Cross-Language Information Retrieval

Prepared by Diana Inkpen, April 2009,
(partly based on slides by Hans Uszkoreit and Feiyu Xu)

CLIR

- **Cross-language information retrieval** deals with retrieving information written in a language different from the language of the user's query.
- Examples:
  - a user can pose a query in English but retrieve relevant documents written in French.
  - multilingual searchers can issue a single query to a multilingual collection.
  - searchers with a limited active vocabulary, but good reading comprehension, in a second language can issue queries in their most fluent language.

CLIR a subset of Multilingual Information Access

Not to be confused with:

- multi-language search engine which allows to query in different languages but which for each language only retrieves documents in the query language

Synonyms for CLIR:

- MLIR (Multi-Lingual Information Retrieval)
- TIR (Translingual Information Retrieval)

Terms Related to CLIR

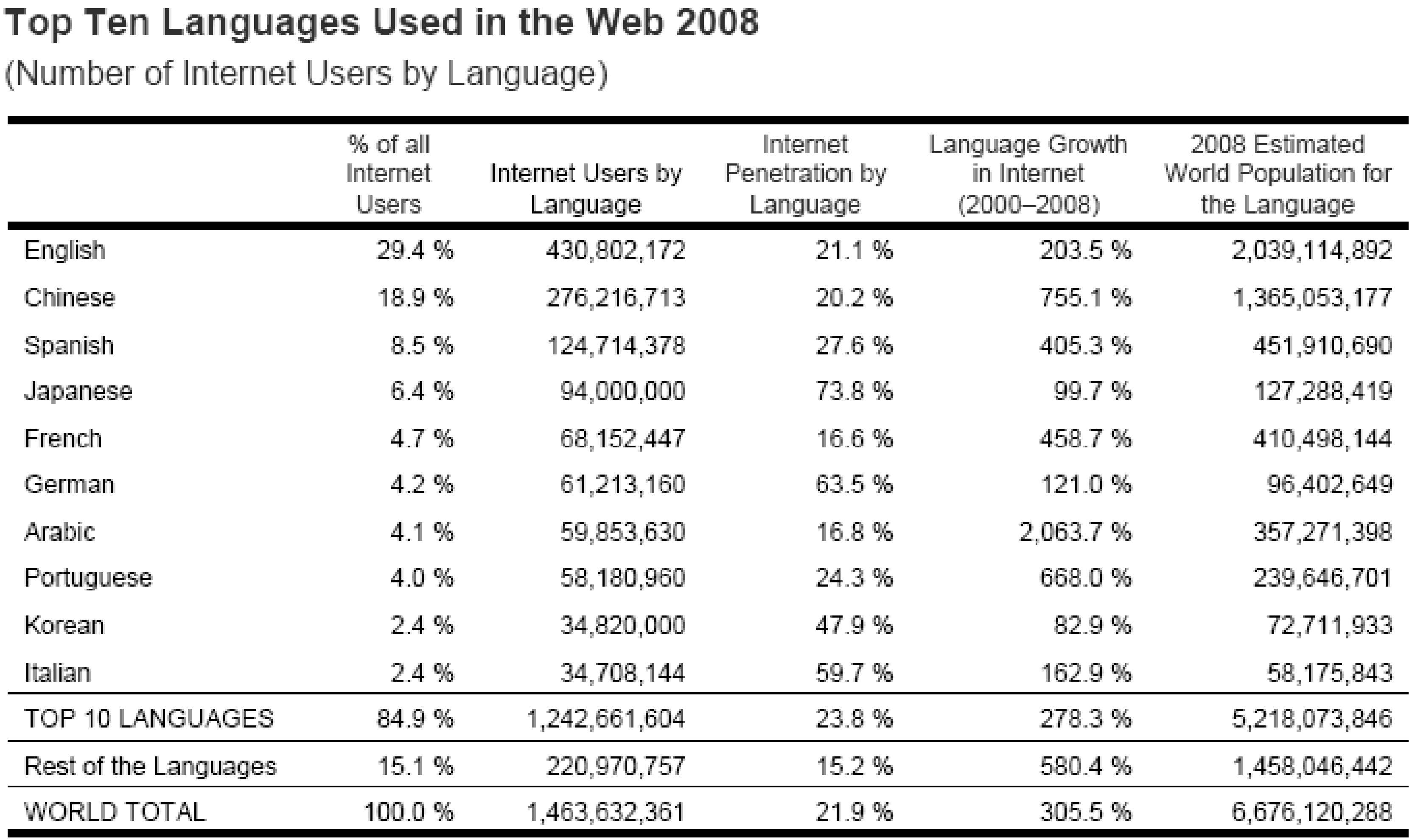
- source language: the language of the query
- target language: the language of the documents which are searched

… and some general IR terms:

- relevance: “the fit of the retrieved information with the information need” (LT World)
- precision: the ratio of relevant information in the retrieved data relating to the overall retrieved data
- recall: the ratio of relevant information in the retrieved data relating to the relevant information available overall

Why CLIR?

source: http://www.internetworldstats.com/stats7.htm



Top Ten Languages Used in the Web 2008

(Number of Internet Users by Language)

	% of all Internet Users	Internet Users by Language	Internet Penetration by Language	Language Growth in Internet (2000–2008)	2008 Estimated World Population for the Language
English	29.4 %	430,802,172	21.1 %	203.5 %	2,039,114,892
Chinese	18.9 %	276,216,713	20.2 %	755.1 %	1,365,053,177
Spanish	8.5 %	124,714,378	27.6 %	405.3 %	451,910,690
Japanese	6.4 %	94,000,000	73.8 %	99.7 %	127,288,419
French	4.7 %	68,152,447	16.6 %	458.7 %	410,498,144
German	4.2 %	61,213,160	63.5 %	121.0 %	96,402,649
Arabic	4.1 %	59,853,630	16.8 %	2,063.7 %	357,271,398
Portuguese	4.0 %	58,180,960	24.3 %	668.0 %	239,646,701
Korean	2.4 %	34,820,000	47.9 %	82.9 %	72,711,933
Italian	2.4 %	34,708,144	59.7 %	162.9 %	58,175,843
TOP 10 LANGUAGES	84.9 %	1,242,661,604	23.8 %	278.3 %	5,218,073,846
Rest of the Languages	15.1 %	220,970,757	15.2 %	580.4 %	1,458,046,442
WORLD TOTAL	100.0 %	1,463,632,361	21.9 %	305.5 %	6,676,120,288

Why CLIR?

In general: better access to more information.

- societal benefits: information exchange to improve understanding
- economic benefits: information to provide competitive advantage
- crisis response: language differences can produce costly delays
- allow anyone to retrieve information that is available in any language

Generic Application Scenarios of CLIR

- A user has no knowledge of a target language, i.e., she cannot search for documents in that language at all
  - with CLIR she can make use of media data pools that are indexed with captions in that language, for example for picture pools, music databases, etc.
  - with CLIR she can make use of factoid textual data which is language independent, for example registers of names
  - with CLIR she can get a preselection of documents that can then be passed on to a translator

Generic Application Scenarios of CLIR

- A user has only passive knowledge of a target language, i.e., she cannot actively search for documents in that language
  - with CLIR she can make use of relevant texts
- A document collection has such a large number of languages that it would be impractical to formulate a query in each of these languages
  - with CLIR one could get relevant documents with only a search query in one of these languages

CLIR The Three Main Approaches to CLIR
(according to a taxonomy developed by Oard & Dorr, 1996)

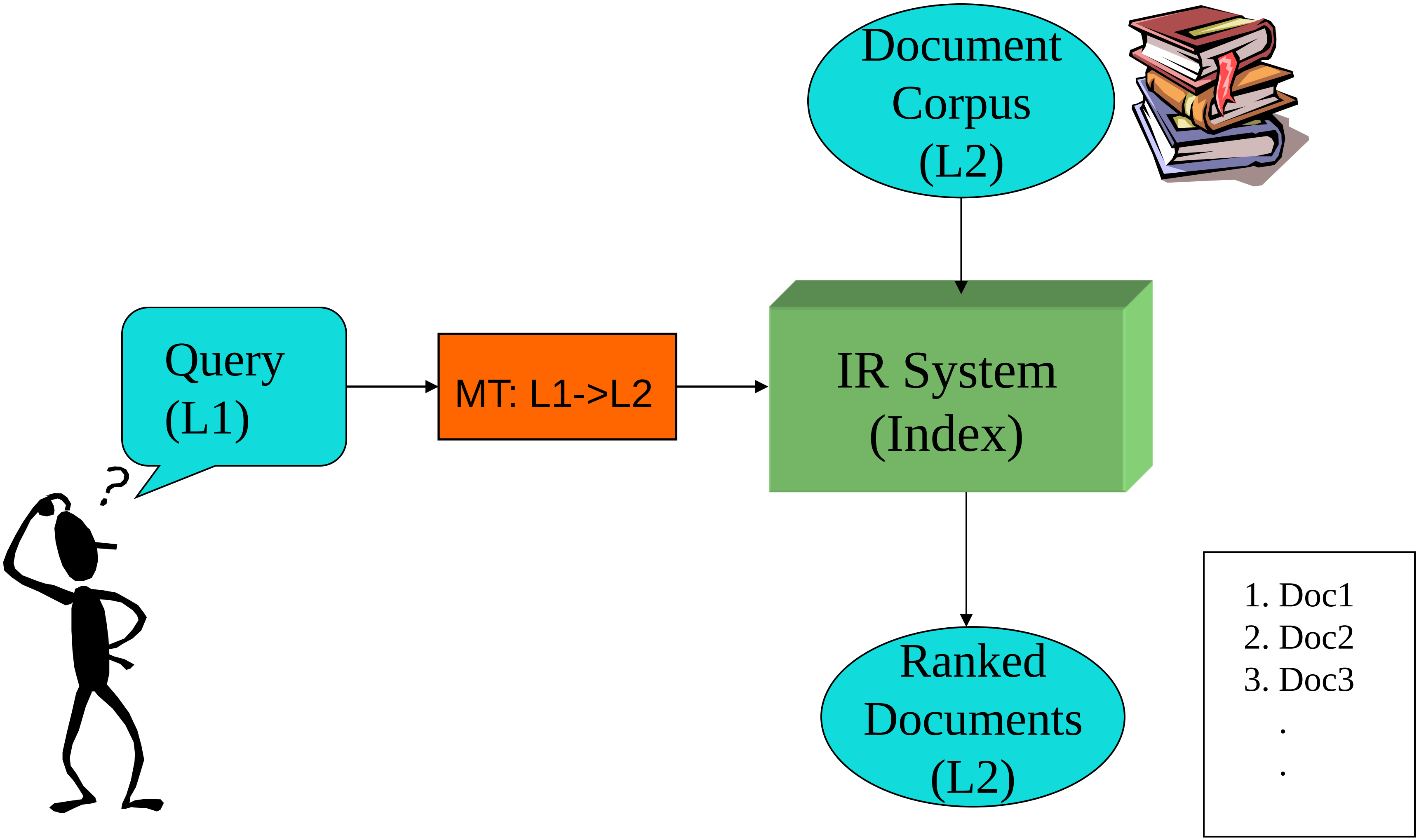
- use of Machine Translation (MT)
  - translation of the search query
  - and/or translation of target documents
- thesaurus-based approaches
  - manual use of thesauri: “controlled vocabulary” systems
  - automatic use of thesauri: “concept retrieval” systems
- corpus-based approaches
  - use of statistical information about term usage from parallel corpora

MT Approach: Query Translation

(1) Search query translation

- helps the user formulating or using a query in the target language by automatically translating the query from the source language to the target language

MT Approach: Query Translation



Document Corpus (L2)

Query (L1)

MT: L1->L2

IR System (Index)

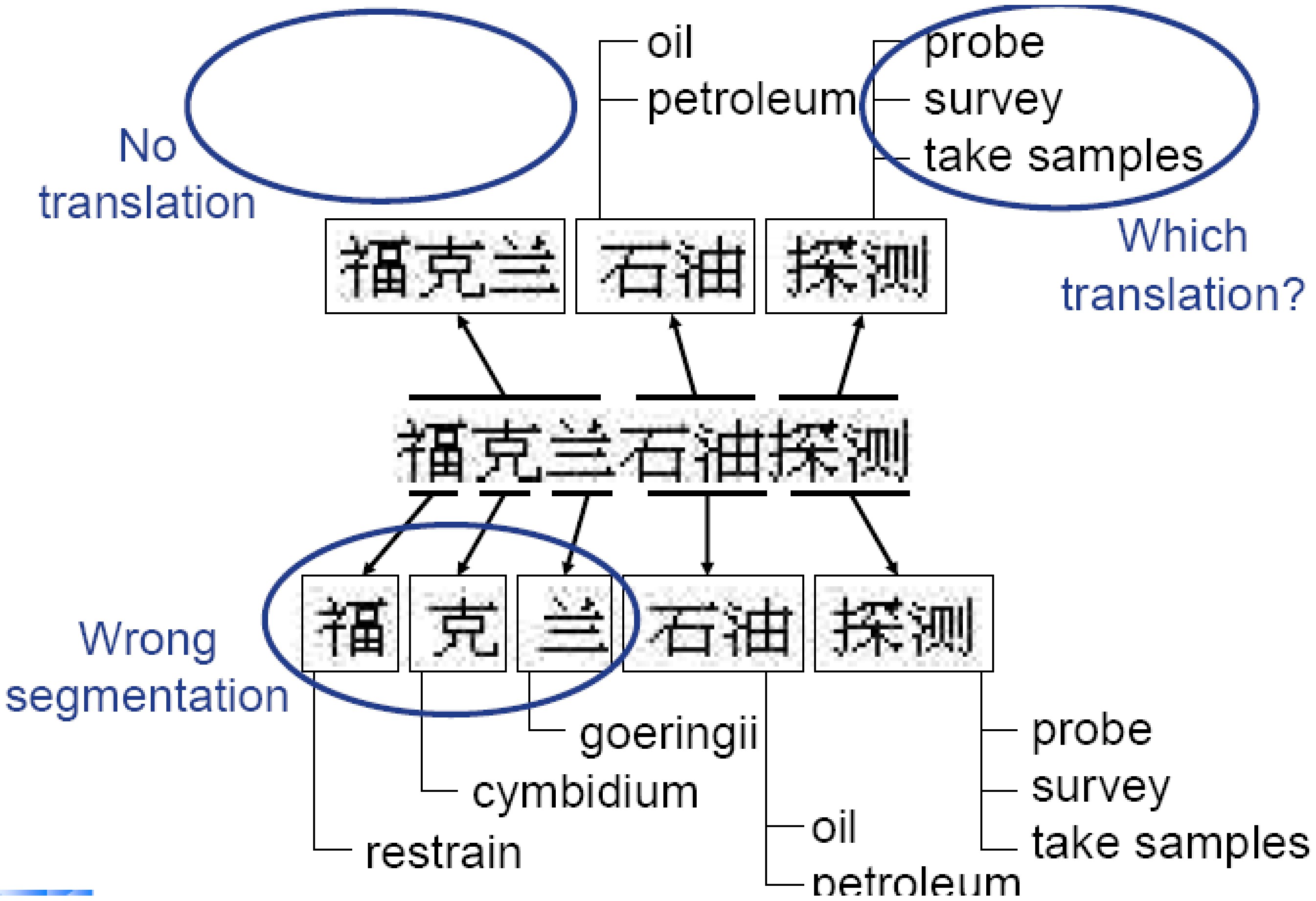
Ranked Documents (L2)

1. Doc1
2. Doc2
3. Doc3
.
.

MT Approach: Query Translation

- pros:
  - straightforward (if an MT system is available)
  - once the query is translated, the retrieval is relatively fast
- cons:
  - user may not always be able to make use of the target language documents
  - queries are usually short which makes MT error-prone
  - inherits most weaknesses of MT (cf. three key challenges for MT on the next slide) and MT system implementations

MT: Three Key Challenges



No translation

oil
petroleum

probe
survey
take samples

Which translation?

福克兰 石油 探测

福克兰石油探测

Wrong segmentation

福 克 兰 石油 探测

goeringii
cymbidium
restrain

oil
petroleum

probe
survey
take samples

Example: CLEF 2007, CL-SR Task

- **Cross-Language Evaluation Forum (CLEF) 2007**
  - **Cross-Language Speech Retrieval (CL-SR) track**

- Collection – oral testimonies collected by the Shoah Foundation Institute for Visual History and Education
  - ASR transcribed text (WER 38%)

    8,104 segments, from 272 interviews with Holocaust survivors, totaling 589 hours of speech
  - automatic keywords, manual keywords and 3-line summaries
- Training queries (38), test queries (25) – actual user requests
- Relevance judgments

System overview
(Alzghool and Inkpen, 2008)

- **SMART IR system** (Buckley et al, 1993)

- Online MT tools

Spanish, German, French:

1. http://www.google.com/language_tools?hl=en
2. http://www.babelfish.altavista.com
3. http://freetranslation.com
4. http://www.wordlingo.com/en/products_services/wordlingo_translator.html
5. http://www.systranet.com/systran/net
6. http://www.online-translator.com/srvurl.asp?lang=en
7. http://www.freetranslation.paralink.com

Czech:

1. http://intertran.tranexp.com/Translate/result.shtml

Example query

<top>

<num>1159

<title>Child survivors in Sweden

<desc>Describe survival mechanisms of children born in 1930-1933 who spend the war in concentration camps or in hiding and who presently live in Sweden.

<narr>The relevant material should describe the circumstances and inner resources of the surviving children. The relevant material also describes how the wartime experience affected their post-war adult life.

</top>

<top>

<num>1159

<title>Les enfants survivants en Suède

<desc>Descriptions des mécanismes de survie des enfants nés entre 1930 et 1933 qui ont passé la guerre en camps de concentration ou cachés et qui vivent actuellement en Suède.

</top>

Example of translated query (from French)

<top>

<num> 1159

<title> surviving children in Sweden

surviving children in Sweden

The children survivors in Sweden

surviving children in Sweden

surviving children in Sweden

The surviving children in Sweden

surviving children in Sweden

<desc> Descriptions of the mechanisms of survival of the children born between 1930 and 1933 who passed the war in concentration camps or hidden and who currently live in Sweden. …

Descriptions of the survival mechanisms of the born children between 1930 and 1933 that passed the war in concentration camps or hidden and that live currently in Sweden. …

</narr>

</top>

Results of the cross-language experiments (MAP scores)

	Language	**Training**	**Test**
1	**English**	**0.0969**	**0.0855**
2	**French**	**0.0912**	**0.0622**
3	**Spanish**	**0.0731**	**0.0682**

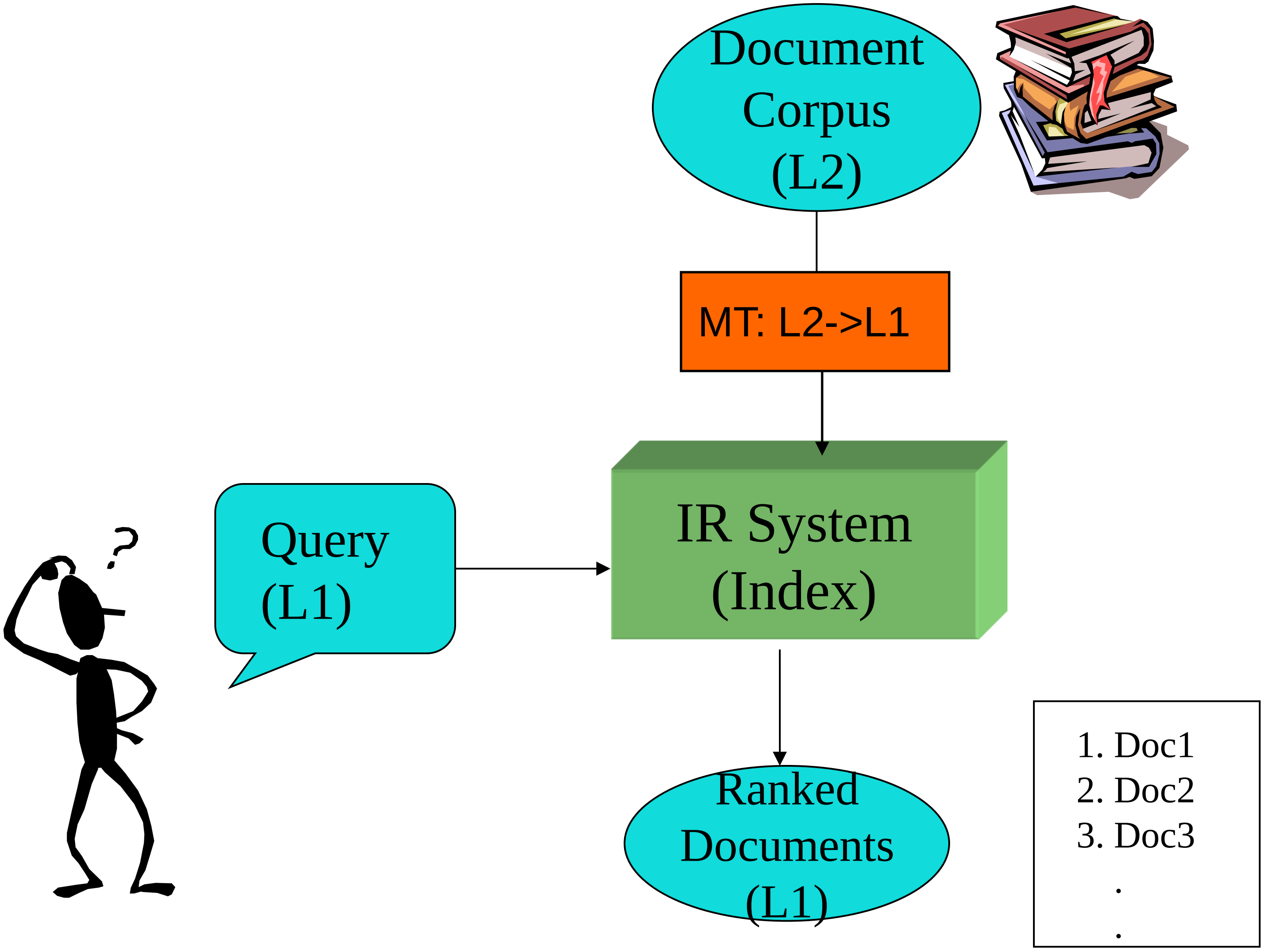
- The cross-language results for French are very close to Monolingual (English) on training data (the difference is not significant), but not on test data (the difference is significant).
- The difference is significant between cross-language results for Spanish and Monolingual (English) on training data but not on test data (the difference is not significant).

MT Approach: Document Translation

(2) Target document translation

- translates target documents before searching through them
- translation is usually done offline and the cached translations are then searched

MT Approach: Document Translation



Document Corpus (L2)

MT: L2->L1

IR System (Index)

Query (L1)

Ranked Documents (L1)

1. Doc1
2. Doc2
3. Doc3

.
.

MT Approach: Document Translation

- pros:
  - straightforward (if an MT system is available)
  - user can directly use the retrieved documents
  - documents usually have more context which allows more
  - robust MT than for query translation
- cons:
  - translation of document collections may be very time consuming
  - offline translation of document collections may require lots of additional storage
  - inherits most weaknesses of MT and MT system implementations

Thesaurus-Based Approach

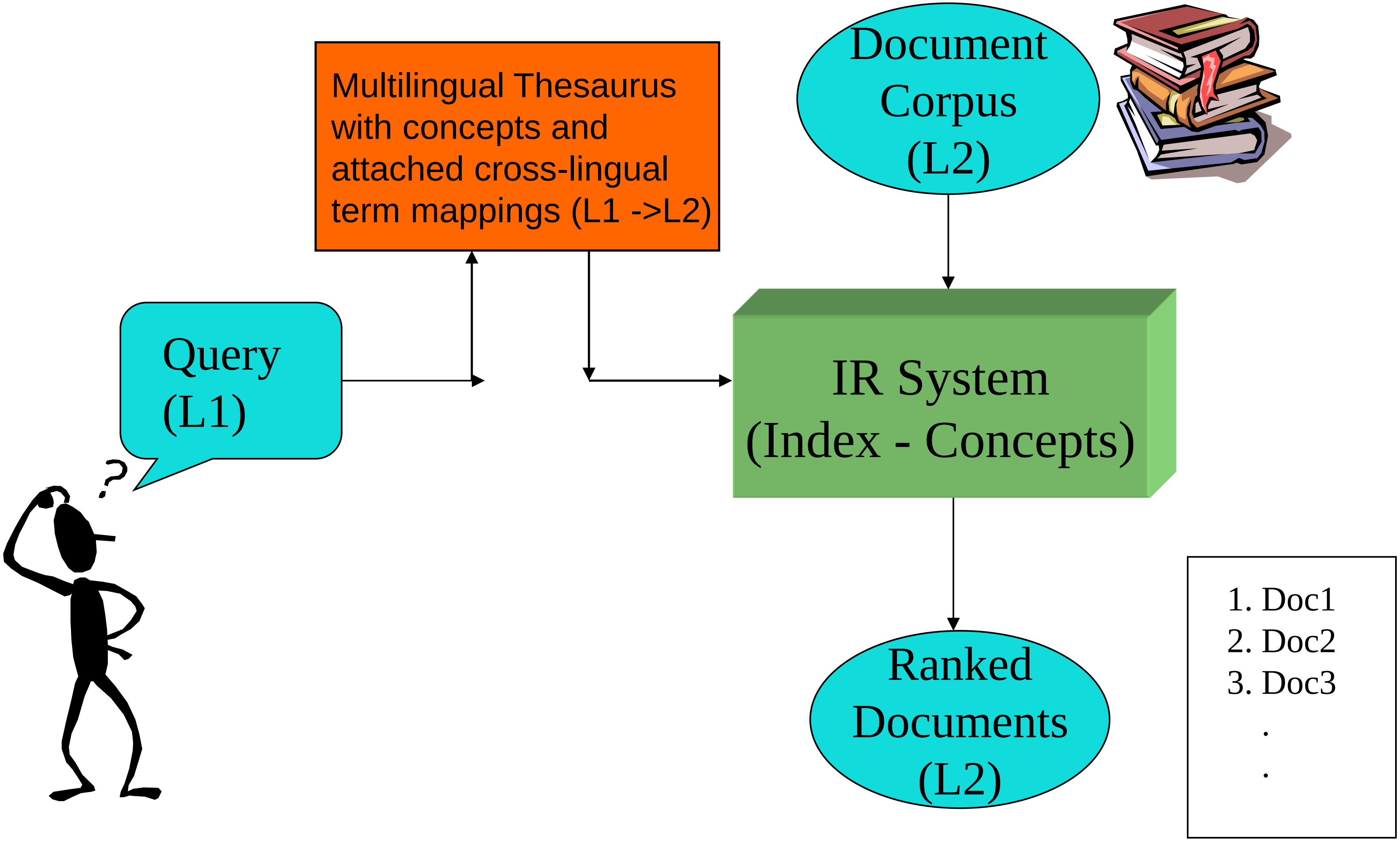
- Thesaurus: a resource which organizes the terminology of a domain of knowledge, i.e., an ontology for terminology
- Multilingual thesauri encode usually:
  - cross-linguistic synonymy
  - sometimes: hierarchical relations between terms (hyperonymy, hyponymy, etc.)
  - seldom: associative relations between terms
- The thesaurus-based approach to CLIR
  - uses multilingual thesauri
  - has a rather broad definition of a thesaurus
- Examples of multilingual thesauri used for CLIR:
  - simple cross-language synonym lists
  - collection of concepts with attached cross-lingual information
  - “classic” syntax and semantics lexicons

Thesauri-based CLIR: Controlled Vocabulary

(1) Manual use of thesauri: controlled vocabulary

- each term in the thesaurus uniquely specifies a concept
- target documents are labeled with concepts from the thesaurus
- with the terms from the thesaurus the user manually specifies the concepts he/she would like to have in the IR query

Thesauri-based CLIR: Controlled Vocabulary



Multilingual Thesaurus with concepts and attached cross-lingual term mappings (L1 ->L2)

Document Corpus (L2)

Query (L1)

IR System (Index - Concepts)

Ranked Documents (L2)

1. Doc1
2. Doc2
3. Doc3
.
.

Thesauri-based CLIR: Controlled Vocabulary

- pros:
  - very productive, especially for skilled users
  - works transparently for the user
  - unambiguous mapping between the query and the target document
- cons:
  - very expensive to create good thesauri
  - target documents must be labeled with concepts
  - may be difficult to use for unexperienced users (e.g., because of the manual selection of the intended concept)
  - doesn’t scale
  - restricted to certain domains
  - IR queries can only be as precise as the predefined thesaurus concept

Thesauri-based CLIR: Concept Retrieval

(2) Automatic use of thesauri: concept retrieval

- basically like the controlled vocabulary approach
- terms in the IR query for which there is no unambiguous cross-lingual mapping are automatically mapped to concepts with either:
  - concept substitution (simple): ambiguous terms in the query are automatically replaced with a list of all possible concepts
  - query expansion (more sophisticated): concept relations from the thesaurus are used to "intelligently" replace ambiguous terms in the query with possible concepts

Thesauri-based CLIR: Concept Retrieval

- pros:
  - increases recall
- cons:
  - may decrease precision (especially in the case of concept substitution)
  - very expensive to create good thesauri
  - target documents must be labeled with concepts
  - doesn’t scale
  - restricted to certain domains
  - IR queries can only be as precise as the predefined thesaurus concepts

Corpus Corpus-Based Approach to CLIR

- use of statistical information about term usage from parallel corpora
- usually based on two general retrieval principles:
  - target documents with frequent usage of query terms are potentially more relevant than target documents with infrequent query term usage
  - rare query terms are more useful than query terms that are very frequent in the overall target document collection
- pros:
  - usage of recent terminology (as provided by the corpora) is possible
- cons:
  - parallel corpora needed
  - restricted to the domains of the parallel corpora

LSI

- See extra slides

Cross-Language LSI

- See extra slides

CLIR Research Community

- Text REtrieval Conference (TREC)
  - http://trec.nist.gov/
  - Arabic, English, Spanish, Chinese, etc.
  - CLIR at TREC: http://www.glue.umd.edu/~dlrg/clir/trec2002/
- Cross-Language Evaluation Forum (CLEF)
  - European languages
  - http://www.clef-campaign.org/
- NTCIR (NII Test Collection for IR Systems)
  - http://research.nii.ac.jp/ntcir/index-en.html
  - with related workshops
- Information Retrieval for Asian Language (IRAL)
  - international workshop

References

- Douglas Oard’s research web page:
  - http://terpconnect.umd.edu/~oard/research.html
- A recent “state of the art” description by Feiyu Xu:
  - http://www.dfki.de/~feiyu/KBIRAF.pdf
- Oard, D. W. and Dorr, B. J. (1996): *A Survey of Multilingual Text Retrieval*. Technical report at the University of Maryland (USA).
  - http://www.glue.umd.edu/~dlrg/filter/papers/mlir.ps
- Fluhr, C. (1995): *Multilingual information retrieval*. In: Cole, R. A.; Mariani, J; Uszkoreit, H.; Zaenen, A. and Zue, V. (eds.): *Survey of the State of the Art in Human Language Technology*. pp. 391–305. Center for Spoken Language Understanding, Oregon Graduate Institute.
  - http://www.lt-world.org/HLT_Survey/ltw-chapter8-5.pdf

Lab session

CLEF (Cross-Language Evaluation Forum)

- http://www.clef-campaign.org/

Demo: Google Cross-Language Search Engine

- http://translate.google.com/translate_s

Multilingual thesauri

- http://www.wordreference.com/

Cross-Language LSI

- http://www.cs.duke.edu/~mlittman/courses/Archive/INLS379/xlang/xlang.html