ARDA
Video Analysis
Content Extraction

Columbia University Video Search System

http://www.ee.columbia.edu/cuvidsearch

Columbia University
in the City of New York

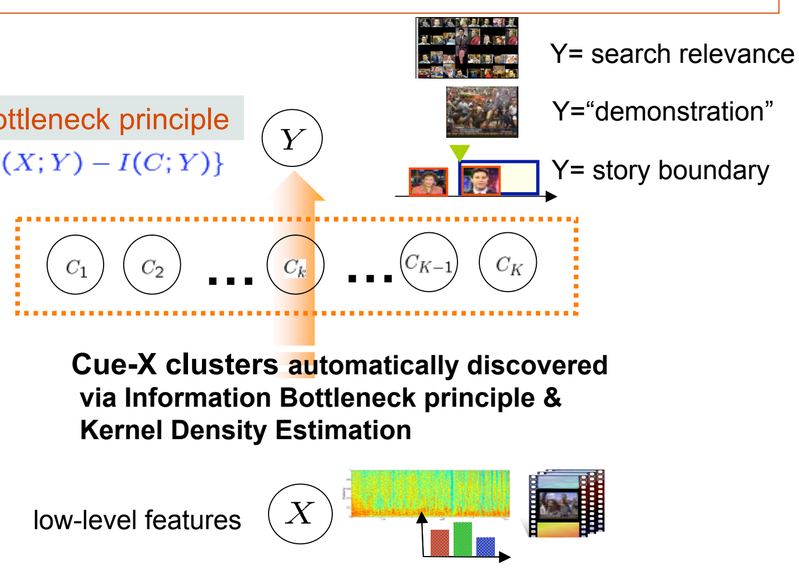
Objectives and Unique Features

- Fusion of detection and searching techniques at different levels across modalities
- Combination of parts-based graph model and fixed-feature classifiers for concept detection
- Information-theoretic Cue-X clustering for story segmentation and search re-ranking
- Semantic search over multi-modal metadata (ASR/MT and semantic concepts)
- Automatic discovery of query topic classes and user search patterns

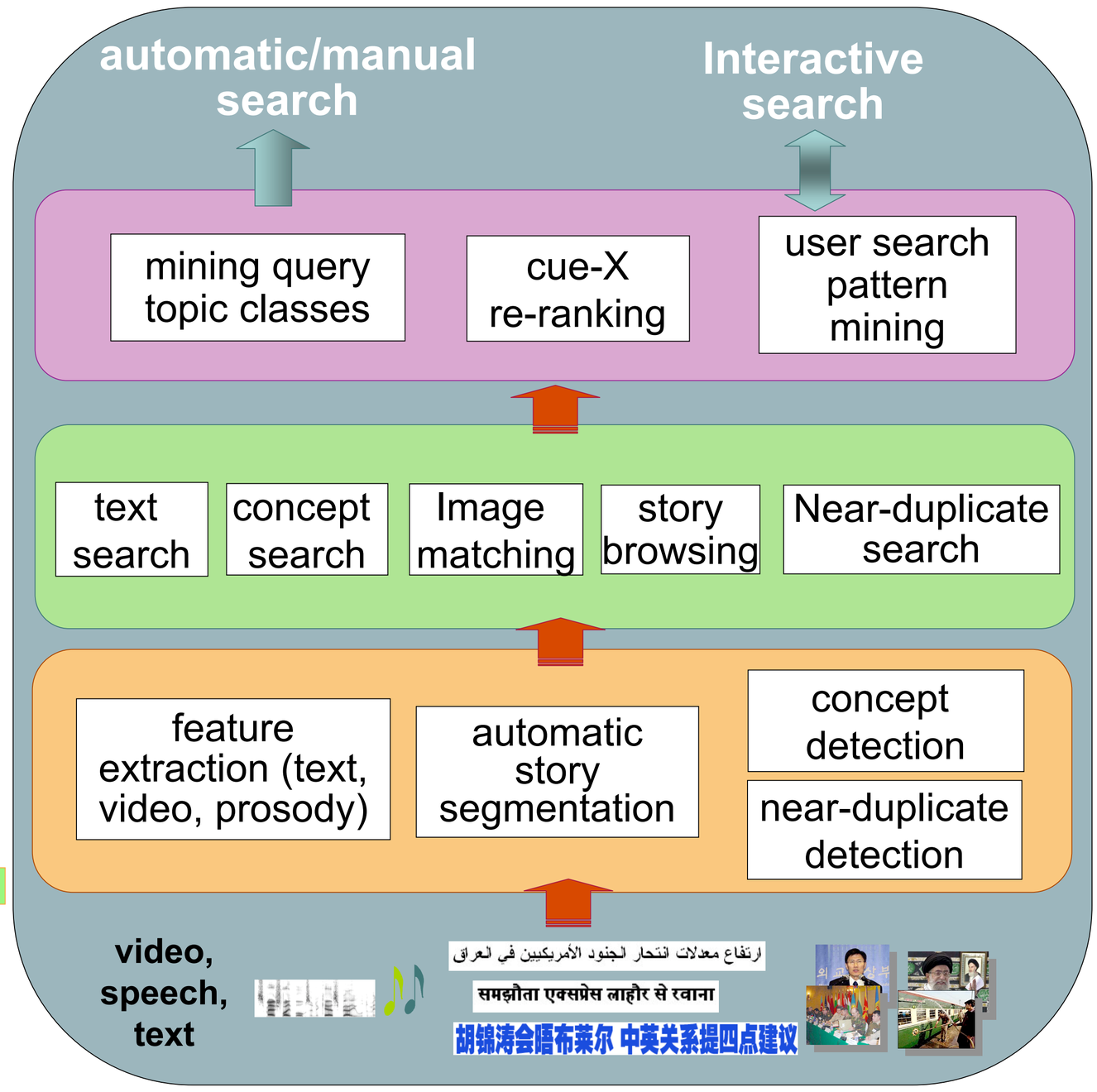
Cue-X Information-theoretic Framework

Information Bottleneck principle

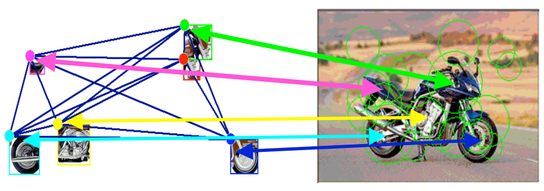
$$C^* = \underset{C|R}{\operatorname{argmin}}\{I(X;Y) - I(C;Y)\}$$



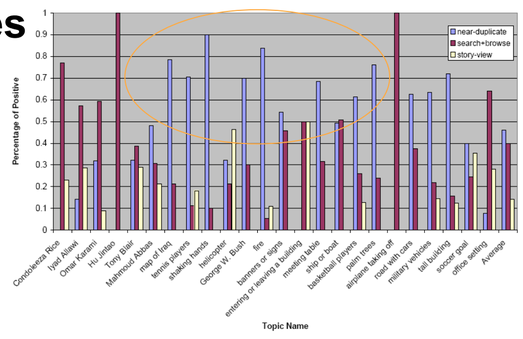
- **Robust story segmentation over TRECVID 05 data, F1=0.87 (ARB), 0.84 (CHN), 0.52 (ENG) w/o using text**
- **Cue-X discovers optimal relevant clusters and re-orders the search results. Shown effective in video search.**



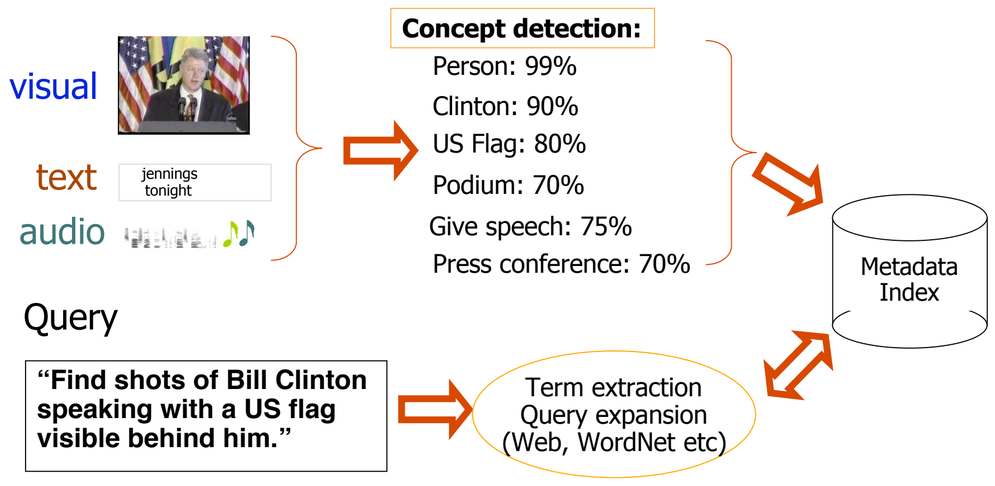
Parts-Based Detector for Objects & Near-Duplicates



- **Parts-based statistical graph models effective for detecting objects/scenes with dominant spatio-feature cues.**
- **Improvement of 10% when fused with fixed-feature classifiers.**
- **Near-duplicate browser as most effective tool in our interactive search.**

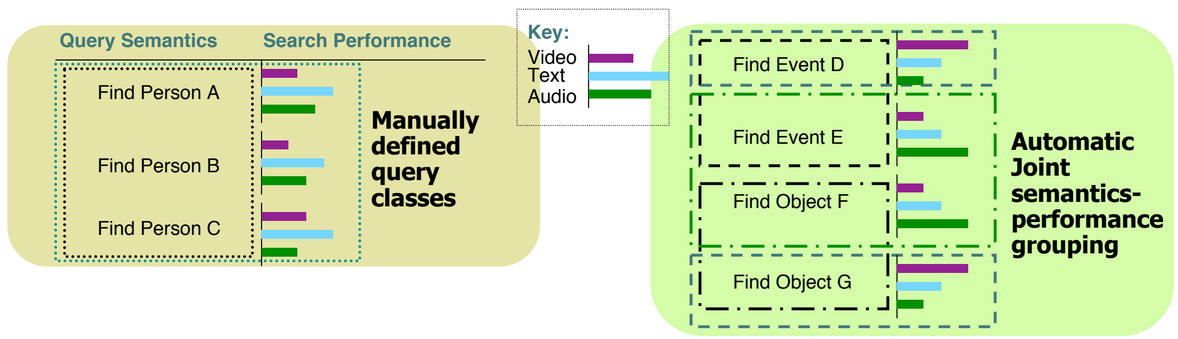


Concept Search and Query expansion



- **Populate visual concepts over a large lexicon**
- **Shots represented as smoothed concept vectors**
- **Match text queries to concept vectors by incorporating semantic relevance (WordNet) and detector robustness**

Automatic Discovery of Query Classes



- **Learn distinct query topic classes by clustering query semantics and search performances jointly**

Evaluation

- **Tested over 170+ hours of multi-lingual news video, TRECVID 2005**
- **Story-based searches improves > 100% accuracy in automatic search**
- **Near-duplicate browsing doubles the relevant shots in interactive search**
- **Cue-X re-ranking and concept search proved very useful**

MAP	Components (in automatic search TRECVID 2005)
0.039	Text
0.087	Text+Story
0.095	Text+Story+Anchor Removal
0.107	Text+Story+Anchor Removal +cue-X reranking
0.111	Text+Story+Anchor Removal +cue-X reranking+CBIR
0.114	Text+Story+Anchor Removal +cue-X Reranking+CBIR +Concept Search

(close to the top performance of automatic search)

System/Demo

- **Web-based interactive search engine deployment**
- **Standard database (MySQL) and modular processing add-ons**
- **Personal user profiles and activity logs**

Columbia on-line Video Search Engine

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http://www.ee.columbia.edu/dvmm