Women in Mathematics: when simple numbers become graphs

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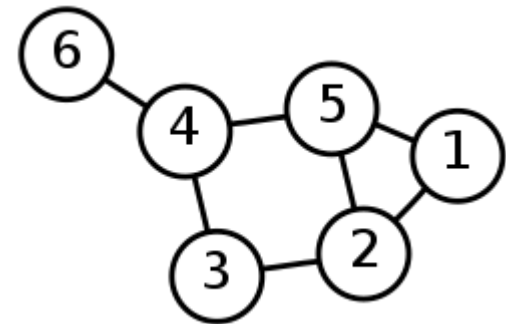
Numbers vs. Graphs

«In mathematics, and more specifically in graph theory, a **graph** is a structure amounting to a set of objects in which some pairs of the objects are in some sense "related". The objects correspond to mathematical abstractions called *vertices* and each of the related pairs of vertices is called an *edge*.
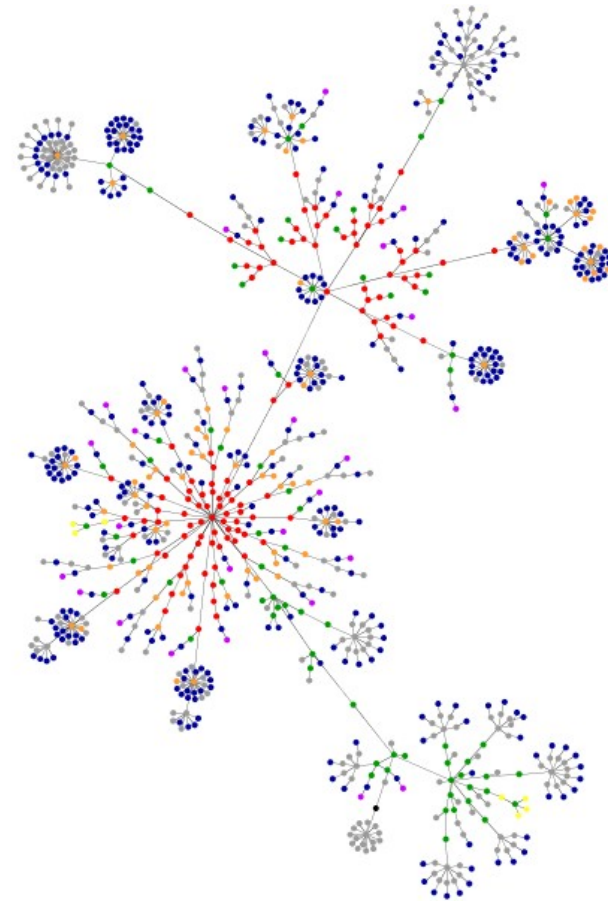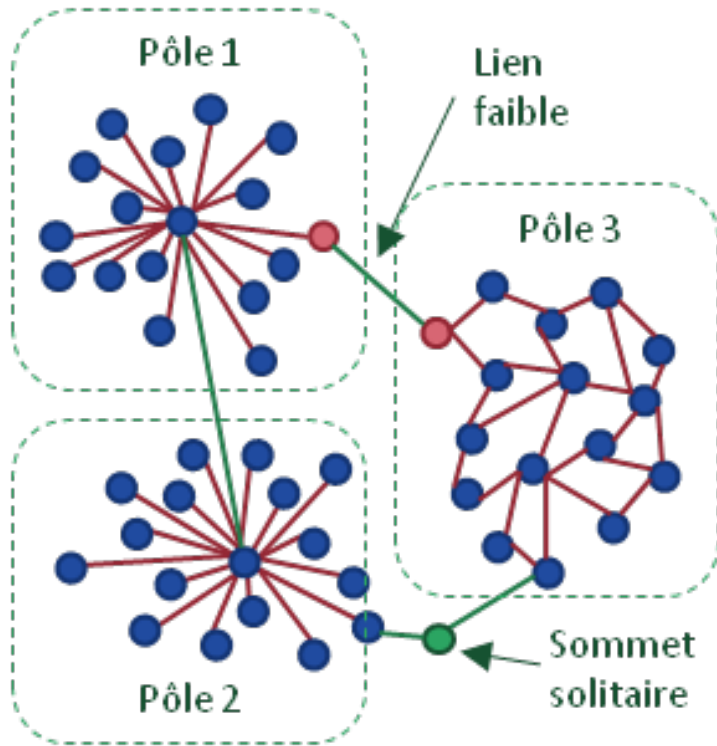Typically, a graph is depicted in diagrammatic form as a set of dots for the vertices, joined by lines or curves for the edges» (Wikipedia).

A drawing of a labeled graph on 6 vertices and 7 edges.

With multiple poles…

… the source code of Wikipedia using graphs

Examples of numbers

Sophie Germain (1776-1831): important contributions in number theory and elasticity theory. As a woman, she could not attend the Ecole Polytechnique, she obtained the lecture notes, but submitted comments under the name of a former student Monsieur Antoine-August Le Blanc. As she later explained to Gauss, she was "*fearing the ridicule attached to a female scientist*".

Examples of numbers

Emmy Noether (1882-1935): important contributions in algebra and mathematical physics. After completing her dissertation in 1907, she teached in Erlangen without pay for seven years. In 1915, she was invited by David Hilbert at the University of Göttingen, but she had to lecture four years under Hilbert's name because she was a woman.

Examples of numbers

Sophia Kovalevskaya (1850-1891): important contributions in analysis and mathematical physics. Women were not allowed to attend universities in Russia, so to move abroad she contracted a "fictitious marriage" with Vladimir Kovalevskij and she went at the University of Heidelberg. First women in Europe to become full professor (Stockholm University).

"*I looked quite stern in the photograph because I think people will not trust me if I smile*", *said Sophia*

(A. Munro, "Too Much Happiness", 2009)

The necessity of becoming graphs

Nowadays:
- we can have the lecture notes
- we can attend the university classes
- we can teach and become full professor,

but… it is usually __very low__ the number of

- full professors in Mathematics
- women in boards of societies and academies
- women in editorial boards
- women in conference committees
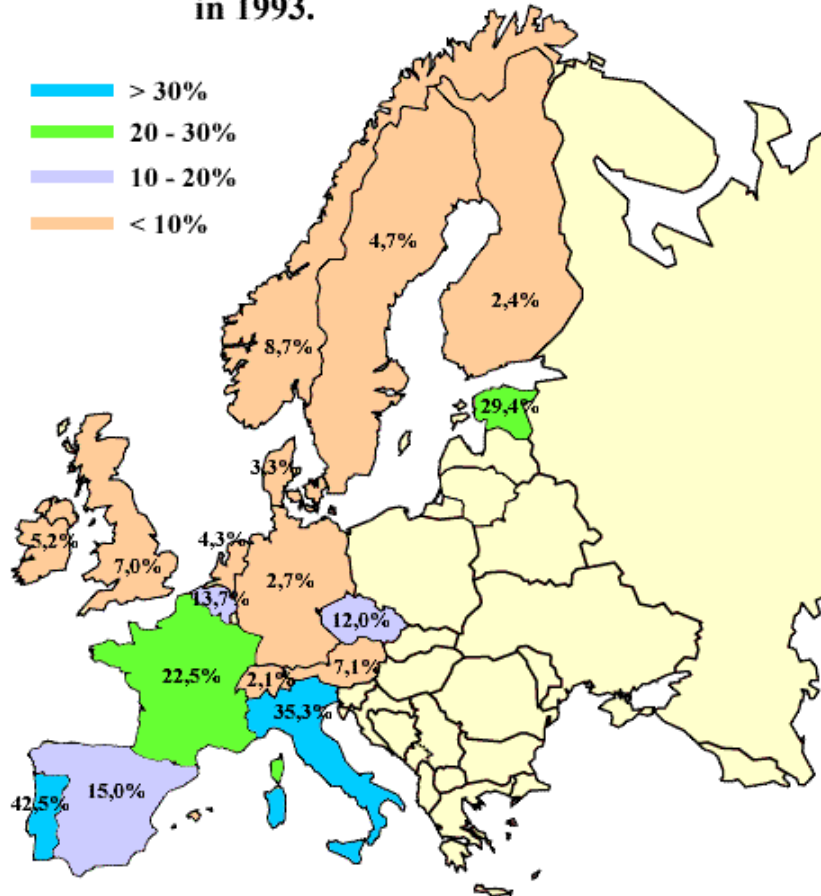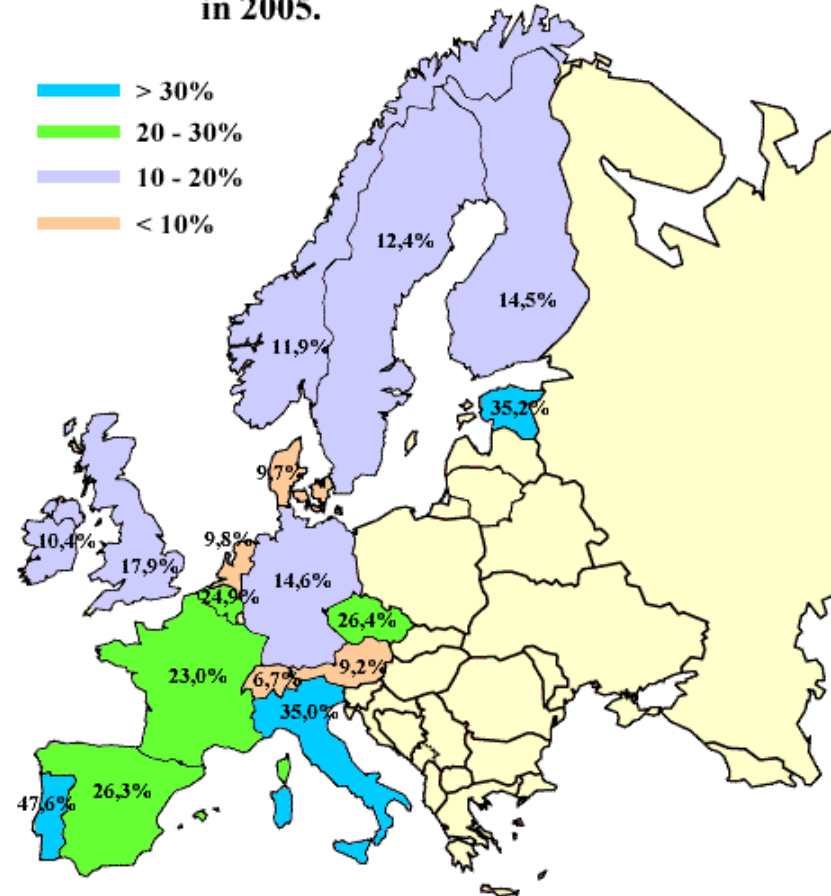- women awarded of prizes
- etc.

Criticalities

Full professors

Editorial boards

Meeting's Committees

Prizes recipients

Academies members

Plenary speakers

Committee's prizes

Some data

Percentage of women mathematicians in 1993.

- > 30%
- 20 - 30%
- 10 - 20%
- < 10%

4,7%
2,4%
8,7%
29,4%
3,3%
5,2%
7,0%
4,3%
13,7%
2,7%
12,0%
22,5%
2,1%
7,1%
35,3%
42,5%
15,0%

Percentage of women mathematicians in 2005.

- > 30%
- 20 - 30%
- 10 - 20%
- < 10%

12,4%
14,5%
11,9%
35,2%
9,7%
10,4%
9,8%
17,9%
24,9%
14,6%
26,4%
23,0%
6,7%
9,2%
35,0%
47,6%
26,3%

- Geographical distribution of women mathematicians in Europe (1993 vs. 2005) *[EWM-European Community]*

Percentage of women full professor in Mathematics in 2005
[EWM-European Community]

Some data

Women in Mathematics in Italy 2018

Bar chart with two series (blue, red) across three categories:

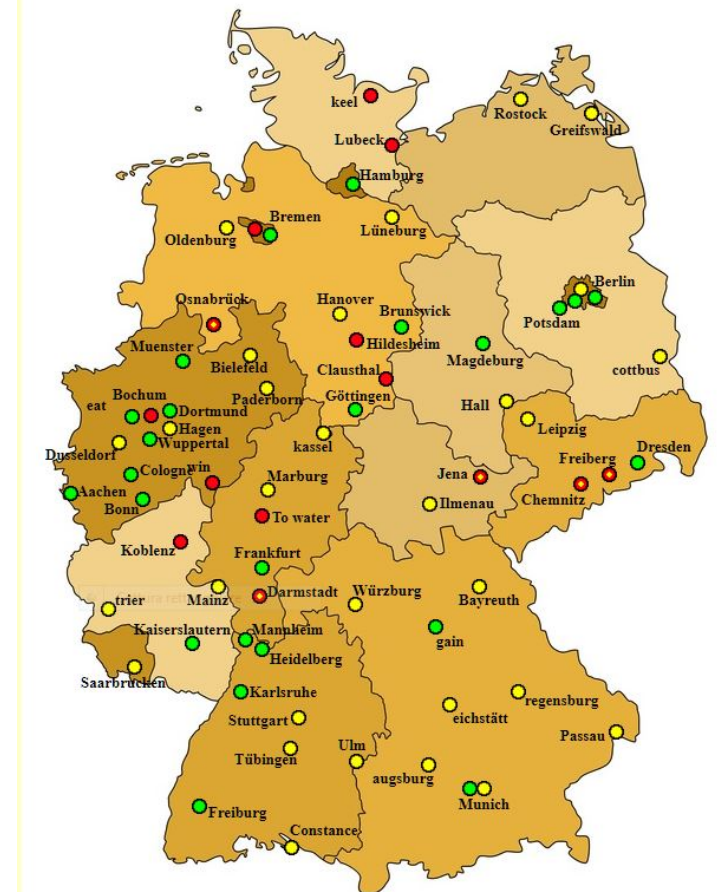| Category	Blue	Red
Researchers 46%	~325	~700
Associate Prof 39%	~315	~810
Full Prof 19%	~120	~630
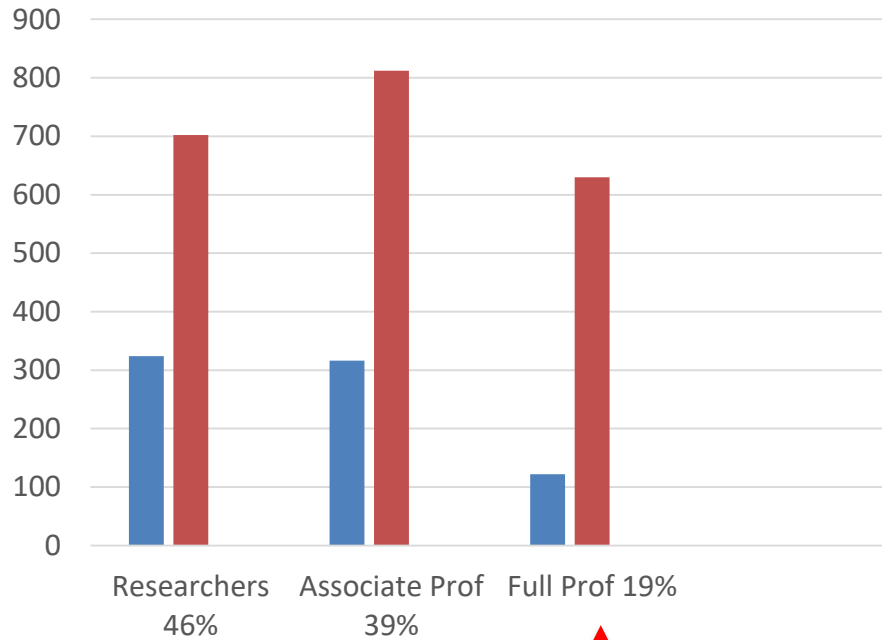
19 %

Women Mathematics Profs in Germany 2018

Last change: 22.4.2018.
Contact: Prof. Dr. med. Christine Bessenrodt , bessen at math.uni-hannover.de

Legend:
- 🔴 no professor of mathematics at the department
- 🟠 no professor appointed permanently, but 1-2 junior or apl.Professorinnen
- 🟡 1-2 at the FB employed female professors, at least one permanently appointed
- 🟢 at least 3 female professors, at least 2 permanently appointed

Some data

EDITORIAL BOARDS:

•	Annals of Mathematics	0/6 women
•	Journal Differential Geometry	0/8 ''
•	Duke Journal of Mathematics	0/4 ''
•	EMS Surveys in Mathematical Sciences	3/22 ''
•	Journal of Noncommutative Geometry	1/26 ''
•	Journal of the AMS	1/8 ''
•	Mathematical Statistics and Learning	2/14 ''
•	Quantum Topology	0/9 ''
•	Groups, Geometry, and Dynamics	2/20 ''
•	Interfaces and Free Boundaries	1/32 ''

TOTAL 10/149 women

PLENARY SPEAKERS:

ECM 2004	1/7	women
ECM 2008	2/10	''
ECM 2012	1/10	''
ECM 2016	3/10	''
ICM 2006	1/19	
ICM 2010	4/20	''
ICM 2014	2/21	''
ICM 2018	5/21	''

TOTAL   19/118 women

Rearrange the Graph
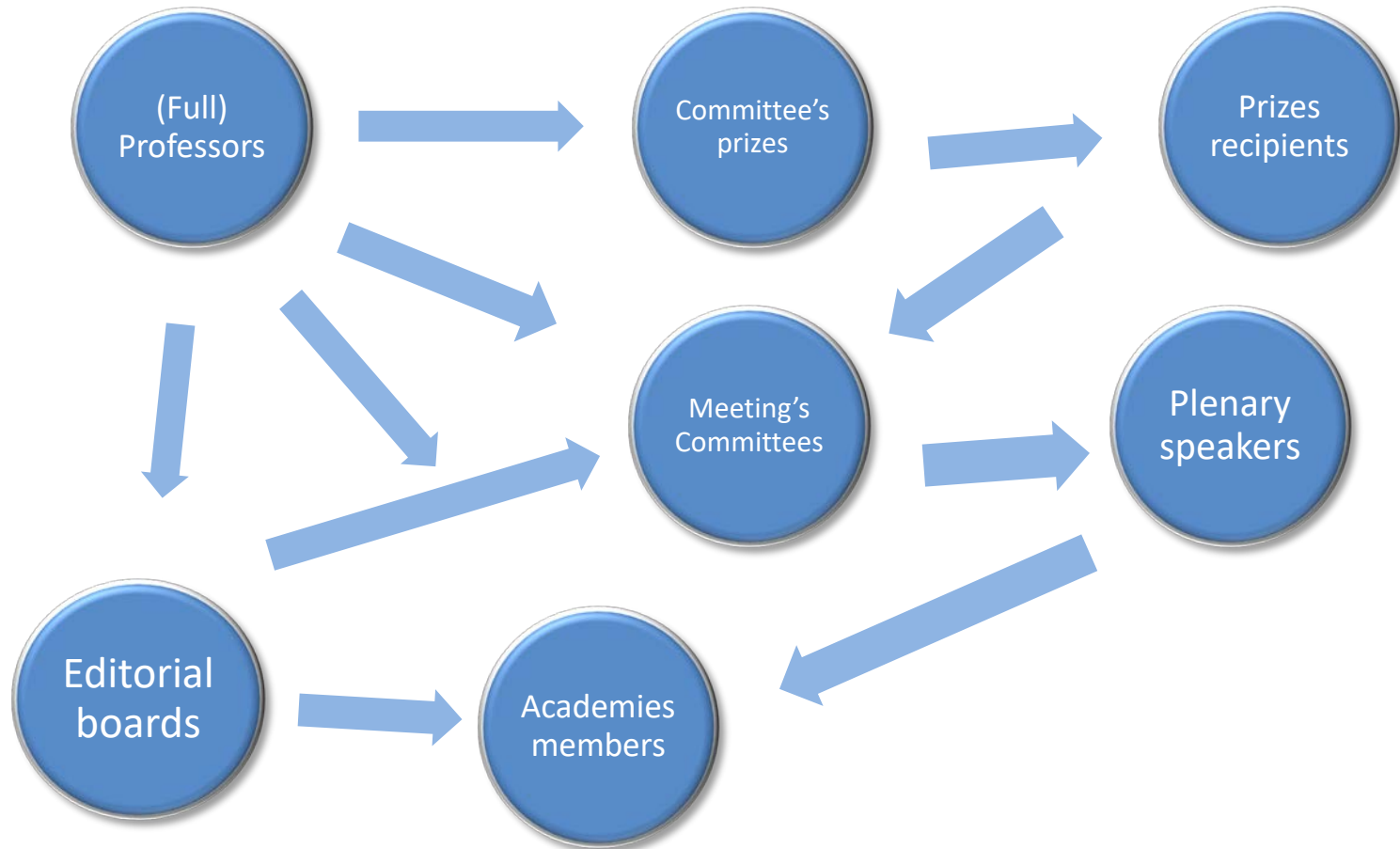
Improve via Networks

CROSS-DISCIPLINARY NETWORKS

- European Women in Mathematics → 573 members
- Committee for Women in Mathematics – IMU
- Association for Women in Mathematics

For example, **EWM** goals:
- *encouraging women to study mathematics*
- *supporting women in their careers*
- *providing a meeting place for like-minded people*
- *promoting scientific communication*
- *cooperating with groups/organizations with similar goals*
- *giving prominence and visibility to women mathematicians*
- *spreading their vision of mathematics and science.*

Improve via Networks

CWM/IMU committee for issues related to women in mathematics worldwide. Goals:

- To **propose**, **encourage** and **facilitate** activities of the IMU or other bodies which would tend to increase the visibility of women in mathematics and lead to an increase in their representation in the community.

- To **promote** international contacts between national and regional organisations for women in mathematics, in particular facilitating the building of networks at the regional or continental level.

- To **provide** a website which is a repository of information for and about women in mathematics worldwide and to enable efficient communication among the international community of women mathematicians.

CWM/IMU-initiatives

CWM offers grants and sponsorship for various types of activities.

CWM organises a satellite meeting of ICM 2018: World Meeting for Women in Mathematics

CWM/IMU-initiatives

The Gender Gap Project in Mathematical and Natural Sciences**,** funded by the International Council for Science

Establish and foster networks of women mathematicians especially in Asia, Latin America and Africa

Improve via Topical Networks

TOPICAL NETWORKS

- Women in optimization
- Women in Number Theory
- Women in Probability
- Women in Topology
- Women in Computational Topology
- Women in Sage

Aftermath of Networking

SUCCESSFUL RESULTS

- Regular meetings (e.g., EWM GA)
- Workshops (e.g., Women in optimization since 2015)
- Schools (especially for young people)
- Dedicated conferences
- Meetings in countries
- Articles and special issues
- Official committees (e.g., WiM-EMS)
- List of CWM-IMU Ambassadors (120 from all-over the world)
- Projects
- Prizes

A complex graph: networking
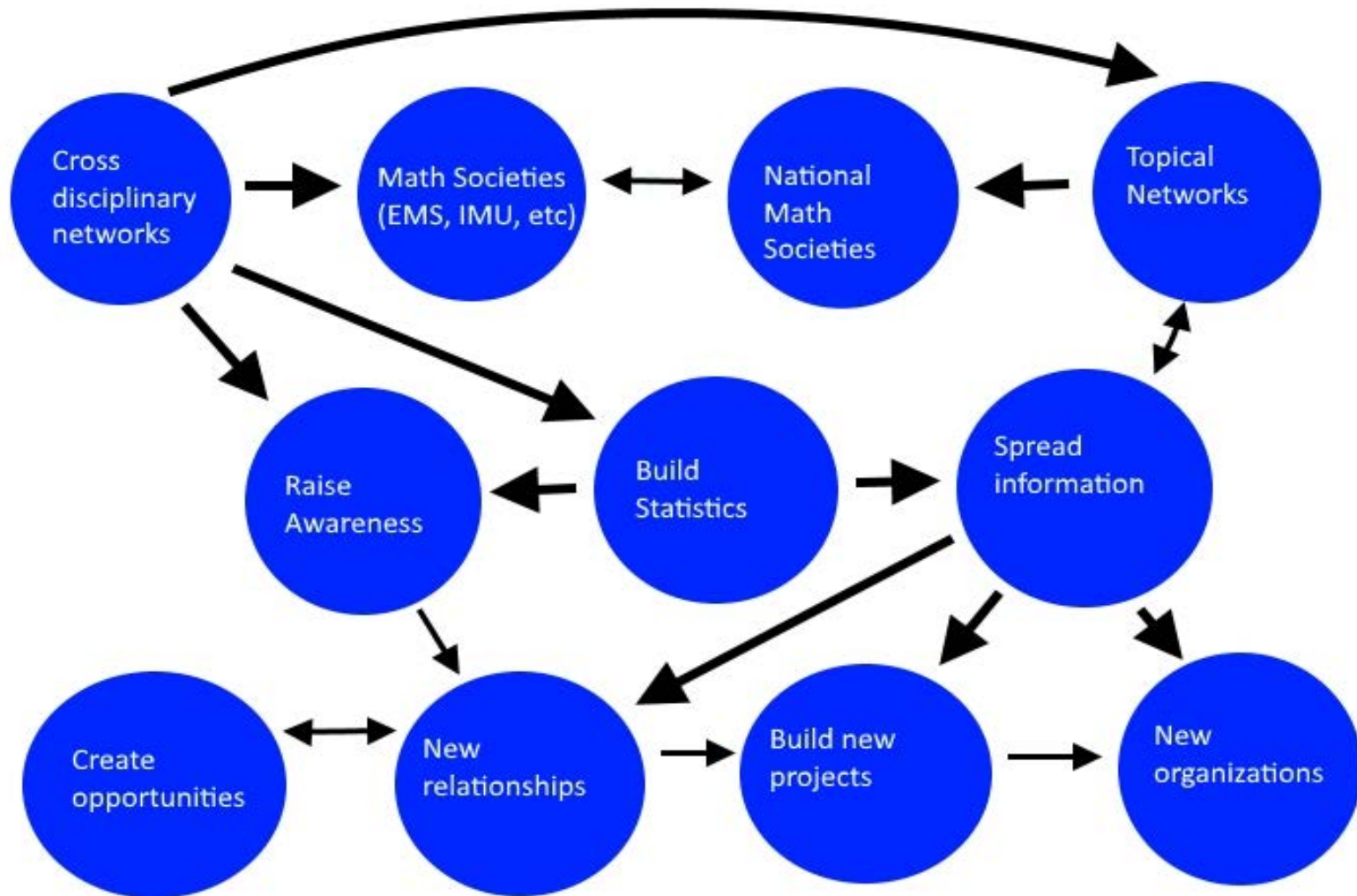
«When a woman, because of her sex, our customs and prejudices, encounters infinitely more obstacles than men in familiarising herself with knotty problems, yet overcomes these fetters and penetrates that which is most hidden, she doubtless has the most noble courage, extraordinary talent, and superior genius»

Carl Friedrich Gauss (1777 - 1855)