Information & Data Visualization

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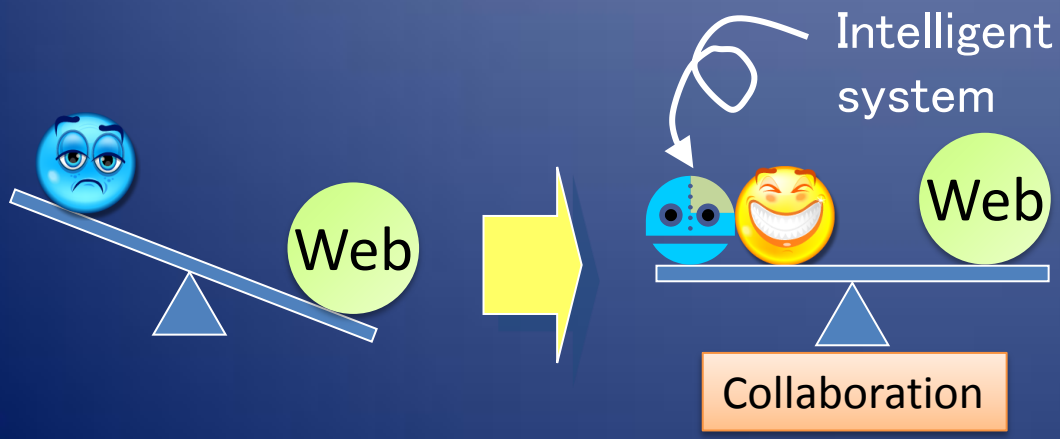
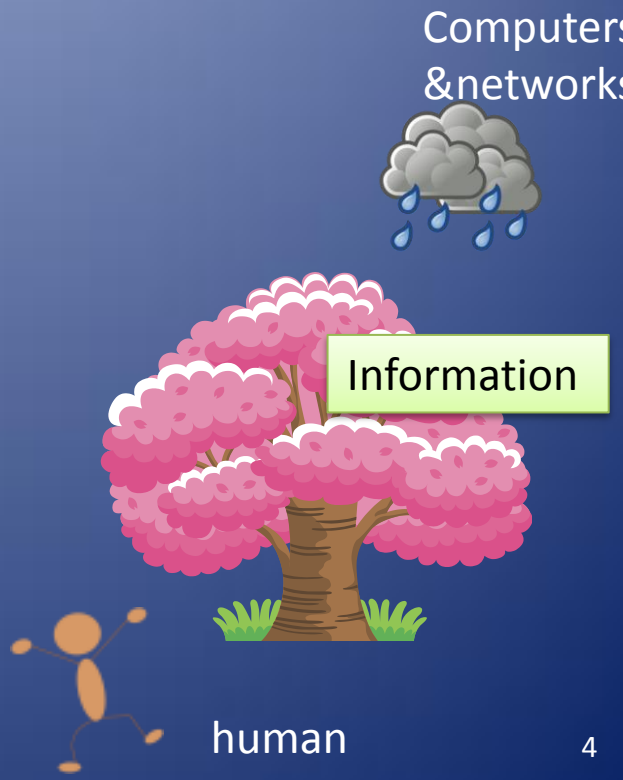
Self Introduction

- Yasufumi Takama, Dr. Eng.
  - Associate Professor,
    Graduate School of System Design, Tokyo Metropolitan University, JAPAN
- Biography
  - 1994.3: B. S. Degree, Univ. of Tokyo , JAPAN
  - 1996.3: M. S. Degree, Univ. of Tokyo , JAPAN
  - 1999.3: Dr. Eng. Degree, Univ. of Tokyo , JAPAN
  - 1999.4-2002.3: Assistant Prof.,
    Tokyo Institute of Technology , JAPAN
  - 2002.4-2005.3: Associate Prof.,
    Tokyo Metropolitan Institute of Technology , JAPAN
  - 2005.3-: Associate Prof., Tokyo Metropolitan Univ., JAPAN

Motivation

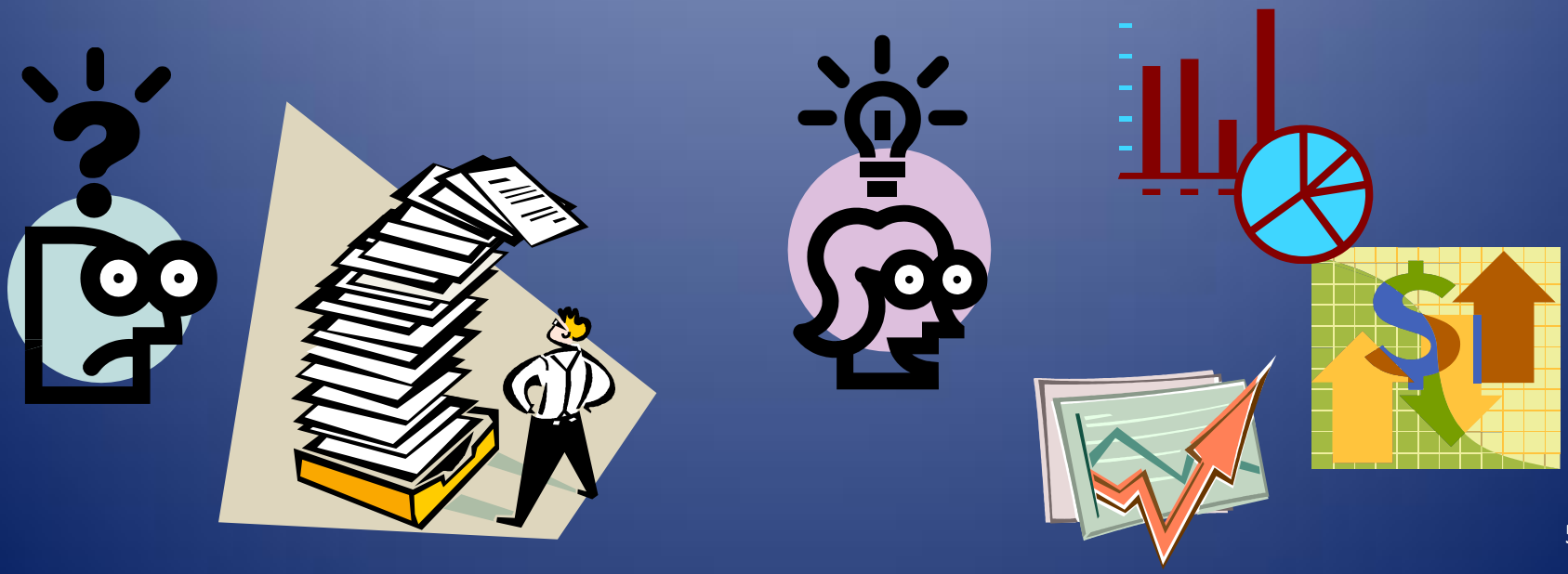
- Growth of Computers & Networks
  - IT resource used for fast & large-scale processing
  - Available information beyond human capacity
- Collaboration between human & computer systems
  - Intelligent system/interface
  - Information visualization





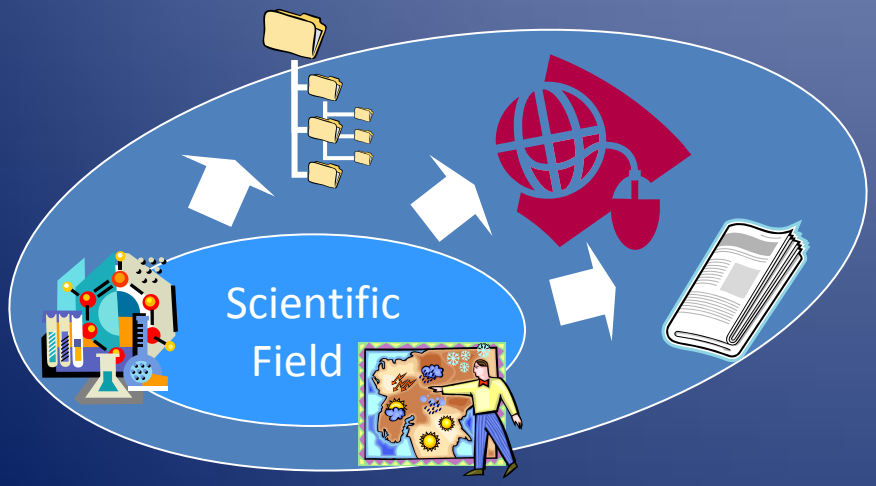
Goal of Information Visualization

- To provide users with data / information in understandable manner
  - Utilizing human's visual perception capability
  - Possible to grasp perspective of large-scale data



From Scientific Visualization to Information Visualization

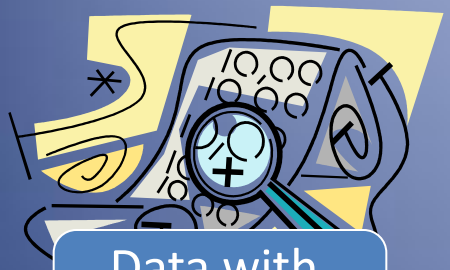
- Data in scientific Field
  - Having physical / spatial structure
  - Geographic data, medical images, etc.
- Data in other field
  - *Abstract, nonphysical data*
  - Business application, data mining, information retrieval, social network, etc.



Improvement of computational power
Spread of computer systems

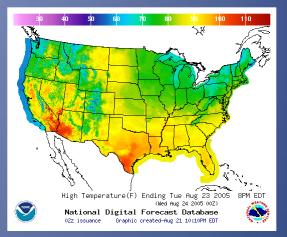
Expansion of visualization target

Importance of Data Organization



Data with structure

How to visualize



Scientific visualization

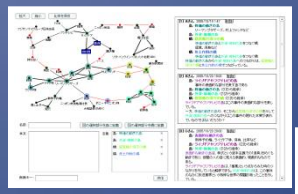
Data processing

Data Analysis

Abstract Data

What to visualize

How to visualize



Information visualization

Social Data Analysis

Social Data Analysis

- Recent trend: Data Sharing on Web
  - Flickr, Google Maps
  - View sharing: Many Eyes[Viegas07], Sense.us[Heer07], NameVoyager[Wattenberg06], Swivel
- Data analysis as collaborative work
  - Difficulty in exploring huge data space by individual
  - Deeper understanding & exploration of data space
- Collaborative information visualization[Heer07]
  - Support of sensemaking process with visualization
  - View as context of discussion & exploration
- Example:
  - NameVoyager [Wattenberg06]
  - Emergence of collaboration

NameVoyager [Wattenberg06]

http://www.babynamewizard.com/voyager

- Trend of Baby's name in USA
  - 500,000 visits within 1st 2weeks
  - Stacked graph: X=year, Y=frequency
  - Dynamic query: filtering by keystrokes

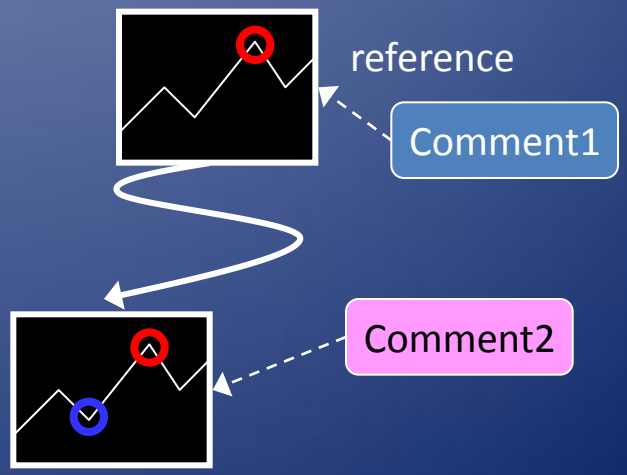
Collaboration with Sharing View

- Collaboration in NameVoyager (NV)
  - Discussion in Blogs & discussion forums (other sites than NV!)
  - Referring to view by keystrokes
- Type of collaboration
  - Sharing of discovery … telling findings to others, sometimes with question
  - Reply from others … answer to question, exchange of opinions
- Problems
  - Difficulty in sharing context (particular view)
  - Repeating similar questions / discussions
  - Grasp & control of discussion (convergence/divergence)

Visualization as common ground for communication

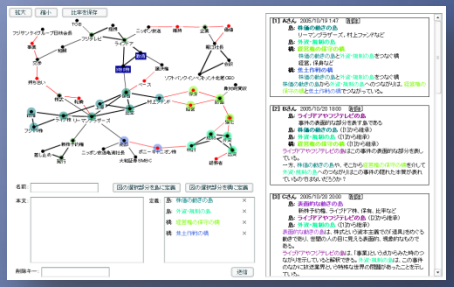
Basic Functionalities for Supporting Social Data Analysis

- Graphical Annotation
  - Adding comments / marks on view
  - Complemental comment (e.g. cause of trend)
  - Point of focus (reference point in comment)
- Visualization bookmark [Heer07][Viegas07]
  - Assign URL to *state* of view (state = basic view + annotations)
  - Link comment to state of view when it is written
- Comment listings



BBS Equipped with Views

- Focusing on Task-oriented discussion
- Employment of BBS
  - Suitable for long discussion
  - Each thread has a view as context
- Graphical annotation
  - Used as reference point in comment
  - *Similarity between annotation*
- Finding similar comments
  - Annotation-based Similarity
- Two applications
  - KGBBS: KeyGraph-based BBS
  - BBS with GoogleMaps:
    Community anticrime action support



BBS with View for Community Anticrime Action Support

- Creation of Community Safety Map by Children
- Online discussion by community residents
- View = Community Safety Map
  - Implemented as GoogleMaps™
  - Annotation = Spot

Providing 2 interfaces for
- Supporting map creation *by children*
- Supporting discussion *by adults*

Supporting Creation of Community Safety Map

- Available from Web browser
- Input spot information on map area
  - Icons showing criteria for judging dangerousness & safety of spots
  - Photos
  - Comments

Danger
- Easy to enter
- Difficult to see

Safe
- Difficult to enter
- Easy to see

Support Discussion about Anticrime Actions

- Spots are referred to in comments

Comment

Reference Box

Map Area

Thread Area

Experimental Results

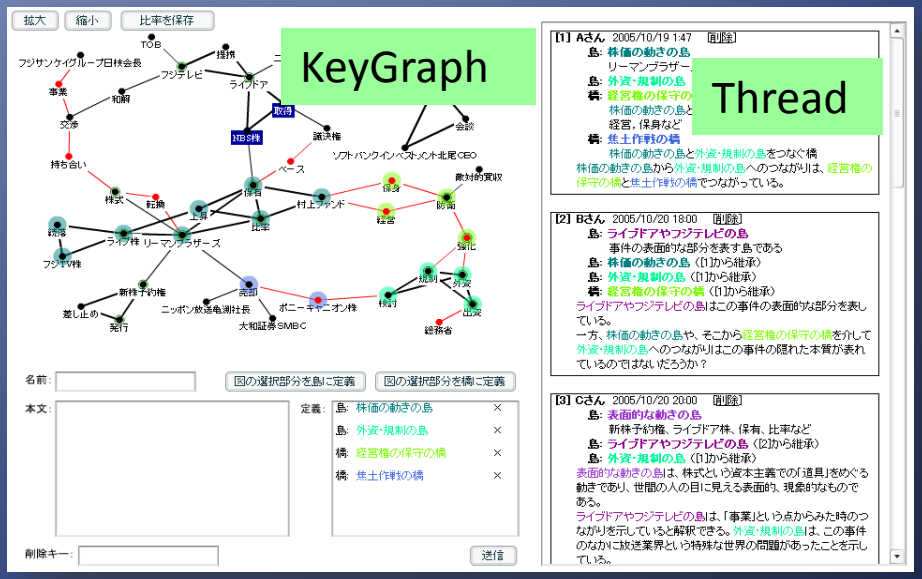
Group	Item	1st trial	2nd trial
A	Support functions	ON	OFF
	# of spots	23	36
	# of comments	15	14
	# of referred spots	25	12
B	Support functions	OFF	ON
	# of spots	23	36
	# of comments	14	11
	# of referred spots	1	14

Using functions makes it easy to have concrete discussion by referring to particular spots

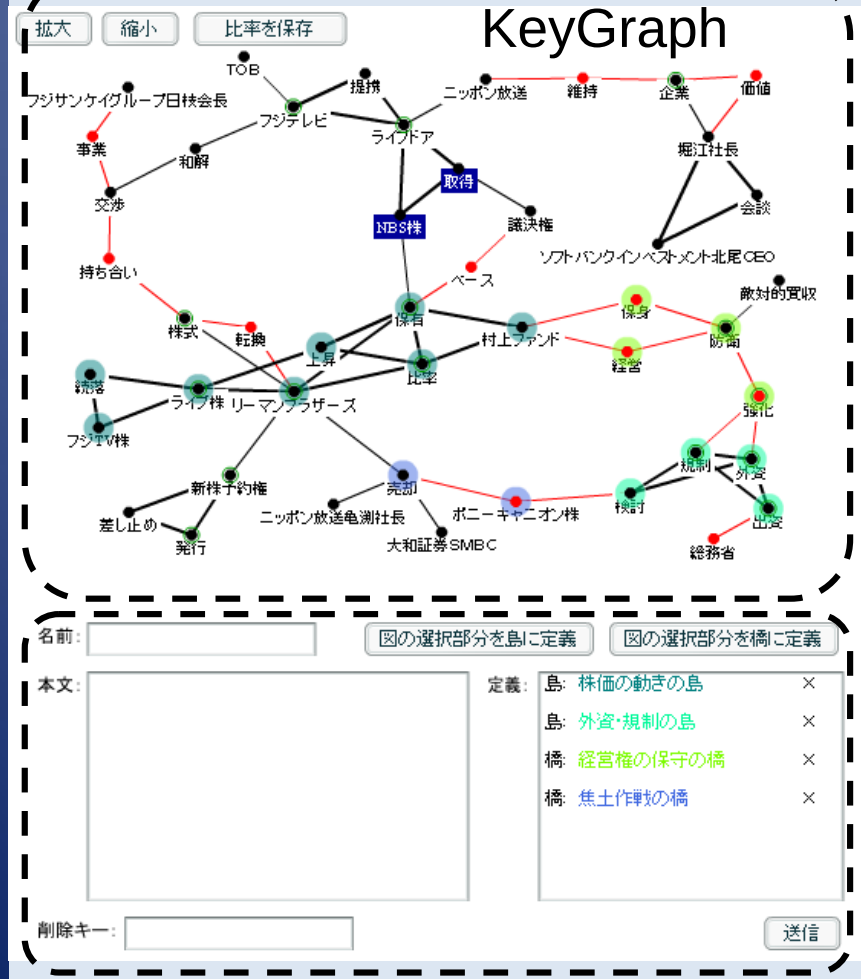
KGBBS: Online Discussion Support for Chance Discovery [Takama07]

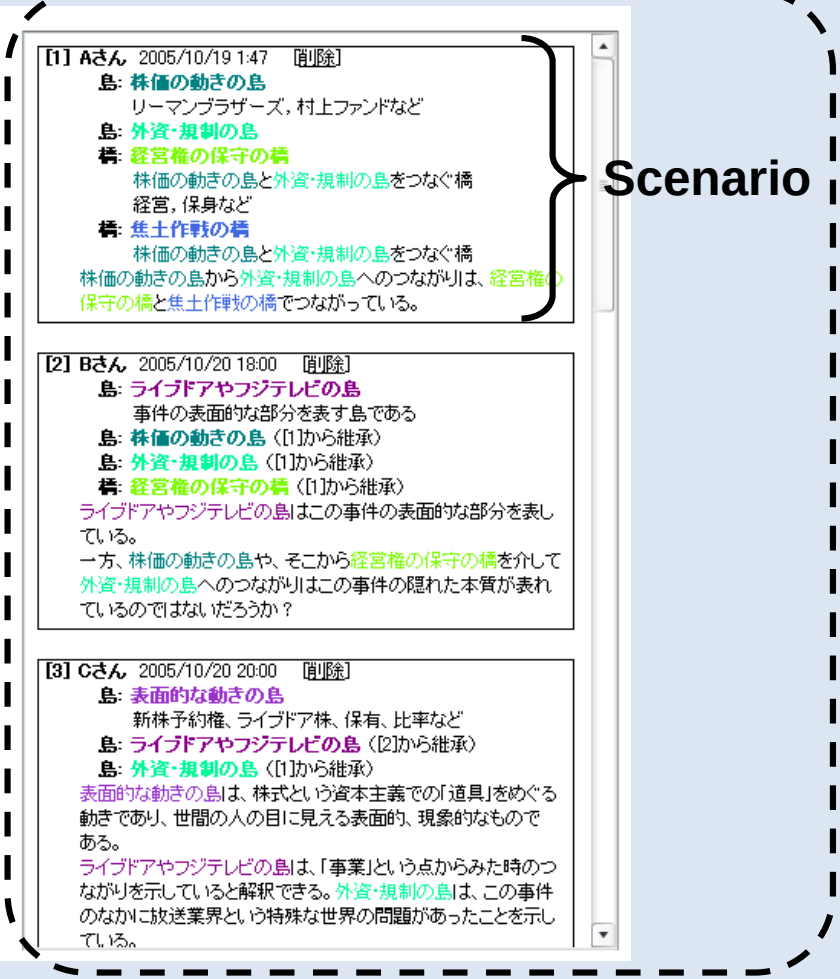
- KeyGraph as *common ground*
- Annotation = making islands & bridges
- Annotation inheritance
- Comment retrieval based on referred annotation

KeyGraph: Typical visualization method for chance discovery
- Islands: node cluster, *common ground*
- Bridge: path between islands, *clue for chance*



Screenshot of KGBBS



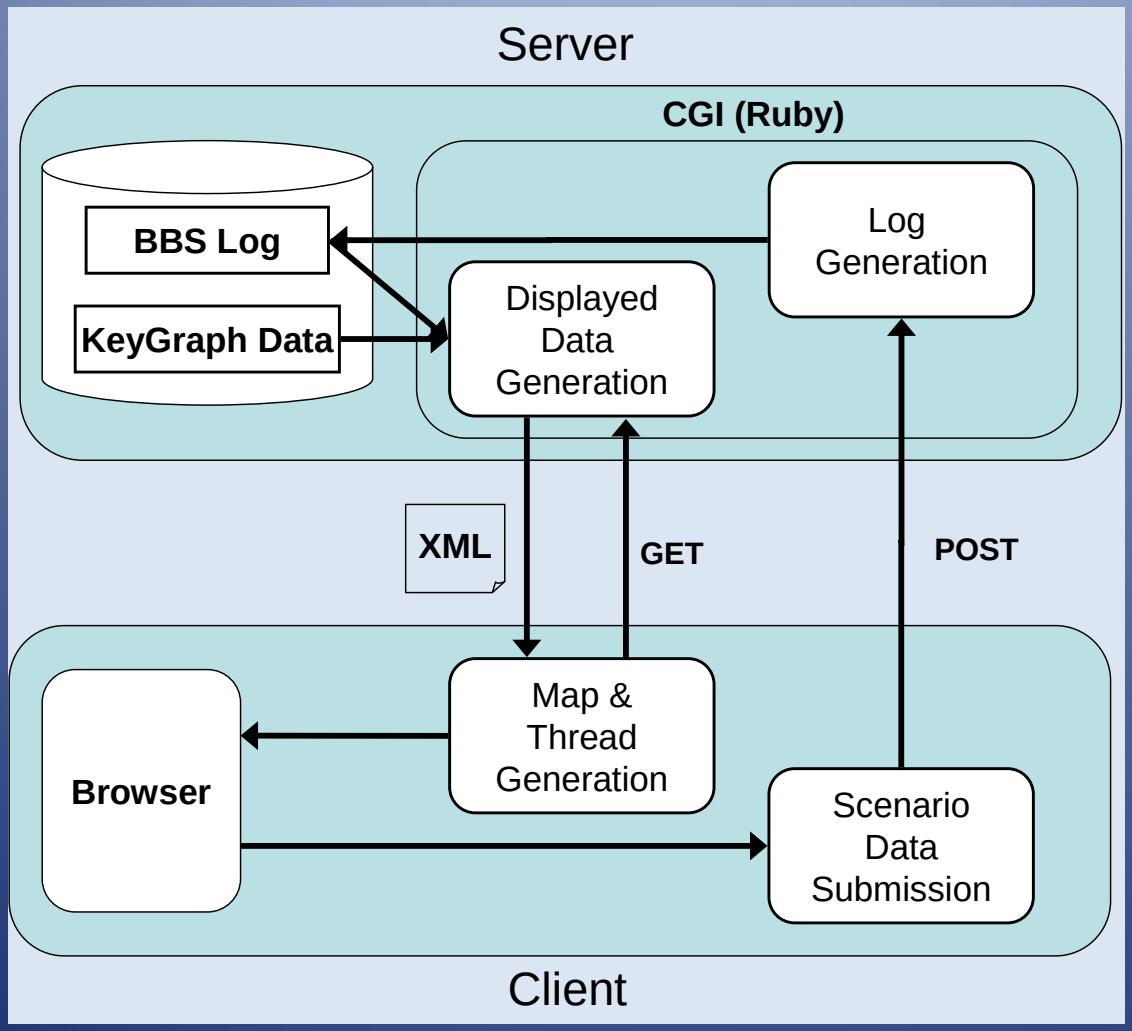


Scenario

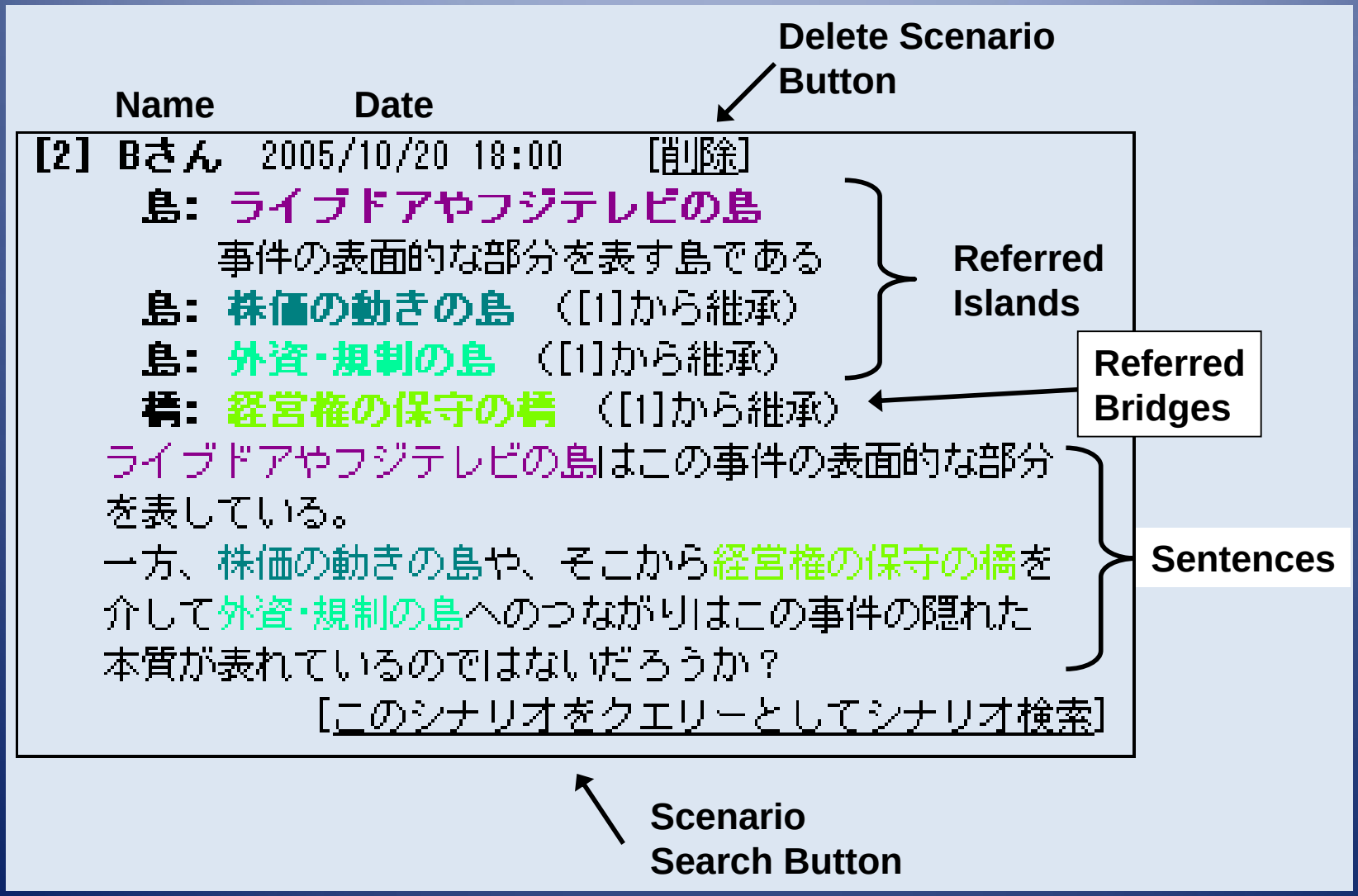
Posting form

Thread

KGBBS: System Architecture



Referring to View in Scenario



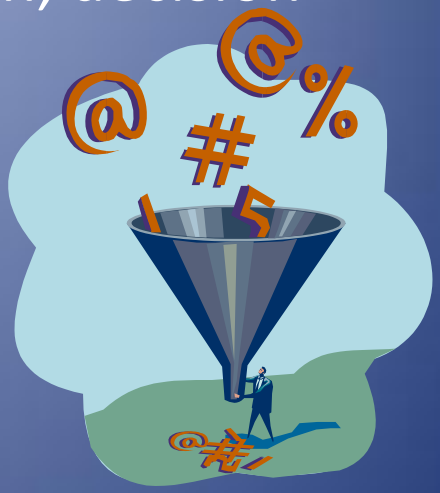
Visualizing Trend Information

Trend Information

- Trend information: Summarization of temporal / spatial data, obtained through synthesis rather than simple enumeration [Kato05]
  - Temporal trend information … movements of gasoline price, approval rating for cabinet, hot topics in blogs, etc.
  - Spatial trend information … distribution of earthquake intensity, interregional comparison of statistical data
  - Spatiotemporal trend information … Swarm earthquakes

Importance of Trend Information

- Useful for situation understanding, prediction, decision making, etc.
- Important information on Web
  - Recent growth of data resources accumulating data continuously
  - Further utilization of Web
- MuST: NTCIR workshop
  - Workshop on Multimodal Summarization for Trend Information
  - Test collection (News articles)
  - Joint field of NLP & IV researchers

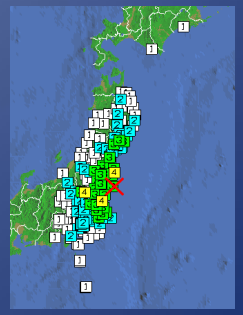


http://must.c.u-tokyo.ac.jp/
http://research.nii.ac.jp/ntcir/index-en.html

Visualization of trend information

- Trend info. essentially represented with graph & chart
- Importance of interaction
  - Exploratory data analysis:
    goal is not defined in advance
  - View data space from various viewpoints
- Problem
  - User interaction become complicated
    cf. interaction model
  - Abstract trend data

http://weathernews.jp/typhoon/



http://www.seisvol.kishou.go.jp/

Target Data for Trend Visualization

- Statistical data: cabinet approval rating, stock market, national census, etc.
  - Easy to visualize: i.e., statistical map, line chart
  - Simple data processing
- Abstract data: trend analysis in Blogs/SNS, topic transition in BBS
  - How to visualize? … Various methods proposed
  - What to visualize? … Need processing for information organization

Visual Summary [Koinuma09]

- Visualization of topic transition in BBS thread
- Help users to grasp topic transition *without reading* BBS posts
  - Identifying thread's main topic
  - Discriminating topic transition patterns
    - Discussion … exchanging opinion about subject
    - Topic-oriented chatting … freely talking about subject
    - Open-ended chatting … freely talking without subject

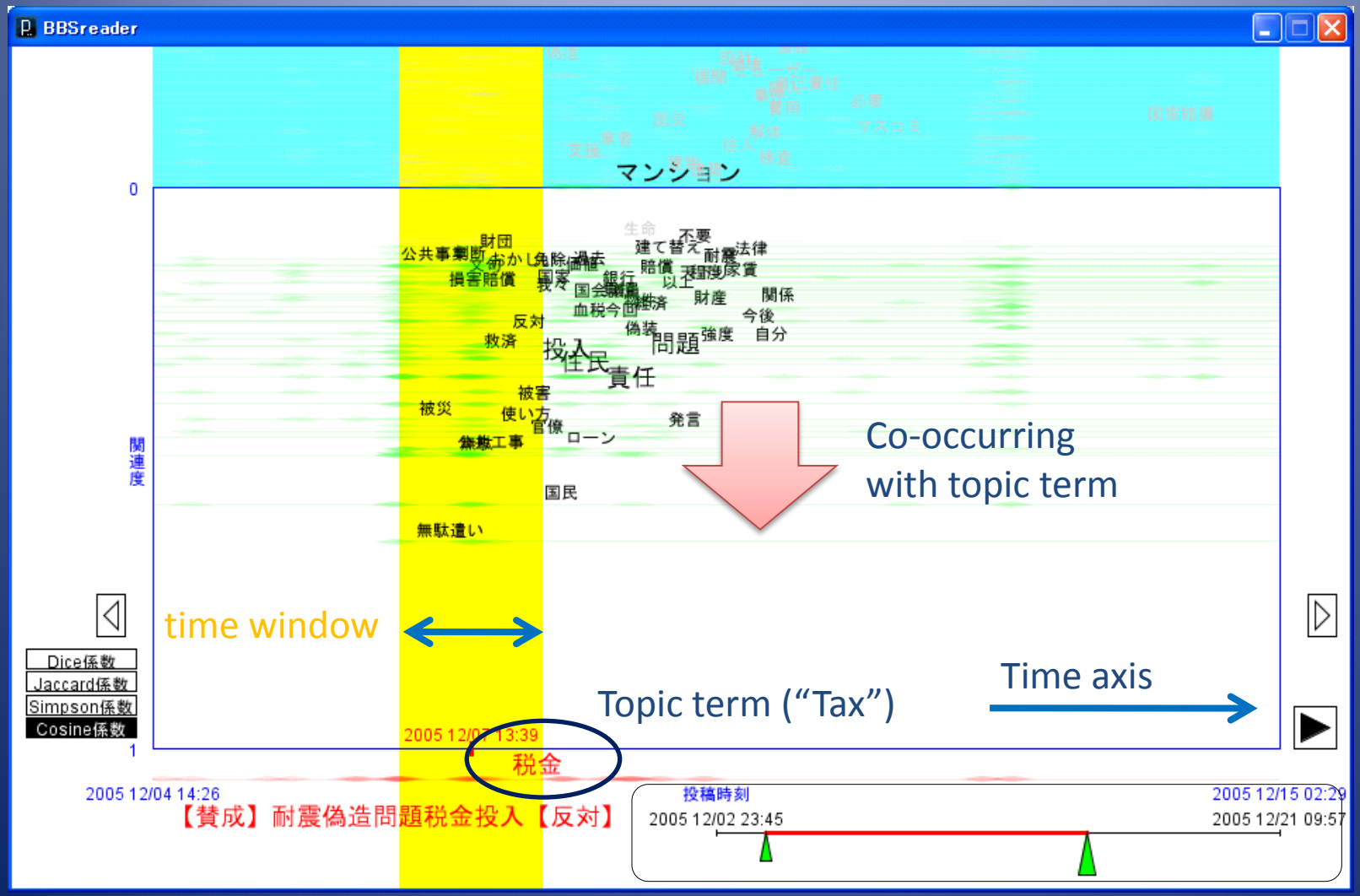
Summary of Visualization Method

- Organization of trend information
  - Co-occurrence of keywords within time window

$$R_{Simpson}(k_i, k_i, t_s, t_e) = \frac{\left|K_i(t_s, t_e) \cap K_j(t_s, t_e)\right|}{\min\left\{K_i(t_s, t_e), K_j(t_s, t_e)\right\}}$$

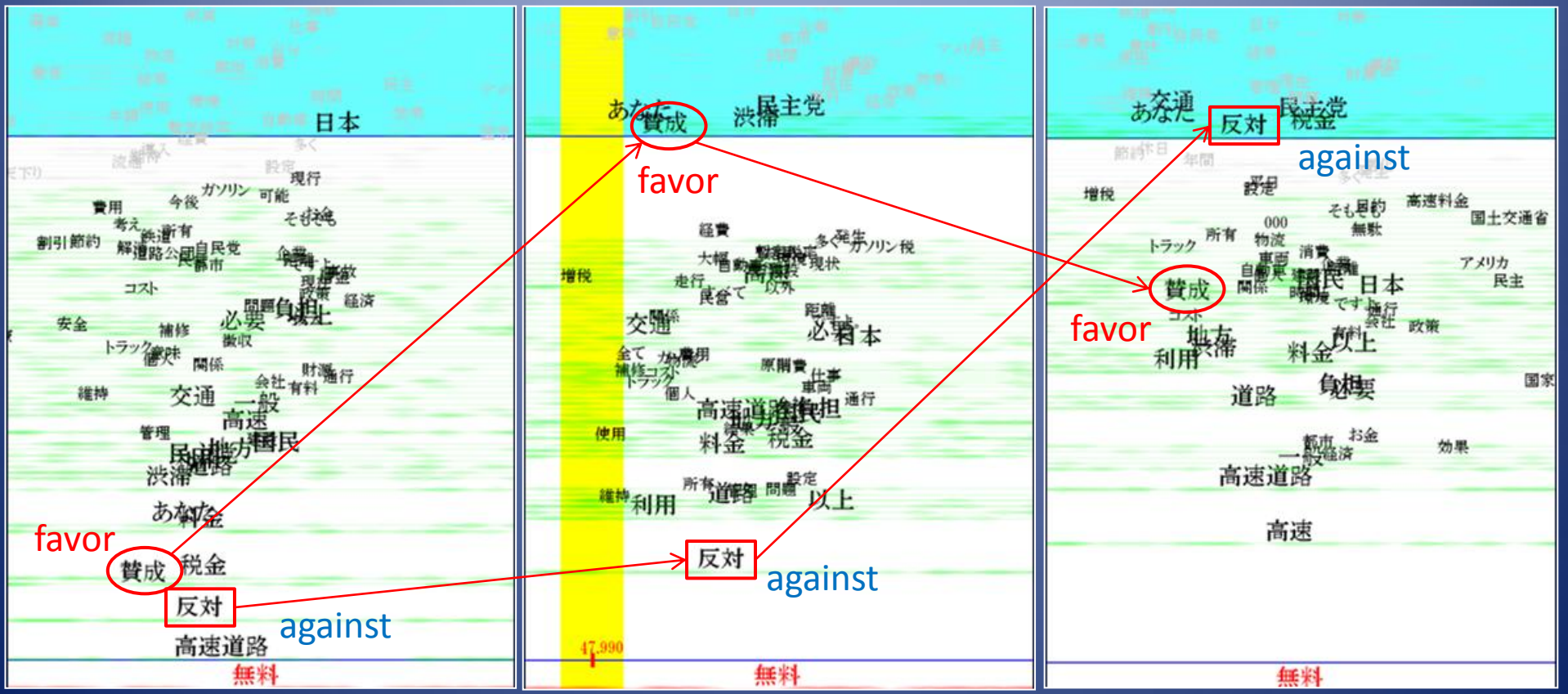
- 2 Visualization mode
  - Frequency mode
  - Topic term model:
    Co-occurrence with topic term
- Interactive visualization
  - Controlling time window
  - Specifying topic term

Screen shot of Visual Summary



Example of Visualizing Topic Transition

Thread title: Expressway should be toll-free?
Topic term ("expressway")



Post #30 → #47 → #143

Conclusion (Future Works)

- Introduction of our 3 research topics
- Social data analysis
  - BBS with sharing view
- Trend information visualization
  - Visual summary: BBS monitoring system
  - Future work: Real-time monitoring of multiple threads
- Interactive visualization
  - Visualization cube
  - Future work: Dual View system with 2 visualization cubes