

# Diagram, Communication, Education: Can we communicate without language?

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# Diagrams and their roles in communicating knowledge

- Diagrams have been used to
  - elicit, organize, and communicate knowledge.
- Well organized diagrams can support even
  - discovery of new knowledge.

# Outline

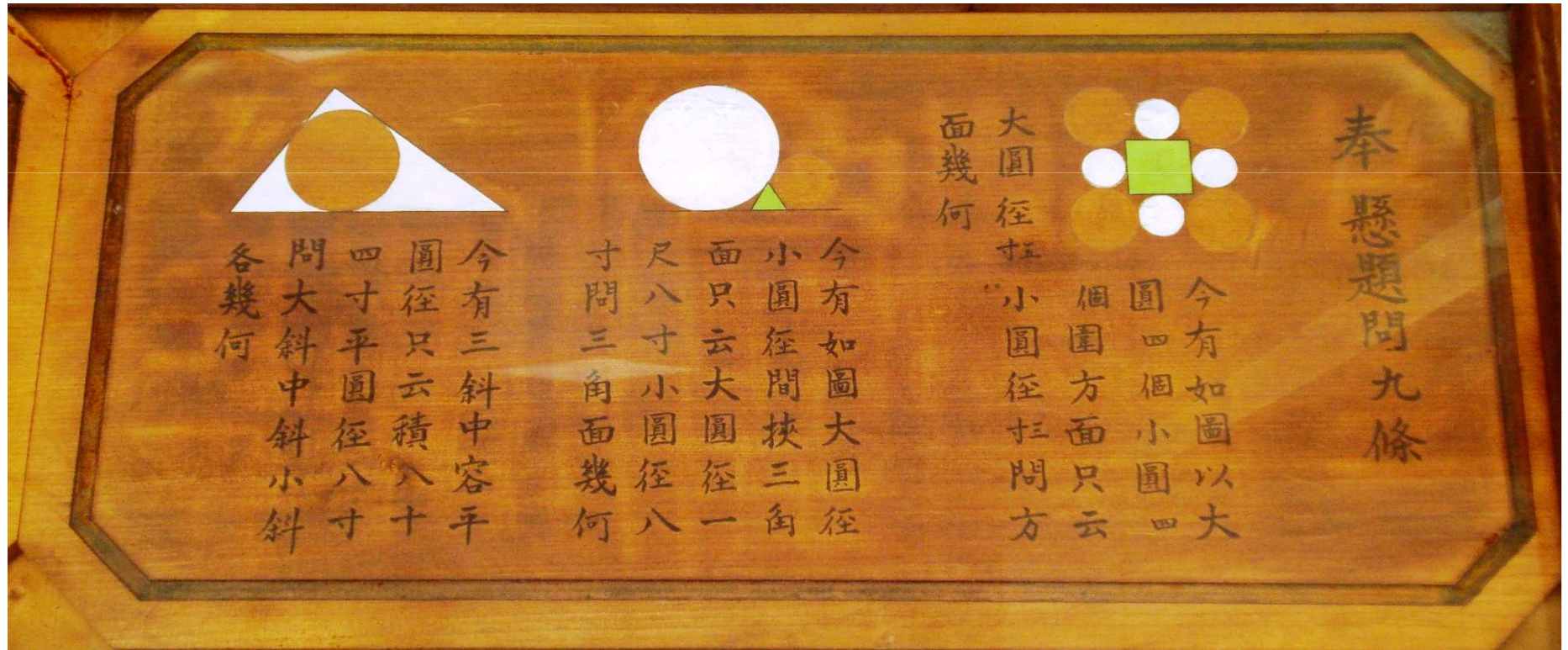
- web museum of diagrams,  
dynamic SANGAKU
- applying diagrammatic reasoning  
to engineering problems
- recent project of network  
visualization of knowledge

# *Sangaku*

- A sheet of votive picture expressing geometric finding.
- *Sangaku* were dedicated to temples during Edo period in Japan.
  - To exchange geometrical findings.
  - To study Japanese traditional mathematics.

# An example of *Sangaku*

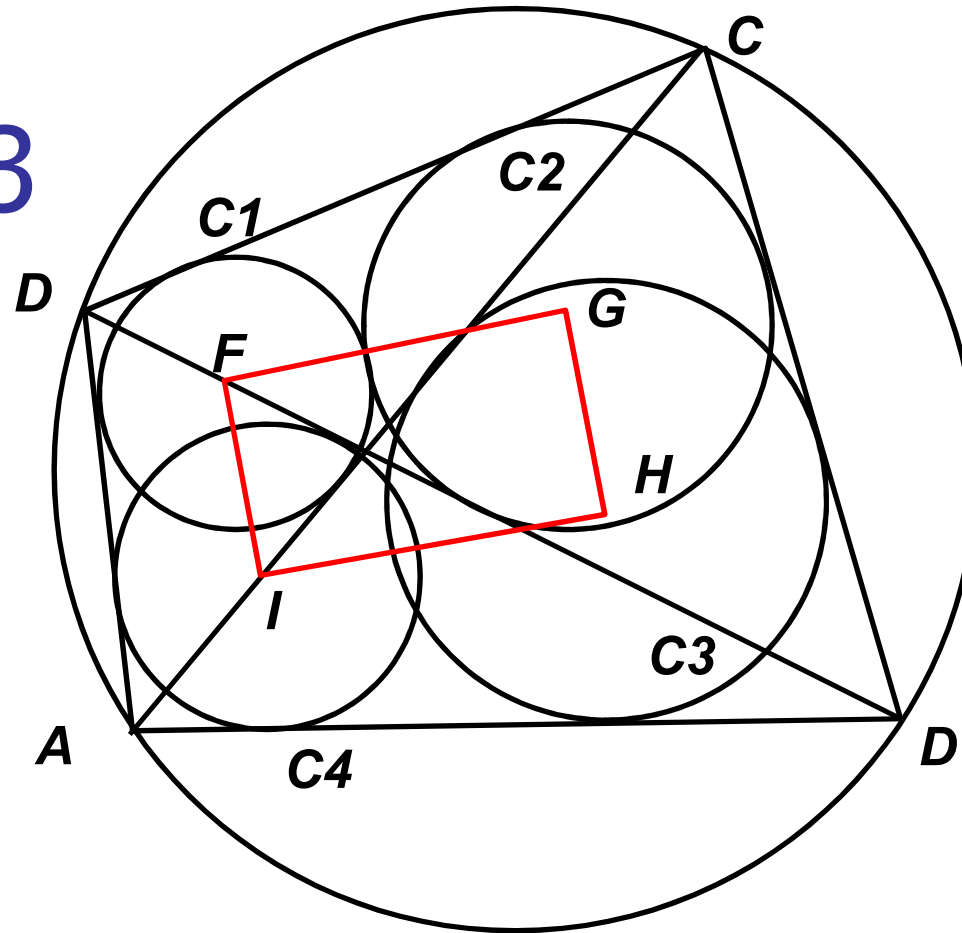
- Those who solved the geometrical problems dedicated.
- About 900 Sangaku exists.



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(長岡天満宮 昭和44年復元奉納 撮影：藤澤)  
The 3<sup>rd</sup> Hanoi Forum on ICT

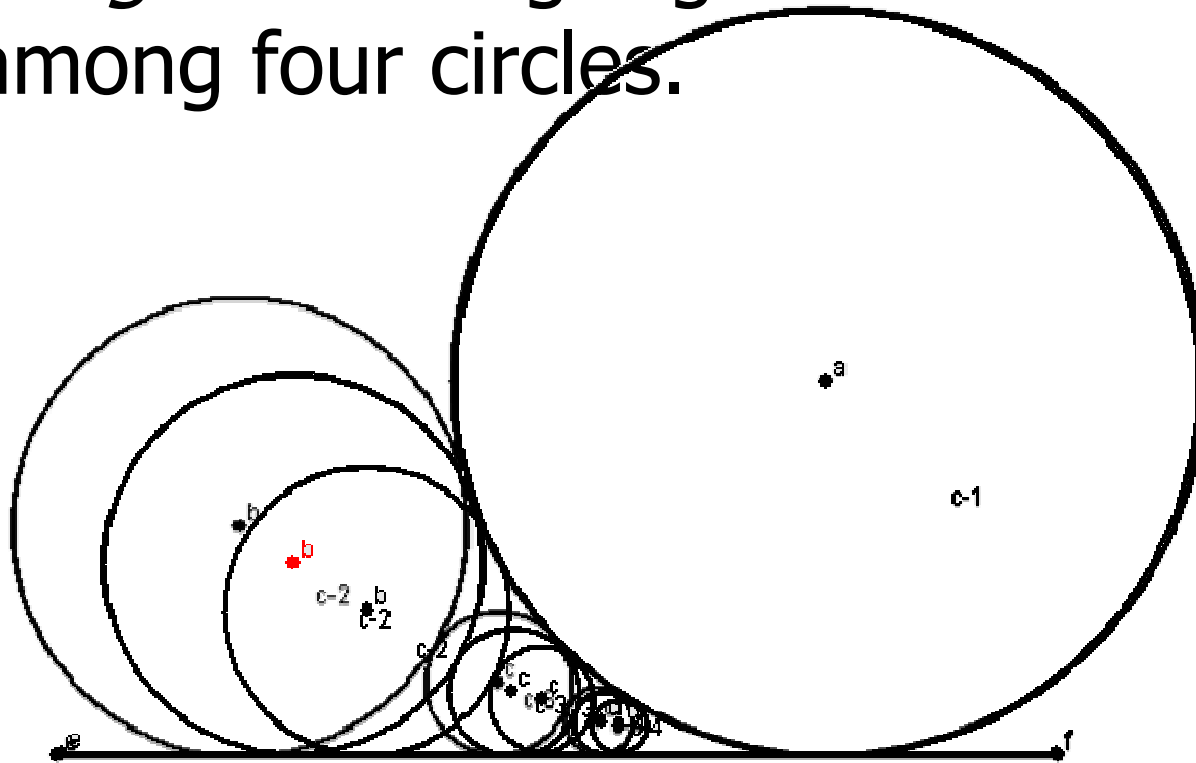
## Example3



The four centers  $F$ ,  $G$ ,  $H$  and  $I$  of the four circles  $C1$ ,  $C2$ ,  $C3$  and  $C4$ , each of which is tangential to a diagonal and two adjacent sides of a quadrilateral  $ABCD$  touching internally with a circle, form a rectangle  $FGHI$ .

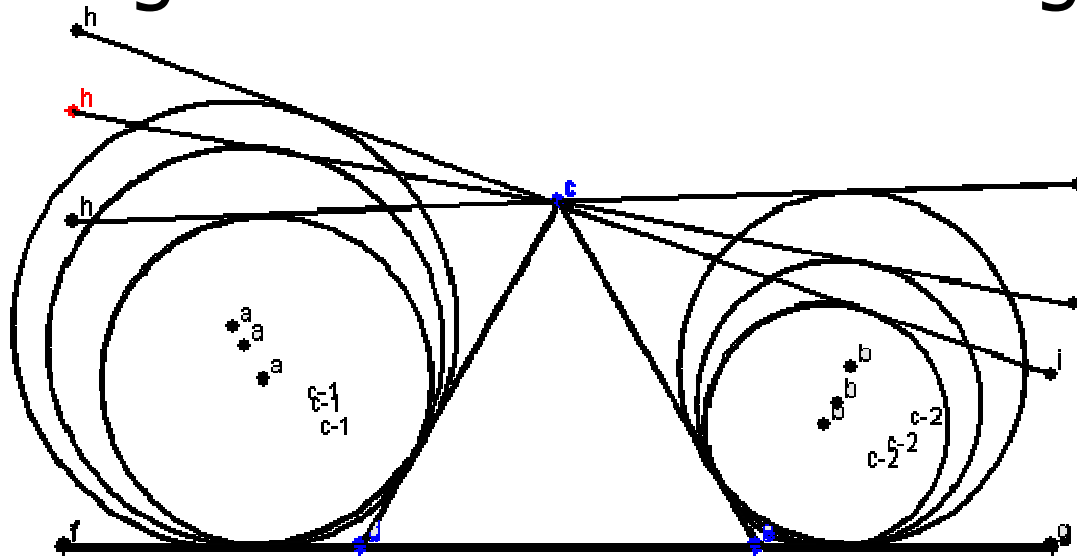
**Example 1**  $R_n = \left( \frac{n-2}{\sqrt{R_1}} + \frac{1}{\sqrt{R_2}} \right)^2$

- *Sangaku* stating a geometric relation among four circles.



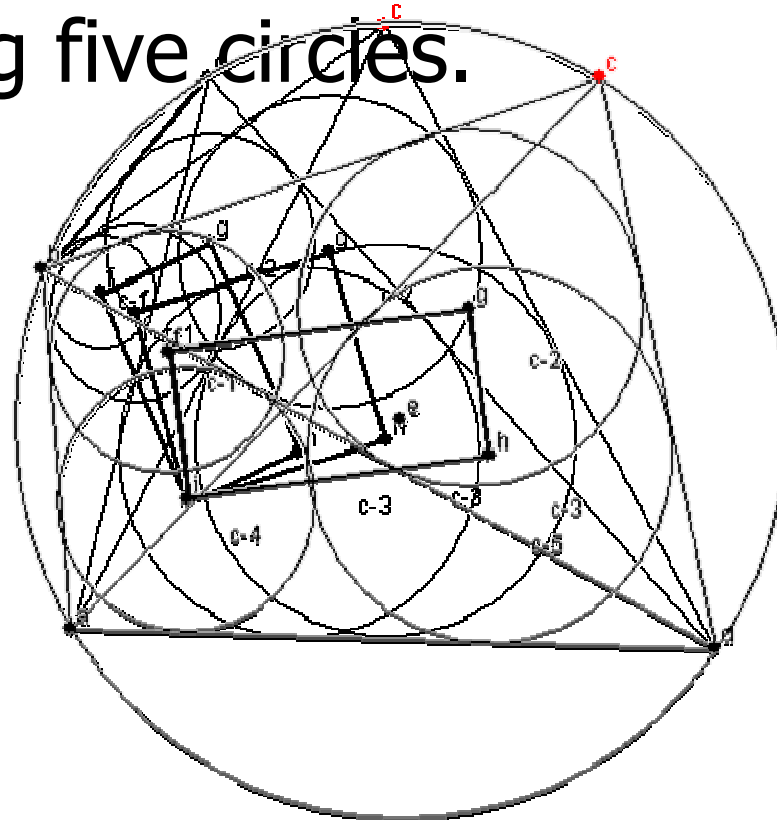
# Example2

- *Sangaku* stating a geometric relation among two circles and a triangle.



# Example3

- *Sangaku* stating a geometric relation among five circles.

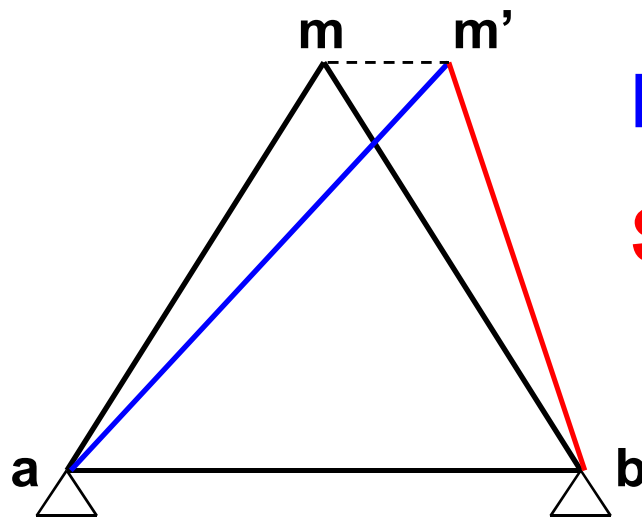


# A web museum of diagrams: dynamic SANGAKU

[www.sys.tutkie.tut.ac.jp/MuJapan.html](http://www.sys.tutkie.tut.ac.jp/MuJapan.html)

- As an example of ICT allowing a new mode of knowledge transfer (E-learning)
- Web-based presentation system, and publication system for Diagrams
- As a Dynamic Geometry Software

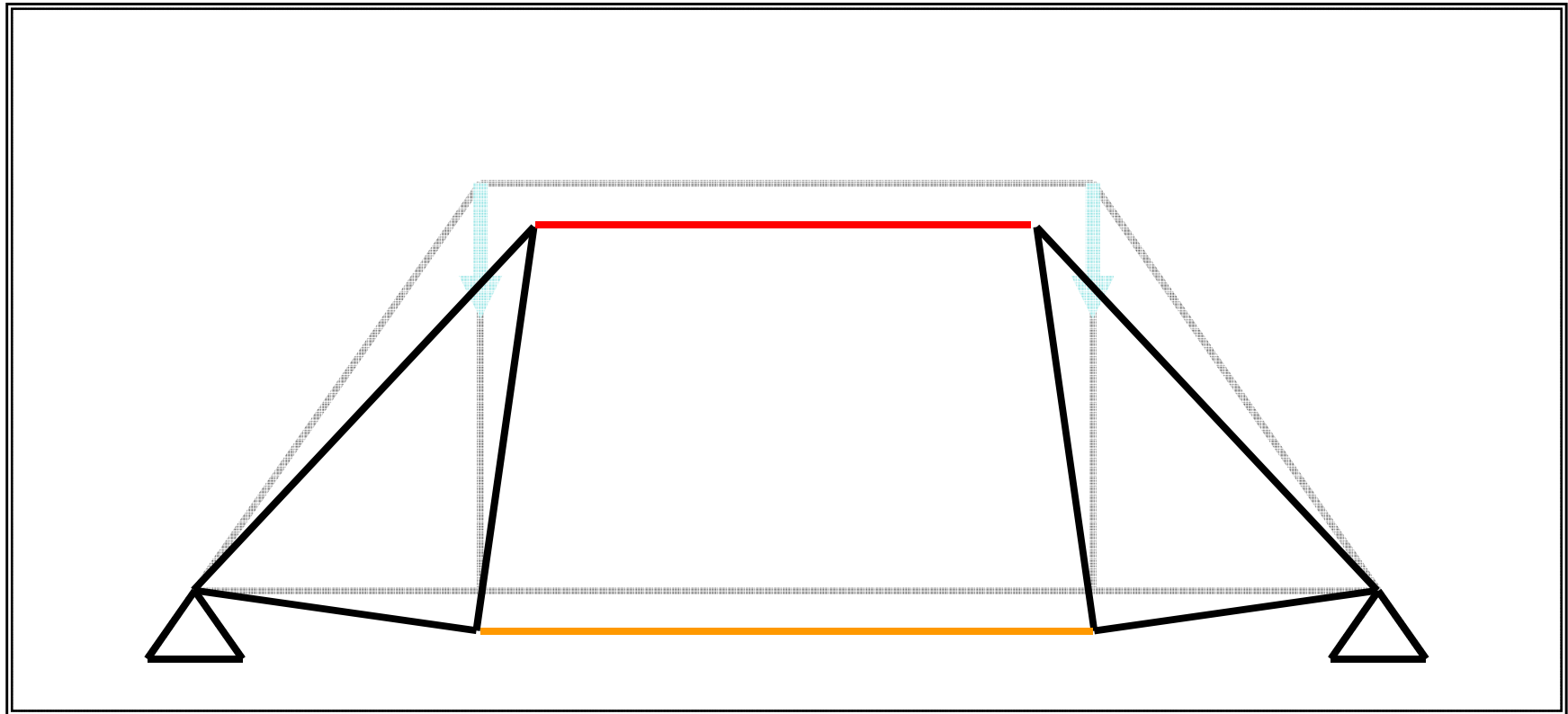
# Truss Structure Analysis



**Elongated→tension**

**Shortened→compression**

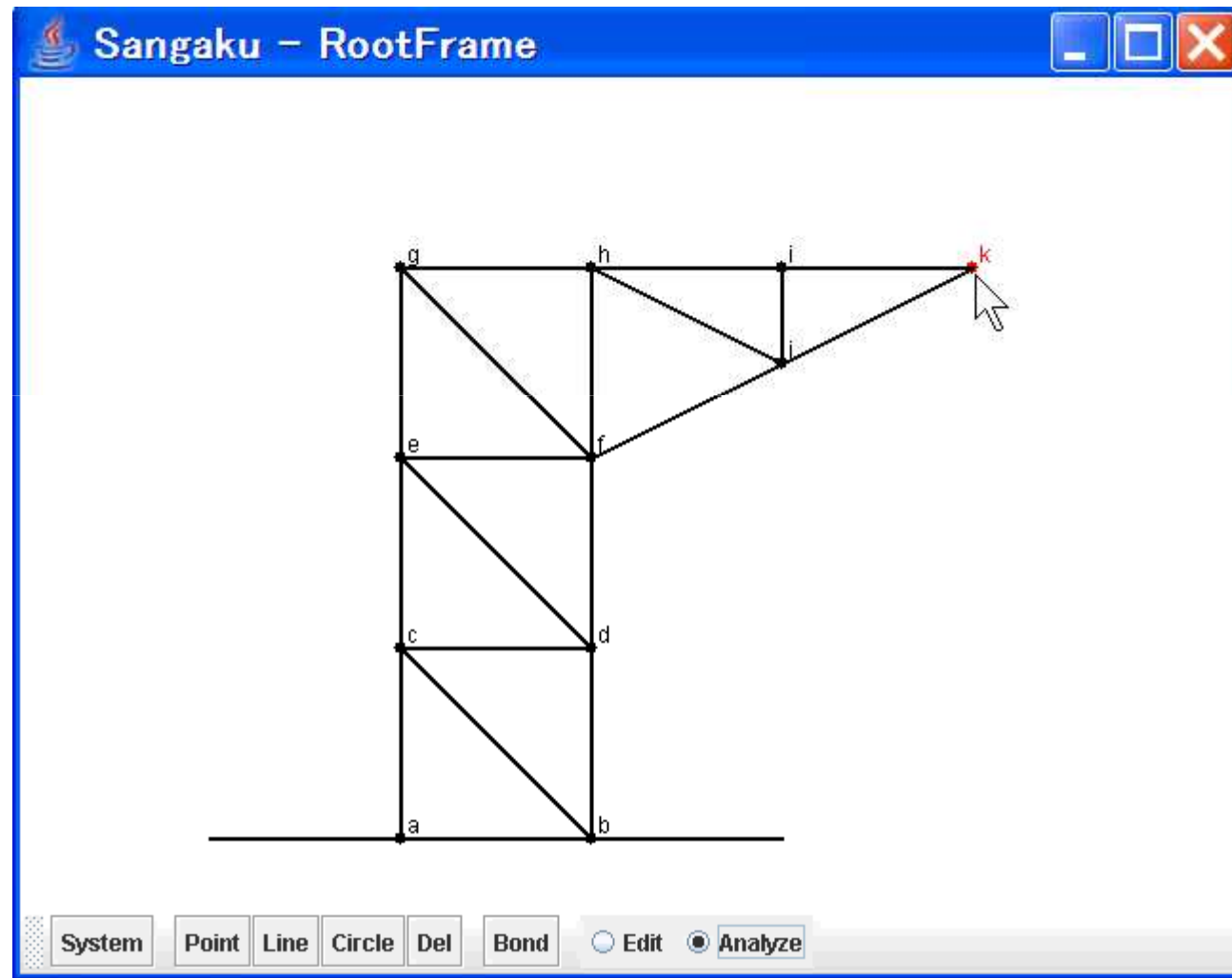
# Truss Structure Analysis



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The 3<sup>rd</sup> Hanoi Forum on ICT

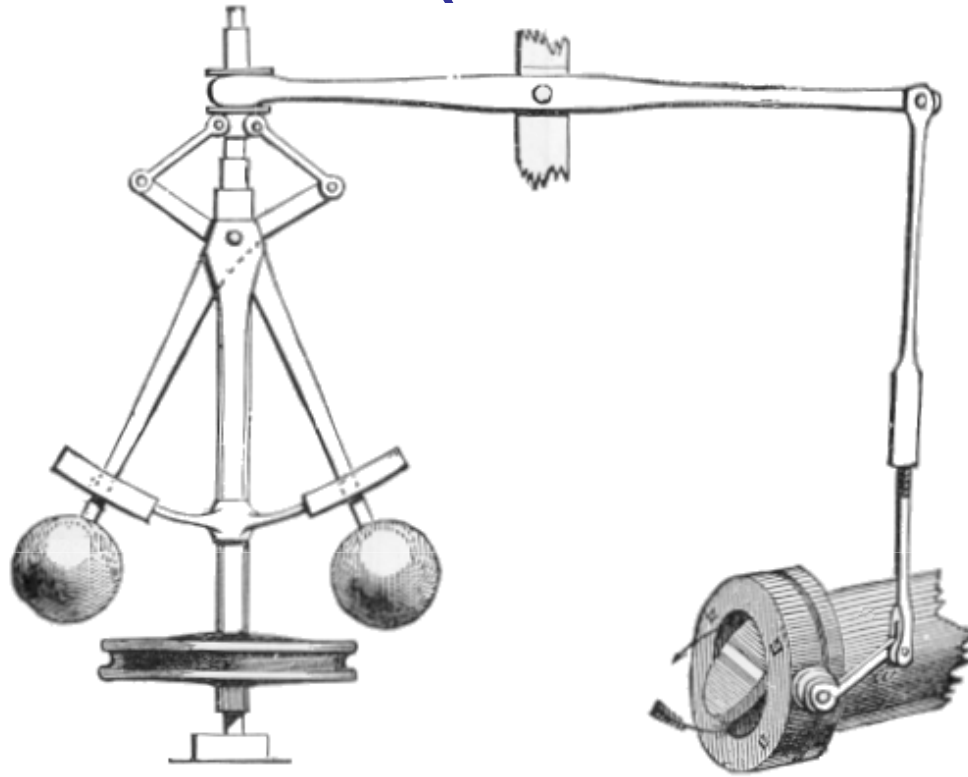
# Truss Structure Analysis



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The 3<sup>rd</sup> Hanoi Forum on ICT

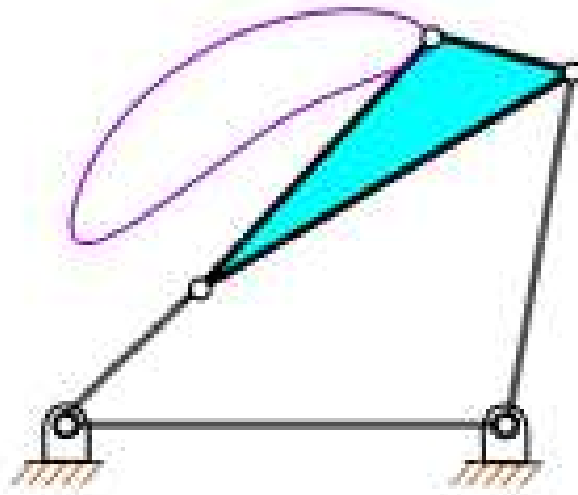
# Link Mechanism ( from wikipedia )



Complex link mechanism controlling  
the speed of the flow

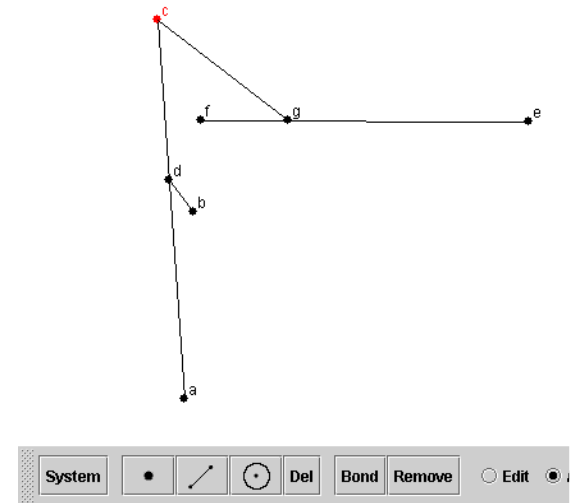
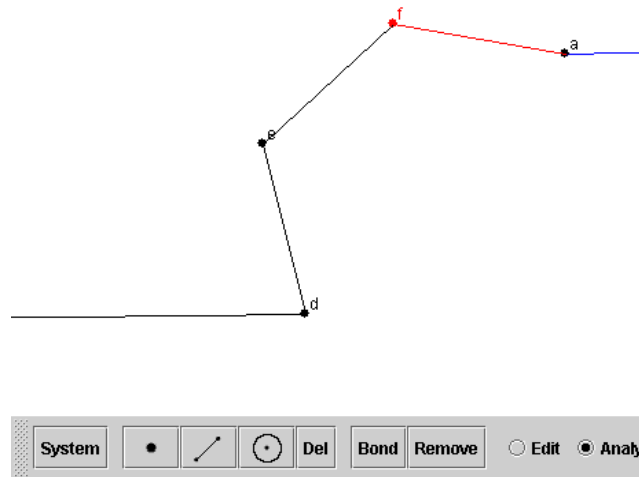
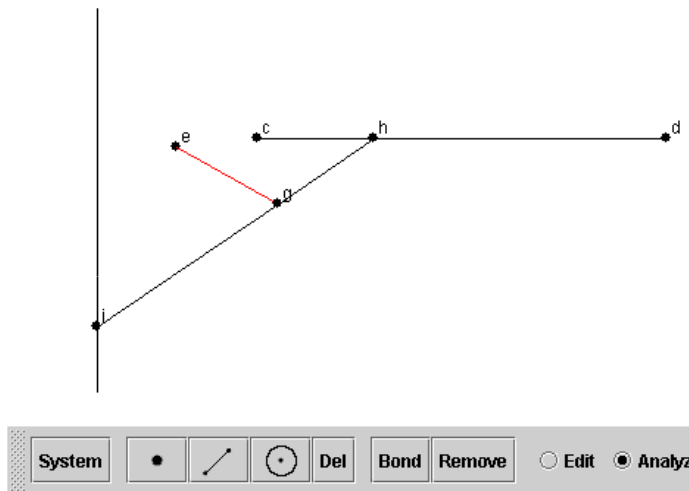
# Link Mechanism

( from wikipedia )



Even a simple link mechanism exhibits a complex motion.

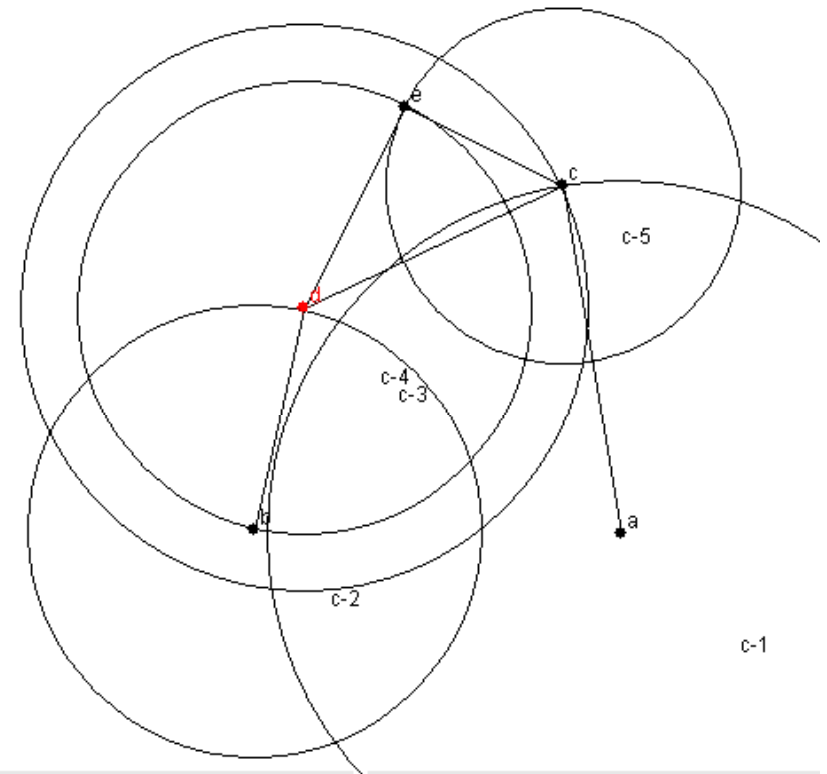
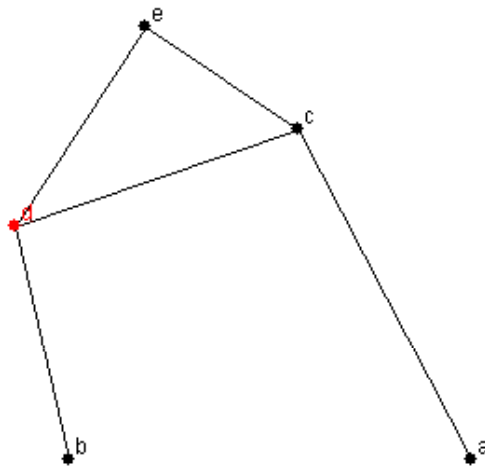
# Example 1



Generation of Linear Movement

Swing Arm

# Example 2



System

•

—

⊙

Del

Bond

Remove

☐ Edit

☒ Analyze

System

•

—

⊙

Del

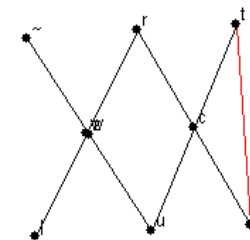
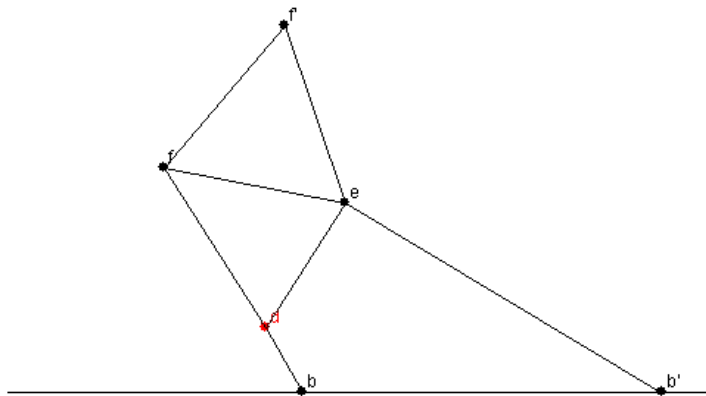
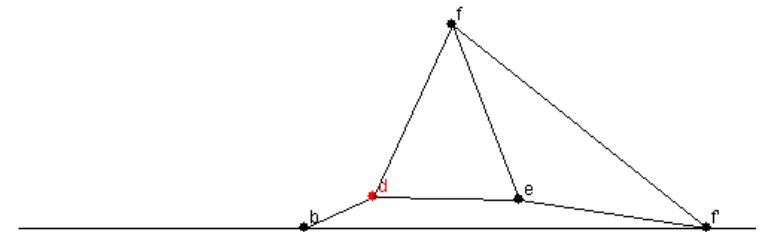
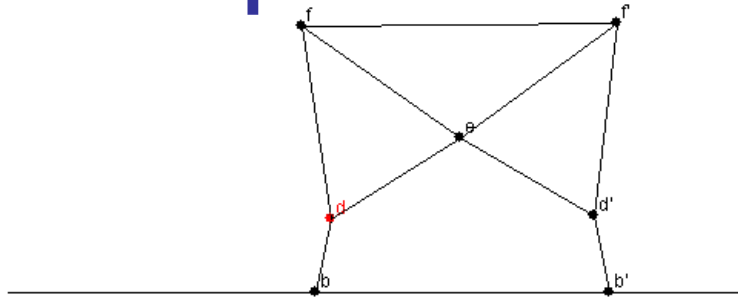
Bond

Remove

☐ Edit

☒ Analyze

# Example 3



d Ha

# Network Visualization

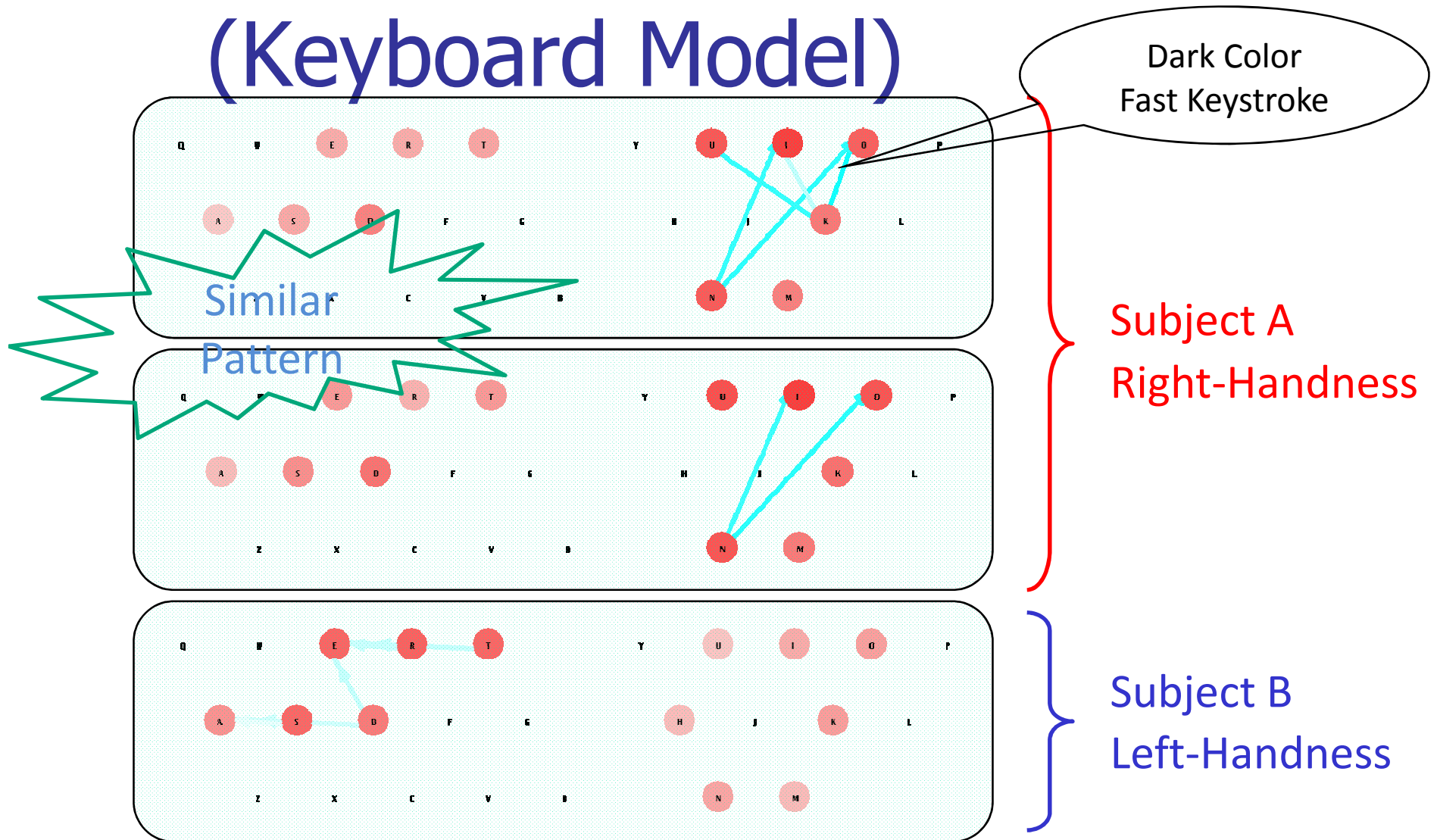
## Projects: DOU-JYO 「道場」

- DOU-JYO (a place to learn or practice martial arts such as JUDO, KENDO, etc.)
- Alliance with many KOSEN (college of technology in Japan)
  - Akashi KOSEN, Kouchi KOSEN, Tokuyama KOSEN, Ube KOSEN, Okinawa KOSEN
- Fully exploit the visual potential of Diagrams

# Examples

- Keystroke Networks with Akashi KO-SEN
- Network Robustness with Kouchi KO-SEN
- Space Weather Forecast with Tokuyama KO-SEN
- Group Formation of Japanese Companies with Ube KO-SEN
- Motion Picture Profiling in Japanese dance with Okinawa KO-SEN
- Movie Profiling and Indexing for educational experiments with Okinawa KO-SEN
- Stable Marriage Problem with a graduate student
- Rule and strategy profiling in spatial games with a graduate student

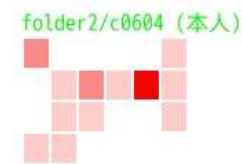
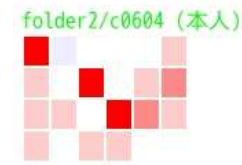
# Keystroke Networks (Keyboard Model)



# Comparison Model

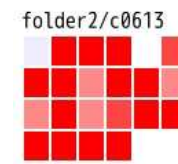
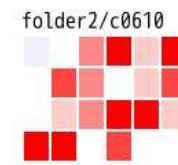
Comparison with profile A and profile B

Subjects of A and B are same.



Light  
red

Subjects of A and B are different.



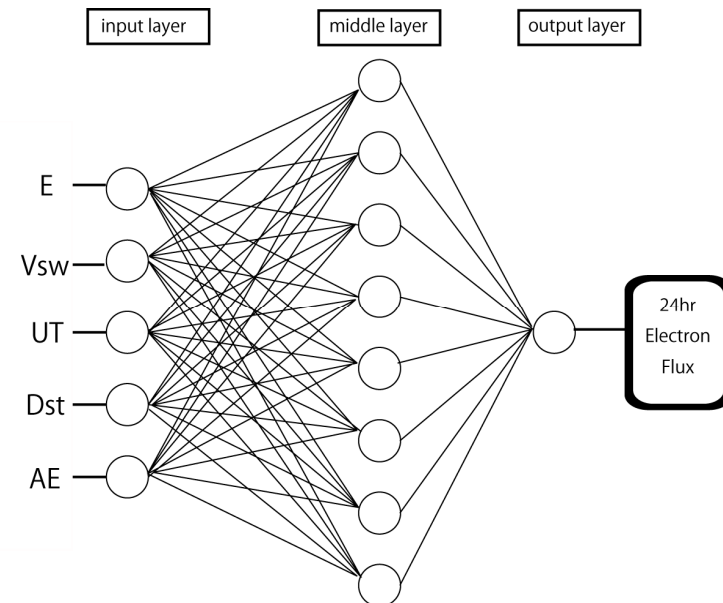
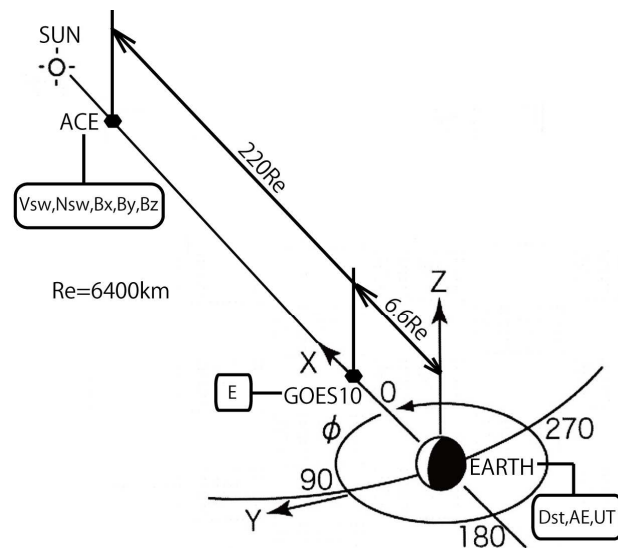
Dark  
red

# Prediction of the high-energy electron flux at geosynchronous orbit

The prediction of the high-energy electron flux, which cases the internal charging of the spacecraft at geosynchronous orbit, recently play an important role for the safety operation of the spacecraft

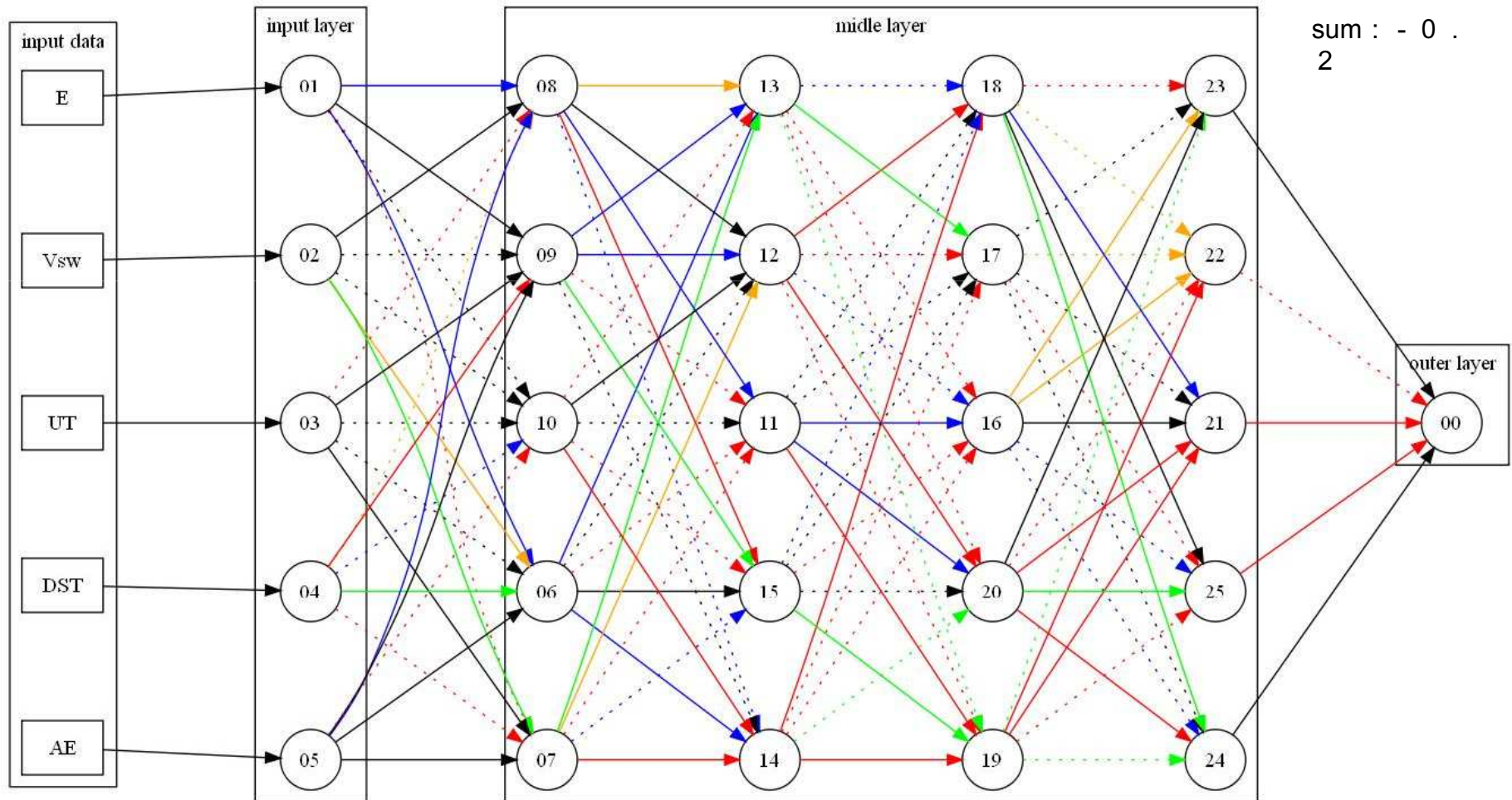
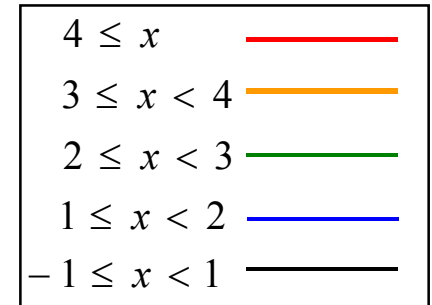
The temporal variation of the electron flux is controlled by the solarwind, so that we attempt to predict the electron flux 24-hours after, using the solarwind data obtained by ACE spacecraft located the upstream of the solarwind.

|       |                                                                                                                       |
|-------|-----------------------------------------------------------------------------------------------------------------------|
| Input | Current electron flux (E), solarwind speed ( $V_{sw}$ ), Universal time (UT), Ground geomagnetic indices (Dst and AE) |
|-------|-----------------------------------------------------------------------------------------------------------------------|

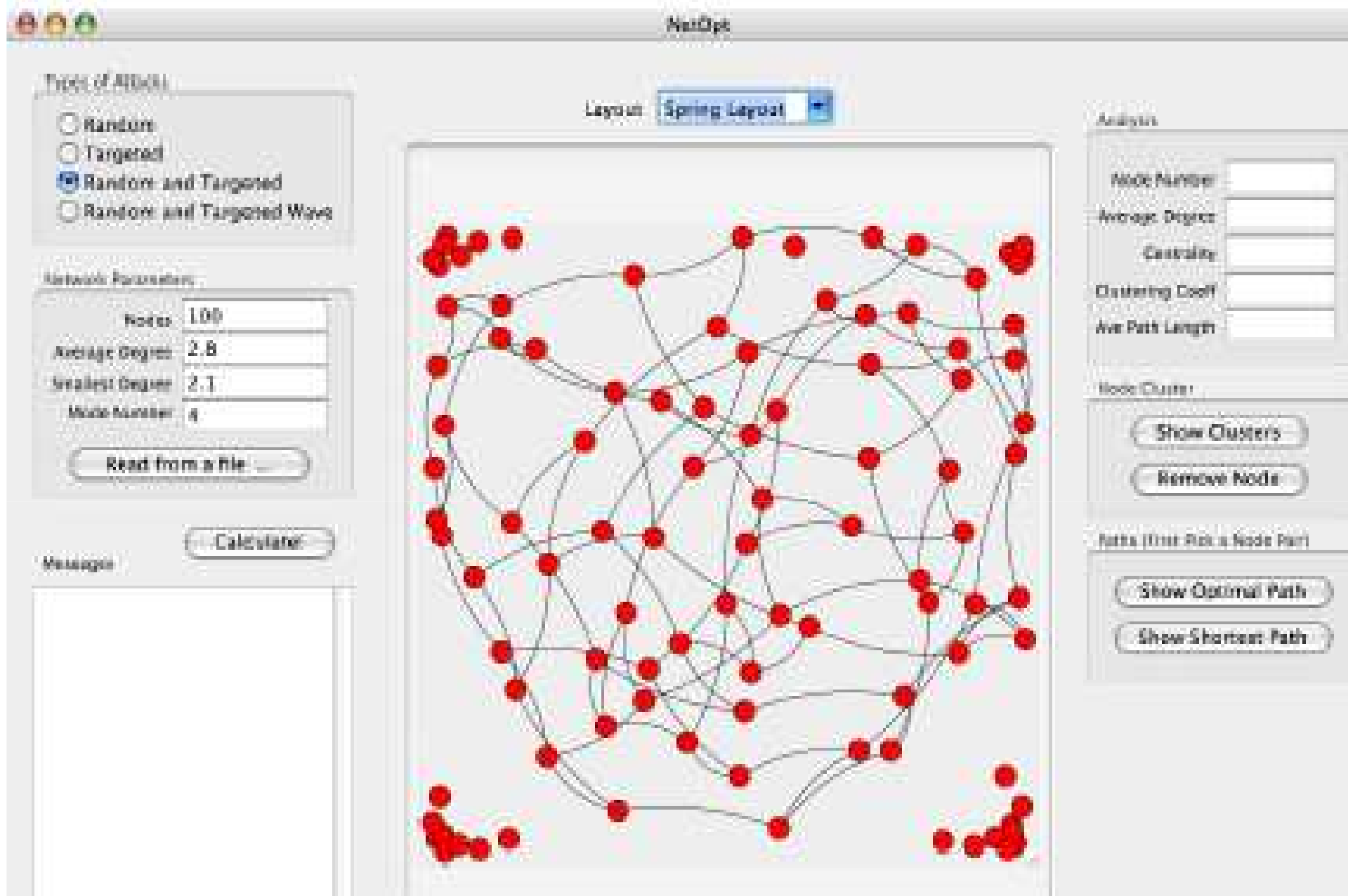


The 3<sup>rd</sup> Ha.....

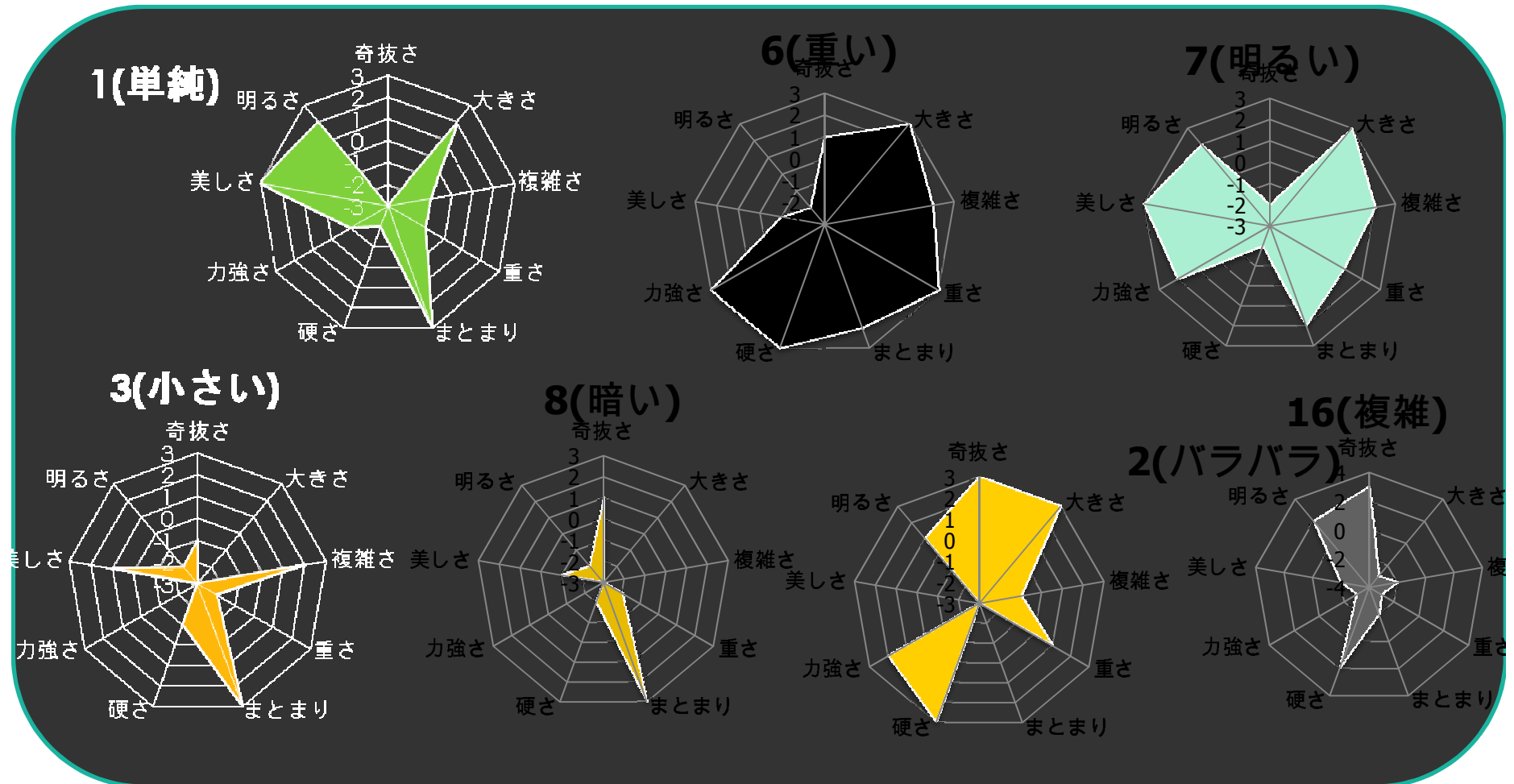
# Distribution of the weight



sum : - 0 .  
2

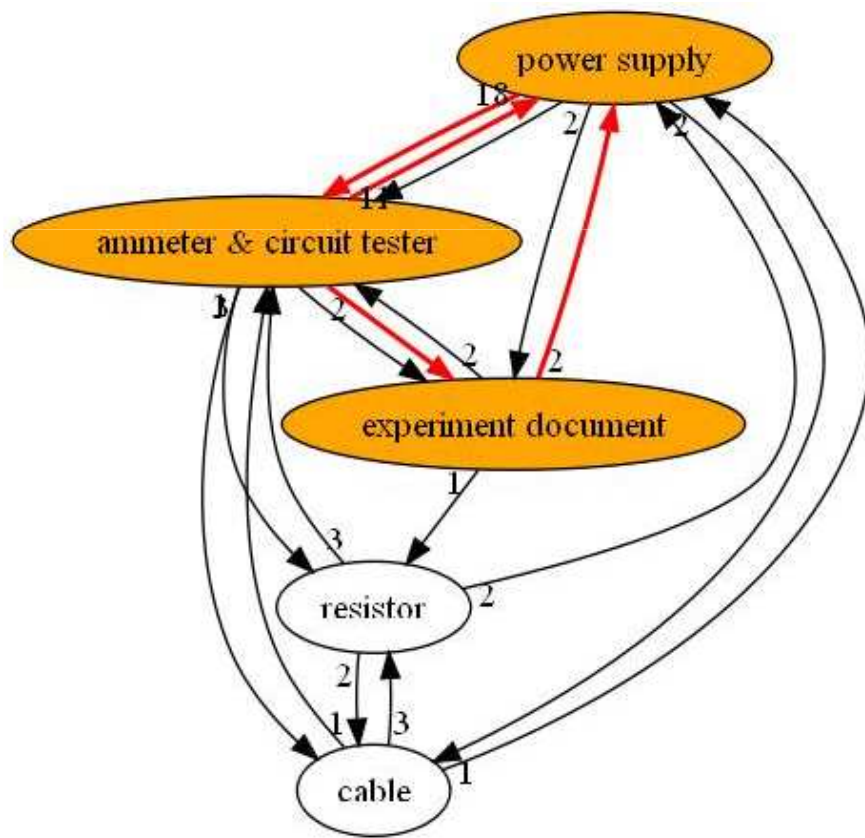


# Motion Picture Profiling in Japanese dance

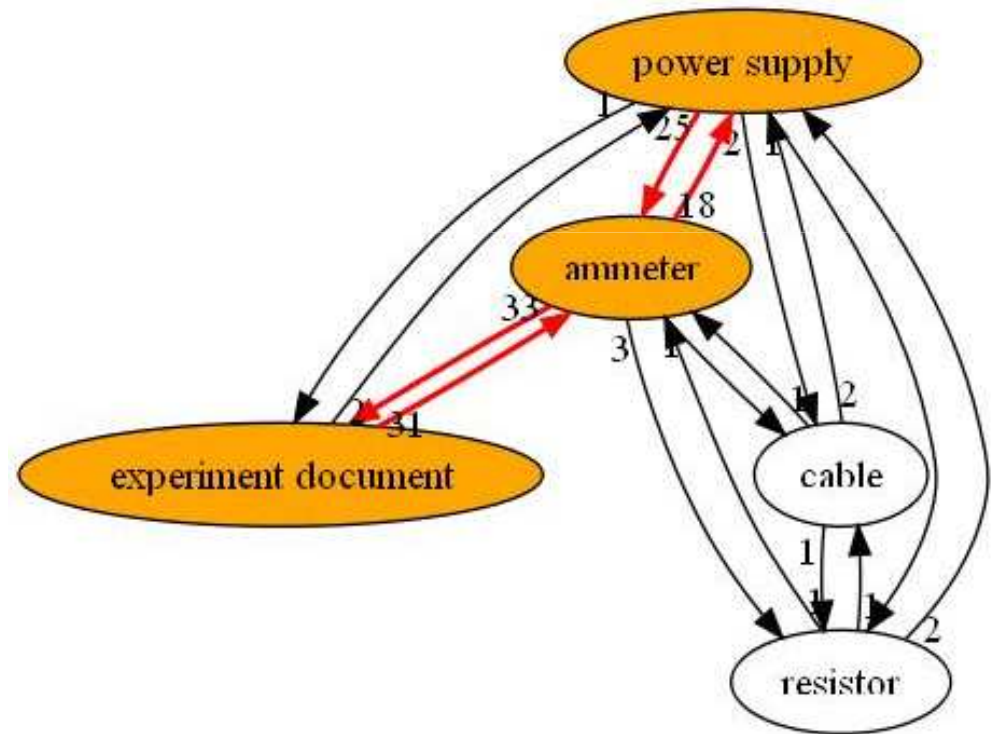


# Movie Profiling and Indexing for educational experiments

Instructor



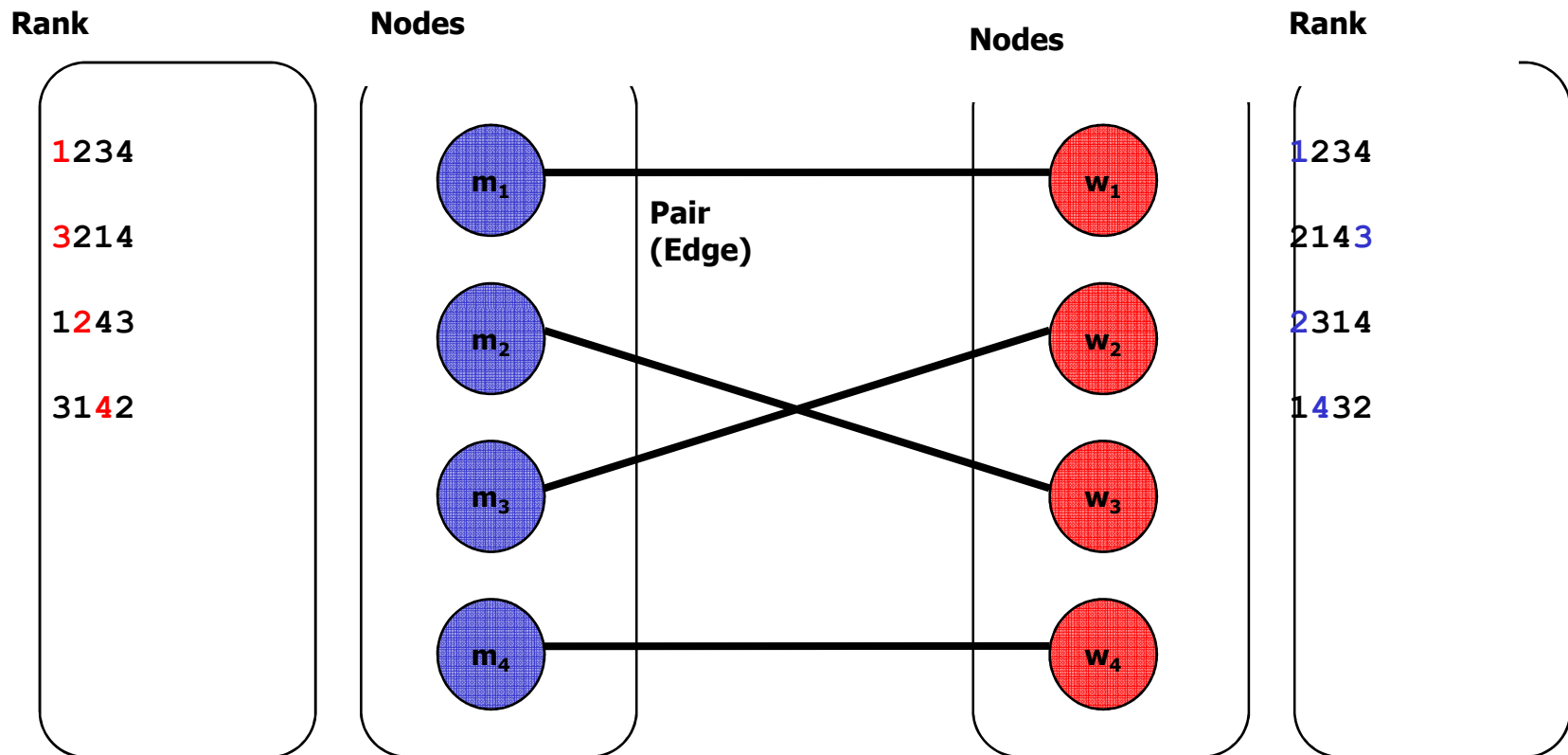
students



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The 3<sup>rd</sup> Hanoi Forum on ICT

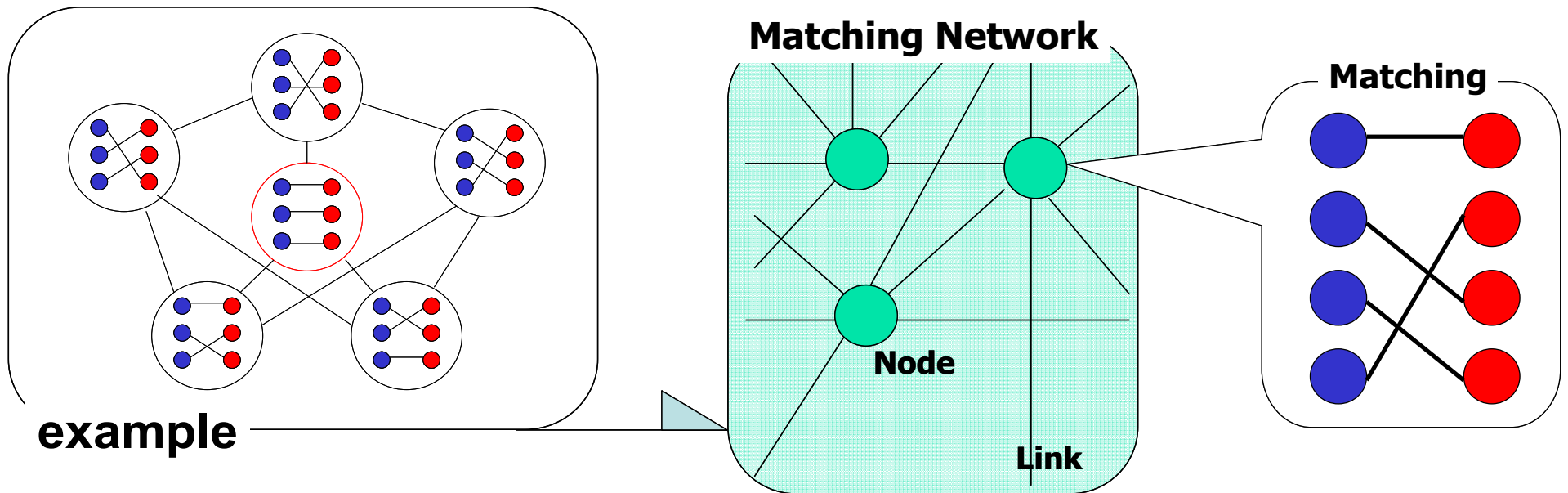
# Stable Marriage Problem



# Preference Matrix

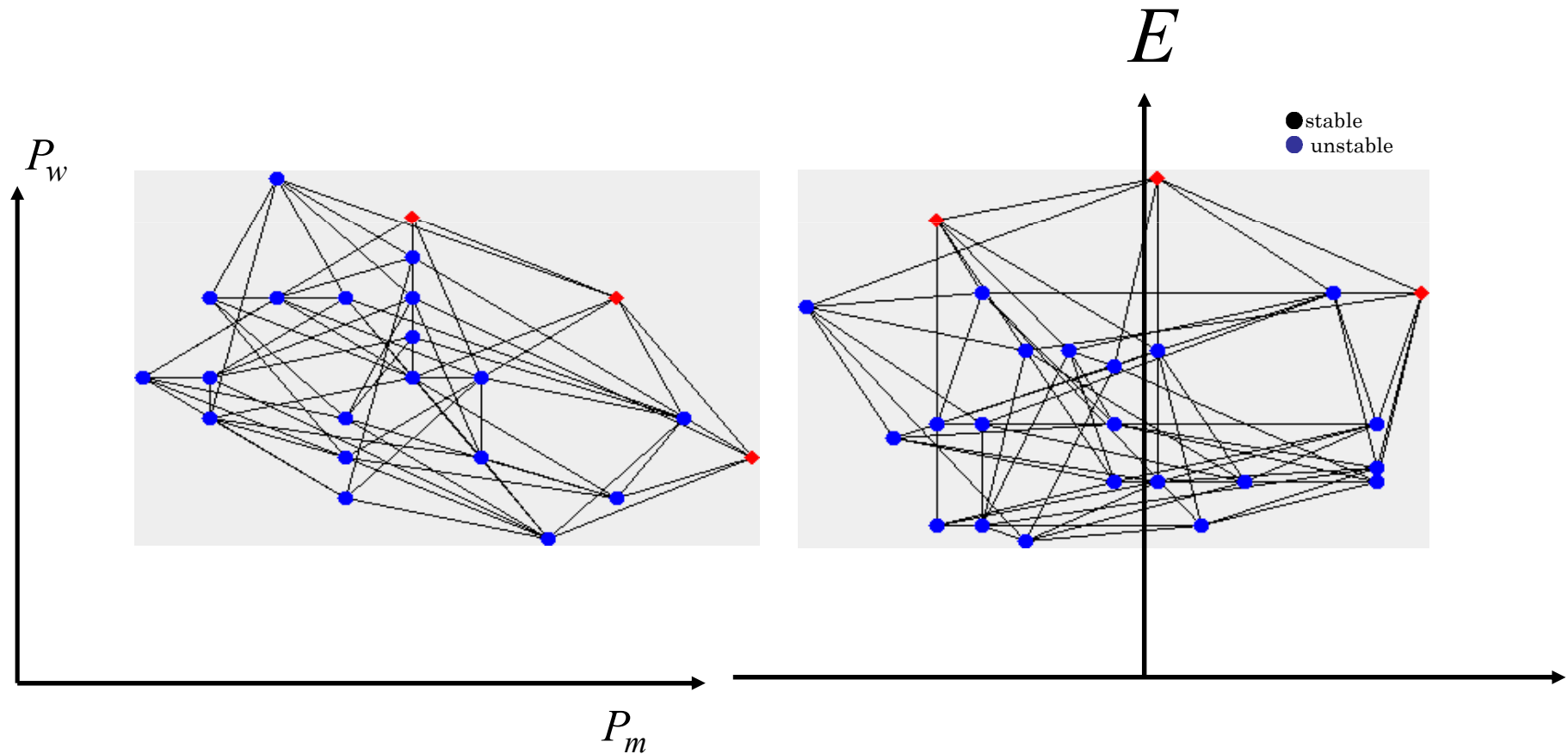
|    | w1  | w2  | w3  | w4  |
|----|-----|-----|-----|-----|
| m1 | 1/4 | 2/3 | 3/2 | 4/1 |
| m2 | 2/3 | 1/4 | 4/1 | 3/2 |
| m3 | 3/2 | 4/1 | 1/4 | 2/3 |
| m4 | 4/1 | 3/2 | 2/3 | 1/4 |

# A matching network (size 3)



# An Example of Matching Network (size 4)

$$P_m = \sum (n + 1 - R_{mi}) \quad E = \sum (n + 1 - R_{mi})(n + 1 - R_{wp})$$



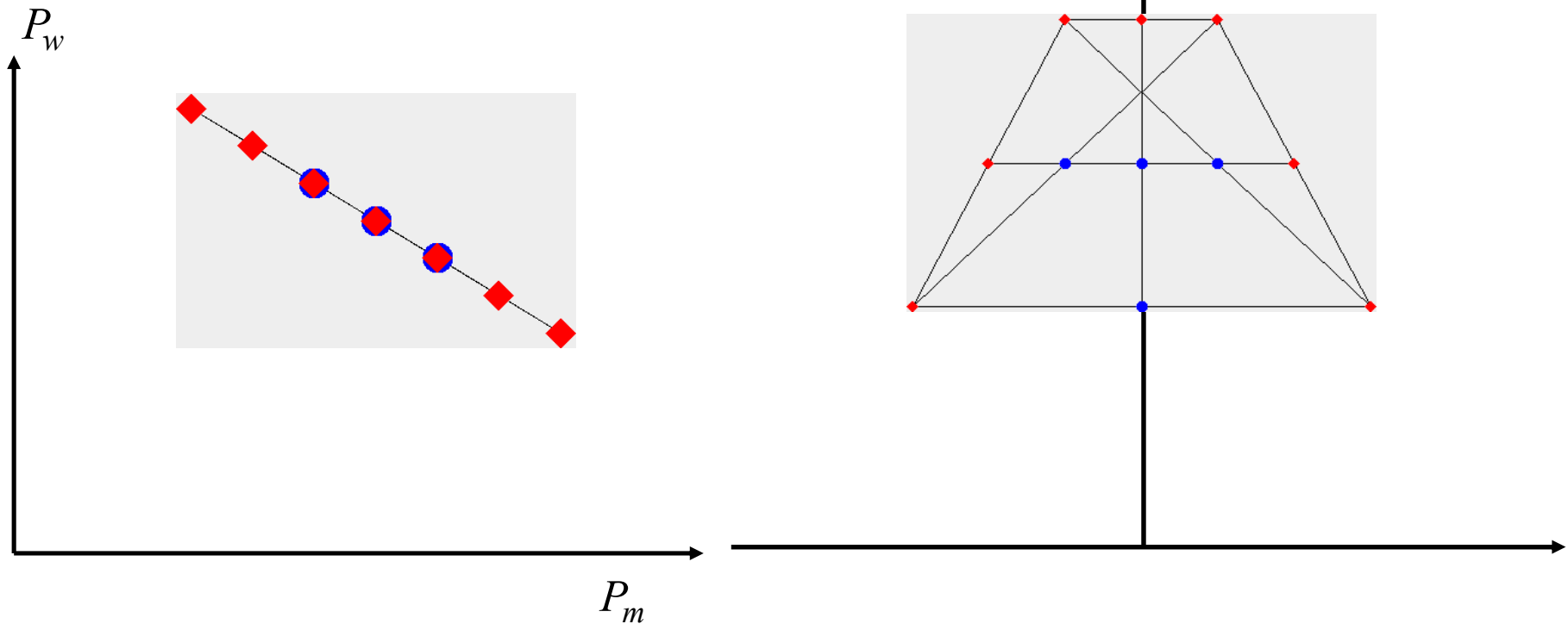
# Latin SMP

$$P_m = \sum (n+1 - R_{mi})$$

$$E = \sum (n+1 - R_{mi})(n+1 - R_{wp})$$

$E$

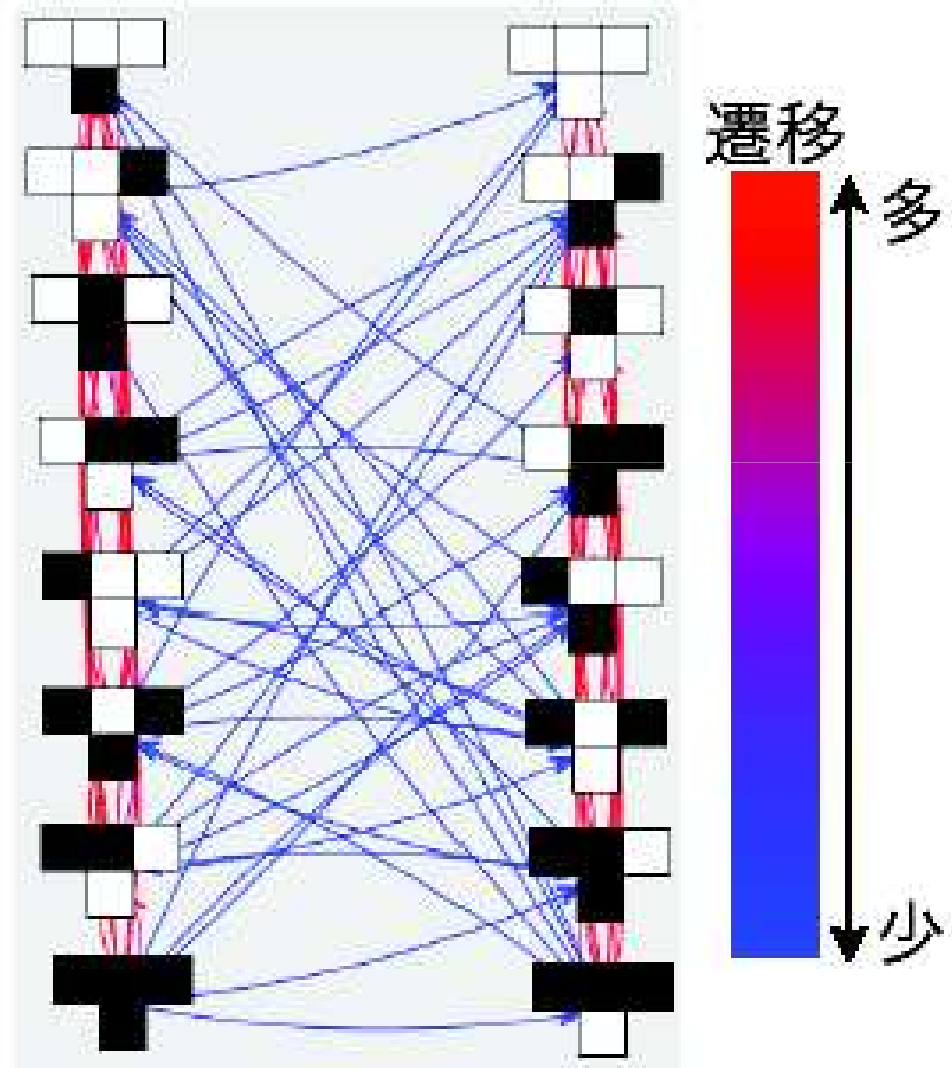
● stable  
● unstable



# Strategy profiling in spatial games

■ CDC対DCD

| 次元 | 1 |
|----|---|
| 近傍 | 3 |
| 戦略 |   |
|    |   |
|    |   |
|    |   |



# Diagrams of Numbered Square Lattice: HOU-JIN

2 by 2 squares also have  
equal sum

|    |    |    |    |
|----|----|----|----|
| 15 | 10 | 3  | 6  |
| 4  | 5  | 16 | 9  |
| 14 | 11 | 2  | 7  |
| 1  | 8  | 13 | 12 |

[1987:ブルガリア数学雑誌、第 1 号掲載; 1987:Crux Math. 問題 1226 番]

[出典]: 山形県鶴岡市荒町日枝神社に寛政 1 2 年に掲額された算額

# Conclusion

- Diagrams could have many roles in communication (including education).
- Diagrams + ICT will give several modes of communication such as an interactive knowledge transfer

# Acknowledgements

- This presentation is made possible by many persons.
- Special Thanks to:
- Prof. Nguyen Ngoc Binh, Dr. Bui The Duy, and Mr. Nguyen Duc Thien.
  
- I would also like to thank you for all the audiences for kind attention.
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