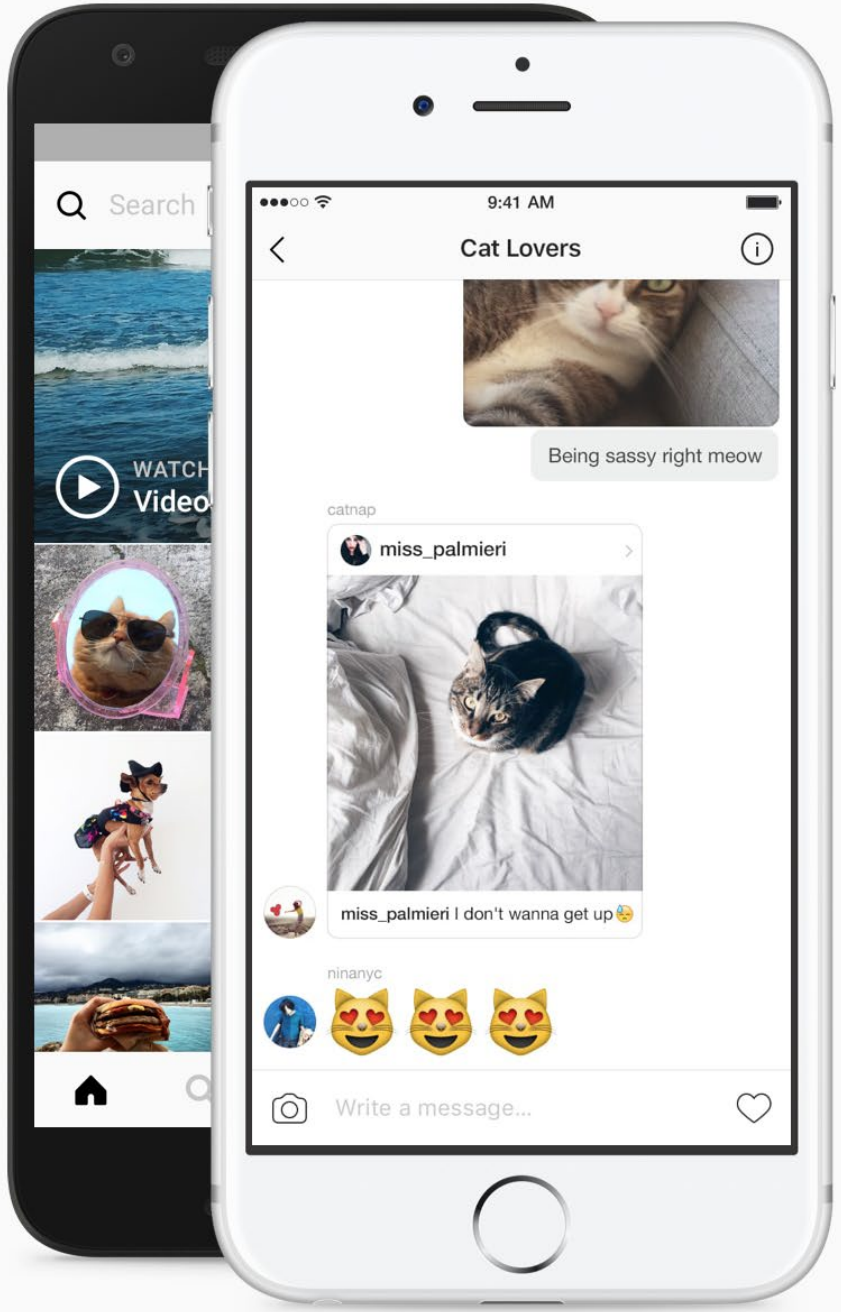
Social design

- Early social design concepts about human behaviour (Sigmund Freud)
  - We act according to our personality; designs should be personality based
  - Our personalities/ inborn tendencies dictate our behaviour
- Recent research (Kurt Lewin)
  - Human behaviour is a function of personality and environment
  - Environment can be physical
    - Physical environment dictates how we behave; when it’s cold outside we wear a jacket
  - Environment can be social
    - The action of others affect how we behave
  - Environment can also be a social software (online social media)

Challenge of social design for social software

- To design interfaces that support the *current* and *desired* social behaviour of the people who use them
  - If the interface is too confining, people won’t use it.
  - If the interface is too flexible, people won’t know how to use it.
  - But the current and desired behaviour of people change frequently
- Find a mid-point to create powerful social software that
  - supports people and their personality and
  - the social environment and the groups they belong to

INTERNET ARCHIVE
WayBackMachine
About this capture



Instagram

Phone number, username, or email

Password

Log In

OR

Log in with Facebook

Forgot password?

Don't have an account? Sign up

Get the app.

Download on the App Store

GET IT ON Google Play

Framework for social design

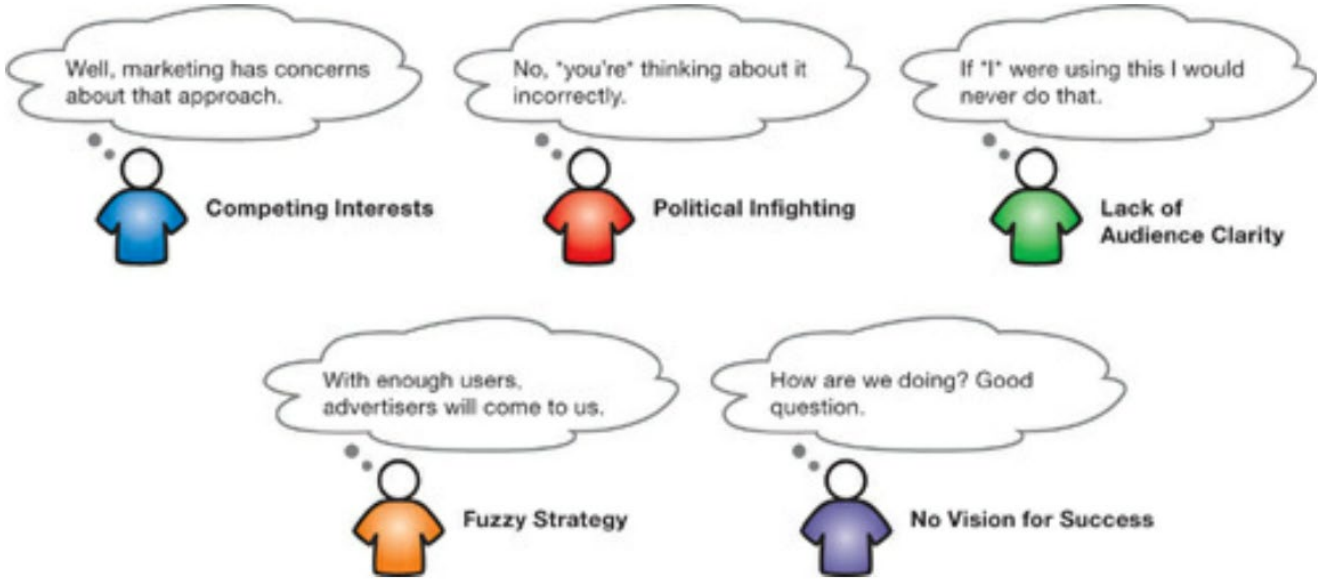
Why we need a framework

- “Feature creep” problem
- Happens when there is a lack of sustained focus on what’s most important
- Building too many features instead of deciding on a few core ones
- Software ends up becoming too difficult to use as many features compete with each other
- Can help focus a team on what’s most important
- Helps answer the questions
  - “What is the primary activity our software is supporting?
  - What features do we need to effectively support that activity?
  - What features can we leave out?

- Think of the social media platforms you use frequently. Which ones do you think suffers from too many features? Why?

Reasons for feature creep

- Competing interests (between marketers, engineers and management)
- Political infighting
- Lack of audience clarity
- Fuzzy strategy
- No vision for success



The AOF method

- Prioritization scheme for designing social web applications
- AOF = Activities, Objects, Features
- **Focus on the primary Activity**
  - what is your audience doing?
- **Identify your social Objects (noun)**
  - the objects that people interact with while doing the primary activity
- **Choose your core Feature set (verb)**
  - what are the actions people perform on the objects and which are important enough to support in a web-application

Focus on the Primary Activity

- Have a deep understanding of the specific activity you're supporting with your design.
- Know all the steps taken in performing the activity, the decisions people need to make at each step, the influencing factors in those decisions, and what types of roles people are in when making them
- Most important question is not "who is using your software?" but "**what are the people using your software doing with it?"**
- Only one activity is usually primary
  - The most successful applications support one specific activity
- Think of the commonly used social media platforms. Do they support only one main activity? (Flickr, Facebook, Instagram, YouTube, Netflix

Identifying the Primary Activity

- The applications people find most compelling allow them to excel at a single activity
  - Do you agree?
- Identifying it –ask yourself "What do people have to do in order **for us** to be successful? "
  - Purchase goods (Amazon), choose movies to watch (Netflix), upload /watch videos (YouTube), share pictures (Flickr)
- User Goals, Activities and Tasks
  - Goals – end conditions people are striving, e.g. purchasing items on Amazon
  - Activities – Set of tasks people do to achieve their goal, e.g. Shopping
  - Tasks – Individual functions that make up a set of activities, e.g. searching for product, comparing products, adding to shopping card, paying…
  - Focus on larger activity instead of tasks, e.g., instead of focusing on task of "purchasing goods", focus on the activity of "shopping"
- Methods used to discover the details we need to know about activities:
  - Interviews, usability testing, on-site observation, observing yourself, listening to people…

Identifying the Primary Activity

Service	Goals	Activities	Tasks
Amazon	Purchasing goods	Shopping	Adding to shopping cart, performing a product search, comparing products
Netflix	Entertainment	Watching movies	Rate movies, browse movies,
Monster	Making money	Finding a job	Searching for a job sending a resume
Flickr	Staying up to date with family	Sharing photos	Uploading a picture, sharing photos

Porter, Joshua. Designing for the Social Web (p. 27). Pearson Education

- Let's think about Facebook, Instagram, YouTube, WhatsApp, Snapchat, TikTok. Can we differentiate between Goals, Activities and Tasks?

Identify your Social Objects

- Social objects are the objects that mediate social activities
- Huge part of software design is managing objects and the social interactions that happen around them
- In social networking, a huge focus is usually on networking and not the social objects that connect us together
- Social networks are not only made up of people but the objects that connect people.
- E.g. Flickr – Photos; Amazon – Products, YouTube – videos
- Can we think of the social objects in Facebook, Instagram, Snapchat, TikTok. Can you think of *uncommon* social objects and where they are used?

Identify your Social Objects

- Social objects can be real-life artifacts
  - Facebook – actual book given to Harvard students containing bio of incoming freshmen
  - Amazon wish list – Modeled after an actual wish list people make and share with others
- Social objects can be abstract
  - They don’t have to have an exact representation of physical objects
  - *Jobs* and *dates* are abstract but are objects in LinkedIn and Monster
- Focus on designing for social objects

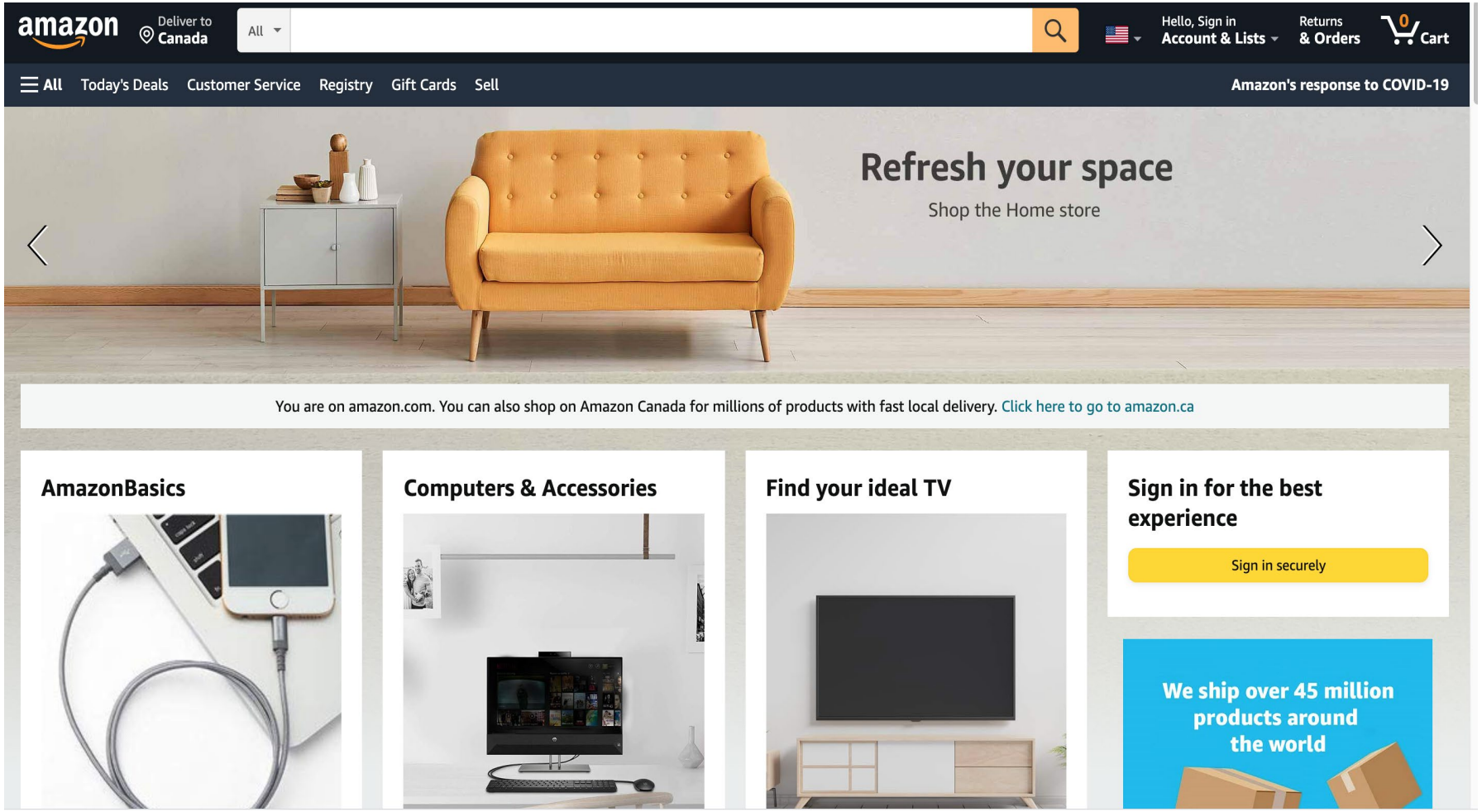
Choose your core Feature Set

- Core feature set – set of possible **actions** that people can do in your application
- Define the **activities** that go on the application
- Features are usually actions – verbs
- See this phase as *"finding your verbs"*
- Could be *personal* and *social*
- Collections of objects people make can be used to create features

Nouns (objects)	Verbs (Actions)
Videos	Play, stop, edit, store, upload, share, comment on, embed in blog
Articles	Upload, read, archive for later, quote, link to, share, comment on, annotate
Photos	Upload, store, view, add to favourites, link to, share, comment on, tag, share
Books	Read, add to cart, purchase, add to wish list, share, add to registry, comment on, rate, discuss, review

Porter, Joshua. Designing for the Social Web (p. 27). Pearson Education

Amazon’s social features



- Activity, objects and features are now in place
- How do you motivate people to actually use the site you will create?

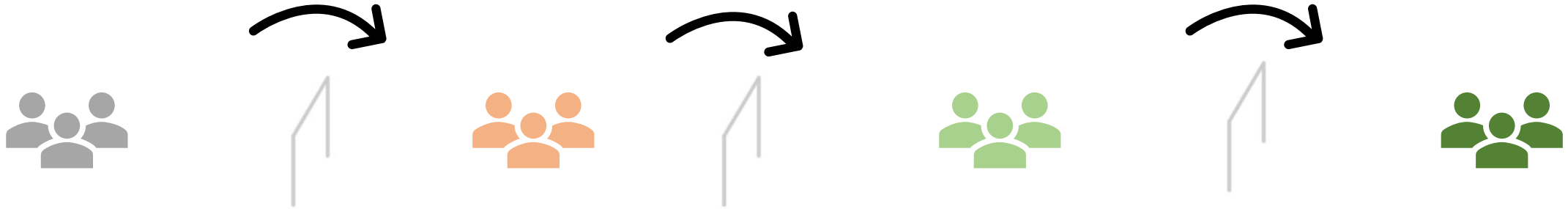
Usage Lifecycle

3 main problems
of social software

Sign-up

Return visits

Emotional attachment/
Ongoing engagement



Interested

First-time use

Regular use

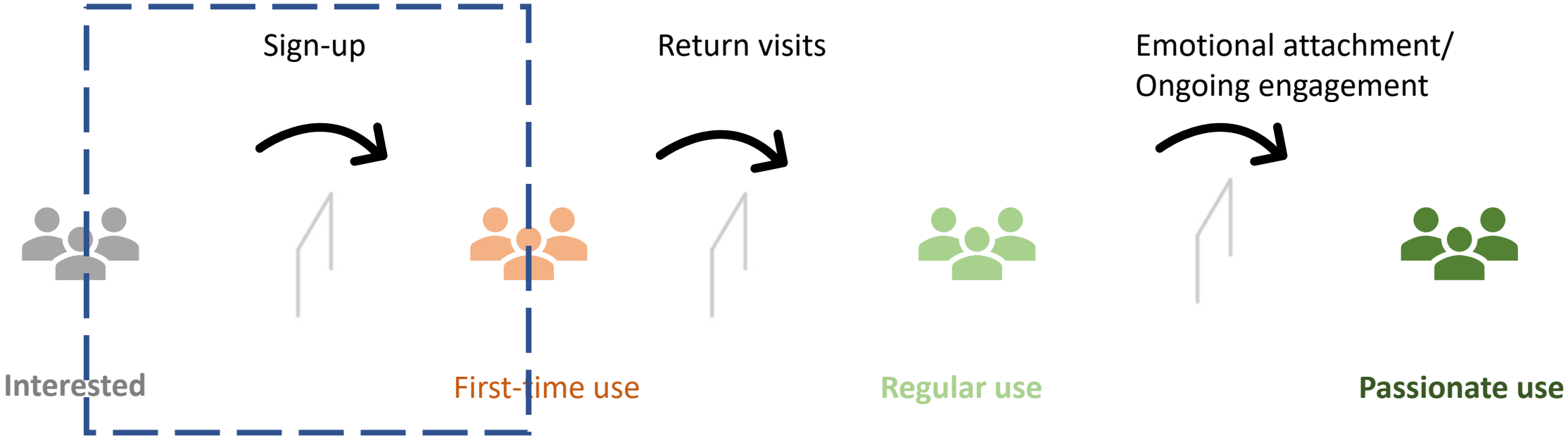
Passionate use

Role of designers at each stage

Stage	Design Goal	Role of Designer
Interested Use	Sign-up	Selling
First-time Use	Positive first experience	Teaching
Regular Use and Passionate Use	Engagement over time	Enable & Support

Usage lifecycle
Sign up hurdle

The sign-up problem

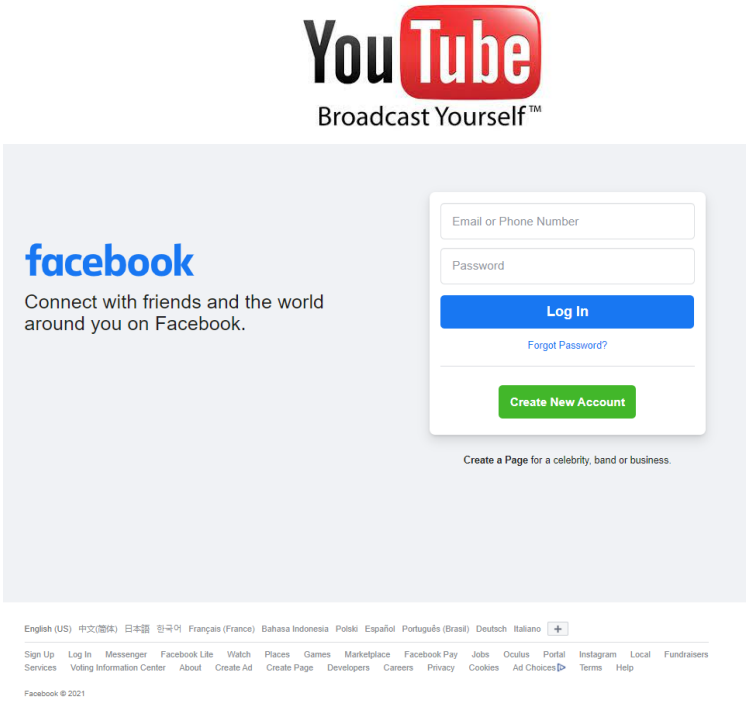


- People seem interested but are not motivated enough to give it a try
  - How is the software valuable to me?
  - I already have software to help me with this
  - I don’t have time to try anything new
  - My team is already using software that does that
  - What does this software do exactly?

Design for sign-up
Sign-up framework

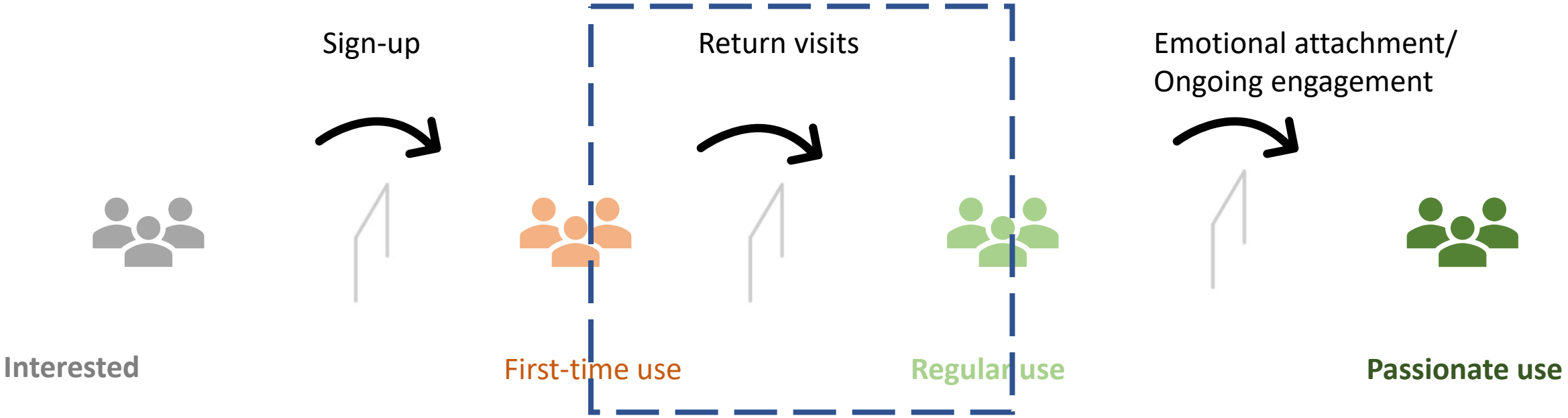
- Create a sign-up framework. It could contain:
  - An elevator pitch or tagline that explains the service you are providing
  - Graphics or illustrations that show how your software works
  - Carefully crafted copywriting that describes your software
  - In-depth feature tour or feature pages
  - Video or screenshot showing actual use
  - Get people started using the software as early as possible
  - Don’t make account creation a requirement until necessary
  - Evidence of other people using the software successfully
- A good sign-up framework should:
  - Clearly communicate the capabilities of the software
  - Allow a person to decide if the software is right for them
  - Answer any outstanding questions people have about the software
  - Confirm or refute any preconceptions people have about the application
- Role of designers at this stage is selling

- Let’s look at https://ca.nextdoor.com/



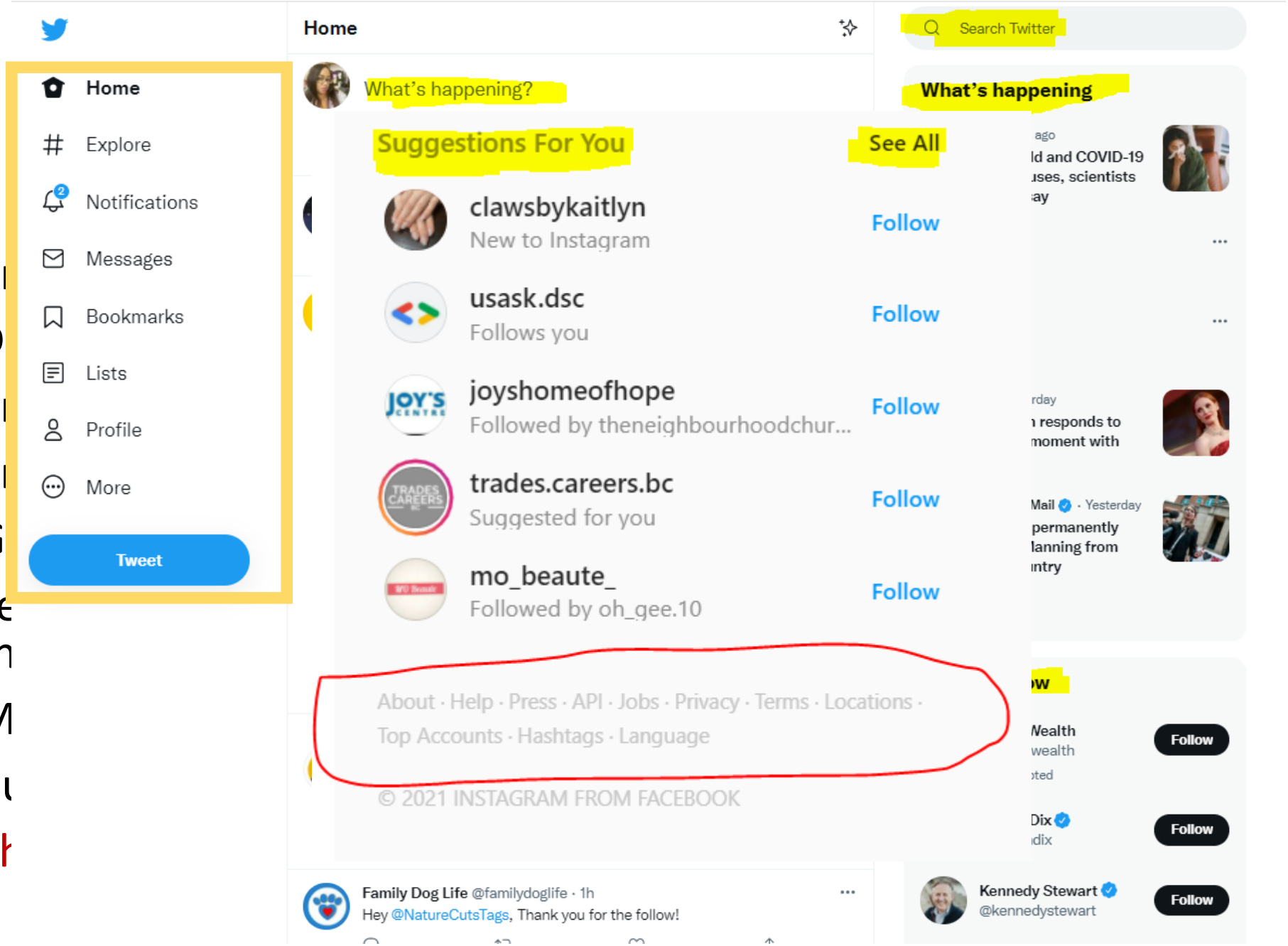
Usage lifecycle
Return visits hurdle

Return visits problem



- People are giving your software a try, but they don't know what to do or how to get going.
  - I'm not sure what to do now
  - I set up my profile, now what?
  - I don't want to learn something new. I need to start immediately
  - Where are my friends?

- P
- D
- P
- P
- G
- Le th
- M
- Bu
- Th

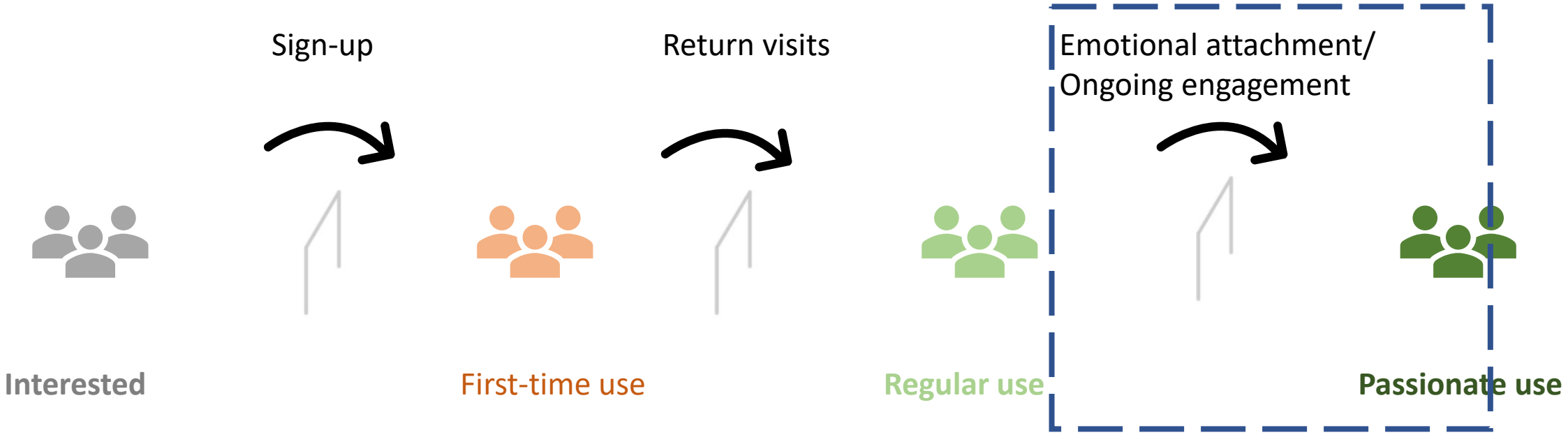


Usage lifecycle
Return visits hurdle

engage

Usage lifecycle
Ongoing engagement

Ongoing engagement problem



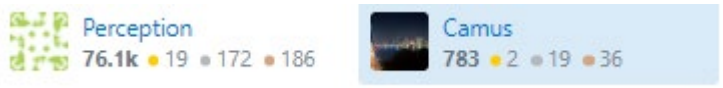
- This product doesn’t do what it says it does
- I kind of forgot about it
- I really don’t see anything compelling me to come back
- None of my friends are here
- I like my current one better

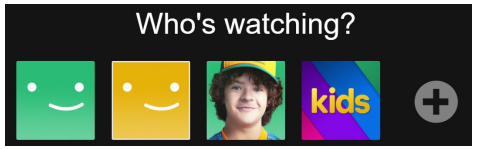
Design for ongoing engagement

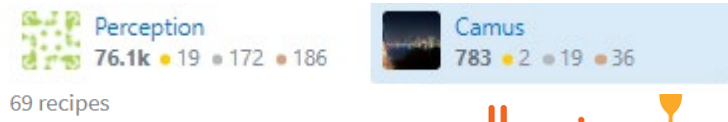
- Motivation is key at this stage; design for motivation
- Identify the right motivations to use
- Create interfaces that support and encourage those motivations
- People are motivated for different reasons.
  - Writing Amazon reviews could be because of the feeling of reciprocity – one recognizes the values they get from reviews so they want to give back.
  - It could also be because of a sense of efficacy – I feel the urge to tell others about my experience so I can help others make a tough decision
- Key is to identify what motivates your users and design your application to support them

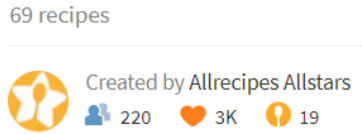
List of common motivations

Motivation	People use social media…..	Possible design solution
Identity	To manage their identity within their social groups	Enable identity management (profile pages, bio, demographics, accomplishments – dependent on platform
Uniqueness	Because they feel their contribution is unique and valuable	Customize the experience to the user. Ex. Netflix. Recommendations are dependent on user
Reciprocity	Because they want to give back, expect others to do same	Common on sites where you have to rate/review items. People can review/rate others and can be rated too
Reputation	Because they want to build reputation, improve relationship with others	Number of friends, number of followers, number of reviews written, ratings of reviews written, number/quality of comments, number of firsts, member since, elite status
Sense of efficacy	To do good work and have a positive effect	Focus on elements that provide feedback to people about how valuable their contribution was (upvoting a review on Amazon, upvoting comments, posts)
Control	To control how their information is shared and displayed	Tools that users can use to control their activities on th site (privacy settings, block users, turn off comments)
Attached to a group	To find like-minded people who share the same values, activities	Ability to create specific groups, join groups, leave groups, moderate groups (ex FB groups, subreddit on Reddit, any other examples?)
Fun	Because it is fun to participate	Fun features such as filters, emojis (Snapchat, Instagram)

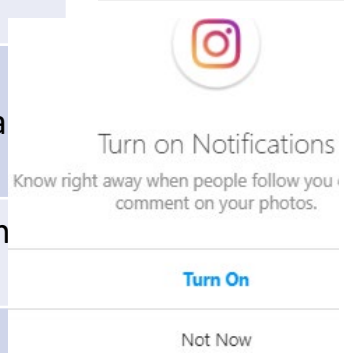


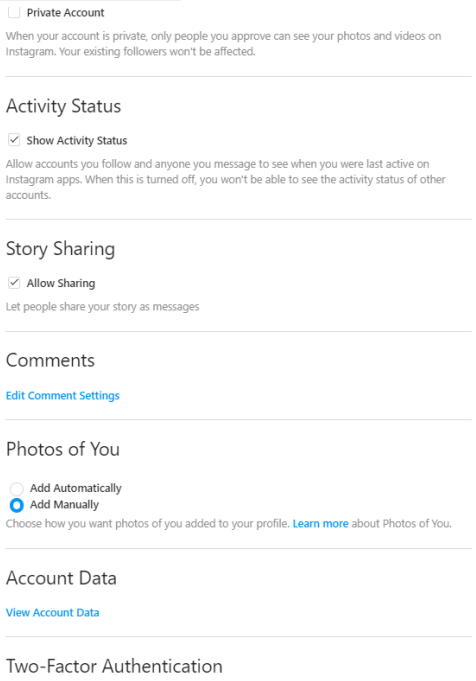






allrecipes



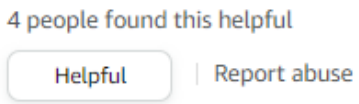


Design for collective intelligence

- Collective intelligence is the intelligence of a group instead of an individual; to aggregate the individual actions of many people in order to present the best/most relevant content
- Works in complex adaptive systems (a system composed of interconnected parts which as a whole is continuously changing)
- Examples include:
  - Amazon. Aggregates the collective opinion of people reading and writing reviews to determine which reviews are helpful
  - Netflix. Aggregates the collective ratings of millions of people to provide better recommendations
  - Wikipedia. Aggregates collective knowledge of editors to provide a single, authoritative encyclopedia

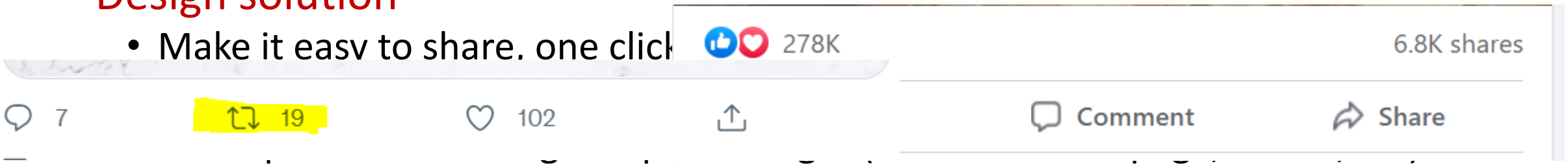
How complex adaptive systems work

- Record the actions of people using the system and look for patterns
- Three main steps:
  - Initial action.
    - Content is submitted into the system (E.g., on Amazon, someone writes a product review, on Stack Overflow, someone posts an answer/question)
  - Aggregate and Display.
    - Content is aggregated and displayed for others to see and act on
    - Display is based on the goals of the site & algorithm (e.g. most recent)
    - Aggregation can be based on chronological order, popularity, ranking, relevance
  - Feedback.
    - People using the system can give feedback on the content to assess its quality, e.g., "helpful" on Amazon
    - Feedback can be positive or negative
    - Feedback can be implicit (e.g. watching a recommended movie on Netflix) or explicit (vote review as "helpful" on Amazon
    - The system re-aggregates and re-displays content (feedback loop)



- Design solution
  - Make feedback easy
  - Leverage points or incentives to make people give feedback

- Building feature peal to the "sharers"
  - Sharers adverti
- We share to enj ion for others, improve our soc
- Sharing can be:
  - Implicit. When pation (Twitter notifies my foll s new job posts with followers
  - Explicit. Sharing
- Design solution
  - Make it easy to share. one click



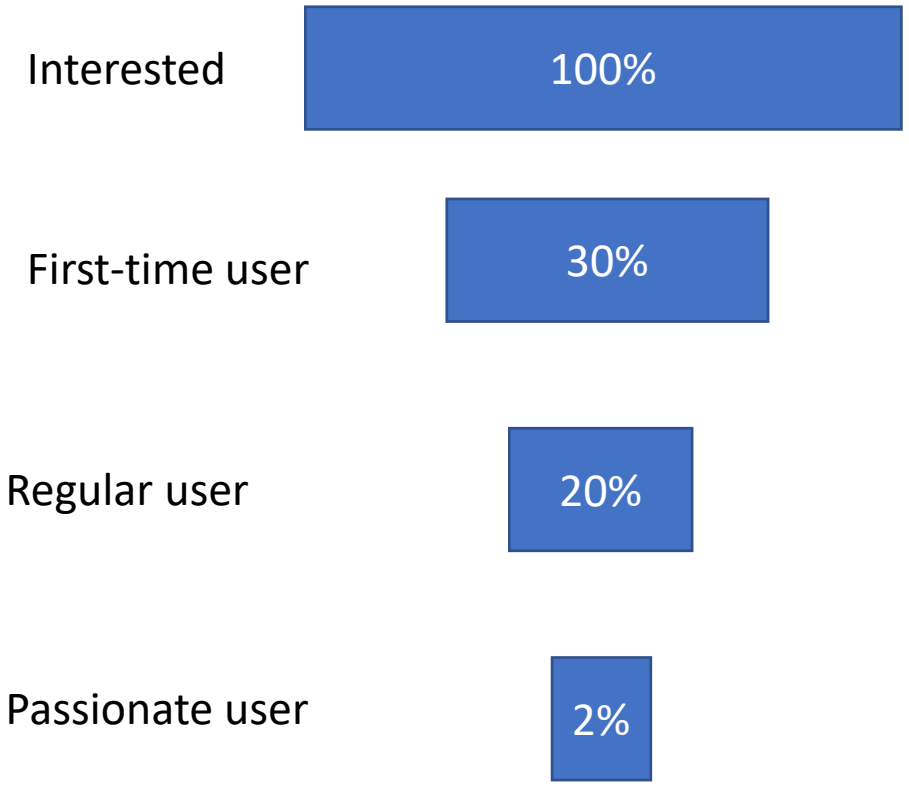
- Activity, objects and features are now in place
- Motivation strategies are now in place to move people along the usage lifecycle from interested user to passionate user
- How do you know if it’s working?

The funnel analysis

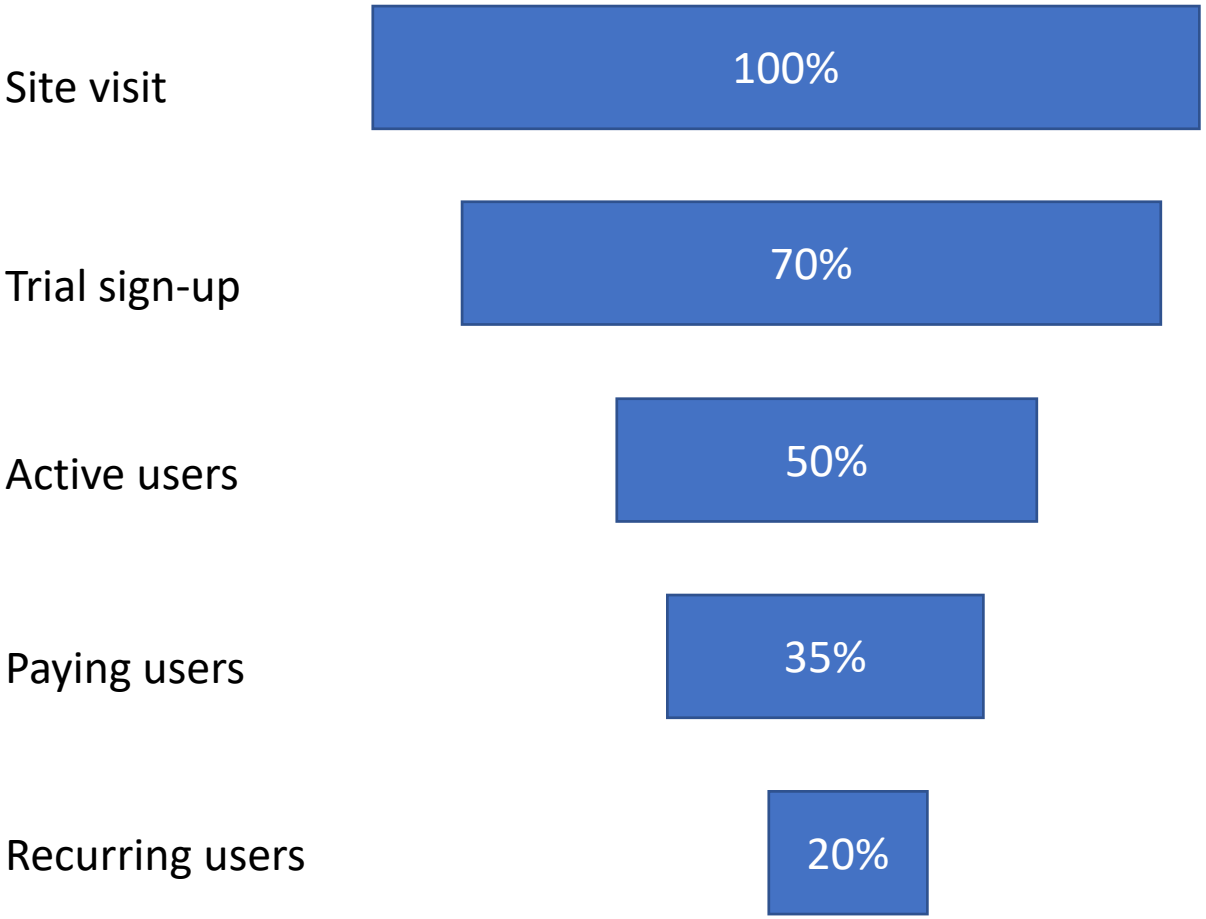
- A simple analysis tool to assess the health of your website
- Can show how good your site is at moving people along the usage lifecycle from interested users to passionate users
- Of the people who are interested in your application, only some will use it for the first time
- Of those that use it once, only some will continue on and use your site regularly
- Of the regular users only some will become passionate users.
- The passionate users often make up only 2% of the original, interested group
- Acknowledge that you will have leaks at every level

The funnel analysis

Conversion funnel for the major milestones in the progression of use



Customized for a website that allows for a trial period with upgrading to paid membership



Metrics for analysis

Metric	What this means	How to measure
Visit	Visiting the site for the first time	Analytics program (e.g. Google analytics)
Trial sign-up	Confirming a trial registration	Analytics program (e.g. Google analytics)
Active users	Logging in a certain number of times (e.g. five a month)	In-house analytics
Paying users	Completing a payment transaction	In-house analytics
Recurring users	Creating several payment transactions	In-house analytics

- It is common to run in-house analytics for lower levels of the funnel
- For in-house analytics, run periodic reports on your database by creating queries that show the information you're looking for

Discovering what needs to change

- Create a baseline. Funnel data for the current design before making any changes
- Choose a level of the funnel to improve. Address the glaring leaky levels, starting at the top of the funnel. Look for numbers that seem rather low/high
- Investigate level for leaks. Analyse the interface, watch people use the app., talk to people in the community or the manager
- Make design changes. Keep changes small to be able to tell if there is any effect
- Measure change and compare to baseline
- Rinse and repeat. To improve your site even more, refine the funnel to show smaller steps

The big picture

- Idea for a social application
- What are the Actions, Objects and Features
- What design strategies will you adopt to move people through the usage lifecycle
  - Design for sign up
  - Design for return visits
  - Design for ongoing participation
  - Design for collective intelligence
  - Design for sharing
- Measure success using Funnel analysis

Summary

- Social design and list the challenges of social design for social software
- Framework for social design and why it is important to have one
- AOF framework for social design
- Usage lifecycle
- Design strategies for sign-up, return visits, ongoing engagement, collective intelligence and sharing
- Funnel analysis

Acknowledgement

- Designing for the Social Web, Joshua Porter (New Riders, 2008) and the tutorial slides “Designing for Social Traction” (http://bokardo.com/talks/designing-for-social-traction.pdf)
- Some of Prof. Julita Vassileva’s lecture notes (with permission)

Fairness and Accountability

Ifeoma Adaji

Learning objectives

- At the end of the class, students should be able to:
  - Explain fairness and accountability in AI
  - Explain AI bias with examples
  - List common ways bias is introduced in AI
  - Describe steps governments are taking towards accountability in AI

Artificial Intelligence

- Systems with the intellectual characteristic of humans, such as the ability to reason, discover meaning, generalize, or learn from past experience.
- A computer system that is able to perform tasks that normally require human intelligence, such as visual perception, speech recognition, decision making, and translation between languages.
- AI is used for email spam filtering, image recognition, recommender systems, understanding human speech (Siri, Alexa), self driving cars, filters in social media, targeted ads in social media, determine whose posts you see in social media, etc.

Problems with AI - Bias

- No technology is free of its creators
- AI systems are not truly separate and autonomous, they start with us
- Technology always comes from and is designed by people; it is no more objective than we are
- AI bias is the underlying prejudice in data that is used to create AI algorithms, which can ultimately result in discrimination and other social consequences
- AI bias is lack of fairness
- AI is bias; bias can be based on
  - Who builds the technology
  - Which assumptions are programmed into them
  - How they're trained - data
  - How they're ultimately deployed
- The data you create for your system to learn from will be biased by how you see the world
  - If an algorithm is trained using data that doesn't represent a particular demographic group, the algorithm will likely be inaccurate when applied to people that are part of that group.

3 common ways bias is introduced

- Algorithmic bias. Algorithms are limited by the assumptions or views of its developers
- Sample bias. Algorithms are trained using incomplete data or data that does not represent a complete picture
- Measurement bias. Algorithms based on faulty sensors or faulty measurement devices, or when measuring devices are nor read/recorded properly

Examples of algorithmic bias

- Algorithm used to predict which patients would need extra medical care was in favour of one race over another.
  - https://www.scientificamerican.com/article/racial-bias-found-in-a-major-health-care-risk-algorithm/
- Facebook's algorithm that made people turn against each other (2020)
  - https://www.independent.co.uk/life-style/gadgets-and-tech/news/facebook-algorithm-bias-right-wing-feed-a9536396.html
- Facebook's news feed algorithmic bias (2016)
  - https://www.nytimes.com/2016/05/19/opinion/the-real-bias-built-in-at-facebook.html
  - https://gizmodo.com/former-facebook-workers-we-routinely-suppressed-conser-1775461006
  - https://tinyurl.com/2d5zvyc3 (how they've changed)
- Amazon's hiring algorithm
  - https://www.theguardian.com/technology/2018/oct/10/amazon-hiring-ai-gender-bias-recruiting-engine

Impact of AI bias

- Real world consequences
  - Discrimination (eg. Age discrimination)
  - Gender bias,
  - Racial prejudice.
  - Living in a bubble (news feed)

Improving algorithmic fairness

- Algorithms can have real world consequences so they should be fair
- AI should be designed to minimize bias and promote inclusive representation
- Be aware of how your choices affect the rest of humanity
- Be aware of what data to use for AI
  - If you train your model with only specific type of data, what happens when data that is out of scope is introduced
  - all subjects should have an equal chance of being represented in the data; obtain data from traditionally underrepresented groups.
- Models should be retrained periodically with new data to start to remove historical biases, even though this will be more expensive
- People should be made aware when algorithms are being used in ways that impact their lives to ensure fairness
  - Knowing which of our data is being used as input to a model and access to any output generated

Improving algorithmic fairness

- Quick intervention when bias is identified.
- Thorough investigation to identify source of bias and how it can be mitigated
- Frequent reviews of algorithms/systems
- Collect data on user identified bias (from users)
- Diversity of teams
- Standardizing processes including
  - unconscious bias training
  - rigorous peer review of algorithms before deployment to check for bias
  - independent post-implementation auditing of the fairness of algorithms to understand its impact on the most vulnerable people affected by it

Accountability

- Who should be held accountable for AI bias?
- Accountability is important because it is the foundation of trust. It is the acknowledgement and assumption of responsibility and “answerability” for actions, decisions, products and policies
- AI designers and developers are responsible for considering AI design, development, decision processes, and outcomes.
- US Government’s Accountability office recently developed first framework to help assure accountability and responsible use of AI
- “Goal is to help organizations and leaders move from theories and principles to practices that can actually be used to manage and evaluate AI in the real world”
- Framework
  - Defines conditions for accountability throughout AI lifecycle
  - Details specific questions to ask
  - Specifies audit procedures to use when assessing AI systems
  - Cover 4 dimensions: governance, data, performance, and monitoring

Four dimensions of AI accountability

- Assess governance structures
  - Understand the governance structure, have well-defined roles, responsibilities, and lines of authority
  - Document technical specifications of the particular AI system
- Understand the data.
  - Documentation of how data is being used for build the AI model and when it is in operation
  - Reliability and representativeness of data
  - Examine data for potential bias, inequity, or other societal concerns
- Define performance goals and metrics
  - After deployment of AI system, evaluate to ensure it meets its intended goals
- Review monitoring plans
  - Ongoing performance monitoring

Source: https://hbr.org/2021/08/how-to-build-accountability-into-your-ai

In Canada….

A paper was developed at the request of the Government of Canada to support the G7 Multistakeholder Conference on Artificial Intelligence: Enabling the Responsible Adoption of AI on December 6, 2018.

- Many stakeholders could be engaged in creating a robust AI accountability framework
  - Policymakers in National Governments
  - Intergovernmental Organizations
  - Policymakers in Sub-National Governments
  - Corporations and Other Data Owners
  - Universities and Colleges
  - Advocacy Groups and Public Interest Organizations
  - Foundations
  - Professional Regulatory Bodies and Organizations

Source: https://www.ic.gc.ca/eic/site/133.nsf/eng/00005.html

In Canada…

- How govt. of Canada is ensuring responsible use of AI

https://www.canada.ca/en/government/system/digital-government/digital-government-innovations/responsible-use-ai.html#toc1

Conclusion

- Bias exists in AI systems; this can effect people in the real world
- AI use should be fair
- There should be accountability structure in place so people do not lose trust

References

- *Understand, Manage, and Prevent Algorithmic Bias: A Guide for Business Users and Data Scientists*. Tobias Baer. Apress, 2019
- *97 Things About Ethics Everyone in Data Science Should Know,* Bill Franks. O'Reilly, 2020
- https://www.computerweekly.com/feature/Accountability-is-the-key-to-ethical-artificial-intelligence-experts-say
- https://www.canada.ca/en/government/system/digital-government/digital-government-innovations/responsible-use-ai.html#toc1
- https://hbr.org/2021/08/how-to-build-accountability-into-your-ai
- https://www.computerweekly.com/feature/Accountability-is-the-key-to-ethical-artificial-intelligence-experts-say
- https://www.ibm.com/design/ai/ethics/accountability
- https://www.ibm.com/design/ai/ethics/fairness
- https://homes.cs.washington.edu/~msap/pdfs/sap2019risk.pdf
- https://www.vox.com/recode/2020/2/18/21121286/algorithms-bias-discrimination-facial-recognition-transparency
- https://hbr.org/2019/11/when-algorithms-decide-whose-voice-will-be-heard

Fairness, Accountability, Transparency and Ethics

Ifeoma Adaji

Learning objectives

- At the end of the class, students should be able to:
  - Explain fairness and accountability in AI
  - Explain AI bias with examples
  - List common ways bias is introduced in AI
  - Describe steps governments are taking towards accountability in AI
  - Describe transparency in AI and its implications
  - Describe AI ethics and its implications

Artificial Intelligence

- Systems with the intellectual characteristic of humans, such as the ability to reason, discover meaning, generalize, or learn from past experience.
- A computer system that is able to perform tasks that normally require human intelligence, such as visual perception, speech recognition, decision making, and translation between languages.
- AI is used for email spam filtering, image recognition, recommender systems, understanding human speech (Siri, Alexa), self driving cars, filters in social media, targeted ads in social media, determine whose posts you see in social media, etc.

Problems with AI - Bias

- No technology is free of its creators
- AI systems are not truly separate and autonomous, they start with us
- Technology always comes from and is designed by people; it is no more objective than we are
- AI bias is the underlying prejudice in data that is used to create AI algorithms, which can ultimately result in discrimination and other social consequences
- AI bias is lack of fairness
- AI is bias; bias can be based on
  - Who builds the technology
  - Which assumptions are programmed into them
  - How they're trained - data
  - How they're ultimately deployed
- The data you create for your system to learn from will be biased by how you see the world
  - If an algorithm is trained using data that doesn't represent a particular demographic group, the algorithm will likely be inaccurate when applied to people that are part of that group.

3 common ways bias is introduced

- Algorithmic bias. Algorithms are limited by the assumptions or views of its developers
- Sample bias. Algorithms are trained using incomplete data or data that does not represent a complete picture
- Measurement bias. Algorithms based on faulty sensors or faulty measurement devices, or when measuring devices are nor read/recorded properly

Examples of algorithmic bias

- Algorithm used to predict which patients would need extra medical care was in favour of one race over another.
  - https://www.scientificamerican.com/article/racial-bias-found-in-a-major-health-care-risk-algorithm/
- Facebook's algorithm that made people turn against each other (2020)
  - https://www.independent.co.uk/life-style/gadgets-and-tech/news/facebook-algorithm-bias-right-wing-feed-a9536396.html
- Facebook's news feed algorithmic bias (2016)
  - https://www.nytimes.com/2016/05/19/opinion/the-real-bias-built-in-at-facebook.html
  - https://gizmodo.com/former-facebook-workers-we-routinely-suppressed-conser-1775461006
  - https://tinyurl.com/2d5zvyc3 (how they've changed)
- Amazon's hiring algorithm
  - https://www.theguardian.com/technology/2018/oct/10/amazon-hiring-ai-gender-bias-recruiting-engine

Impact of AI bias

- Real world consequences
  - Discrimination (eg. Age discrimination)
  - Gender bias,
  - Racial prejudice.
  - Living in a bubble (news feed)

Improving algorithmic fairness

- Algorithms can have real world consequences so they should be fair
- AI should be designed to minimize bias
  - Eg. randomized block design, blinding, random sampling, bias –variance tradeoff.
- AI should be designed to promote inclusive representation
- Be aware of how your choices affect the rest of humanity
- Be aware of what data to use for AI
  - If you train your model with only specific type of data, what happens when data that is out of scope is introduced
  - all subjects should have an equal chance of being represented in the data; obtain data from traditionally underrepresented groups.
- Models should be retrained periodically with new data to start to remove historical biases, even though this will be more expensive
- People should be made aware when algorithms are being used in ways that impact their lives to ensure fairness
  - Knowing which of our data is being used as input to a model and access to any output generated

Improving algorithmic fairness

- Quick intervention when bias is identified
- Thorough investigation to identify source of bias and how it can be mitigated
- Frequent reviews of algorithms/systems
- Collect data on user identified bias (from users)
- Diversity of teams
- Standardizing processes including
  - unconscious bias training
  - rigorous peer review of algorithms before deployment to check for bias
  - independent post-implementation auditing of the fairness of algorithms to understand its impact on the most vulnerable people affected by it

Accountability

- Who should be held accountable for AI bias?
- Accountability is important
  - foundation of trust
  - acknowledgement and assumption of responsibility and “answerability” for actions, decisions, products and policies
- AI designers and developers are responsible for considering AI design, development, decision processes, and outcomes.
- US Government’s Accountability office recently developed first framework to help assure accountability and responsible use of AI
- “Goal is to help organizations and leaders move from theories and principles to practices that can actually be used to manage and evaluate AI in the real world”
- Framework
  - Defines conditions for accountability throughout AI lifecycle
  - Details specific questions to ask
  - Specifies audit procedures to use when assessing AI systems
  - Cover 4 dimensions: governance, data, performance, and monitoring

Four dimensions of AI accountability

- Assess governance structures
  - Understand the governance structure, have well-defined roles, responsibilities, and lines of authority
  - Document technical specifications of the particular AI system
- Understand the data.
  - Documentation of how data is being used for build the AI model and when it is in operation
  - Reliability and representativeness of data
  - Examine data for potential bias, inequity, or other societal concerns
- Define performance goals and metrics
  - After deployment of AI system, evaluate to ensure it meets its intended goals
- Review monitoring plans
  - Ongoing performance monitoring

Source: https://hbr.org/2021/08/how-to-build-accountability-into-your-ai

In Canada….

A paper was developed at the request of the Government of Canada to support the G7 Multi-stakeholder Conference on Artificial Intelligence: Enabling the Responsible Adoption of AI on December 6, 2018.

- Many stakeholders could be engaged in creating a robust AI accountability framework
  - Policymakers in National Governments
  - Intergovernmental Organizations
  - Policymakers in Sub-National Governments
  - Corporations and Other Data Owners
  - Universities and Colleges
  - Advocacy Groups and Public Interest Organizations
  - Foundations
  - Professional Regulatory Bodies and Organizations

Source: https://www.ic.gc.ca/eic/site/133.nsf/eng/00005.html

In Canada…

- How govt. of Canada is ensuring responsible use of AI

https://www.canada.ca/en/government/system/digital-government/digital-government-innovations/responsible-use-ai.html#toc1

Transparency of AI

- The issues of Fairness and Accountability have led to a call for *transparency* and *responsibility* in AI: AI that is explainable to employees and customers and aligns with a company's values
  - AI now has a huge impact on lives; it is used for critical decisions (bank loans, employment)
- Transparency means being able to assess the inner workings of a system
- Involves explaining how an AI-based decision was made, what the decision was based on
- Explanation should be sufficiently understandable to those affected by the model
- Allows humans see if models have been thoroughly tested, if models make sense, and why particular decisions are made

Questions on transparency

- What of Intellectual property issues? Competitors?
- Can people make sense of AI models?
- Will seeing the code help especially without the data that was used?
- Will companies be willing to share data (privacy issues)?

How do you create transparent AI?

- Technical correctness should be checked
- Developer of the model should explain how they addressed the problem, what technology was used and why, and what data sets where used.
- Others should be able to replicate the process or audit it
- Check that no groups are under-represented in the outcomes; make changes if necessary (can detect hidden bias)
- Use open source AI with care; if you understand how the model works
- Companies need to understand the technologies they use for decision making
- Follow the latest research

General Data Protection Regulation - GDPR

- Privacy & security law of the EU
- Imposes obligations on companies anywhere as so long as they target or collect data of people in the EU
- **Lawfulness, fairness and transparency** — Processing must be lawful, fair, and transparent to the data subject.
- **Accountability** — The data controller is responsible for being able to demonstrate GDPR compliance with all of these principles.

Challenges of openness

- What of Intellectual property issues? Competitors?
- Can people make sense of AI models?
- Will seeing the code help especially without the data that was used?
- Will companies be willing to share data (privacy issues)?
- Others?

AI Ethics

- What is good or bad? What is right or wrong?
- How developers, manufacturers, authorities and operators should behave to minimize ethical risks that results from using AI in society
  - Design, inappropriate application, intentional misuse of the technology
- Impact on decision making, equality and wellbeing
- Impact several societal sectors: employment, labour, social interaction, healthcare etc.
- Change human experience, raise concerns over the reliability of information sources, human dignity
- Who decides what is right/wrong, good/bad?

AI ethics

- Is it ethical to secretly collect personal data about someone without their knowledge and then sell that data to multiple third parties for use in targeted marketing?
- Is it ethical to ask a person to consent to tracking for the sole purpose of analyzing and improving their experience on a website, and then to honor their consent (or lack thereof)
- Is it ethical to give a person the option to opt out of being tracked and then, if they do not opt out, to track their behavior and use that data to market to them with targeted banner ads on other sites as they browse the internet?
- Is it ethical to give someone access to a website only if they consent to being tracked?

Source: 97 Things About Ethics Everyone in Data Science Should Know, Bill Franks. O'Reilly, 2020

Ethical framework for AI

- Non-maleficence. AI should be good, should not cause harm
- Responsibility or accountability. Who should be held responsible when AI causes harm
- Transparency and explainability. Understanding what and why AI does what it does
- Justice and fairness. AI should not discriminate, should be fair
- Respect for various human rights (privacy, security). AI should respect human rights

Conclusion

- Bias exists in AI systems; this can effect people in the real world
- AI use should be fair
- There should be accountability structure in place so people do not lose trust
- Transparency can lead to trust
- AI should be ethical

References

- *Understand, Manage, and Prevent Algorithmic Bias: A Guide for Business Users and Data Scientists*. Tobias Baer. Apress, 2019
- *97 Things About Ethics Everyone in Data Science Should Know,* Bill Franks. O'Reilly, 2020
- https://www.computerweekly.com/feature/Accountability-is-the-key-to-ethical-artificial-intelligence-experts-say
- https://www.canada.ca/en/government/system/digital-government/digital-government-innovations/responsible-use-ai.html#toc1
- https://hbr.org/2021/08/how-to-build-accountability-into-your-ai
- https://www.computerweekly.com/feature/Accountability-is-the-key-to-ethical-artificial-intelligence-experts-say
- https://www.ibm.com/design/ai/ethics/accountability
- https://www.ibm.com/design/ai/ethics/fairness
- https://homes.cs.washington.edu/~msap/pdfs/sap2019risk.pdf
- https://www.vox.com/recode/2020/2/18/21121286/algorithms-bias-discrimination-facial-recognition-transparency
- https://hbr.org/2019/11/when-algorithms-decide-whose-voice-will-be-heard

Communities

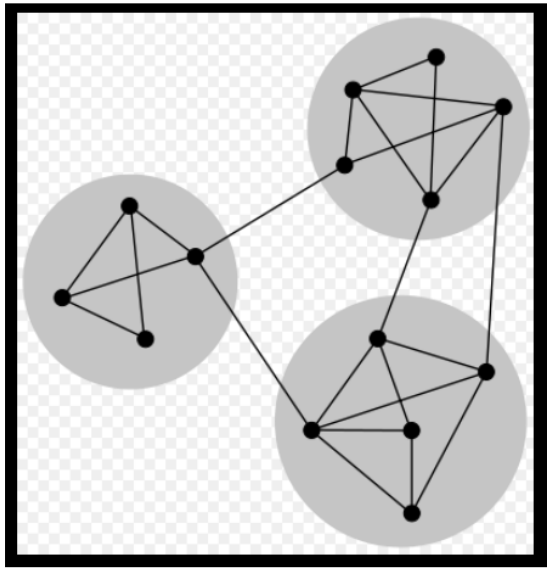
Ifeoma Adaji

Learning outcomes

- Describe communities in networks with examples
- Explain what makes a community
- Describe how communities are formed

Communities

- A community is a group of nodes that have a higher likelihood of connecting to each other than to other nodes from other communities
- A community is the gathering of nodes into groups such that there is a higher density of edges within groups than between them
- A community is a group of nodes in a network that are more densely connected internally than with the rest of the network
- Network divides naturally into groups of nodes with dense connections internally and sparser connections between groups
- Overlapping is allowed
- Examples in social networks:
  - Employees of a company
  - Circle of friends
  - Groups of individuals who pursue same hobbies
  - Students in same school
  - People living in same neighbourhood
- Communities are important
  - Play a role in how diseases spread, how misinformation spreads, etc.

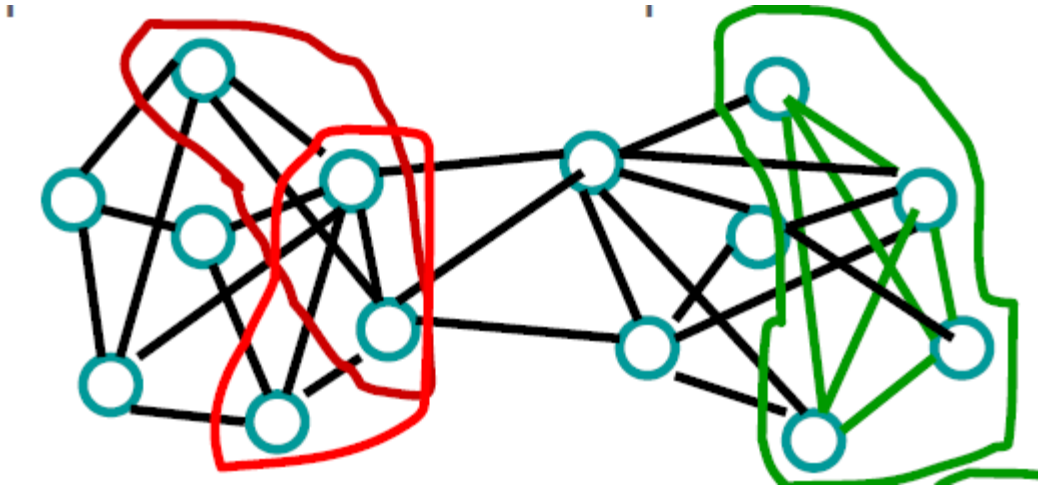


What makes a community

- Mutuality of ties
  - everybody in the group knows everybody else (cliques)
- Frequency of ties among members
  - everybody in the group has links to at least k others in the group (k-cores)
- Closeness or reachability of subgroup members
  - individuals are separated by at most n hops (n-cliques)

Cliques

- Cliques are formed when every member of the group has links to every other member
- Cliques can overlap

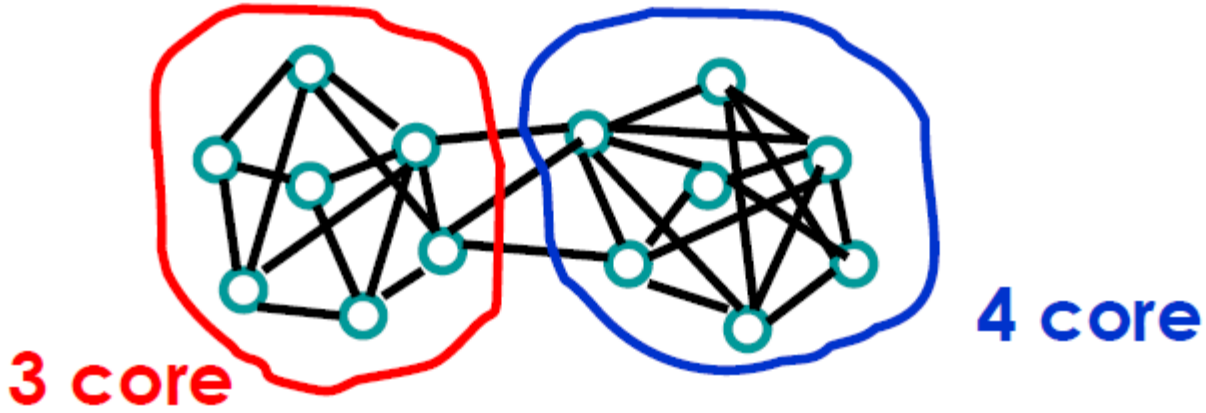


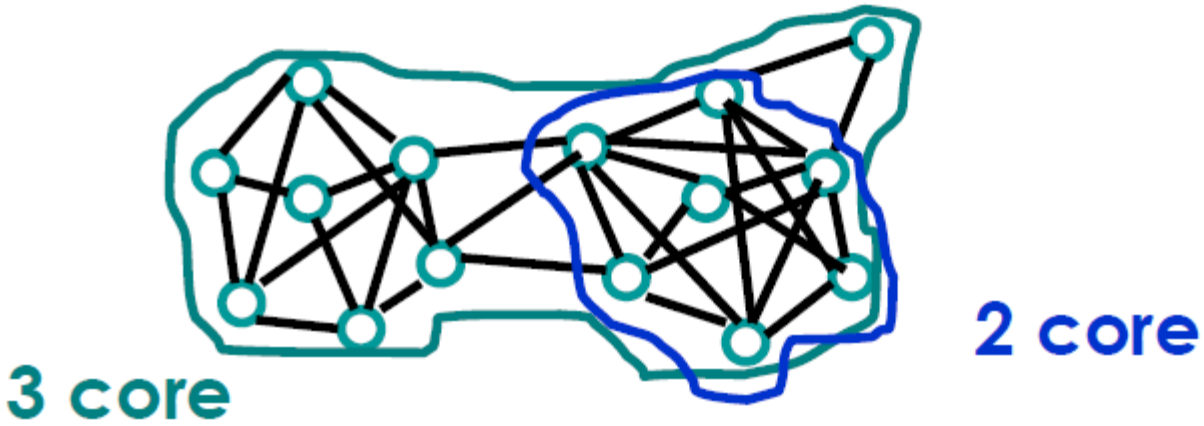
overlapping cliques of size 3

clique of size 4

k-cores

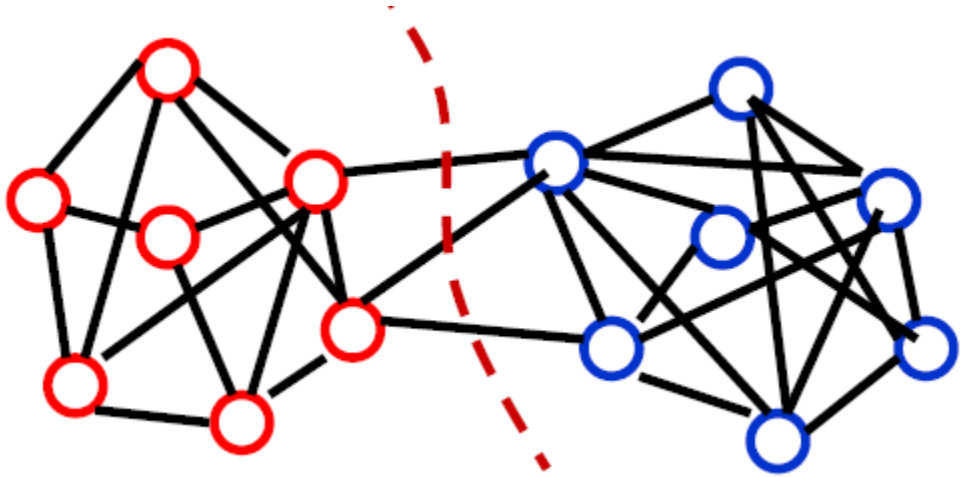
- Similar to cliques but is less stringent
- Each node within a group is connected to at least k other nodes in the group





Community finding

- Social and other networks have a natural community structure
- We want to discover this structure rather than impose a certain size of community or fix the number of communities

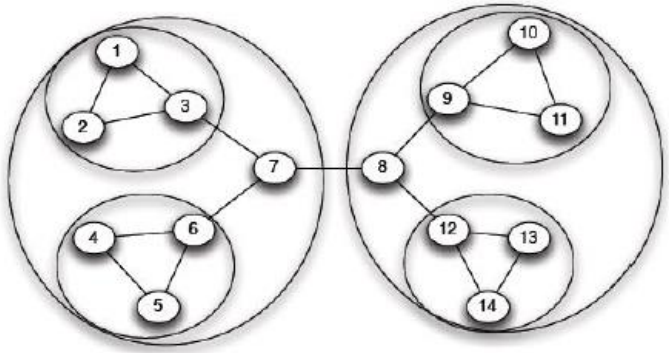


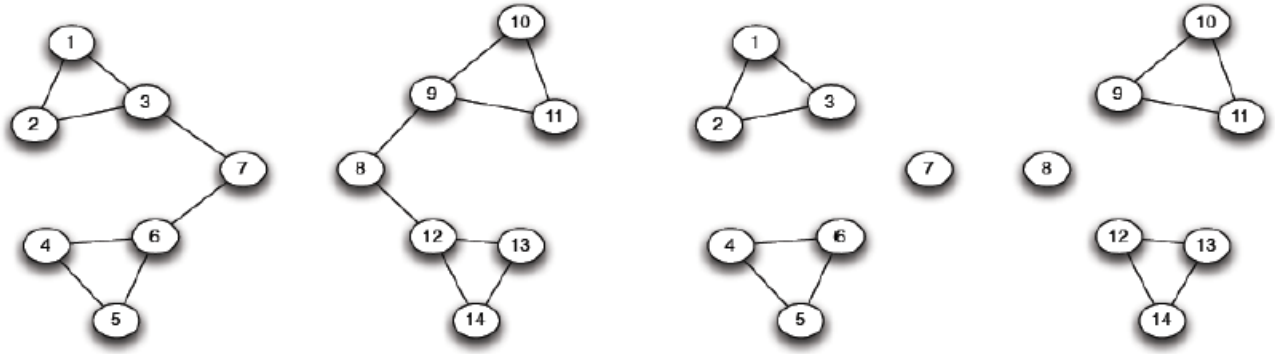
Betweenness clustering

- Algorithm
  - compute the betweenness of all edges
  - while (betweenness of any edge > threshold):
    - remove edge with highest betweenness
    - recalculate betweenness
- Betweenness needs to be recalculated at each step
  - removal of an edge can impact the betweenness of another edge
  - very expensive, slow
  - does not scale to more than a few hundred nodes, even with the fastest algorithms

Betweenness clustering

- Successively remove edges of highest betweenness (the bridges, or local bridges), breaking up the network into separate components





(a) *Step 1* (b) *Step 2*

Betweenness clustering

- Girvan and Newman
  - Uses edge betweenness as a metric to identify the boundaries of communities.
  - The algorithm makes heavy demands on computational resources
  - Slow

Other algorithms

- Clauset-Newman-Moore (CNM)
  - Uses modularity
  - faster than the algorithm of Girvan and Newman
- Wakita-Tsurumi
  - Uses consolidation control

Summary

- Communities are group of nodes that have a higher likelihood of connecting to each other than to other nodes from other communities
- Examples of communities in a network include employees of a company, circle of friends, groups of individuals who pursue same hobbies, students in same school, people living in same neighbourhood
- Communities can be formed through mutuality of ties, frequency of ties among members, closeness or reachability of subgroup members
- Several *community finding* algorithms exist including betweenness clustering.

References

- *Network science* by Barabási, Albert-László. Cambridge University Press, 2016.
- *Linked. How everything is connected to everything else and what it means for business, science and everyday life* by Barabási, Albert-László, 2002.
- Lectures notes in Social Computing. Julita Vassileva.

Social Network Analysis

Ifeoma Adaji

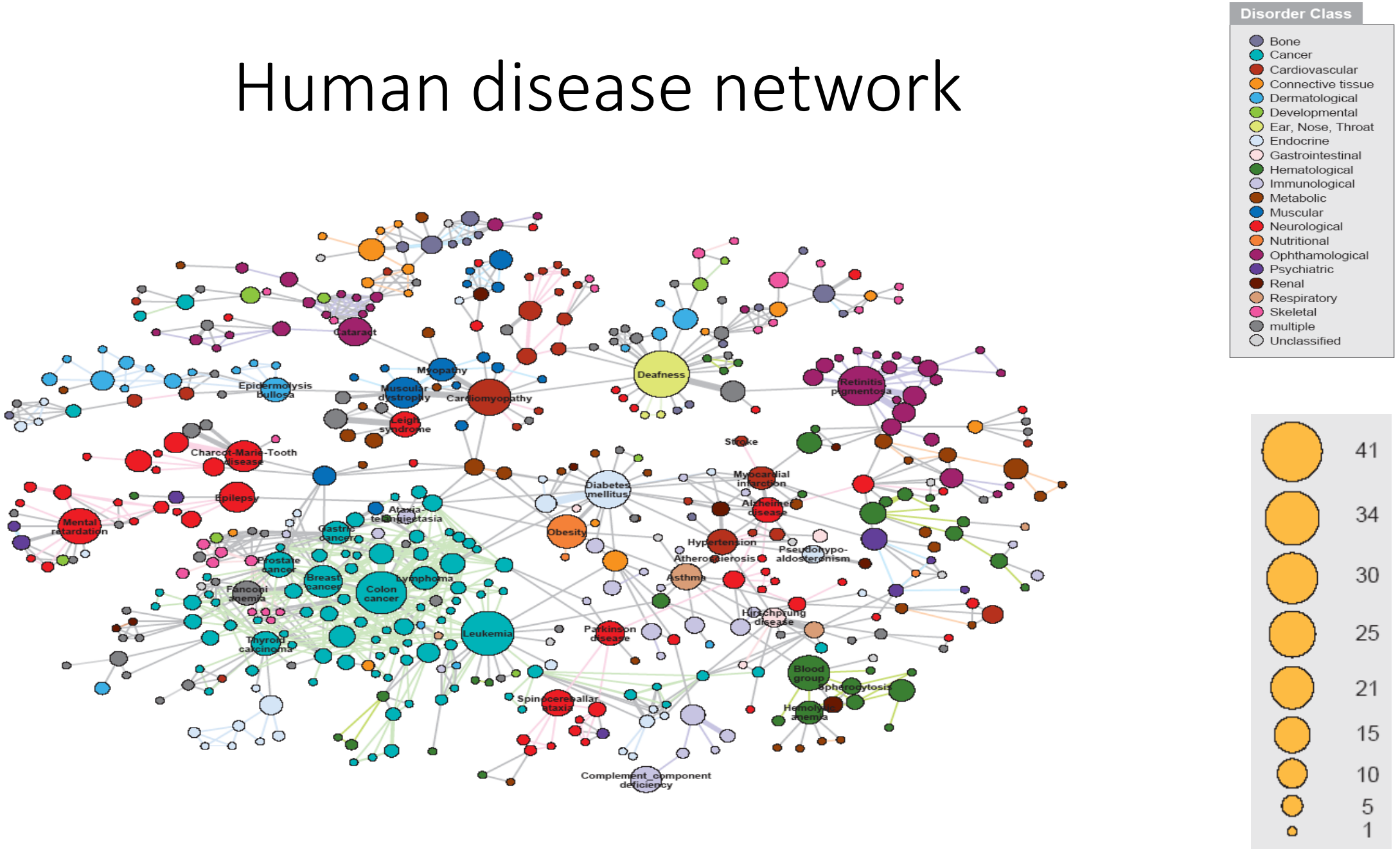
Learning objectives

- What is social network analysis
  - Why is it important
- Network elements
  - Nodes, edges
- Network metrics
  - Centrality (degree, closeness, betweenness)
- Application of social network analysis
  - Movie galaxy
- Tools for social network analysis
  - NodeXL
  - Gephi

Social Network Analysis

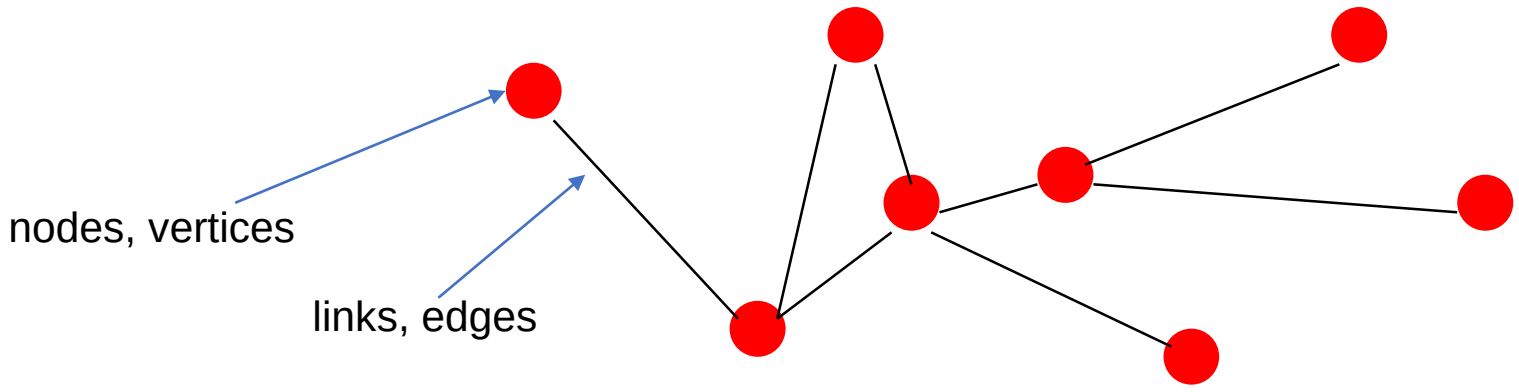
- Analysis of the structure of relationships between social entities
- Process of investigating social structures in networks
- SNA uses mathematical concepts & graph theory
- Consists of nodes and edges

Human disease network



Networks

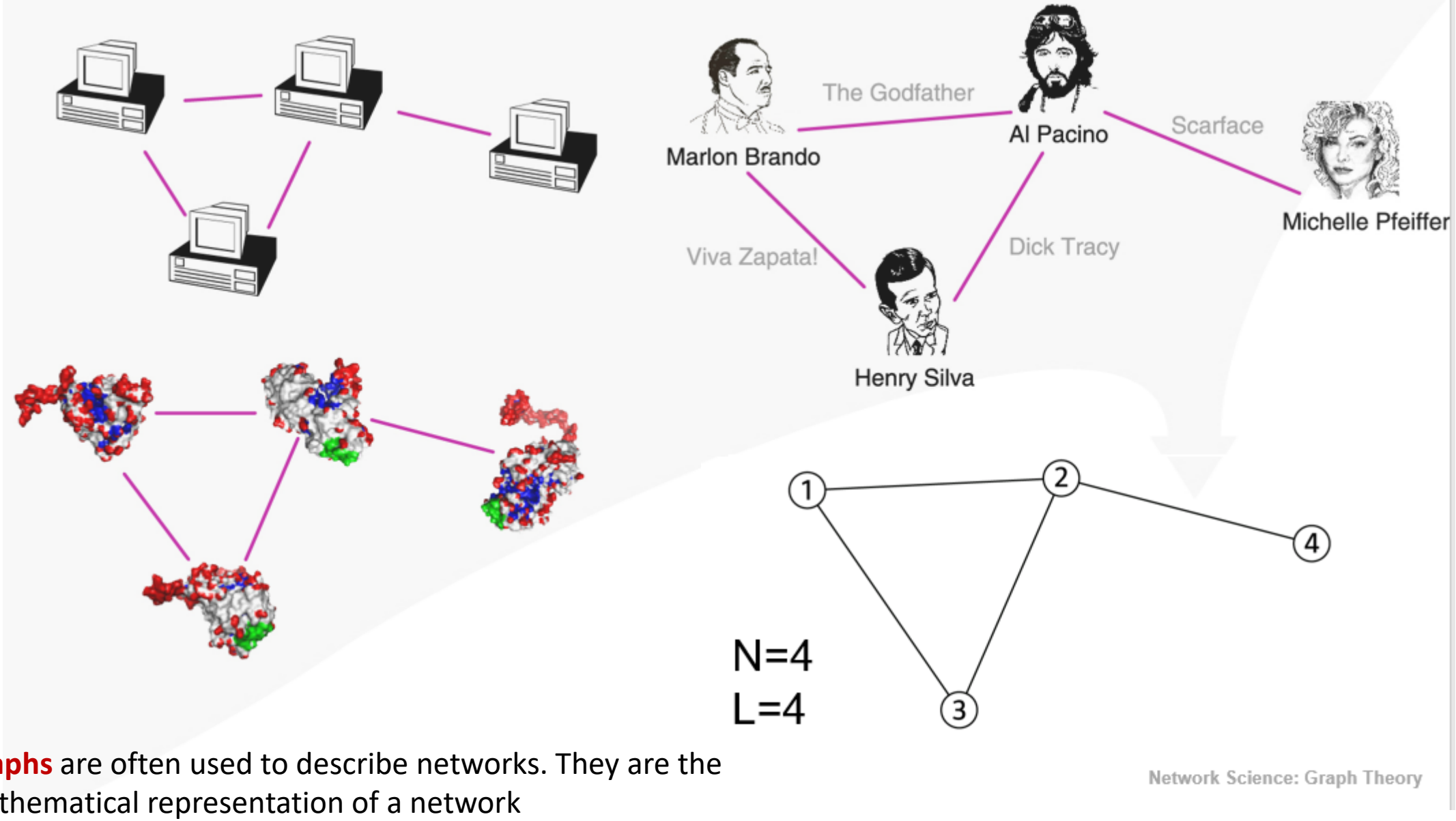
- Networks are at the heart of complex systems
  - Composed of many interconnected parts
- A network is a catalog of a system's components (nodes, N) and the direct interactions between them (links or edges, L)
- Network often refers to real systems
  - The world wide web, social network, network of actors



Nodes can be individuals, actors, people or things within a network (books in a library)

Points	Lines	Discipline
Vertices	Edges, arcs	Math
Nodes	Links	Computer science
Sites	Bonds	Physics
Actors	Ties, relations	Sociology

Networks

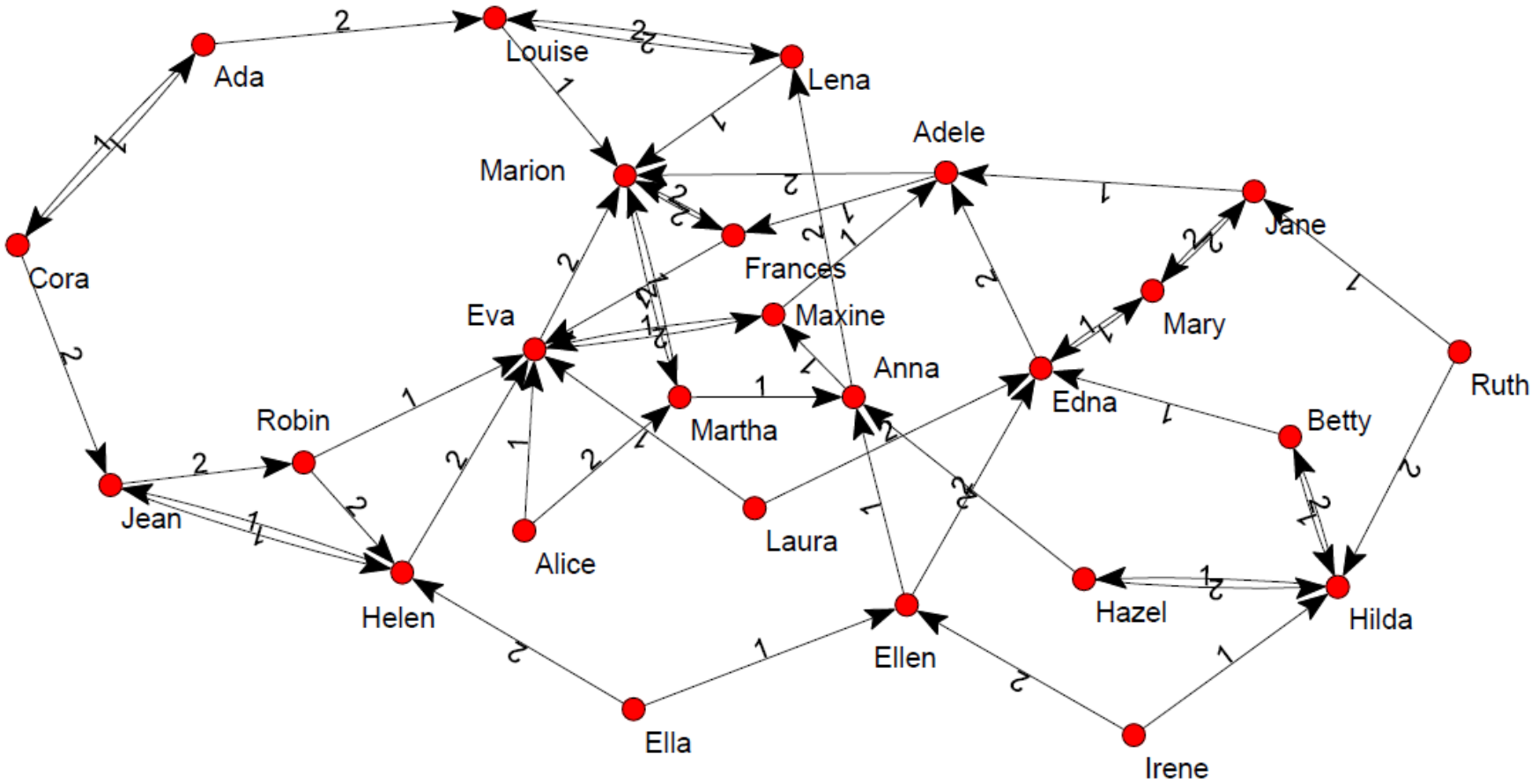


Graphs are often used to describe networks. They are the mathematical representation of a network

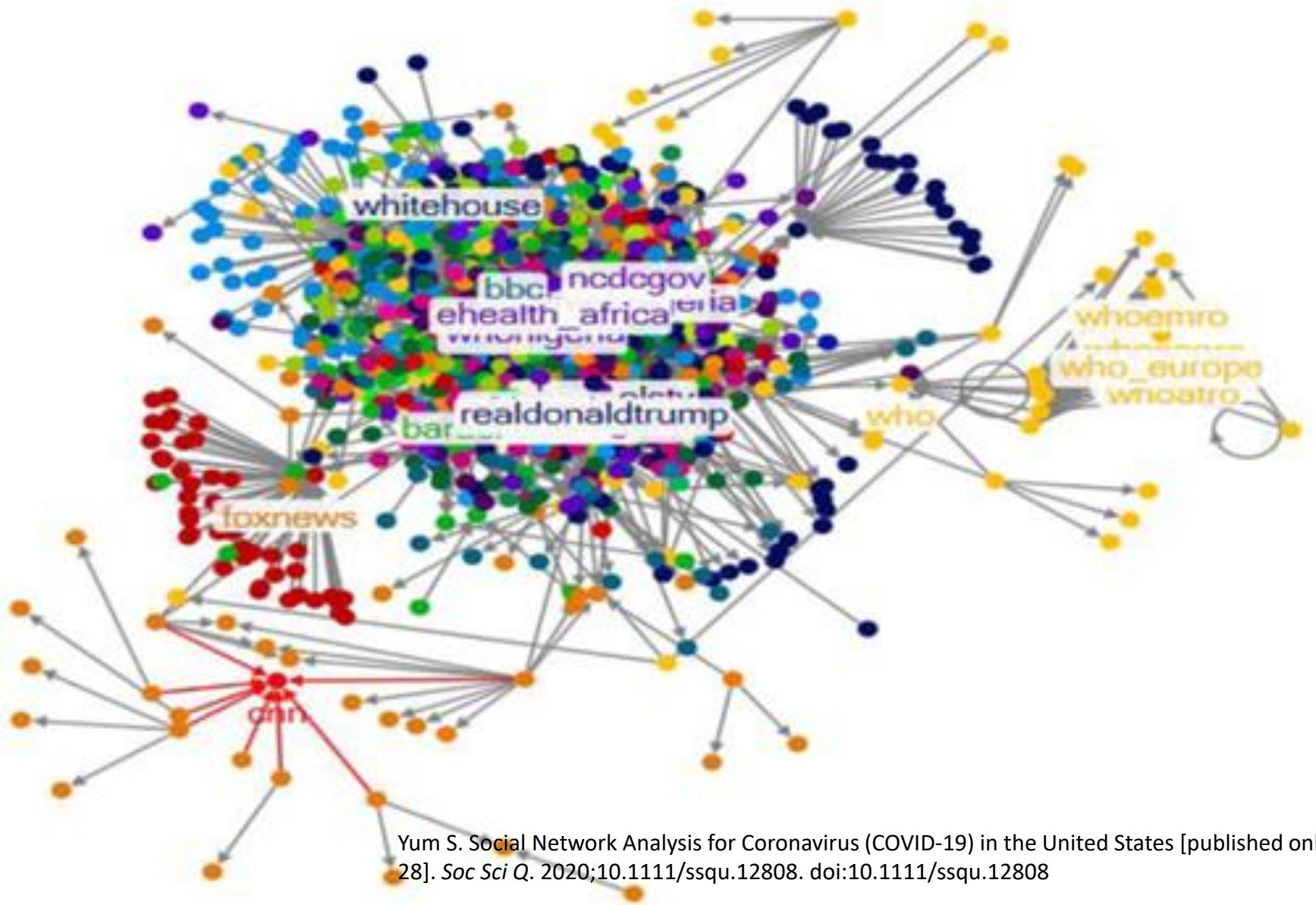
Networks

- Edge/links can be directed or undirected
- A network is directed if all of its links are directed
  - Retweet, likes, following on social media
  - Jane follows John; John might not follow Jane (Jane -> John)
- A network is undirected if all its links are undirected
  - Jane and John follow each other (Jane <-> John or Jane – John)

Example of directed network

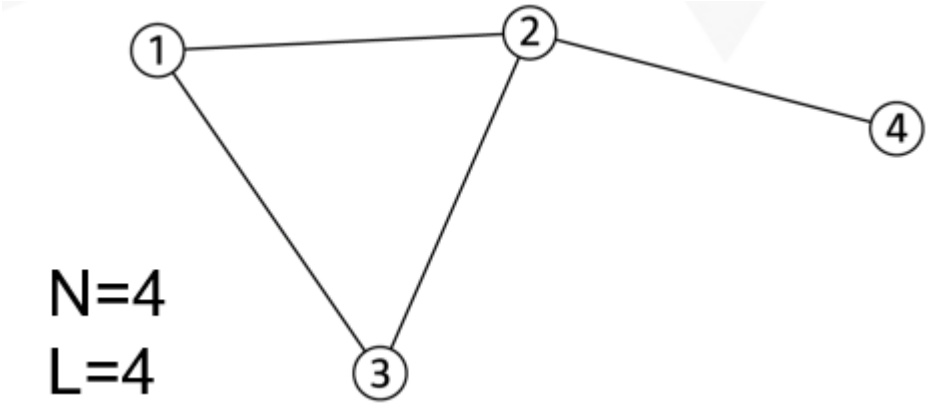


Choosing , 1st and 2nd dining table partners in a girls' school dormitory (Moreno, *The sociometry reader*, 1960)



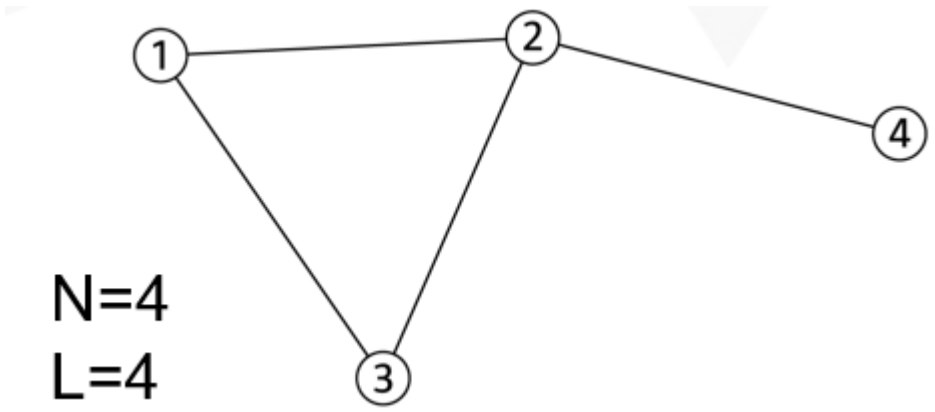
Yum S. Social Network Analysis for Coronavirus (COVID-19) in the United States [published online ahead of print, 2020 May 28]. *Soc Sci Q*. 2020;10.1111/ssqu.12808. doi:10.1111/ssqu.12808

Adjacency matrix

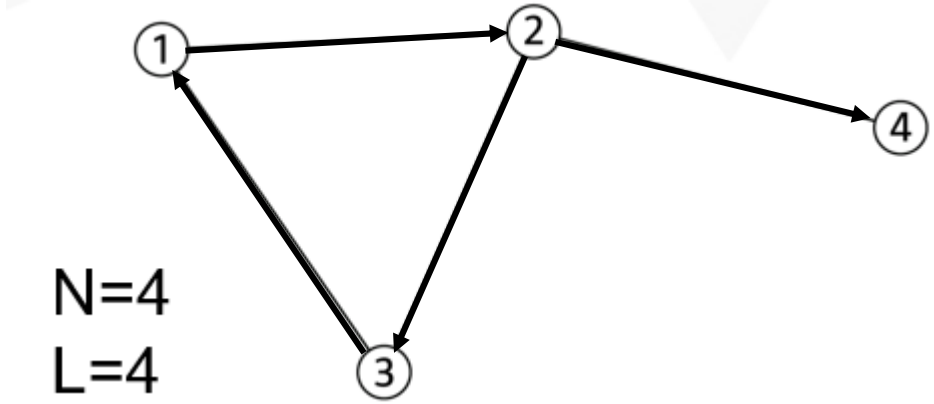


- The adjacency matrix of a directed network of N nodes has N rows and N columns, its elements being:
  - A_{ij} = 1 if there is a link pointing from node i to node j
  - A_{ij} = 0 if nodes i and j are not connected to each other
- The adjacency matrix for an undirected network has two entries for each link, for example, link (1,2) is represented as A_{12} = 1 and A_{21}=1
- Hence, the adjacency matrix of an undirected network is symmetric, $A_{ij} = A_{ji}$
- A_{ii}=0 unless the node has self loops

Adjacency matrix



$$A_{ij} = \begin{array}{c|cccc} & 1 & 2 & 3 & 4 \\ \hline 1 & 0 & 1 & 1 & 0 \\ 2 & 1 & 0 & 1 & 1 \\ 3 & 1 & 1 & 0 & 0 \\ 4 & 0 & 1 & 0 & 0 \end{array}$$



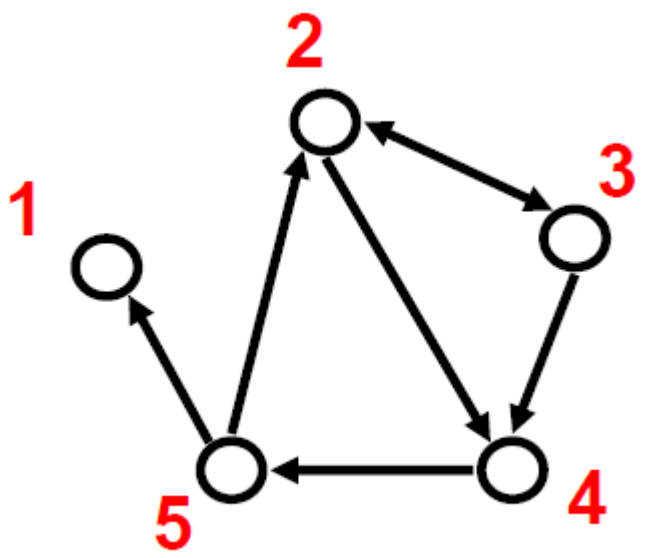
This one > 1 2 3 4

This one > points to

$$A_{ij} = \begin{array}{c|cccc} 1 & 0 & 1 & 0 & 0 \\ 2 & 0 & 0 & 1 & 1 \\ 3 & 1 & 0 & 0 & 0 \\ 4 & 0 & 0 & 0 & 0 \end{array}$$

- A_{ij} = 1 if there is a link pointing from node i to node j
- A_{ij} = 0 if nodes i and j are not connected to each other
- A_{ii}=0 unless the node has self loops
- $A_{ij} = A_{ji}$ if the network is undirected

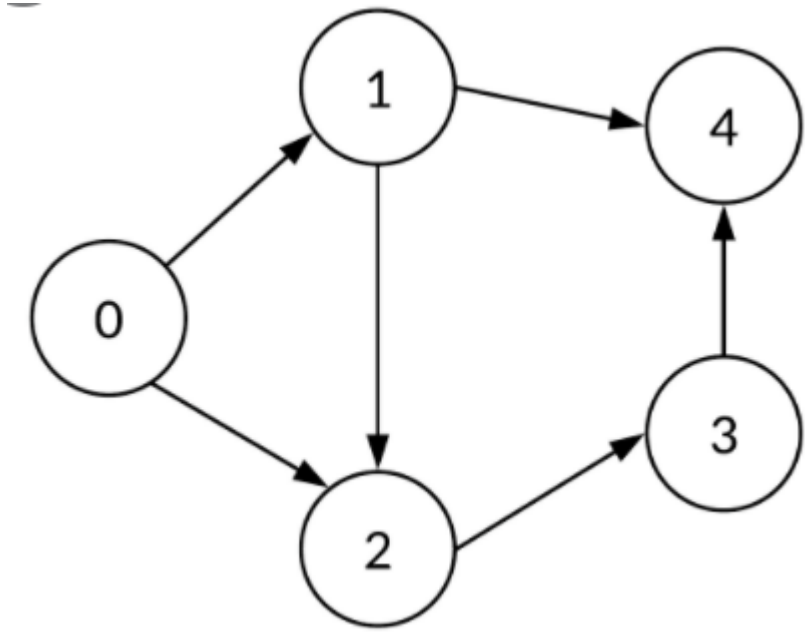
Adjacency matrix of the network below



$$A = \begin{array}{c} \\ 1 \\ 2 \\ 3 \\ 4 \\ 5 \end{array} \begin{array}{c} \begin{array}{ccccc} 1 & 2 & 3 & 4 & 5 \end{array} \\ \begin{pmatrix} 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 1 & 0 \\ 0 & 1 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \\ 1 & 1 & 0 & 0 & 0 \end{pmatrix} \end{array}$$

Draw the corresponding directed graph for the adjacency matrix below

$$A_{ij} = \begin{array}{c} \\ 1 \\ 2 \\ 3 \\ 4 \\ 5 \end{array} \begin{array}{c} \begin{array}{ccccc} 1 & 2 & 3 & 4 & 5 \end{array} \\ \begin{bmatrix} 0 & 1 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 & 1 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix} \end{array}$$



Network metrics – Indices of centrality

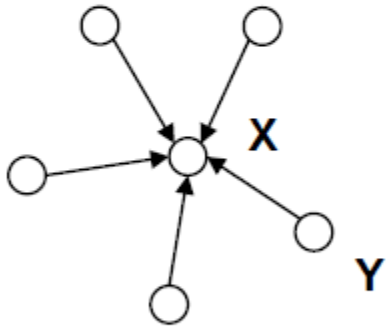
- Centrality indices are answers to the question

  "What characterizes an important node?"

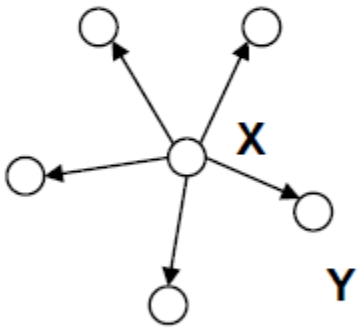
- They are measures of nodes and their relationship to the overall network
  - E.g. The most important/influential person in a network, spreaders of disease, topic discussed the most.
- Degree –Indegree, Outdegree: How many people can this person reach directly?
- Betweenness: How likely is this person to be the most direct route between two people in the network?
- Closeness: How fast can this person reach everyone in the network?

Network metrics – Indices of centrality

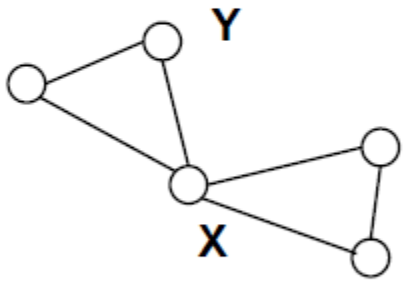
In each of the following networks, X has higher centrality than Y according to a particular measure



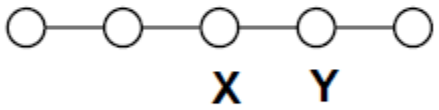
indegree



outdegree



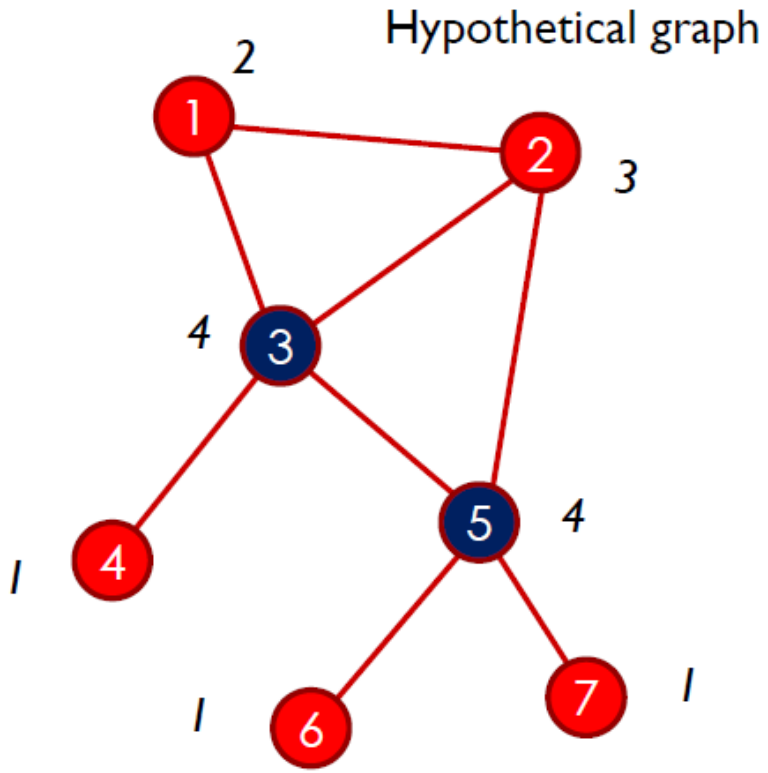
betweenness



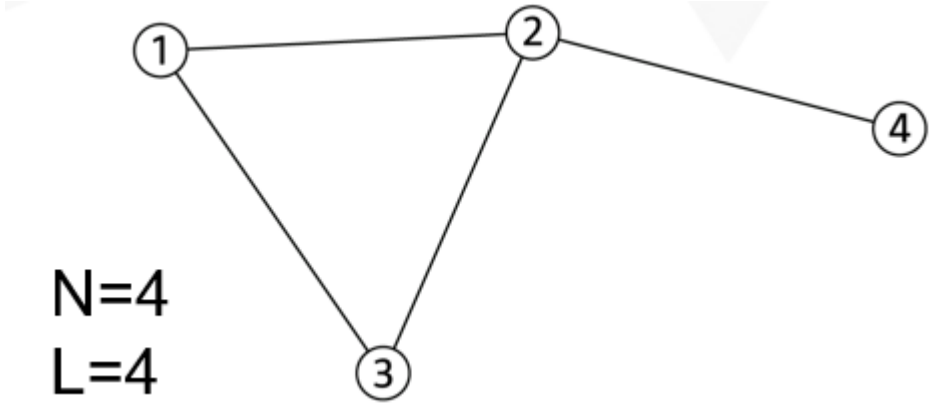
closeness

Degree centrality

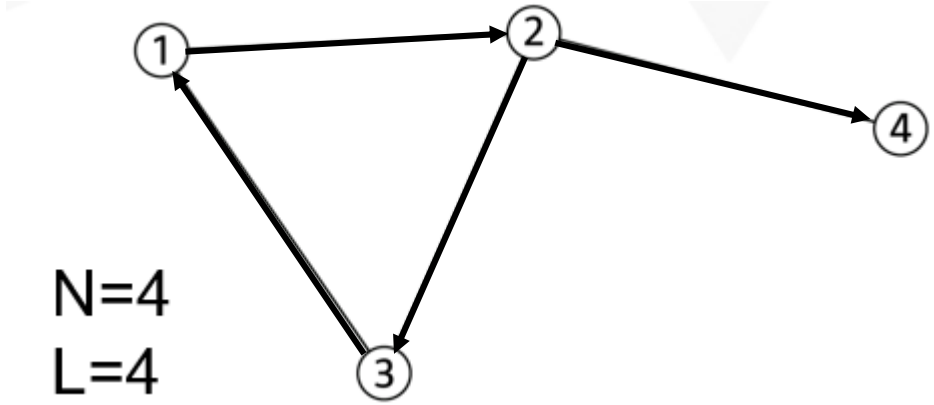
- Representation of a system's components (N)
  - Ex. Actors, people, things within a network
- Node network properties
  - Degree of a node: Number of links that lead into or
  - Indegree: how many directed edges (arcs) are incid
  - Outdegree: how many directed edges (arcs) origina



Calculating degree from adjacency matrix



$$A_{ij} = \begin{array}{c|cccc} & 1 & 2 & 3 & 4 \\ \hline 1 & 0 & 1 & 1 & 0 \\ 2 & 1 & 0 & 1 & 1 \\ 3 & 1 & 1 & 0 & 0 \\ 4 & 0 & 1 & 0 & 0 \end{array}$$



Indegree

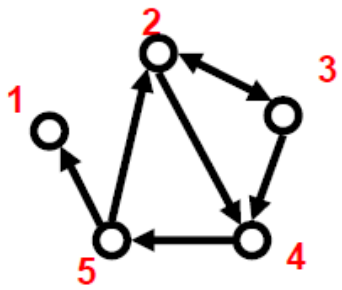
Outdegree

$$A_{ij} = \begin{array}{c|cccc} & 1 & 2 & 3 & 4 \\ \hline 1 & 0 & 1 & 0 & 0 \\ 2 & 0 & 0 & 1 & 1 \\ 3 & 1 & 0 & 0 & 0 \\ 4 & 0 & 0 & 0 & 0 \end{array}$$

- A_{ij} = 1 if there is a link pointing from node i to node j
- A_{ij} = 0 if nodes i and j are not connected to each other
- A_{ii}=0 unless the node has self loops
- $A_{ij} = A_{ji}$ if the network is undirected

Calculating degree from adjacency matrix

- Outdegree = $\sum_{j=1}^{n} A_{ij}$



$$A = \begin{array}{c|ccccc} & 1 & 2 & 3 & 4 & 5 \\ \hline 1 & 0 & 0 & 0 & 0 & 0 \\ 2 & 0 & 0 & 1 & 1 & 0 \\ 3 & 0 & 1 & 0 & 1 & 0 \\ 4 & 0 & 0 & 0 & 0 & 1 \\ 5 & 1 & 1 & 0 & 0 & 0 \end{array}$$

example: outdegree for node 3 is 2, which we obtain by summing the number of non-zero entries in the 3rd *row*

$$\sum_{j=1}^{n} A_{3j}$$

- Indegree = $\sum_{i=1}^{n} A_{ij}$

$$A = \begin{array}{c|ccccc} & 1 & 2 & 3 & 4 & 5 \\ \hline 1 & 0 & 0 & 0 & 0 & 0 \\ 2 & 0 & 0 & 1 & 1 & 0 \\ 3 & 0 & 1 & 0 & 1 & 0 \\ 4 & 0 & 0 & 0 & 0 & 1 \\ 5 & 1 & 1 & 0 & 0 & 0 \end{array}$$

example: the indegree for node 3 is 1, which we obtain by summing the number of non-zero entries in the 3rd *column*

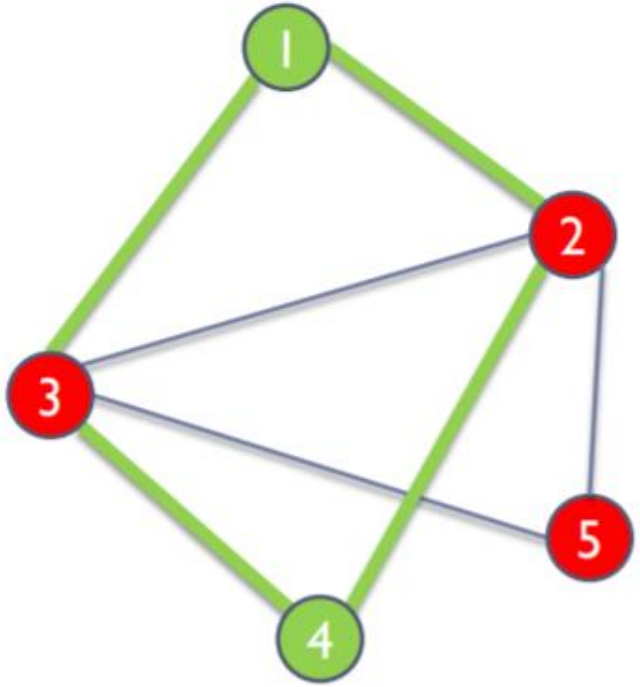
$$\sum_{i=1}^{n} A_{i3}$$

Paths and shortest paths

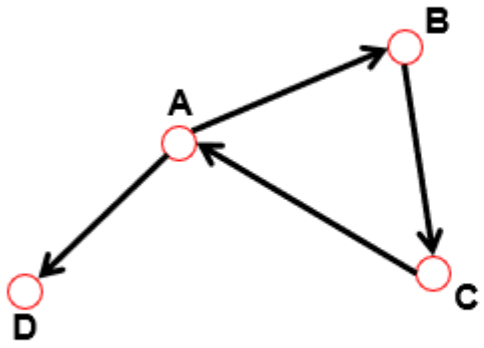
Shortest path

- A *path* between two nodes is any sequence of non-repeating nodes that connects the two nodes
- The *shortest path* between two nodes is the path that connects the two nodes with the shortest number of edges (also called the *distance* between the nodes)
- In the example to the right, between nodes 1 and 4 there are two shortest paths of length 2: {1,2,4} and {1,3,4}
- Other, longer paths between the two nodes are {1,2,3,4}, {1,3,2,4}, {1,2,5,3,4} and {1,3,5,2,4} (the longest paths)
- Shorter paths are desirable when speed of communication or exchange is desired (often the case in many studies, but sometimes not, e.g. in networks that spread disease)

Hypothetical graph



Paths and shortest paths

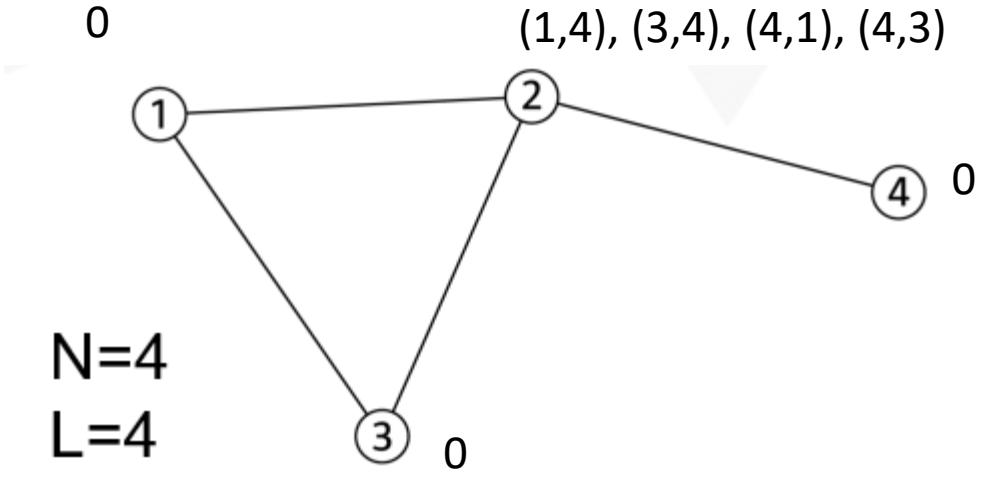


In directed graphs each path needs to follow the direction of the arrows.

Thus in a digraph the distance from node A to B (on an AB path) is generally different from the distance from node B to A (on a BCA path).

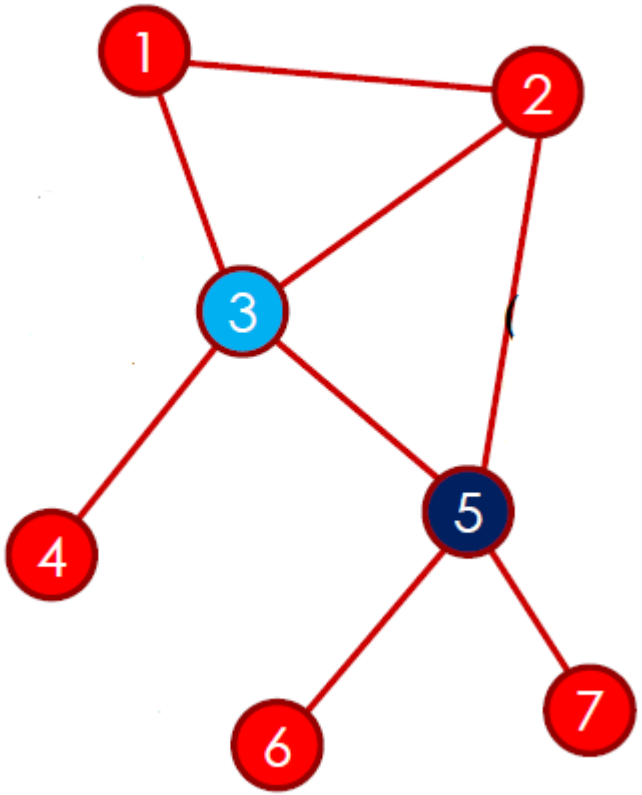
Betweenness: captures brokerage

- Quantifies the number of times a node acts as a bridge along the shortest path between 2 other nodes.
- How many pairs of individuals in the network would be connected through you on their shortest path to each other
- Shows which nodes are more likely to be in communication paths between other nodes
- How likely is this person/node to be the most direct route between two people in the network? – Information control



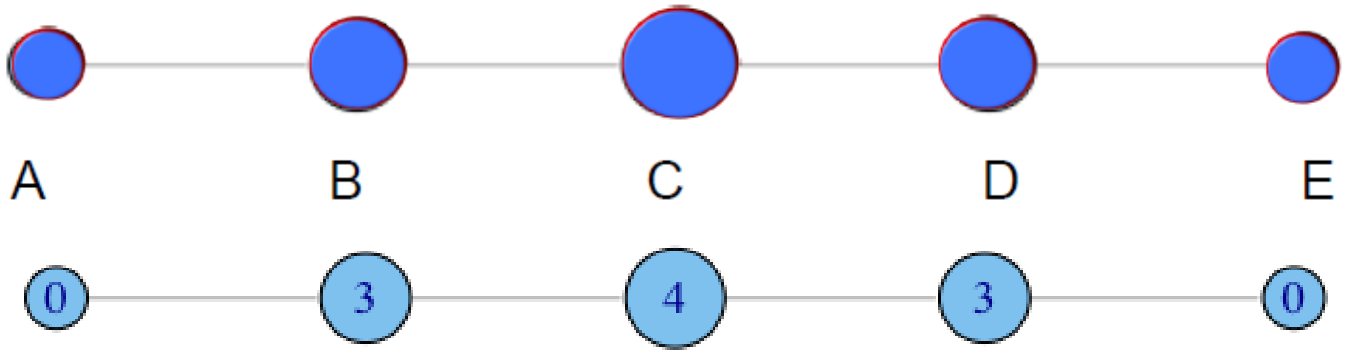
What node has the highest betweenness centrality?

- How many node pairs will go through each node on their shortest path to each other?
- Which nodes are more likely to be in communication paths between other nodes
- Useful in determining points where the network would break apart (think who would be cut off if nodes 3 or 5 would disappear)



Node 5 has higher betweenness centrality than 3
No node pairs need to go through 1,4,6 or 7 to get to each other

What node has the highest betweenness centrality?



- A lies between no two other vertices
- B lies between 3 pairs of vertices: (A,C), (A,D), (A,E)
- C lies between 4 pairs of vertices (A,D),(A,E),(B,D),(B,E)
- D lies between 3 pairs of vertices (A,E), (B,E), (C,E)
- E lies between no two other vertices

Closeness centrality

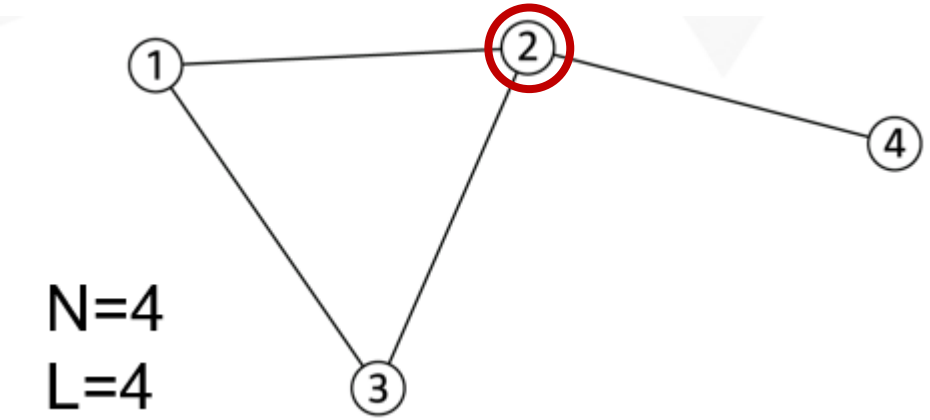
- Closeness is a measure of reach
  - The speed with which information can reach other nodes from a starting node
- Useful in cases where speed of information dissemination is main concern
- Calculate the mean length of all shortest paths from a node to all other nodes in the network (i.e. how many hops on average it takes to reach every other node)
- Take the reciprocal of the above value so that higher values are 'better' (indicate higher closeness) like in other measures of centrality

$$C(x) = \frac{1}{\sum_y d(y, x)}$$

Closeness centrality

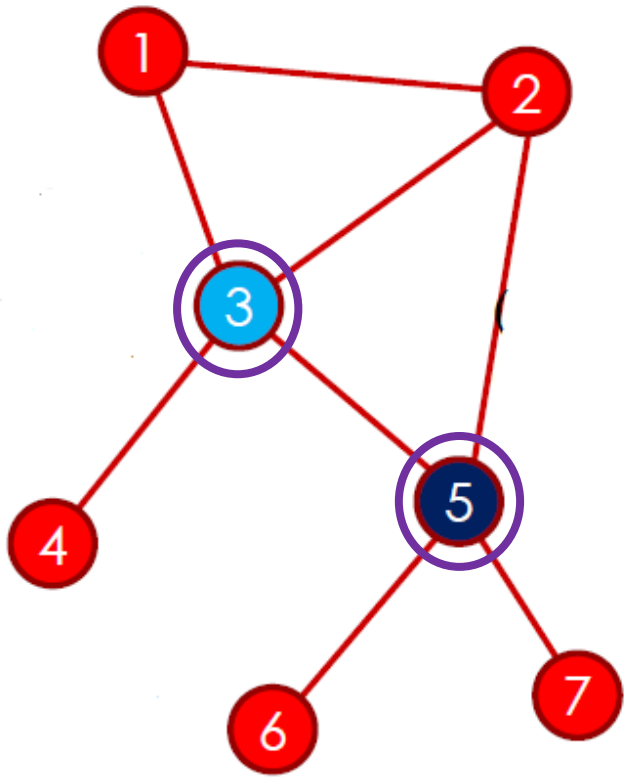
- Calculate the mean length of all shortest paths from a node to all other nodes in the network (i.e. how many hops on average it takes to reach every other node)
- Take the reciprocal of the above value so that higher values are 'better' (indicate higher closeness) like in other measures of centrality

	1	2	3	4	Sum	Avg	Rec
1							
2							
3							
4							



What node has the highest Closeness centrality

	1	2	3	4	5	6	7	Sum	Avg	Rec
1	-	1	1	2	2	3	3	12	2	0.5
2	1	-	1	2	1	2	2	9	1.5	0.67
3	1	1	-	1	1	2	2	8	1.3	0.75
4	2	2	1	-	2	3	3	13	2.17	0.46
5	2	1	1	2	-	1	1	8	1.33	0.75
6	3	2	2	3	1	-	2	13	2.17	0.46
7	3	2	2	3	1	2	-	13	2.17	0.46



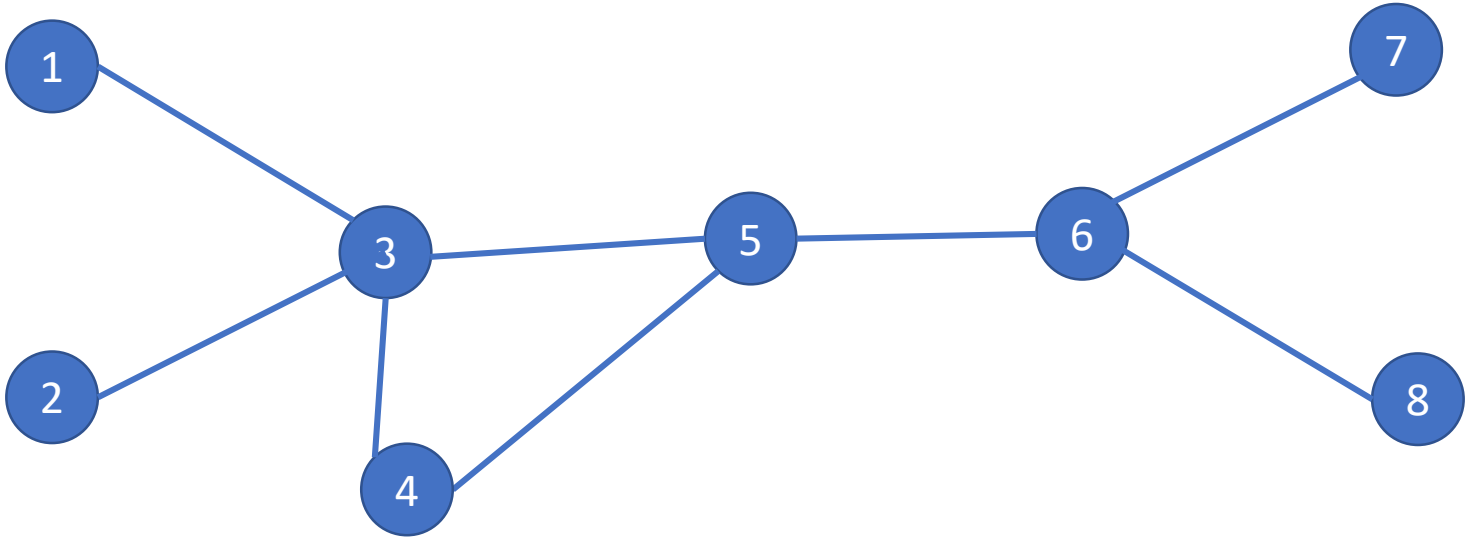
Centrality measures

Centrality measure	**Interpretation in social networks**
Degree	How many people can this person reach directly?
Betweenness	How likely is this person to be the most direct route between two people in the network?
Closeness	How fast can this person reach everyone in the network?

Centrality measures

Centrality measure	**Other possible interpretations…**
Degree	In network of music collaborations: how many people has this person collaborated with?
Betweenness	In network of spies: who is the spy through whom most of the confidential information is likely to flow?
Closeness	In network of relations work/family: how fast will Tuberculosis spread from this person to the rest of the network?

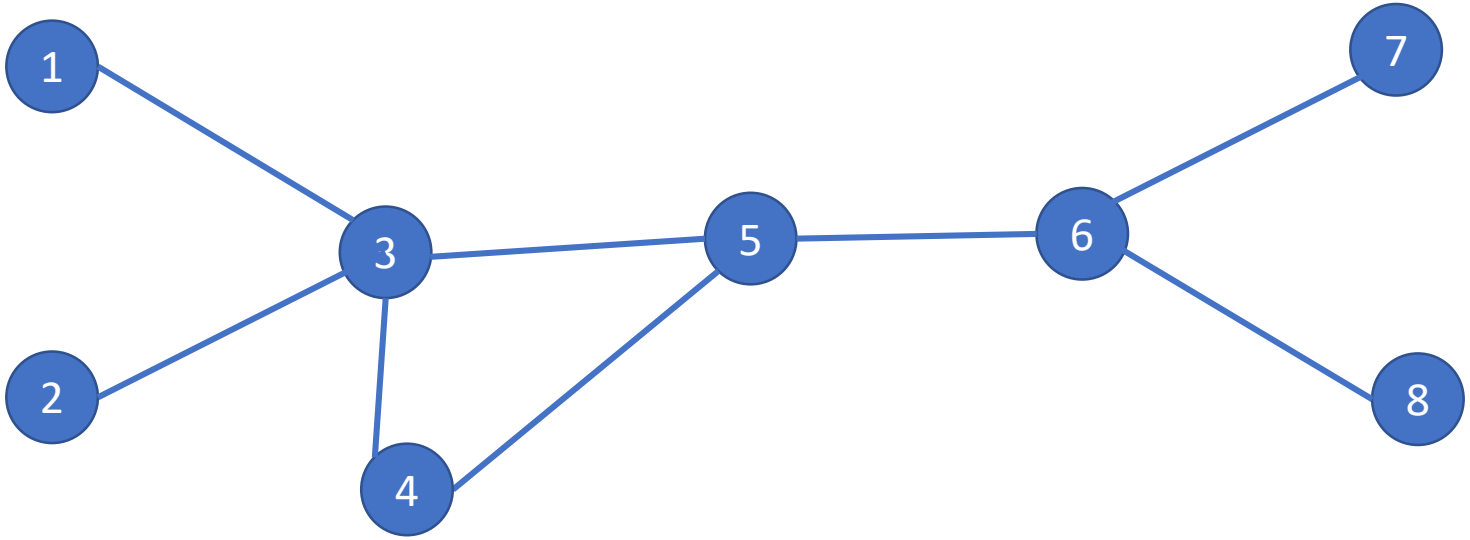
Exercise



- Let's assume the above network is a friendship network. Each node represents a person and the edge represents friendship between people. If one is interested in the node(s) that can most efficiently (quickly) get information from every other node in the network, what centrality measure will be most appropriate? Why?

- Closeness centrality

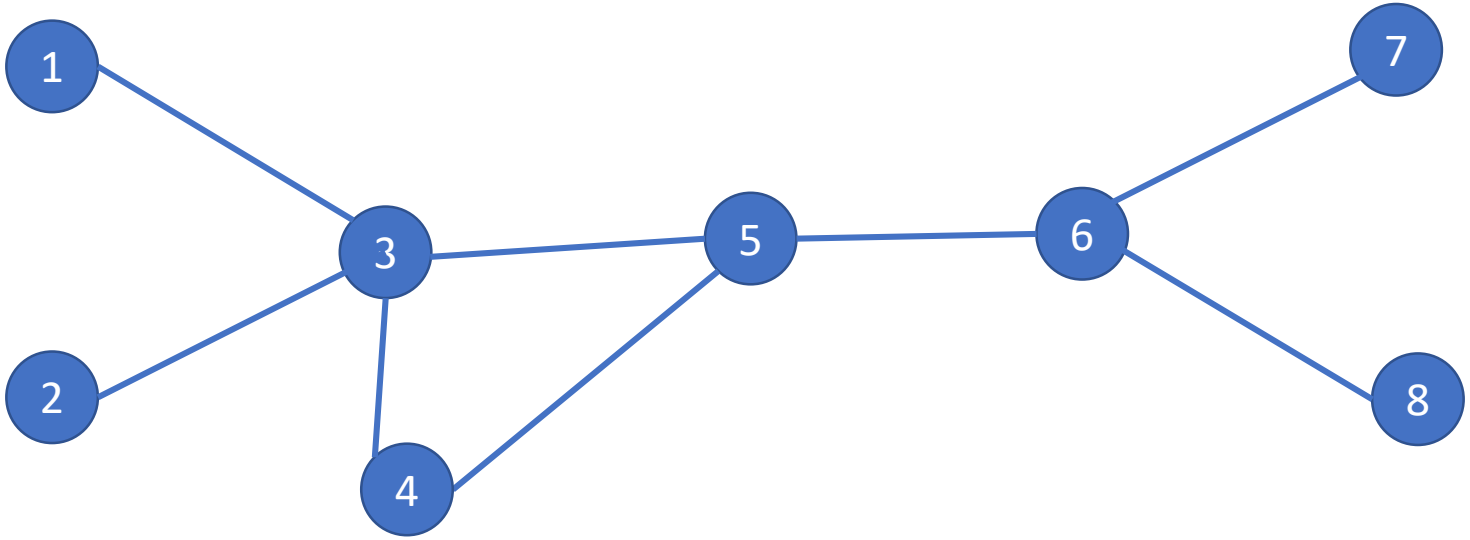
Exercise



- Let's assume the above network is a friendship network. If one is interested in finding the node that can most frequently control information flow in the network, which centrality measure will be most appropriate? Why?

- Betweenness centrality

Exercise



- Let's assume the above network is a friendship network. Each node represents a person and the edge represents friendship between people. If one is interested in finding the most popular person in the network, which centrality measure will be most appropriate? Why?

- Degree centrality

Application of SNA – Movie Galaxy

- Movie Galaxy uses SNA to represent the character interaction and relationships between actors in movies.
- Nodes = actors, Links/edges = co-appearance (same screen appearance)
- A relationship exists if 2 people appeared in the same screen.
- http://moviegalaxies.com/movies/828-Titanic

Tools for SNA – NodeXL and Gephi

- NodeXL
  - Tool for SNA; network overview, discovery and exploration
  - Implemented as add-in to MS Excel
  - Allows import from FB, Twitter and other networks
  - Represents network as an edge list
- Gephi
  - Tool for visualizing graphs and networks
  - Open source and free

Why is SNA important

- Marketing insights
- Detecting crime
- Detecting epidemics
- Understanding relationship structures

Conclusion

- Social network analysis describes the relationship between entities in a network
- Networks are represented as nodes and edges
- Centrality metrics
  - Degree
  - Closeness
  - Betweenness

References

- *Network science* by Barabási, Albert-László. Cambridge University Press, 2016.
- *Linked. How everything is connected to everything else and what it means for business, science and everyday life* by Barabási, Albert-László, 2002.
- Lectures notes in Social Computing. Julita Vassileva.

Mining Social Data

Ifeoma Adaji

Learning objectives

- Define social data mining
- Identify data sources
- Explain how to extract data for analysis
- Identify and explain possible algorithms for analysis
- Evaluate results

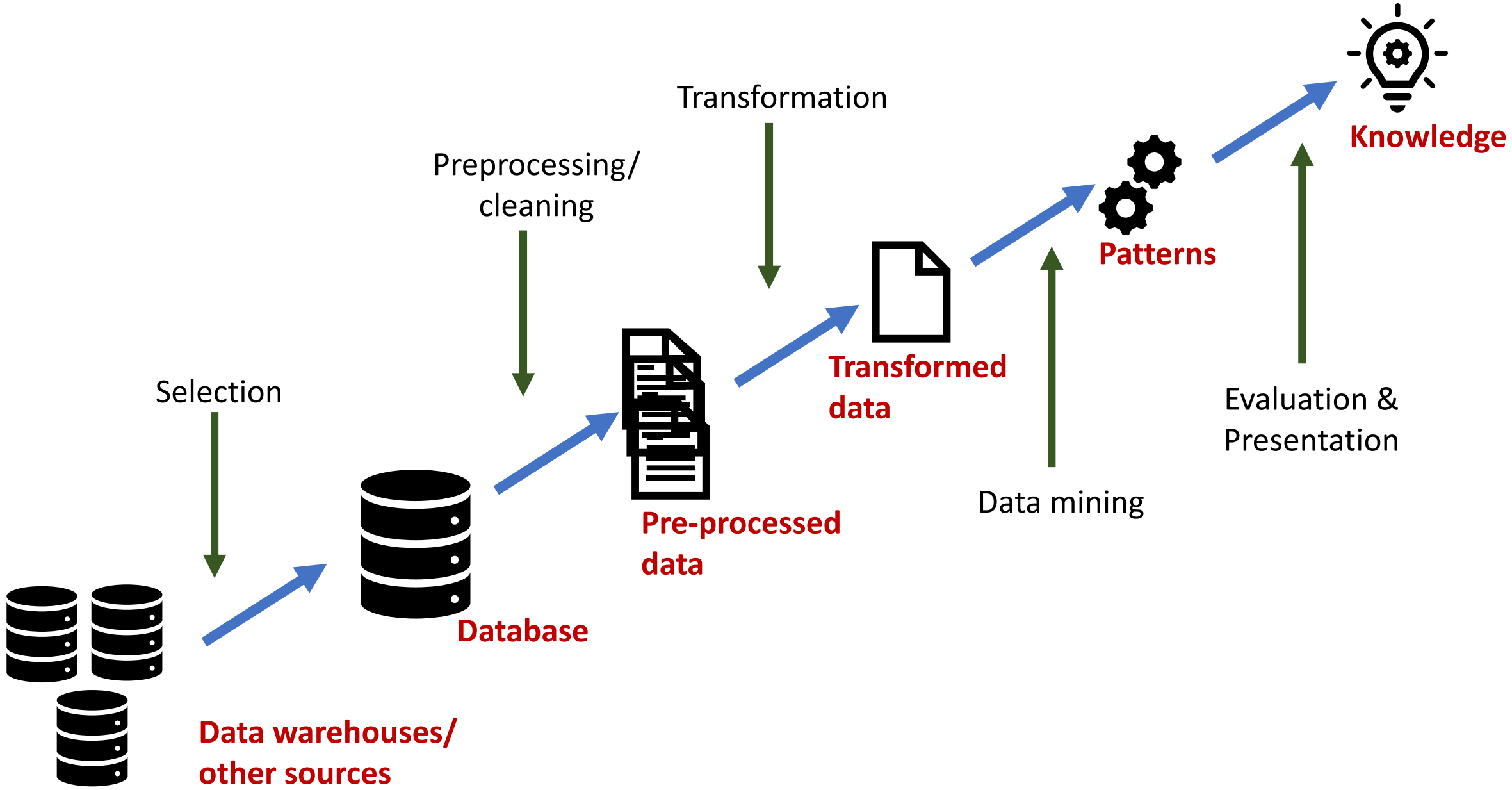
Why data mining

- We live in a world where vast amounts of data are collected daily on social platforms
  - Think of the amount of data generated on social media: Facebook, Instagram, TikTok, Twitter, Netflix
  - Think of data generated on e-commerce platforms: Amazon, Walmart, Ebay
- Data is generated frequently on multiple platforms
- Data is noisy
- Tools are needed to uncover valuable information from these data, to transform such to organized knowledge

Data mining

- Knowledge mining from data (social data)
- Process of discovering interesting patterns and knowledge from large amounts of data
- Extracting novel and actionable patterns from data
  - Meaningful, readily apparent, not easily obtainable
  - Not just about retrieving information from a database
  - Involves methods of Machine learning, Information Retrieval, Statistical Analysis
- Step in the process of knowledge discovery

Steps in the process of knowledge discovery



Data selection

- Various sources of social data
  - Data explorer e.g. Stack Overflow
  - APIs e.g. Reddit, Twitter
  - Web crawling e.eg Beautiful soup (Python)
  - Other data repositories e.g. https://www.kaggle.com/, https://snap.stanford.edu/

Pre-processing and cleaning

- To remove noise and inconsistent data
- Everything you do before data mining
- Anonymization - removing identifying information
- Normalization - weighted all features equally
- Feature Selection – including only necessary features
- Noise/Spam removal

Data mining algorithms

- Supervised learning
  - The use of labeled datasets to train algorithms that classify data or predict outcomes accurately
  - Requires prior knowledge of the data class labels
  - Often used in classification (predicting label) & regression (predicting quantity) problems
- Unsupervised learning
  - Uses unlabeled data to discover patterns that help solve clustering or association problems
  - Particularly useful when one is unsure of common properties within a data set.

Supervised learning

- Classification
  - Uses an algorithm to accurately assign test data into specific categories.
  - It recognizes specific entities within the dataset and attempts to draw some conclusions on how those entities should be labeled or defined.
  - Start with a set of labelled training data
  - Build a model based on the training data
  - Use model to categorize new data

Classification example

Steps in knowledge discovery

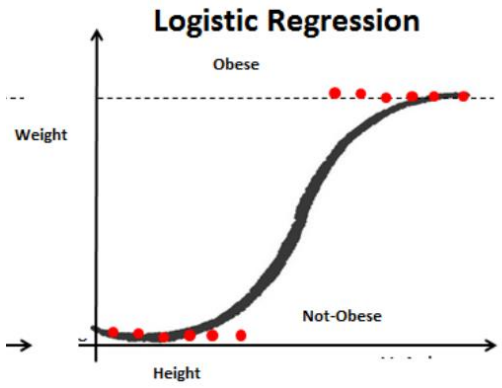
ID	Verified account	# Days old	# Followers	# Following	Frequency of posts	Profile picture	Troll?
1	No	1,883	200k	4k	200	1	No
2	Yes	201	65k	8K	18	1	No
3	No	89	1	2k	344	0	Yes
4	No	11	181	9k	566	0	Yes
5	No	33	456	2k	12	0	Yes
6	No	62	655	9k	96	0	Yes
7	Yes	978	121k	1k	15	1	No
8	No	34	30	3k	240	1	Yes
9	No	131	12	3k	103	0	Yes
10	Yes	222	11k	1k	34	0	No

Features
- Verified account
- # days old
- # followers
- # following
- Frequency of posts
- Profile picture

Label
- Troll (Yes/No)

Classification algorithm
- Logistic regression
- Random forests
- Naive Bayes

Classification algorithms



- Logistic regression
  - Used when dependent variable (what one is predicting) is categorical; true/false, yes/no
  - Used to model the probability of a class/event happening
  - Uses a logistic function to model the relationship between independent variables and dependent variables
  - Should not be used when the number of observations is less than number of features
- Naive Bayes
  - Works on Bayes theorem of probability to predict the class of unknown data sets
  - Assumes independence among predictors – main problem

Formula

$$P(A \mid B) = \frac{P(B \mid A) \cdot P(A)}{P(B)}$$

A, B = events

$P(A|B)$ = probability of A given B is true

$P(B|A)$ = probability of B given A is true

$P(A), P(B)$ = the independent probabilities of A and B

Img source: https://www.analyticsvidhya.com/blog/2020/12/beginners-take-how-logistic-regression-is-related-to-linear-regression/

What is the probability that a user will like the post of a friend?

Connection	Like post
Friend	No
Family	Yes
Celebrity	Yes
Friend	Yes
Friend	Yes
Family	Yes
Celebrity	No
Celebrity	No
Friend	Yes
Celebrity	Yes
Friend	No
Family	Yes
Family	Yes
Celebrity	No
Friend	???

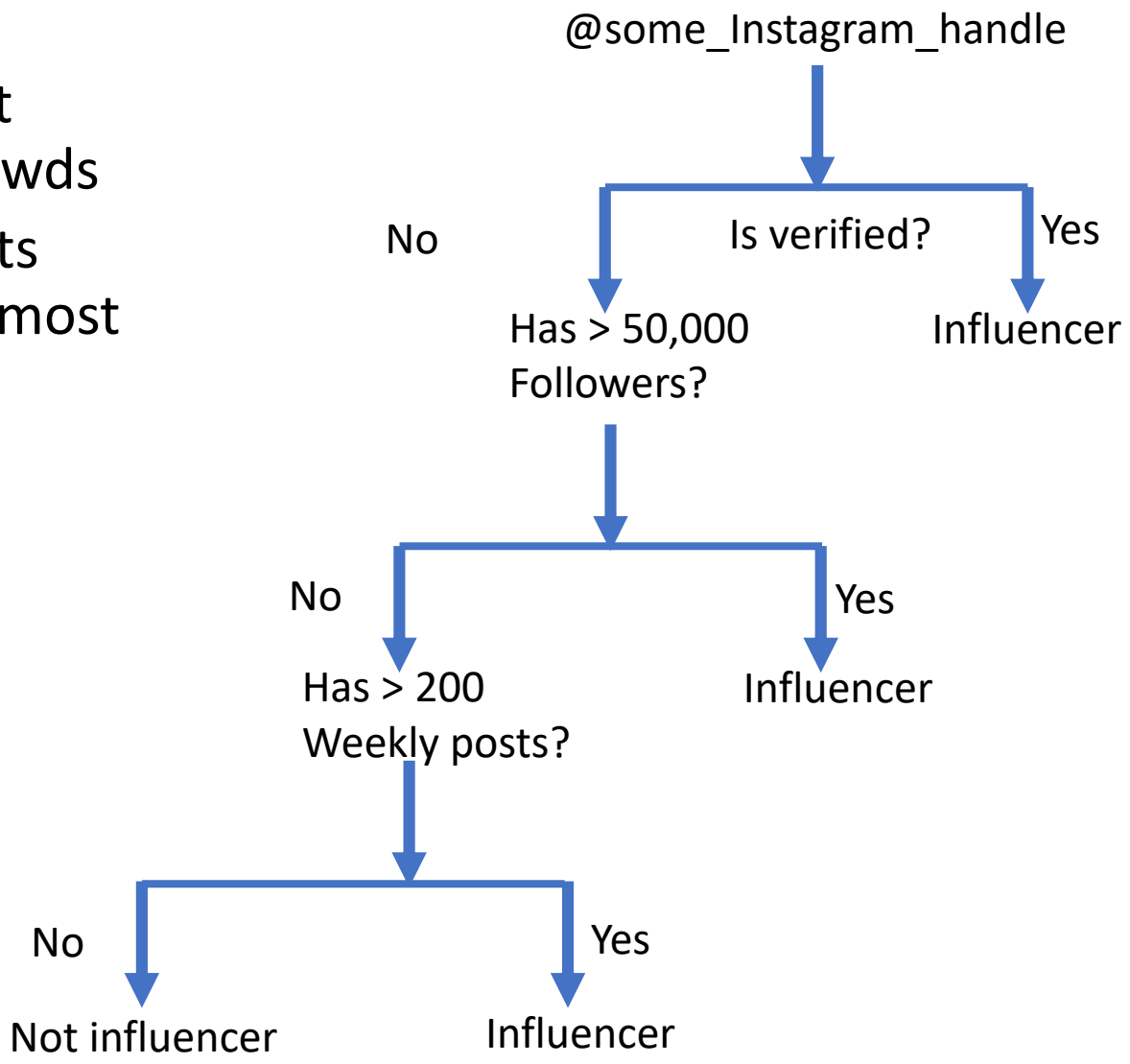
Frequency Table		
Connection	**No**	**Yes**
Family		4
Celebrity	3	2
Friend	2	3
Grand Total	5	9

P(Yes | Friend) = P(Friend | Yes) * P(Yes) / P (Friend)
P (Friend |Yes) = 3/9 = 0.33, P(Friend) = 5/14 = 0.36, P(Yes)= 9/14 = 0.64
P (Yes | Friend) = 0.33 * 0.64 / 0.36 = 0.60

Likelihood table				
Connection	**No**	**Yes**		
Family		4	=4/14	0.29
Celebrity	3	2	=5/14	0.36
Friend	2	3	=5/14	0.36
All	**5**	**9**		
	=5/14	=9/14		
	0.36	0.64		

Classification algorithms

- Random forests
  - Consists of many decision trees
  - Prediction of the group is more accurate that prediction of individual tree – wisdom of crowds
  - Each individual tree in the random forest spits out a class prediction and the class with the most votes becomes the model's prediction
  - Low correlation between models is the key.
  - The trees protect each other from their individual errors
- Other classification algorithms include
  - Support vector machines
  - Neural networks



Unsupervised learning - Clustering

- Used for exploratory data mining
- Determines which samples are similar to each other based on the similarity of the data elements
- The algorithm does not require labels showing how the samples should be group together
- Commonly used in recommendation systems
- Examples
  - k-means clustering

K-means clustering

- Aims to partition n observations into k clusters in which each observation/data point belongs to the cluster with the nearest mean (cluster centers or cluster centroid)
- Initialize K random centroids.
  - Pick K random data points and make those your starting points or
  - Pick K random values for each variable.
- For every data point, look at which centroid is nearest to it.
  - Using some sort of measurement like Euclidean or Cosine distance (commonly used in text mining)
- Assign the data point to the nearest centroid.
- For every centroid, move the centroid to the average of the points assigned to that centroid.
- Repeat the last three steps until the centroid assignment no longer changes.
  - The algorithm is said to have “converged” once there are no more changes.

Evaluation

Accuracy

$$Accuracy = \frac{number\ of\ correctly\ classified\ test\ sample}{total\ number\ of\ test\ sample}$$

Precision

$$Precision = \frac{number\ of\ relevant\ results\ that\ were\ ranked\ or\ retrieved}{number\ of\ retrieved\ results}$$

Recall

$$Recall = \frac{number\ of\ relevant\ results\ that\ were\ ranked\ or\ retrieved}{number\ of\ relevant\ results}$$

F1 Score

$$score = 2 * \frac{precision * recall}{precision + recall}$$

Applications of social media data mining

- Advertising
  - Determine what messages are most effective among certain demographic groups
  - Determine the best time of the day to run a specific ad on a specific digital platform
- Influencer marketing
  - Helpful in identifying influencers/users with strong follower base and engagement rates
- Predictive analysis
  - Predicting churn/customer attrition, misinformation spread, etc.
- Recommender systems
- Trend analysis
- Event detection
- Spam detection

Problems

- Privacy
- Ethical issues
- Bias
- Data ownership
- Identity theft – fraud

Summary

- Valuable information is hidden in vast amounts of social media data
- Mining this data can discover actionable knowledge that is otherwise difficult to find
- Mining can be done using various methods including clustering and classification

References

- Mining the Social Web, 3rd Edition By Matthew A. Russell, Mikhail Klassen
- Data Mining: Concepts and Techniques, 3rd Edition By Jiawei Han, Jian Pei, Micheline Kamber

Privacy

Ifeoma Adaji

What caused yesterday's social media outage?

Learning objectives

- Define privacy
- List threats to privacy
- Describe the risks to privacy that come with new technology
- Explain the risks associated with privacy
- List fair information principles
- Explain the 2 aspects of privacy in social networks
- Describe privacy policies in Canada, EU and US

Privacy

- Freedom from intrusion – being left alone
- Control of information about oneself
- Freedom from surveillance (from being followed, tracked, watched and eavesdropped upon?
- Can we truly expect complete privacy?
  - Others may initiate conversation
  - We can't always control information about ourselves. Friends know where we work, people talk about us when we are not there
  - People can follow us/track us on social media and physically
- Critics of privacy argue that it gives cover to deception, hypocrisy and wrong doing.
  - Allows fraud and protects the guilty(?)
  - Concern for privacy may be regarded as suspicious – What do you have to hide?
- The desire to keep things private does not imply we are doing anything wrong?
  - On social media, are your accounts private?
  - We may want to keep our health, relationship and family issues private
  - We may choose not to share religious beliefs - to avoid distracting arguments
- Privacy of information can be important to safety and privacy
  - Travel plans, financial data, home address – think of what happens if these are publicly available on social media

Privacy threats

Threats to privacy come in several categories:

- Intentional, institutional use of personal information
  - In the government sector for law enforcement and tax collection
  - In the private sector for marketing and decision making
- Unauthorized use or release by insiders – the people who maintain the information
- Theft of information
- Unintentional leakage of information through negligence or carelessness
- Our own actions (intentional and unintentional)

New technology, new risks

- Government and private databases
  - Bankruptcy records, DNA databases, social media posts, purchase, search
- Sophisticated tools for surveillance and data analysis

  GPS and cameras on mobile devices, internet of things (IOT)
- Vulnerability of data
  - Patient data available online – possibility of breach

New technology, new risks - Examples

- Search query data
  - Search engines collect many terabytes of data daily.
  - Data is analyzed to target advertising and develop new services.
  - Who gets to see this data? Why should we care?
- Smartphones
  - Location apps
  - Data sometimes stored and sent without user’s knowledge
  - Companies use the data to build location-based services that are valuable to public/companies
- Why does it matter?
  - Data is vulnerable to loss, hacking and misuse
  - This can pose security issues

Privacy risks

- Anything we do online can be recorded and traced back to our computer/phone/IOTs
- Increase/affordability in cloud storage -> companies/government storing huge amounts of customers’/citizens’ data
- People are not usually aware of information collected about them
  - Who reads terms of use?
- Complex nature of software -> businesses don’t know what data software's collect
- Leaks happen
- Collection of several small items of information give a detailed description of a person or their life

Privacy risks

- Information on social media is available to everyone; anyone can find it if they look hard enough
- Once information goes online, difficult to delete it
- Very likely that data collected for one purpose (e.g. connecting with friends) will be used for other purposes (e.g. marketing, tracking)
- Government sometimes requests/demands for personal information held by companies
- We sometimes can’t protect information about ourselves; we depend on companies that manage it to protect it
  - From thieves, accidental loss, leaks and governments

Terminology for managing personal data

Informed consent and invisible information gathering.

- Informed consent. Informing people about data collection and use policies so they can decide whether to use a service/tool/app/business or not
- Invisible information gathering. Collection of personal information without a person's knowledge
  - Many companies have policy statements, privacy statements, terms of service/use that inform clients of their policy on collecting and using personal data. Many people don't read them or forget after they do

Terminology for managing personal data

Secondary use. Use of personal information outside the use it was provided for

- Sale of social media information to marketers or other businesses
- Use of text message/social media post for employment decision
- People should have control over secondary use of their information
  - Option to opt in/opt out of secondary use
  - Opt out. People are already in when they sign up for a service (Facebook/Instagram). They have to take action to opt out
  - Opt in. Intentionally sign up for a service

Fair information principles

- Fair Information Principles or Fair Information Practices
  - Principles for protecting personal data
  - Reasonable ethical guidelines
- Inform people when you collect their information, what you collect and how it is used
- Collect only needed data
- Offer an opt out option
- Keep data only as long as is needed
- Keep data accurate; provide means of people to verify and correct their data
- Secure people’s data from theft, accidental leaks
- Create policies for responding to law enforcement requests for data

- Have you used the opt out option of Facebook/Instagram?
- Have you read any privacy policies? Were any deceptive/surprising?

Privacy in social networks

Two aspects of social networks to consider:

- What *we* do - our responsibilities
  - We often want access to information about others but don’t want others to have access to same information about us.
    - For e.g. LinkedIn, we want to know who checked our profile but don’t want others to know we checked their profile
  - Recruiters can search our profiles for our posts including opinions, religious views, political views during hiring process. What will they find? Is it ethical?
  - People post locations when away on a trip – security issues
  - People care about privacy but don’t always act that way on social media

Privacy in social networks

- What *they* do - responsibilities of social network companies
  - Companies deploy new features very often that could affect existing privacy settings
  - New features and selection of default settings
  - Should a social network company introduce new, significant features turned on for everyone? Or should they let people opt in if they want/like the feature
  - Which would you recommend, an opt out or opt in policy?

A right to be forgotten

- The right to remove information about themselves from a company's records – e.g. from social media
  - An offensive comment (posted in anger)
  - An offensive comment posted by others
  - A photo
  - News article
  - Personal data posted by others
- Easier when the information is in a person's account
- Should a company always comply?
- How easy is it do delete something from the internet?

Personalized ads in Facebook

Data about your activity from partners

Personalised ads based on your activity on other websites, apps or offline

To show you relevant ads, we use data that advertisers and other partners provide to us about your activity on their websites and apps, as well as certain offline interactions, such as purchases. For example, we may show you an ad for a shirt based on your visit to a clothing website. We never sell your data. Learn more

Choose where we can use data from our partners to show you personalised ads.

Information from partners.

Advertisers, app developers and publishers can send us information through Facebook Business tools that they use, including our social plugins (such as the Like button), Facebook Login, our APIs and SDKs, or the Facebook pixel. These partners provide information about your activities off Facebook – including information about your device, websites you visit, purchases you make, the ads you see and how you use their services – whether or not you have a Facebook account or are logged in to Facebook. For example, a game developer could use our API to tell us what games you play, or a business could tell us about a purchase you made in its shop. We also receive information about your online and offline actions and purchases from third-party data providers who have the rights to provide us with your information.

Partners receive your data when you visit or use their services, or through third parties that they work with. We require each of these partners to have lawful rights to collect, use and share your data before providing us with any data. Learn more about the types of partners we receive data from.

Facebook’s use policy

- https://www.facebook.com/policy.php?ref=pf

Avenues for dealing with privacy

- Law
  - Legislation to deal with users/consumers' privacy
- Industry norms
  - Code of conduct that companies have to follow
- Reliance on marketplace
  - Companies in a marketplace can compel operators to abide by privacy principles
- Consumers
  - People should learn to safeguard their privacy
    - Post content responsibly
    - Opt out of services where privacy is an issue
    - Be aware of terms of use

Privacy legislation in Canada

The Canadian Privacy Act.

- Privacy rights regarding interactions with the federal government
- Applies to how government collects, uses, discloses, retains and disposes of personal information.
- Right to access personal information held by government

Collection	Government institution can only collect personal information if it directly relates to its operations
Use	Only for the purpose it is collected for – unless one consents to other uses
Accuracy	Take reasonable steps to ensure information is accurate, up to date and complete
Retention	Retained for at least 2 years unless one consents to its disposal
Disclosure	Can’t be disclosed without consent except in some special circumstances
Access to personal information	One may have access to personal information about themselves

Privacy legislation in Canada

The Personal Information Protection and Electronic Documents Act (PIPEDA)

- Applies to private sector organizations that collect, use or disclose personal information during commercial activity
- Companies must follow 10 fair information principles to protect personal information
  - Accountability
  - Identifying purposes
  - Consent
  - Limiting collection
  - Limiting use, disclosure and retention
  - Accuracy
  - Safeguards
  - Openness
  - Individual access
  - Challenging compliance

Privacy legislation in Canada

- Provincial privacy laws
  - Health related – ON, NB, NF, NS
  - Employment related – AB, BC
- Sector specific privacy laws
  - Bank Act
  - Provincial laws governing credit unions
  - Consumer credit reporting

Privacy legislation in the European Union (EU)

- EU has a comprehensive General Data Protection Regulation (GDPR)
  - Came into law on May 25, 2018
  - Stricter than regulations in US and Canada
- Harmonizes national data privacy laws throughout the EU
- Applies to all companies handling personal data of EU residents
  - Includes companies outside the EU offering goods and services to EU residents
- Covers processing of personal data, collection, use, storage, retrieval, transmission, destruction, etc.
- Processing of data is only permitted if the person has consented unambiguously or if processing is necessary to fulfil contractual/legal obligations
- Prohibits transfer of personal information to countries outside the EU that do not have an adequate system of privacy protection.
- Penalties for non-compliance – fines up to 4% of global annual turnover or €20 million

Privacy legislation in the US

- No standard federal privacy laws
- Has a mix of laws that cover privacy in various sectors
  - HIPPA - Health insurance portability and accountability act (HIPAA) to protect privacy of medical records
  - FCRA – Fair credit reporting act to regulate how credit bureaus disclose financial information
  - ECPA – Electronic Communications Privacy Act restricts the government's use of wiretaps on telephone calls and electronic signals.
  - FTC – Empowers the Federal Trade Commission to go after apps or websites that violates their own (the app or website's) privacy policy
- Some states have comprehensive data privacy laws
  - California – CPRA. California privacy rights act
  - Virginia – VCDPA. Virginia's consumer data protection act
  - Colorado – ColoPA. Colorado privacy act

Reference

- *A Gift of Fire. Social, Legal and Ethical Issues for Computing Technology*. Fifth Edition. Sara Baase and Timothy M. Hemry. Pearson

Online Security

Ifeoma Adaji

Learning objectives

- Define what online/cyber security is
- List and explain types of online security threats and ways to prevent them
- Explain what hacking is and the common types of hackers
- Explain who is responsible for online security
- Describe cyber security laws that exist in US and Canada

Online security

- Rules, actions and processes that happen to ensure safety on the internet
- Tactics for protecting activities and transactions carried out online
- Security is essential because:
  - Many of our daily activities are carried out online – tons of data and sensitive information is constantly being shared online
  - High risk of intrusion by hackers and cybercriminals

Types of online security threats

- Malware
- Denial of Service
- Phishing
- Botnet
- SQL injection

Malware

- Malicious software such as viruses, ransomware, spyware, computer worm created to harm or exploit a device or network
  - Virus. Computer code that replicates itself from device to device. Alters the way a computer operates. Needs human action to spread
  - Ransomware. Encrypts a victim's files until a ransom is paid to the attacker
  - Spyware. Aims to collect information about a victim (individual/company) and forward it to a third party without consent
  - Computer worm. Similar to virus but they spread on their own. Once in a system, a worm can, for example attach itself to an email and be delivered to all one's contacts.
- Can be used by cybercriminals to extract data they can leverage for financial gain
- Can be used to trick people into revealing personal data – identity theft
- Can be used to steal credit card or financial data
- Can be used for denial-of-service (DoS) attacks
  - DoS attack is when a computer/network is shut down or made unavailable to intended users

Preventing malware threats

- Hire cyber security experts
- Ensure cyber security updates and patches are up to date
- Use reputable antivirus and anti malware solutions
- Protect devices; keep o/s up to date, don’t click on link in popup
- Train employees on cyber security awareness so they avoid suspicious websites, emails with download links, etc.
- Limit user access and application privileges; restrict download permission to administrators
- Perform regular checks; run a scan using security software, check bank account regularly

Denial of Service

- DoS attack is when a computer/network is shut down or made unavailable to intended/legitimate users
- Cyber attackers flood computer or network with traffic so it is unable to respond or send it information that triggers a crash
- Individual networks can be affected by DoS attacks without being directly targeted
  - E.x. if a network's ISP or cloud service provider is a victim of a DoS attack, the network will experience a loss of service
- Symptoms include unusually slow network performance (opening files or accessing websites), unavailability of your website
- Detect DoS through network traffic monitoring/analysis – network administrator
- DDoS – Distributed denial of service. Same as DoS but attack is from a network of computers

Preventing DoS attacks

- Employ cyber security experts
- Sign up for DoS protection that can detect abnormal flow of traffic in your network. DoS traffic is filtered out while genuine traffic is allowed to pass through the network
- Create a disaster recovery plan to ensure recovery in a case of attack
- Install antivirus software and keep up to date
- Install firewall and configure to restrict incoming and outgoing traffic
- If experiencing DoS attack, contact network administrator; network admin can confirm if there is a DoS and identify the source and reroute traffic

Phishing

- Phishing is when a cybercriminal attempts to steal private or sensitive information from a user or a business
- Attackers use social engineering. Art of manipulating, influencing or deceiving you to gain access to your computer
- Commonly happens through fraudulent emails, text messages or social media
  - Ask you to verify your account, confirm billing address, send you a bill and ask you to verify/cancel by clicking link
- Attackers can hijack username/password
- Steal money/open credit card in one's name
- Make purchases
- Phishing emails
  - Request for confidential information
  - Use scare tactics, emotional language, portray a sense of urgency
  - Have misspelled URLs, spelling mistakes

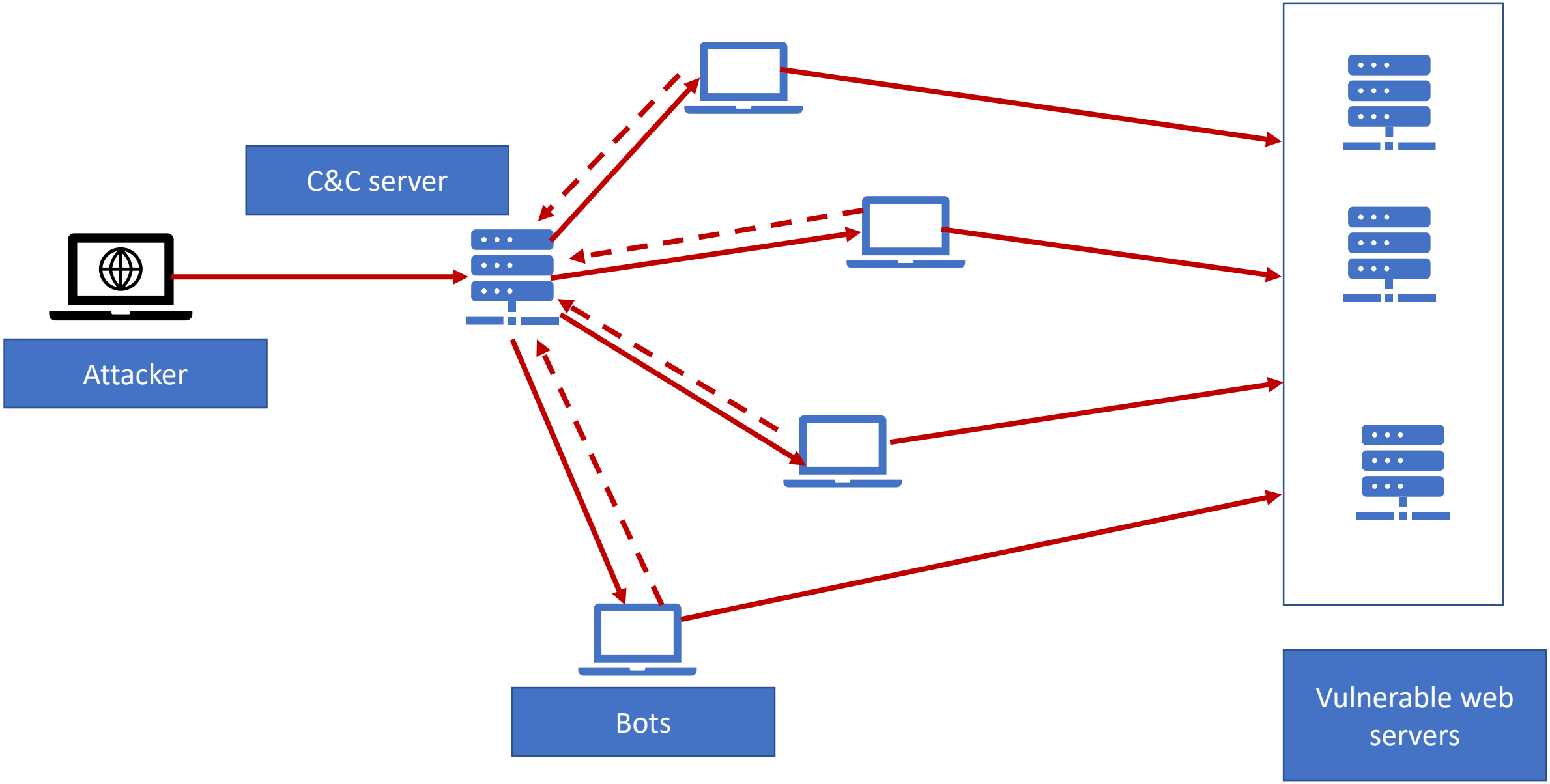
Preventing phishing attack

- Be suspicious of emails asking for personal information. Don’t provide personal information by email
- If suspicious of an email from say a bank, don’t click the link but go directly to the bank’s website or app and login from there
  - Contact the bank directly to ensure the email is legitimate
- Use varied and complex password for all your accounts or use a password management service/2 factor authentication
- Check personal accounts frequently
- A company should
  - Provide a way to report phishing emails
  - Run random phishing simulations
  - Create cyber security awareness training for employees
  - Use reliable email/spam filters
  - Require 2 factor authentication
  - Use email encryption for sensitive emails, emails with personal information

Botnet

- (Robot network), a network of computers infected by malware that are controlled by an attacker
- The attacker can use each computer on the network (bot) to simultaneously carry out criminal action like attack a company's network for financial gain
- Botnet remains under control of remote attacker, infected computers can receive updates and adapt to new instructions
- Attacker can use command and control (C&C) software
- Common actions of botnets:
  - Bulk spam emails
  - Distributed denial of service (DDoS) – most common
  - Financial breach
  - Malware

Botnet



Preventing botnet attacks

- Employ a cyber security expert
- Keep software up to date
- 24-hour monitoring of the network using analytics tools
- Monitor failed login attempts
- Use botnet detection solutions/tools

SQL injection

- Allows attacker to interfere with queries that an application makes to its database
- Attacker is able to view data that they are not normally able to retrieve – user data or data that the application can access
- Attacker can modify/delete data causing data integrity issues

SQL injection

https://somewebsite.com/products?category=Halloween

- String query = "SELECT * FROM products WHERE category = ' "+ input + " ' ";
- Application makes SQL query to database to retrieve products in Halloween category
- SELECT * FROM products WHERE category = 'Halloween' AND released = 1
- This SQL query asks the database to return:
  - all details (*)
  - from the products table
  - where the category is Halloween
  - and released is 1 – product has been released for sale, 0 – not yet released
- Hacker can construct SQL injection in the form

https://somewebsite.com/products?category=Halloween’--

- Results in query

SELECT * FROM products WHERE category = ‘Halloween'--' AND released = 1

-- is used for comments in SQL so rest of line from – is interpreted as comment

Database will process

SELECT * FROM products WHERE category = ‘Halloween’

and return ALL products released or not

Preventing SQL injection vulnerabilities

- Use prepared statements - parameterized queries
- Prepared statements always treat client-supplied data as content of a parameter and never as a part of an SQL statement.
  - String query = "SELECT * FROM products WHERE category = ' "+ input + " ' ";
- Do instead
  - PreparedStatement statement = connection.prepareStatement("SELECT * FROM products WHERE category = ?");
  - statement.setString(1, input);
  - ResultSet resultSet = statement.executeQuery();

Hacking

- Intentional, unauthorized access to computer systems
- Relies on security vulnerabilities to gain unauthorized access to devices or networks
- Hackers use malware (or other types of security threats) to break into an organization's network or a personal computer
  - Malicious hackers (Black hat hackers). Usually engage in criminal activity, such as breaking into protected digital systems without permission. Aim to steal and sell data for personal financial gain or work to modify, delete, or leak valuable data to harm an organization or individual
  - Ethical hackers (White hat hackers). Use their hacking skills to identify vulnerabilities in a network and improve security
  - Hactivists. Use of hacking to promote a political cause

- Is hacking that does no direct damage a bad thing?
- Is hiring former hackers to enhance security a good thing?

Responsibility for security

- Developers have a responsibility to develop with security in mind
  - OWASP Top 10
- Companies have a responsibility to hire security personnel who can use tools to monitor their systems to prevent security attacks
- Individuals have a responsibility to secure their home networks using firewalls, anti-virus and anti-spyware. Home users also have a responsibility to be cautious when clicking on links in their emails

Laws

- 1986 Congress passed the Computer Fraud and Abuse Act (CFAA)
- US cybersecurity bill designed to address legal and illegal access to federal and financial IT systems
- The law prohibits accessing a computer without authorization
- Covers government computers, financial and medical systems, and activities that involve computers in more than one state, including computers connected to the Internet

Laws

- *“Willful interception of private communications is a criminal offence under Section 184 of the Criminal Code of Canada, RSC 1985, c C-46 (the "**Code**"), with a maximum sentence of five years' imprisonment”*
- *“Section 342.1 of the Code prohibits fraudulently obtaining any computer service or intercepting any function of a computer system. Use of a computer system with intent to commit such an offence and use or possession of a computer password to enable such an offence are also prohibited. The maximum sentence is 10 years' imprisonment.”*
- *“Hacking has also been prosecuted under*
  - *Section 380(1) of the Code, which prohibits defrauding the public or any person of property, money, valuable security or a service*
  - *Section 430 of the Code”*

Source: https://www.mondaq.com/canada/security/1012302/cybersecurity-laws-and-regulations-2021

Links

- https://www.cbc.ca/news/canada/edmonton/macewan-university-phishing-scam-edmonton-1.4270689
  - MacEwan University phishing attack
- https://www.nbcnews.com/tech/security/ubiquiti-networks-says-it-was-victim-47-million-cyber-scam-n406201
  - Ubiquiti Networks Says It Was Victim of $47 Million Cyber Scam
- https://www.cpomagazine.com/cyber-security/verizon-data-breach-report-2021-pandemic-has-caused-major-surge-in-phishing-ransomware-and-web-app-attacks/
  - Verizon’s 2021 data breach report

Verizon's 2021 data breach report

"Denial of service (DDoS) were the most common type of attack, but social engineering and basic web application attacks caused the majority of data breaches. Among these breaches, a whopping 85% were attributed to a "human element." 61% additionally involved the use of unauthorized credentials. Over 10% of data breaches involved ransomware, double the number seen in 2019."

"In addition to the spike in ransomware attempts, the count of data breaches that involved phishing rose to 36% (from 25% the previous year). But in all the incidents that involved hacking, attacks on web applications were overwhelmingly frequent (80%)."

Source: https://www.cpomagazine.com/cyber-security/verizon-data-breach-report-2021-pandemic-has-caused-major-surge-in-phishing-ransomware-and-web-app-attacks/

Summary

- Online security are the tactics/ways for protecting activities and transactions carried out online
- Online security threats include malware, Denial of Service, phishing, botnet, SQL injection
- Hacking is the use of malware to break into an organization’s network or a personal computer
- Types of hackers include malicious hackers, ethical hackers, and hacktivists
- Everyone is responsible for online security; developers, companies and individuals
- Security laws exist to protect people/companies and to prosecute cyber criminals/attackers

Reference

- *A Gift of Fire. Social, Legal and Ethical Issues for Computing Technology*. Fifth Edition. Sara Baase and Timothy M. Henry. Pearson

Persuasion and Persuasive Technology

Ifeoma Adaji

Learning objectives

- Define persuasion
- Explain why it is important
- Describe persuasive technologies (PT)
- List its application areas with examples
- Explain personalization of PT and how it is done
- Describe the ethics of persuasion

Will you drink these?

- Friends on social media say you should drink it
- Health authority says you should drink it
- Limited in edition/scarce
- I drank something you offered me in the past without questions
- You promised to do what I asked you to do
- You like exploring new drinks

Persuasion

- Changing a person's attitude or behaviour without coercion
  - Commonly used by salespeople, fundraisers, marketers, recruiters, etc.
- There are many tactics (influence/persuasive principles) that are used by these people to influence others
- The communicator's prime goal at the time determines which influence principle they should use
  - When cultivating a positive relationship -> *liking*
  - When reducing uncertainty after a relationship has been established -> *social proof, authority*
  - When actual behaviour change is the goal after a long established relationship -> *consistency*

Changing Human Behaviour

- What is human behaviour?
  - An individual's habits, decisions, courses of actions, goal-setting, attitudes
- Changing human behaviour
  - Setting the environment so that it supports, cues, triggers the desired behaviour
  - Motivating people to do certain things
- Theories of Persuasion from Psychology
  - Persuasion can be used to influence participation in a social network

Human behaviour

- Human behaviour. The way people act, conduct themselves, their habits, emotions and values
- Can be biological; I write with my right hand
- Can be based on social interactions/identity; how one acts on Facebook could differ from how they act on LinkedIn
- Can be based on intellectual abilities; some people are more challenged by problem solving summary writing
- Can be cultural; people of certain cultures respect people in authority and will most likely do what they (authority figures) say
- Can be based on status; a new iPhone is out. To maintain one's social status, one needs to upgrade
- Can be based on gender; certain genders are more nurturing

Why change human behaviour?

- Social good
  - Stop bullying, start treating people better
- Health benefits
  - Lose weight, eat better, be more active, smoking cessation
- Economic benefits
  - Buy certain products (phone, clothes, books etc.)
- Academic rewards
  - Do better in school

Challenges of changing human behaviours

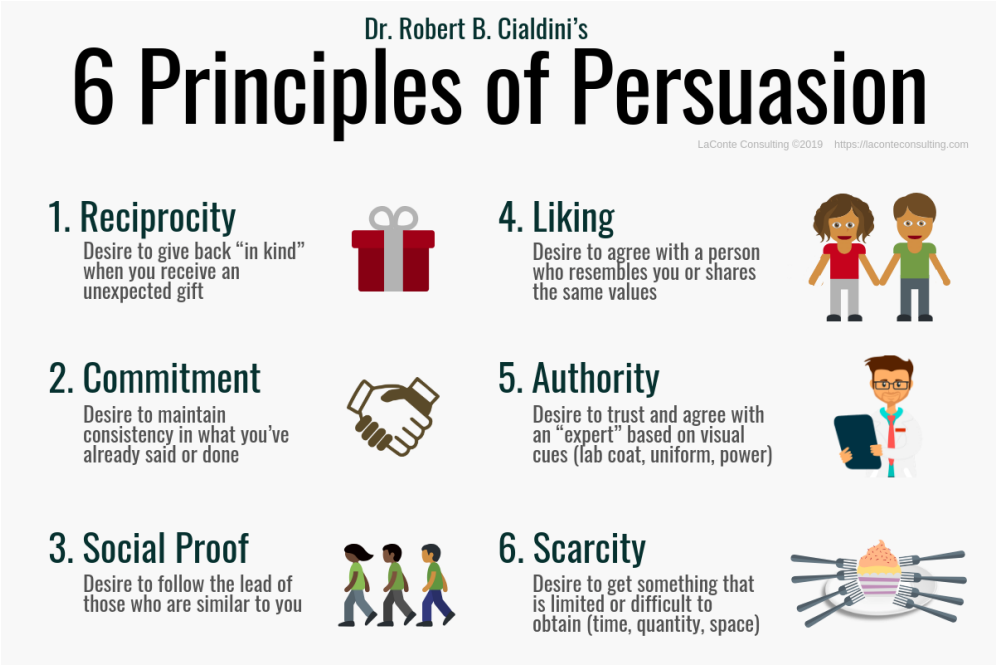
- People behave differently
  - How can a system adopt to a particular person’s behaviour
- Motivation can be intrinsic or extrinsic
  - How can both be implemented in a system
- Ethical issues of behaviour change
  - Is it ethical to persuade someone to shop for certain products? To adopt healthier lifestyles?

Persuasive strategies used in designing Persuasive Technologies

- BJ Fogg's 7 persuasive strategies
  - **Reduction** – Simplifying a task, e.g., one click by Amazon, click to share post
  - **Tunneling** – Sequence of steps to accomplish a task, e.g. install a new application
  - **Tailoring** – Customizing application to the user, e.g. When logged in, no need to **re-enter** shipping address on Amazon, being able to see your previous orders
  - **Suggestion** – "Recommended items similar to your past purchases" on Amazon, Netflix, YouTube etc.
  - **Self-monitoring** – Track one's behaviour e.g. past orders on Amazon, completed courses on Coursera
  - **Surveillance** – observe user in order to influence a target behaviour, e.g. surveillance camera in stores to prevent theft
  - **Conditioning** – reinforcement or punishment to a user to influence a target behaviour, e.g. rewards (badges, points) in Stack Overflow

Persuasive strategies used in designing Persuasive Technologies

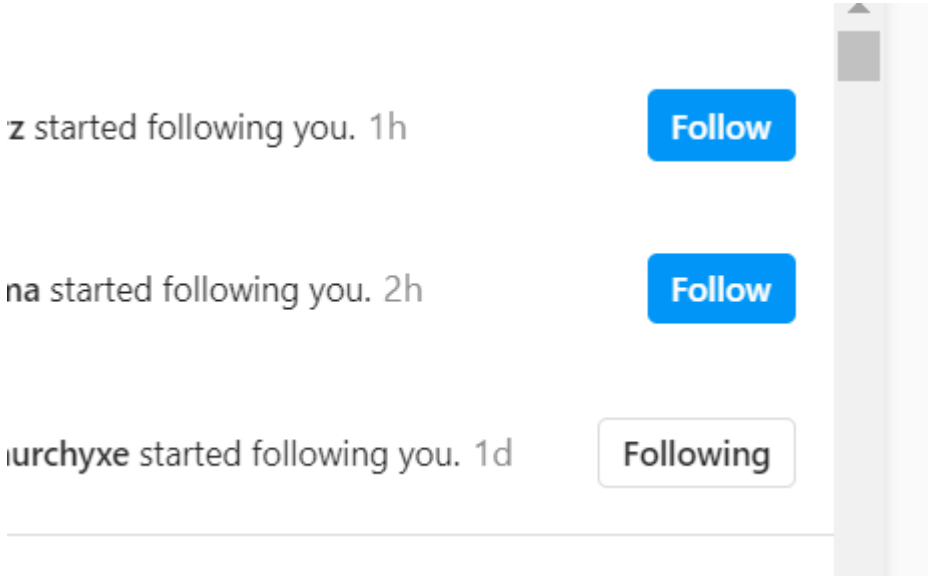
- Cialdini's 6 persuasive strategies
  - Reciprocity
  - Commitment
  - Social proof
  - Liking
  - Authority
  - Scarcity
- Recently added a 7th
  - Unity



https://laconteconsulting.com/2019/07/08/mlms-psychology-of-influence/

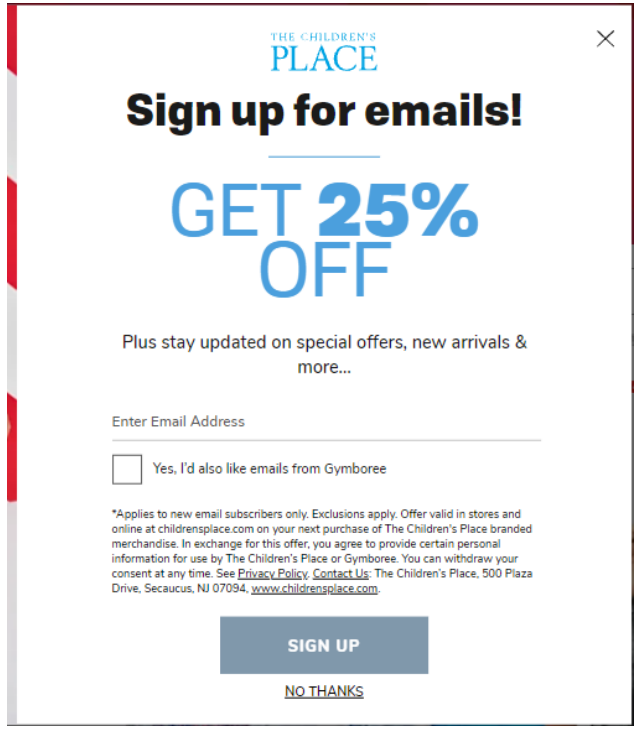
Reciprocity

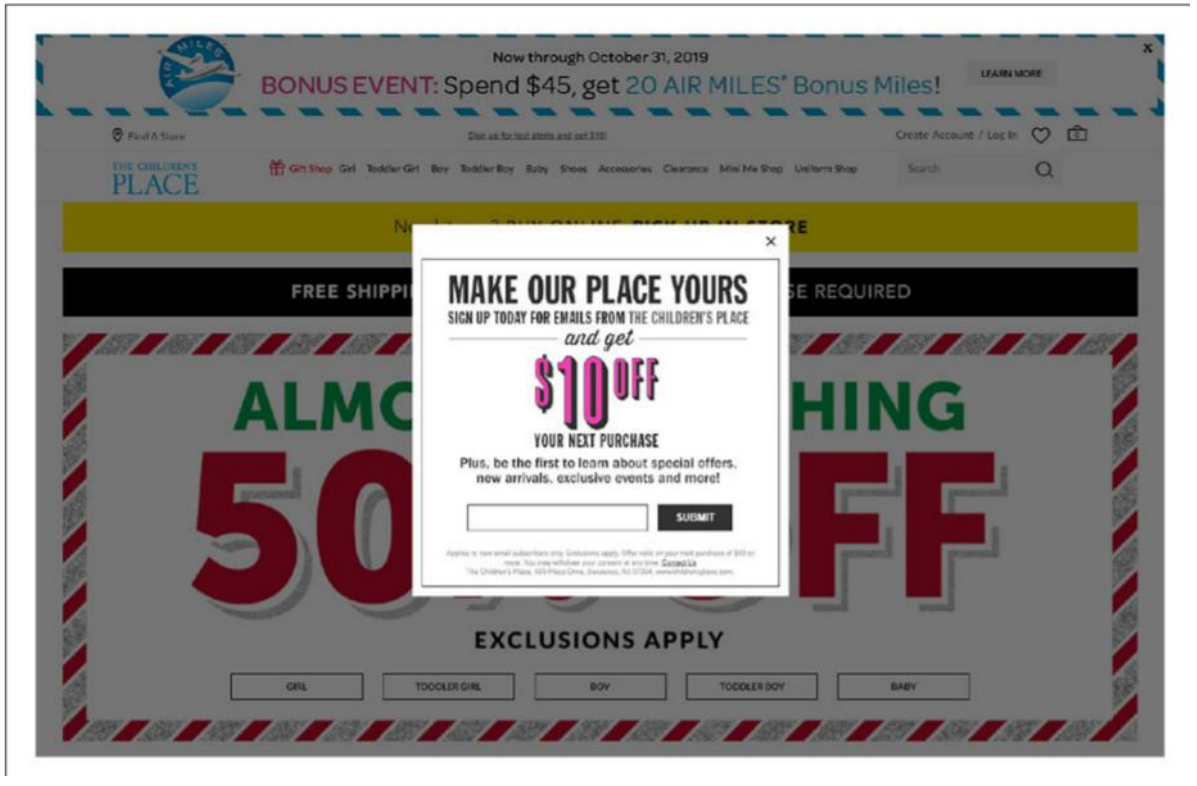
- Desire to give back when we receive an unexpected gift
- Span is not unlimited; desire to repay fades over time
- Following people in social media who follow us
- Buying products from companies that give us discounts



Commitment (& consistency)

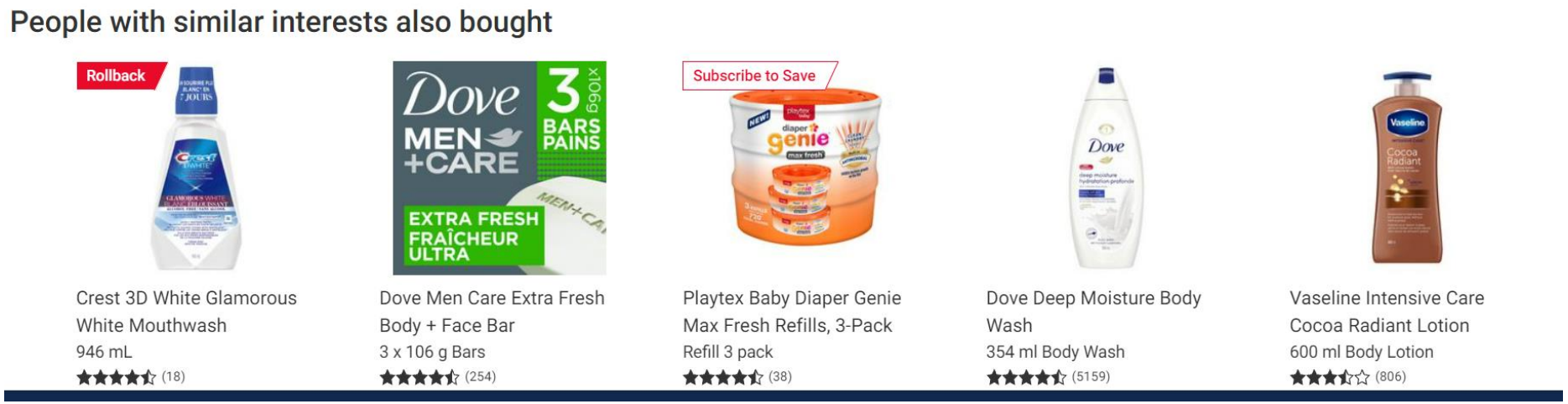
- Desire to maintain consistency in what we have said or done
- Inconsistency is undesirable; people tend to be consistent so they commit to what they said they would do





Social proof

- We look onto others to determine what we think is correct
- When unsure how to act, we look to see how others are acting/behaving



Liking

- Desire to agree with a person who resembles you (who you like) or shares same values as you
- We follow people on social media based on what we like about people
- Liking can be
  - Physical attraction
  - Similarity – opinions, views, culture, location etc.

Authority

- Desire to trust and agree with an expert (sometimes based on visual cues such as lab coat, religious dressing etc.)
- Obedience to authority figures

Top review from Canada

Product description

Top reviews from other countries

Review

"Robert Cialdini has done the impossible: he has improved a masterpiece. The new version of *Influence* is a marvelously rich and engaging account of the subtle power that people exert on each other." -- **Daniel Kahneman, Nobel Prize laureate and author of *Thinking, Fast and Slow* and *Noise***

"If there is only one book you'll ever read, if there is only one expert whose advice you'll trust, it should be this book and this author, Robert Cialdini." -- **Angela Duckworth, author of *Grit* and founder and CEO of Character Lab**

"This is the most important book ever written about the science of persuasion, and it just keeps getting better. I can't imagine a more fascinating, more practical read." -- **Adam Grant, *New York Times* bestselling author of *Think Again* and *Originals* and host of the TED podcast *WorkLife***

"Anyone who wants their abilities in communication or negotiation to be at their highest level *has* to read Robert Cialdini's book *Influence*. Your knowledge base is simply incomplete without it." -- **Chris Voss, author of the *Wall Street Journal* bestseller *Never Split the Difference***

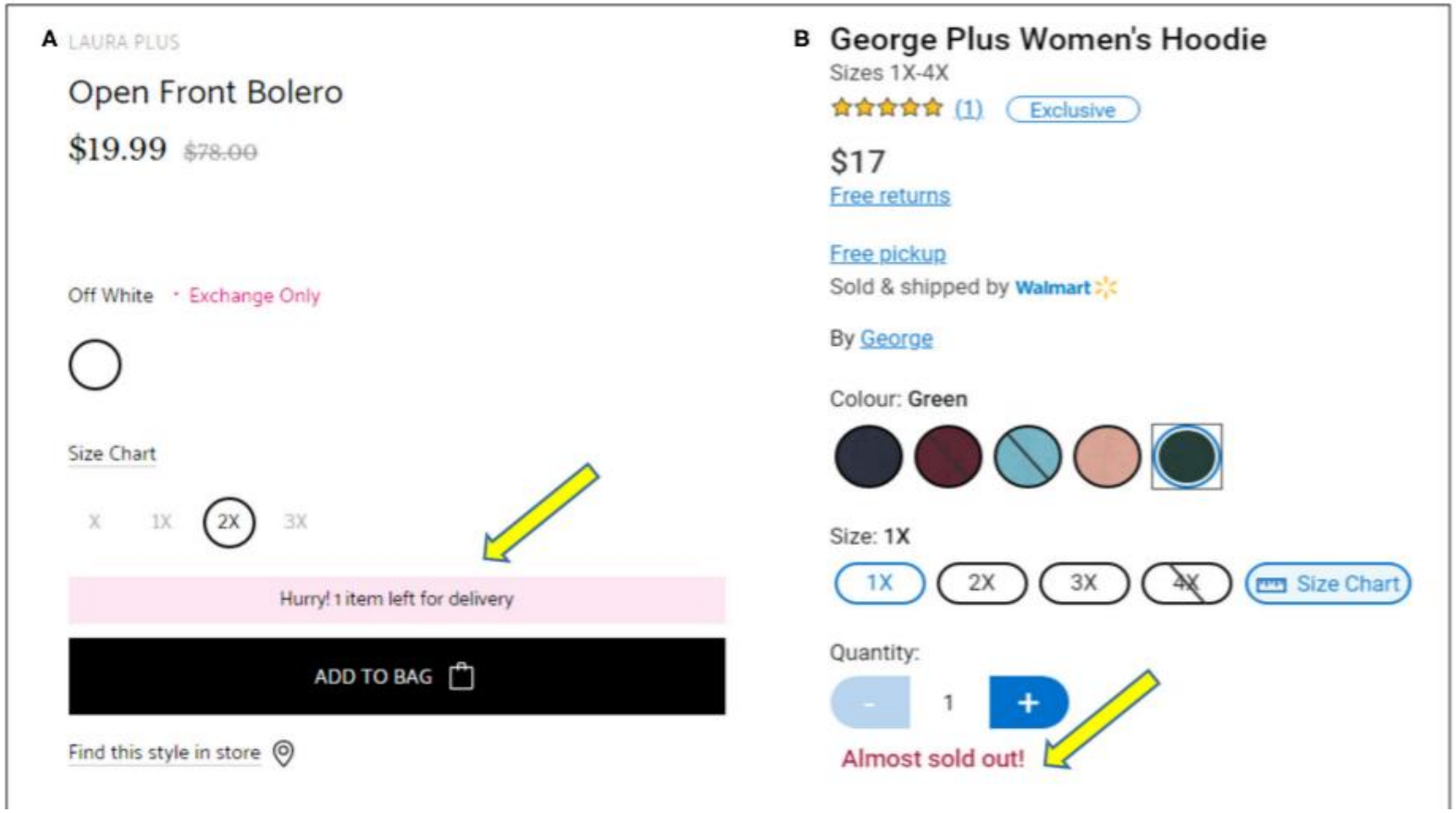
Scarcity

- Desire to get something that is difficult to get or limited
- Opportunities seem more valuable to us when they are less available
- People are motivated to make choices designed to avoid losing something of value to them
- In business, managers weigh potential losses more heavily than potential gains in their decisions
- About potential loss
  - “Less is best and Loss is worst”
- Rare items are seen as more valuable
- When an item is rare or unavailable, consumers' base its fair price on the item’s scarcity
- Words used to show scarcity: limited, rare, scarce, almost sold out

Unity

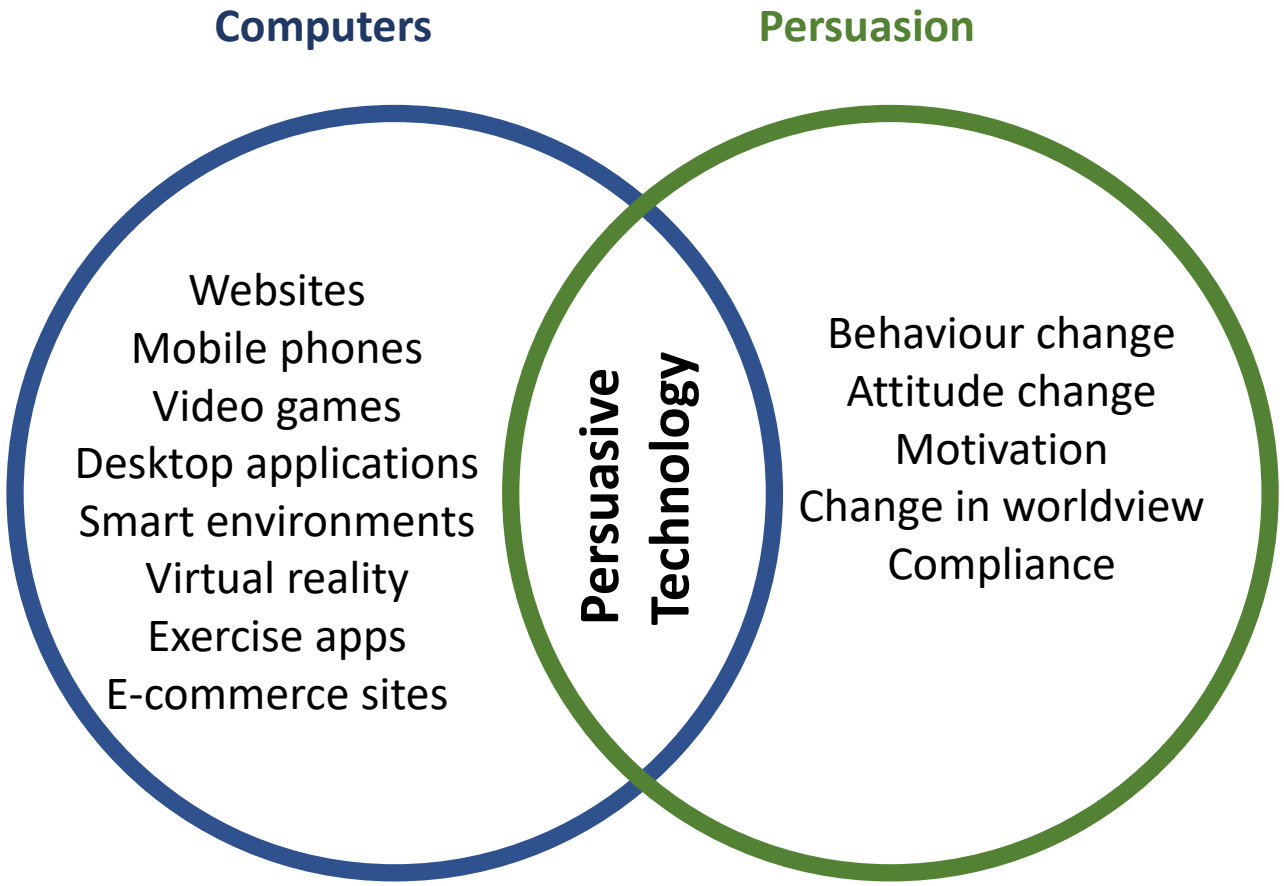
- Shared identity that the influencer shares with the person being influenced
- People tend to divide others into those with whom the pronoun “we” does and does not apply to
- Those within the “we” boundary get more agreement, trust, help, liking, support etc.
- What is the best way to characterize such “we” relationships?
  - How do you identify “one of us?” – people tend to say yes to people they consider one of them?
  - Can be social, physical, cultural
  - Doesn’t make it ethical and fair

Scarcity


A
LAURA PLUS
Open Front Bolero
$19.99 $78.00
Off White · Exchange Only
Size Chart
X 1X 2X 3X
Hurry! 1 item left for delivery
ADD TO BAG
Find this style in store
B
George Plus Women's Hoodie
Sizes 1X-4X
(1) Exclusive
$17
Free returns
Free pickup
Sold & shipped by Walmart
By George
Colour: Green
Size: 1X
1X 2X 3X 4X Size Chart
Quantity:
- 1 +
Almost sold out!

Persuasive technologies (PT) – Behaviour change systems

- *"Any interactive computing system designed to change people's attitudes and behaviors" –BJ Fogg*
- Use persuasive principles



Source: Dr. Julita Vassileva's lecture notes

Why use persuasive technologies

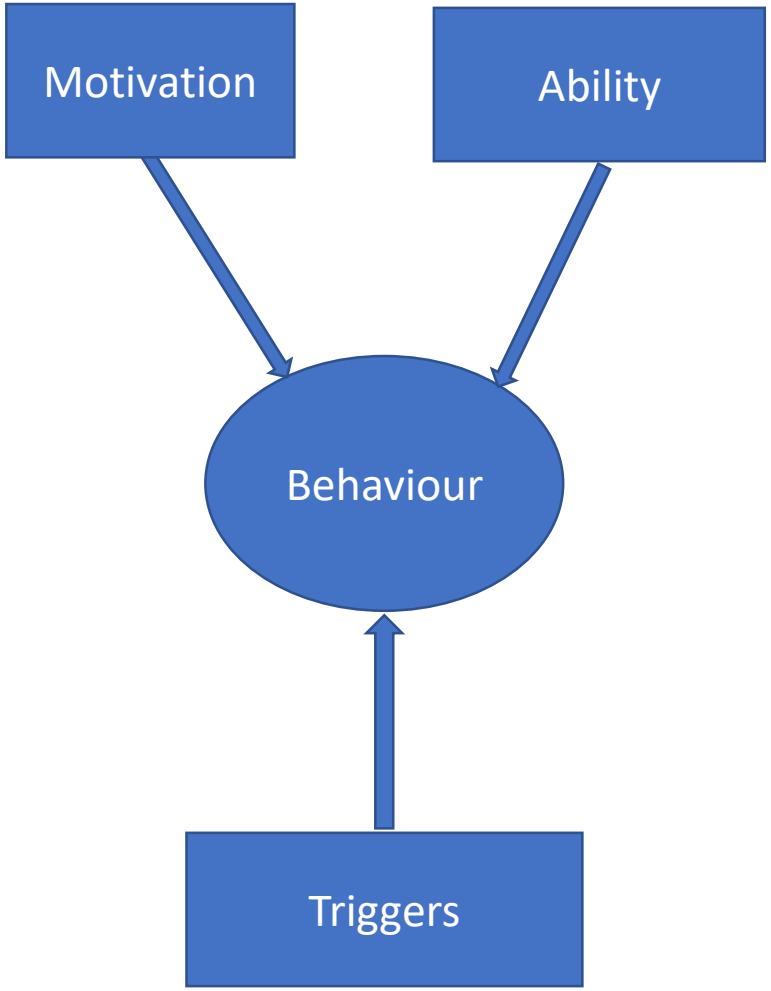
- Scalable
- Ubiquitous
- More persistent
- Greater anonymity

Several frameworks for PT

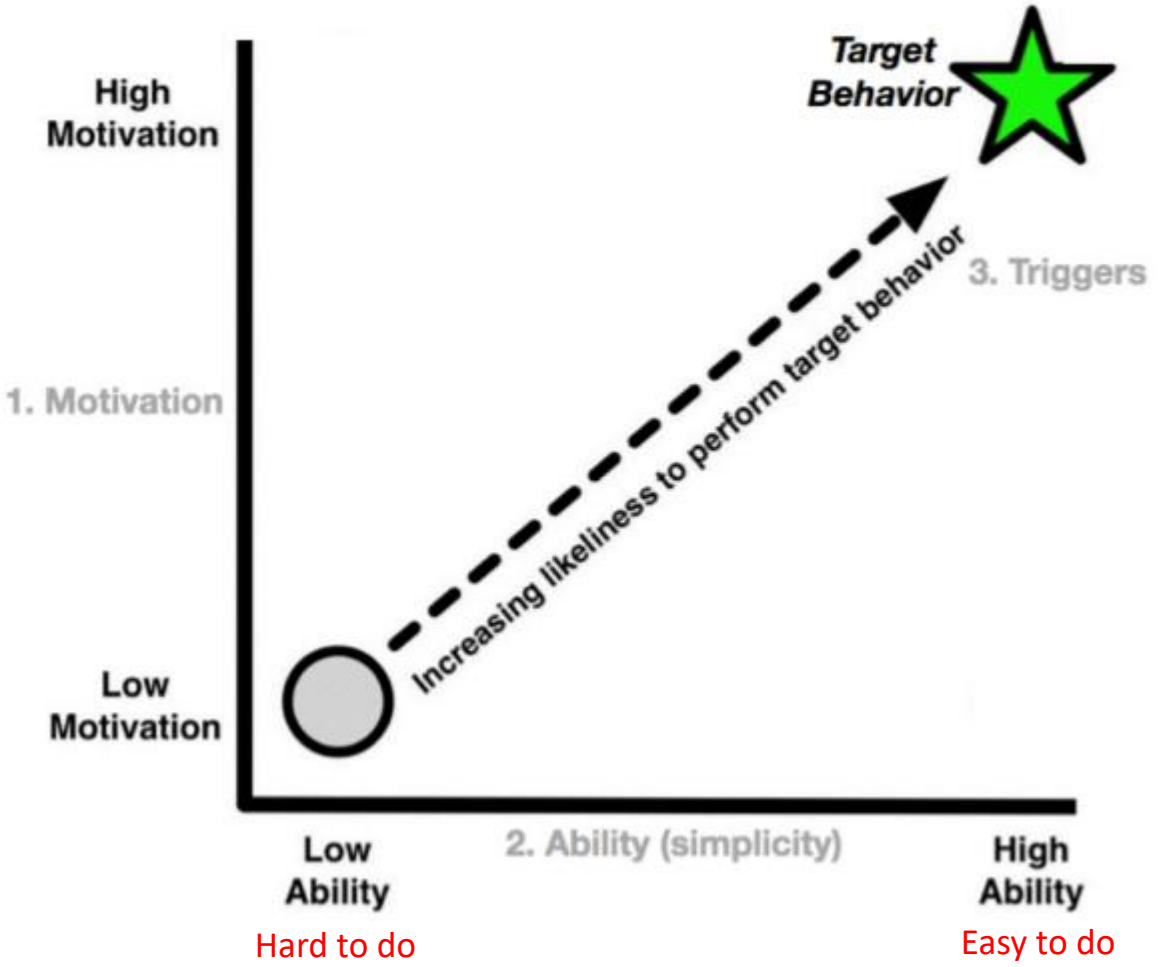
- Describe how the persuasive strategies should be implemented
- BJ Fogg behaviour model
- Persuasive systems design framework

BJ Fogg behaviour model (FBM)

- Model that help designers and developer understand the drivers of human behaviour
- 3 elements/factors must converge at the same time for a person to carry out a target behaviour
  - Motivation
  - Ability
  - Triggers or prompts
- These factors must occur at the same time
- FBM is useful in the analysis and design of persuasive technologies



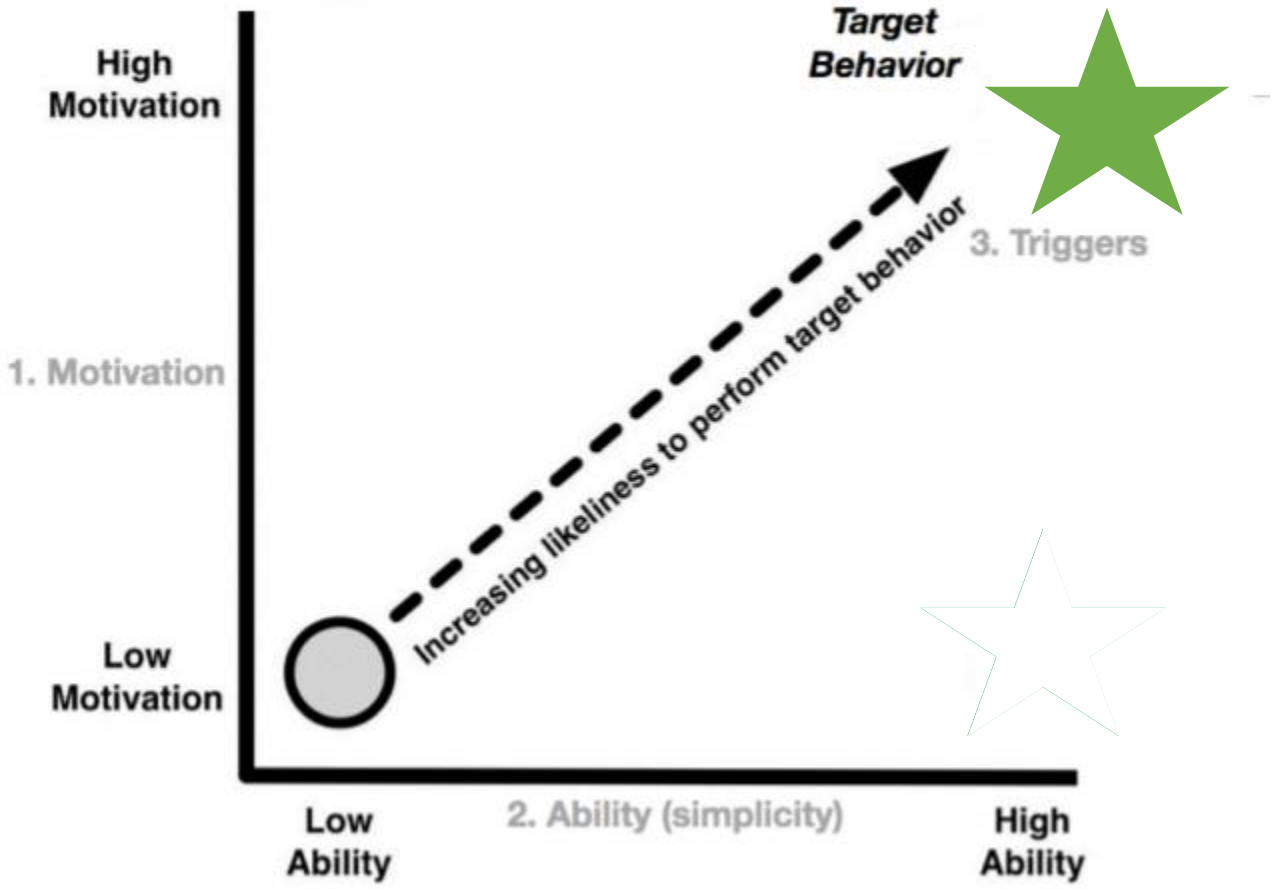
FBM – Motivation and Ability



- In most cases of persuasion, people are not on the extremes.
- People have at least a modest level of motivation and ability
- These levels can be manipulated.
- Effective persuasive technologies will boost either motivation or ability (making something simpler, like 1-click purchasing, easy to share a post) or both

Source: Fogg, Brian J. "A behavior model for persuasive design." *Proceedings of the 4th international Conference on Persuasive Technology*. 2009

FBM – Motivation and Ability



Things that can influence Motivation and Ability

Motivation

- Pleasure/pain – result is immediate
- Hope/fear – anticipation of an outcome (good or bad)
- Social acceptance/rejection – controls social behaviour
  - Strong motivation for people who use social media

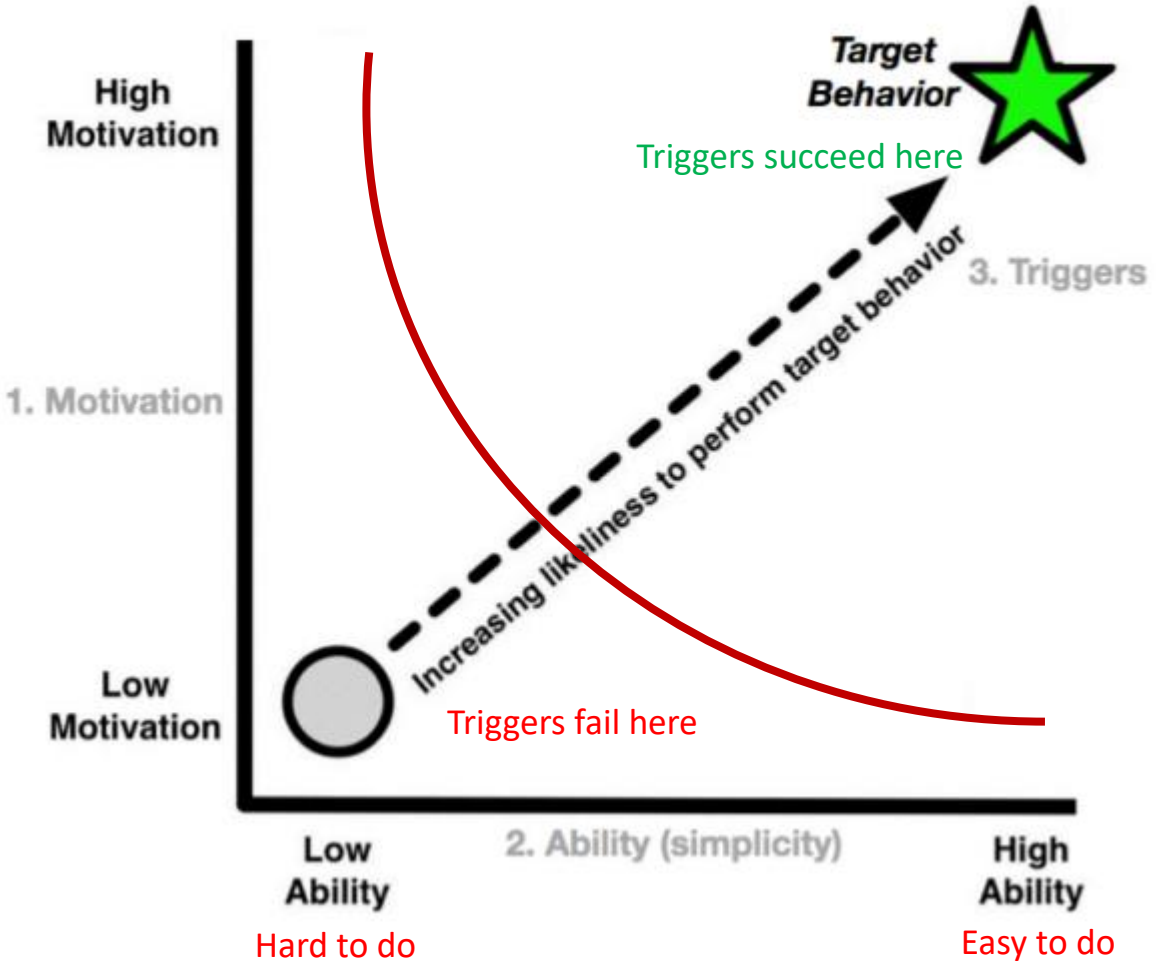
Ability

- Time
- Money
- Physical effort
- High intellect
- Social deviance – going against norms

FBM – Triggers/Prompts and Timing

- Something that prompts/causes us to carry out a target behaviour
- Without an appropriate trigger, target behaviour will not be carried out
- Trigger can take many forms; alarm, text message, email, pain etc.
- Successful triggers have 3 characteristics:
  - We notice it
  - We can associate the trigger with a target behaviour
  - Trigger occurs when we are motivated and able to achieve the behaviour
- Timing is very important in making a trigger successful

FBM – Triggers/Prompts and Timing



- Red curve is activation threshold
- Below the line, triggers won't lead to target behaviour
- Applications don't always do a great job of triggering behaviour
  - Spam mails, pop-ups, ads not always effective

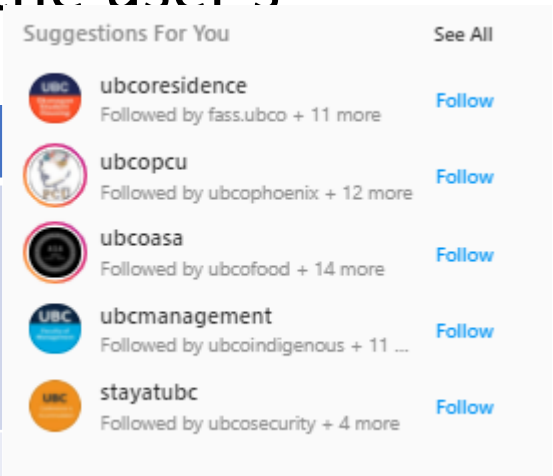
Persuasive Systems Design Framework - PSD

- Developed by Harri Oinas-Kukkonen and Marja Harjumaa, 2009 (University of Olulu, Finland)
- A system's persuasiveness is mostly about system qualities.
- 3 categories of system design principles when developing persuasive technologies
  - Primary task: Reduction, tunneling, tailoring, personalization, personalization, self-monitoring, simulation, rehearsal
  - Dialogue support: Praise, rewards, reminders, suggestion, similarity, liking, social role
  - System credibility: Trustworthiness, expertise, surface credibility, real-world feel, authority, 3rd party endorsements, verifiability
  - Social support: Social learning, social comparison, normative influence, social facilitation, cooperation, competition, recognition

Primary task support

- Design principles in this category support carrying out the user's primary task

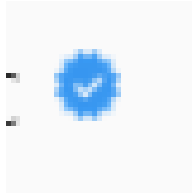
Principle	Explanation	Example implementation
Reduction	A system should reduce a complex task into smaller ones	"Buy now with 1-click" option in Amazon. Adding multiple friends from the same window on IG, FB.
Self monitoring	A system should provide ways in which users can track performance, status, progress	Profile showing number of friends, number of followers, number of posts. Mobile app showing step counts.
Personalization	A System should offer content specific to users	Recommendations from FB differ from person to person.
Rehearsal	A System should provide ways of "practicing" a target behaviour	Amazon's "Look inside" feature. Being able to use a site/application before registering, for example, searching for people on Facebook/LinkedIn without having an account.



Dialogue support

- Interactive systems provide some feedback to users
- The design principles in this category support computer-human dialogue to keep users moving towards their goal or target behaviour

Principle	Explanation	Example implementation
Praise	System should praise users in form of words, images, symbols, audio etc.	Upvotes, likes, “best answer” vote on Stack Overflow
Rewards	System should provide virtual rewards for performing target behaviour	Verification badge/check in social media
Reminders	System should remind users to carry out a target behaviour	Email reminders to rate a product on Amazon
Suggestions	System should suggest how users can carry out a target behaviour	Suggestions for people to follow on Instagram, Facebook and LinkedIn. Suggestions of products to purchase on Amazon



System Credibility Support

- Show how to design a system that is perceived as credible by users

Principle	Explanation	Example implementation
Trustworthiness	System should provide truthful, fair and unbiased information	“Sponsored” and “verified purchase” on Amazon
Verifiability	System should provide means of verifying claims on site	Links to other websites such as Goodreads and IMDB on Amazon
Surface credibility	System should look credible	Too many ads on a site, not using https

Social support

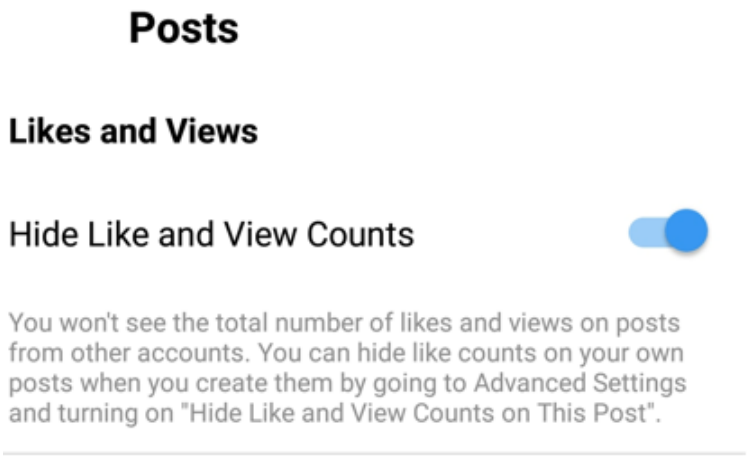
- Describes how to design the system so that it motivates users by leveraging social influence

Principle	Explanation	Example implementation
Social comparison	System should provide ways in which users can compare themselves to others	View profile of others, see number of comments/upvotes/likes a post has
Recognition	System should provide ways of recognizing users	Verification badge/check in social media

Personalization

- Friends on social media say you should drink it – social proof
- Health authority says you should drink it - authority
- Limited in edition/scarce - scarcity
- I drank something you offered me in the past without questions - reciprocity
- You promised to do what I asked you to do – commitment
- You like exploring new drinks - liking

Personalization



- Persuasion is more effective when tailored to individuals or groups of similar people
- Personalization. Designing persuasive technologies or using persuasion in a way that appeals to individuals or groups of similar individuals
- Health applications - Age, gender, weight, height
- Social media – control over features in app
  - Private account
  - Hide comments with certain words
- Gaming – using gamer type (BrainHex gamer types) and gaming elements (rewards, status, loyalty, social connections) - *Orji, Rita, et al.*
- E-commerce –using users' shopping motivation and behaviour - *Adaji, Ifeoma et al.*

Ethics of persuasion; Persuasion vs Coercion

- Persuasion is not coercion, ethically there are differences
- Coercion uses force or threats
- For example threatening to fire someone if they do not comply to your directives
- Coercion doesn’t give people control of the situation
- There is no option to opt out.
  - Persuasion steer people in particular directions but also allow them to go their own way
- There are consequences if one does not comply

Ethics of persuasion; Persuasion vs Coercion

- Coercion is unacceptable unless it is designed to prevent harm to others and prevent breaking the law.
  - For example, large fines, jail, if people don’t comply with a government directive such as paying taxes
- Generally people are of the opinion that persuasion is okay if
  - Should be transparent and not misleading
  - Control is given to the user
  - They have the option to opt out, say “no”, stop communication etc.
  - Does not cause harm
  - Is for social good

Ethics of persuasion; Persuasion vs Coercion

- Coercion:
  - *"If you don't like and share my post on social media, we will stop being friends"*
- Persuasion*:*
  - *"All your friends have shared my last post on social media, why don't you share it too"* – Social proof
  - *"My last post on social media is about a new technology that WHO says can save lives, why don't you share it too"* - Authority
  - *"I shared your last post, shy don't you share mine"* - Reciprocity
  - *"You said you would share my last post, you still haven't"* - Commitment

Discussion articles

- https://medium.com/swlh/amazon-is-changing-how-it-nudges-in-response-to-coronavirus-c4b47cfba45d
- https://www.thestar.com/business/tech_news/2018/02/23/amazon-wristbands-could-track-workers-hand-movements.html
- https://www.cbsnews.com/news/facebook-new-measures-teens-kids-harmful-content/

Summary

- Persuasion is influencing people to carry out a target behaviour
- Several strategies exist to achieve this
- Persuasive technology is the use of persuasion in systems design to build applications that can influence people’s attitude or behaviours
- Persuasion can be ethical
- Persuasion is different from coercion

References

- Influence, New and Expanded: The Psychology of Persuasion by Robert Cialdini, 2021
- Fogg, B. J. (2009, April). A behavior model for persuasive design. In *Proceedings of the 4th international Conference on Persuasive Technology*(p. 40). ACM.
- Oinas-Kukkonen, Harri, and Marja Harjumaa. "Persuasive systems design: Key issues, process model, and system features." *Communications of the Association for Information Systems* 24.1 (2009): 28.
- https://www.nytimes.com/2015/11/01/upshot/the-power-of-nudges-for-good-and-bad.html
- Orji, Rita, et al. "Tailoring persuasive health games to gamer type." *Proceedings of the sigchi conference on human factors in computing systems*. 2013
- Adaji, Ifeoma, Kiemute Oyibo, and Julita Vassileva. "E-Commerce Shopping Motivation and the Influence of Persuasive Strategies." *Frontiers in Artificial Intelligence* 3 (2020): 67.

Recommender Systems

Ifeoma Adaji

Learning objectives

- Define recommender systems and state why they are important
- List domains where recommender systems are used
- List the goals of recommender systems
- Explain the three common algorithms for recommendation
  - Describe how they differ
  - Give examples of where they are used
  - List the advantages and limitations of each
- Explain the utility matrix of recommender systems

Recommender systems

- Also called recommendation systems
- Predict a user's rating or preference for an item
- Algorithms that suggest relevant items to users
  - Movies to watch, books to read, products to buy
- Aim to predict users' interests; recommend items that users will find interesting
- Use feedback data from likes, ratings, reviews to infer people's interests
- Based on previous interaction between users and items – movies, books etc.

Why recommender systems?

Too many choices. Users can’t see all; they will have a hard time choosing

- A lot of user generated content online
  - Posts on social media, news paper articles
- Online stores have a lot of inventory
  - Amazon is a market place with many sellers with lots of products
  - Netflix has lots of movies. How many?
  - Audible has lots of books
  - Spotify has lots of music etc.
- Too many types of ads.
  - Which should users see?

Goals of recommender systems

- To assist users to find what they want
- To help users make decisions according to needs, interests, and goals
- Relevance
  - Recommend items that are relevant t the user
- Novelty
  - Helpful when recommended item has not been seen by user and is relevant
- Serendipity
  - Surprising, pleasant, beneficial recommendation
- Increasing recommendation diversity
  - Ensures user doesn’t get bored by repeated recommendation of similar items
- Can improve overall user satisfaction and customer loyalty
  - Relevant recommendations can lead to repeat clients

Classic algorithms for recommendation

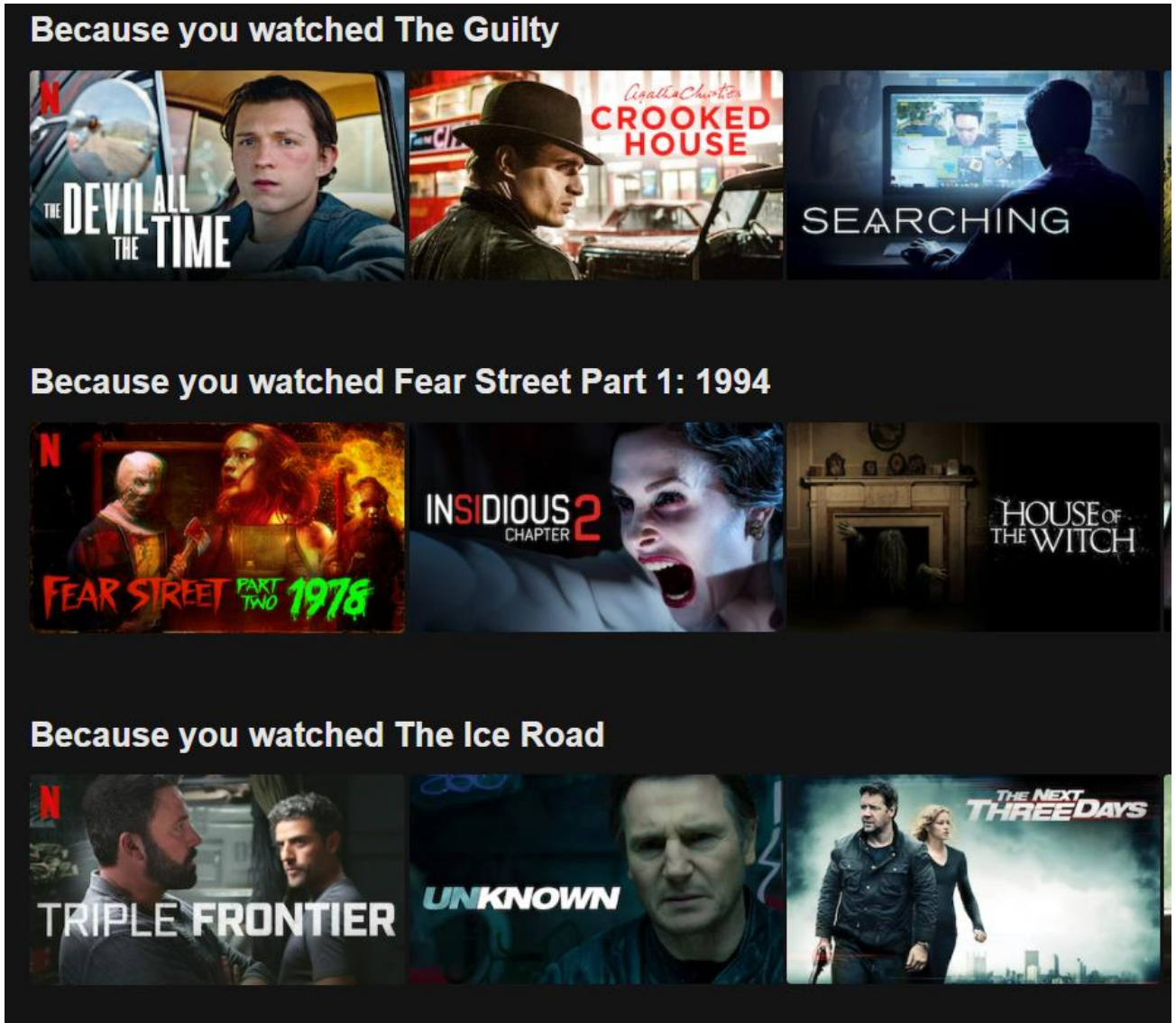
- Feature based (content based)
  - Recommendation is based on the descriptive attributes of the items being recommended
  - Descriptive attributes include movie genre, actors, producers, authors
- Collaborative filtering
  - Recommendation is based on ratings provided by multiple users
  - Example, recommend books that other user have bought before
- Hybrid
  - Feature based + collaborative filtering

Utility matrix

USERS	HP1	HP2	HP3	TW	SW1	SW2	SW3
A	4			5	1		
B	5	5	4				
C				2	4	5	
D		3					3

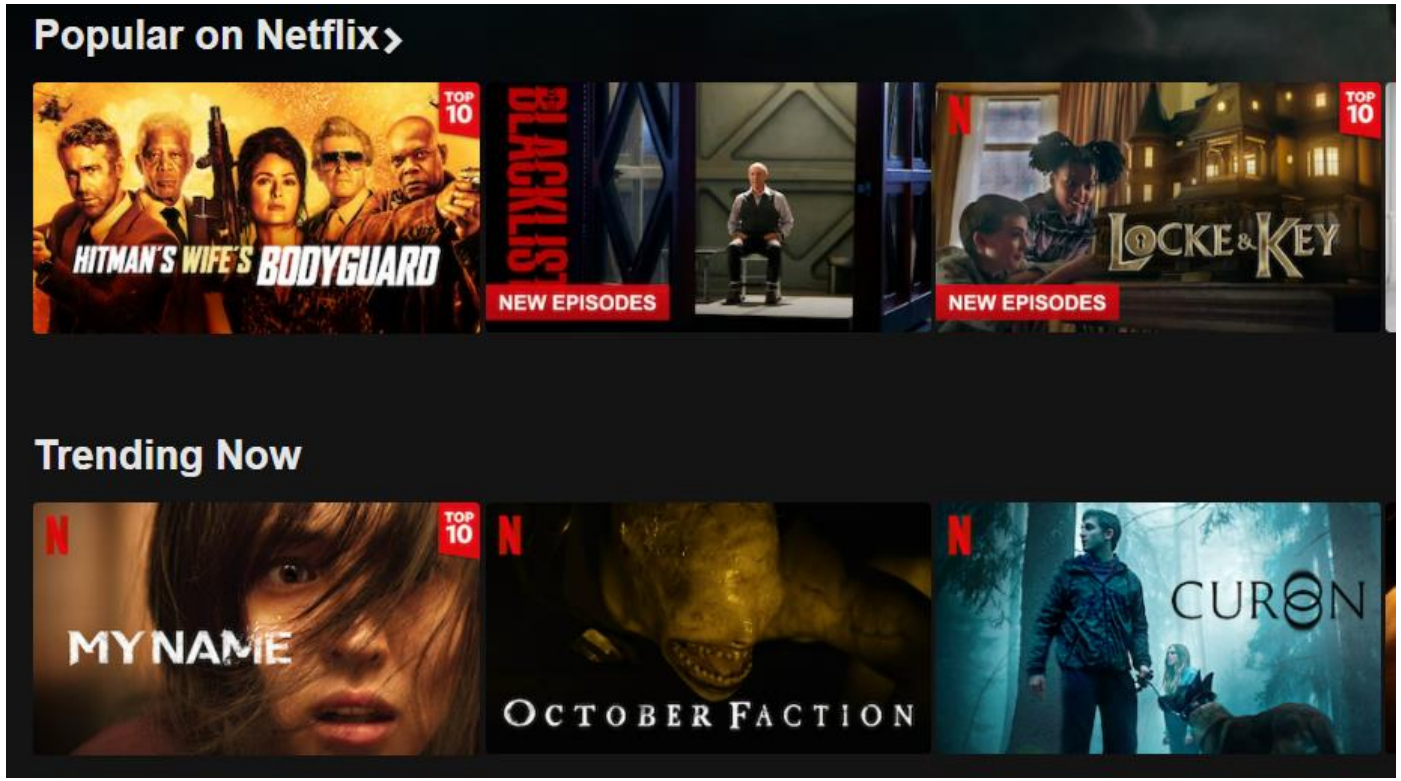
- In recommendation systems, 2 classes of entities: users and items
- The data is represented as a utility matrix; for each user-item pair, a value that represents the degree of preference of the user for the item.
- Values come from an ordered set, e.g., integers 1–5 representing the number of stars that the user gave as a rating for that item
- Matrix is usually sparse with unknow entries; user hasn't rated item yet
- The goal of a recommendation system is to predict the blanks in the utility matrix. For example, would user A like SW2?

Feature/content based filtering – based on attributes of items



Source: Netflix.com

Collaborative filtering – based on ratings of others

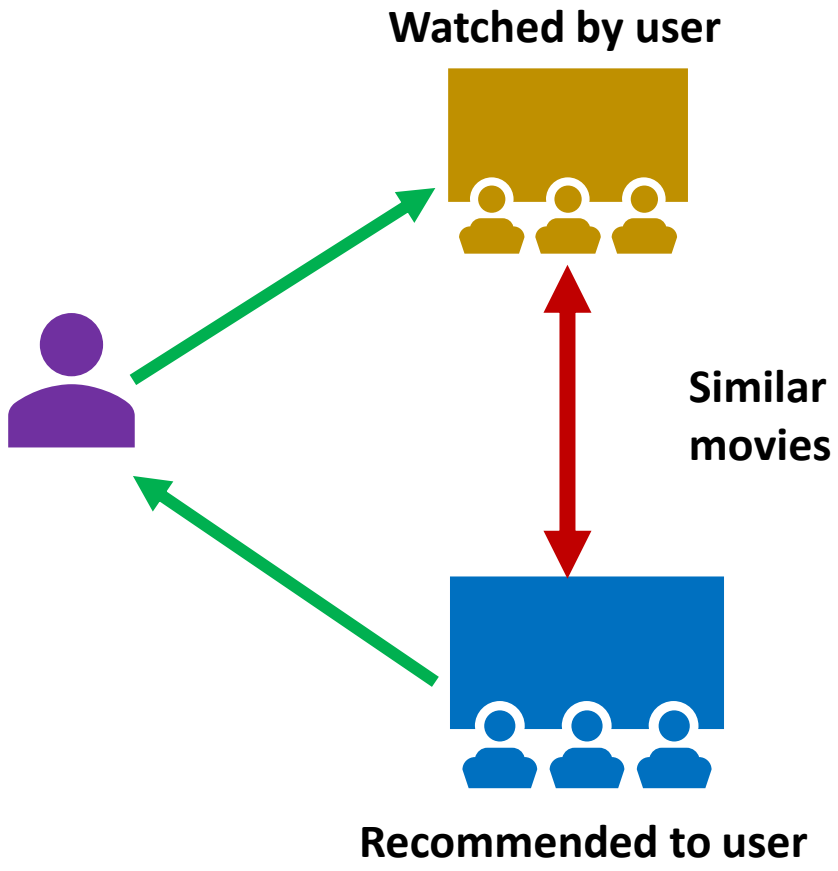


Source: Netflix.com

- What recommendation algorithm does Facebook use?
- What recommendation algorithm does Amazon use?

Feature based recommendation

- General Idea
  - Given a set of items that user has shown interests before or the preferences explicitly specified by user, find the most similar items that user might be interested in now
- Similarity of items is determined based on features
  - Example: movie's features: genre, director, actors, etc.
  - Example: book features: genre, author, year of publication
- Advantages:
  - Takes into account features of items, easy to explain why a certain item is recommended
  - Similarity of items can be processed offline in advance to save online computation time
  - Recommendation right away based on explicit specification of user's preferences (even works for newcomers)



Feature based recommendation

Limitations:

- Overspecialization, *obvious* recommendation
  - Recommend only items that are similar to those already rated
  - Example: a person with no experience with Greek food would never receive a recommendation for even the greatest Greek restaurant in town
- Limited content analysis
  - Limited by features that are explicitly associated with objects that these systems recommend, normally manually encoded
  - Features depend on context, type of content
  - Example: features of video content cannot be processed automatically
- No wisdom of the group
- What happens to a new user who has never liked/rated/read an item before?

References

- Recommender Systems: The Textbook 1st ed. 2016 Edition, by Charu C. Aggarwal, Springer
- Prof. Julita Vassileva’s lecture notes on social computing

Reputation Mechanisms

Ifeoma Adaji

Learning objectives

- Describe what reputation systems are and why they are important
- List some challenges of reputation systems
- Describe some examples of reputation systems
- List things to consider when designing reputation systems

Before reputation systems

- No outside instrument of reputation
- Easy for sellers to misrepresent products
- Easy to ship slowly after receiving payment
- Buyers were forced to assume risk
  - Buyers were not willing to pay high prices

Reputation systems

- Reputation. Belief or opinions held about something or someone
- Reputation. Information used to make value judgement about something or someone
- Modern web based reputation systems are deeply rooted in physical world social systems.
  - Credit score – measure of credit worthiness
  - Supply industry – companies rate suppliers
  - Consumers digest – used to publish five-star ratings long before personal computers
- People have reputation, so do things
  - Schools, restaurants, companies

Reputation systems

- Reputation takes place (is earned) within a context
  - Best buy has a high reputation for electronics (maybe not so high for furniture?)
  - Reputations earned in one context can influence reputation in other contexts
- Reputation is used to make decisions. Can be
  - Assertions about something by 3rd party
  - Factual statistics
  - Prizes or awards someone/something has earned
- Reputation follows the structure
  - A *Source* makes a *claim* about a *target*

Online reputation systems

- Before web 2.0, it was almost impossible to gather enough information about a product's quality from friends, co-workers, family etc.
- Online Reputation systems. Programs or algorithms that let users rate others in online communities to develop trust through reputation
- Reputation systems allow members of a community to submit their opinions about others in the community
- Submitted feedback is analyzed, aggregated and made publicly available to the community
- Top websites use reputation to improve products and services

Why reputation systems

- Applications and algorithms use reputation to sort and filter content before presenting to users
  - Where to eat, what to watch, from whom to buy
- Reputation systems collect, aggregate and distributes feedback
- Reputation systems bring structure to chaos
  - There’s a lot of information online; impossible to filter/sort all
  - Inform buyers whether potential trading partners are trustworthy
- Deters opportunistic behavior
  - Past actions affect future business
  - Open record of transaction history

Challenges of reputation systems

- Exploitation
  - New accounts, colluding
- No central history of reputable transactions or universal identity as you have in physical world
  - How do you identify people online; different identities on different platforms
- Scale
  - How can we manage and present the overwhelming inflow of users' contribution
- Engagement
  - How should contributions be rewarded to keep users engaged and willing to continue
- Moderation
  - How to identify and quickly remove spam, trolls or fake reviews/rankings

Potential solutions

- Limit Reputation by context
  - Reputation in one platform should not influence/affect reputation on another platform
- Focus on quality over quantity
  - When users are rewarded for contributing content to reputation, the users can be motivated to give feedback because of the rewards not experience
  - This can lead to abuse of the system e.x. Digg
- Mitigate Abuse through meta-moderation
  - Rate the raters; second level cross check of ratings & reviews

Example of RS

- Based on product reviews
  - Customers are ranked based on the quality and helpfulness of their reviews by other Amazon customers
  - Built in meta-moderation model, "*Was this review helpful*"
  - *Top Reviewers* program tracks reputable reviews and trusted reviewers; shows top reviewers at the moment
  - *Hall of Fame Reviewers* shows highly ranked reviewers from previous years

- https://www.amazon.com/hz/leaderboard/top-reviewers

- https://www.amazon.com/hz/leaderboard/hall-of-fame

- https://www.amazon.com/vine/about

Is this ethical in your opinion?

Example of RS

ebay Feedback Forum

Shop by category | Search for anything | All Categories | Search | Advanced

Feedback Forum

Find a member | Enter User ID or email address | Search

Each time you buy or sell something, you have an opportunity to leave Feedback about your experience. That Feedback is an essential part of what makes eBay a successful community.

Feedback consists of a positive, negative, or neutral rating, along with a short comment. Buyers and sellers build reputations that are based on all the Feedback ratings and comments left by their trading partners.

This information is available in each member's Feedback Profile, and helps prospective trading partners buy and sell with confidence.

More fast facts about Feedback:

- Along with an overall rating, buyers can also rate sellers on the details of the purchase. These detailed seller ratings are anonymous, and don't count toward the overall Feedback Score.
- Since Feedback becomes a permanent part of your record, buyers are encouraged to contact sellers to try to resolve any issues before leaving neutral or negative Feedback.
- Buyers can revise Feedback they've left for sellers in the case of a mistake.
- Sellers can leave only positive ratings for buyers. That means buyers should feel free to leave honest Feedback without fear of retaliation. We also have safeguards in place to protect sellers against unfair negative or neutral Feedback.

Feedback basics

All about Feedback
Frequently asked questions
Feedback policies
Detailed seller rating tips for sellers
Protecting the seller's reputation
Take a tutorial on Feedback

Feedback tools

Leave Feedback
View a Feedback Profile
Reply to Feedback received
Follow up to Feedback left
Request Feedback revision
Make Feedback public or private
Report buyer problems

Read a note from eBay's founder, Pierre Omidyar, outlining the philosophy, values, and benefits of the Feedback Forum.

https://www.ebay.com/fdbk/feedback_profile/buyspry?q=334133291704&_trksid=p2047675.l2560

"Since Feedback becomes a permanent part of your record, buyers are encouraged to contact sellers to try to resolve any issues before leaving neutral or negative Feedback."

- What is your opinion of this? Is it ethical?

"Sellers can leave only positive ratings for buyers."

- https://pages.ebay.com/services/forum/feedback.html

Source: https://pages.ebay.com/services/forum/feedback.html

Example of RS

- Ranking is carried out by service provider and customer
- Are there any benefits?
- What are the disadvantages?

Example of RS

During a recent stay at an Airbnb in Brazil, my host invited me to eat a traditional local snack of pão de queijo and have tea. It was a lovely gesture, but it was 10 p.m. and I had arrived from an 18-hour bus ride through the countryside earlier that day.

I just wanted to sleep.

But when gauging whether to go to bed or be friendly, I had to consider another factor: My Airbnb rating. The app lets hosts and guests rate each other on cleanliness, friendliness and "overall experience." If I rejected her invite, would the host think I was rude? Or, if I did eat with her, would she think I was freeloading and look upon me less favorably?

Source: https://www.marketwatch.com/story/how-rating-everything-from-your-uber-driver-to-your-airbnb-host-has-become-a-nightmare-2019-04-01

Example of RS

- *“Reputation is a rough measurement of how much the community trusts you; it is earned by convincing your peers that you know what you’re talking about. The more reputation you earn, the more privileges you gain and the more tools you'll have access to on the site - at the highest privilege levels, you'll have access to many of the same tools available to the site moderators.”*
- Some ways to gain reputation include:
  - question is voted up: +10
  - answer is voted up: +10
  - answer is marked “accepted”: +15 (+2 to acceptor)
  - suggested edit is accepted: +2 (up to +1000 total per user)
- Some ways to lose reputation include:
  - your question is voted down: −2
  - your answer is voted down: −2
  - you vote down an answer: −1
- https://stackoverflow.com/help/whats-reputation

Designing reputation systems

- Online reputation has real world implications so methods matter
- Know your users
  - Not everyone is a creator, most people are users of the system
  - Not everyone has good intentions; spammers, trolls exist
- Positive and negative reputations count
  - Don’t exclude negative reputations
- Reward high-quality content – incentive mechanisms (badges in Amazon and Stack Overflow)
- Motivate quality contributors – think persuasive strategies
- Increase visitor value and contributions – think persuasive strategies

Designing reputation systems

2 questions to ask:

- What is the content control pattern?
  - Who is going to create, review and moderate content
- What types of incentives will likely work based on content control?
  - Money, badges, points, freebies etc.

What is the content control pattern?

- What content will be generated?
  - Reviews on a 5/7 point scale or positive-negative-neutral, ratings etc.
- Who will create the content?
  - Users, verified users/customers, anyone etc.
- How will it be managed?
  - Can it be edited after posting? What issues will that raise?
  - How does it get posted to the site? Will it be reviewed before it is posted? Can users post directly or will it be moderated by humans first?
  - Will content be evaluated (for helpfulness) by other users or by a moderator?
  - Will an evaluation promote or demote content?

What types of incentives will likely work?

- Incentives motivate people to carry out a target behaviour
- Incentives are a form of payment to stimulate one to carry out a desired behaviour
- Incentives should be appropriate for the tasks users will carry out

What types of incentives will likely work?

3 main groups of incentives

- Altruistic incentives. For the good of others –people who like to share
  - Incentive is internal
  - Examples – **inviting** people to contribute to a site to improve it
- Commercial incentives. To generate money. Can be directly, as soon as possible or indirectly by a promotion
  - Examples – compensation (money, freebies, exposure)
- Egocentric incentives. For self-gratification. Common in online shopping sites, computer games
  - Influenced by the desire to complete a task assigned by a system, oneself, a friend, family etc.
  - Influenced by the desire to be praised by others
  - Influenced by the need to improve oneself
  - Examples – recognition, ranking

Summary

- Describe what reputation systems are and why they are important
- Describe some examples of reputation systems
- List some challenges of reputation systems

References

- Building web reputation systems. By Randy Farmer and Bryce Glass. O’Reilly. 2014
- http://buildingreputation.com/

Cognitive bias

Ifeoma Adaji

Learning objectives

- Define cognitive bias and why it is important
- List and explain examples of cognitive biases and how we can reduce them
  - Social comparison
  - Anchoring effect
  - Conformity bias
  - Cognitive dissonance

Cognitive bias

- When our personal experience and preferences influence or limit our objective thinking
- Describes the tendency for people's feelings and experiences to affect their judgment.
- Result of one’s brain attempting to simplify information processing
- Cognitive bias refers to one's thought processes

Why cognitive bias

- We are influenced by cognitive bias – think persuasive strategies
- Systems are developed taking advantage of our cognitive biases
  - Important to identify them and understand how they influence peoples' decisions
- Cognitive bias can be introduced into AI systems
- AI systems can be complicated by how humans analyze and interpret data and form human-level explanations
- The more we know about cognitive bias, the better we can work with AI and machine learning algorithms.

Types of cognitive biases

- Social comparison
- Anchoring effect
- Conformity bias
- Cognitive dissonance

Social comparison

- Based on Festinger (1954)'s theory of social comparison
- Hypothesized that:
  - *"Other people who are **similar** to an individual are especially useful for self-evaluation. "*
- People derive sense of self through comparing themselves with others
- Similarity can be based on attributes of people such as gender, age, physician condition, position, views/opinions culture, religion, etc.

Social comparison

- People constantly evaluate themselves, and others, in domains like attractiveness, wealth, intelligence, and success
- People determine their own social and personal worth based on how they compare against others
- Comparing self to others
  - May motivate people to improve
  - May lead to feelings of dissatisfaction, guilt, or remorse, and engage in destructive behaviors like lying or disordered eating

Motives for social comparison

Self evaluation of abilities

- Compare oneself with someone who performs some initial relevant task
  - A target similar to oneself
  - Means of measuring personal development
- “Can I do X?” anticipated success at unfamiliar tasks

Self evaluation of opinions

- Preference (e.g. “Do I like X?)
- Belief Evaluation (e.g. “Is X correct?”)
- Preference Prediction (e.g. “Will I like it?”)

Motives for social comparison

Self-enhancement

- To improve self-esteem
- Interpret information from self-comparison positively and use it to further enhance one’s goals
- Upward comparison or downward comparison

Social comparison

Upward comparison

- We make upward comparisons consciously or subconsciously when we compare ourselves with others we think are “better”(e.g. on social media)
  - “Better” is subjective
- Can boost subjective well-being
  - Can help individuals self-evaluate and self-improve which could lead to self-enhancement
  - Can make people feel good about themselves; when they see similarities between themselves and others that are “elite” or “superior”
- Can harm subjective well-being
  - Can make one feel “less” than others. E.g. social media followers for influencers
    - But can be a source of motivation. E.g. using the picture of slimmer people to motivate one to lose weight

Social comparison

Downward comparison

- We make downward comparisons consciously or subconsciously when we compare ourselves with others we think we are “better” than
  - “Better” is subjective
  - Can be a defensive mechanism for self-evaluation
- Can boost subjective well-being
  - Can make people feel good about themselves; when they see they are *better* than many people
- Can harm subjective well-being
  - Can make one realize how “bad” things are for others
    - Could result in the feeling of guilt for some

Social comparison in social media

- Compared to offline setting, information on social media is more visible
- “When users are notified about other people’s life updates through social media postings, they would spontaneously and unintentionally practice social comparison”
- “Social media generates ubiquitous comparison information and accessible feedback, such as the number of followers, likes, comments, and retweets.”
  - “Such information allows people to form impressions of others quickly”
- “Patients use social media to compare themselves with other patients to find out how “bad” their health conditions are and how well the treatments work.”

Source: Jiang, Shaohai, and Annabel Ngien. "The effects of instagram use, social comparison, and self-esteem on social anxiety: A survey study in Singapore." *Social Media+ Society* 6.2 (2020): 2056305120912488.

Social comparison and social media

- “Social comparison increased one’s social anxiety”
- “Social media users often compare themselves with others’ appearance, ability, popularity, and social skills (Feinstein et al., 2013)”
- “Such comparisons trigger strong psychological responses, particularly when others selectively present more positive information”
- “Instagram provides various filters to edit and enhance photos, and the exposure to these idealized images of others can activate negative emotions, contributing to poor psychological well-being such as social anxiety (Sherlock & Wagstaff, 2018)”

Source: Jiang, Shaohai, and Annabel Ngien. "The effects of instagram use, social comparison, and self-esteem on social anxiety: A survey study in Singapore." *Social Media+ Society* 6.2 (2020): 2056305120912488.

Social comparison and social media

- https://www.floridatechonline.com/blog/psychology/why-facebook-is-making-us-sad-social-comparison/
- https://www.socialmediatoday.com/news/facebook-shares-new-data-on-the-psychological-impacts-of-social-comparison/576771/

Anchoring effect

- A person's decisions are influenced by a particular reference point or "anchor"
  - This could be the first information we receive
- Once the anchor is established, you are biased towards it
- We tend to adjust our decisions from this reference point only
  - Reference point is our current emotional state
- the first impression or perception that we make of anything stays with us no matter how much we claim to have analyzed all possible factors in making a decision
- It influences the amount we pay for products

Anchoring effect

Customer: “This $50 shirt is too expensive for me”

Sales person: “We have this piece on sale. You can get it for 25% off”

Customer: “That sounds like a good deal. I will buy it. ”

Group A: Are there more or fewer than 10 ethnic groups in Nigeria?

Group B: Are there more or fewer than 50 ethnic groups in Nigeria?

Group C: How many ethnic groups are there in Nigeria

Source: Holm, Charles. The 25 Cognitive Biases: Uncovering The Myth Of Rational Thinking

Source: https://blog.marketing360.com/design-and-branding/tips-on-using-the-anchoring-effect-in-marketing/

Anchoring effect

- A way to overcome the anchoring effect bias is to compare things
  - emotions, prices, characteristics
- Sticking to one will end up biasing your evaluation capability
- We should always be open to alternative options

Conformity bias

- Adapting our behaviours to that of others because of the need to belong or be similar to others
- Imitating others instead of using our individual judgements
- Could be unintentional
- People seem to be more comfortable behaving like others
  - We contribute to a charity if people we know are doing it
  - We follow someone if our friends have followed them too
- Could be used to make people change for the better but can have its disadvantages too
  - People doing something wrong because those around are doing it
  - Eating out with others, we order dessert if they do
- Consensus (social proof) strategy of Cialdini takes advantage of this

Conformity bias

Reducing conformity bias

- Practice in small ways
  - Make choices ahead, e.g. decide not to eat dessert before going to a restaurant with others
- Change social circle if possible or reduce group size
  - Conformity bias increases with group size
- Accept others with differing opinions so that others in the groups start to accept people with other opinions
  - Conformity bias reduces when there is at least one person with differing opinions

Cognitive dissonance

- We have an inner drive to hold all our attitudes and beliefs in harmony (or consistency) and avoid disharmony (dissonance)
  - Festinger's (1957) cognitive dissonance theory
- Mental conflict that occurs when a person's behaviors and beliefs do not align.
  - E.g. when a person holds 2 beliefs that contradict one another
- Causes feelings of unease and tension
- Commitment strategy of Cialdini takes advantage of this bias

Cognitive dissonance

Can be caused by

- Forced compliance. When one is asked to do something they really don't want to do
  - If behaviour Is carried out, dissonance will have to be reduced be re-evaluating their attitude towards the action
- Decision making. In making decisions, both alternatives have good and bad points
  - You have to accept the disadvantages of the chosen alternatives
  - You can't enjoy advantages of the unchosen alternative
  - To reduce dissonance, one can increase attractiveness of the chosen alternative and decrease attractiveness of the rejected alternative
- Effort. We often place a lot of value on things that we have achieved through considerable effort
  - Dissonance will be caused if we spent a lot of effort to achieve something and then valued it negatively.
  - To reduce dissonance, we re-evaluate the effort or the value of the thing

Cognitive dissonance

Can be reduced by:

- Changing existing beliefs
- Adopting new beliefs
- Reducing the importance of one’s beliefs

Summary

- Cognitive bias describes the tendency for people's feelings and experiences to affect their judgment.
- Examples include
  - Social comparison
  - Anchoring effect
  - Conformity bias
  - Cognitive dissonance

References

- BIASES and HEURISTICS : The Complete Collection of Cognitive Biases and Heuristics That Impair Decisions in Banking, Finance and Everything Else by Henry Priest. July 2019. (The Psychology of Economic Decisions Book 7) . Cognitt Consulting
- Jiang, Shaohai, and Annabel Ngien. "The effects of instagram use, social comparison, and self-esteem on social anxiety: A survey study in Singapore." *Social Media+ Society* 6.2 (2020): 2056305120912488.
- Sherlock, M., Wagstaff, D. L. (2018). Exploring the relationship between frequency of Instagram use, exposure to idealized images, and psychological well-being in women. Psychology of Popular Media Culture, 8, 482–490.
- Yang, C.-c, Robinson, A. (2018). Not necessarily detrimental: Two social comparison orientations and their associations with social media use and college social adjustment. Computers in Human Behavior, 84, 49–57.
- Feinstein, B. A., Hershenberg, R., Bhatia, V., Latack, J. A., Meuwly, N., Davila, J. (2013). Negative social comparison on Facebook and depressive symptoms: Rumination as a mechanism. Psychology of Popular Media Culture, 2, 161–170.
- https://www.simplypsychology.org/cognitive-dissonance.html
- Solomon E. Asch, Effects of Group Pressure Upon the Modification and Distortion of Judgments. In Harold Guetzkow (ed.), Groups, Leadership and Men (Pittsburgh, PA: Carnegie Press, 1951) pp. 177–190; Solomon E. Asch, Studies of Independence and Conformity: I. A Minority of One Against a Unanimous Majority, *Psychological Monographs*, 70, 1-70 (1956).

Emergence

Ifeoma Adaji

Learning objectives

- Explain what emergence is
- Explain what self-organizing system is
- Give examples of systems that exhibit emergent behaviour
- Explain the emergent mechanisms:
  - Neighbour interaction
  - Patter match
  - Feedback
  - Control

Emergence

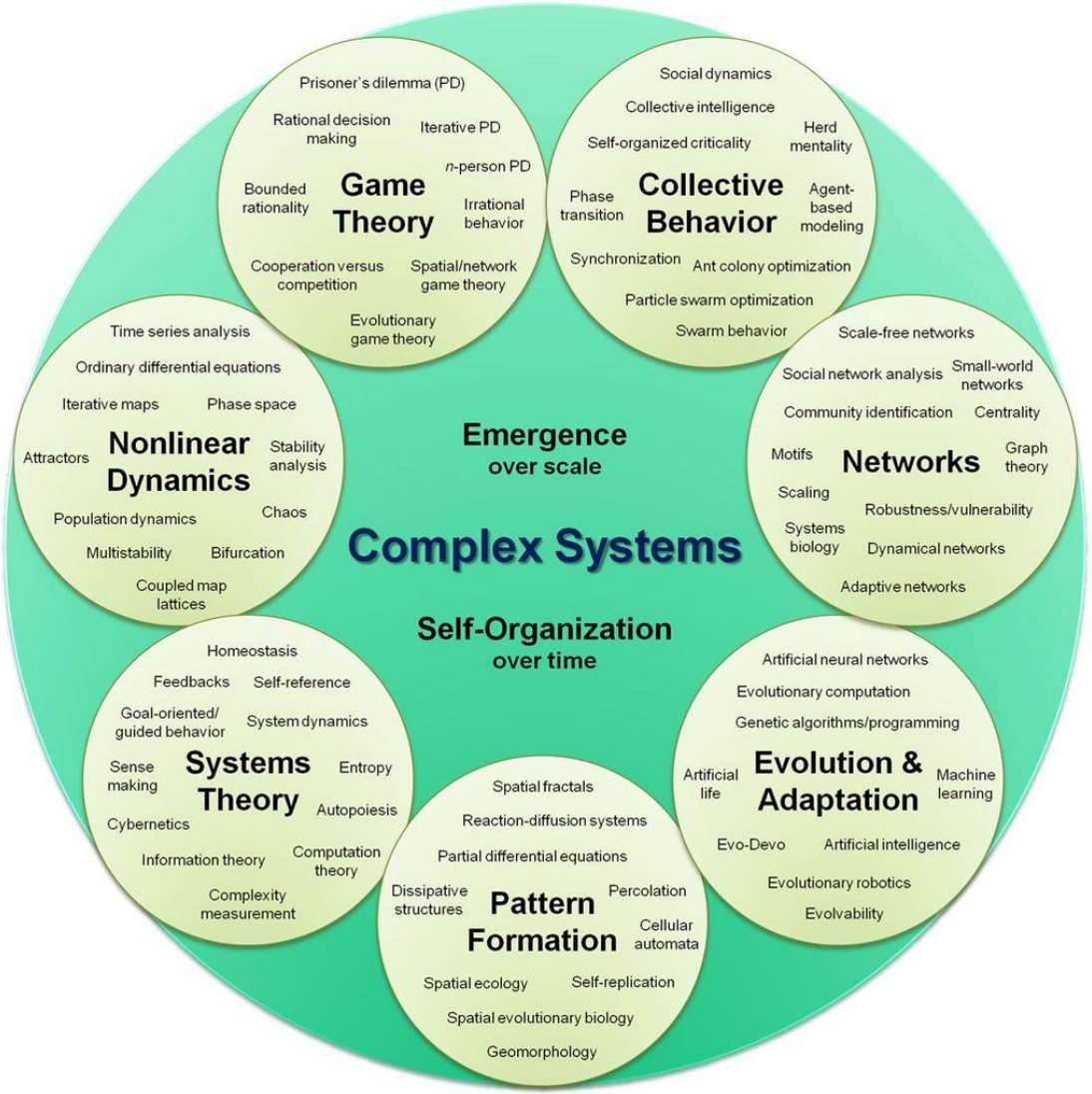
- Occurs when a system has properties that the individual parts of the system do not exhibit
  - Occurs when the parts of the system interact or work together to form a whole
- Emergence is the appearance of new phenomena on higher levels of a system
  - The appearance of new qualitative features on the level of an entire system that can not be observed at the level of its components
- Emergence is about the system's properties at different scales/volume/size
- Emergence solves problems by drawing on the intelligence of the system as a whole instead of the intelligence of individual parts of the system
- Emergence results from self-organizing systems
  - It refers to the ability of a class of systems (self-organizing systems (SOS)) to change their internal structure and/or their function in response to external circumstances
  - As a system grows, the system self-organizes (with time) and emergent behaviours emerge
- Self-organization and emergence are characteristics of scale-free networks

Emergence

Systems with emergent behaviour

- Show an increase in order as the system grows without external control
- Show new behaviour on a higher level of description which could not have been easily predicted from interactions of components at the lower level
- Are a result of a self-organization process
- Respond to specific and changing needs of their environment
- Form patterns in time
- Follow simple rules rather than a single, intelligent “executive” to create collectively efficient structures which are better than any conscious design
- Adapt to external conditions (environmental feedback)
- Are bottom-up systems; from low-level to higher level sophistication

How it all fits together



Source: Hiroki Sayama, D.Sc. - Created by Hiroki Sayama, D.Sc., Collective Dynamics of Complex Systems (CoCo) Research Group at Binghamton University, State University of New York

Early examples of emergence

- Ant colonies
- City Neighbourhoods
- Brain neurons
- Markets

Ants

- Queen is not an authoritative figure but plays a major role in colonies
  - She lays eggs and is fed/cared for by the workers
  - She doesn’t decide which worker does what
  - She is responsible for giving birth to all members of the colony; in the best interest of colony to keep her safe
- One queen and many workers taking flexible roles
- Communication through pheromone trails for food finding
- Gestures to express emotions
- Ants create a midden – garbage dump and a cemetery
  - These are created as far away as possible from the colony and from each other

Manchester in 1842

- Became a hub for wool trade in 1600s. Was exporting goods to other parts of the world
- Grew rapidly between 1700 and 1850 when it then officially became a city (1853)
- Was a busy place which attracted workers and merchants but was not recognized as a city until much later
  - There was no government structure in place
- Despite the seemingly chaotic industrial part of town, there was a strange type of order that was noticed by Friedrich Engels
  - “I have never elsewhere seen a concealment of such fine sensibility of everything that might offend the eyes and nerves of the middle class. And yet it is precisely Manchester that has been built less according to a plan and less within the limitations of official regulations –and indeed more through accident –than any other town”.

New York neighbourhood, 1961

- To understand how a city works, one has to approach it as a problem from the street level up
- Jane Jacobs:
  - “Vital cities have marvelous innate abilities for understanding, communicating, contriving and inventing what is required to combat their difficulties. They get their order from below; they are learning machines, pattern recognizers”

Fundamental principles of design of systems that learn from the ground level up

- More is different. There should be a critical mass of individuals/subjects in the system
  - We learn more from 10 ants vs 1000 ants
  - The global behaviour only becomes apparent by studying the entire system and not individuals
  - If we studied one ant in isolation, we won't know that pheromone secretion was part of an overall effort to create a distribution line
- Ignorance is useful.
  - Make it simple; build an interconnected system of simple elements
  - If parts are complicated, the system easily gets complicated.

Fundamental principles of design of systems that learn from the ground level up

- Encourage random encounters.
  - While connections are not random, provide ways that random encounters can occur
  - This allows new discovery
- Look for patterns in the signs
  - To allow for a flow of information
  - The pattern creates a gradient, providing (environmental) feedback
    - Ants rely heavily on patterns. A gradient in the pheromone trail leads them towards a food source
- Pay attention to neighbours
  - Local information can lead to global wisdom
  - Individuals who can't assess the global situation still *work together* in a coordinated way
  - They think locally and act locally but their collective action produces global behaviour
  - More individuals in the system = more neighbours
  - Without ants stumbling on one another, colonies will exist without logic

Emergence mechanisms

- Neighbour interaction
- Pattern match
- Feedback
- Control

Neighbour interaction

- Ant-colonies: ants interacting through pheromones and observing their neighbours
- Cells in the embryo–all cells reading different sections of the same DNA, taking cues from their neighbours about what section to ”read”
- SimCity – city-building video game
- Sidewalks as providers of interactions that change people’s behavior

Pattern match

- Patterns emerge as optimal points (equilibriums) in interactions and their driving forces
  - What is equilibrium? A balance of forces , e.g. a point of mutual convenience for everyone involved.
  - Example: Trading streets in old cities, e.g. Florence
- Complex systems “learn” patterns
  - Learning is not contingent on consciousness
  - Our immune systems learn throughout our lifetime building antibodies
  - Social networks/social media learn from our activities and behaviours and make recommendations

Florence XI –XXI Century

- Do cities learn?
  - Silk weavers and goldsmiths settled on Por Santa Maria street north of Ponte Vecchio in the XI-th century, they are still there now
  - The pattern is “learned” by the city, but not consciously; it persists due to individual conscious decisions, but at a lower level (self-interest, max. utility)
  - If a time traveler from the past visits Florence, they will still locate where the silk weavers and gold smiths are
- Certain elements of cities get passed on from generation to generation because they are associated with a physical structure that has its own durability
  - Cathedrals and universities
- City can also learn about the *specialization of the city* which could also make structures stay in place over time
  - Florence

Feedback

- Self organizing systems rely extensively on feedback for growth and self-regulation
- Positive feedback and negative feedback
  - Positive feedback propels one onward
  - Positive feedback boosts a particular action
  - Negative feedback steers towards a target (e.g. a thermostat)
  - Negative feedback is a way of reaching an equilibrium point despite unpredictable and changing external conditions
- Examples
  - Pheromone trails of ants when finding food
  - Online communities like Netflix; watching or not watching their recommendations
  - Systems with user ratings: Amazon and eBay

Control

- Emergent system “is a little chaos machine, unexpected things happen and you only control it from the edges” -Eric Zimmerman, scientist, artist, game designer
- “The rules make the game”, emergent systems are rule-governed as well (low level rules)… if an agent stops following the rules, anarchy or chaos results
- Group behaviour can evolve in unpredictable ways
  - e.g. Online games - SimCity has no pre-defined objectives
  - The more autonomous the system, the more irrelevant the player is
  - Game designers wonder how far off the edge should a player be, to keep him/her interested in the game?
- For online emergent systems, find some middle ground between too much order and too little
  - Social networks do this well

Summary

- Emergence is a result of a self-organization process
- Self-organization and emergence are characteristics of scale-free networks
- Emergence existed before technology, e.g. ant colony, cities etc.
- Emergence mechanisms include neighbour interaction, pattern match, feedback, and control

References

- Emergence. The connected lives of ants, brains, cities and software. Steven Johnson. 2004.
- Banzhaf, W. (2009). Self-organizing Systems. *Encyclopedia of complexity and systems science*, *14*, 589.
- Introduction to the Modeling and Analysis of Complex Systems. Hiroki Sayama. 2015.
- Lecture notes on Social Computing. Prof. Julita Vassileva

Scale free networks

Ifeoma Adaji

Learning objectives

- Define scale-free networks
- Explain the characteristics of scale-free networks
  - Power law distribution
  - Scale-free
  - Small world
  - Hubs and connectors
  - Growth
  - Competition
  - Robustness

How Everything Is Connected to Everything Else and What It Means for Business, Science, and Everyday Life

Linked

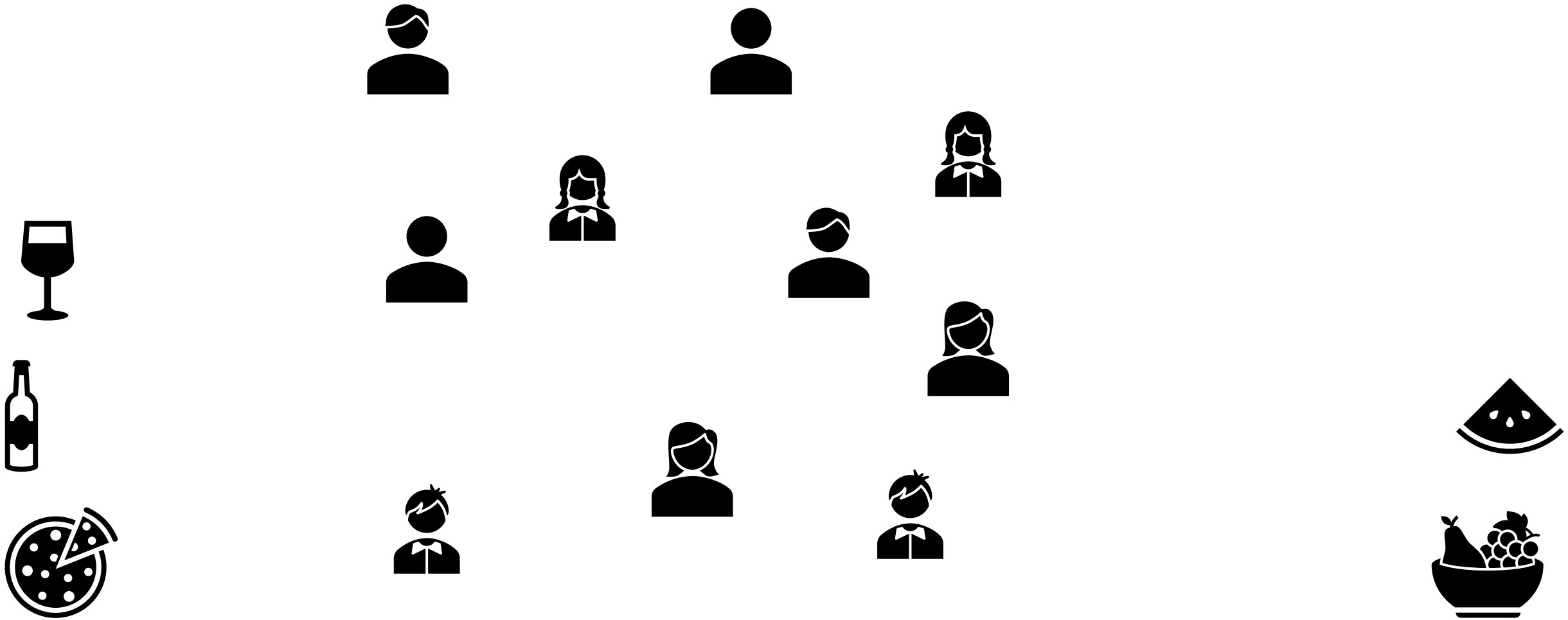
"Remarkable.... A sweeping look at a new and exciting science." —*Science*

Albert-László Barabási

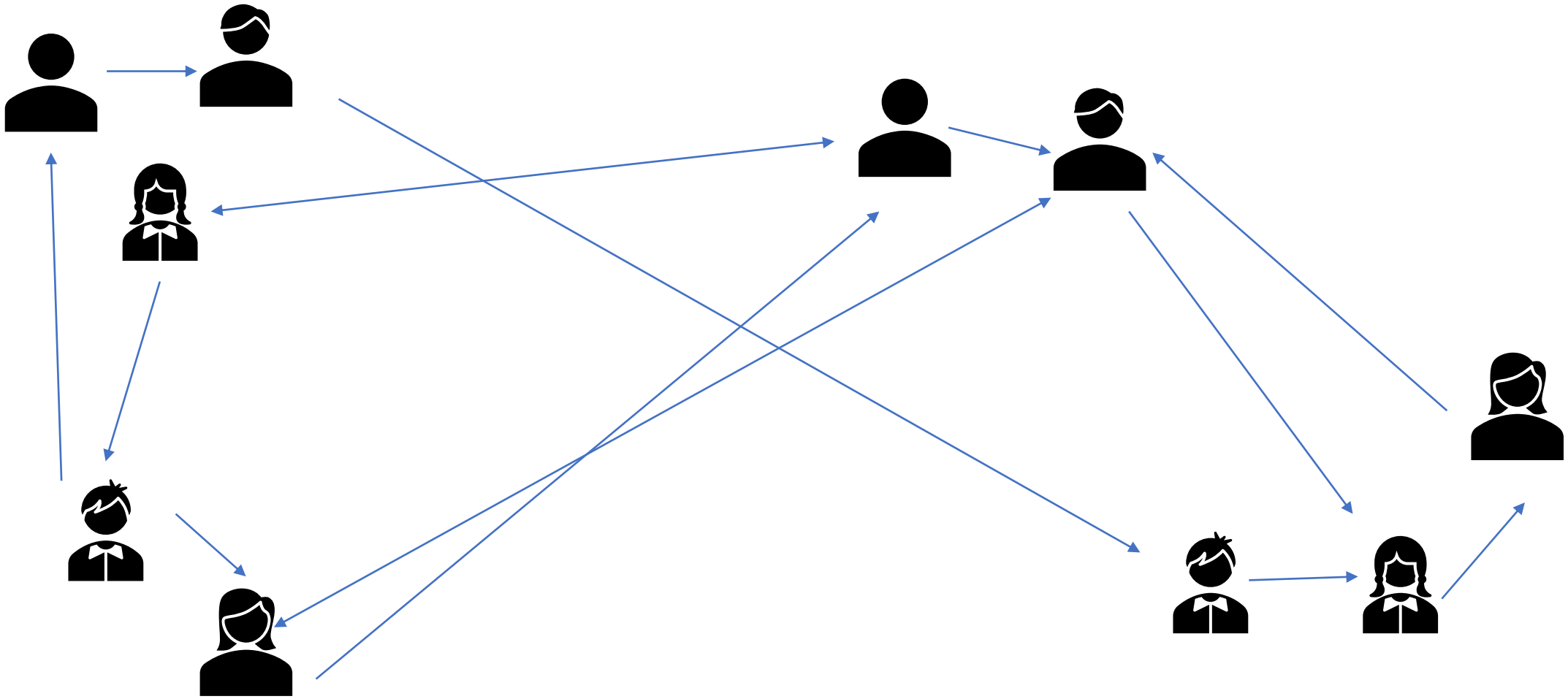
Networks

- Networks are present everywhere
  - The internet, power grids and transportation systems
- Networks have existed before the internet
- “How networks form” is an area of ongoing research
  - How do the interactions of several malfunctioning nodes in a complex genetic network result in cancer?
  - How does diffusion occur so rapidly in certain social and communications systems, leading to epidemics of diseases and computer viruses?
  - How do some networks continue to function even after the vast majority of their nodes have failed?
  - How does misinformation spread so quickly and have a wider reach compared to *correct* information?

How networks form

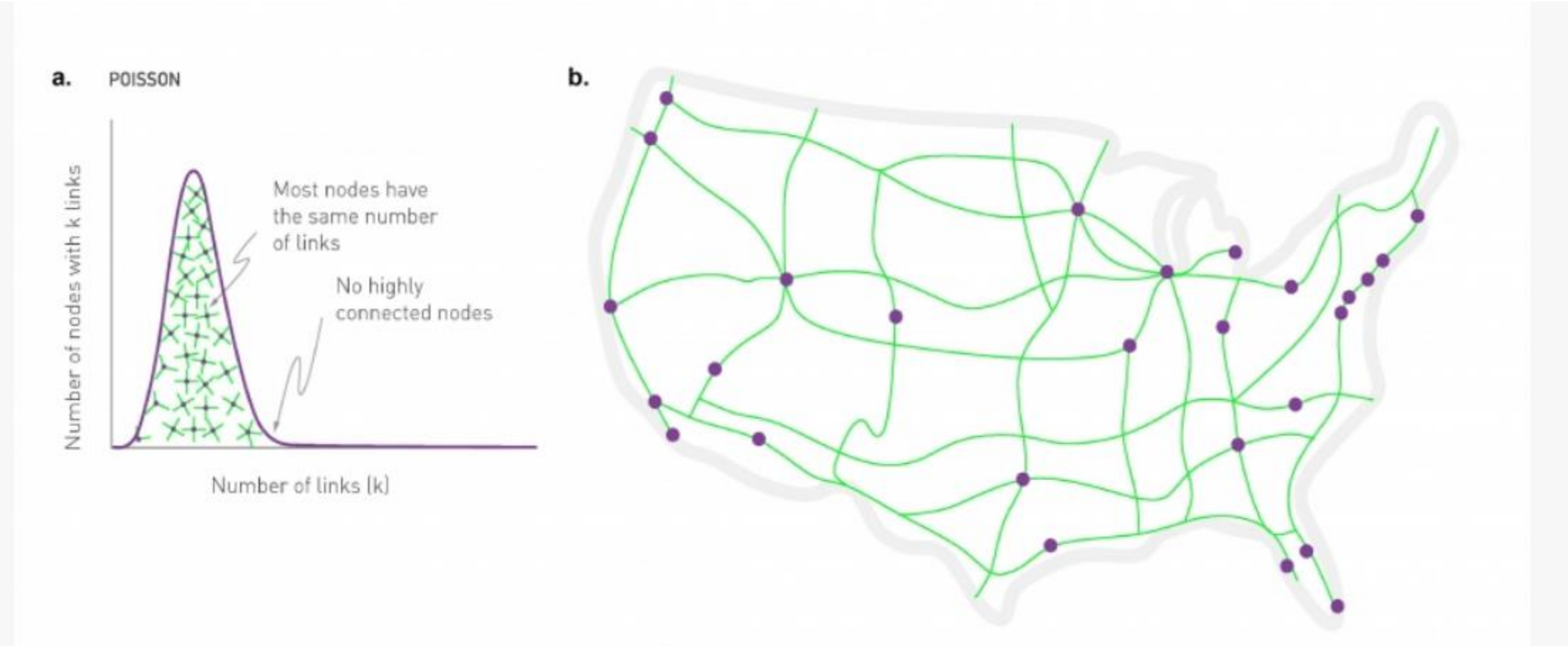


How networks form



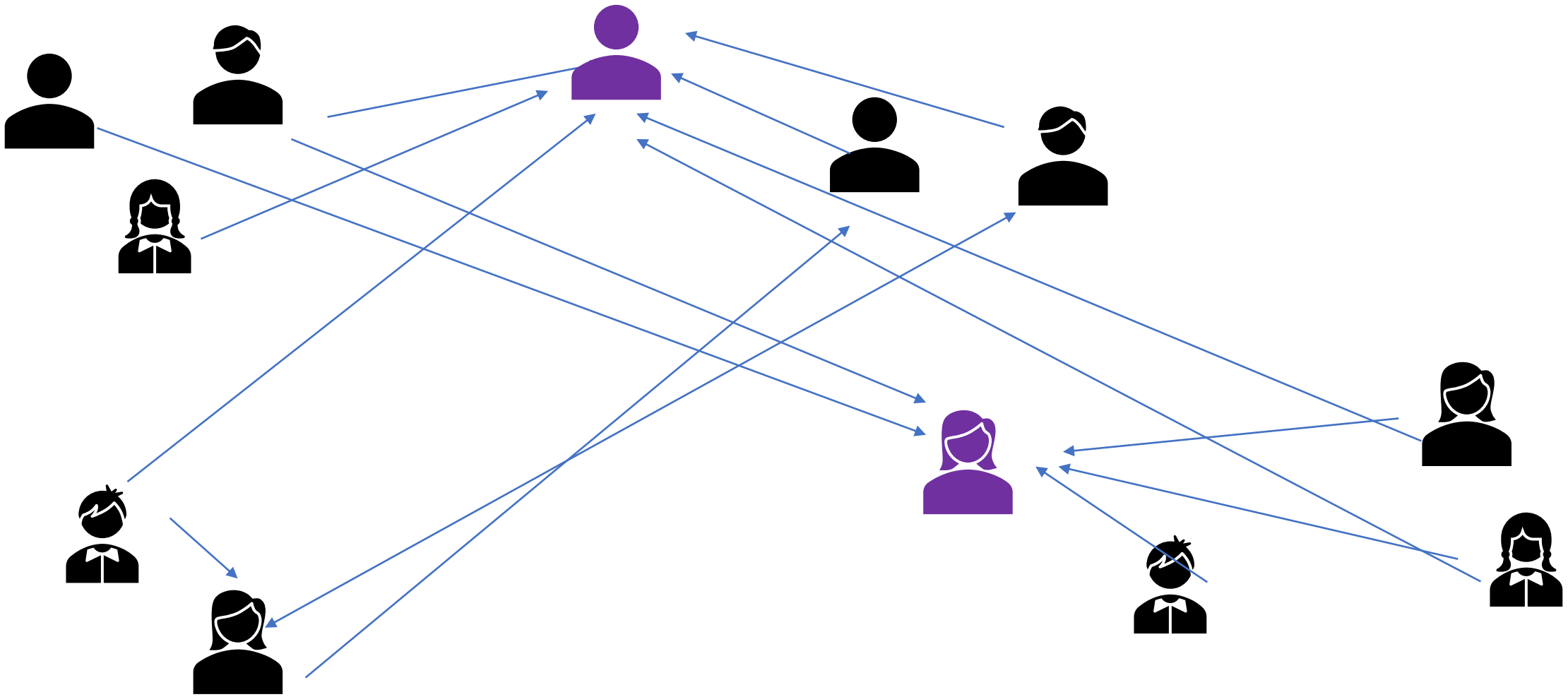
Random networks

- Connections are random
- Usually no outliers
- No highly popular individuals/nodes
- Most nodes have comparable degrees
- Typically have a Poisson distribution
- Accidental failure of a node in the network can fracture the system into non-communicating islands
- Number of nodes is constant over time
- All nodes have similar degree, thus no competition
- For many years, researchers treated networks as being random



Source: Network Science. Barabasi. 2016

How networks form



Scale-free networks

- A scale-free network is one where the nodes are not randomly connected
- The degree distribution follows the power law
  - Few nodes have very high degree
  - Few nodes are connected to most of the other nodes in the network
- Scale-free networks include many "very connected" nodes, called hubs, that shape the way the network operates

Some characteristics of scale-free networks

- They are scale-free
- Follow the power law distribution
- Form a small world
- Have hubs and connectors
- Growth
- Competition
- Robustness

Scale-free

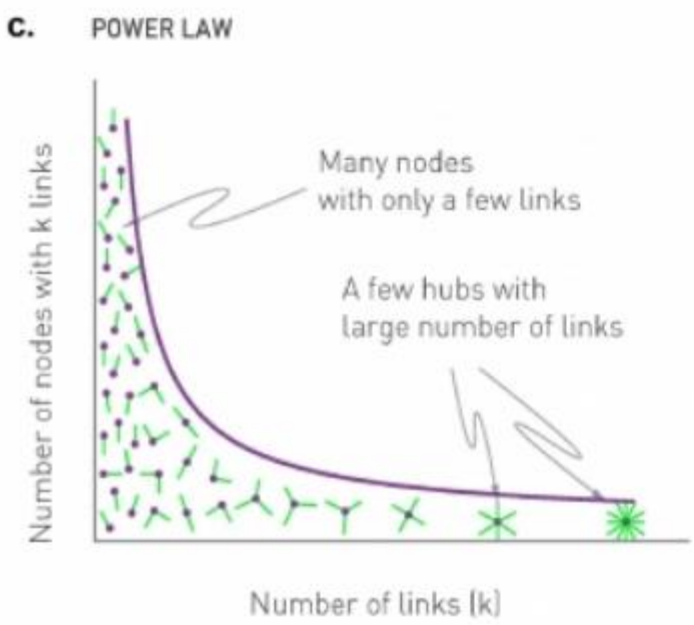
- They lack a scale
  - If we randomly choose a node, the node's degree could be small or arbitrarily large, thus, they have no meaningful internal scale but are "scale-free"
  - Nodes with widely different degrees coexist in the network
- Some nodes have an unlimited number of links

Power law distribution

- Scale-free networks follow the power law distribution
  - Most nodes have only a few links. These numerous small nodes are held together by a few highly connected nodes.
  - Few nodes have many links
- Also known as the 80/20 rule, Pareto principle
- Vilfredo Pareto, 1910 observed:
  - 80% of the peas are produced by 20% of the plants
  - 80% of the wealth in Italy was owned by 20% of the population
  - 80% of profits are generated by 20% of the employees (Murphy's law)
  - 80% of the complaints are generated by 20% of the customers
  - 80% of the decisions are made in 20% of the meeting time…
  - 4/5 of our efforts are largely irrelevant
  - 80% of the links point to 15% of the websites
  - 80% of the citations go to 38% of the scientists…

Power law distribution

- Follow the power law distribution
  - Most nodes have only a few links. These numerous small nodes are held together by a few highly connected nodes.
  - Few nodes have many links



Source: Network Science. Barabasi. 2016

Small world

- The Stanley Milgram experiment, 1967
  - find the average “distance” between any two people in the US
  - 42 of the 160 letter made it to the destination
  - Average path length: 5.5
- Experiment repeated with email by Watts and Strogatz
  - resulting in average path length about 6.8
- So human networks (social networks) form a **small world**…
- How about the Web?
  - Analysis of 800,000,000 nodes (documents) found that the average path length is 18.59…. Still a small world.
- Does this knowledge make it easy to find what you look for?
  - No, we need cues to search, some extra information

Small world

- Short path between any 2 nodes in scale-free networks
  - Concept of a small world
- https://www.youtube.com/watch?v=Rmn-amJ9UA4
  - Kevin Bacon
- https://oracleofbacon.org/

Hubs and connectors

- Nodes with very high degree
- Can connect other nodes in the network
- Typically create the shortest path to everyone else in the network
- The unpopular nodes are held together by the connectors/hubs
- Few connectors know an unusually large number of people
- In a random network, everyone has an equal chance of being noticed
- In a scale-free network, the hubs/connectors get noticed more
- Examples –huge variances between:
  - Number of acquaintances people have (some have 2000+ FB friends!)
  - Number of links pointing to websites varies hugely
  - Number of daily visits of websites
  - Number of phone calls placed by different telephones in the network
  - Number of reactions done by different molecules in a cell
- Hubs/connectors are important because they
  - Create trends
  - Make important deals
  - Spread information
  - Help launch a product

Growth

- Scale-free networks grow incrementally with the addition of new nodes
  - Unlike random networks where the number of nodes is constant over time
- How do networks grow?
  - In a random network, new nodes connect to randomly picked existing nodes
  - But in reality, new nodes are more likely to connect to nodes which already have a lot of connections – *rich-get-richer* phenomenon
  - Preferential attachment; popularity attracts
- Growth and preferential attachment explain the hubs and power laws in complex networks.
- But this model predicts that the oldest nodes would have most links
- Newcomers will have no chance.
- In random networks, all nodes stand the same chance. Not the same in real world networks

Competition

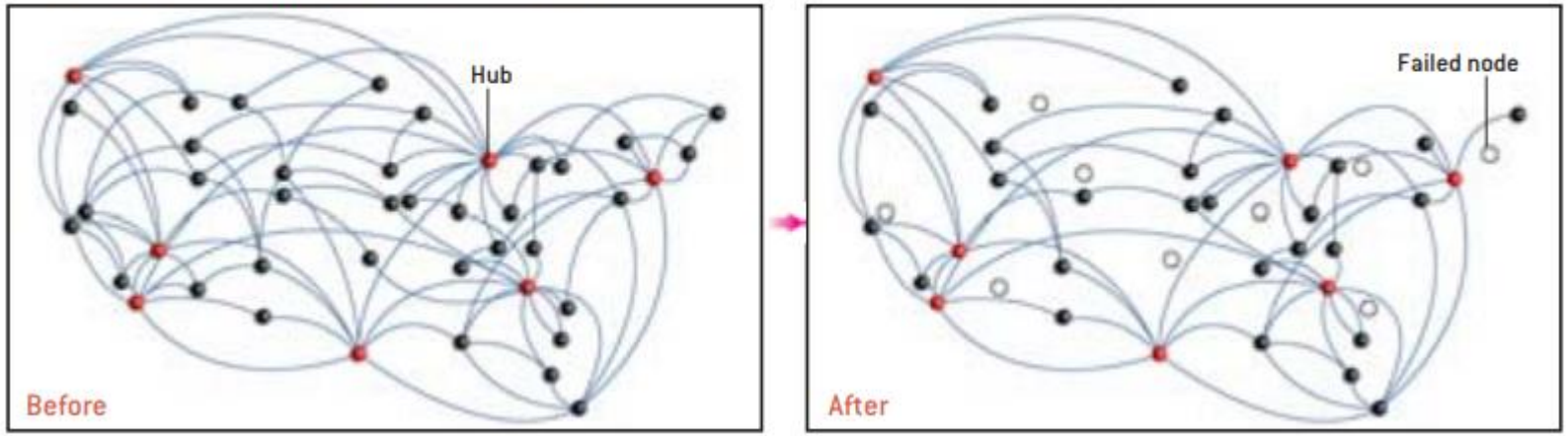
- How do we explain successful newcomers?
  - For example, Google?
- Scale-free networks are competitive systems in which nodes fight for links
- Each node has unique characteristics that are apparent; intrinsic qualities that influence the rate at which they acquire links
- All nodes are not equal, some are “better”, more attractive, offer a better quality of service, or are better at making friends, or have better looks (younger actors/actresses)
- Each node has a certain fitness
  - Ability to make friends relative to others, company’s competence in luring and keeping customers, actor’s aptitude to be likes and recommended compared to other aspiring actors
- Fitness of a node is a measure of its ability to stay in front of the competition
- The “Fit get rich” model leads to a scale-free topology

Robustness

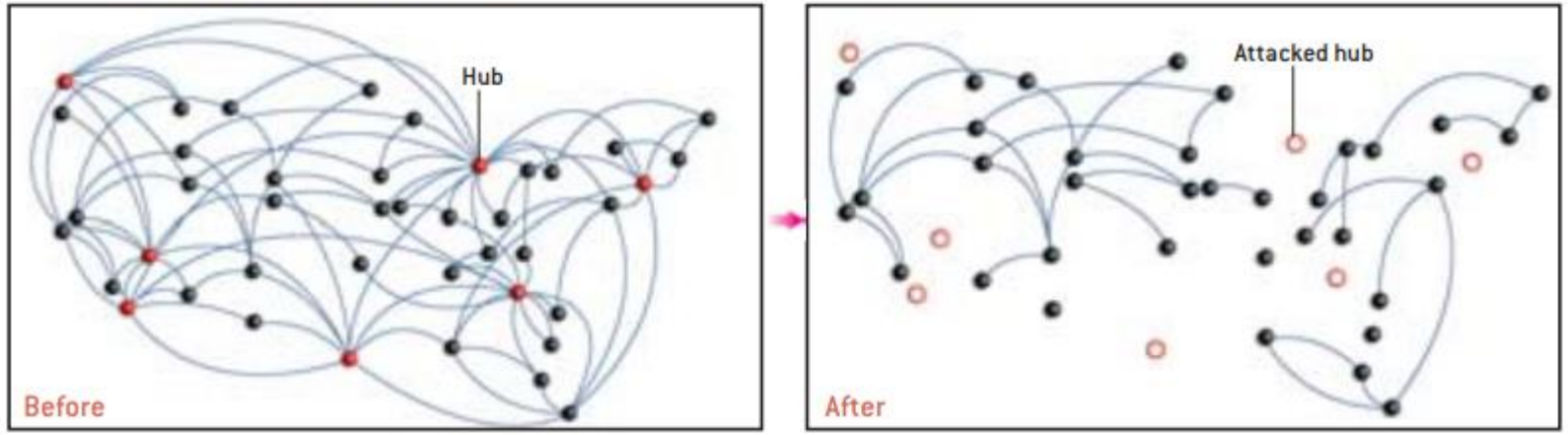
- Scale-free networks are extremely robust in case of random failures
- Robustness. The ability of complex systems to still function when their structure changes significantly
- Studying network resilience
  - In random networks, some node failures can easily break a network into isolated, non-communicating frameworks –e.g. closing simultaneously highways in and out of Jacksonville and Lake City, FL, will close Florida to the rest of the US.
  - Yet, a study of the Internet resilience showed that we can remove 80% of all nodes, and the remaining 20% will still remain connected
  - The key to this is the presence of hubs, removing nodes randomly is not likely to affect them, and they hold the NW
  - Since there are more small nodes than hubs (nodes with high degree), if failures in networks affect each node with an equal chance, small nodes will far more likely be affected than hubs
  - Accidental removal of a single hub will also not be fatal since the other large hubs can maintain the network?
    - Does this apply in social networks? What of an attack on all hubs?

Robustness

Scale-Free Network, Accidental Node Failure



Scale-Free Network, Attack on Hubs



Differences between random network and scale-free network

Random	Scale free

References

- Linked: How Everything Is Connected to Everything Else and What It Means for Business, Science, and Everyday Life by Albert-László Barabási (2014)
- Networks. Understanding Networks Barabási, A.-L. (2011).
- Barabási, A.-L., & Bonabeau, E. (2003). Scale Free Networks. *Scientific American*, (May), pp 50–59
- Lecture notes on social computing. Prof. Julita Vassileva

Wisdom of Crowds

Ifeoma Adaji

Learning objectives

- Explain the concept of wisdom of crowds – smart crowds
- List and explain the 4 characteristics of smart crowds
  - Diversity
  - Independence
  - Decentralization
  - Aggregation

Smart crowds

- Under the right circumstances, groups can be intelligent
- Often smarter than the smartest people in them
- Groups do not need to be dominated by exceptionally intelligent people in order to be smart
- Even if most people within a group are not especially well informed or rational, it can still reach a collectively wise decision
- Our collective intelligence is often excellent
- Groups do better than individuals, larger groups do better than smaller ones

Smart crowds: examples

- In 1906 Francis Galton attended the annual West England fat stock and poultry exhibition
  - Estimate the size of an ox
- In 1920 sociologist Hazel Knight started a series of experiments with her students:
  - Estimate the temperature in the room
  - Estimate the number of beans in a jar
  - Ranking 10 similar items by size…
- Who wants to be a millionaire

- The Challenger disaster and the stock market

4 characteristics of smart crowds

- Diversity of opinion (each person should have some private information)
- Independence (people's opinions are not influenced by those of others)
- Decentralization (people are able to specialize and draw on local knowledge)
- Aggregation (a mechanism exists for turning private judgments into a collective decision)
- Each person's guess/prediction has 2 components: information and error, Subtract the error and you are left with information.
- For a group to be smart, there has to be some information
  - E.g. one won't ask a group of children to buy and sell stock in the wake of the Challenger accident

Diversity

4 characteristics
of smart crowds

- Through the history of most technologies, the early stages were characterized with a huge number of alternatives
  - Cars
  - Personal computers
  - Browsers, Web search engines
  - PDAs / cell phones…
  - Social media
- Through a collective search process, some designs win over others
  - The winners are “smarter” (cheaper, more universal, better, prettier…)
  - The search process is more like a biological phenomenon –like ant colony intelligence, or survival of the fittest in evolution, than a deliberative process.
- Lack of diversity in deliberative processes also leads to failures
- Diversity adds new/differing perspectives
- A diverse group is better at problem solving

Diversity

4 characteristics
of smart crowds

Positive case for diversity

- Expands a group’s set of possible solutions
- Allows new ideas, new ways of doing things

Diversity

4 characteristics
of smart crowds

Issues arising

- Homogenous groups can be formed
  - Homogenous groups can be insulated from outside opinions
- Pressure of conformity
  - People change their opinions not because they believe a different perspective but because they want to conform to the group, they don’t want to be challenged
  - Diversity should make it easier for people to say what they think

Independence

- Independence doesn’t mean isolation
- Means relative freedom from the influence of others
- If we are independent, our opinions are our own
- Decision is likely better when people are independent
- Individual errors won’t affect group’s decision
- Making decisions dependently can introduce bias
- Independence brings diverse perspectives

Independence

4 characteristics of smart crowds

- Can be hard because we are social beings
  - We look onto others in social settings (social proof)
- Solomon Asch's experiment.
  - "What's up in the sky?"
- When things are uncertain, best thing to do is follow along
- Social proof can limit independent group thinking
- We "social proof" because
  - It is easier to follow along than be different
  - Not following our peers could lead to high risk if out decisions/choices are wrong – we believe it is safest to follow the herd

Independence

4 characteristics of smart crowds

- Information cascades can also limit independent group thinking
- Happens when people in a group don’t make decisions simultaneously but in sequence
- There is no peer-pressure, conformity, or mindless trend-following, people believe that what they choose is better
- Individuals stop paying attention to their own knowledge and look at the actions of others before them
- “If everyone has the likelihood of making the right choice and everyone before me made the same choice, then I should do what everyone else has done”
- Ratings online; not wanting to give a negative rating because everyone else gave a positive rating
- If the first decision/rank/prediction is wrong, it cascades to everyone else.
  - The group’s decision becomes flawed
- Happens in reviews, ratings etc.

Independence

- Good cascades
  - “Follow the crowd and you will find the buffet” – We can’t always know everything
  - Imitation of profitable behaviour is usually profitable for the imitator too
    - Gives an array of options and information
  - Farmers imitate their neighbors who started growing better crops from new seeds
- Bad cascades: result from people switching off their private information/reasoning…
- Yet they are a mechanism for aggregating information, just like a voting system or a market

Decentralization

Example:

- The US security agencies (CIA created in 1947 to centralize all intelligence… but FBI, NSA remained, all formed by independent, self-interested agents)
- Efficient in gathering information, but couldn't prevent Perl Harbor, the bombing of the WTC in 1993, the US Embassy in Kenya, and 9/11
- The politicians' reaction has always (1946, 2001) been to call for **centralization, opposite to** the trends in business, academy, science, technology

Decentralization

4 characteristics of smart crowds

- Two main features of decentralized systems (DS):
  - Power does not fully reside in one central location
  - People coordinate with each other without someone being in charge
  - Many important decisions are made by individuals based on their own specific knowledge rather than by an omniscient or farseeing planner
- DS foster and are fed by specialization, tacit (context-based) knowledge
- DS allow for independent agents to coordinate their actions and solve difficult problems
- Increases scope and diversity of opinions and information in the system

Decentralization

4 characteristics of smart crowds

- Problems of decentralized systems:
  - Relevant local information may never get propagated to where it will be useful
  - Valuable information never gets disseminated, making it less useful that it could be
- Solution is to have mechanisms that allow aggregating information
- Imagine autonomous individuals trying to solve a problem without any means of putting their solutions together
- Aggregation is important to the success of decentralized systems

Aggregation

4 characteristics
of smart crowds

- A decentralized system can only produce intelligent results if there is a means of aggregating the private information of everyone
- An aggregation mechanism is a form of centralization/summation, (ideally) of all the private information of the participants
  - Sifting through the information to figure out what is important
- Aggregation leads to organization
- Should provide incentives for revealing truthfully private information
- Should not inject extra bias in the system
- Mechanisms:
  - One person with foresight
  - Deliberation
  - Polls / votes

Summary

- Wisdom of crowds relies on the collective intelligence of a group instead of individual intelligence - smart crowds
- Has the advantage of more people bringing in their diverse, independent opinions
- Smart crowds have 4 characteristics:
  - Diversity of opinion (each person should have some private information)
  - Independence (people's opinions are not influenced by those of others)
  - Decentralization (people are able to specialize and draw on local knowledge)
  - Aggregation (a mechanism exists for turning private judgments into a collective decision)

References

- The wisdom of crowds. James Surowiecki
- Infotopia. How many minds produce knowledge. Cadd Sunstein
- Lecture notes. Prof. Julita Vassileva

Crowdsourcing

Ifeoma Adaji

Learning objectives

- Describe crowdsourcing with examples
- Explain the relationship between wisdom of crowds and crowdsourcing
- Explain the difference between wisdom of crowds and crowdsourcing
- Give examples of crowdsourcing
- Explain why crowdsourcing is possible and successful

Crowdsourcing

- “The Act of taking a job traditionally performed by designated agent and outsourcing it to an undefined , generally large group of people in the form of an open call. “ Jeff Howe, WIRED, June 2006
- For example
  - You use the internet and computer software to contact individuals, offer them things to do, reward them, and collect the results of their work
- Made possible by technology
- Companies capitalize on a crowd’s excess capacity to design new products, review products, rate videos etc.
- Maps companies with needs to people with solutions to their needs
- Amazon’s Mechanical Turk (MTurk), Threadless, InnoCentive

Crowdsourcing

- Uses technology to foster collaboration and meaningful exchanges between people across geographical locations
  - Also between companies and customers
- Companies are moving tech support functions to user forums where volunteers can help customers in need
  - Koodo Mobile https://community.koodomobile.com/

Wisdom of crowds Vs Crowdsourcing

- The crowd is a crucial element of both concepts
- Both concepts are based on distributed systems
- Both benefit from diversity
- The key difference lies in the extent to which the crowds contributions are aggregated
  - In crowdsourcing, input of the crowd isn't necessarily aggregated into a final output
  - Wisdom of a crowd requires the aggregation of individual contributions into an output
- Focus of "wisdom of crowds" is increasing quality. Focus of "crowdsourcing" is increasing efficiency
  - The **quality (wisdom of crowds)** of the result or the **efficiency (crowdsourcing)** of the process leading up to it.
    - Not always the case

amazon mechanical turk

Overview | Features | Pricing | Help | Developer Resources | Customers | Sign in as a Requester

Amazon Mechanical Turk

Access a global, on-demand, 24x7 workforce

Get started with Amazon Mechanical Turk

Amazon Mechanical Turk (MTurk) is a crowdsourcing marketplace that makes it easier for individuals and businesses to outsource their processes and jobs to a distributed workforce who can perform these tasks virtually. This could include anything from conducting simple data validation and research to more subjective tasks like survey participation, content moderation, and more. MTurk enables companies to harness the collective intelligence, skills, and insights from a global workforce to streamline business processes, augment data collection and analysis, and accelerate machine learning development.

While technology continues to improve, there are still many things that human beings can do much more effectively than computers, such as moderating content, performing data deduplication, or research. Traditionally, tasks like this have been accomplished by hiring a large temporary workforce, which is time consuming, expensive and difficult to scale, or have gone undone. Crowdsourcing is a good way to break down a manual, time-consuming project into smaller, more manageable tasks to be completed by distributed workers over the Internet (also known as 'microtasks').

Benefits

Optimize efficiency

Increase flexibility

Reduce cost

Benefits

Optimize efficiency

MTurk is well-suited to take on simple and repetitive tasks in your workflows which need to be handled manually. Using MTurk to outsource microtasks ensures that work gets done quickly, while freeing up time and resources for the company – so internal staff can focus on higher value activities.

Increase flexibility

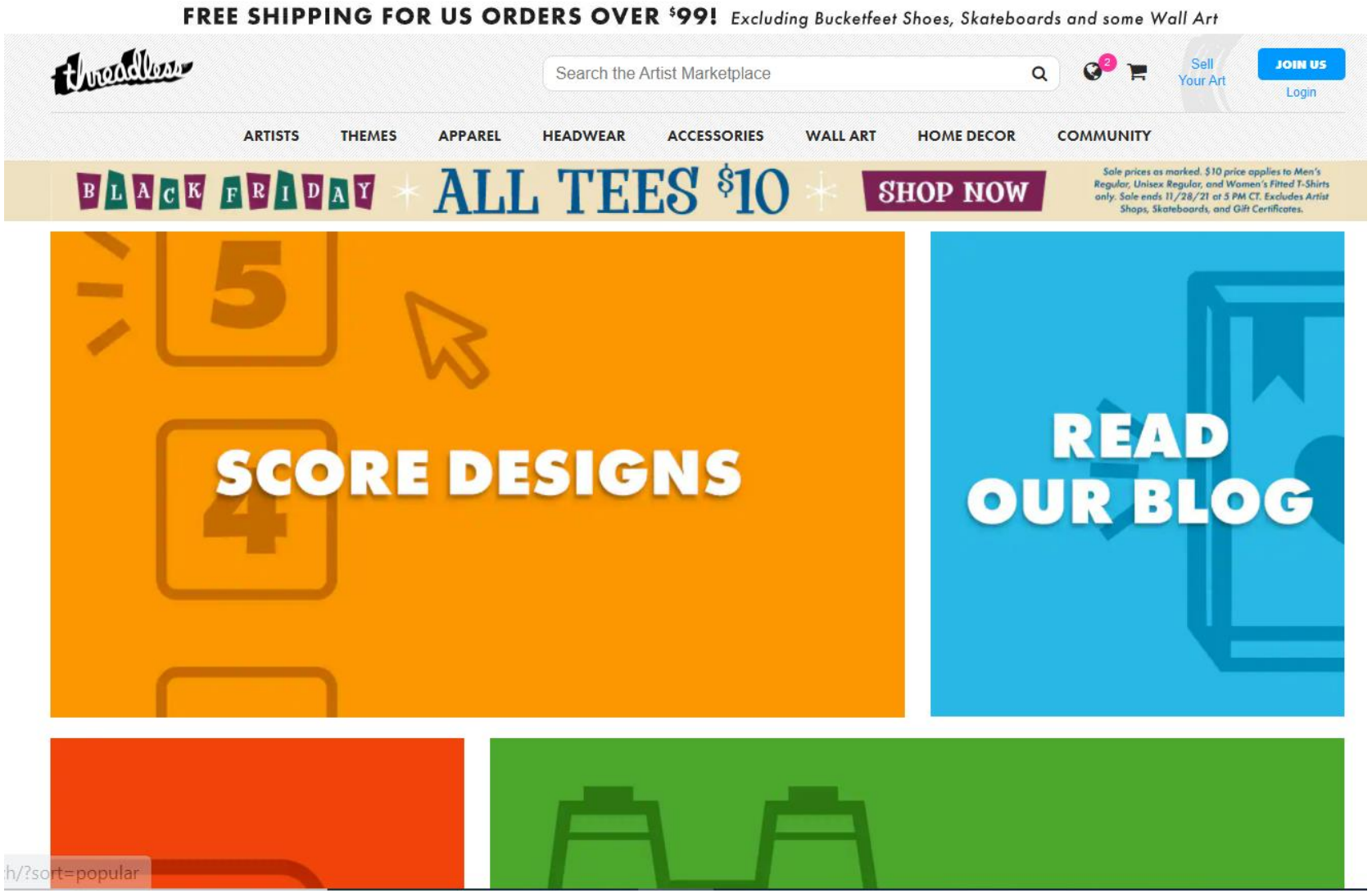
Scaling up and down a workforce isn't the easiest undertaking. With access to a global, on-demand, 24x7 workforce, MTurk enables businesses and organizations to get work done easily and quickly when they need it – without the difficulty associated with dynamically scaling your in-house workforce.

Reduce cost

MTurk offers a way to effectively manage labor and overhead costs associated with hiring and managing a temporary workforce. By leveraging the skills of distributed Workers on a pay-per-task model, you can significantly lower costs while achieving results that might not have been possible with just a dedicated team.

Source: https://www.mturk.com/

Threadless



Source: https://www.threadless.com/designs/

InnoCentive

innocentive

Challenges Solvers Resources About Us

Log in Register as a Solver

Solving some of the World's biggest problems

There are many types of people in the world and many types of problems that need solving. Since 2001, InnoCentive has helped global businesses, governments, public sector organisations and charities harness the power of a crowd. With over 500,000 Solvers tackling problems from facilitating access to clean water at a household level to passive solar devices designed to attract & kill malaria-carrying mosquitos InnoCentive has become the market leading Open Innovation organisation.

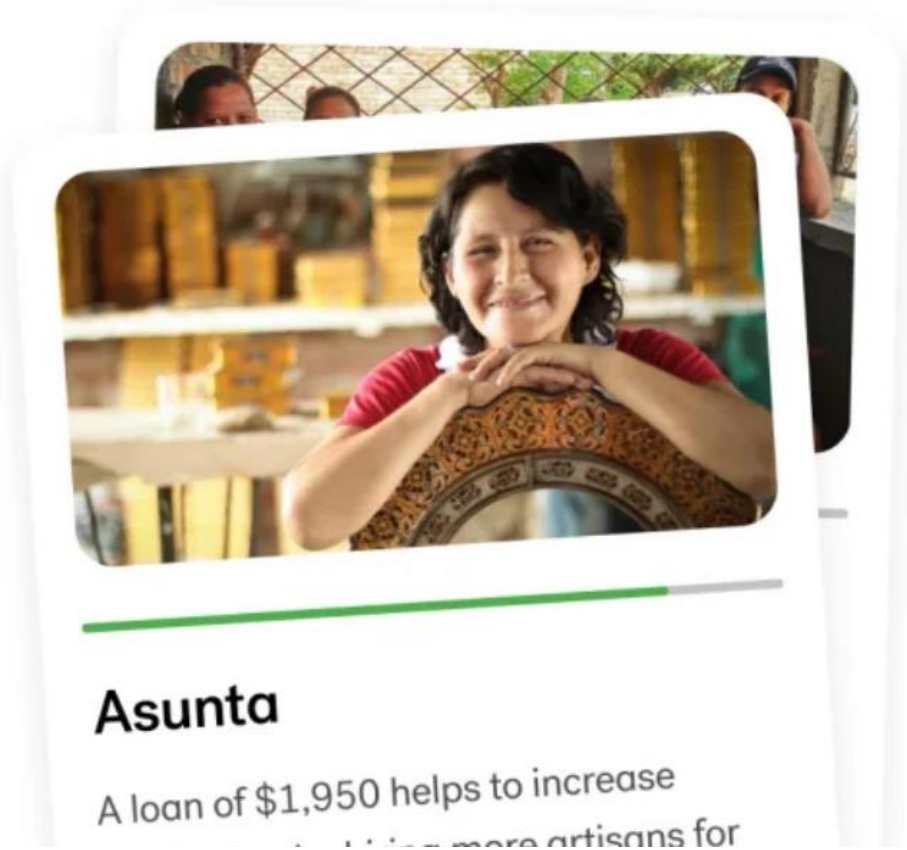
Our origins

The idea for InnoCentive came to Alph Bingham and Aaron Schacht in 1998 while they worked together at the pharmaceutical giant Eli Lilly and Company. In 2005, InnoCentive was spun out of Eli Lilly.

Source: https://www.innocentive.com/about-us/about/

Kiva

kiva Lend Borrow About Sign in



Make a loan, change a life.

With Kiva you can lend as little as $25 and make a big change in someone's life.

Find a borrower

Source: https://www.kiva.org/

GoFundMe

Search For individuals For charities gofundme How it works Sign in Start a GoFundMe

1. Start your fundraiser

- Set your fundraiser goal
- Tell your story
- Add a picture or video
- Watch a video tutorial

2. Share with friends

- Send emails
- Send text messages
- Share on social media
- Watch a video tutorial

3. Manage donations

- Accept donations
- Thank donors
- Withdraw funds

Start a GoFundMe

Source: https://www.gofundme.com/

Others

- https://ideas.lego.com/
- “Do Us a Flavor” campaign
- https://videodirect.amazon.com/home/landing
- https://www.istockphoto.com/

Crowdsourcing

- Why it is possible and successful
  - Contributors
  - Accessible tools
  - Online communities
  - Diversity
  - User-generated content

Contributors don’t have to be professionals

- Crowdsourcing attracts people with and without professional credentials
- Contributors are not always motivated by money
  - Some projects pay their contributors (iStock) while others do not (Wikipedia)
- Crowdsourcing capitalizes on our interests being more diverse than our formal training/education
  - Many people are performing tasks (and can perform tasks) they were not formally trained for
- Crowdsourcing has no regard for professional qualifications, same with nationality

Increase in availability of tools of production

- Means of production have become accessible to consumers
  - Many open source and free to use software
  - Lots of user generated content that contributors can learn from
- Multiple cheap online venues to publish content
- Cost of creating content has decreased significantly over the years
  - Mobile phones have good cameras that non-professionals take advantage of
  - Decline in cost of recording equipment and software
- E.g., iPhoto feature that allows users to upload photos to iStock website using one click, uploading to platforms is easy
- Over time, technology has become cheaper, faster, smaller and easy to use

Increase in online communities organized according to people's interests

- The community is the basic organizing force behind crowdsourcing
- Online communities don't form along geographical lines
- People are creating online communities that perform the same functions as "offline" social communities
- Availability of personal computers and the internet made forming of online communities possible
- Almost every interest has an online community
  - Sewing, moms, dads, programing, data science, job search

Increase in online communities organized according to people's interests

- Many readers have turned to writers
  - Blogs. Social media, Medium, Blogger
- Newspapers now provide the opportunity for a 2-way conversation between paper and readers – comment section
- Motivation to participate in crowdsourcing can be intrinsic – e.g. Wikipedia or extrinsic – e.g. Amazon Mechanical Turk
- Online communities are often moderated to ensure quality – Amazon Mechanical Turk

Diversity

- Individuals possess knowledge that others find valuable
  - Crowdsourcing makes a connection between the two
- Collective intelligence works better – group cognition
- Collective intelligence should be diverse too
- Diversity can be based on ideas, knowledge level, culture, skills etc.
- Diversity will only help if the crowd/group has some pre-existing knowledge

User-generated content

- Crowdsourcing creates user-generated content
- This gives companies multiple cheaper options
  - Buying photos from iStock instead of hiring a professional photographer
  - Getting idea to solve specific problems instead of appointing “Experts” – OpenIdeo (https://www.openideo.com/challenges)
- Other users also benefit from the content
  - Solutions of problems posted online
  - People can shop for products on Threadless
- Crowd creates content, crowd is in charge
- Rule of participatory media (by Bradley Horowitz, VP at Yahoo)
  - 1:10:89
  - For every 100 people on a given site, 1 will actually create something, another 10 will vote on it and 89 will consume the creation (e.g. reading a review)

Issues in crowdsourcing

- Labour and the status of creative professionals
- Quality of work
- Legal issues
- Intellectual property and copyright issues
- Ethical issues
  - Critics of crowdsourcing have accused crowdsourcing organizations of “click servitude,” “digital slavery,” and “crowdsploitation”(exploiting crowds) (Brabham, 2013)

Summary

- Crowdsourcing
- Crowdsourcing Vs Wisdom of crowds
- Examples of crowdsourcing
- Why crowdsourcing is possible and successful
- Issues in crowdsourcing

References

- Crowdsourcing: Why the Power of the Crowd Is Driving the Future of Business. Jeff Howe
- Crowdsourcing. Daren C. Brabham
- The wisdom of crowds. James Surowiecki
- Infotopia. How many minds produce knowledge. Cadd Sunstein
- Lecture notes. Prof. Julita Vassileva