



# MEDICAL CASE RETRIEVAL

**Mario Taschwer**

mario.taschwer@aau.at

AAU Klagenfurt, Austria

Doctoral Symposium @ ACM Multimedia 2014

November 5, 2014



# MEDICAL CASE RETRIEVAL

## Problem statement

```

<?xml version="1.0" encoding="UTF-8" ?>
<TOPIC>
<ID>1</ID>
<TYPE>case-based</TYPE>
<EN-DESCRIPTION>
A 42 year old man with painless, gross hematuria. Abdominal CT scan revealed a large left renal mass with extension into the retrorenal pelvis and ureter.
</EN-DESCRIPTION>
<EN-DESCRIPTION>
</EN-DESCRIPTION>
<IMAGE>Case02ryImage200211_3.jpg</IMAGE>
<Image>Case02ryImage200211_2.jpg</Image>
<Image>Case02ryImage200211_1.gif</Image>
</TOPIC>
    
```

Patient's symptoms

How to find



relevant documents?

```

<?xml version="1.0" encoding="UTF-8" ?>
<article pmid="101307" pmid="1191425" doi="10.1186/1471-2121-3-2" pmc-article-
url="http://www.ncbi.nlm.nih.gov/pmc/articles/PMC101307" original-article-
url="http://www.biomedcentral.com/1471-2121/3/2" ?>
<title>
The new anti-actin agent dihydrohalichondramide reveals fenestration-forming centers in hepatic
endothelial cells
</title>
<authors></authors>
<abstract></abstract>
<fulltext></fulltext>
</figure>
<figure Iri="1471-2121-3-2-3" ?>
<caption>
Fluorescence micrographs showing the effects of MALI and di-HALI on actin organization in
LSECs, monitored with rhodamine-phalloidin (F-actin / red) and fluorescein-blebbistatin staining
(G-actin / green). Blue color represents the nucleus stained with DAPI. (A) F-actin distribution in
    
```

Medical publications / health records

- 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



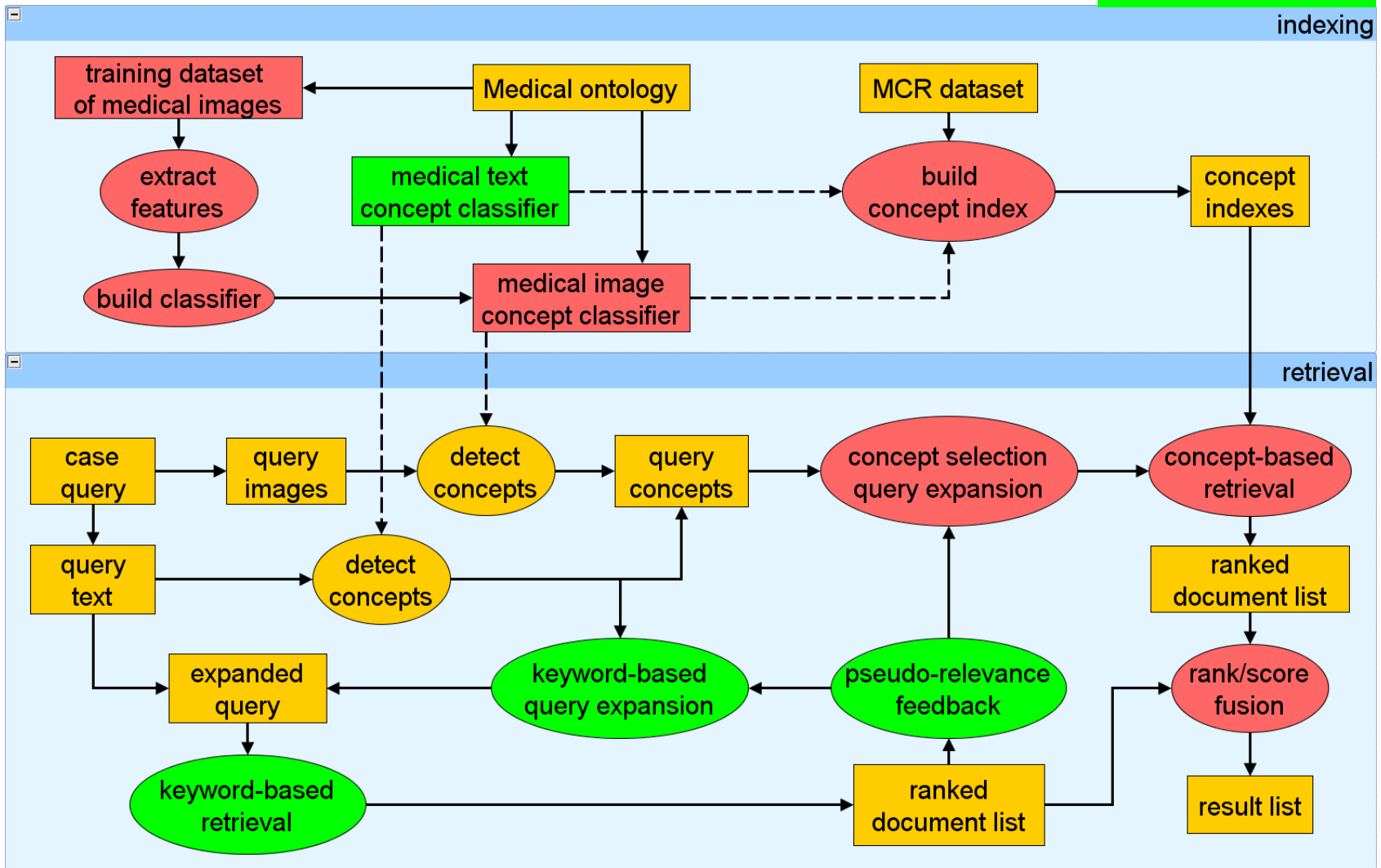
# APPROACH

- **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

further work  
previous work

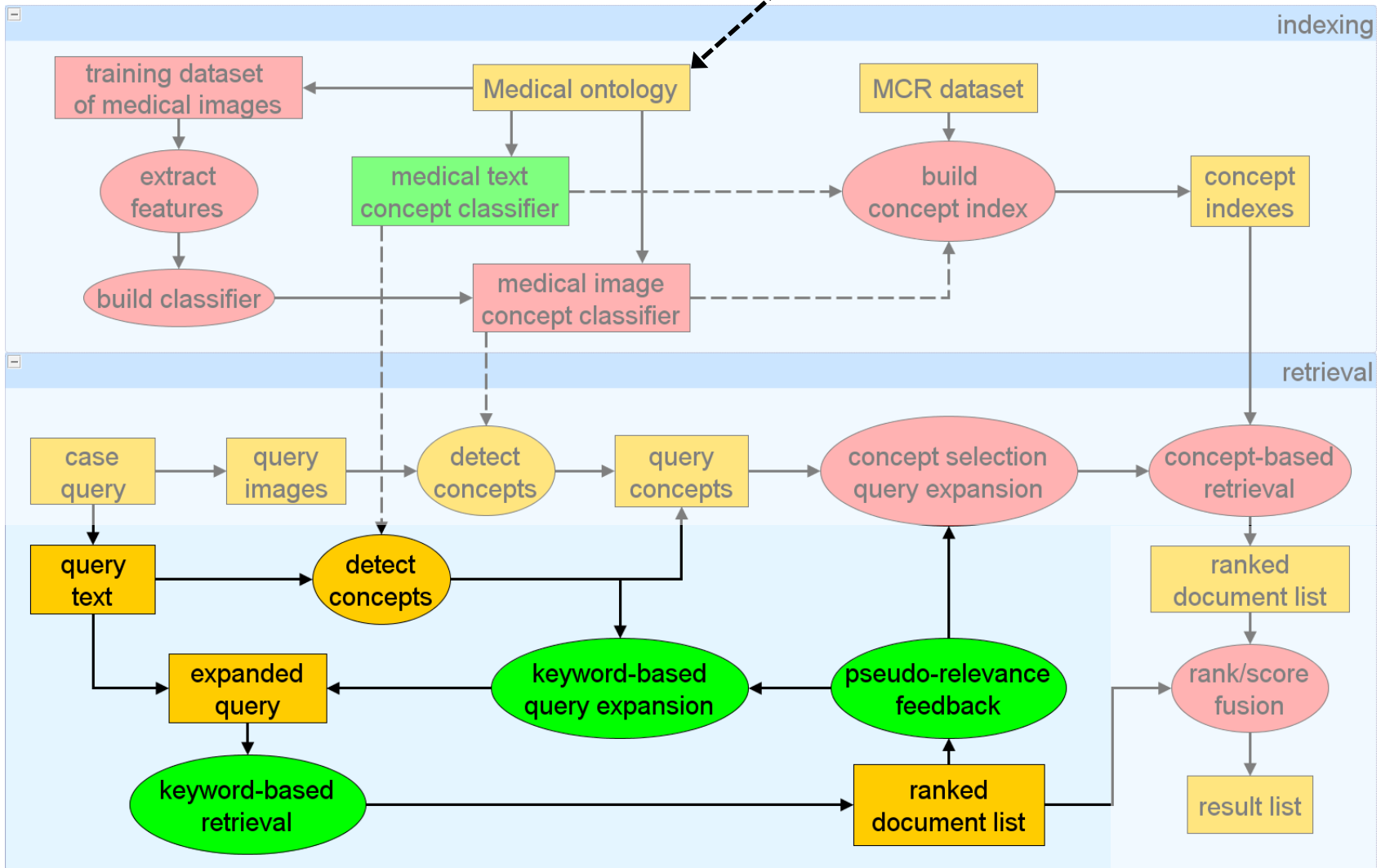






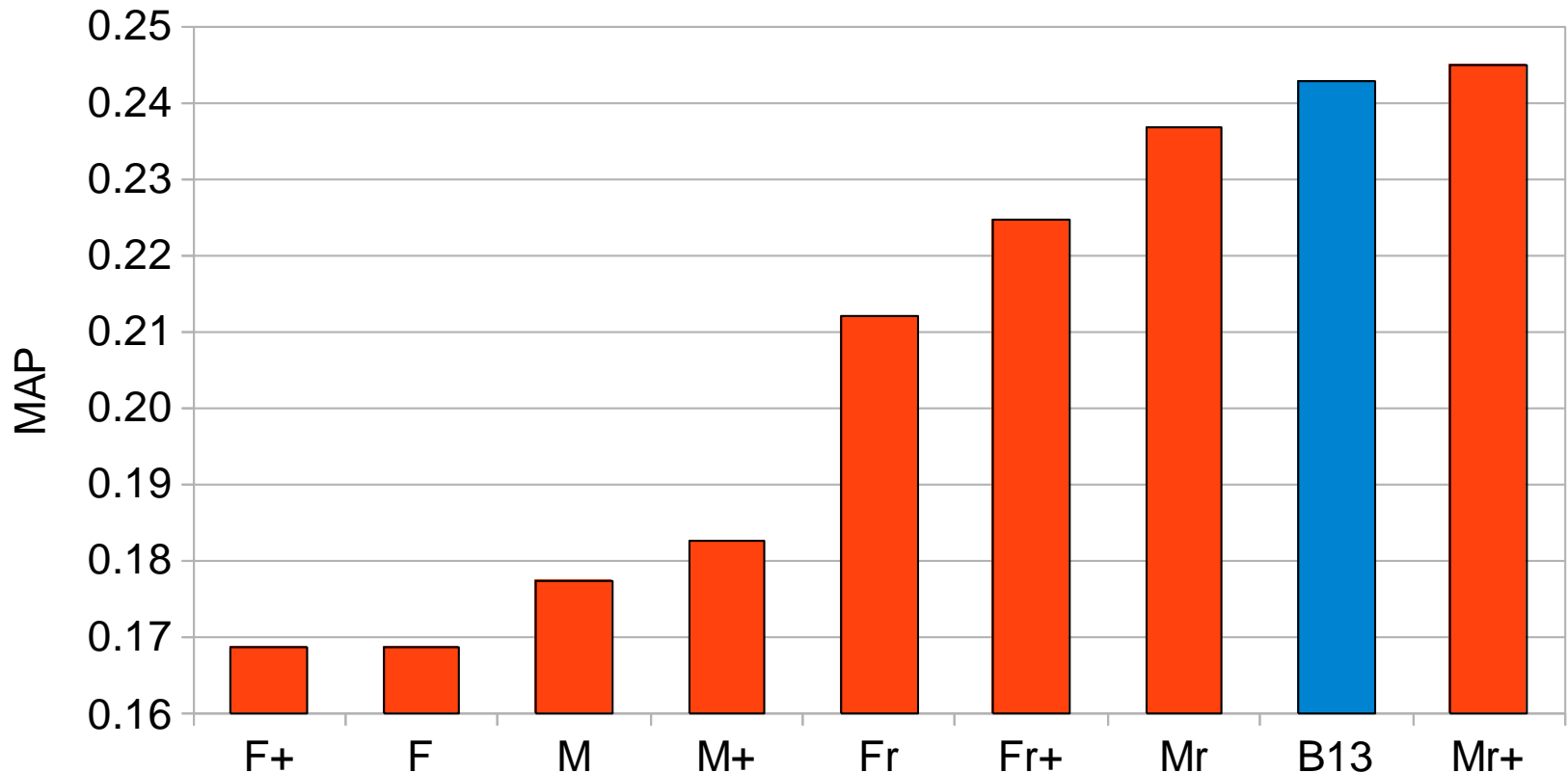
# TEXT RETRIEVAL

MeSH = Medical Subject Headings





# TEXT RETRIEVAL RESULTS



F full text

M MeSH query expansion

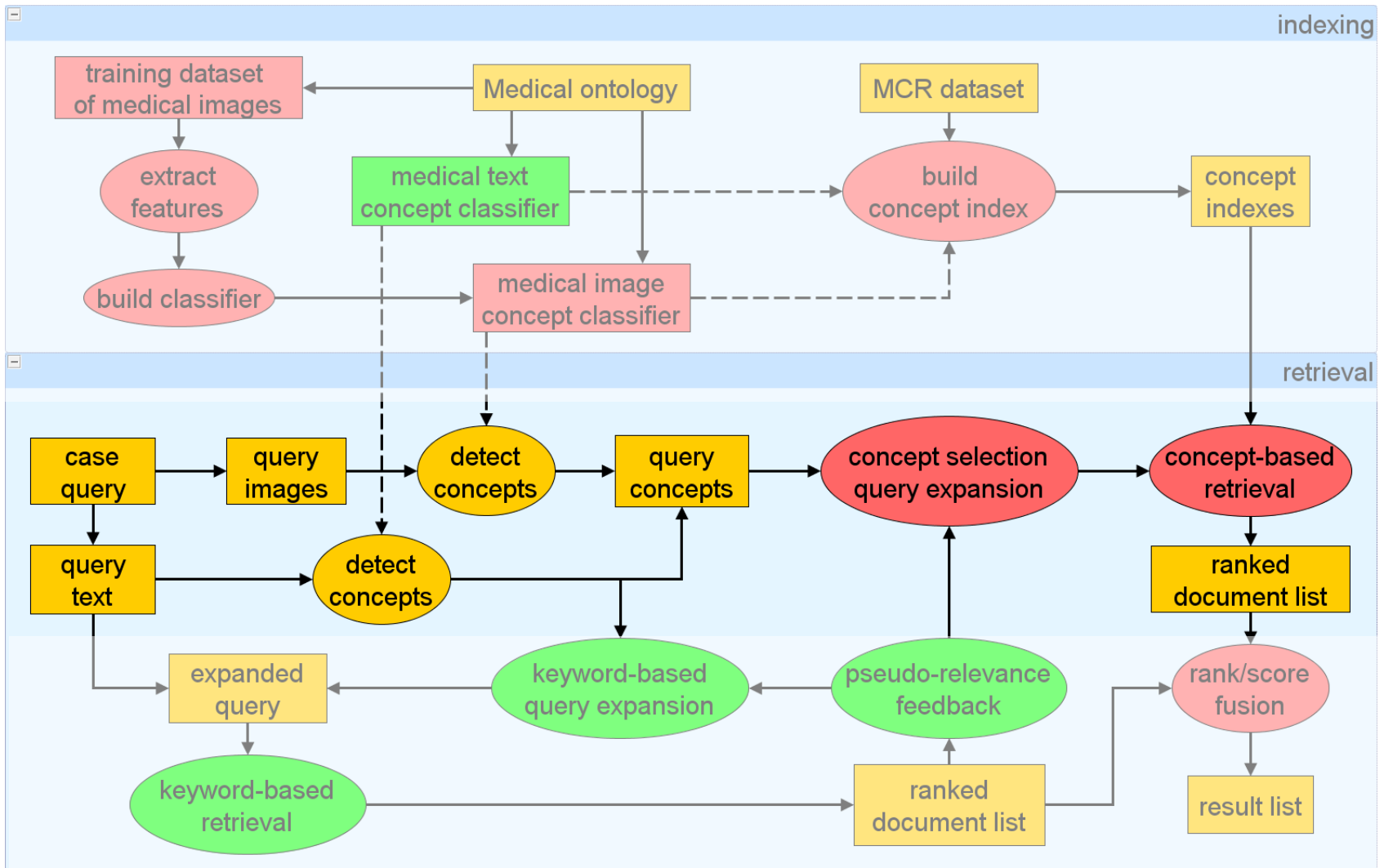
B13 best result at ImageCLEF 2013

+ MeSH document expansion

r pseudo-relevance feedback

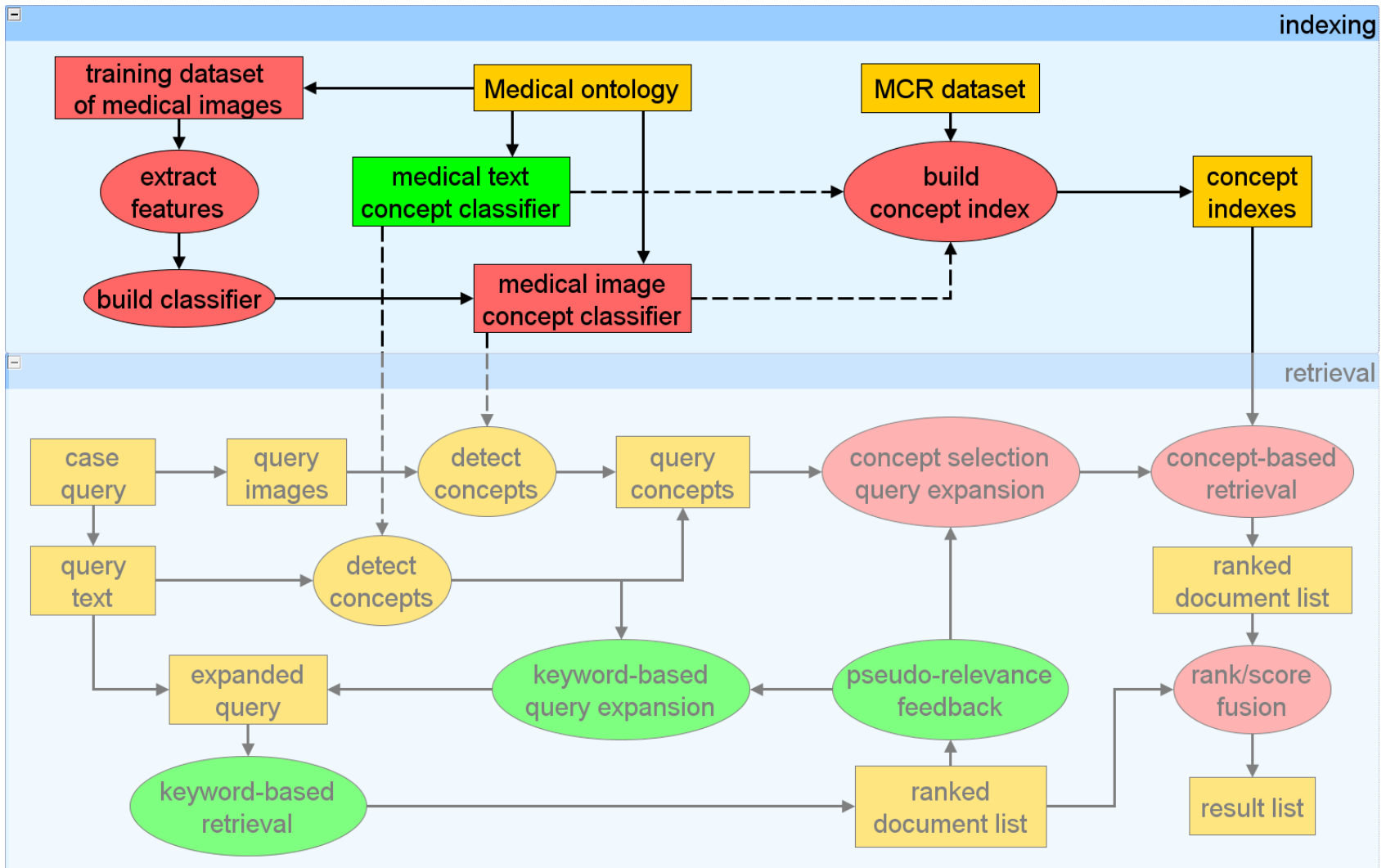


# CONCEPT-BASED RETRIEVAL





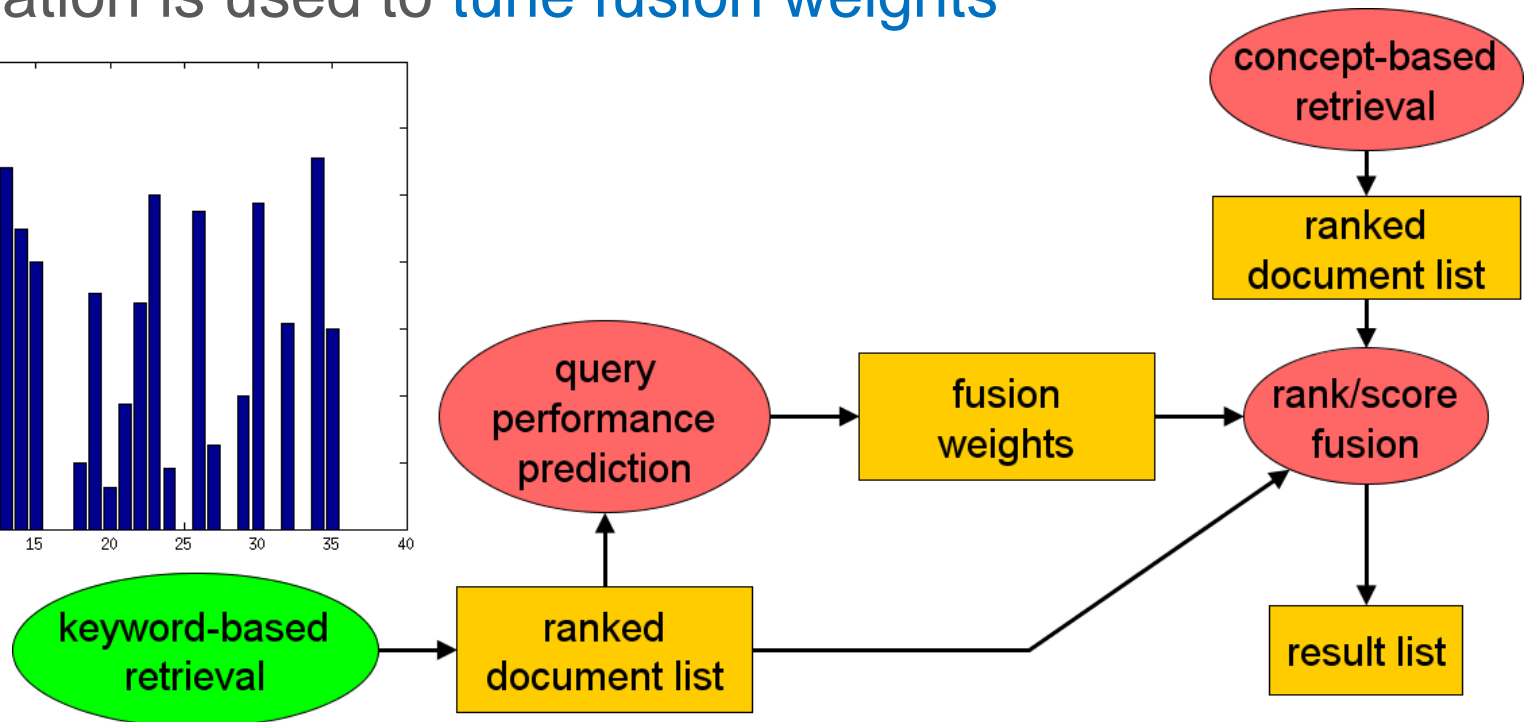
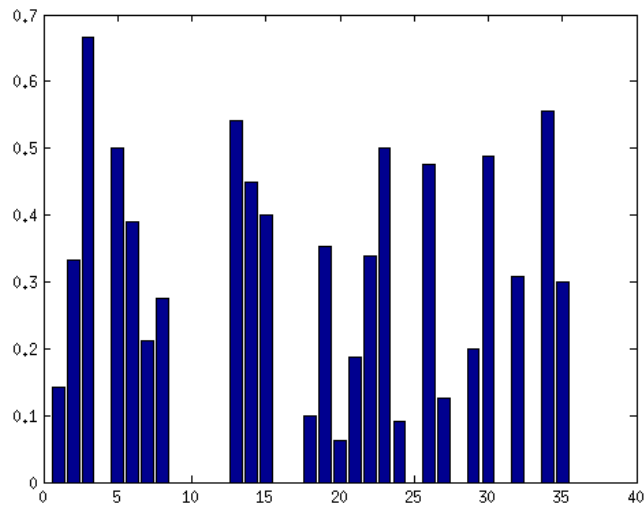
# SEMANTIC INDEXING





# QUERY-ADAPTIVE FUSION

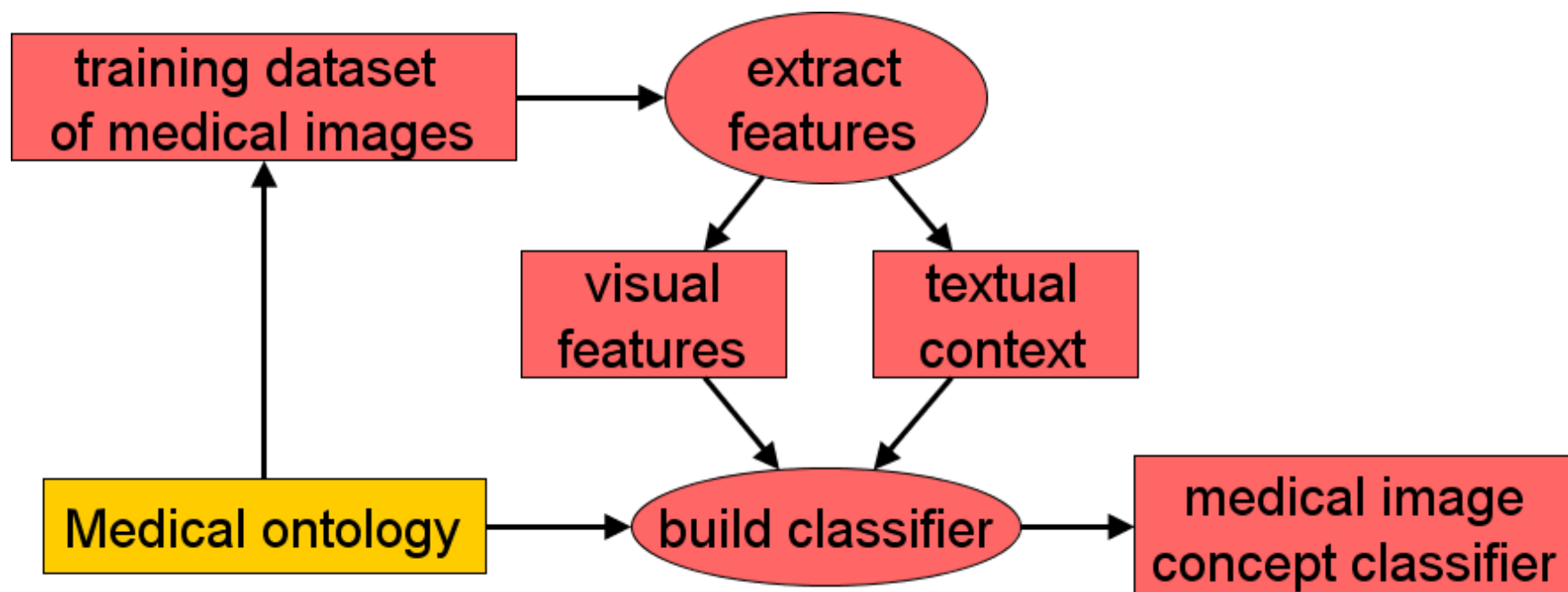
- Retrieval performance varies from query to query
- Performance is estimated from pseudo-relevant docs
- Estimation is used to tune fusion weights





# 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/>