# Tsinghua @ TRECVID2007.search

Zhikun Wang, Dong Wang, Huiyi Wang, Tongchun Xiao,
Duanpeng Wang, Yingyu Liang, Yang Pang
Jianmin Li, Fuzong Lin, Bo Zhang

# Outline

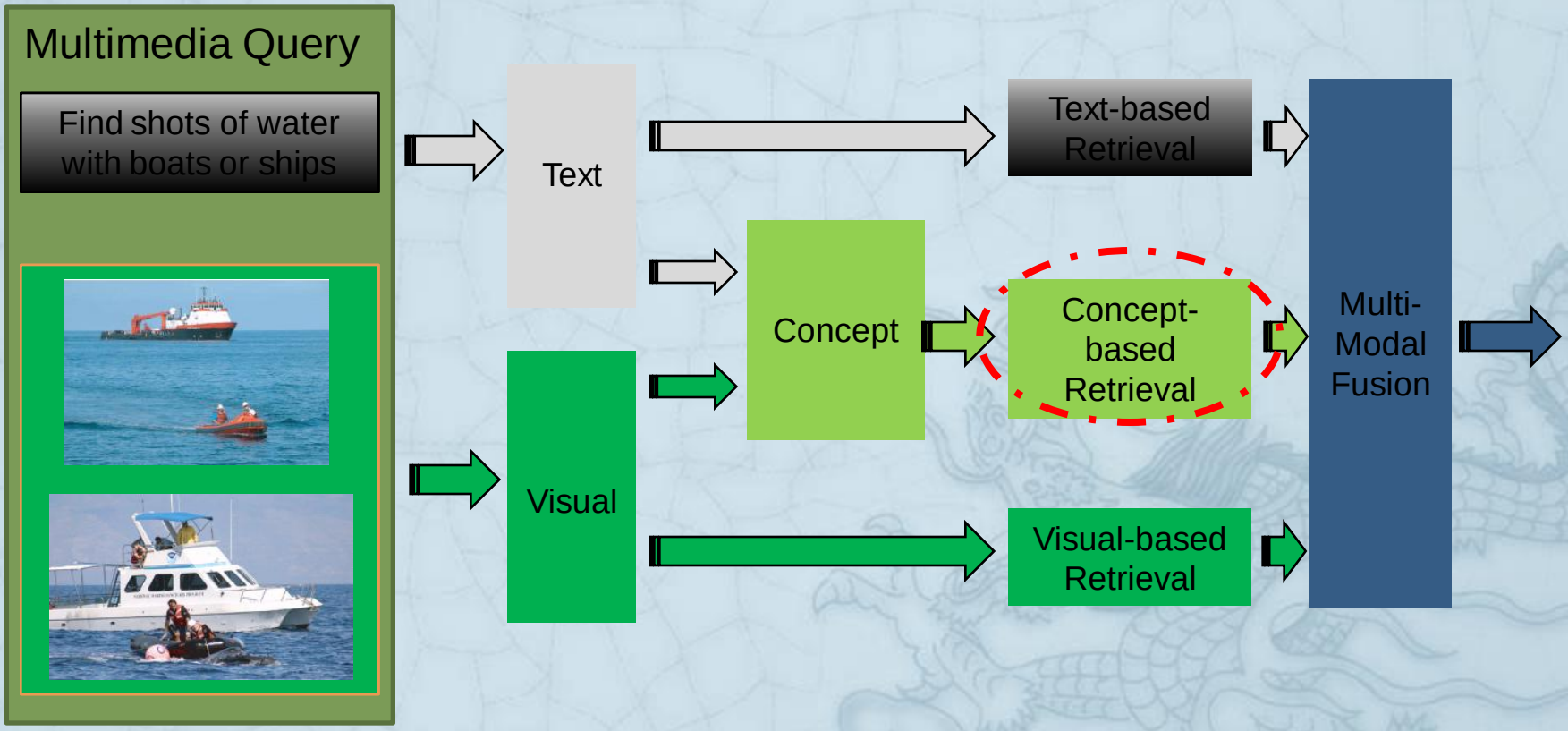
- System Overview
- Concept-Based Search
- Experiments & Results
- Conclusion

# Outline

- System Overview
- Concept-Based Search
- Experiments & Results
- Conclusion

# Automatic Search System

- Framework



# Automatic Search System

- Text-based search
  - Keywords: expanded by WordNet
  - Transcript segmentation:

    shot-level, story-level, video-level
  - Result expansion for shot-level search:

    scores spread along the timeline

# Automatic Search System

- Text-based search
- Visual-based search
  - Richer feature set
  - Feature selection & fixed-value fusion weight:

    MAP & consistency

    5 features involved
  - Several SVM classifiers for each feature
  - Weighted average multi-feature fusion

# Automatic Search System

- Text-based search
- Visual-based search
- Concept-based search
  - Query-concept mapping
    - Text-concept mapping
    - Example-concept mapping
  - More details come later.

# Automatic Search System

- Text-based search
- Visual-based search
- Concept-based search

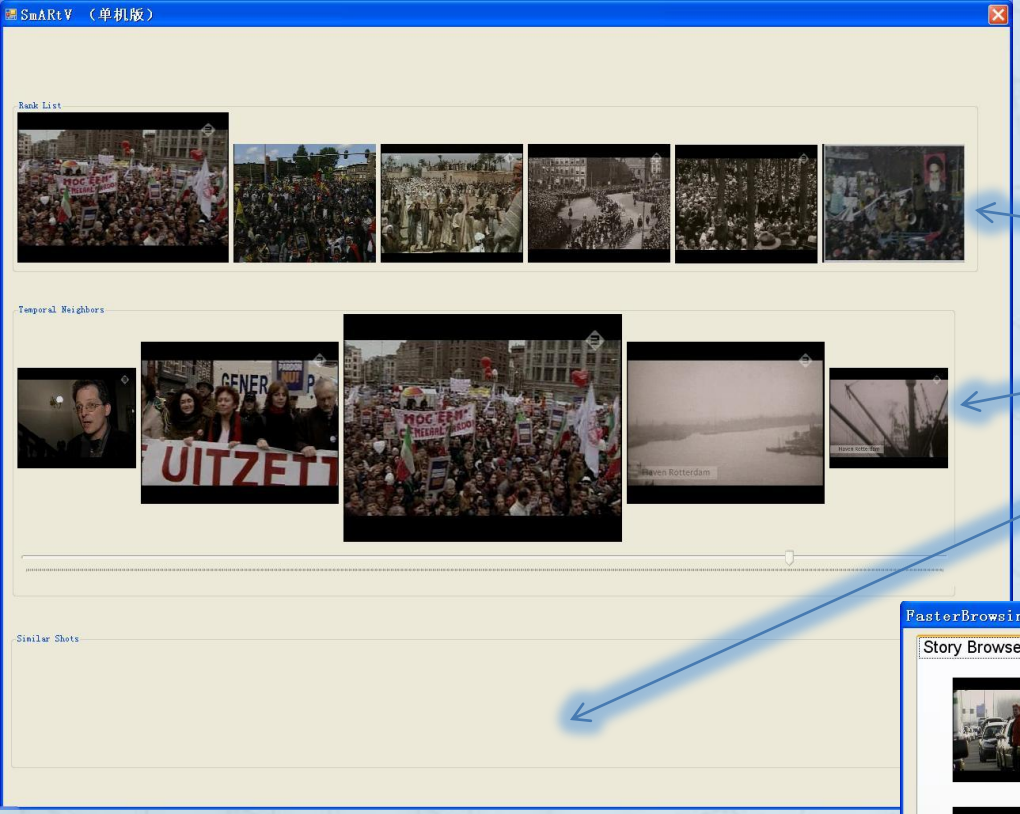
- Fusion
  - Weighted average
  - Query-independent

# Interactive Search System

- User interface
  - faster, faster and faster
  - Browsing functions
- Server end
  - Several options

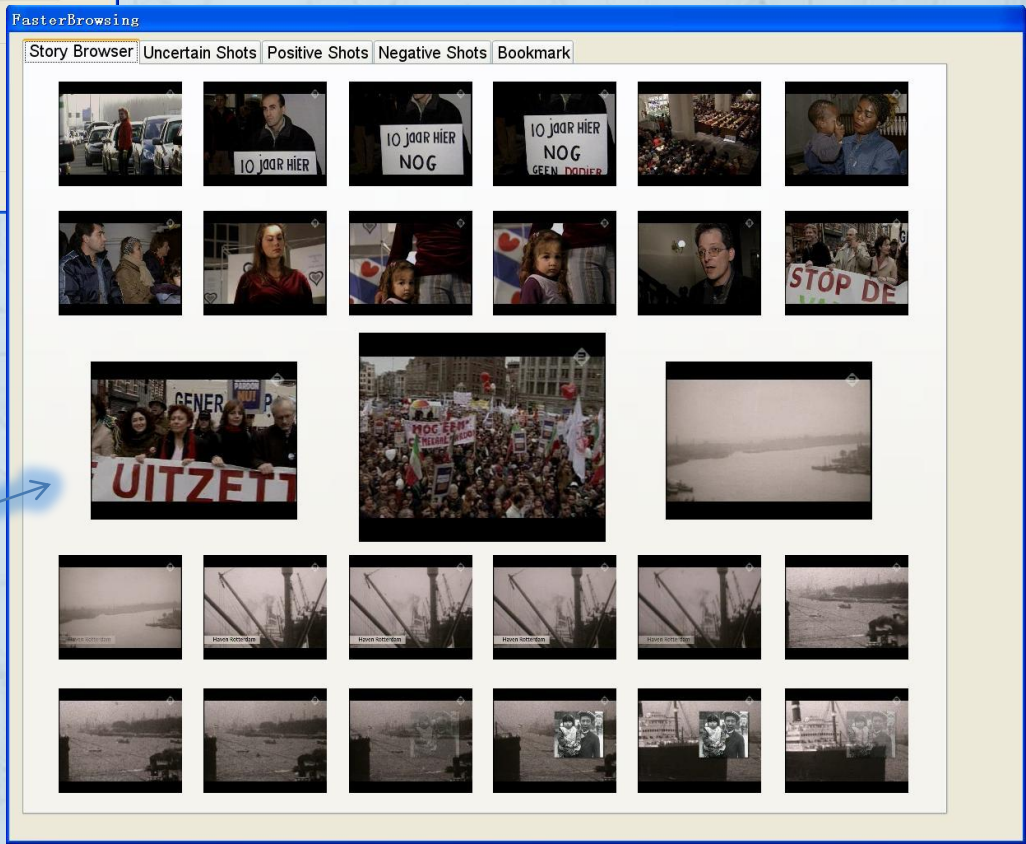
# Interactive Search System: UI

- Double-screen interface
- Multi-thread browsing
  - Temporal thread
  - Visual neighbor thread
- Frame-level browsing
- Browsing function
  - Forward, Backward, Bookmark
- Hotkey




# Browsing

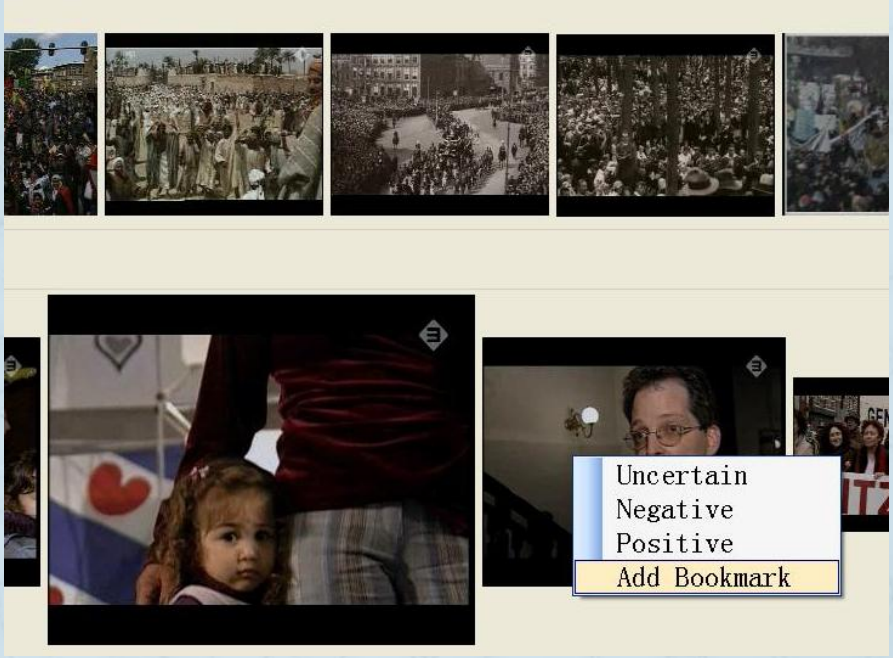
Rank list
Temporal thread
Visual neighbor thread

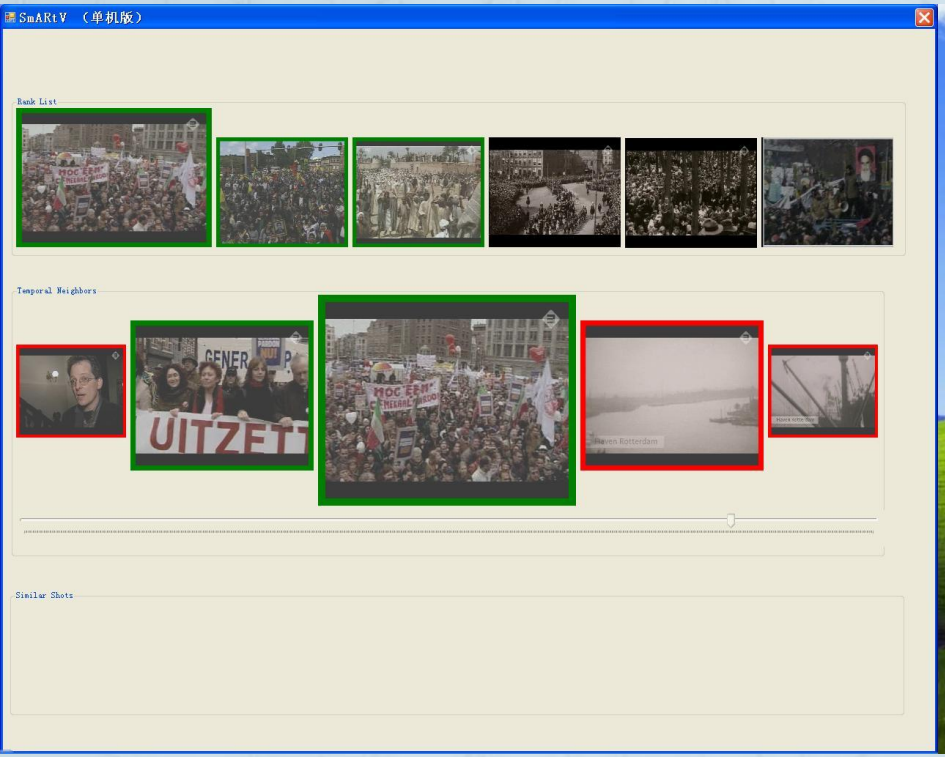


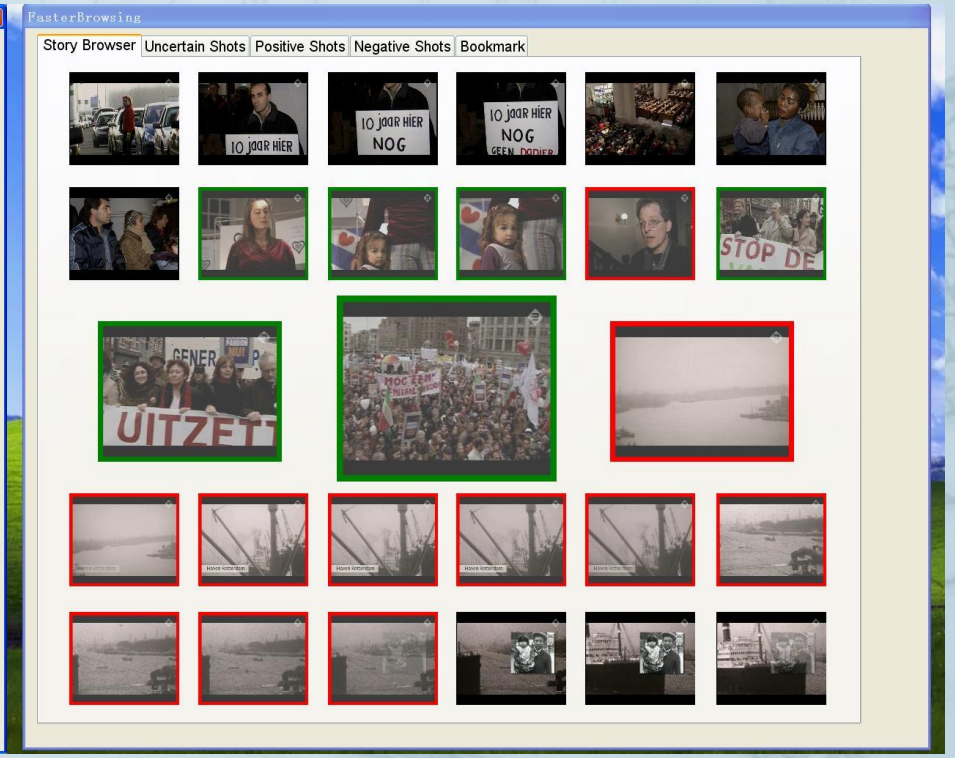

# Faster Browsing

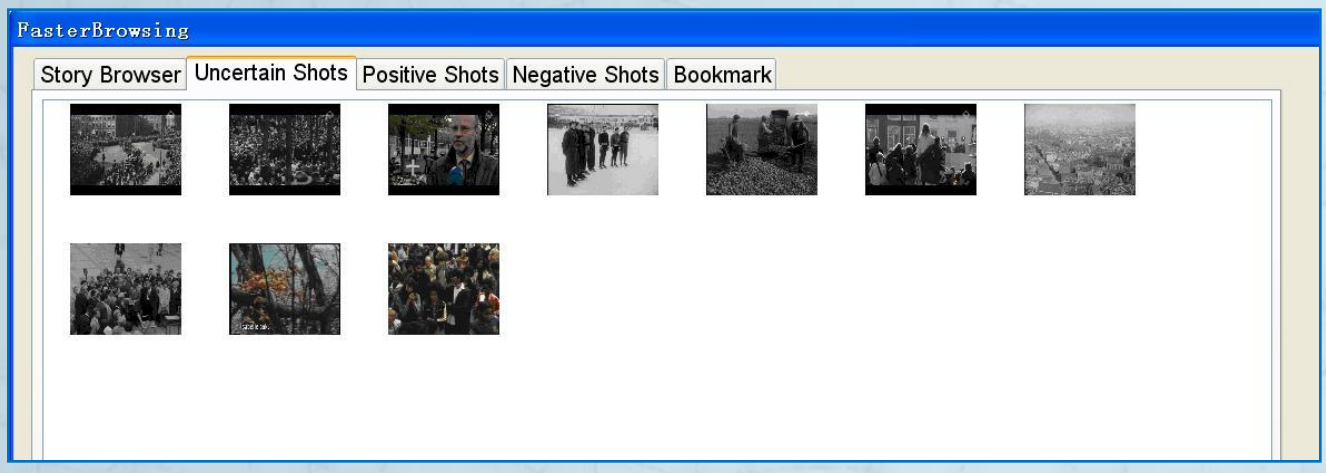
Story browser
Frame-level browsing

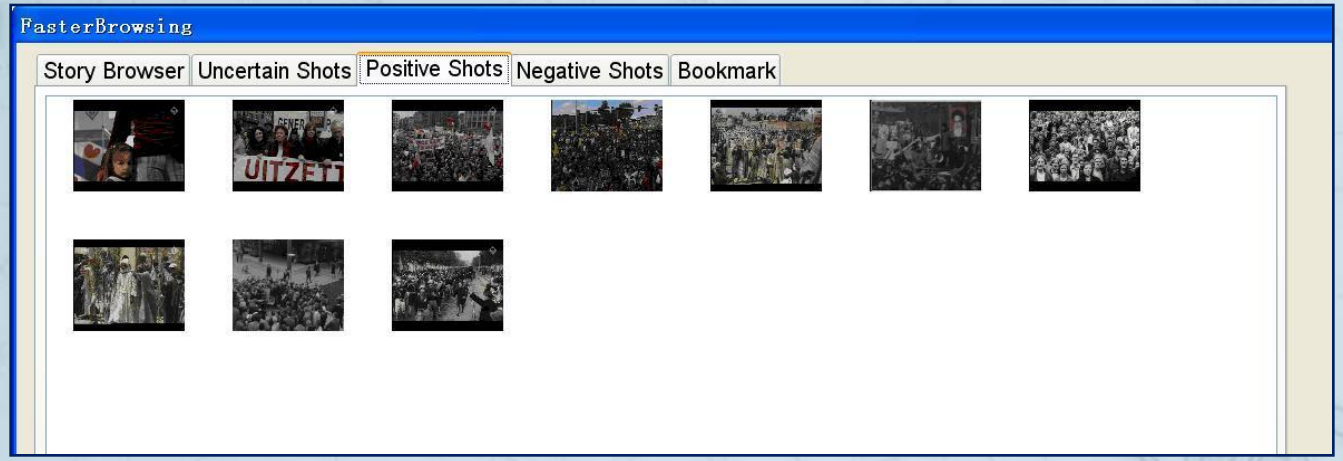
# Labeling:
## Hotkey & Mouse

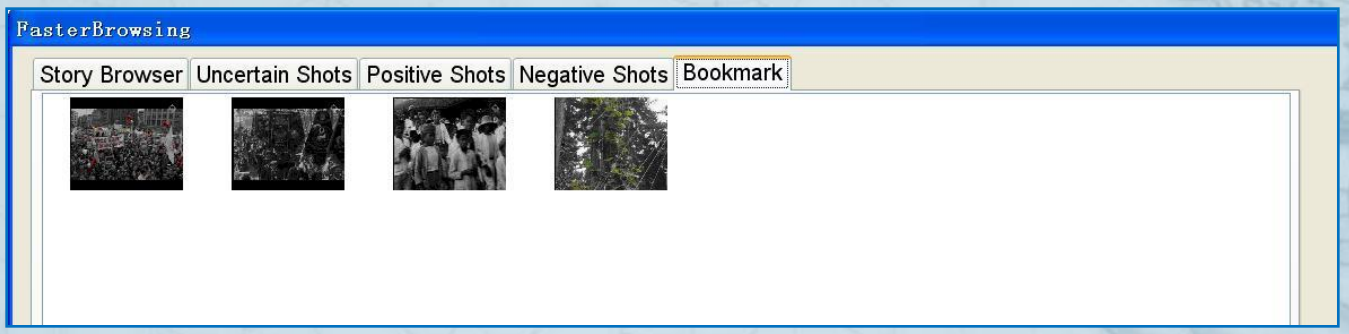





# Refining

Positive samples

Negative samples

Uncertain samples

# Bookmark

# Server end

- Distributed server end
- More options
  - 1 text-based server
  - 4 SVM models with different features
  - 2 concept-based servers
  - manually adjusted options Vs. default options

# Outline

- System Overview
- Concept-Based Search
- Experiments & Results
- Conclusion

# Concept-Based Search

- Well established approach
- Need theoretical guidance for practical issues
- Query-Concept Mapping (QUCOM)

**Example**

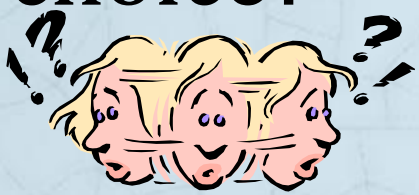
- tall building → Building, Cityscape, Conference_Building, ...
- scenes with snow → Snow

Query Image

Boat/Ship, Waterscape, …

# Possible Solutions for QUCOM

- User choice?



- Text Match

  ([Snoek, 2006], [Chang, 2006], etc)

  - Effective if well matched
  - Fails to consider
    - visual correlation
    - concept performance
    - concept distribution over the collection

- Concept Space

Search in Full Space

(e.g. SVM, KNN [Natsev, 2006], PMIWS [Zheng, 2006])

Search in ***Concept Subspace***

# Concept Selection via c-tf-idf Metric

**Concept Relevance Ranking**

**Definition in text area**

- tf: frequency of a term in a document → *term popularity*
- idf: inverse document frequency of a term → *term specificity*

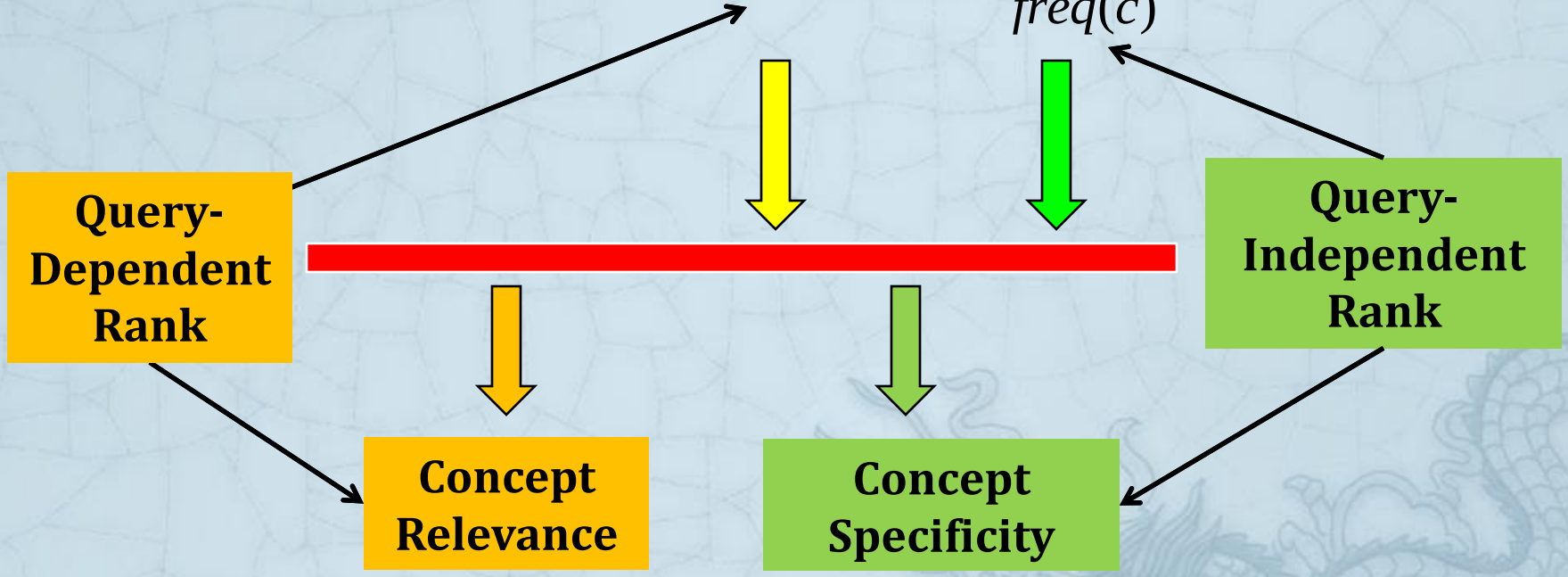
**c-tf-idf: tf-idf for concept**

c: concept, d: shot

$$c-tf-idf(c,d) := freq(c,d)\log(\frac{N}{freq(c)}) = P(c \mid d)\log(\frac{N}{freq(c)})$$

# Insight of the *tf-idf* based Principle

$$c-tf-idf(c,d) := freq(c,d)\log(\frac{N}{freq(c)})$$



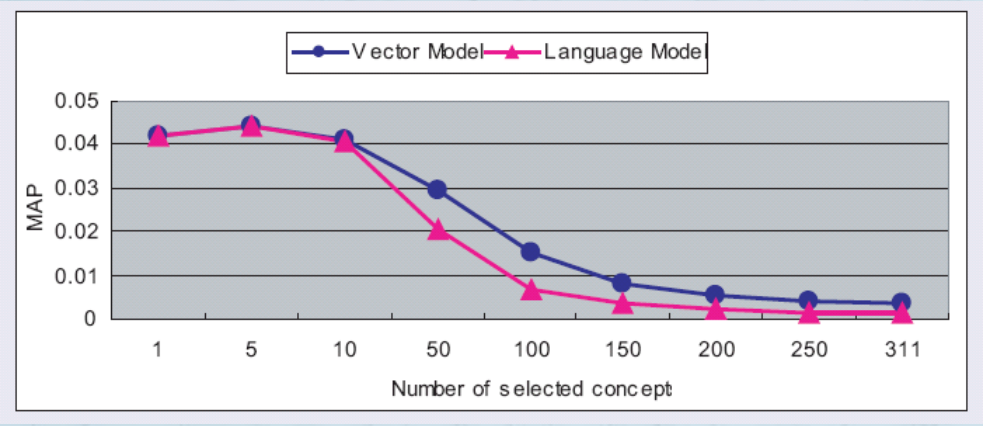

***c-tf-idf*** is a good combination of query-dependent ranks and query-independent ranks, and a promising solution for QUCOM.

# Two Settings for QUCOM

- Automatic video retrieval (AVR)
  - limited information as text input, and possibly, image examples
- Interactive video retrieval (IVR)
  - unrealistic to ask user provide relevant concepts
  - Infer the implicit semantic concepts by explicit user feedback
- QUCOM should be
  - On a per query analysis basis, on-the-fly,
  - Combat against varied concept detection performance
  - Scalable to
    - Concepts in a given lexicon
    - Video archive size

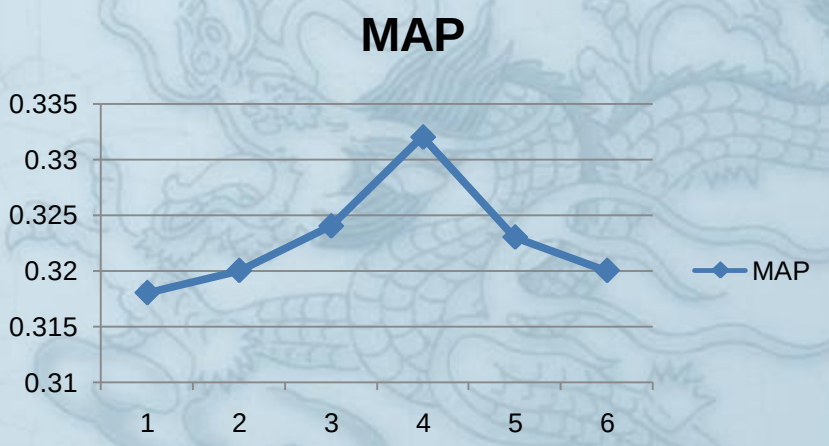
# Concept-Based Search: Search

- Search in concept subspace
- Impact of dimension of subspace




Experiment on TRECVID 2006, automatic search

Experiment on TRECVID 2006, interactive search

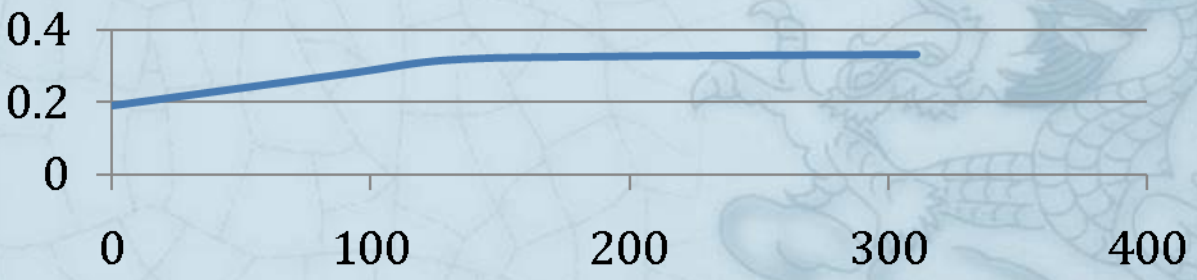


# Inferring implicit concepts through explicit feedback: Interactive Search

- Interactive Search
  - Using relevance feedback as examples
  - Higher efficiency: Vs. user-provided examples
    - Pre-computed offline
  - Lower user labor: Vs. manual concept selection
  - Better performance: Vs. previous system
    - 65% improvement upon previous method (without using concepts)
    - experiment on TRECVID 2006, interactive search

# Concept-Based Search: Lexicons

- LSCOM-lite
  - 39 concept detectors from HLF task
- LSCOM
  - 374 concepts chosen from LSCOM
- Impact of quality & quantity?
  - Experiment on TRECVID 2006, interactive search

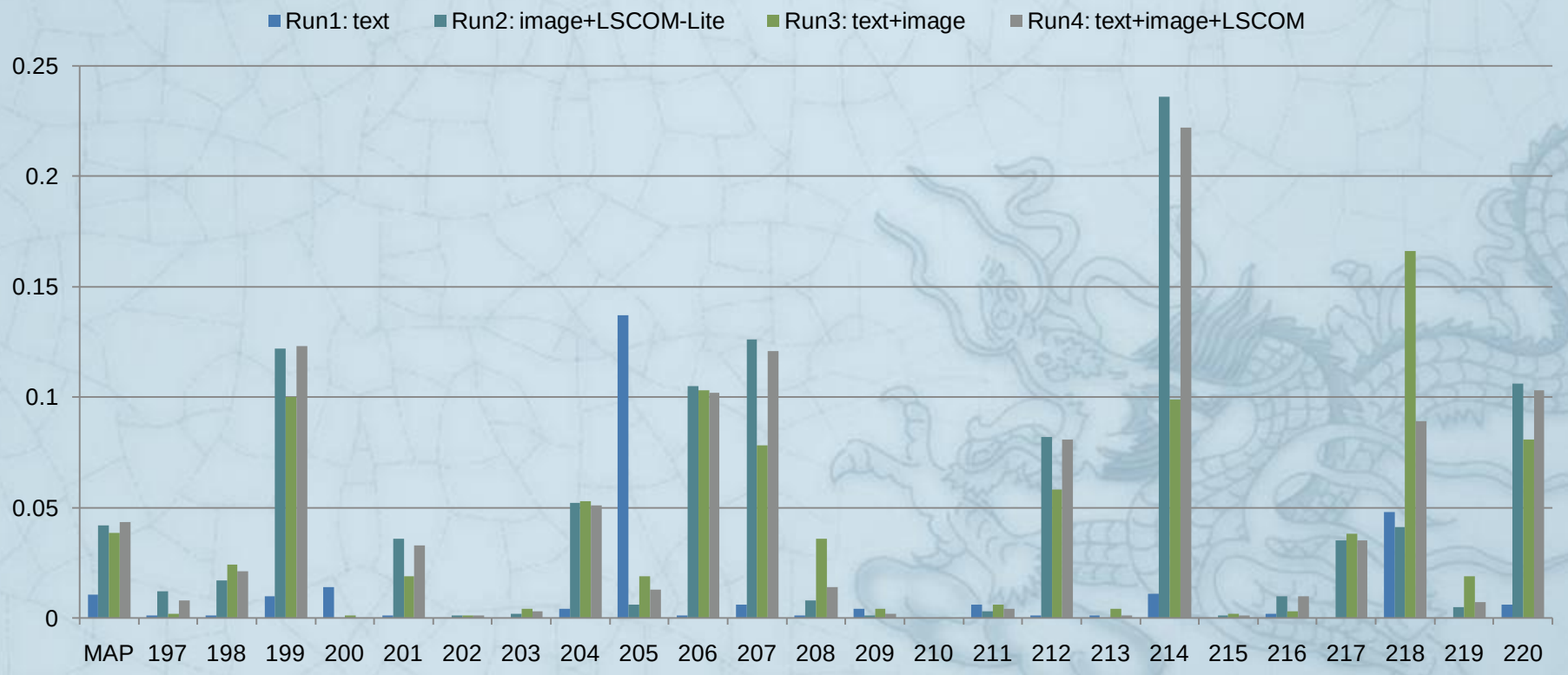


# Outline

- System Overview
- Concept-Based Search
- Experiments & Results
- Conclusion

# Automatic runs

- Run1:text :0.011
- Run2:image + LSCOM-Lite :0.042
- Run3:text+image :0.038
- Run4:text+image+LSCOM :0.043

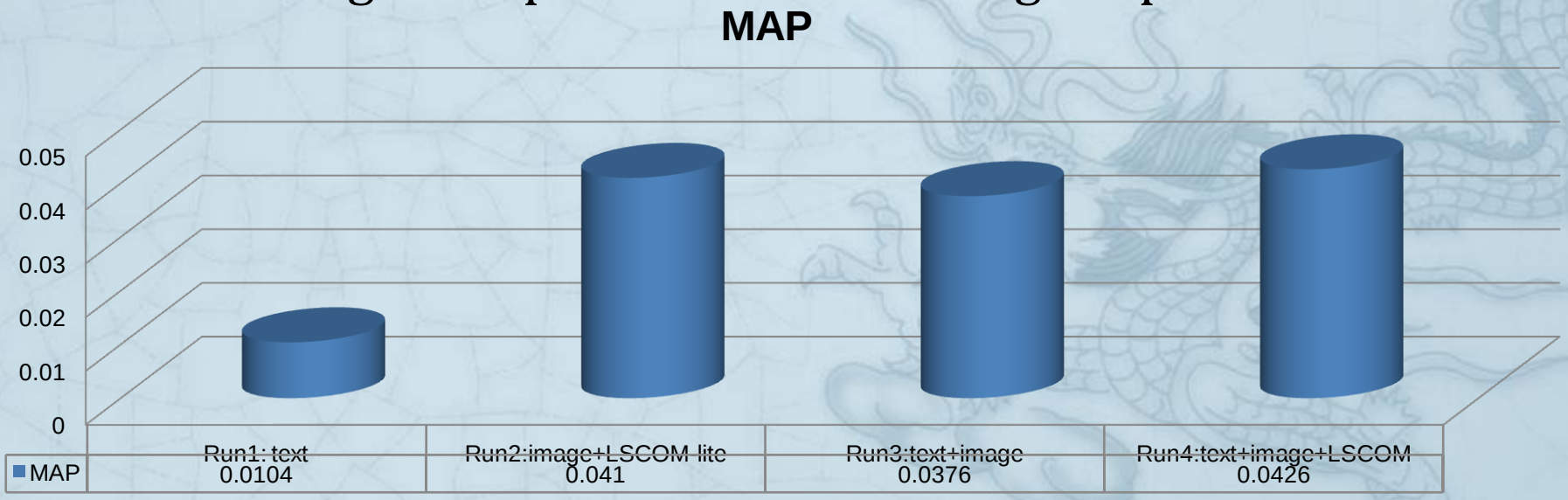


# Run1

- Text-based search
  - Helpful to topics about Object
  - Useless to topics about Event or Scene
  - Unsatisfactory upon non-news video

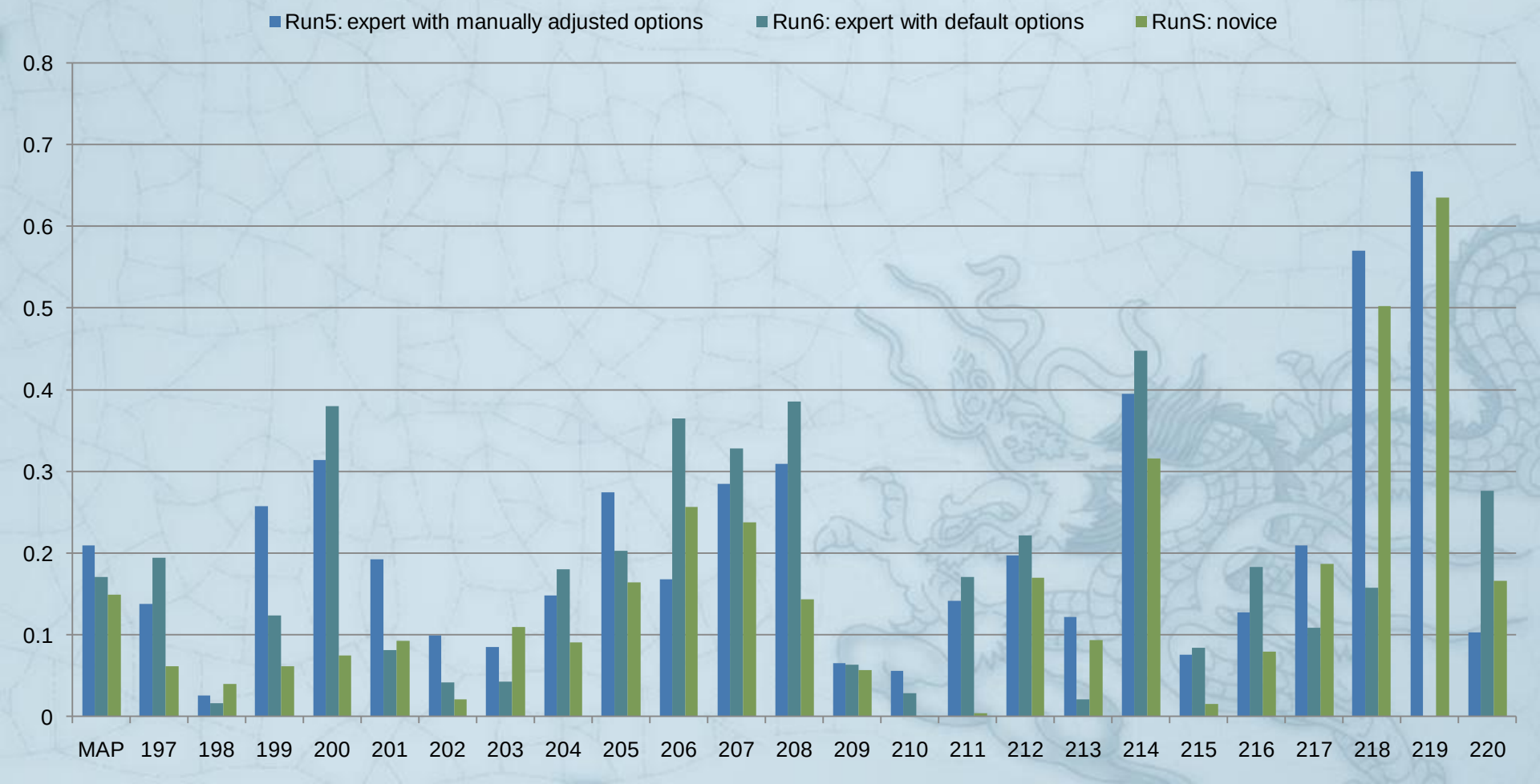
# Run2, Run3, Run4

- Run2 Vs. Run 4
  - Concept detectors from LSCOM(except 39 concepts from HLF) are trained upon different dataset.
- Run2 Vs. Run3
  - Involving concept-based search brings improvement.

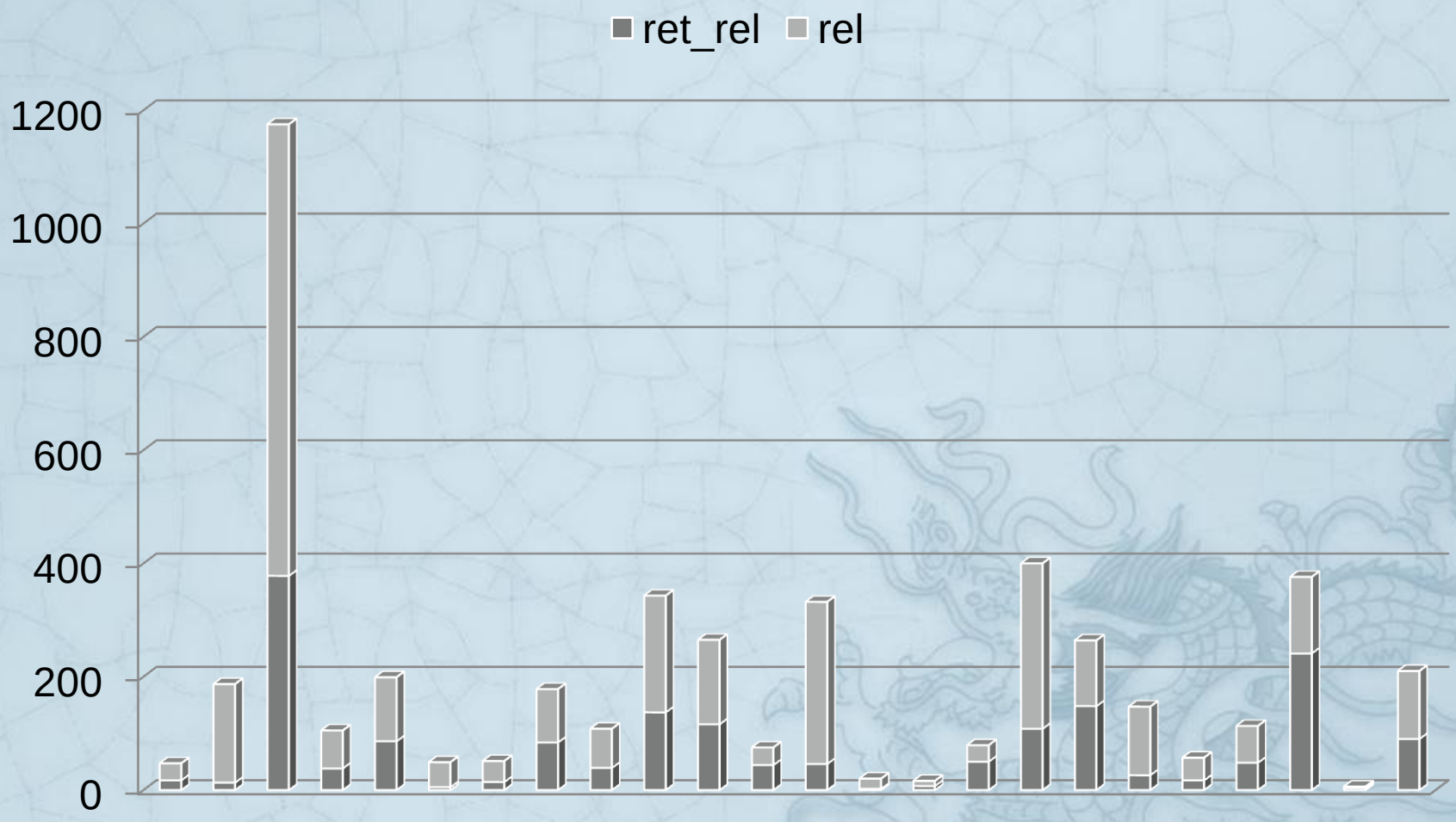


# Interactive runs

- Run5: expert with manually adjusted options :0.209
- Run6: expert with default options :0.171
- RunS: novice with default options :0.149



# Relevant results retrieved



# Outline

- System Overview
- Concept-Based Search
- Experiments & Results
- Conclusion

# Conclusion

- Concept-based search is fruitful and complement to text and visual search
- A easy-to-use UI is essential to interactive search
- User can make-up the drop in automatic