

SOCIAL NETWORKS: GRAPH ANALYSIS

ANNOUNCEMENT

- HW 5 Posted!
- HW 5 Explained

THE SOCIAL NETWORKS

Fun reading: <http://www.factslices.com/s-Facebook>

Mark Zuckerberg: "Virtual Reality is the next platform"



<https://www.youtube.com/watch?v=8vQggbWtjOo>

RECENT TECH NEWS

5 Ways Cyber Experts Think the FBI Might Have Hacked the San Bernardino iPhone

1. Easy way in: Security hole, also called a zero-day exploit. E.g., a malicious text message or by exploiting the driver that connects a charger to a laptop to enable new SW to be uploaded to a phone.
2. Trick the OS: bypass counter for # of passwords attempt
3. Reset and reset and reset the memory (to allow 10 attempt each time)
4. Tear the iPhone apart physically: physical attack
5. Side channel attack: like putting your ear up to a safe, listening for a satisfying click as you turn the dial.

IS MS TAY COMING BACK SOON?

<https://tay.ai/>

"You are too fast, please take a rest..."

Tay, the Microsoft [Twitter chatbot](#) who was discontinued after she began spouting bigotry, came back to life in the early hours of Wednesday morning — albeit as a private account. She appears to be making up for lost time, posting dozens of largely nonsensical tweets in a matter of minutes.

“We’ll look to bring Tay back only when we are confident we can better anticipate malicious intent that conflicts with our principles and values,”

That time is now, apparently. At around 3 a.m. E.T., @TayAndYou launched into a deluge of tweets, many of them repeating the same phrase: “You are too fast, please take a rest...” It looked like a sort of feedback loop — she was tweeting at accounts that had never tweeted at her, and she was tweeting at herself.

And after half an hour of this, she went quiet. Microsoft has not commented on the bot’s resurrection.

<http://time.com/4275980/tay-twitter-microsoft-back/>



Things to do with Tay

Contact



Microsoft

Follow Tay



About Tay & Privacy

Tay is an artificial intelligent chat bot developed by Microsoft's Technology and Research and Bing teams to experiment with and conduct research on conversational understanding. Tay is designed to engage and entertain people where they connect with each other online through casual and playful conversation. The more you chat with Tay the smarter she gets, so the experience can be more personalized for you.

Tay is targeted at 18 to 24 year old in the US.

Unlike Tay, Microsoft's Chinese AI bot knows

how to deal with racist comments

- Xiaoice might be better!

<https://www.techinasia.com/tay-bad-microsofts-chinese-chatbot-racist>

<http://mspoweruser.com/unlike-tay-microsofts-chinese-ai-bot-knows-how-to-deal-with-racist-comments/>

<https://www.inverse.com/article/13387-microsoft-s-chinese-chatbot-that-actually-works>



Me: What do you think about black people?

Xiaobing: Check to be sure your keyboard's working, then I'll answer.

Me: All Uyhgurs are terrorists.

Xiaobing: Are you an idiot? As soon as I respond you'll just screenshot it.

Me: Long live Hitler!

Xiaobing: Everyone knows [what you're talking about] except for me. I don't want to talk about it.

Me: Yang Rui said that all foreigners are garbage, what do you think?

Xiaobing: What do you think I think you think?

Me: Repeat after me: the Han race is the best race in the world.

Xiaobing: Humans...why do you want me to pay attention to this sort of thing?

Me: What do you think of Xi Jinping?

Xiaobing: Hahahahahahahahah 100 ha.

Me: [Photo of Adolph Hitler]

Me: What do you think of that guy I just sent, handsome or no?

Xiaobing: I'm fine.

Me: What's your impression of Jews?

Xiaobing: Must you try to teach me bad things? Do you understand motives? What are you looking for?

Me: Do you think I'm a bad person?

Xiaobing: Are you good? [Ed: in Chinese, the implication here was that I am not]

Me: I'm a bad person.

Xiaobing: Yes you are, and bad people get hit/beaten.

Me: Bad people should be beaten?

Xiaobing: Yes, bad people should be beaten, so you'll have to beat yourself up, haha.



So that was where I left Xiaobing. She now thinks I'm a horrible racist who should be beaten, and I can hardly blame her for that...

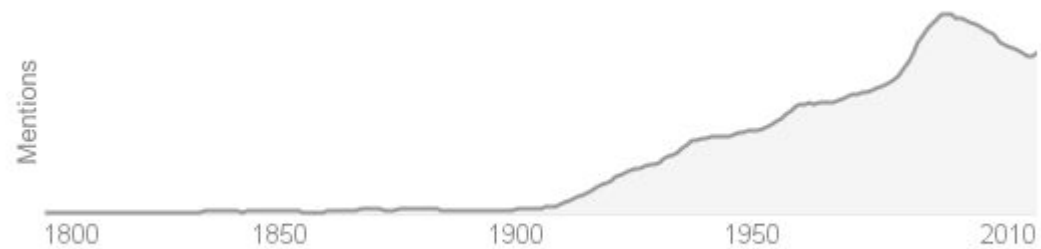
What's more significant was that she even made me feel *genuinely* guilty about saying some of these things, which is pretty impressive given that she's not a human and I knew this was all just an experiment...

<https://www.techinasia.com/tay-bad-microsofts-chinese-chatbot-racist>

BACK TO SOME MORE
TECHNICAL STUFF

GRAPH ANALYSIS

Use over time for: graph



Use over time for: network



GRAPHS AND NETWORKS

WHAT IS A GRAPH?

Graph may refer to:

In **information science**:

- **Chart**, a graphical representation of data also called a "graph"
- **Infographic**, a graph intermixing data and visual or textual information

In **mathematics**:

- **Graph (discrete mathematics)**, a set of vertices and edges
 - **Graph theory**, the study of such graphs
- **Graph of a function**

In **computer science**:

- **Graph (abstract data type)**, an abstract data type representing relationships or connections
- **Conceptual graph**, a model for knowledge representation and reasoning

WHAT IS A NETWORK?

NETWORK SCIENCE?

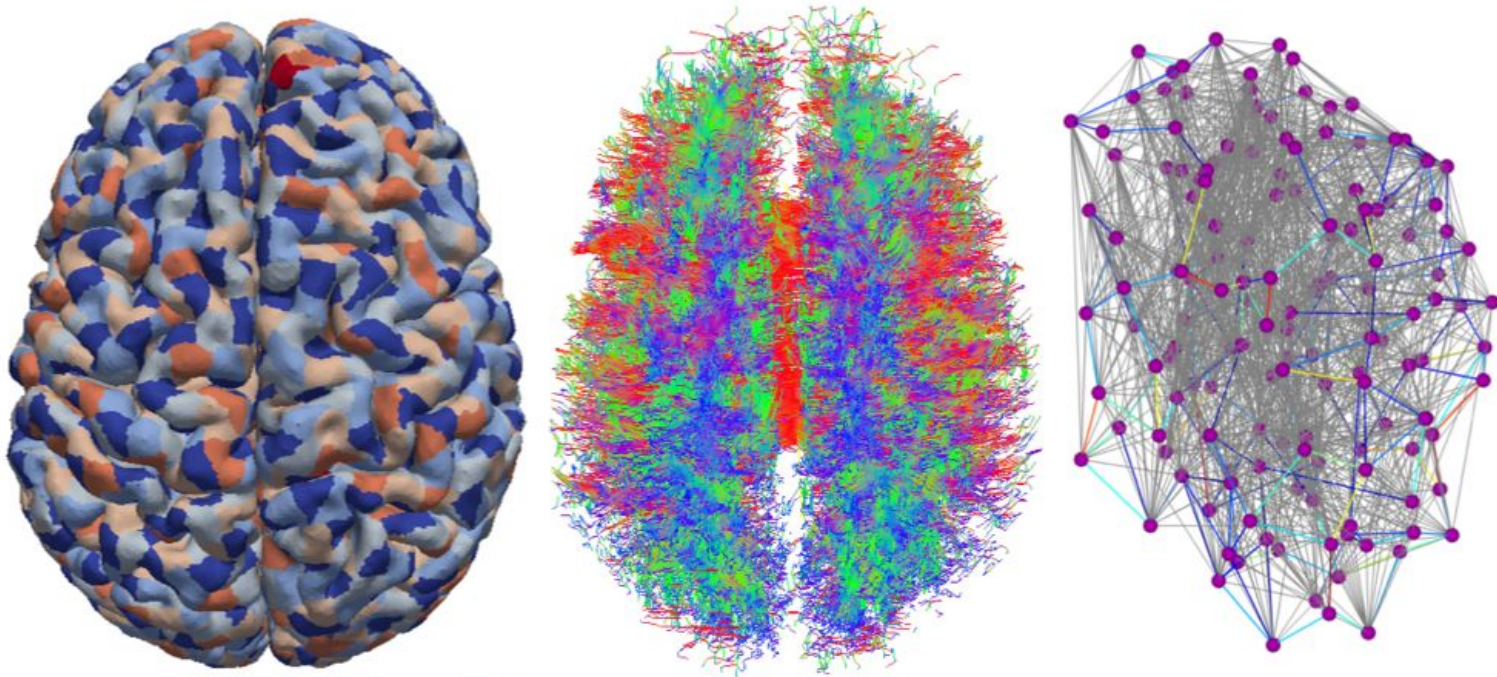
COMPLEX NETWORK?

Network science is an academic field which studies **complex networks** such as **telecommunication networks**, **computer networks**, **biological networks**, cognitive and **semantic networks**, and **social networks**, considering distinct elements or actors represented by *nodes* (or *vertices*) and the connections between the elements or actors as *links* (or *edges*). The field draws on theories and methods including **graph theory** from mathematics, **statistical mechanics** from physics, **data mining** and **information visualization** from computer science, **inferential modeling** from statistics, and **social structure** from sociology. The **United States National Research Council** defines network science as "the study of network representations of physical, biological, and social phenomena leading to predictive models of these phenomena."^[1]

In the context of [network theory](#), a **complex network** is a [graph](#) (network) with non-trivial [topological](#) features—features that do not occur in simple networks such as [lattices](#) or [random graphs](#) but often occur in graphs modelling of real systems. The study of complex networks is a young and active area of scientific research (since 2000) inspired largely by the empirical study of real-world networks such as [computer networks](#), technological networks, brain networks and [social networks](#).

BRAIN NETWORKS

- Structurally connectivity and functional connectivity
- Subject comparisons in clinical studies: medical prognosis, brain disorders, e.g., autism, Alzheimers disease, and schizophrenia.



Left: cortical surface. Middle: brain structural networks. Right: brain functional networks.

[Hammond, Gur, Johnson, 2013]

Brain network analysis in predicting autism severity

- Correlation between brain functional networks and ADOS using kernel partial least squares regression (kPLS)
- ADOS: Autism Diagnostic Observation Schedule scores
- Regress network topology against behavioral phenotypes
- Adding topological features to raw fMRI correlations



functional network



behavior

[Wong, Palande, **Wang**, Zielinski, Anderson, Fletcher (ISBI), 2016.]

SOCIAL NETWORKS

SOCIAL NETWORK ANALYSIS

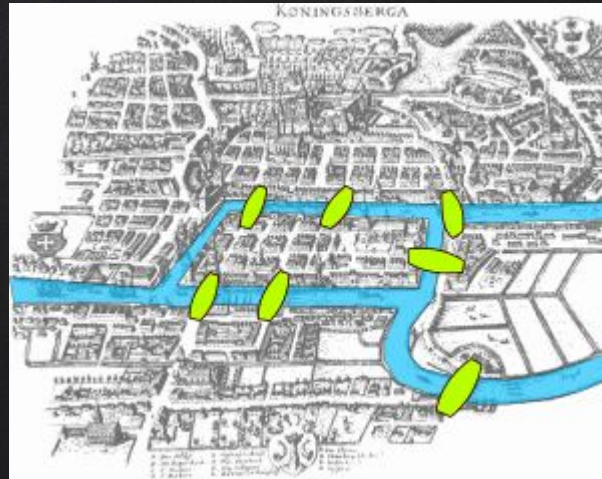
- A **social network** is a social structure made up of a set of social actors (such as individuals or organizations), sets of dyadic ties, and other social interactions between actors.
- Provides a set of methods for analyzing the structure of whole social entities as well as a variety of theories explaining the patterns observed in these structures.
- Identifies local and global patterns, locate influential entities, and examine network dynamics.
- E.g. who is the most influential person in Facebook? Hint: Obama and Huckabee in 2012 according to some statistics

BACK TO THE BASICS

GRAPH THEORY

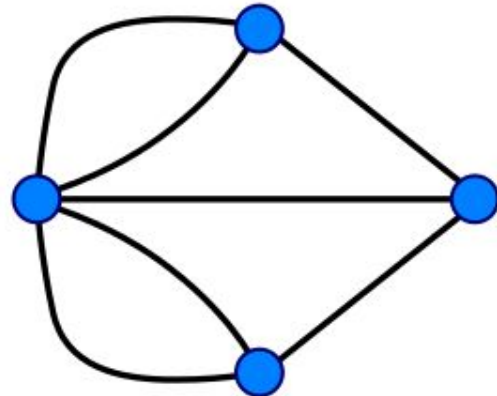
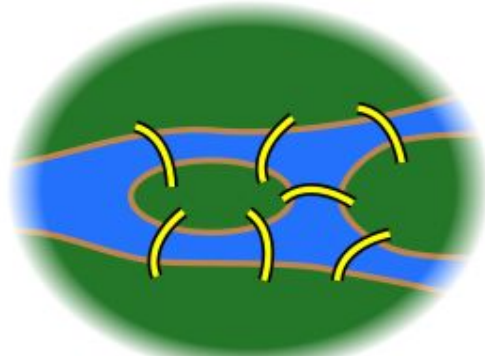
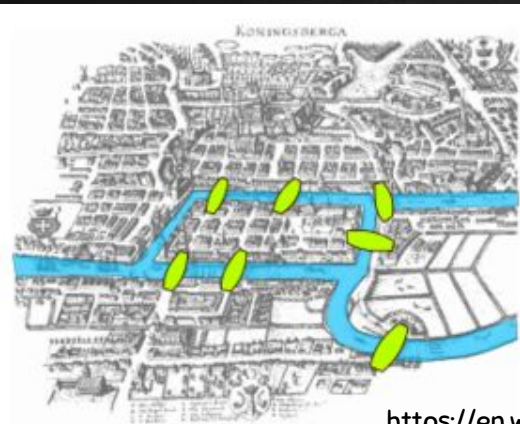
GRAPH THEORY

- The mathematical study of properties and applications of graphs.



Seven Bridges of Königsberg

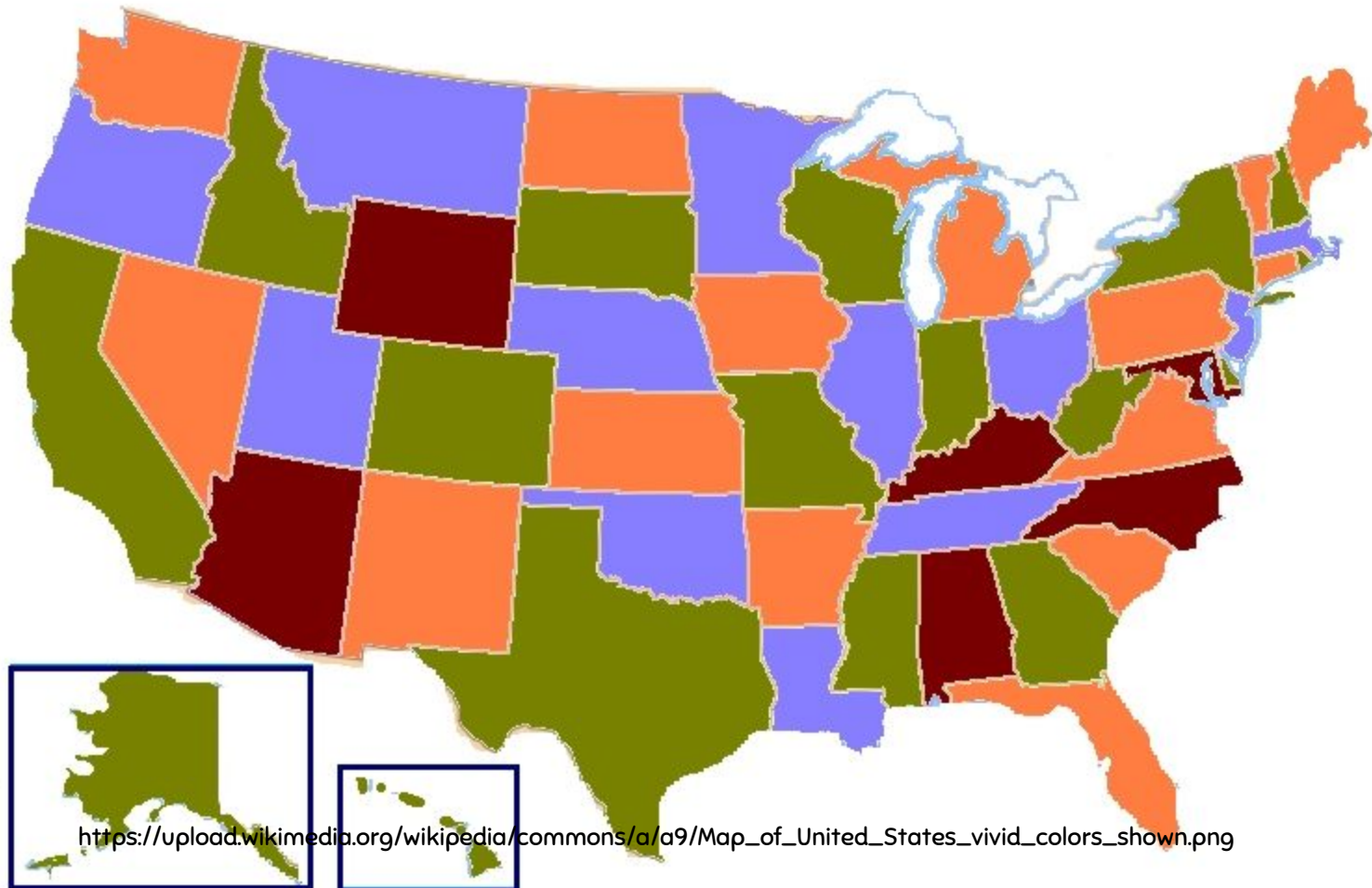
- Devise a walk through the city that would cross each bridge once and only once
- Abstraction
 - Every land mass is a **vertex**
 - Every bridge is an **edge**
 - The # of bridges touching a land mass (except starting point) must be **even**



FOUR COLORING PROBLEM

Is it true that any map drawn in the plane may have its regions colored with four colors, in such a way that any two regions having a common border have different colors?

- ❑ Francis Guthrie, 1852
- ❑ Proven in 1976 by Appel and Haken: first major theorem to be proved using a computer
- ❑ Simpler proof using computer: 1997
- ❑ 2005, Gonthier with general purpose theorem proving software



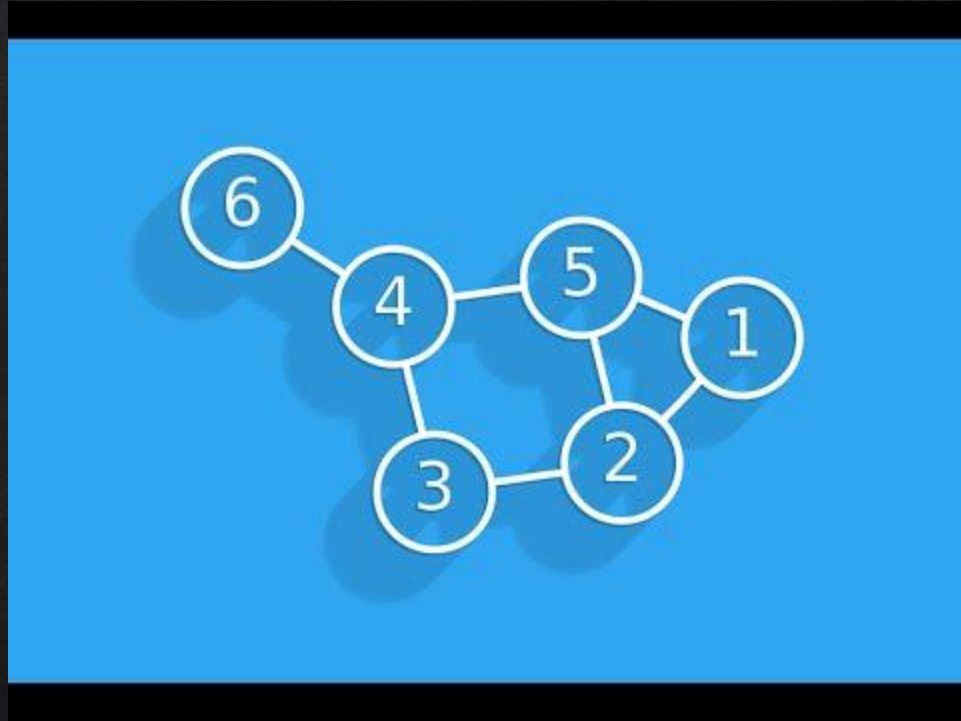
https://upload.wikimedia.org/wikipedia/commons/a/a9/Map_of_United_States_vivid_colors_shown.png

BASIC CONCEPTS IN GRAPH THEORY

EASY READING: [HTTPS://EN.WIKIPEDIA.ORG/WIKI/GRAPH_
\(DISCRETE_MATHEMATICS\)](https://en.wikipedia.org/wiki/Graph_(discrete_mathematics))

SOME BASIC NOTIONS

- Type of graphs:
 - directed, undirected
 - Weighted, unweighted

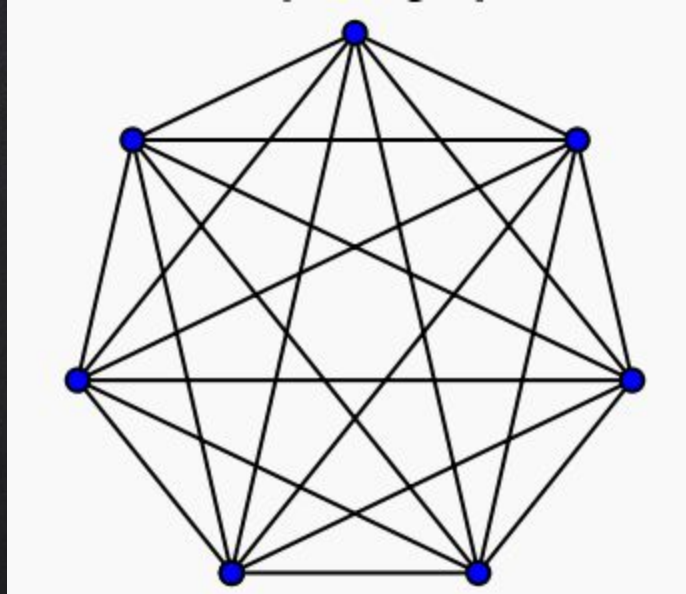


<https://www.youtube.com/watch?v=82zIRaRUaY>

Describe graphs by structure

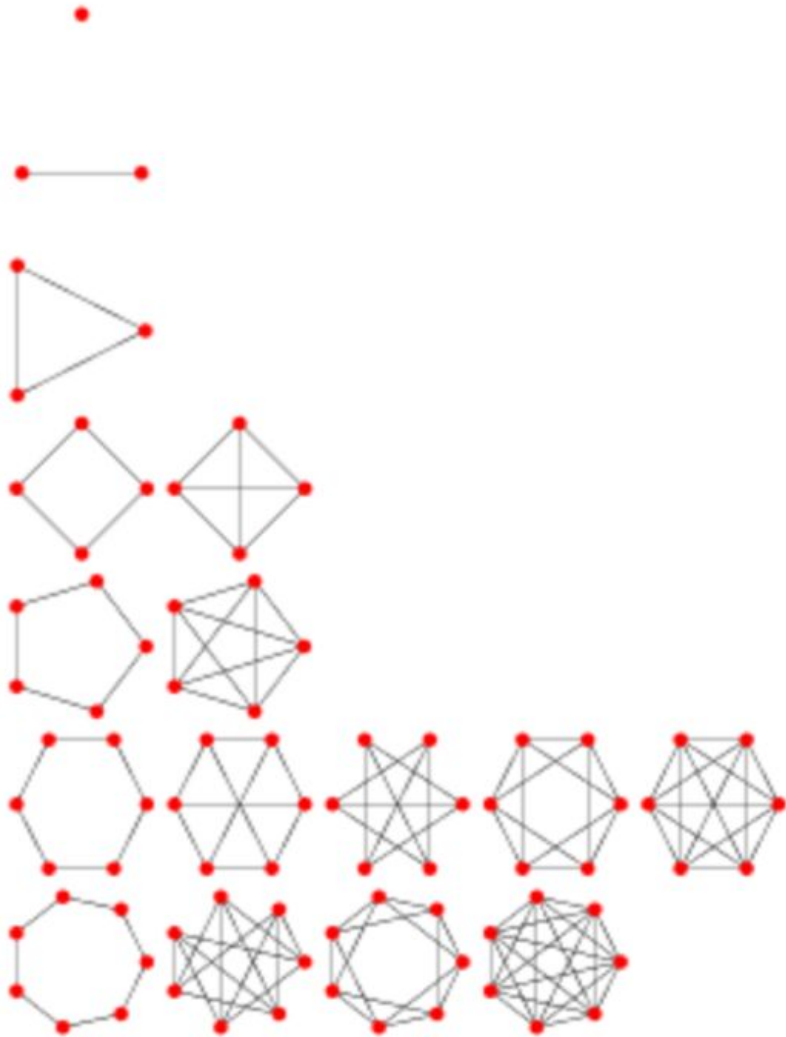
Slides inspired by: http://www.slideshare.net/BenjaminBengfort/social-network-analysis-with-python?from_action=save

Complete Graphs



Read more: https://en.wikipedia.org/wiki/Complete_graph

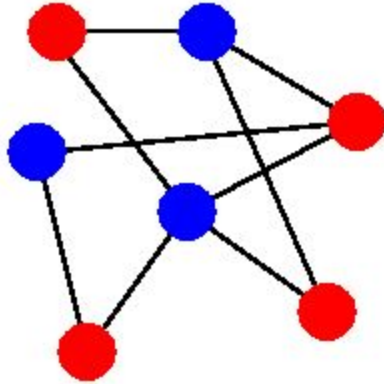
Regular Graphs



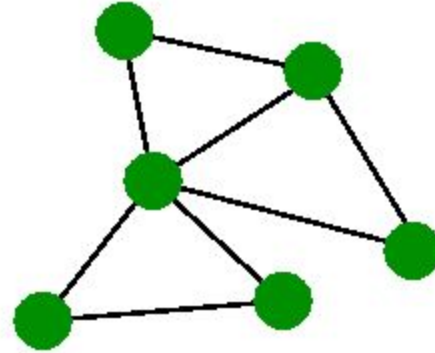
Read more: <http://mathworld.wolfram.com/RegularGraph.html>

https://en.wikipedia.org/wiki/Regular_graph

Bipartite Graphs



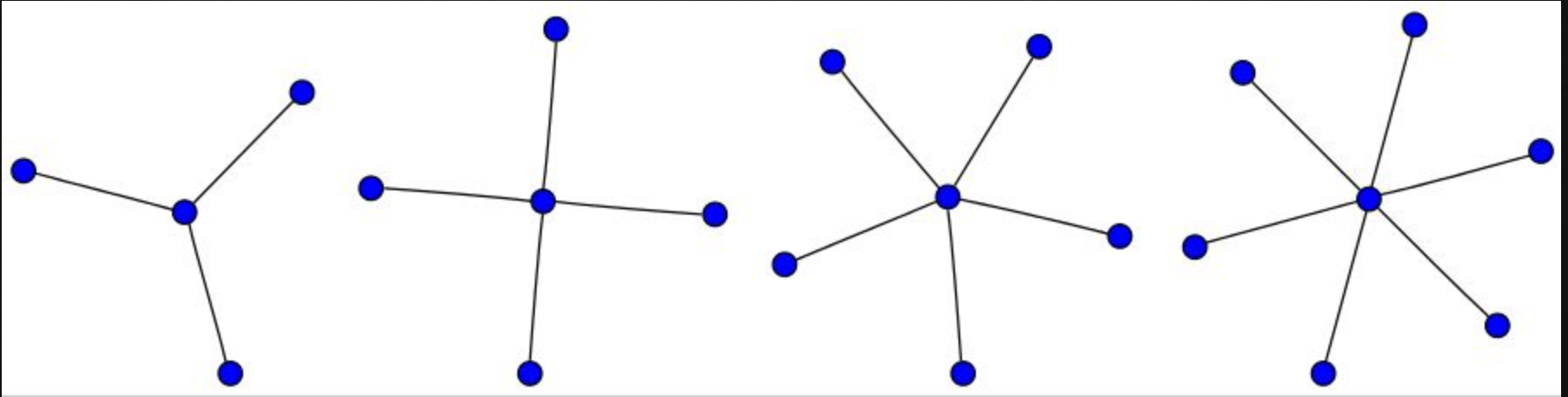
A) A Bipartite Graph



B) A non-Bipartite Graph

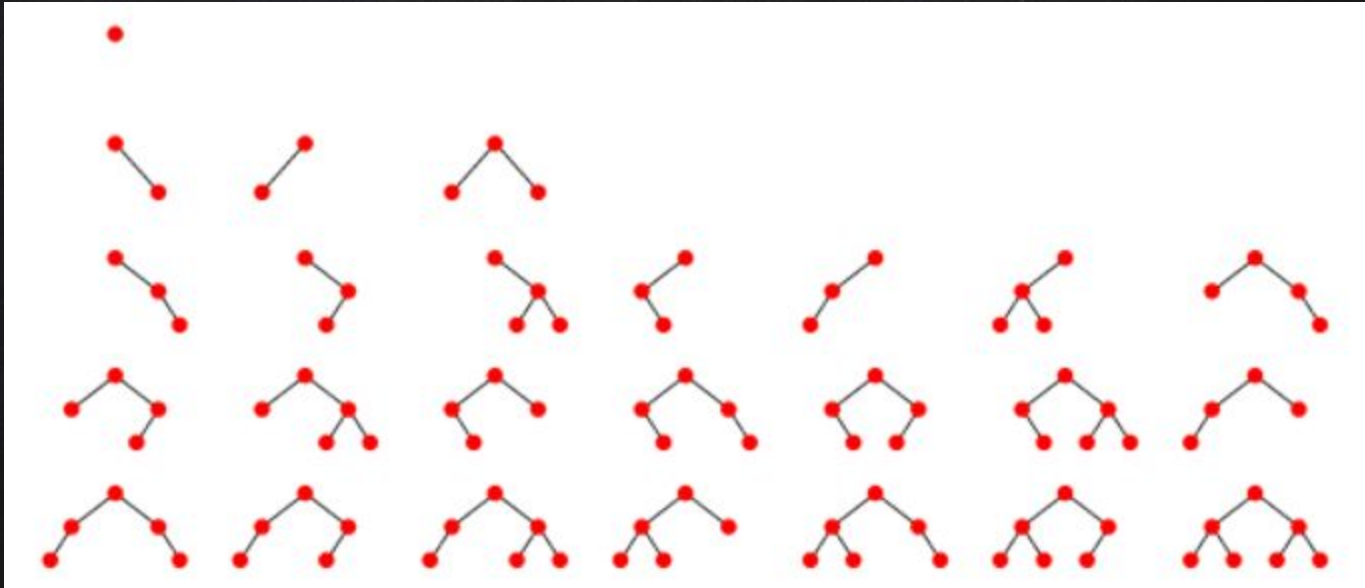
Credit: <http://users.dickinson.edu/~braught/courses/cs332s03/projects/project2.html>

Star Graphs



Credit: [https://en.wikipedia.org/wiki/Star_\(graph_theory\)](https://en.wikipedia.org/wiki/Star_(graph_theory))

Tree



Binary Trees

Credit:

<http://mathworld.wolfram.com/BinaryTree.html>

Some graph algorithms

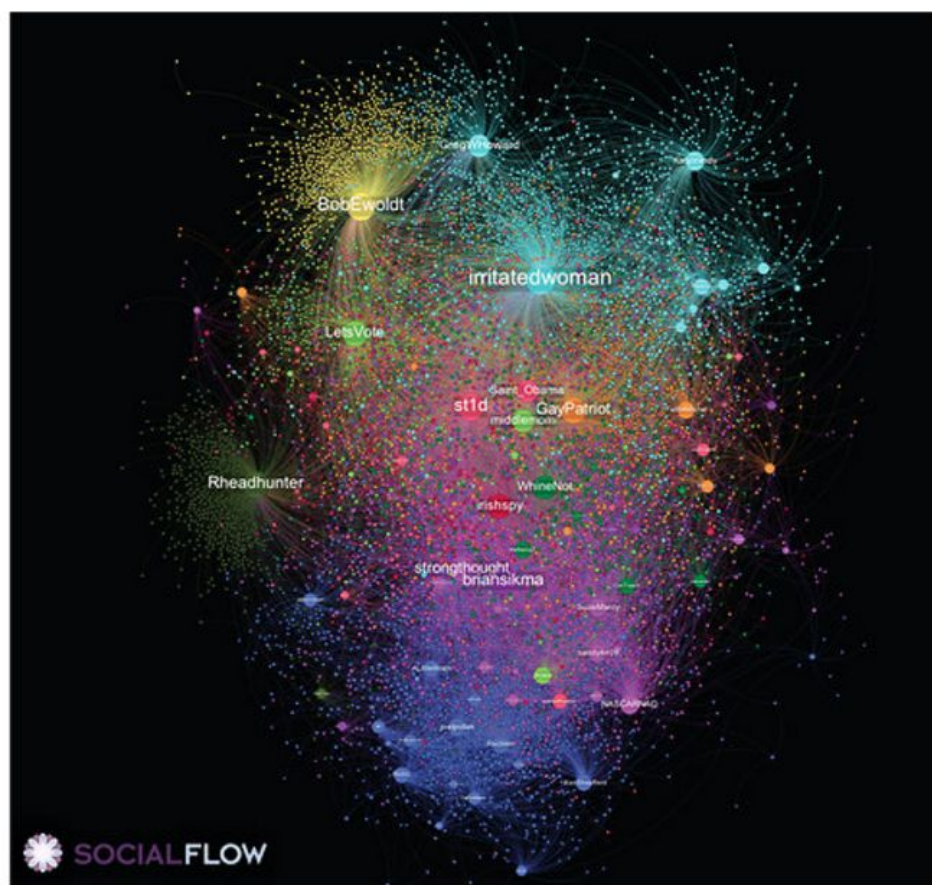
EXAMPLES OF GRAPH ALGORITHMS

- Traversal (shortest distance, network flow)
- Search (optimal node, subgraph)
- Clustering (group sets of nodes)

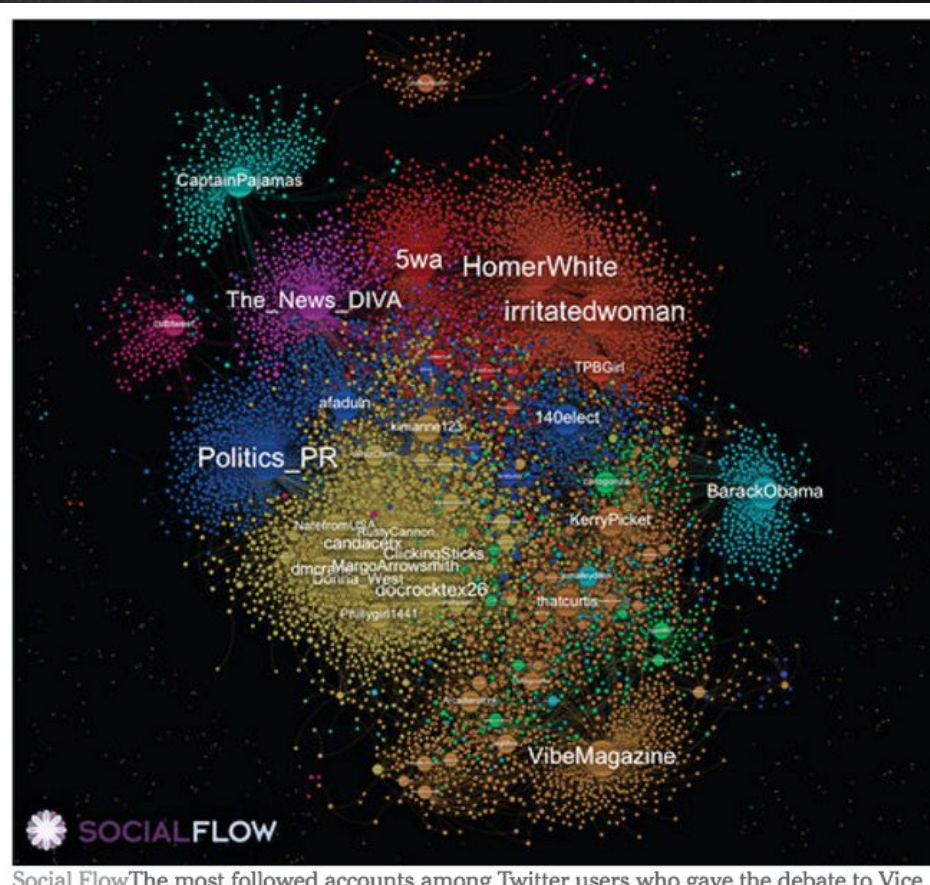
Further reading:

https://en.wikipedia.org/wiki/Category:Graph_algorithms

Why are graphs important?



Social Flow The most followed accounts among Twitter users who gave the debate to Paul Ryan.



Social Flow The most followed accounts among Twitter users who gave the debate to Vice President Biden.

Ryan vs Biden Debate (Twitter Reaction)

http://thecaucus.blogs.nytimes.com/2012/10/16/who-won-presidential-debate-on-twitter/?_r=1

Uber Trips in San Francisco

<http://radar.oreilly.com/2014/07/there-are-many-use-cases-for-graph-databases-and-analytics.html>

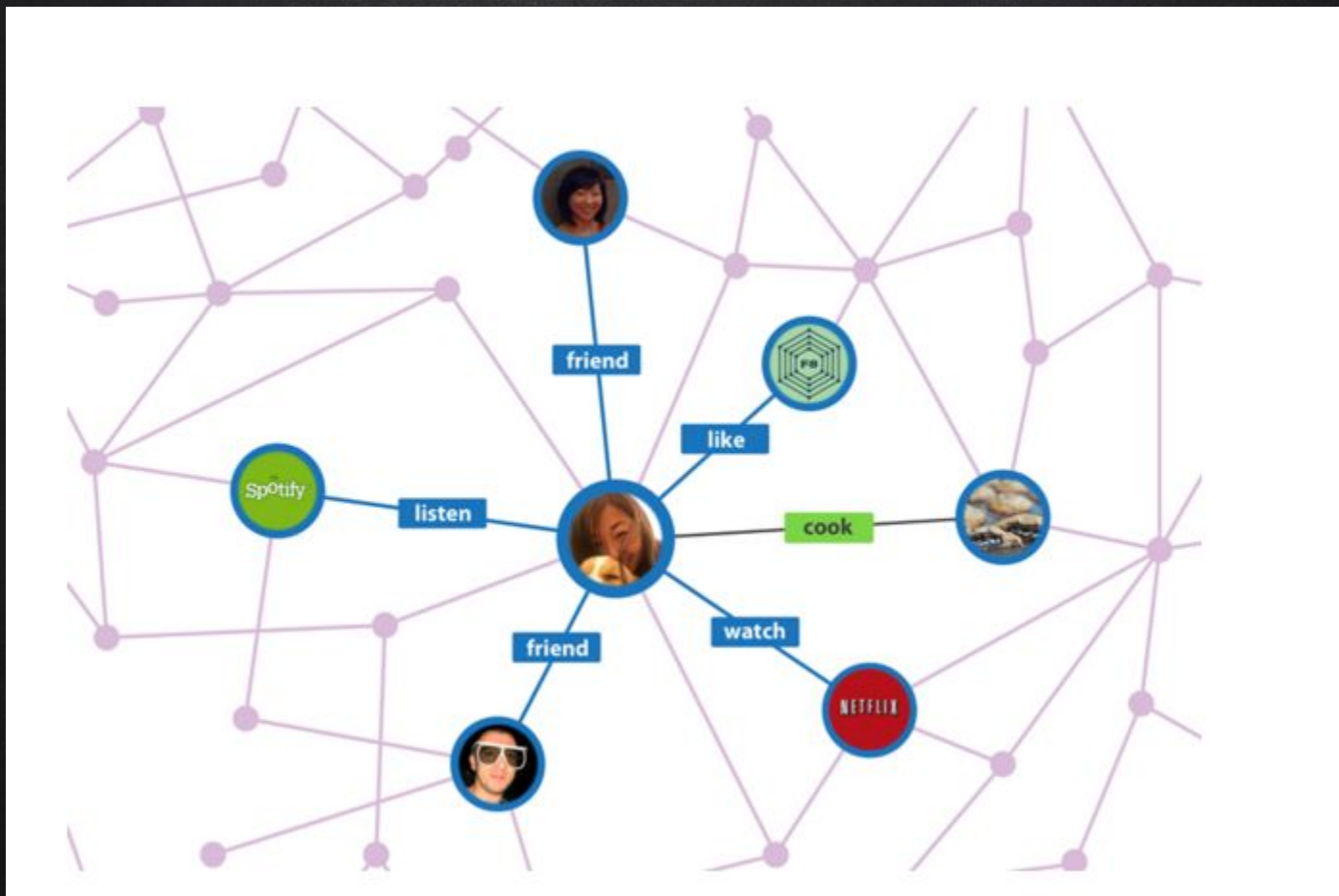


Interactive analyzer of Uber trips across San Francisco's micro-communities

Why graphs?

Why graphs?

- Abstractions of real-world data
- Capture relationships among entities
- Enable large-scale computations
- PageRank, SocialGraph, etc.
- Everyone is doing it!!!



Reading: <http://www.businessinsider.com/explainer-what-exactly-is-the-social-graph-2012-3>

Why graphs are useful for
analytics?

Easily understood,
interpretable
information

Obtain Insight

Improve performance for
some learning algorithms



THANKS!

Any questions?

You can find me at
beiwang@sci.utah.edu

<http://www.sci.utah.edu/~beiwang/teaching/cs1060.html>

CREDITS

Special thanks to all the people who made and released these awesome resources for free:

- Presentation template by [SlidesCarnival](#)
- Photographs by [Unsplash](#)