Microsoft Research

Microsoft Research Asia
Faculty Summit 2010

John Hopcroft

- 1986 Turing Award recipient
- Member of the National Academy of Sciences and the National Academy of Engineering
- Fellow of the American Academy of Arts and Sciences, the American Association for the Advancement of Science, IEEE, and ACM

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- National Science Board
- National Research Council's Commission on Physical Sciences, Mathematics, and Applications

ACM Karl V. Karlstrom Outstanding Educator Award

- "for his vision of and impact on computer science, including co-authoring field-defining texts on theory and algorithms, which continue to influence students 40 years later,
- advising PhD students who themselves are now contributing greatly to computer science, and
- providing influential leadership in computer science research and education at the national and international level."


Alfred Aho
Zvi Galil
Robert Tarjan (Turing Award recipient)

Day Two: Breakout Session

Microsoft Research Asia
Faculty Summit 2010

Finding, Keeping and Nurturing Talent: The Key to Success

Date and Time: 09:00am -13:00pm, Oct. 19, 2010

Venue: Room 201, 2F, East Tower

Session
Overview: Talent Programs at Microsoft Research Asia Lolan SONG, Microsoft Research Asia
Requests from Customers, and Our Efforts and Plans to the Requests HyunWook PARK, Korea Advanced Institute of Science and Technology
Recruiting, Cultivating, and Retaining Talented Academic Researchers: The Case of the Computer Science and Engineering Department at the Hong Kong University of Science and Technology Mounir HAMDI, Hong Kong University of Science and Technology
Reducing Talent Gaps Xiaoning LING, X-Gainian Foundation
Experience in Teaching Advanced Software Engineering Xin ZOU, Microsoft Research Asia
Panel Discussion: Finding, Keeping and Nurturing Talent: The Key to Success **Chair:** Baining GUO, Microsoft Research Asia **Panelists:** Sadaoki FURUI, Tokyo Institute of Technology John HOPCROFT, Cornell University Seung-won HWANG, Pohang University of Science and Technology Weiping LI, University of Science and Technology of China

Growing Talent

John Hopcroft
Cornell University
Ithaca, NY 14853

Outline

- The US research model
- Teaching in the United States
- Some recommendations for Asia Pacific
- Spotting and mentoring talent
- How to get started in research

United States science policy

- Basic research done in universities
  - Guarantees next generation of scientists
- Applied research in government laboratories

United States Research Policy

- Be world-class in all areas of science
  - Sufficient research effort such that if there was a break through in some discipline, we would hear about it and be able to reproduce it in the US
- Be number one in certain areas of science
  - Enabling discipline
    - Molecular biology
    - Computer Science
    - Mathematics
  - Capture imagination of society
    - Placing a man on the moon
  - Coupled to national objectives

Competition

- 50 states each with their own educational system
- Many private institutions
  - Cornell, Stanford, Princeton, Harvard, Yale
- Each institution can experiment and then adopt strategies that work

Mobility

- Most universities encourage their under graduates to go to another institution for their Ph.D.
- Most institutions do not hire their own Ph.D. students as faculty
- Student does under graduate, Ph.D., Post doc, faculty position at four different institutions

External review

- External letters for promotion. Seek letters from international experts in the field.
- Ask what have they done, why is it important, how has it impacted the work of others.
- Counting papers is a mistake.

Avoid top down management

- New course – little approval
- PI directed research – peer reviewed
- Faculty members make their own decisions as to directions they want to pursue

Quality of Ph.D. students

- Quality of Ph.D. students is the most important factor in faculty hiring
  - Universities seek the best graduate students world wide
  - Institutions pay students full tuition and fees plus stipend of approximately $25,000
- Vital for faculty development
  - Assistant professors can supervise Ph.D. students

Multiple avenues

- Multiple sources of funding
- NSF, DARPA, ONR, AFOSR, ARO, etc
- Budget – PI can spend without seeking approval with the exception that salary cannot be increased without permission

Ph.D. program at Cornell
Others similar

- Ph.D.'s admitted by field not by individuals
- Funded as long as in good standing
- Student picks his or her field of study
- Student picks his or her Ph.D. supervisor

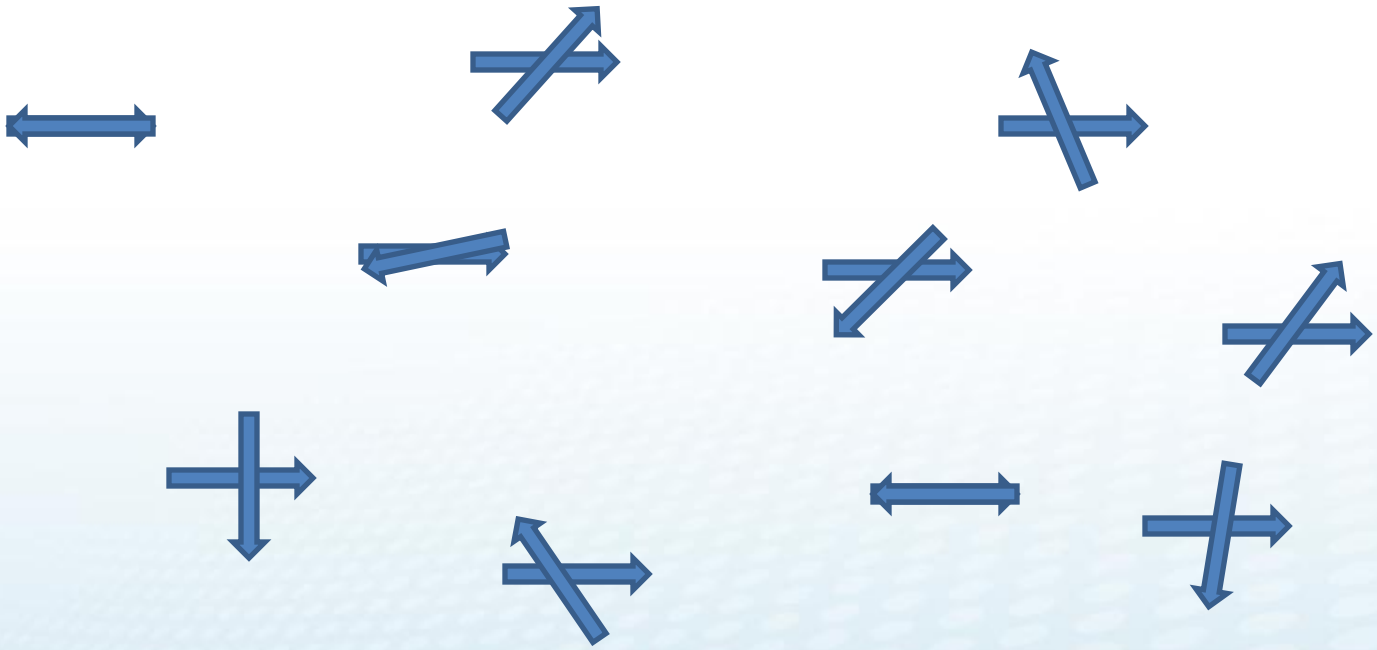
Miscellaneous

- English is the language of science and business
- Size of departments 35
- Chalk not power point
- Wednesday lunch
- Research for large software projects
- 1st class Aho, Ullman, Kernigan

Suggestions for Asia Pacific

- Each University needs to develop a strategic plan
- Make salaries competitive
- Increase flexibility and creativity
- International standards for evaluation and promotion
- Transparency
- Ph.D. to faculty ratio
- Increase use of English
- Coherent physical location
- Faculty governance

Impact of strategic plan



Spotting and mentoring talent

- Get to know your students
- Hold office hours
- Assign optional exciting problems
- Offer research experience for under graduates
- Meet with your Ph.D. students at least twice a week
- Along with a Ph.D., work with a small group of under graduates

How to get started in research

- Position yourself for the future
- Ignore well established open problems
- Formulate new direction or area
- Start simple

Students getting started in research

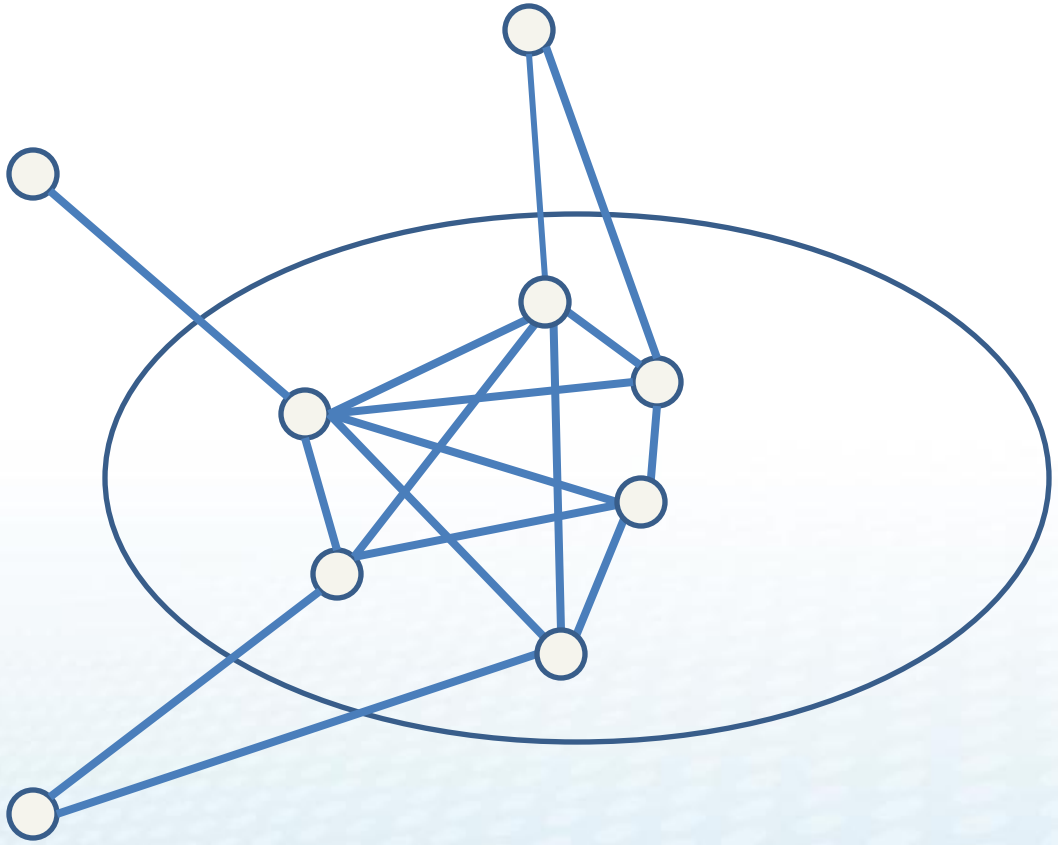
The following is an example of the sequence of steps that some researchers at Cornell took to start their research.

They began with a series of simple questions.

"Clustering Social Networks"
Mishra, Schreiber, Stanton and Tarjan

Introduced concept of alpha-beta community

- Each vertex in community is connected to at least a beta fraction of vertices in community
- Each vertex outside the community is connected to at most an alpha fraction of vertices in the community



Example of alpha-beta community

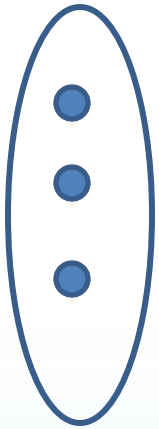
Supasorn Suwajanakorn asked if every graph had an alpha-beta community

In answering, he developed an algorithm to convert a random set of *k* vertices to an alpha-beta community of size *k*

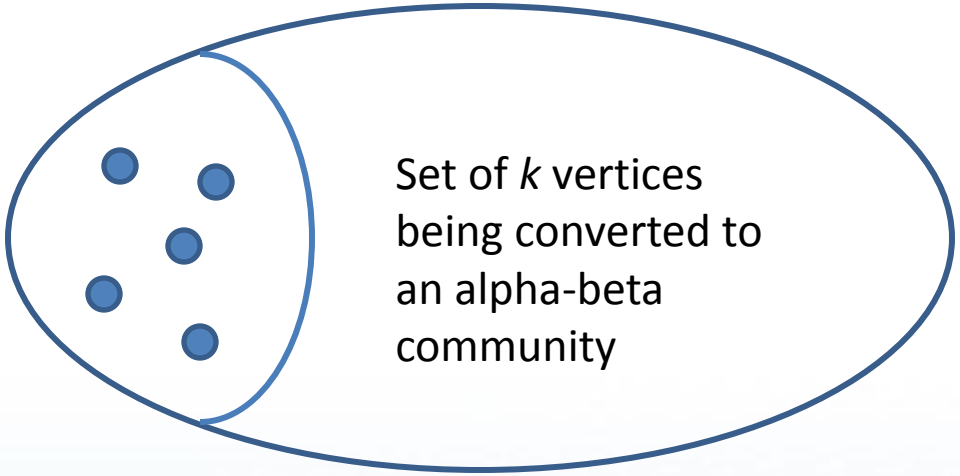
Random set of *k* vertices

Algorithm to convert random set of vertices to an alpha-beta community

Alpha-beta community of size *k*

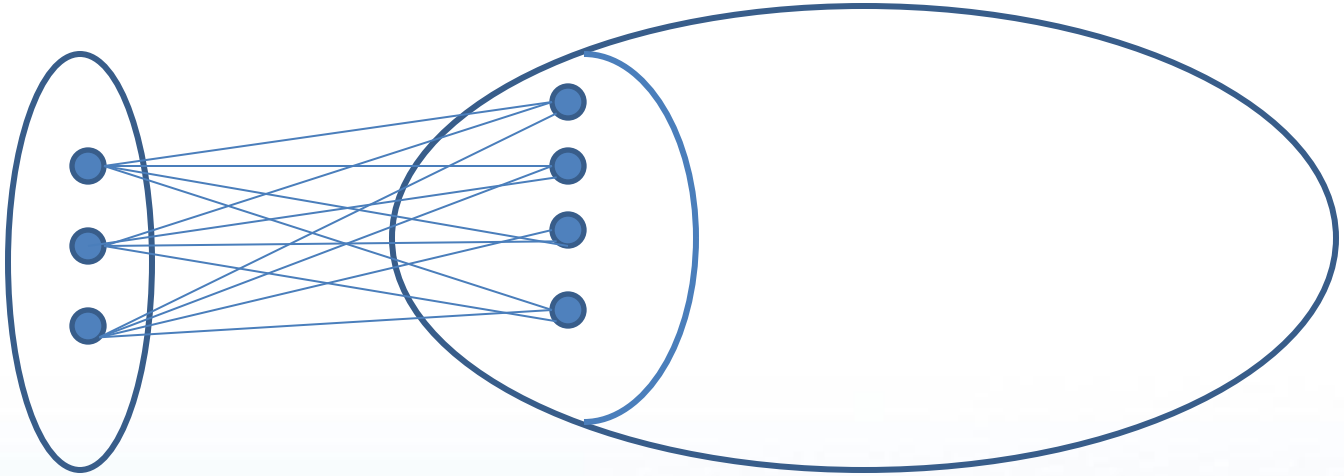


Highest alpha value



Lowest beta value

If alpha greater than beta, swap pair of vertices



Highest alpha value

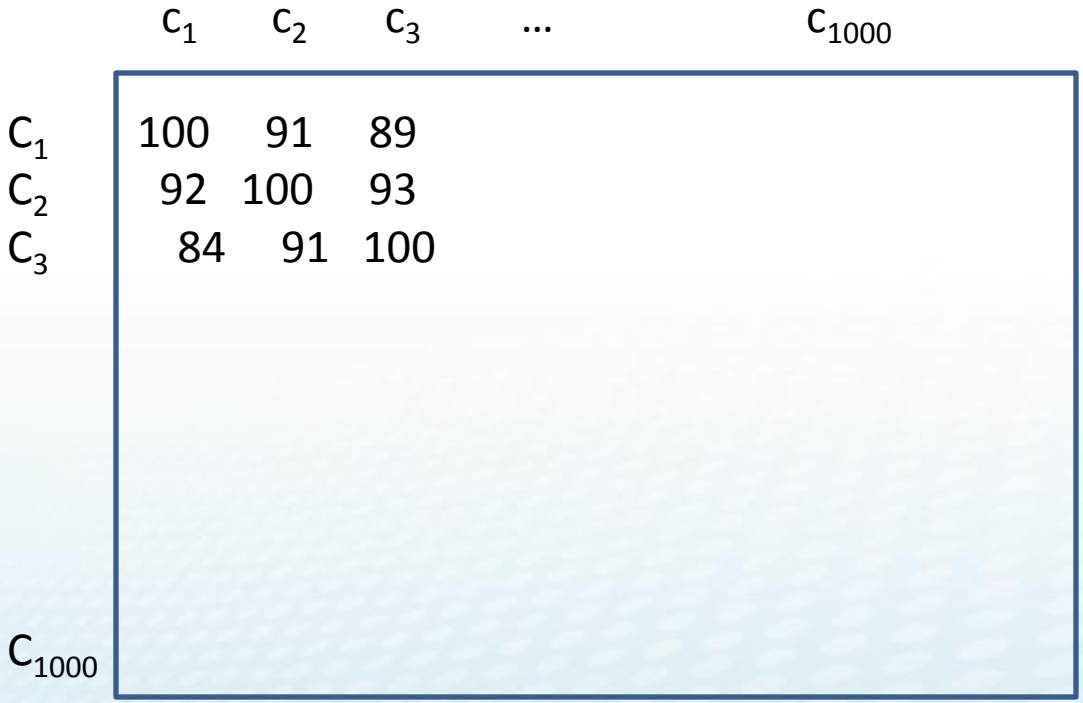
Lowest beta value

Algorithm terminates when alpha less than or equal to beta. If equal then vertices in A and B form a biclique and certain other conditions.

Jing He, Hongyu Liang, and Liaoruo Wang asked how many alpha-beta communities are there in a social network such as Twitter.

- Randomly generate 1000 sets of 100 vertices and convert each set to an alpha-beta community.
- Ask if there are any duplicate communities
- If not, at least one million size 100 alpha-beta communities

Do communities overlap?

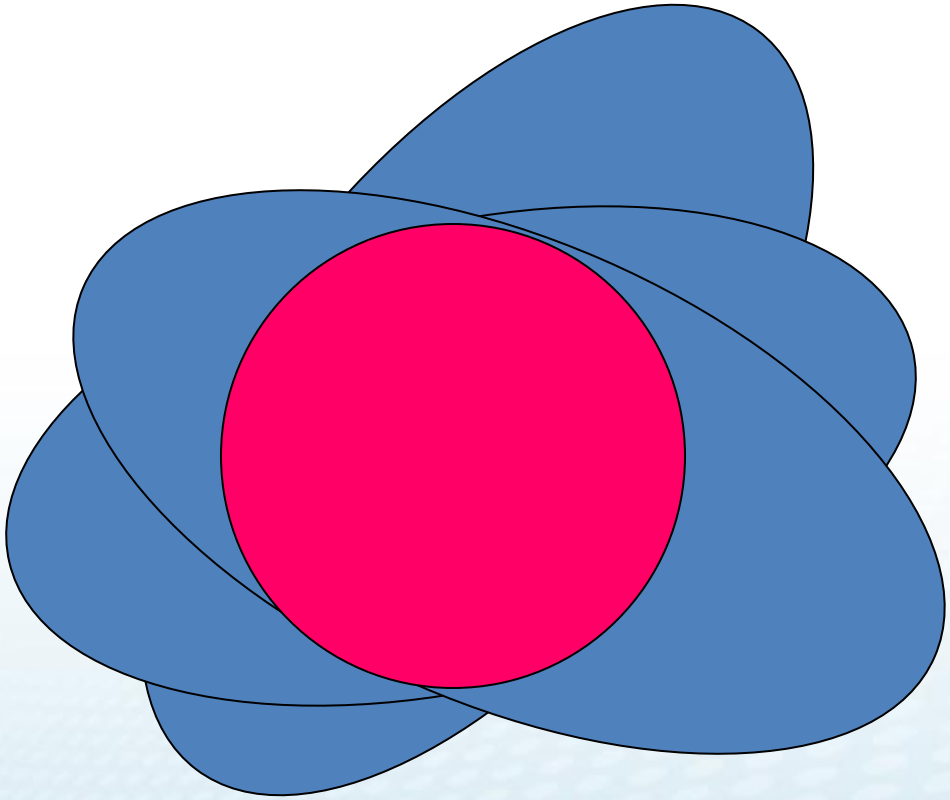


(A intersect B) / (A union B)

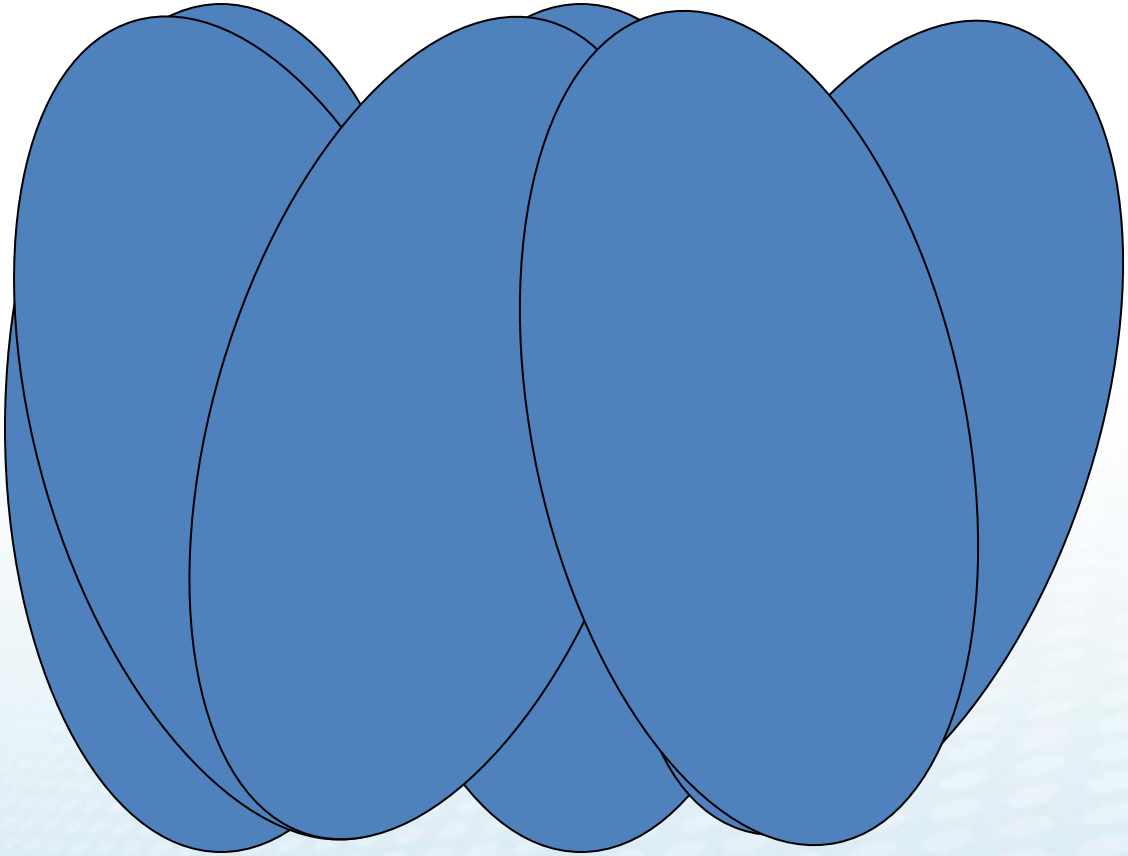
Massively overlapping communities

- Are there a small number of massively overlapping communities that share a common core?

- Are there massively overlapping communities in which one can move from one community to a totally disjoint community?



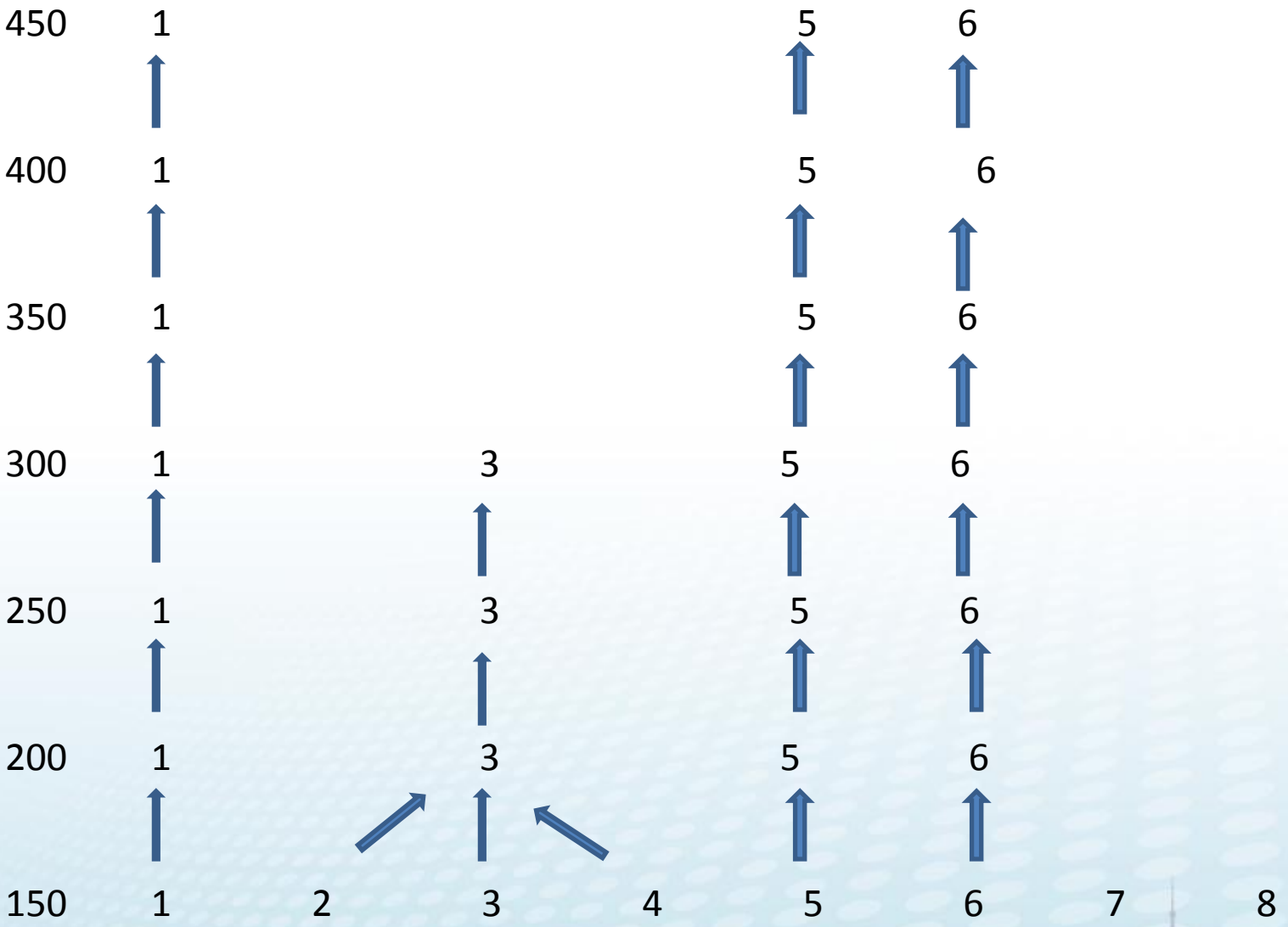
Massively overlapping communities with a common core



Massively overlapping communities

- Define the core of a set of overlapping communities to be the intersection of the communities.
- There are a small number of cores in the Tweeter data set.
- Similar in certain other social networks but not all.
- Fundamentally different than G(n,p).

Size of initial set	Number of cores
25	221
50	94
100	19
150	8
200	4
250	4
300	4
350	3
400	3
450	3


450
400
350
300
250
200
150
1
2
3
4
5
6
7
8

- What is the graph structure that causes certain cores to merge and others to simply vanish?
- Are there any bridges between cores?
- Why so few clusters?
- Are certain cores attractors and we do not find certain communities?
- How does beta vary with size of core?
- What is the structure of cores as they get larger? Do they consist of concentric layers that are less dense at the outside?

Do some cores really vanish as the size increases?

- Add one vertex at a time to the core and convert to new alpha-beta community.
- One of the cores grew from 150 to 200.
- The other disappeared.

Are there any bridges?

- Consider two clusters of 150 vertices each. Their cores are of size about 100.
- Take 75 vertices from each core and convert the 150 vertex set to an alpha-beta community.
- In one in a 100 random experiments a bridging community was found.

What idea should you walk way with?

- Research starts by asking simple questions.

- Learn to ask questions.

Thank you

- I hope my remarks may have helped you in some small way
- I look forward to seeing many of you and your students as they present their research at major conferences