MEDICAL CASE RETRIEVAL

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Doctoral Symposium @ ACM Multimedia 2014

November 5, 2014

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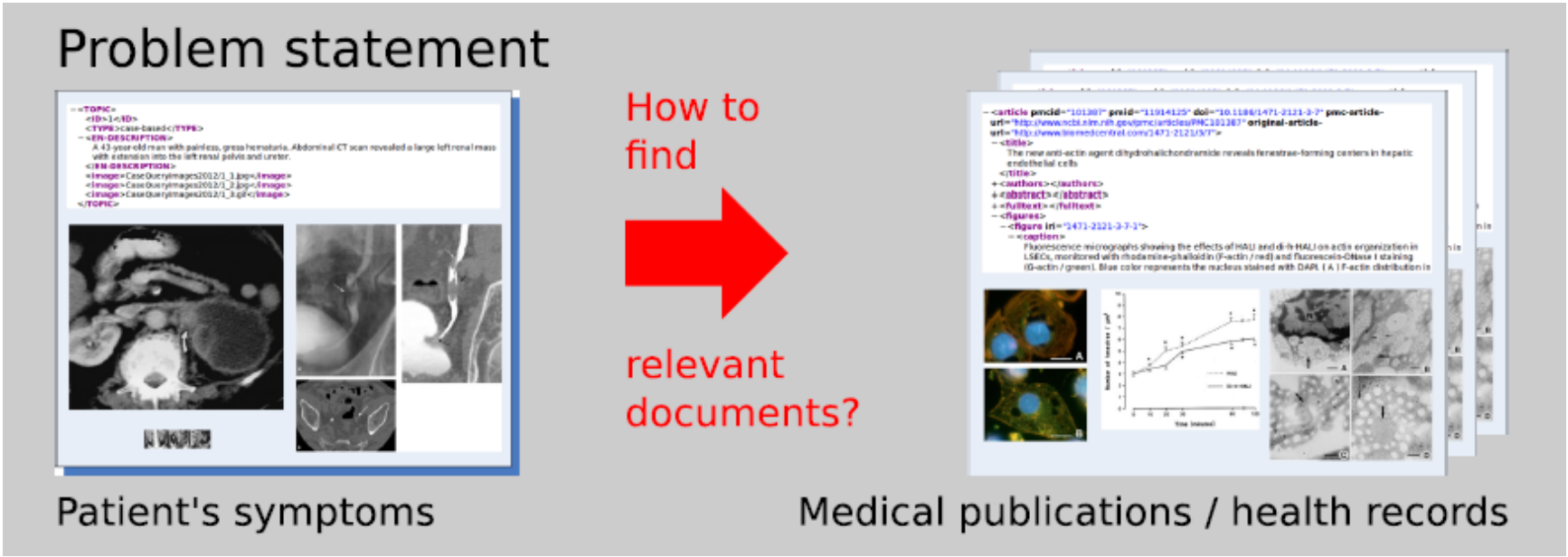


- Major component of medical decision support systems based on case-based reasoning
- Solution may help to generate datasets for medical education and research

IMAGECLEF MCR CHALLENGE

- 2013 MCR dataset:
  - ~ 75,000 documents (biomedical publications)
  - 35 queries (symptom descriptions, diagnostic images)
  - ~ 15,000 relevance judgments of medical experts
  - enables TREC-style evaluation of MCR approaches
- Best results achieved in 2013:
  - Text retrieval: 24% MAP (mean average precision)
  - Visual retrieval: 2.8% MAP
  - Combined text and visual retrieval: 16% MAP

RESEARCH NEED

- Multimodal MCR for general datasets is an open research problem:
  - No systematic treatment in literature
  - Proposed approaches either apply general multimedia IR techniques or specialize to restricted datasets
- How to build a multimodal MCR model that performs substantially better than keyword-based retrieval?

RESEARCH OBJECTIVES

- Concerning multimodal techniques for MCR:
  - **O1** Determine the reasons for moderate retrieval performance of current techniques
  - **O2** Design a novel multimodal MCR model enabling a substantial improvement of retrieval performance (to > 30% MAP on ImageCLEF 2013 dataset)
- Concerning an MCR system built from O2:
  - **O3** Investigate potential of further improvement by long-term learning from medical expert users

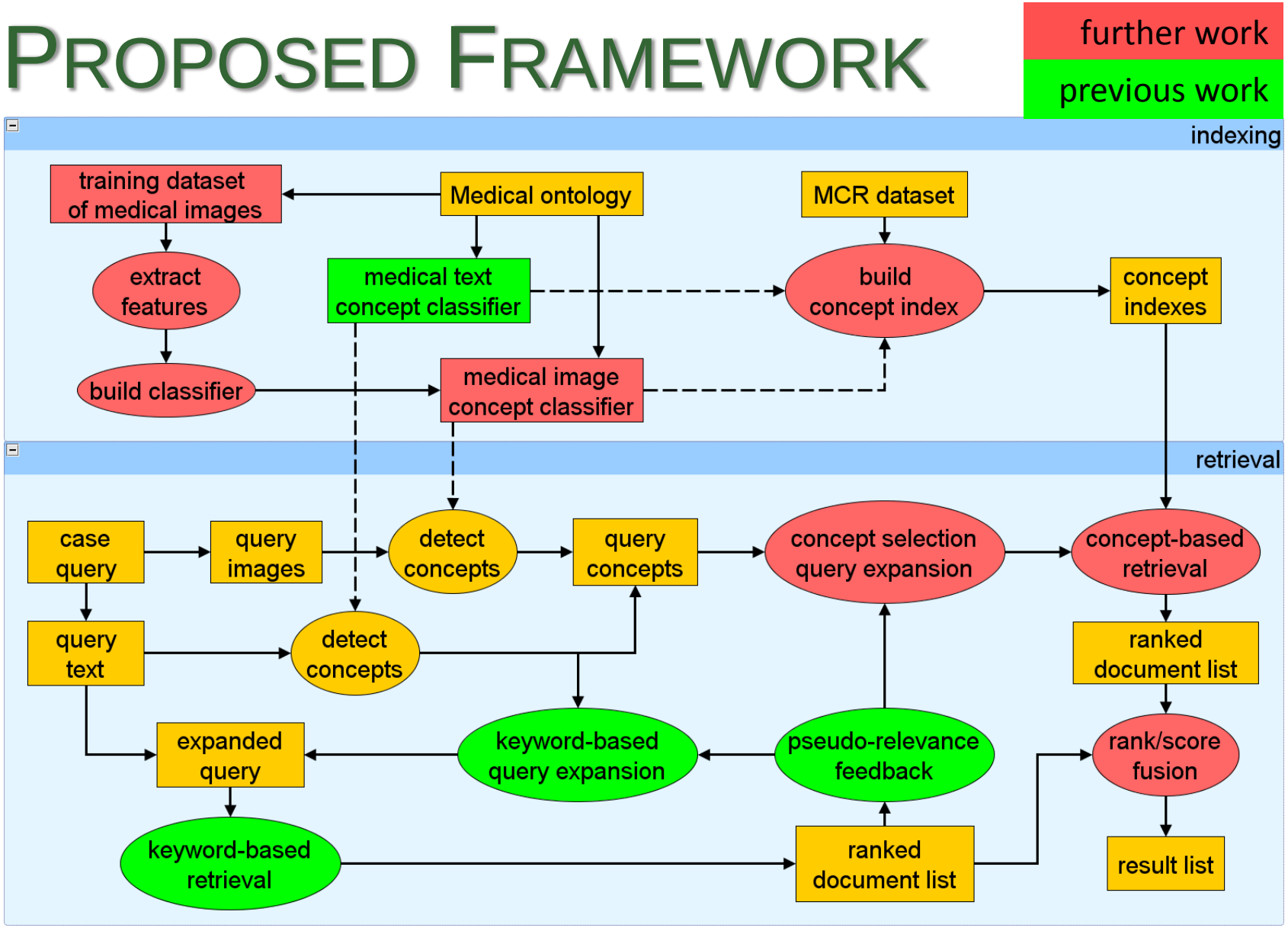
DIFFICULTIES

- Medical terms may mislead text retrieval:
  - may contain stop words, e.g. “vitamin A”
  - there are many synonyms or hyponyms
- More precise queries, less relevant documents
- Visual similarity of medical images is of little help
- Semantic meaning of medical images arises mainly from textual context

APPROACH

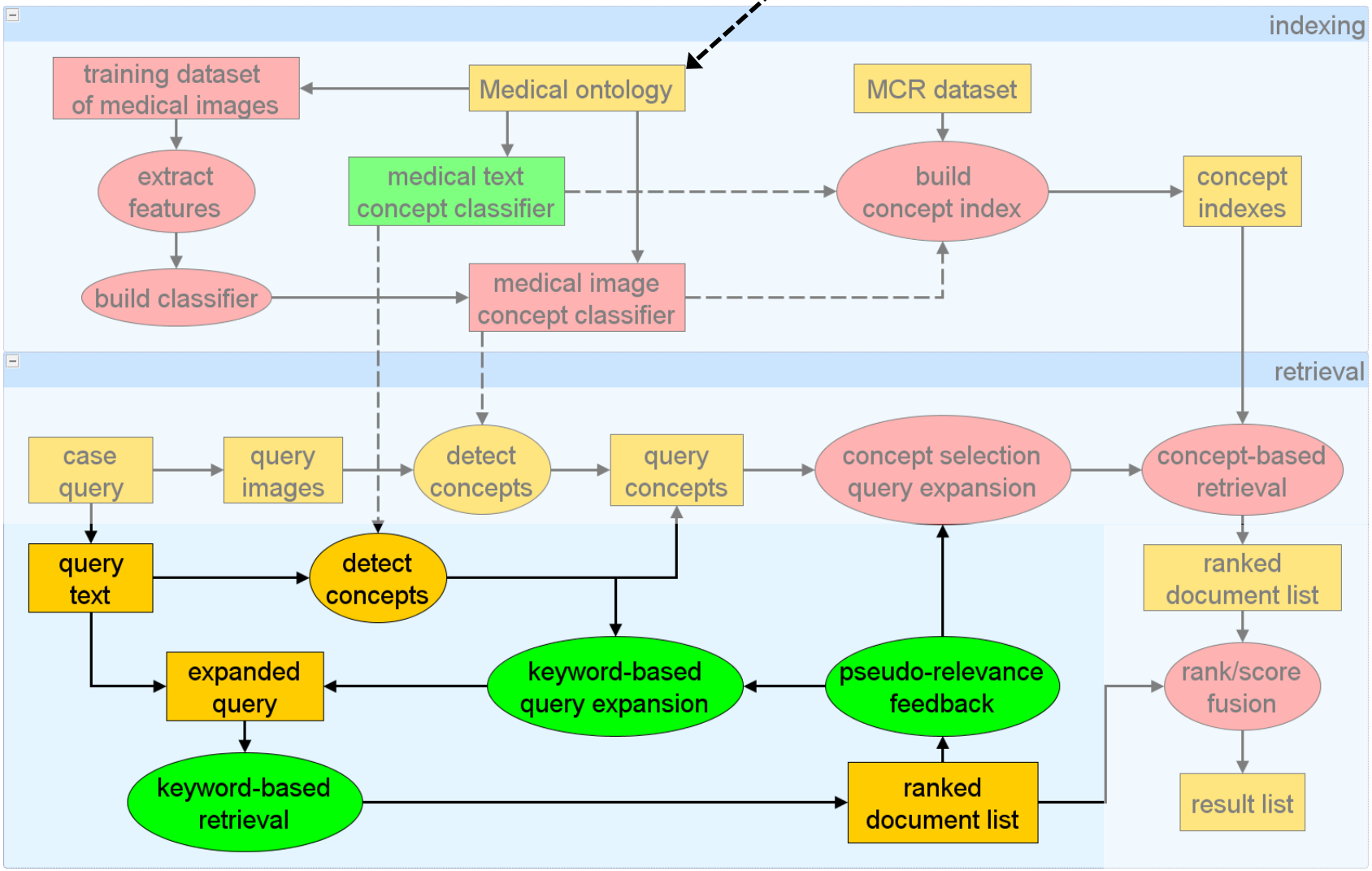
- O2 – Designing an MCR model benefits from:
  - choosing well-performing text retrieval techniques
  - improving visual retrieval performance (e.g. by using textual context information)
  - utilizing medical knowledge (e.g. ontologies, thesauri) to detect semantic concepts in text and images
  - combining textual, visual, and concept-based retrieval using data fusion methods
- O3 – Evaluation of long-term learning:
  - will be simulated using the ImageCLEF MCR dataset

PROPOSED FRAMEWORK

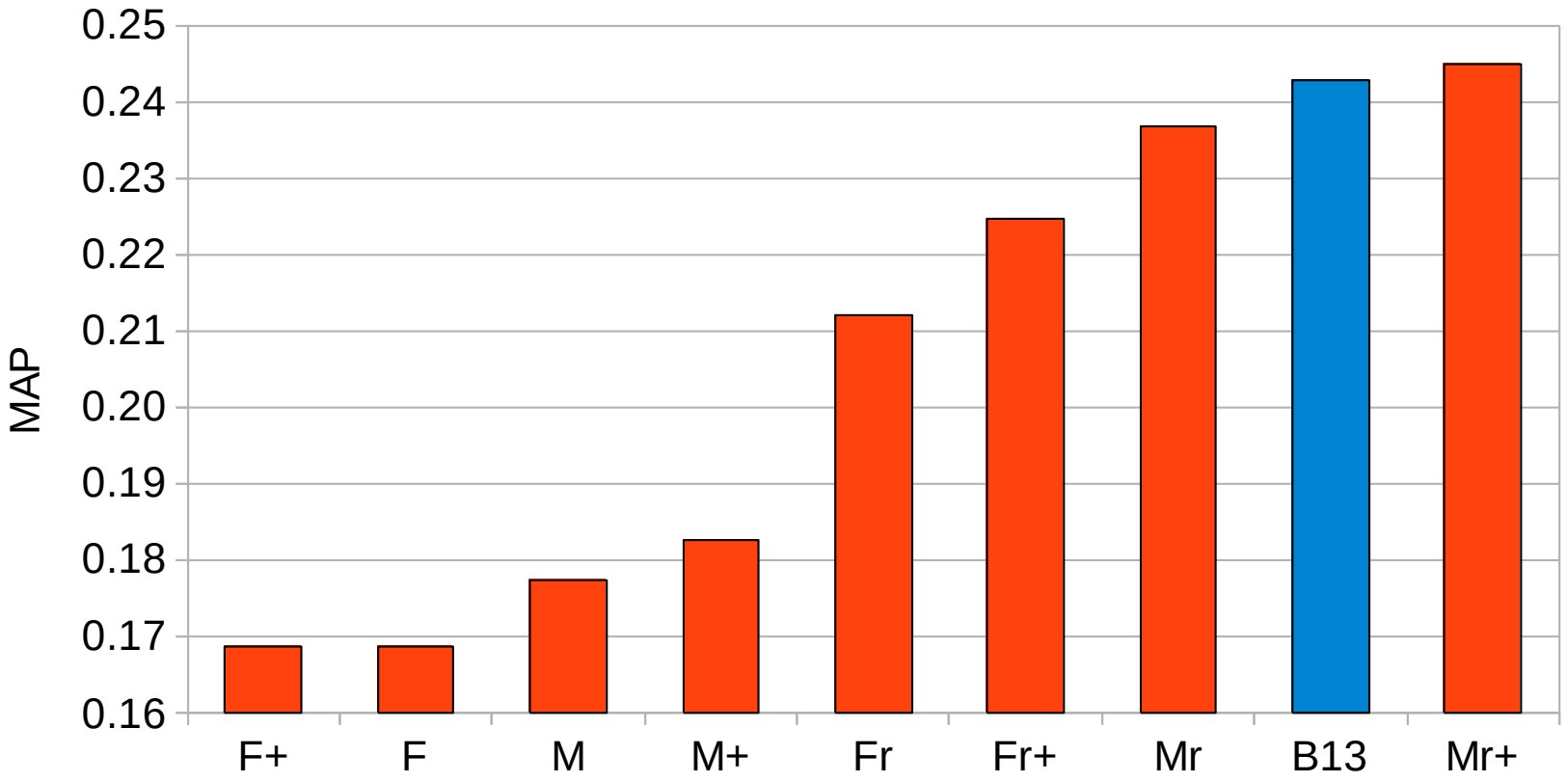


TEXT RETRIEVAL

MeSH = Medical Subject Headings

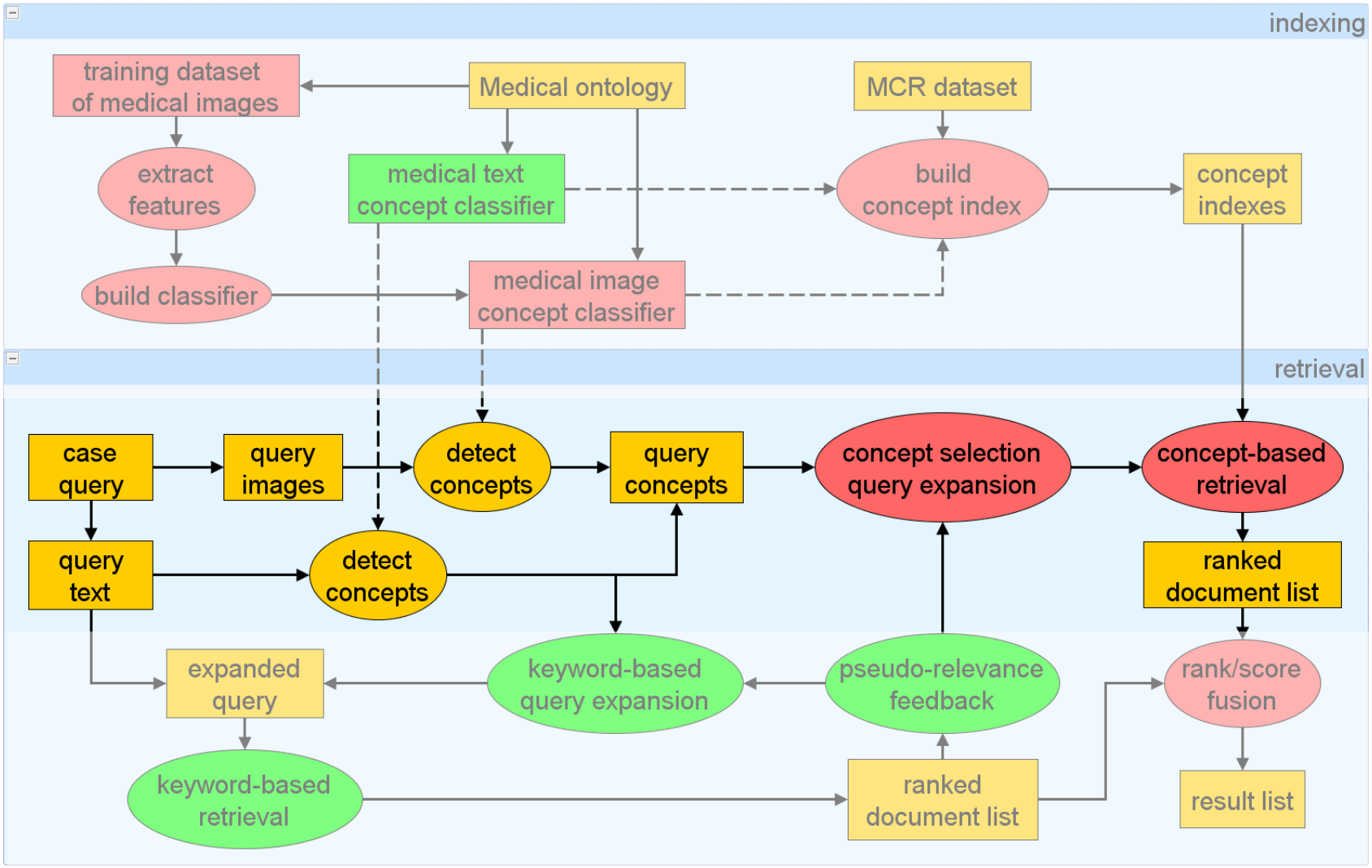


TEXT RETRIEVAL RESULTS

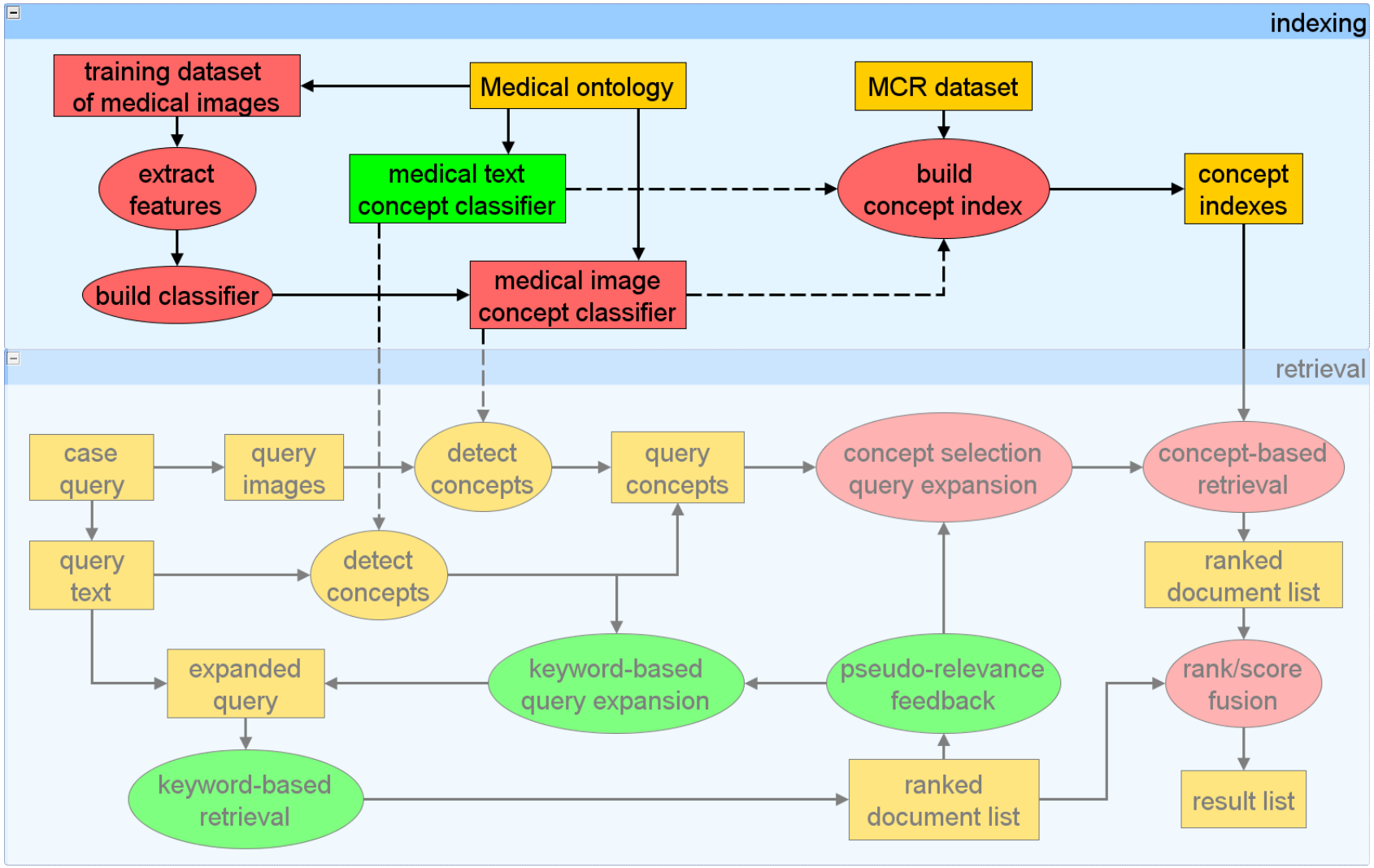


F	full text	+	MeSH document expansion
M	MeSH query expansion	r	pseudo-relevance feedback
B13	best result at ImageCLEF 2013		

CONCEPT-BASED RETRIEVAL

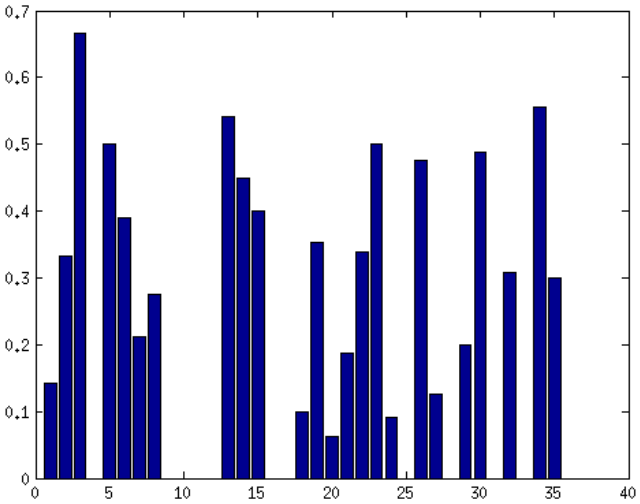


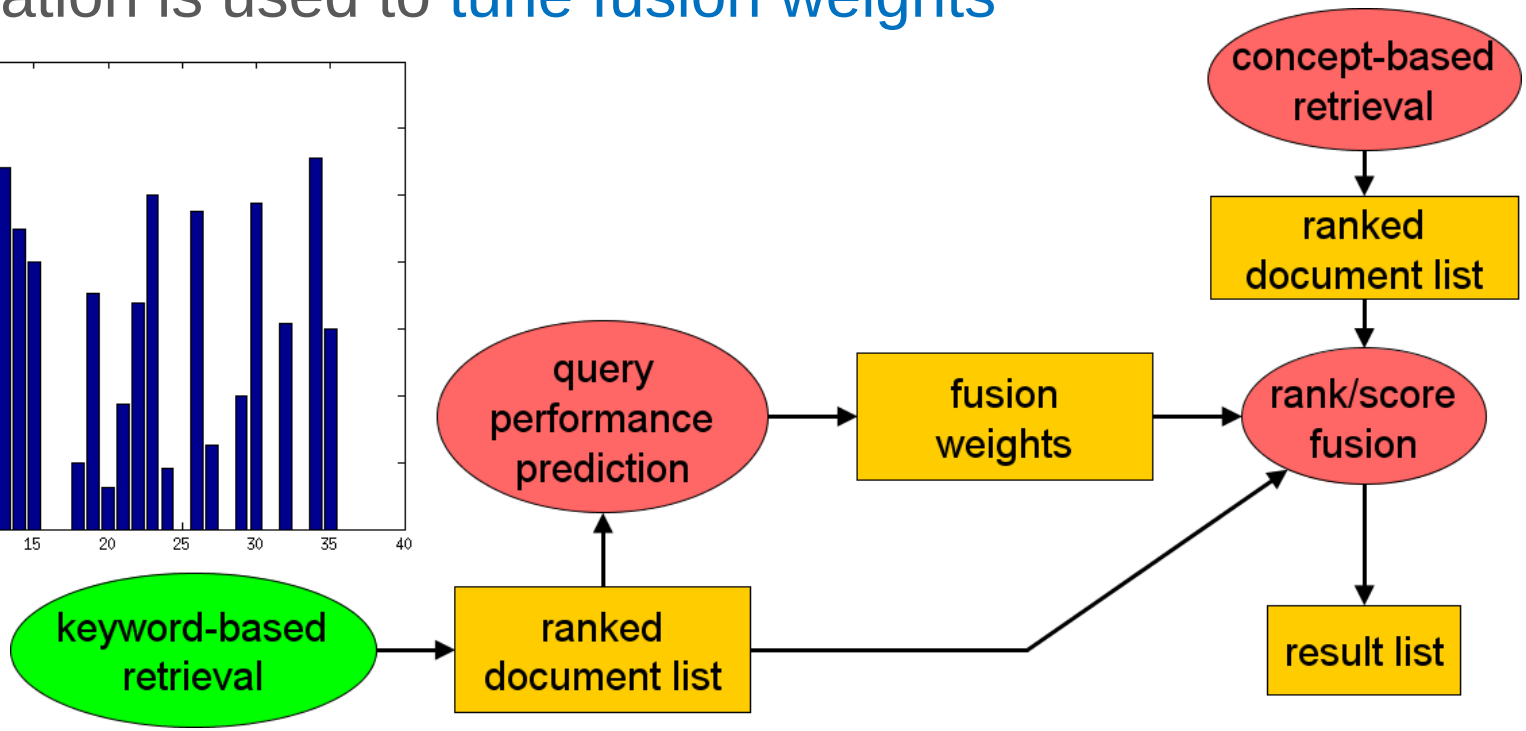
SEMANTIC INDEXING



QUERY-ADAPTIVE FUSION

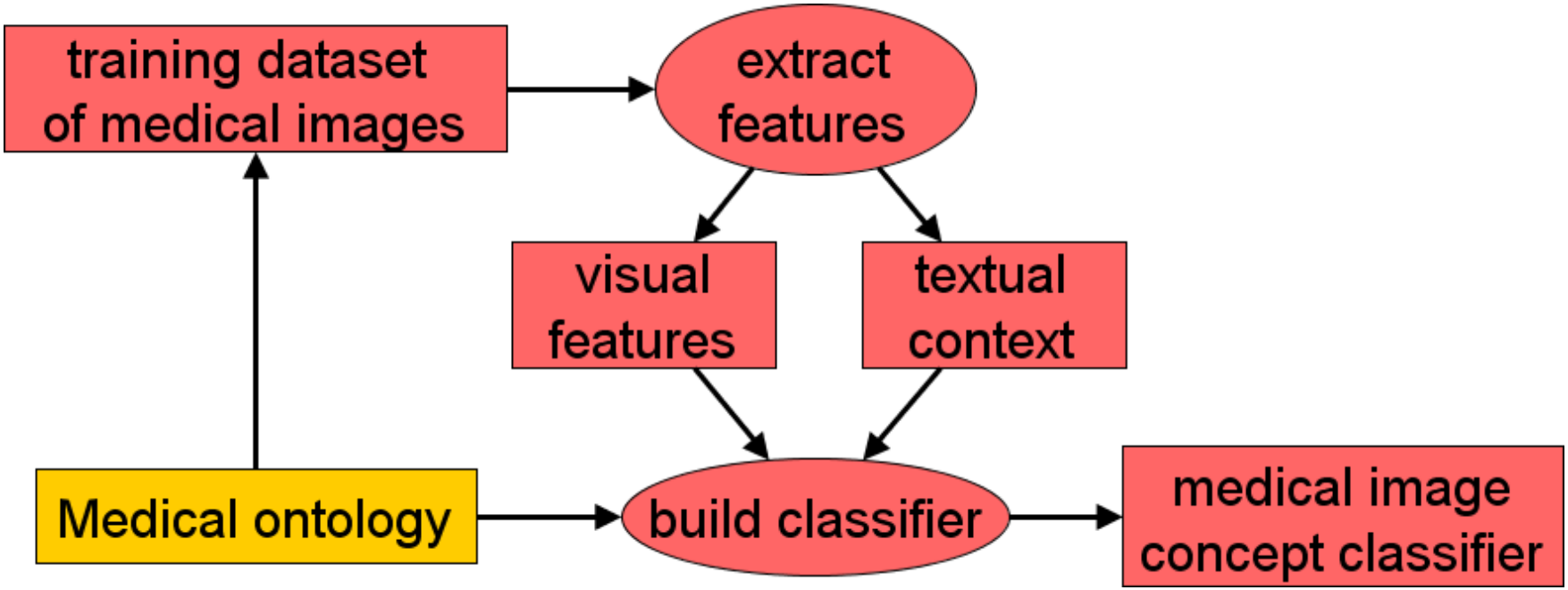
- Retrieval performance varies from query to query
- Performance is estimated from pseudo-relevant docs
- Estimation is used to tune fusion weights





CONCEPT DETECTION IN IMAGES

- Preprocessing: compound figure separation, image modality filtering, arrow detection



SUMMARY

Thank you for your attention!

- MCR is an open research problem involving multimedia information retrieval (IR)
- Main PhD objective is to improve multimodal MCR over keyword-based retrieval
- Proposed components of MCR model:
  - concept detection according to medical ontology
  - combined keyword-based and concept-based IR
  - query expansion and query-adaptive fusion
- See also http://www-itec.uni-klu.ac.at/~mt/