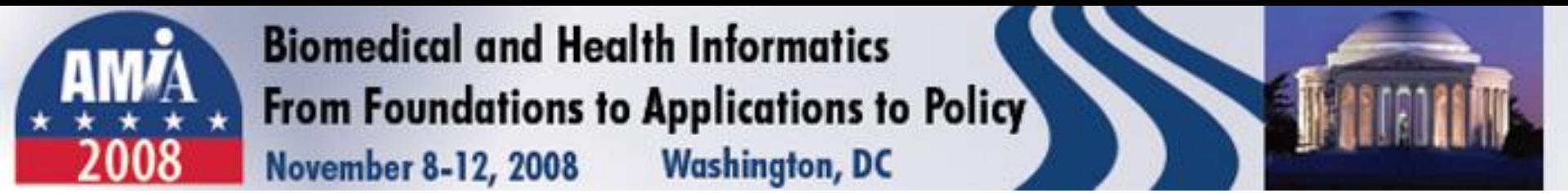

Evaluation of a Document Search Engine in a Clinical Department System

Stefan Schulz[1], Philipp Daumke[2], Pascal Fischer[3], Marcel Müller[3]

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averbis
medical language technology

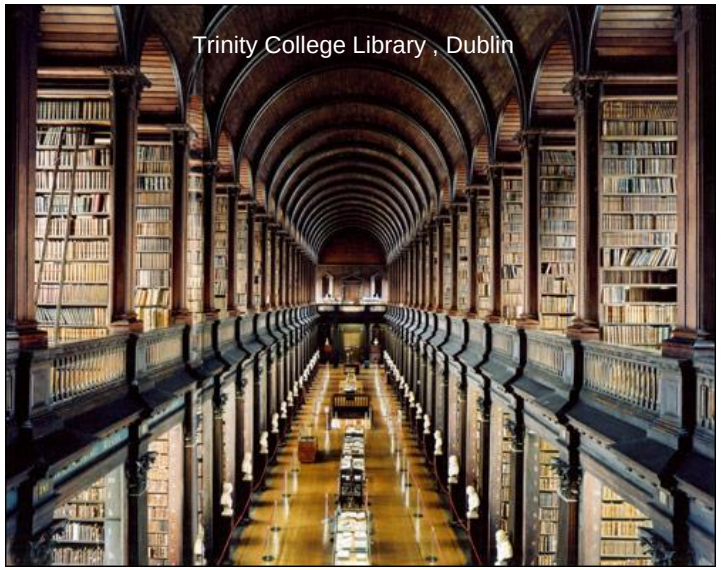
UNIVERSITÄTS KLINIKUM FREIBURG

Navigation paradigms

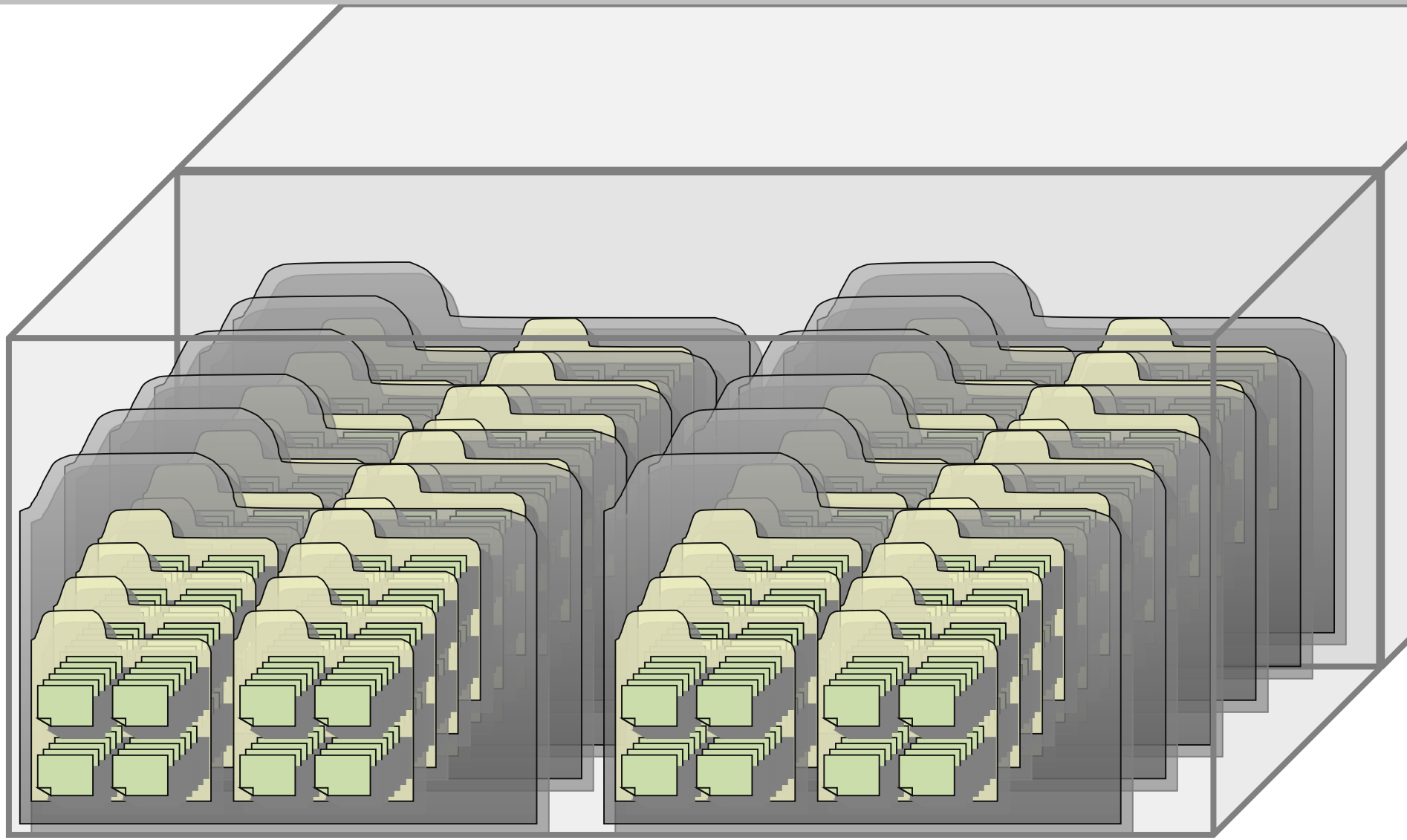
Vertical Paradigm

Vertical Paradigm

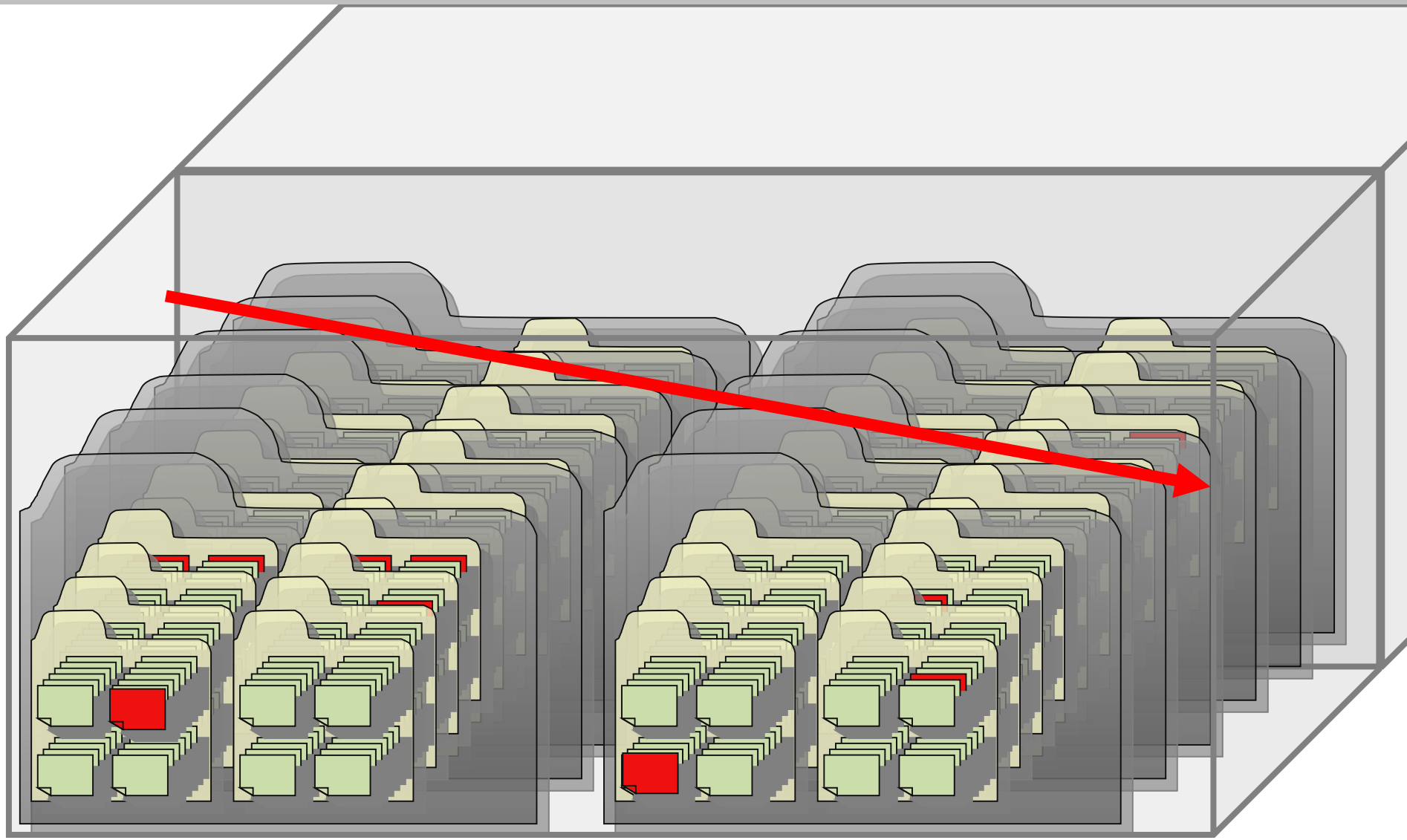
- Vertical data access:
  - hierarchical
  - ordered
  - systematic
  - complete



Horizontal Paradigm



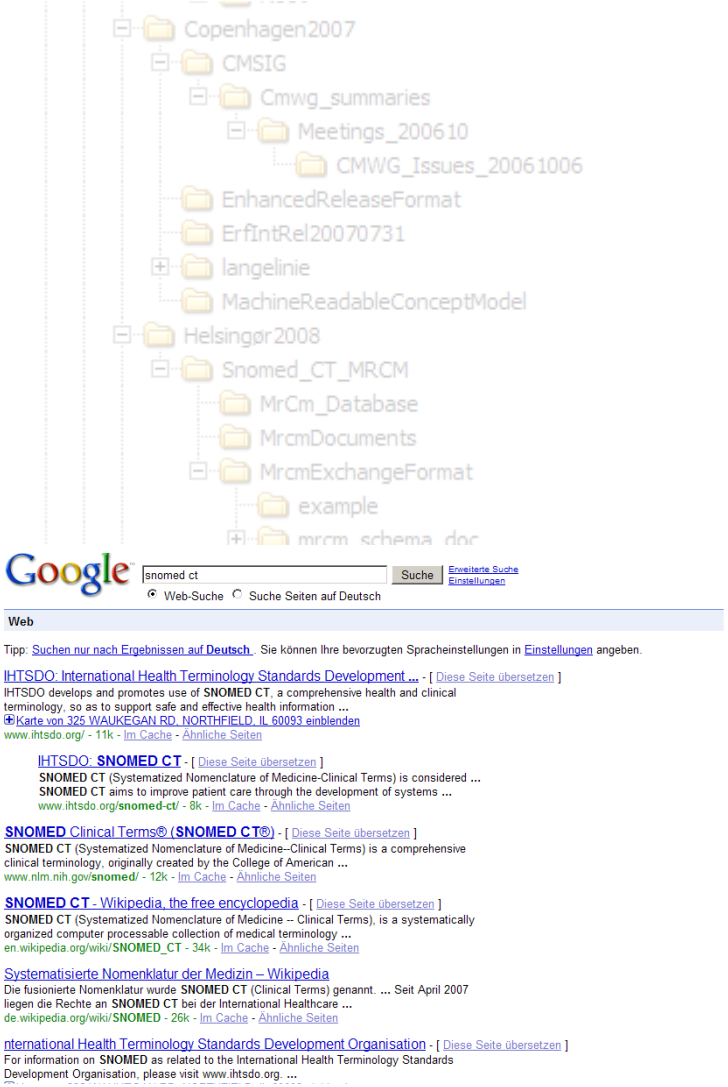
Horizontal Paradigm



Horizontal Paradigm

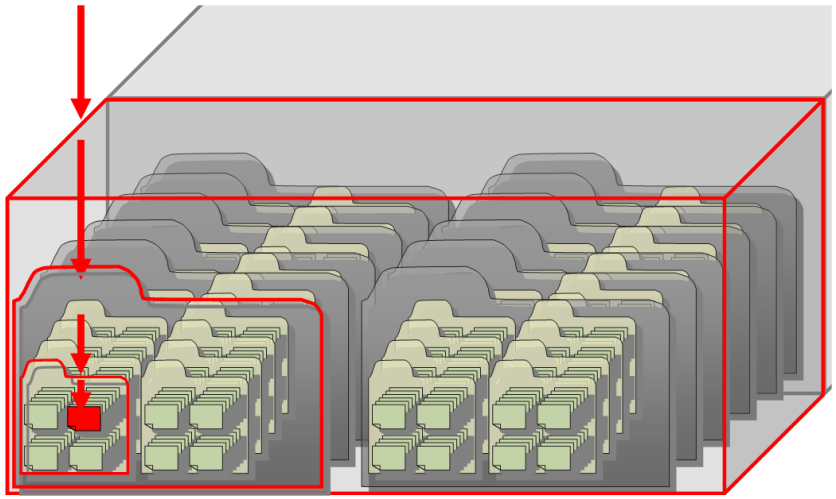
- Vertical data access:
  - hierarchical
  - ordered
  - systematic
  - complete

- Horizontal data access:
  - unsystematic
  - anarchic
  - incomplete

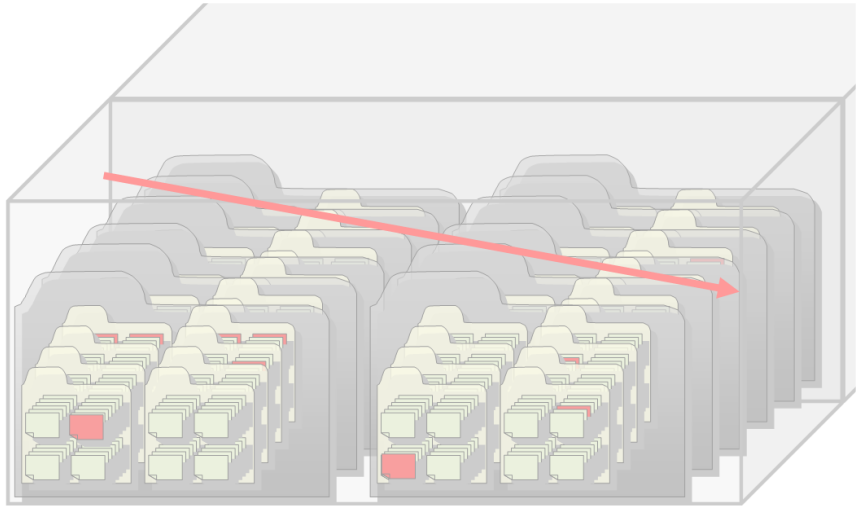


Document access in the electronic health record

Document access in the electronic health record



vertical



horizontal

Document access in the electronic health record

- Vertical access appropriate for systematic patient / case related routines
- Horizontal access:
  - querying structured data across patients: for business statistics, clinical epidemiology
  - use case for querying unstructured documents across patients?
- Can users benefit for “googling” the EHR?

"Googling" medical narratives

- Word index is not enough
  - Term variations
  - Spelling variations
  - Synonyms
- Example: German "Colon Cancer"
- Linguistic variations (morphology, syntax, (morpho-semantics) make (medical) document retrieval difficult

Web search	# Hits total	# Hits exclusive
Kolonkarzinom	2070	1780
Colonkarzinom	248	135
Coloncarcinom	111	73
Colon-Ca	203	169
Kolon-Ca	66	46
Dickdarmkrebs	4000	3610
Dickdarmkarzinom	288	175
Dickdarmcarcinom	13	10
Kolonkarzinoms	471	253
Kolonkarzinome	275	139
Kolonkarzinomen	265	166

Morphosemantic Document Indexing

Morphosemantic Document Indexing

- *"The true, significant elements of language are . . . either words, significant parts of words, or word groupings." [Sapir 1921]*

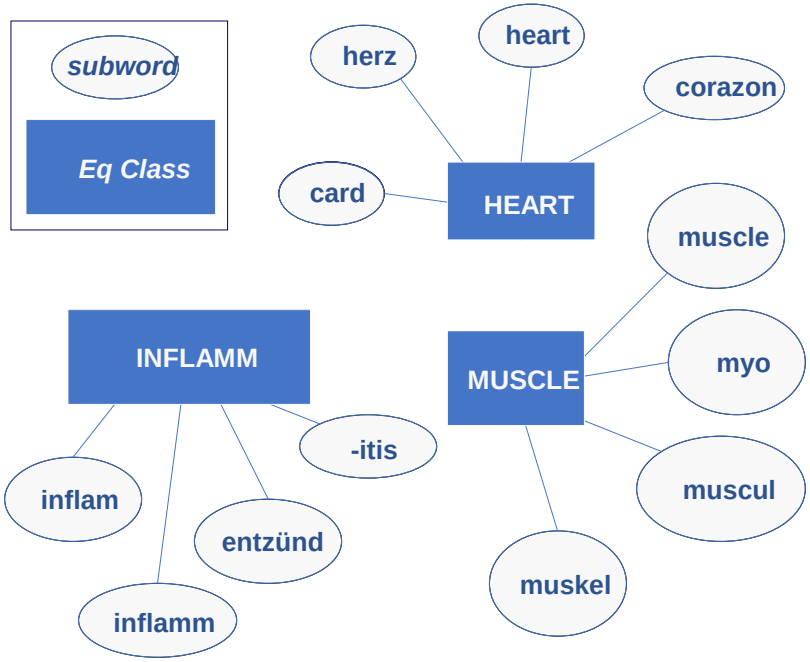
- *Extract significant word fragments (subwords) and map them to semantic identifiers / concepts:*

–#derm = { derm, cutis, skin, haut, kutis, pele, cutis, piel, … }

–#inflamm = { inflamm, -itic, -itis, -phlog, entzuend, -itis, -itisch, inflam, flog, inflam, flog, ... }

MorphoSaurus semantic indexer

- Thesaurus ~ 21.000 equivalence classes
- Lexicon entries:
  - English: ~23.000
  - German: ~24.000
  - Portuguese: ~15.000
  - Spanish : ~11.000
  - French: ~ 8.000
  - Swedish: ~10.000
  - Italian: ~ 4.000



Segmentation:

Myo | **kard** | **itis**

Herz | **muskel** | **entzünd** | ung

Inflamm | ation of the **heart muscle**

Indexation:

#muscle #heart #inflamm

#heart #muscle #inflamm

#inflamm #heart #muscle

Implementation

Implementation

- Department of Dermatology, University Medical Center, Freiburg
- Scope:
  - 30,000 German-language narratives (discharge letters, surgical reports and immuno-dermatologic findings)
  - Database of dermatological images
- Pilot users: 25 physicians and students


Arztbrief-Recherche Hautklinik Freiburg - suitSearch - Mozilla Firefox
Datei Bearbeiten Ansicht Chronik Lesezeichen Extras Hilfe
Universitätsklinikum Freiburg - Abt. Medizinische Informatik & Universitäts-Hautklinik
SUITSEARCH®
HEALTH RECORDS
hauttumor
Suche
Zurücksetzen
PIZ:
Nachname:
Vorname:
Geschlecht:
Relevanz
10
14635 Ergebnisse in 24 msecs gefunden. 100% Genauigkeit. --- Zeige Ergebnisse 81 bis 90:
Info
Tipp: Externe Suche mit "hauttumor" in » ICD-10 » Literatur » Bilder
00000000 Patient 1 X 21.11.1922
... der sich zwischen dem 13.10. und 9.11.2004 in unserer ambulanten Behandlung befand. Diagnosen: 1 Basaliom vom superfiziellen Typ Rücken links. 2 Basaliom vom superfiziellen Typ Rücken BWS links. 3 Basaliom vom solid-zystischen Typ Schulter links. ... ... Typ Brust rechts. Anamnese: Die Vorstellung des Patienten erfolgte wegen seit ca. einem Jahr bestehender scharf begrenzter erythemato-squamöser tumoröser Hautveränderungen im Bereich des Rückens und der Brust. Beurteilung/Therapie: Am 9.11.2004 erfolgte die Exzision von insgesamt vier tumorösen Hautveränderungen in oben ...
Ersteller: Dr. Andrea Schlöbe Erstellung: 24.11.2004
15186941 Patient 2 X 31.08.1944
... der sich am 07.10. und 18.10.2005 in unserer Ambulanz vorstellte. Diagnose: Keratoakanthom Anamnese/Befund: Herr X berichtete über ein schnell wachsenden halbkugelförmigen hyperkeratotischen Tumor auf der linken Brust der sich im Verlauf der ... ... vulgaris zu denken. Der Tumor ist zu beiden Seiten in toto exzidiert. Beurteilung/Therapie: Wir exzidierten am 18.10.05 die verdächtige Hautveränderung in Lokalanästhesie. Die histologische Untersuchung lieferte das Bild eines epidermalen Tumors vereinbar mit dem Bild eines Keratoakanthoms. Der Tumor ist ...
Ersteller: Dr. Constance Huyke Erstellung: 11.11.2005


Web-Fotofinder - Universitäts-Hautklinik Freiburg - Mozilla Firefox
Datei Bearbeiten Ansicht Chronik Lesezeichen Extras Hilfe
Web-Fotofinder
Universitäts-Hautklinik Freiburg
Datum
04.12.2006 12:58:07 Uhr
Patient
Patient 1, geb. 31.08.1944 (PIZ 00000000)
Benutzer
marcelm
Diese Webseite stellt Ihnen 90147 Photos der Universitäts-Hautklinik, welche in den Jahren 2000 bis 2006 erstellt und gespeichert wurden, zur Verfügung. Bitte beachten Sie, dass die Angaben zur Patientenindentifikation fehlerhaft sein können.
Datum: 30.12.2002 (Nr. 28814)
Lokalisation: KH
Datum: 19.01.2004 (Nr. 42184)
Lokalisation: KH

Evaluation Methodology

1. User satisfaction (questionnaire): Impact of horizontal EHR navigation on:
   - clinical performance
   - scientific performance
   - medical education
2. Clinical-epidemiological use case
   - select suspected or manifest syphilis cases based on information discharge summaries (coding unreliable)
   - typical terms: *“Syphilisverdacht”, “syphilitischer Primäraffekt”, “Luesserologie”,…*
   - precision / recall analysis

Gold standard and baselines

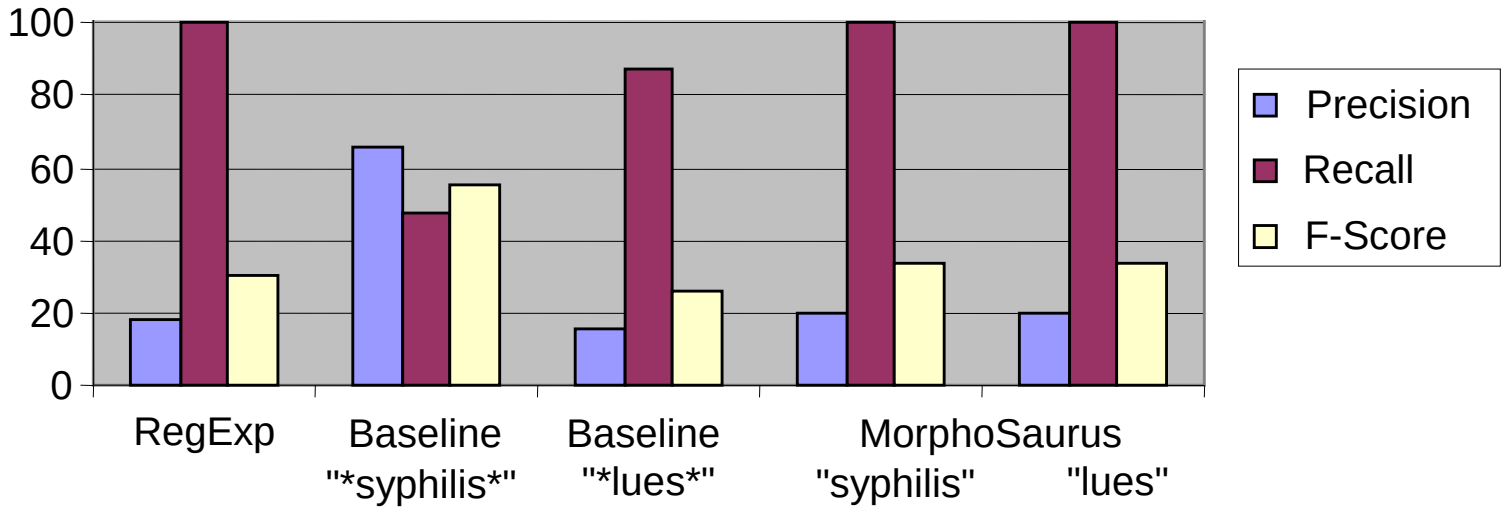
- RegExp search:
  - *"*lues*", "*luet*", "*syphil*", "*fta-abs*", "*fta abs*", "*schanker*", "*pallid*", "*treponem*": yield:* 226 / 30,000 documents
  - manual relevance check: 40 / 226 → Gold standard
- Baseline 1: substring search for *"*syphilis*"*
- Baseline 2: substring search for *"*lues*"*
- Experiment: MorphoSaurus search for *"Lues" and "Syphilis"*

Results

Results of retrieval experiments

- Baseline 1: substring search for *"*syphilis*"*
  - precision = 65.5%, recall = 47.5%, F-score: 55.1
- Baseline 2: substring search for *"*lues*"*
  - precision = 15.4, % recall = 87.5%, F-score: 26.2
- MorphoSaurus 1: search for *"syphilis"*
  - precision = 20.1 %, recall = 100%, F-score 33.5
- MorphoSaurus 2: search for *"lues"*
  - precision = 20.1 % recall = 100%, F-score 33.5

Comparative results



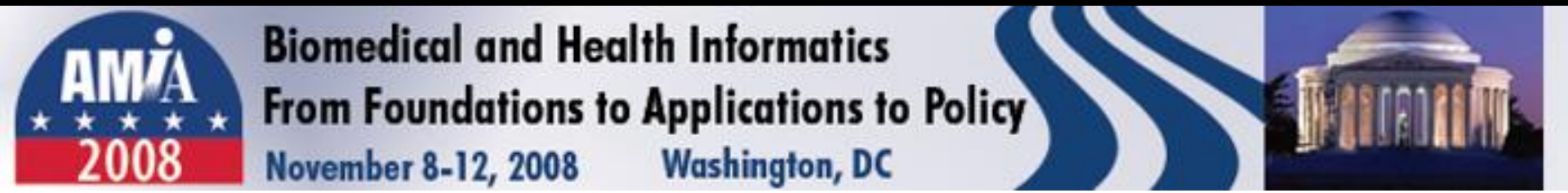
- Morphosaurus search retrieves all relevant documents
- equivalent to the laborious RegExp search
- Baseline search “*syphilis*” yields the best F-value
- Usefulness of Morphosaurus search depends on task

User satisfaction results

- User satisfaction (n = 20)
  - “system could enhance my clinical performance”: 80%
  - “have a positive impact on my scientific work” 90%
  - „has a positive impact on medical education“ 50%
    (reason: restriction to discharge summaries and pictures not sufficient, no good integration with the EHR so far)

Conclusion

- Horizontal access to EHR data well accepted
- New usage of medical record narratives
  - Search for related cases / similar images / cases for medical education
- Morphosemantic indexing for document filtering (under reserve: single use case / German language):
  - recall (not precision) optimized
  - robust against query formulation
  - outperforms naïve substring search in precision
  - equal to laborious search by hand-crafted regular expressions



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Thank You!

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