



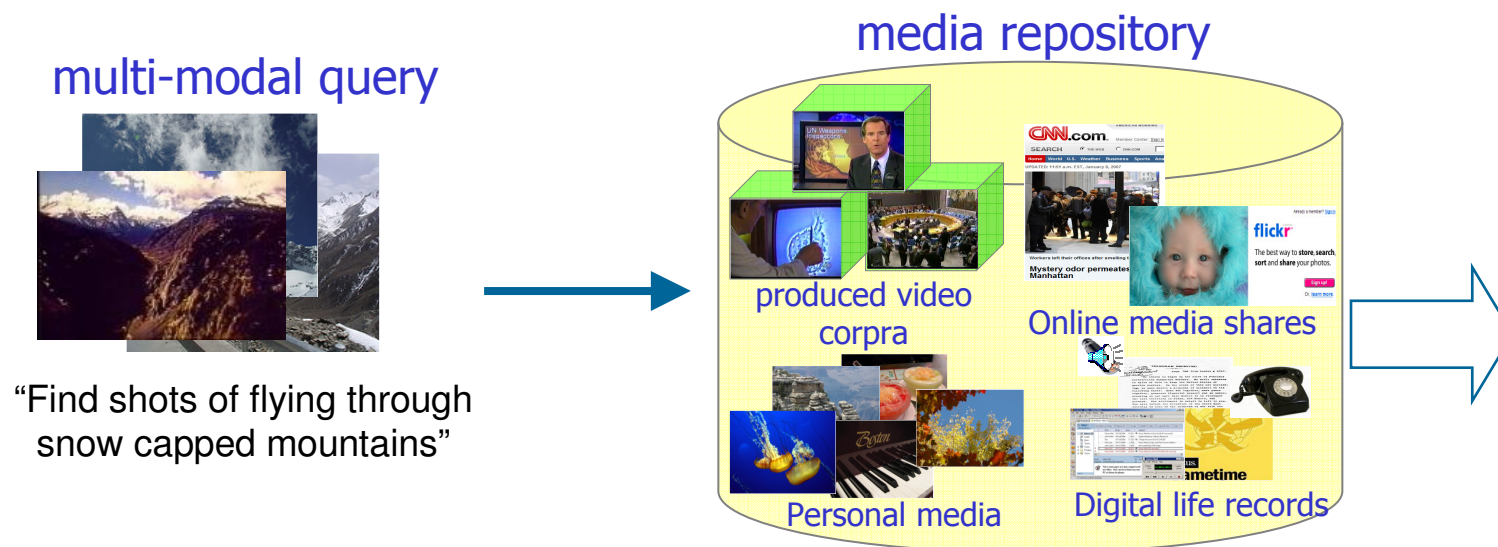
Dynamic Multimodal Fusion in Video Search

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IBM T. J. Watson Research Center

July 5th, ICME 2007, Beijing

The Multimedia Search Problem



- Wide impact
 - consumer, media, enterprise, web, science ...
- Multiple Tipping Points:
 - Multimedia semantics learning,
 - Multimedia ontology,
 - Systematic benchmark and evaluations

The Challenge of Choices in Multimodal Search

queries
retrieval experts



Find shots of Condoleezza Rice



Find shots of soccer game with goalpost visible



Find scenes of snow capped mountains

Text

...which he was accompanied by his wife are trying to light and Foreign Minister who resigned as successor **Condoleezza Rice**, Bush was greeted at the airport Governor-General of

?

??

??

Image similarity

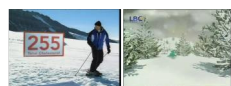


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Semantic concepts



??

??

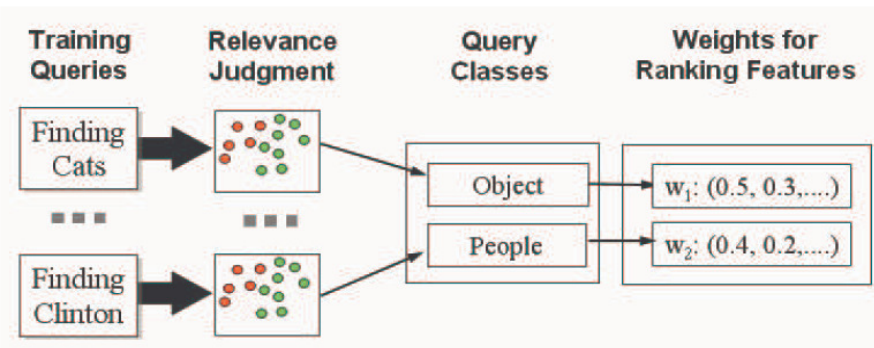
?

Outline

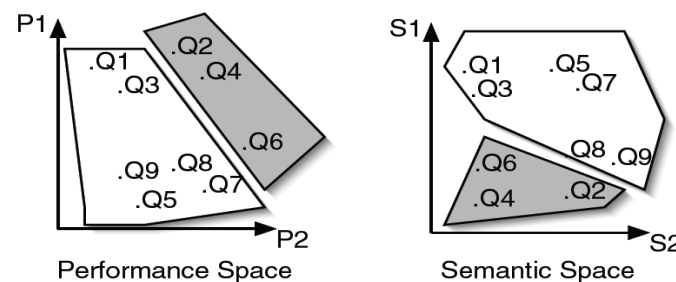
- The problem
- Dynamic multimodal fusion
 - Query feature extraction
 - Query matching
- Experiments and evaluation
- Conclusion

Prior Work on Query Dependent Fusion

- Query-classes: manually defined
 - [Chua et. al., NUS]
 - [Yan et. al., CMU]

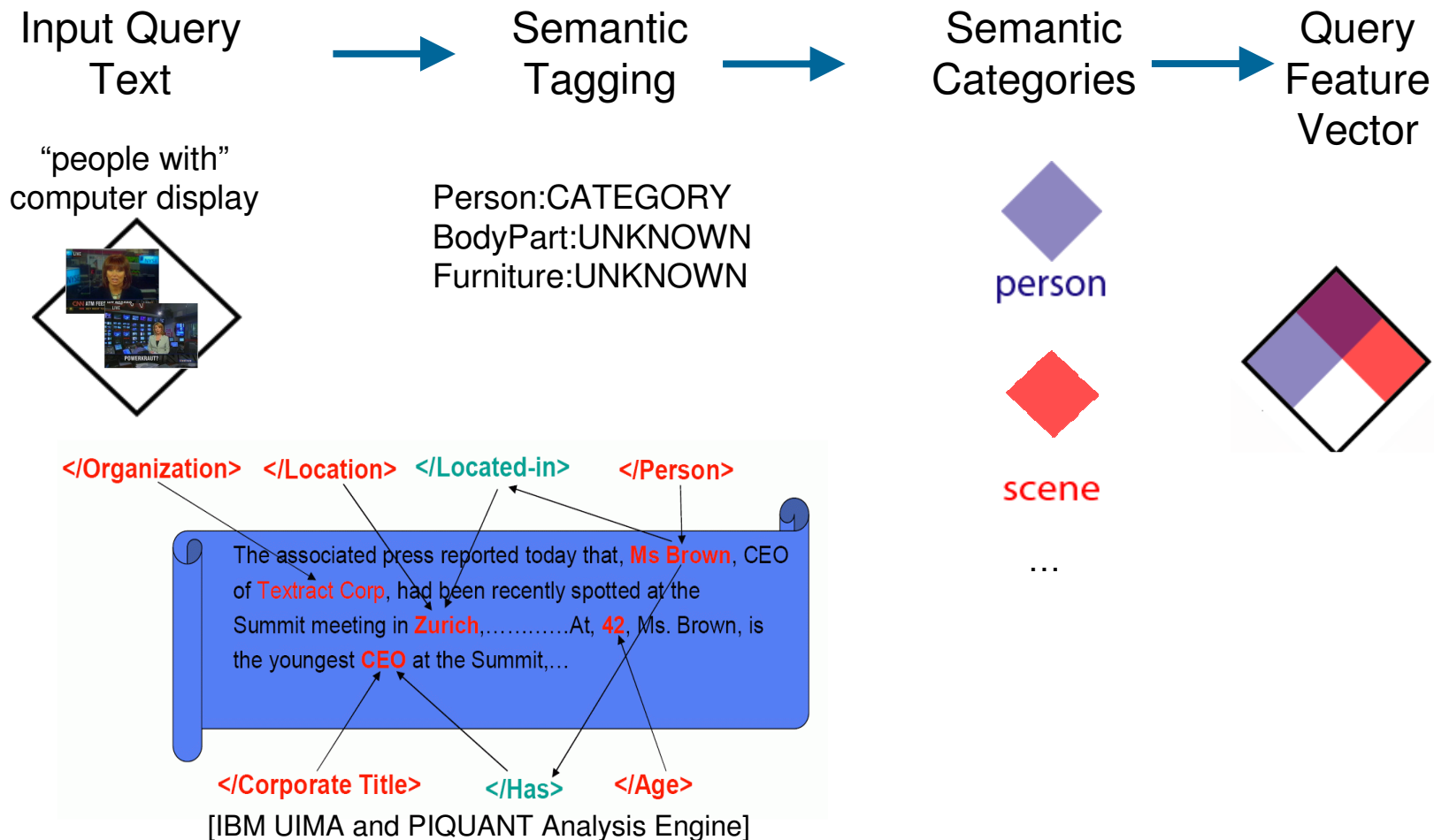


- Joint clustering of queries in feature + performance space [Kennedy et. al.]

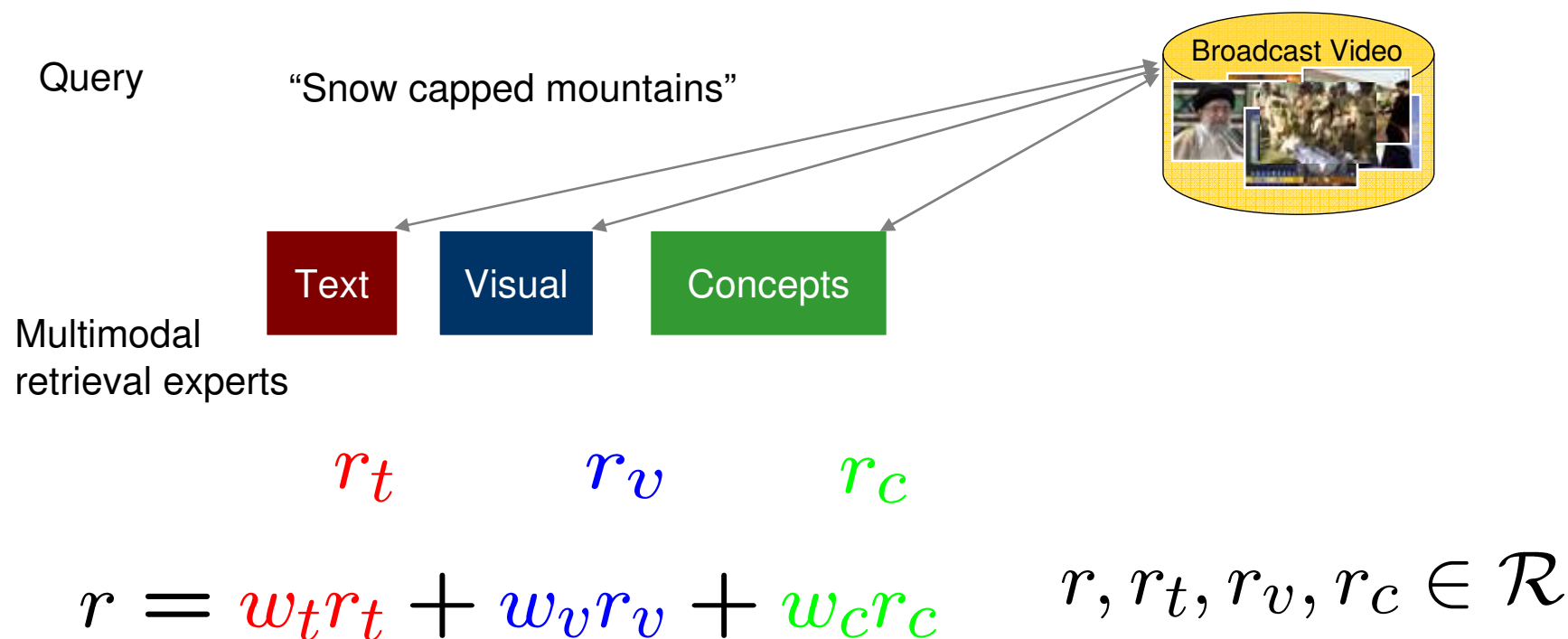


- Our approach
 - Can we fuse without pre-defined “query classes” or “query clusters”?
 - Deep text analysis for query features and query matching

Extract Semantic Query Features



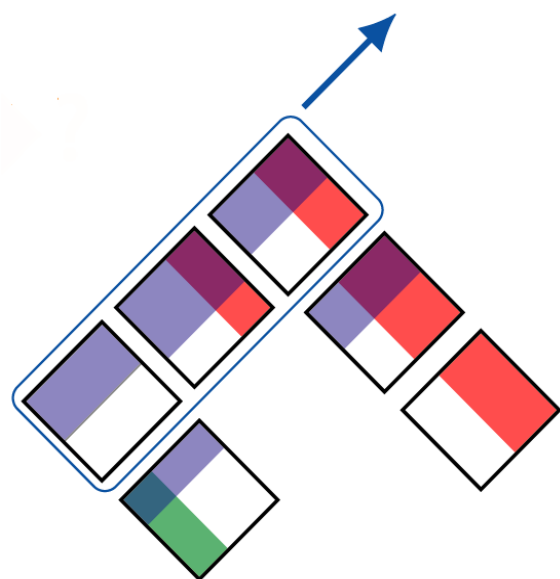
Weighted linear fusion



Three Query-dependent Fusion Strategies

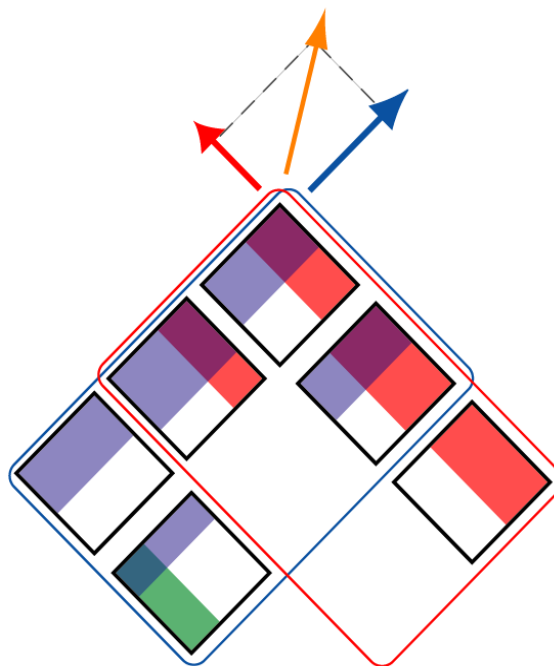


Qclass

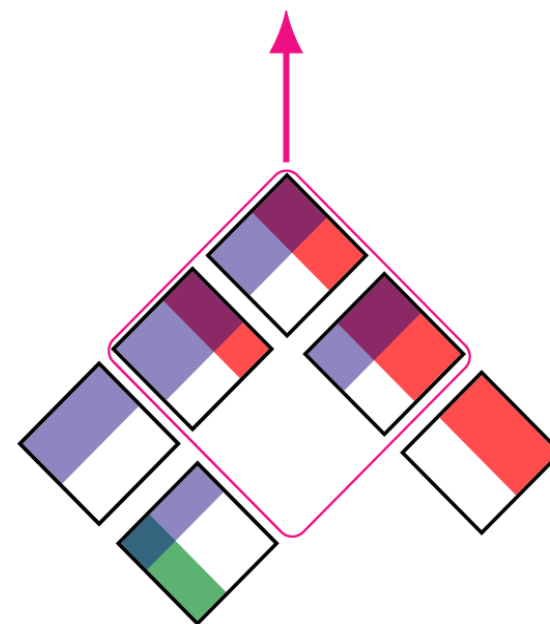


training queries

Qcomp



Qdyn



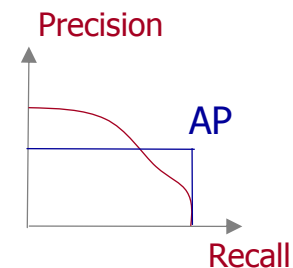
Experimental setup

- TRECVID benchmark corpora
 - Multi-lingual news from 6 channels
 - Training/test split:
 - 2005 24 queries, 110 hours
 - 2006 24 queries, 160 hours
- Measure AP (average precision) on each query

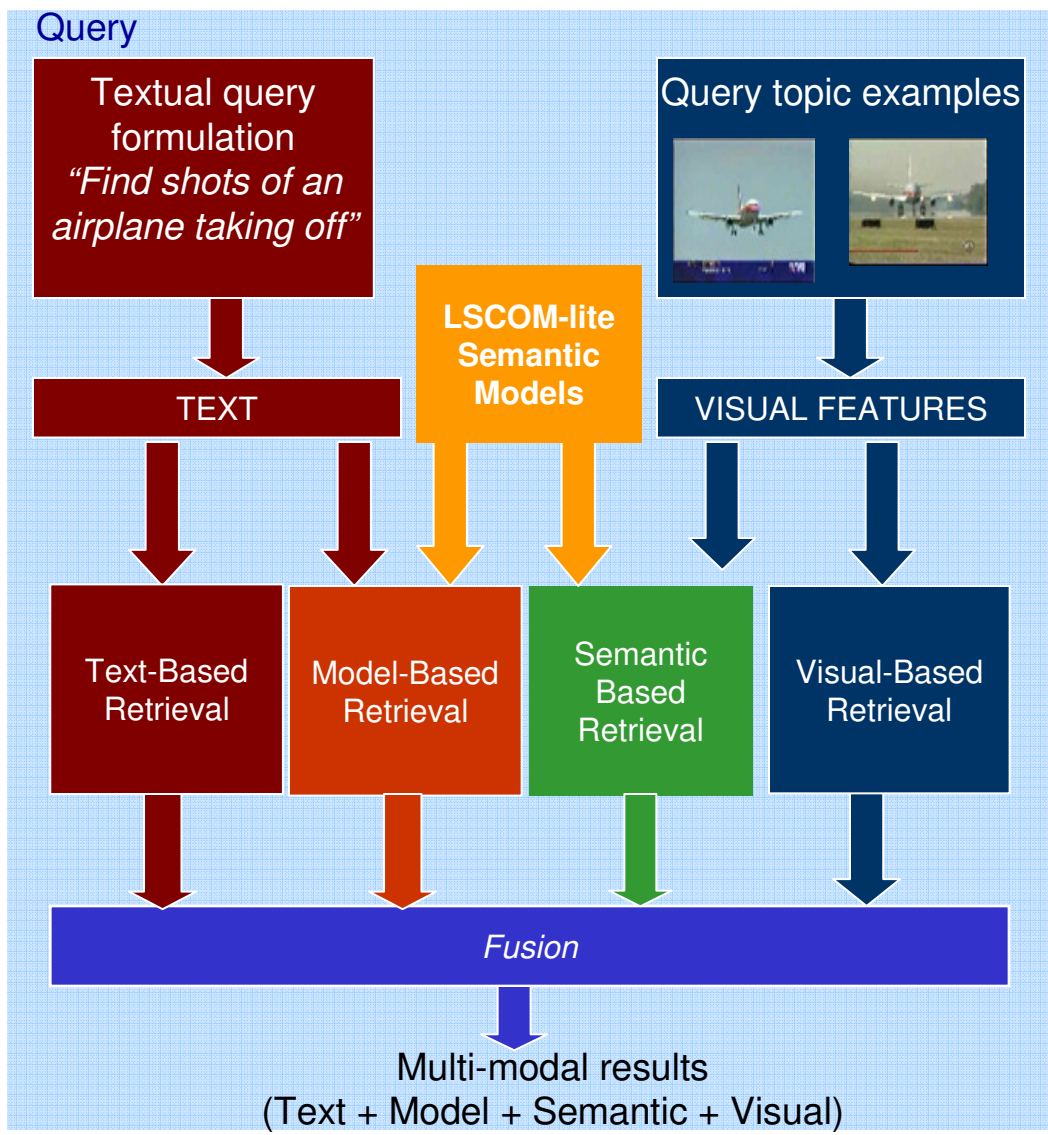
news videos



Average precision



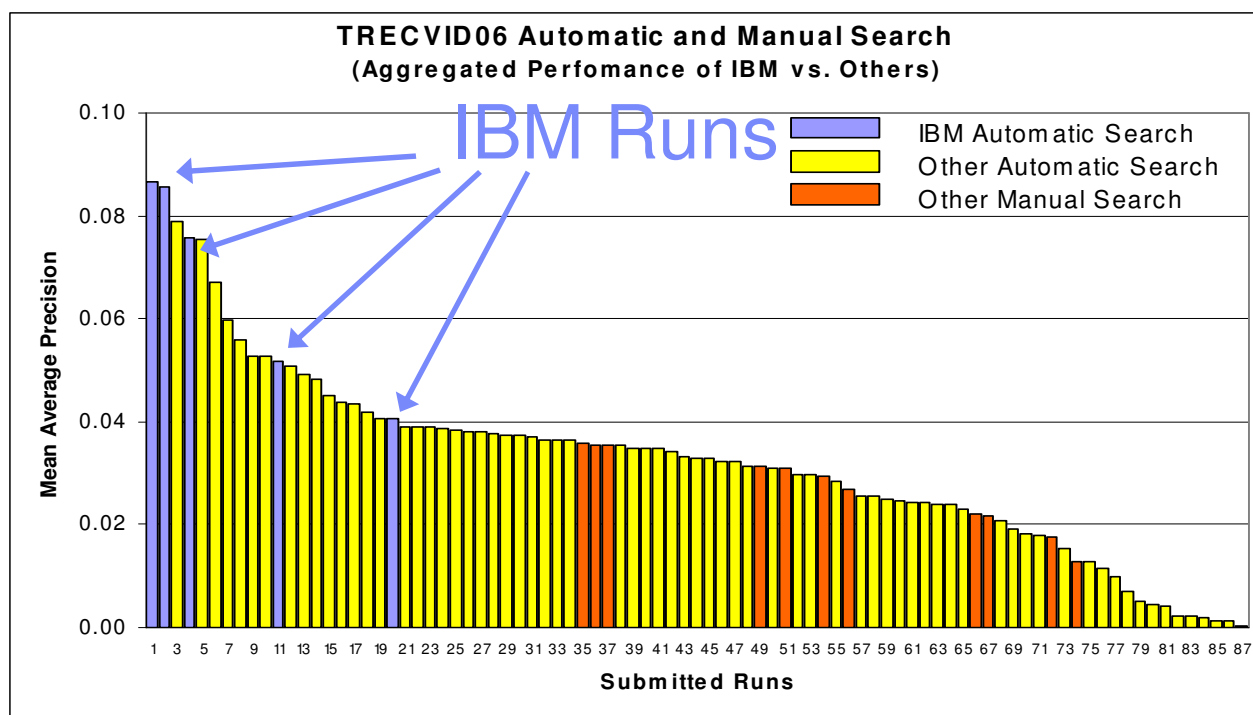
IBM Multimedia Search System Overview



Approaches:

1. Text-based: story-based retrieval with automatic query refinement/re-ranking
2. Model-based: automatic query-to-model mapping based on query topic text
3. Semantic-based: cluster-based semantic space modeling and data selection
4. Visual-based: light-weight learning

Automatic/Manual Search Overall Performance (Mean AP)



IBM Official Runs:

Text (baseline): **0.041**

Text (story-based): **0.052**

Multimodal Fusion:

Query independent: **0.076**

Query classes (soft): **0.086**

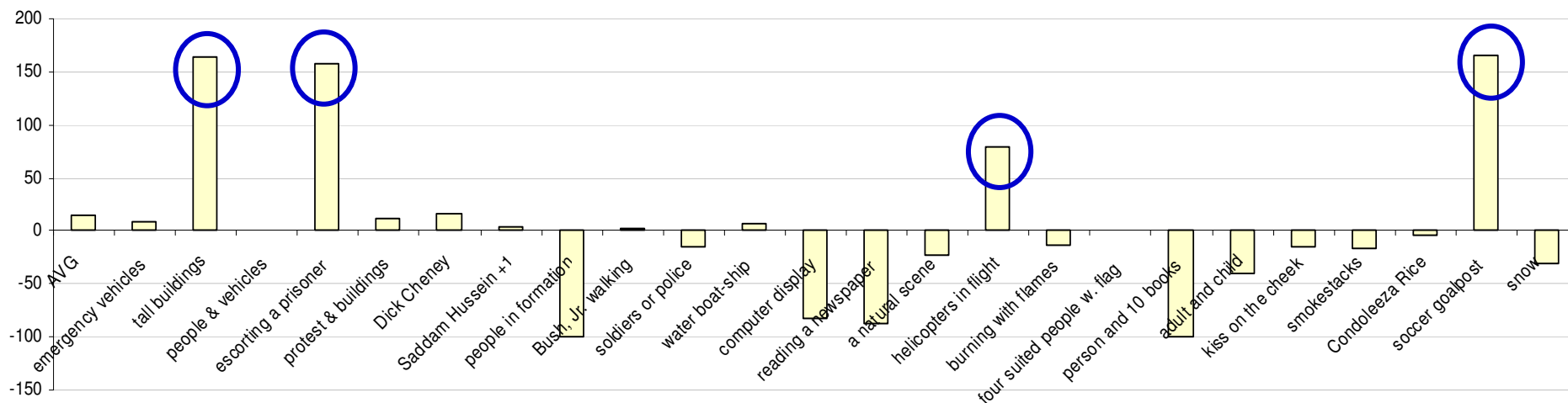
Query classes (hard): **0.087**

- Multi-modal fusion doubles baseline performance.
- Text-based query matching has the best performance among TRECVID runs
- Improves upon query-independent fusion by 14%

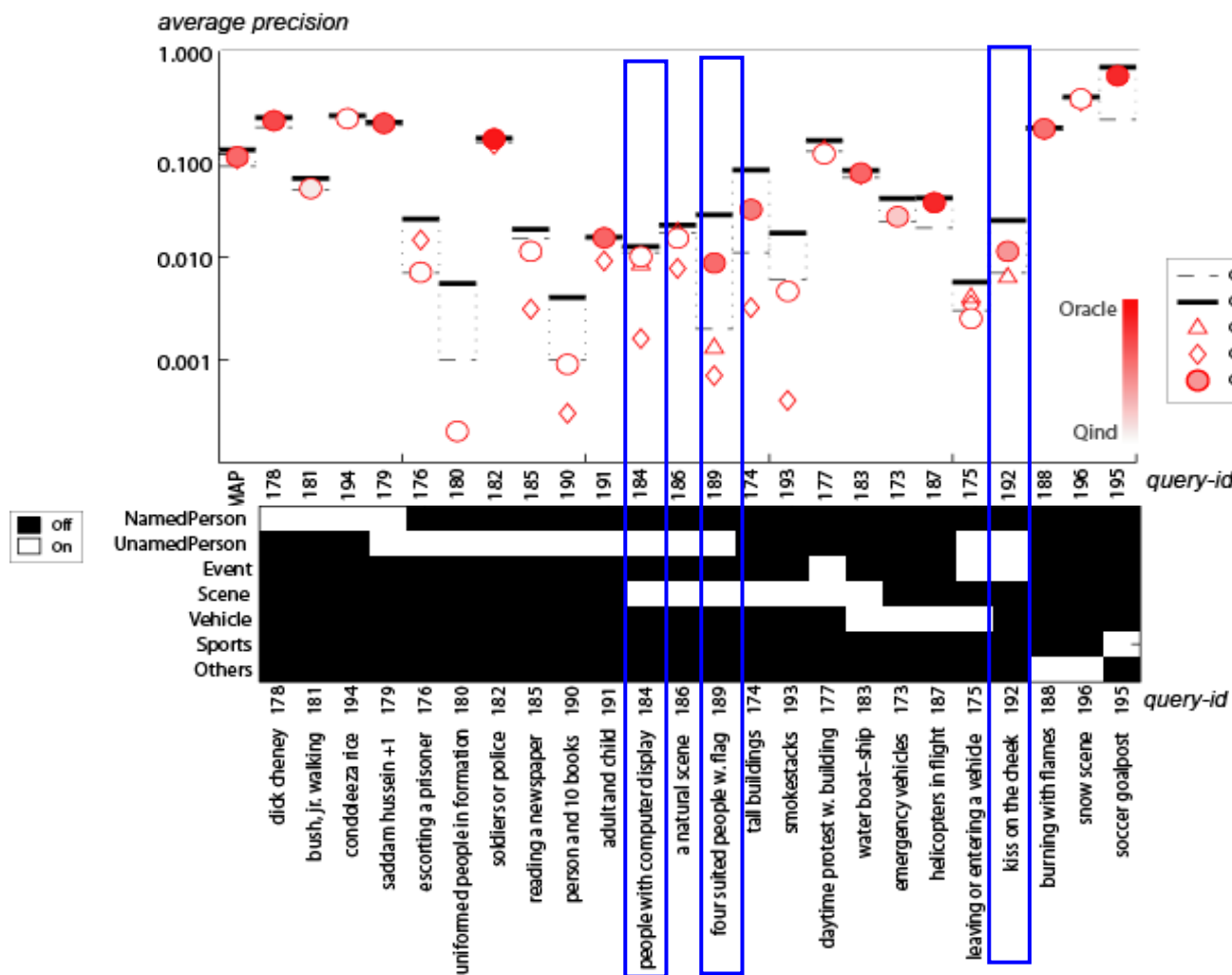
Query-dependent Fusion Breakdown

- Observation:
 - Concept-related queries improved the most:
“tall building”, “prisoner”, “helicopters in flight”, “soccer”
 - Named-entity queries improved slightly:
“Dick Cheney”, “Saddam Hussein”, “Bush Jr.”
 - Generic people category deteriorated the most:
“people in formation”, “at computer display”, “w/ newspaper”, “w/ books”

Relative improvement (%): Qcomp vs. Qind



Dynamic Query Fusion Results



- Qdyn further improves MAP of Qclass by 8%, to 0.094
- The improvement is mainly in generic people queries → where Qclass failed previously

Demo: multimodal interactive search

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Multimedia Analysis and Retrieval System

Welcome to the IBM Research Multimedia Analysis and Retrieval System External Site

Search Engine System	Video Data Set	Overview
IBM Multimedia Analysis and Retrieval System (2006)	TRECVID 2005 Videos	
IBM Multimedia Analysis and Retrieval System (2006)	BBC Rushes 2005 Videos	

IBM Multimedia Analysis and Retrieval System
 Contact: John R. Smith, IBM T. J. Watson Research Center

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Group by: Shots (ungrouped) Combination: None Aggregation: Avg Similarity: Color (spatial) Page 1

Search Clear

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Group by: Shots (ungrouped) Combination: None Aggregation: Avg Similarity: Color (spatial) Page 1

soccer worldcup Search Clear Query terms (add all): [soccer](#) | [worldcup](#)

Refine with: [FACE](#) | [ANIMAL](#) | [MILITARY](#) | [OFFICE](#) | [SNOW](#)

Filter by VIDEOS: [TRECVID2005 28 \(26\)](#) | [TRECVID2005 48 \(10\)](#) | [TRECVID2005 13 \(7\)](#) | [TRECVID2005 97 \(4\)](#) | [TRECVID2005 140 \(3\)](#)

 <p>32459. [More like this]</p> <p>China's National Football Team in World Cup soccer qualifying competition being eliminated after Chinese officials that they should all the blame to coach Arica artists body but also confirmed that officials in the...</p>	 <p>32458. [More like this]</p> <p>China's National Football Team in World Cup soccer qualifying competition being eliminated after Chinese officials that they should all the blame to coach Arica artists body but also confirmed that officials in the...</p>	 <p>32457. [More like this]</p> <p>China's National Football Team in World Cup soccer qualifying competition being eliminated after Chinese officials that they should all the blame to coach Arica artists body but also confirmed that officials in the...</p>	 <p>32460. [More like this]</p> <p>China's National Football Team in World Cup soccer qualifying competition being eliminated after Chinese officials that they should all the blame to coach Arica artists body but also confirmed that officials in the...</p>	 <p>[0.979] [More like this]</p> <p>China's national soccer team to the World Cup soccer qualifying competition regret that... ...Football Team in World Cup soccer qualifying competition being eliminated after Chinese officials that they should all the blame to coach...</p>	 <p>[0.979] [More like this]</p> <p>China's national soccer team to the World Cup soccer qualifying competition regret that... ...Football Team in World Cup soccer qualifying competition being eliminated after Chinese officials that they should all the blame to coach...</p>
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soccer worldcup LIKE@32458 LIKE@32459 concepts@s

Concepts@Sky
Concepts@Snow
Concepts@Sports
Concepts@Studio

VID2005 97 (4) | TRECVID2005 140 (3)

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soccer worldcup LIKE@32458 LIKE@32459 Concepts@Sports Search Clear

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Displaying 50 Images in 24 Group(s) (Collapse all, Expand all)



Group 1 [0.750]: Videos@TRECVID2005_29 (2 items)

 [0.772] [More like this](#)  [0.728] [More like this](#)







Group 2 [0.723]: Videos@TRECVID2005_97 (4 items)

 [0.755] [More like this](#)  [0.732] [More like this](#)  [0.721] [More like this](#)  [0.684] [More like this](#)

Group 3 [0.660]: Videos@TRECVID2005_140 (2 items)

 [0.674] [More like this](#)  [0.646] [More like this](#)

Group 4 [0.593]: Videos@TRECVID2005_28 (18 items)

Conclusion

- Presented a solution to query-dependent multimodal fusion problem for video search
 - Query features based on deep semantic parsing
 - Dynamic query matching
 - Improvement on TRECVID queries
- Future work
 - More retrieval modality, more diverse queries

Thank You

For more information:

- IBM Multimedia Retrieval Demo
<http://mp7.watson.ibm.com/>
- “Data modeling strategies for imbalanced learning in video search”, J. Tesic, A. Natsev, L. Xie, J. Smith, ICME’07 → next poster session
- “Semantic Concept-Based Query Expansion and Re-ranking for Multimedia Retrieval: A Comparative Review and New Approaches”, A. P. Natsev, A. Haubold, J Tesic, L. Xie, R. Yan, ACM Multimedia 2007, to appear