More Social Networks: Limitations and Potential of Computation
Announcement

- Bonus 5 due today
- T-shirt size choice: S, M, L, XL
- T-shirt design ideas
- Sign up for demo session on Thursday 15 minutes: 10 people
More Social Networks
Why graphs are useful for analytics?
Easily understood, interpretable information
Obtain Insight
Improve performance for some learning algorithms
Social networks revisited
Model Social Networks as Graphs

http://randomwire.com/linkedin-inmaps-visualises-professional-connections/
Centrality

Identification of vertices that play the most important role
https://www.youtube.com/watch?v=NgUj8DEH5Tc
Clustering and connectedness

Detection of communities in a network
Limitations and Potential of Computation
What a computer Can Not Do?

- We’ve studied computers
  - What they are
  - What they can do
  - How to use them to solve problems
- Discussion: What are the limits of computers?
- Discussion: What are new directions for computing?
Hardware Limitations

- Representation of information is finite
  - Must fit in physical memory
  - Round-off error

Example:
- There is room for 3 digits per number
- Add 100 + 1.5 = 100.5
- Stores 100 as answer

Example: $\frac{1}{3} = 0.33333333333\ldots$
Hardware limitations

- Binary conversion in real life
- In Excel, try
  - $A = 1.12$, $B = -1.23$, $C = 0.11$
  - $A + B + C = 1.249E-16$
  - $A + C + B = 0$
  - $A + B + C$ not equals to $A + C + B$

Is this a real problem?
Limitation in Computing Power

- Advances in computer power has been one of the great successes of all time
  - Computers become faster and cheaper
- Moore’s law
  - Transistor density doubles every year to 18 months
  - Transistor: signal amplifying
- Osborne portable
  - 1982
  - Vs. iPhone
Not Just for Computer Chips
Problems with Moore’s Law

The Foundry Dilemma

- Chipmakers need to keep pace with tech and focus on design
- ...while the cost of manufacturing and R&D continue to grow

Source: Anandtech
Transistor Size

- Computer chips made up of billions of transistors
  - Insulating layer is only a few atoms thick!
  - How can Moore’s law continue?
- 2012: single-atom transistor shown in lab
  - No practical for production
  - Is this the limit?
Is this the limit? - (start at 2:13) https://www.youtube.com/watch?v=bm6ScvNygUU
Is this the limit?

- Biological computers
- Optical transistors
- Nanomagnet transistors
- Quantum computers
Software Limitations

- Computers must be programmed
- Computer software (programs) may contain errors
- Humans design, write and check software
  - Software verification
  - Software engineers
- There are important branches of computer science
  - Crypto verification
- How does open-source software development affect software quality?
Bad bugs

- Notorious software errors
  - At&T down
    - Error triggered by bug in software update
  - Therac-25 radiation therapy machine
    - Overflow error
  - Mars Climate Orbiter burn up
    - English vs metric units
  - Heartbleed security bug
SOFTWARE LIMITATIONS

- Are there fundamental limits to the problems we can solve on computers?
  - We had some discussion about intelligence
  - Can we prove anything about problems computers can or cannot solve?
- Alan Turing gave an example of a problem computer cannot solve
  - Halting problem
THANKS!

Any questions?

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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