Annotation and Ontologies in the Context of IR

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(based on a joint work with Loïc Maisonnasse and Jean-Pierre Chevallet)

What is IR ?

- A collection of documents
- Users with information needs
- Finding (parts of) documents relevant to a given information need

Illustration

Collection of annotated medical images (CLEF 2007 - [1])

Example of an information need :

Show me chest CT images with emphysema

Specificities of IR

- The information need corresponds to one or several search topics
  - which may be imprecisely formulated
  - which need be interpreted by the IR ystem
- The overlap between topics dealt with in a document and an information need is in general partial
  $\longrightarrow$ degrees of relevance

Main components of an IR system

An IR system comprises three main modules :

1. A module for indexing information needs ($\rightarrow$ queries)
2. A module for indexing documents
3. A module for matching queries and document representations

The *bag of words* : a commonly used representation

Example *show, chest, CT, image, emphysema*

Standard IR models

For a general presentation, see ([2], [3] and [4])

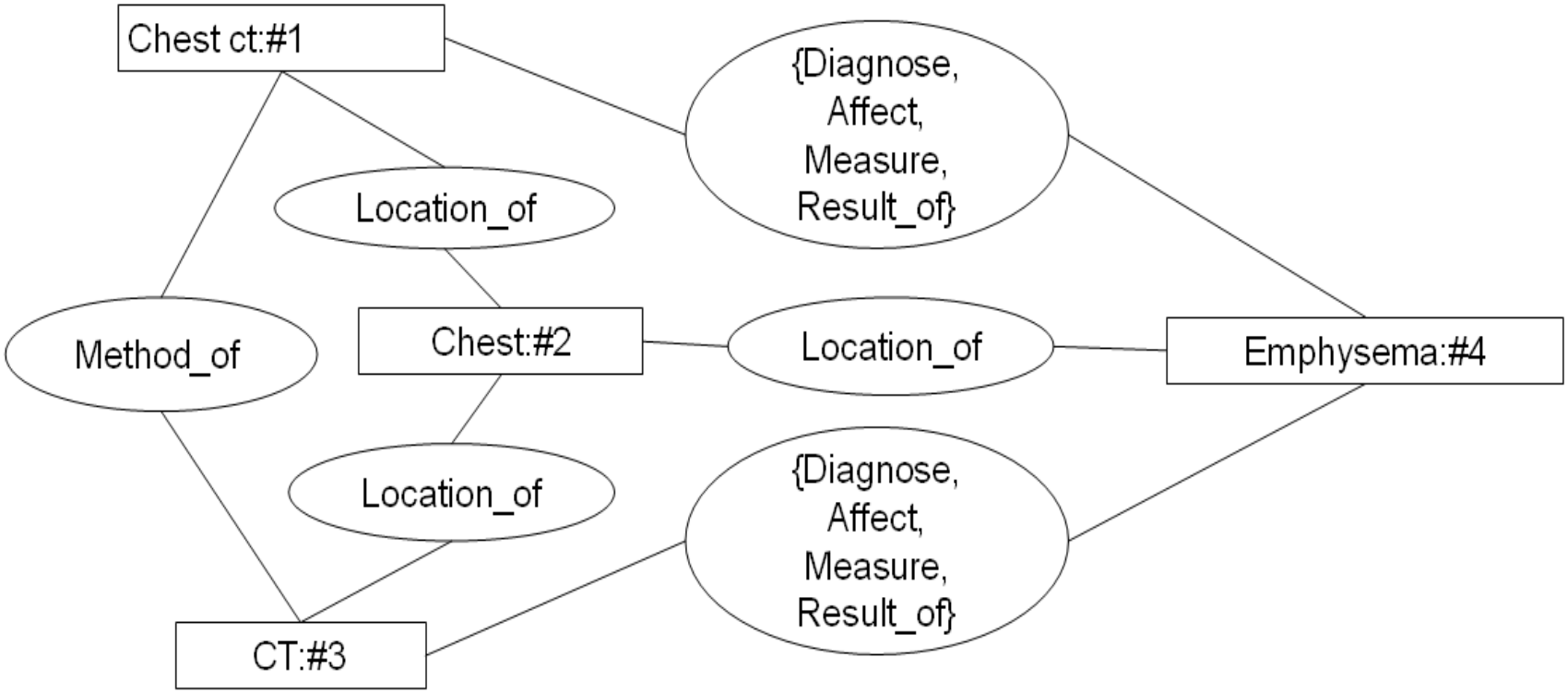
1. Boolean model
2. Vector space model
3. Probabilistic models
   - Standard probabilistic model ([5])
   - Language modeling approach ([6])
   - Divergence from randomness ([7])

Statistical approach currently widely used

What if ?

(show, CT, chest, image, emphysema)

Replaced by



What do we need ?

1. A module for buiding semantic graphs from documents and information needs

2. A module for matching semantic graphs

Building semantic graphs (1)

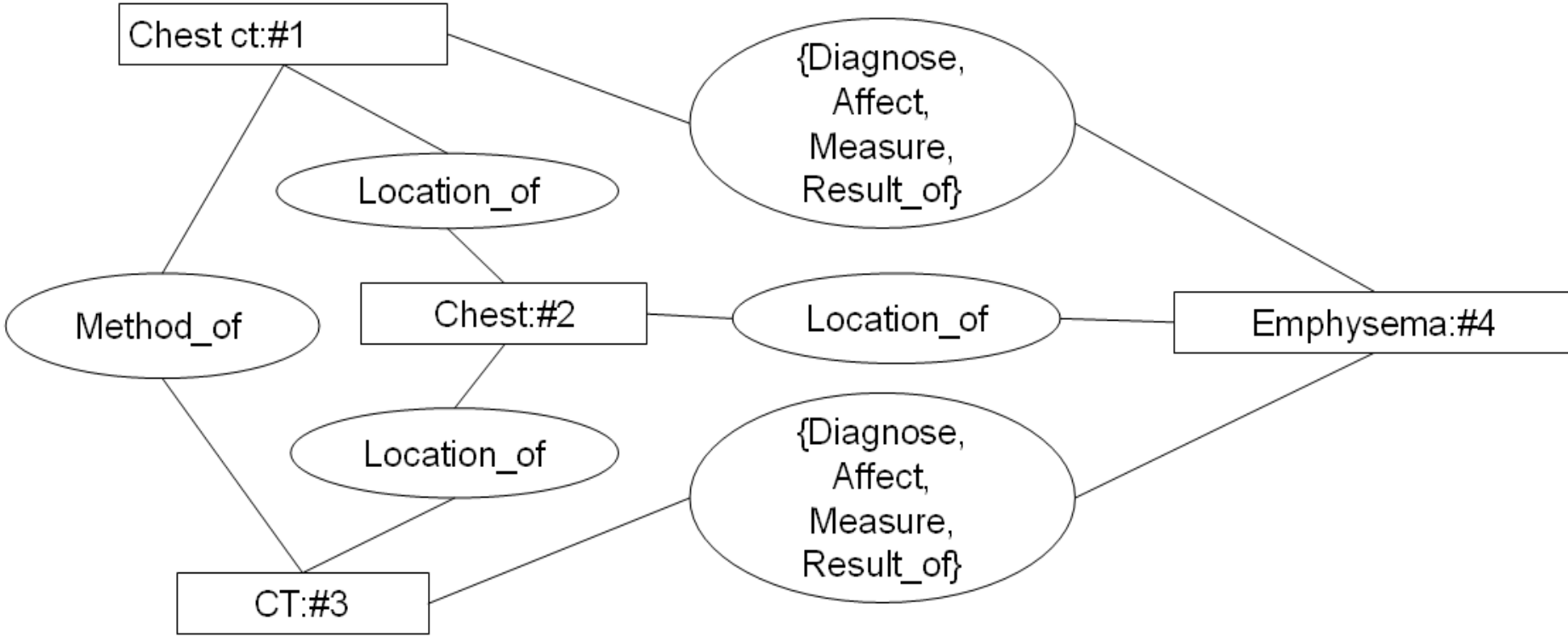
NLP processing and use of semantic resources (ontologies, thesauri)

1. Morphological analysis : POS (part-of-speech) tagging with lemmatization
2. Stopword removal : filtering empty words on the basis of their POS
3. Lexical lookup in the concept set associated with the semantic resource
4. Possibly : additional filtering on the domain
5. Relation extraction from semantic resources (on the basis of the output of a shallow parser ; using existing relations)

Building semantic graphs (2)

Available tools : MetaMap ([8]), Minipar ([9]), Treetagger ([10])

Example



Matching semantic graphs

Extending the language modeling approach to deal with semantic graphs

Queries and documents are represented as graphs :
$G_q(=< W_C^q, W_E^q >)$

Probability of the query graph to be generated by the document (graph) model M_d :

$$P(G_q|M_d) = P(W_C^q|M_d) \times P(W_E^q|W_C^q, M_d)$$

Cf. [11,12]

Recall vs precision enhancement procedures

Conceptual indexing mainly seen as a recall enhancement procedure

Relational indexing mainly seen as a precision enhancement procedure

Experimental illustration

Collection of 55,485 documents, with 85 information needs (43 used for training, 42 for testing)

	λ_u	λ_r	λ_e	Training	Test
MAP					
GLM (words)	0.4	-	-	0.222	0.218
GLM (concepts)*	0.4	-	-	0.246	0.284
GLM (relations)*	0.3	1	0.5	0.252	**0.294**
P@5					
GLM (words)	0.2	-	-	0.401	0.320
GLM (concepts)*	0.1	-	-	0.433	0.488
GLM (relations)*/**	0.1	0.3	0.5	0.457	**0.521**

Best results in bold ; */** : significant difference with *words*/*concepts* (Wilcoxon test, p=0.05)

Conclusion

1. Use of semantic resources and extended IR models improves IR system
   - Fairly straightforward use of the semantic resource
   - Complete semantic resource (meta-thesaurus and semantic network)
2. Is it a domain-specific approach ?
   - Adequacy of the resource wrt the collection under consideration
   - The case of *WordNet* and general language collections
3. Is the approach applicable to other domains ?
   - Medical and biological domains well suited (several works on semantic IR in these domains)
   - Semantic resources exist in other domains (geology, chemistry, $\cdots$) but not necessarily evaluation resources

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