Data Analysis and High Performance Computing

Presented by

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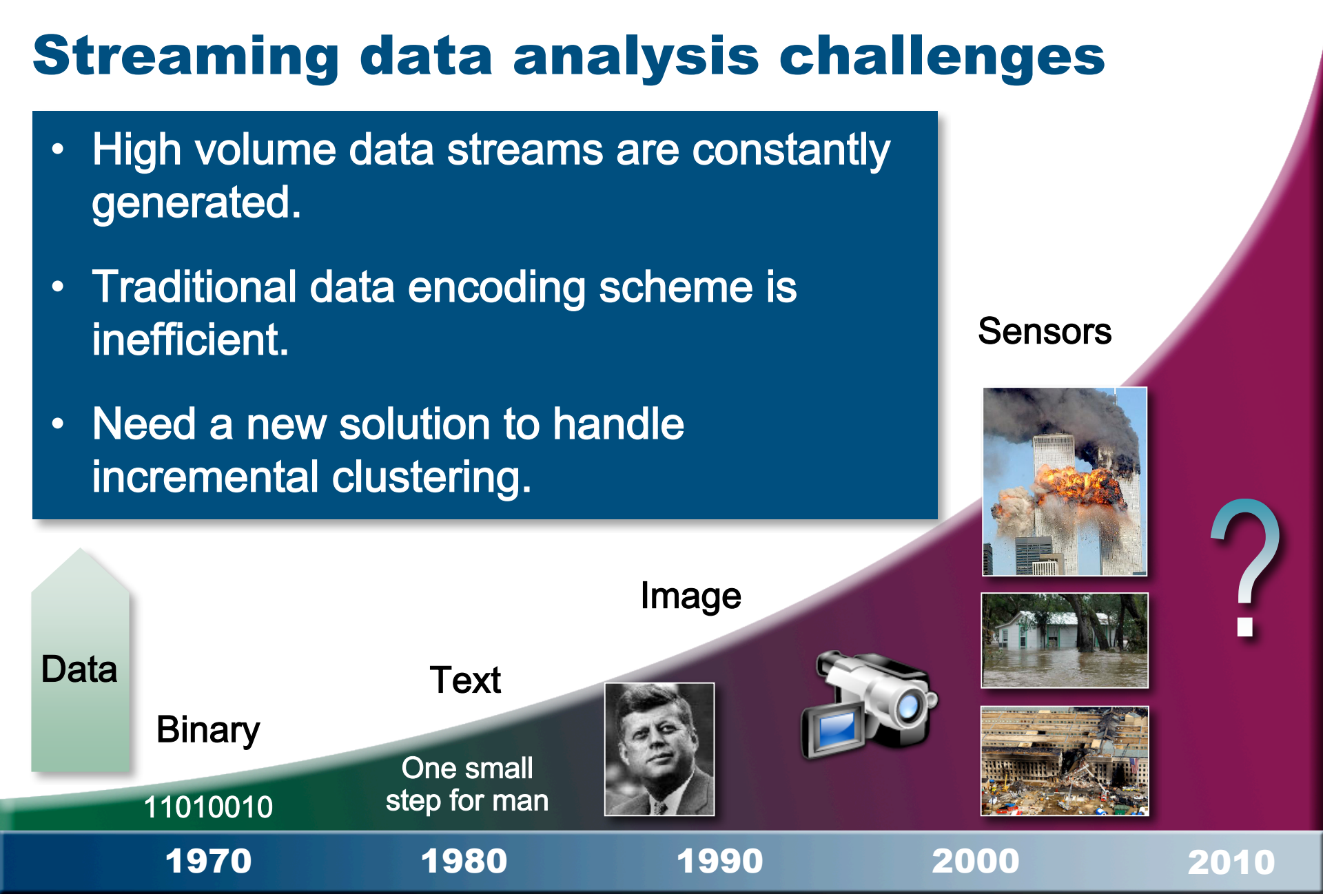
Computational Sciences and Engineering Division

Streaming data analysis challenges

- High volume data streams are constantly generated.
- Traditional data encoding scheme is inefficient.
- Need a new solution to handle incremental clustering.



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Distributed data stream mining with Piranha

- Piranha utilizes distributed and parallel data clustering to process data streams.
- Piranha applies a novel data encoding scheme, Term Frequency-Inverse Corpus Frequency (TF-ICF).
- Piranha handles incremental clustering using a threshold-based solution.

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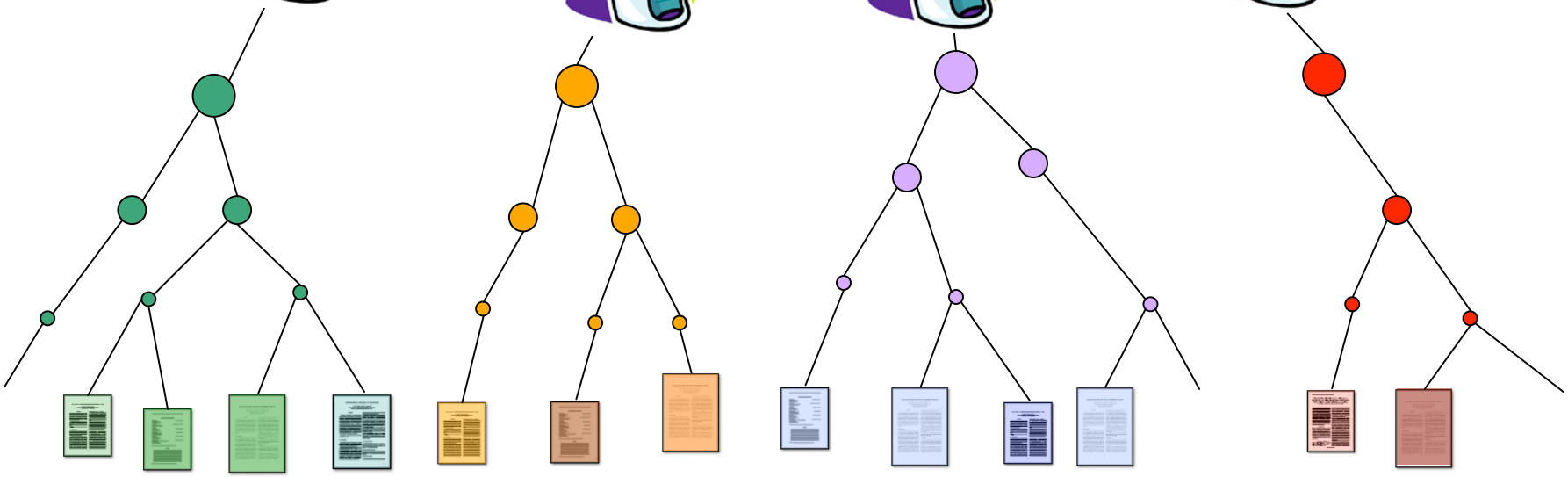
headnode

worknode

worknode

worknode

worknode



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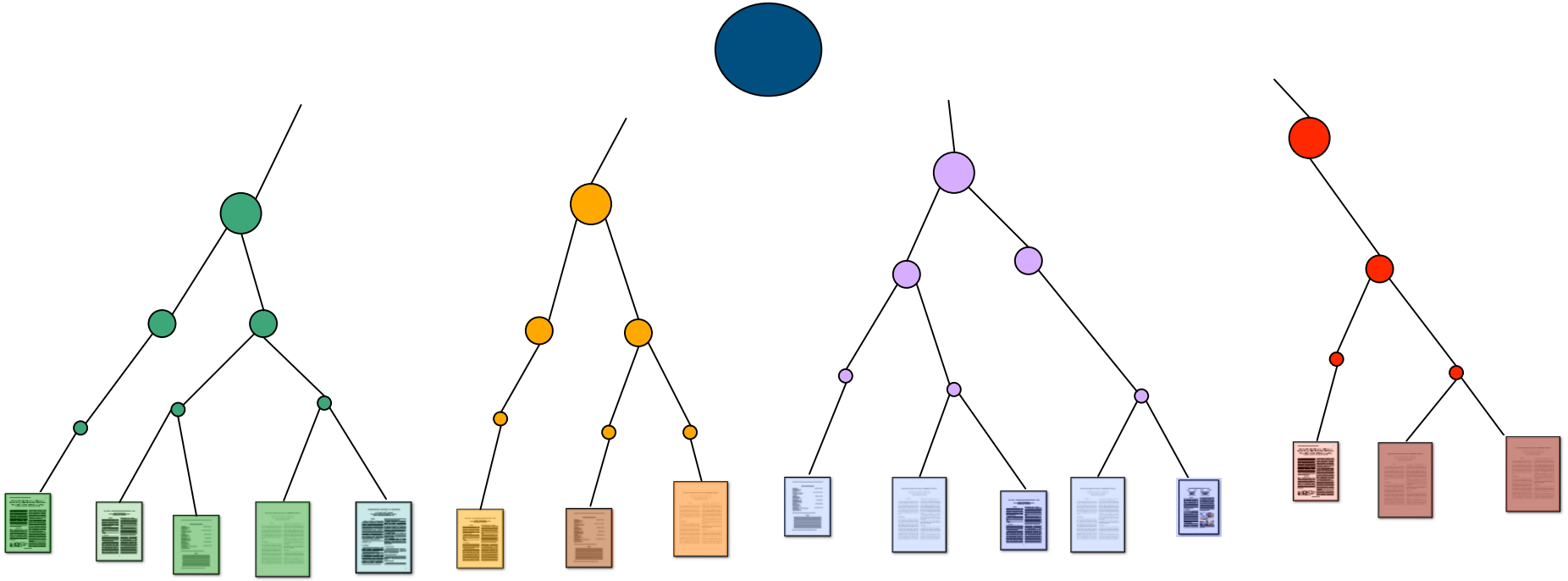

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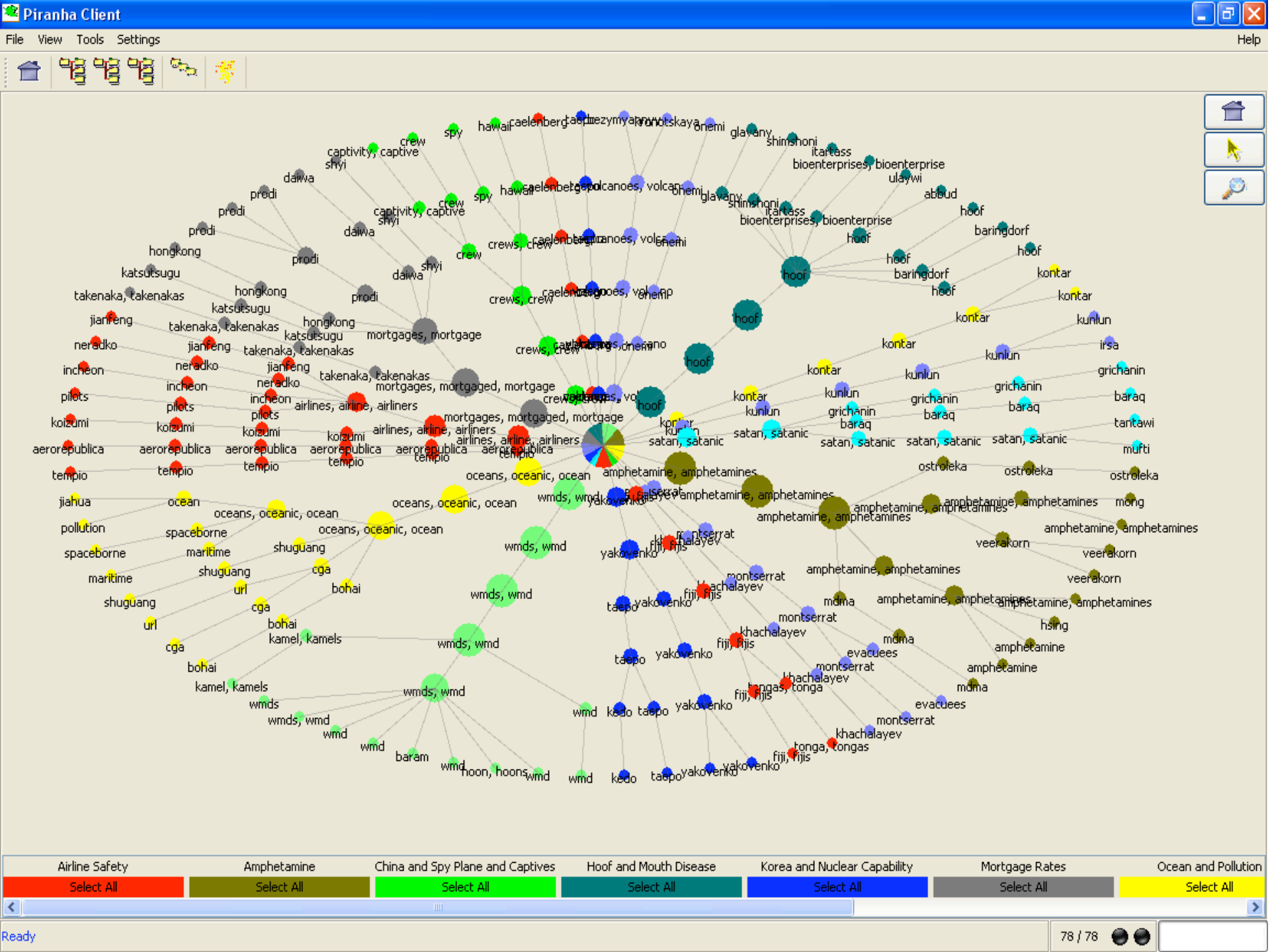
Piranha Client
File View Tools Settings Help
Airline Safety
Amphetamine
China and Spy Plane and Captives
Hoof and Mouth Disease
Korea and Nuclear Capability
Mortgage Rates
Ocean and Pollution
Select All
Select All
Select All
Select All
Select All
Select All
Select All
Ready
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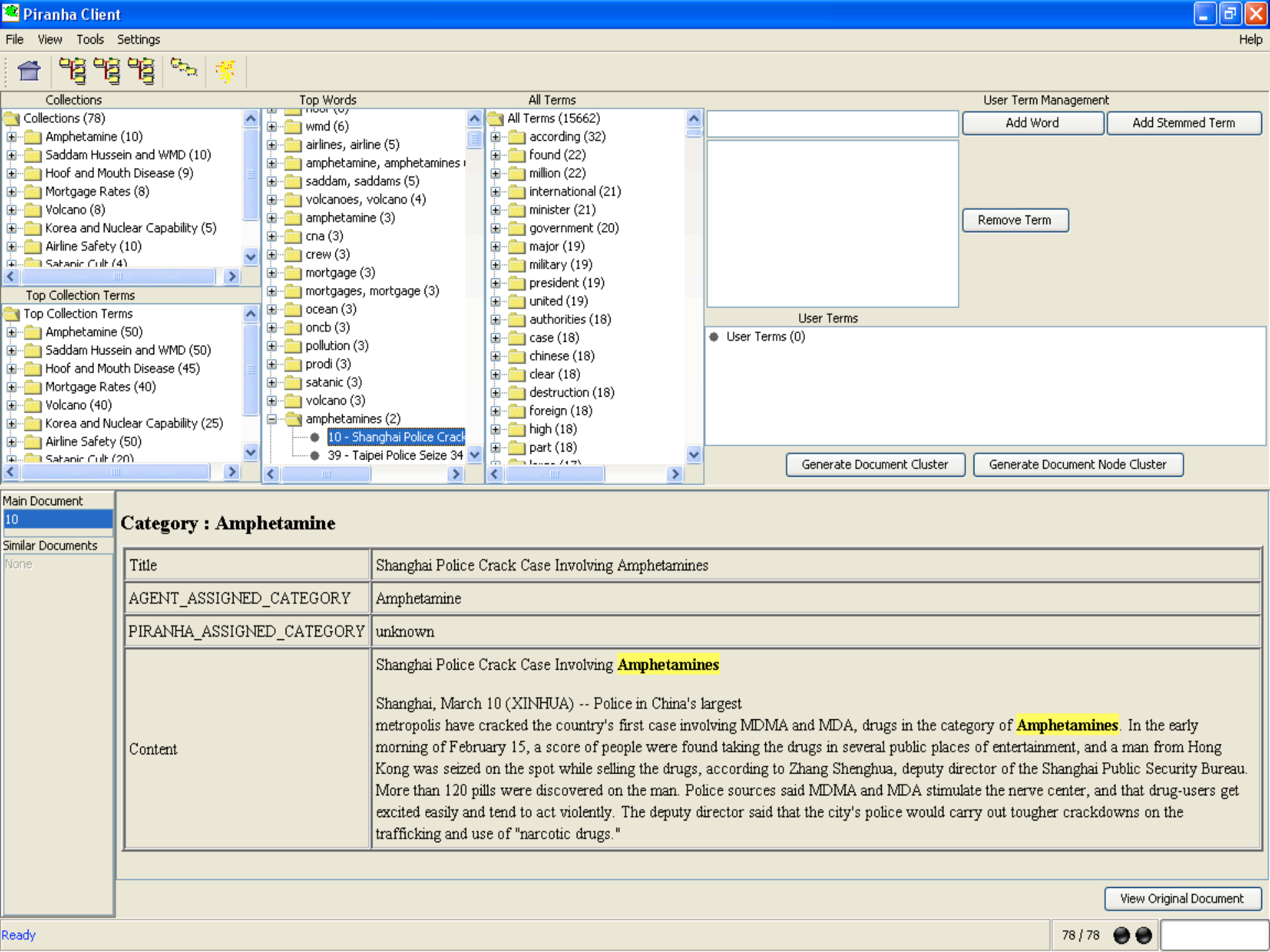
Piranha Client
File View Tools Settings Help
Collections
Collections (78)
Amphetamine (10)
Saddam Hussein and WMD (10)
Hoof and Mouth Disease (9)
Mortgage Rates (8)
Volcano (8)
Korea and Nuclear Capability (5)
Airline Safety (10)
Top Collection Terms
Top Collection Terms
Amphetamine (50)
Saddam Hussein and WMD (50)
Hoof and Mouth Disease (45)
Mortgage Rates (40)
Volcano (40)
Korea and Nuclear Capability (25)
Airline Safety (50)
Top Words
wmd (6)
airlines, airline (5)
amphetamine, amphetamines
saddam, saddams (5)
volcanoes, volcano (4)
amphetamine (3)
cna (3)
crew (3)
mortgage (3)
mortgages, mortgage (3)
ocean (3)
oncb (3)
pollution (3)
prodi (3)
satanic (3)
volcano (3)
amphetamines (2)
10 - Shanghai Police Crack
39 - Taipei Police Seize 34
All Terms
All Terms (15662)
according (32)
found (22)
million (22)
international (21)
minister (21)
government (20)
major (19)
military (19)
president (19)
united (19)
authorities (18)
case (18)
chinese (18)
clear (18)
destruction (18)
foreign (18)
high (18)
part (18)
User Term Management
Add Word
Add Stemmed Term
Remove Term
User Terms
User Terms (0)
Generate Document Cluster
Generate Document Node Cluster
Main Document
10
Similar Documents
None
Category : Amphetamine
Title
Shanghai Police Crack Case Involving Amphetamines
AGENT_ASSIGNED_CATEGORY
Amphetamine
PIRANHA_ASSIGNED_CATEGORY
unknown
Content
Shanghai Police Crack Case Involving Amphetamines
Shanghai, March 10 (XINHUA) -- Police in China's largest
metropolis have cracked the country's first case involving MDMA and MDA, drugs in the category of Amphetamines. In the early
morning of February 15, a score of people were found taking the drugs in several public places of entertainment, and a man from Hong
Kong was seized on the spot while selling the drugs, according to Zhang Shenghua, deputy director of the Shanghai Public Security Bureau.
More than 120 pills were discovered on the man. Police sources said MDMA and MDA stimulate the nerve center, and that drug-users get
excited easily and tend to act violently. The deputy director said that the city's police would carry out tougher crackdowns on the
trafficking and use of "narcotic drugs."
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Modeling the impact of policies

Policy: Budget cut for public transportation

Effect: Gas price soars to $6.00 per gallon

Car Emission

Volcano Activity

Solar Activity

Ocean Activity

Cloud Feedback

Industrial Pollution

Rainfall

Global Cooling

Global Warming

Climate Change

Population Change

Oil Production

Regional Conflicts

Abnormal Weather

Disappearing Glacier

Endangered Ecosystem

New Diseases

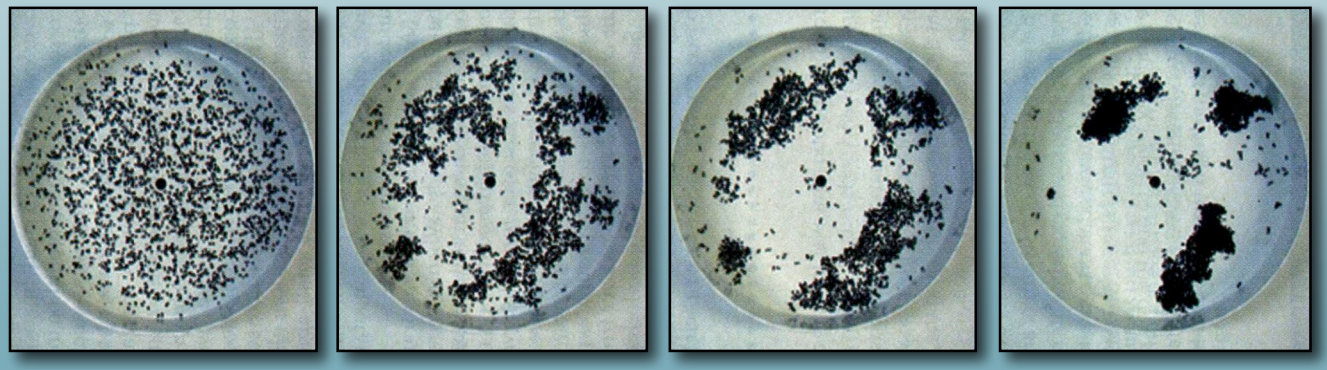
Drought

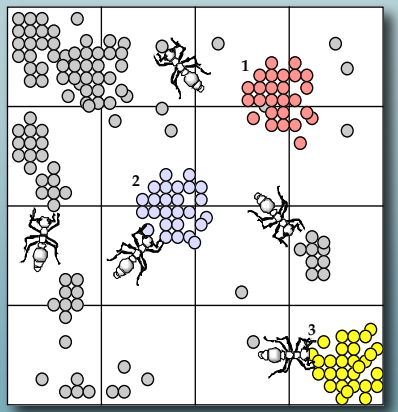
Causes

Effects

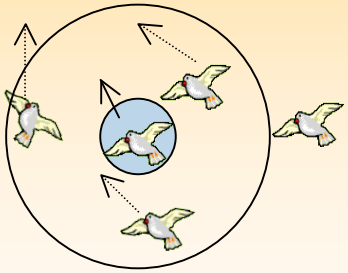
Breakthrough—bioinspired distributed solution

Ant colony optimization

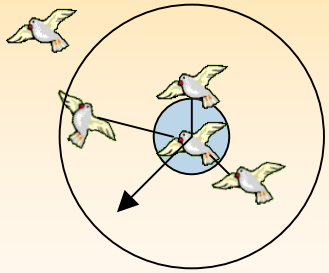




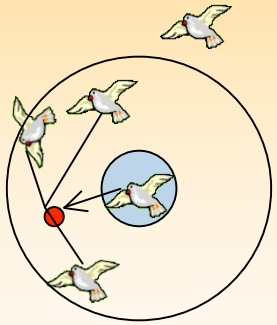
Bird flocking model



Alignment



Separation



Cohesion

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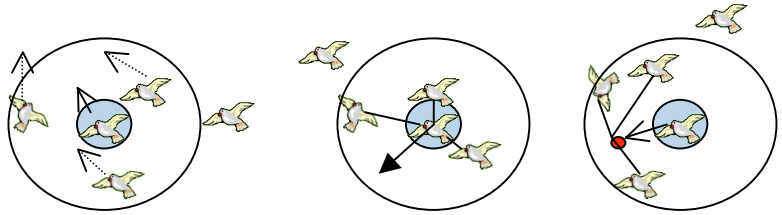
Multiple species flocking (MSF) document clustering



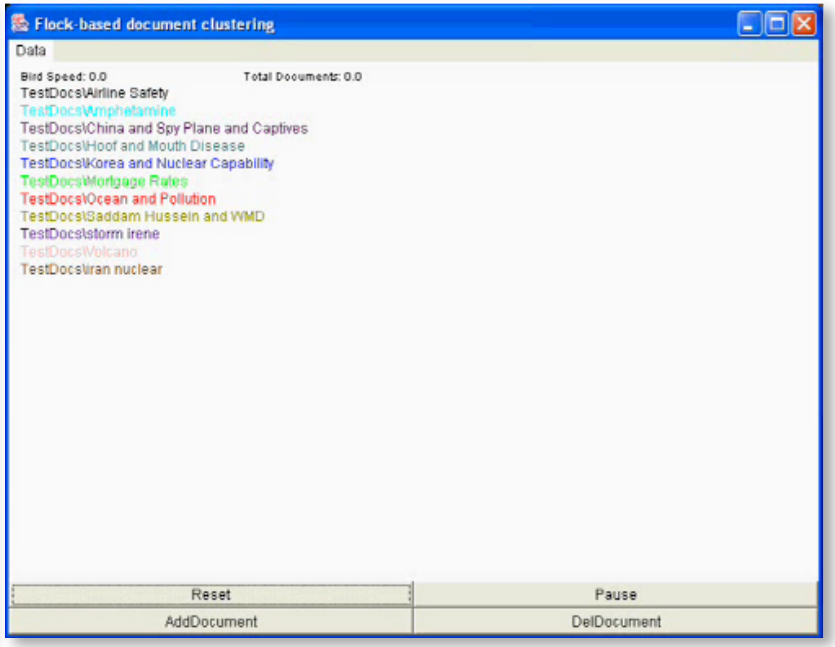
$$d(P_x, P_b) \le d_2 \Rightarrow \overrightarrow{V}_{sr} = \sum_x^n \frac{\overrightarrow{V}_x + \overrightarrow{V}_b}{d(P_x, P_b)}$$

$$d(P_x, P_b) \le d_1 \cap d(P_x, P_b) \ge d_2 \Rightarrow \overrightarrow{V}_{ar} = \frac{1}{n}\sum_x^n \overrightarrow{V}_x$$

$$d(P_x, P_b) \le d_1 \cap (P_x, P_b) \ge d_2 \Rightarrow \overrightarrow{V}_{cr} = \sum_x^n (\overrightarrow{P_x - P_b})$$

	Category/topic	Number of articles
1	Airline safety	10
2	China and spy plane and captives	4
3	Hoof and mouth disease	9
4	Amphetamine	10
5	Iran nuclear	16
6	North Korea and nuclear capability	5
7	Mortgage rates	8
8	Ocean and pollution	10
9	Saddam Hussein and WMD	10
10	Storm Irene	22
11	Volcano	8

The document collection dataset



The clustering results of K-means, ant clustering and MSF clustering algorithm on synthetic and document datasets after 300 iterations

	Algorithms	Average cluster number	Average F-measure value
Synthetic dataset	MSF	4	0.9997
	K-means	4	0.9879
	Ant	4	0.9823
Real document collection	MSF	9.105	0.7913
	K-means	11	0.5632
	Ant	1	0.1623

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Summary

- Current technology **cannot solve** emerging national challenges.
- Intelligent software agents are a **significant breakthrough** technology.
- Results indicate **high potential** to help solve these national challenges.
- We have a progression of significantly successfully deployed agent systems and research to our credit.

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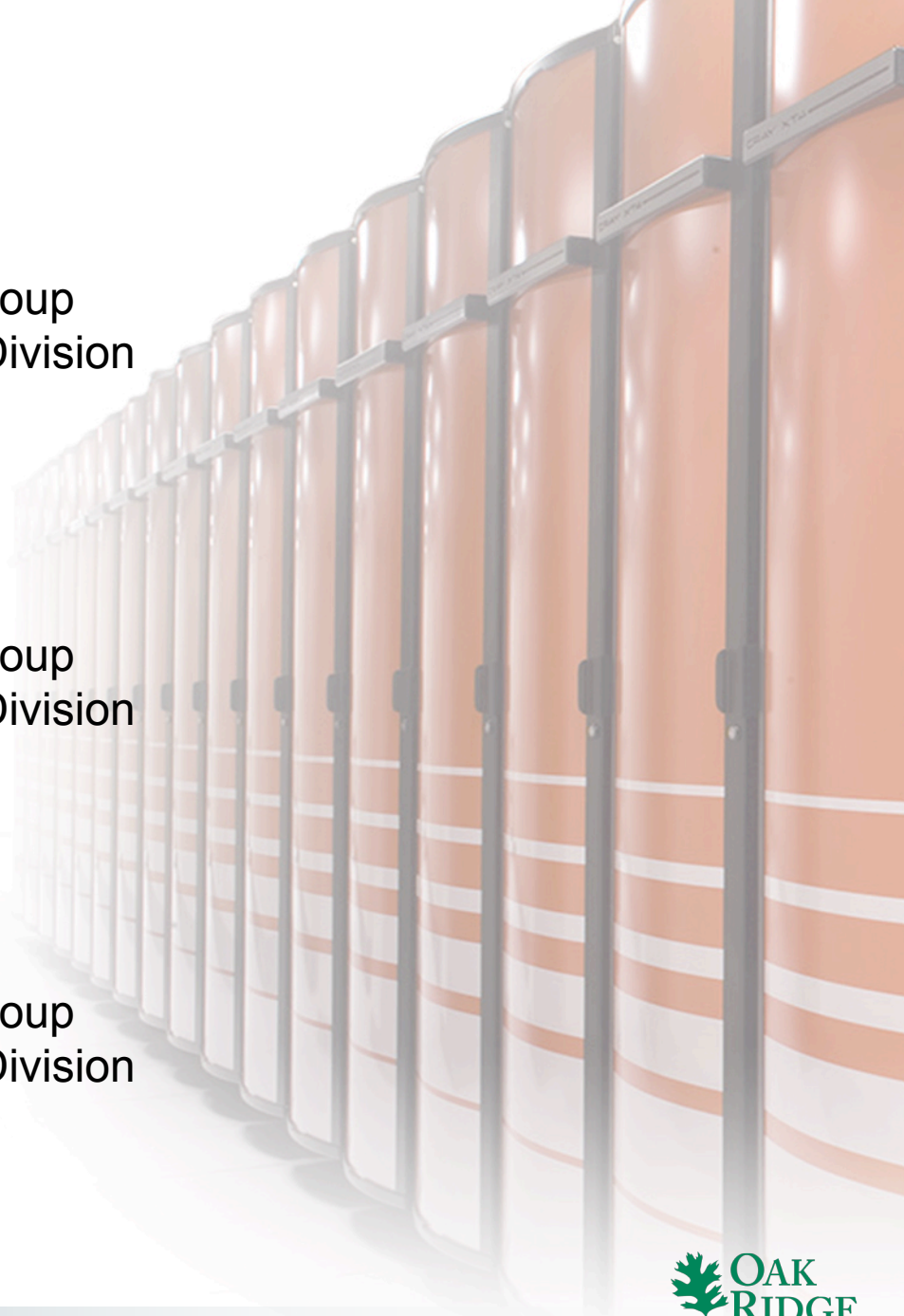

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