

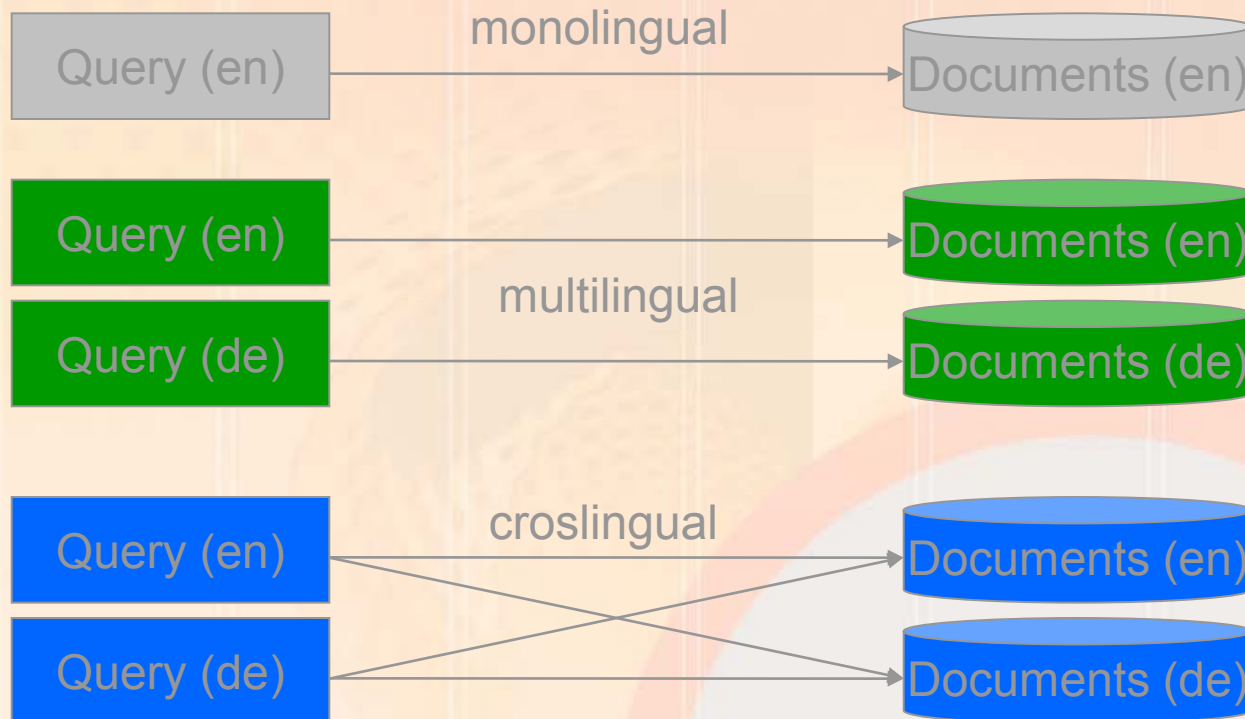
Cross-Lingual Information Retrieval

Language Technology I

101001010100111101000010010111010010
00410000101001010010010100001012010010101400001111010010101001110100001001011010010
11010101010111010000410000101001010010010100001011010010101400001111010010

Terminology

- monolingual, multilingual, cross-lingual



Use Scenarios (I)

- 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 get a pre-selection of documents that can then be passed on to a translator*



Use Scenarios (II)

- 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*



Use Scenarios (III)

- 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 approaches

- Machine translation:
 - *uses NLP tools like PoS-tagger, parser, morphological analyzers, etc.*
- Thesaurus-based approaches
 - *manual use of thesauri: “controlled vocabulary” systems*
 - *automatic use of thesauri: “concept retrieval” systems*
- Corpus-based methods: work with frequency analysis
 - *Implication: aboutness of the two collections should be similar*

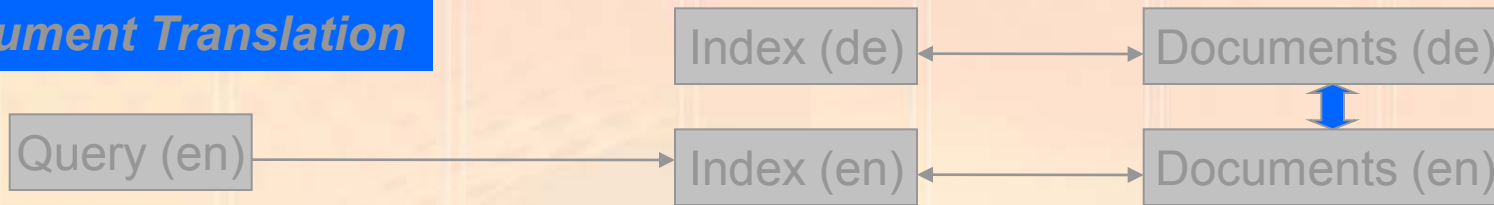


MT Approach - Architecture

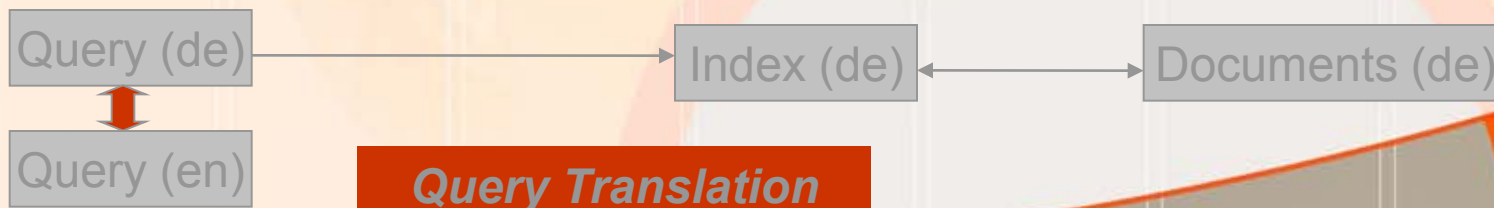
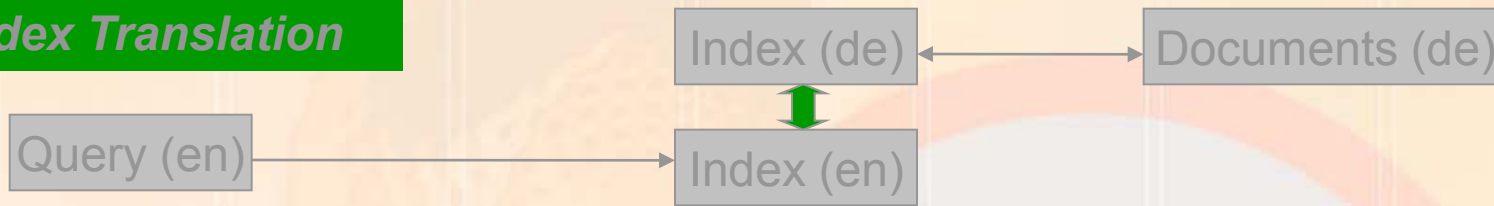
CLIR



Document Translation



Index Translation



Query Translation



Document Translation

- Problem solved by multiplying the texts
 - *Make texts available in all languages*
 - *multilingual (= several monolingual) retrieval*
- Feasibility:
 - *Required in some applications*
 - *Patents, multilingual states (EG, Belgium, ...)*
 - *Impossible in other areas (Internet)*
- Evaluation:
 - *From costly to impossible*
 - *Results depend on translation quality*
 - *translation dictionary updates invalidate search on existing document pool (->retranslate everything)*



Index Translation

- Idea:
 - *multilingual Index*
 - *Analyze query in query language, translate terms*
 - *Search with all document language index terms*
 - *(Problem of retranslation of the hits)*

- Feasibility:

- *Not feasible*
 - *Ambiguity of index terms*
 - *Multiword terms not in index*
 - *Context dependency of translations*

Fehler: mistake, fault, error, bug
nuclear: Kern~, zentral, nuklear
power: Macht, Kraft, Strom
plant: Pflanze, Unternehmen

=> Organize the index as a special resource!



Query Translation

- Approach: Translation of query
 - *Analyse and translate the query terms*
 - *Search in (monolingual) Backend-System*
- Evaluation
 - *Backend database stays unchanged*
 - *Translation changes do not affect document base*
 - *Cross-lingual component as system frontend*
 - *contains multilingual linguistic resource*
 - *Which is also usable for re-translation*
 - *And can be maintained independently*
 - *Cross-linguality is transparent for the users*
 - *Fine-tuning between frontend and backend required*



MT Approach

- 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: “Thesauri”

- 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*




MULINEX Search - Netscape

File Edit View Go Communicator Help

MULINEX Hemm The Force Wi THE Presenta

Location: <http://mulinex.dfki.de/mulinexproto/cgi-bin/mulinex.sh>

Back Forward Reload Home Search Guide Print Security Stop



english deutsch français

search advanced search help

Search

Tailor the search engine to fit your needs and preferences.

- [About Mulinex](#)
- [I want to register](#)
- [login](#)

Search for

The language of the query is

Find documents in

- English
- French
- German

[search](#) | [advanced search](#) | [help](#)
[login](#) | [I want to register](#)
[e-mail](#) | [about mulinex](#)

Document: Done


MULINEX Query Assistant - Netscape

File Edit View Go Communicator Help

MULINEX Hemm The Force Wi THE Presenta

Location: http://mulinex.dfki.de/mulinexproto/cgi-bin/mulinex.sh

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english deutsch français
search advanced search help

Query translation

Your search will be carried out with the following translations of your query. You can modify the translation by:

- turning off unwanted translations
- adding your own translations in the text fields

English query terms	French translations	German translations
<input checked="" type="checkbox"/> euro	<input checked="" type="checkbox"/> euro <input type="text"/>	<input checked="" type="checkbox"/> Euro <input type="text"/>
<input checked="" type="checkbox"/> introduction	<input type="checkbox"/> instauration <input checked="" type="checkbox"/> introduction <input checked="" type="checkbox"/> présentation <input type="text"/>	<input type="checkbox"/> Empfehlungsschreiben <input checked="" type="checkbox"/> Einleitung <input checked="" type="checkbox"/> Einführung <input type="text"/>
<input type="text" value="Germany"/>		

[search](#) | [advanced search](#) | [help](#)
[login](#) | [I want to register](#)
[e-mail](#) | [about mulinex](#)

Document: Done





MULINEX Search Results - Netscape

File Edit View Go Communicator Help

MULINEX Hemm THE Presenta

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mulinex

Personal search
Tailor the search engine to fit your needs and preferences.

- [Feedback](#)
- [I want to register](#)
- [login](#)

Search for

The language of the query is

Find documents in

English
 French
 German

You searched for the English query **euro introduction Germany** in German, French, English.

100 documents 22 documents 57 documents 21 documents

- French
- 1 [Charte PME OEC](#)
Category: Politics, , Legal, Macintosh, Finance
Summary: CHARTE DE LA PROPARATION DES PME □ L'EURO. Questionnaire PME-EURO. Ventes, politique commerciale, marketing. Achats, politique diapprovisionnement, logistique. Gestion financière. Ressources humaines. Système d'information et informatique. Comptabilité, comptes annuels et information de gestion. '
Summary in: [English](#) [German](#)
<http://www.finances.gouv.fr/euro/charte/98-111-2.htm> Size 18 K
- German
- 2 [Europarl: der Euro - VIERTE WAHLPERIODE \(1994-1999\)](#)
Category: Legal, Politics, Finance, Travel
Summary: VIERTE WAHLPERIODE (1994-1999). 1. Legislativberichte. 2. Nichtlegislative Berichte. 3.LAUFENDE ARBEITEN. Europarl: der Euro - VIERTE WAHLPERIODE. VIERTE WAHLPERIODE Legislativberichte Nichtlegislative Berichte Laufende Arbeiten 1. Legislativberichte A4-0379/96 - PV 28 11 96 - ARI

Document: Done



Thesaurus-Based Approach: “Thesauri”

- 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 concepts*

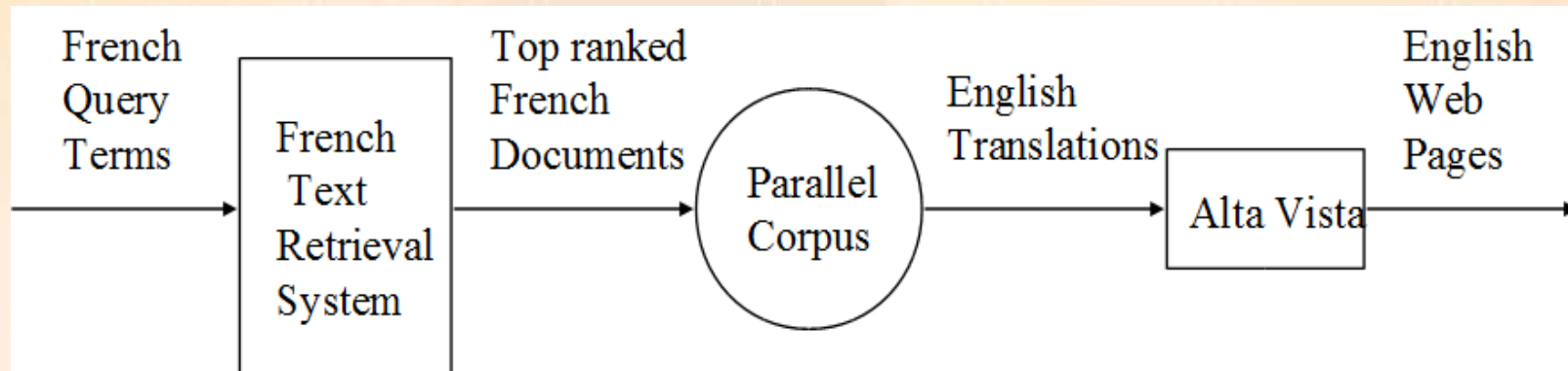


Corpus-Based Approach

- 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*

Pseudo-Relevance Feedback

- Enter query terms in French
- Find top French documents in parallel corpus
- Construct a query from English translations
- Perform a monolingual free text search



Learning From Document Pairs

- Count how often each term occurs in each pair
 - Treat each pair as a single document*

	English Terms					Spanish Terms			
	E1	E2	E3	E4	E5	S1	S2	S3	S4
Doc 1	4		2			2			1
Doc 2	8		4			4			2
Doc 3		2		2			2	1	
Doc 4		2	1				2		1
Doc 5	4				1	2		1	

Similarity based Dictionaries

- Automatically developed from aligned documents
 - *Terms E1 and E3 are used in similar ways*
 - *Terms E1 & S1 (or E3 & S4) are even more similar*
- For each term, find most similar in other language
 - *Retain only the top few (5 or so)*





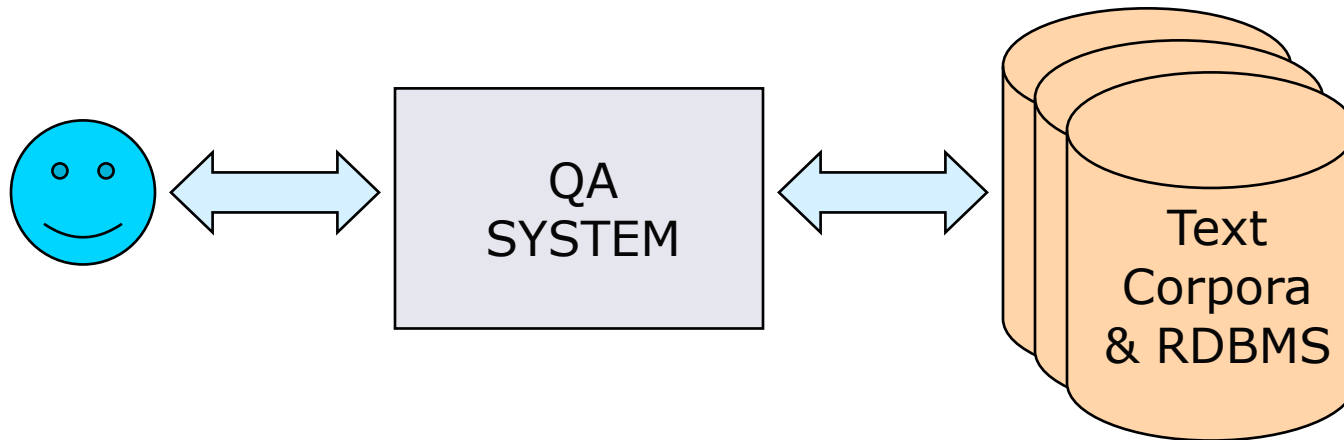
CLIR Research Community

- 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*
- and quite a few others

Open-domain Cross-lingual Question Answering from Unstructured Documents

Question Answering

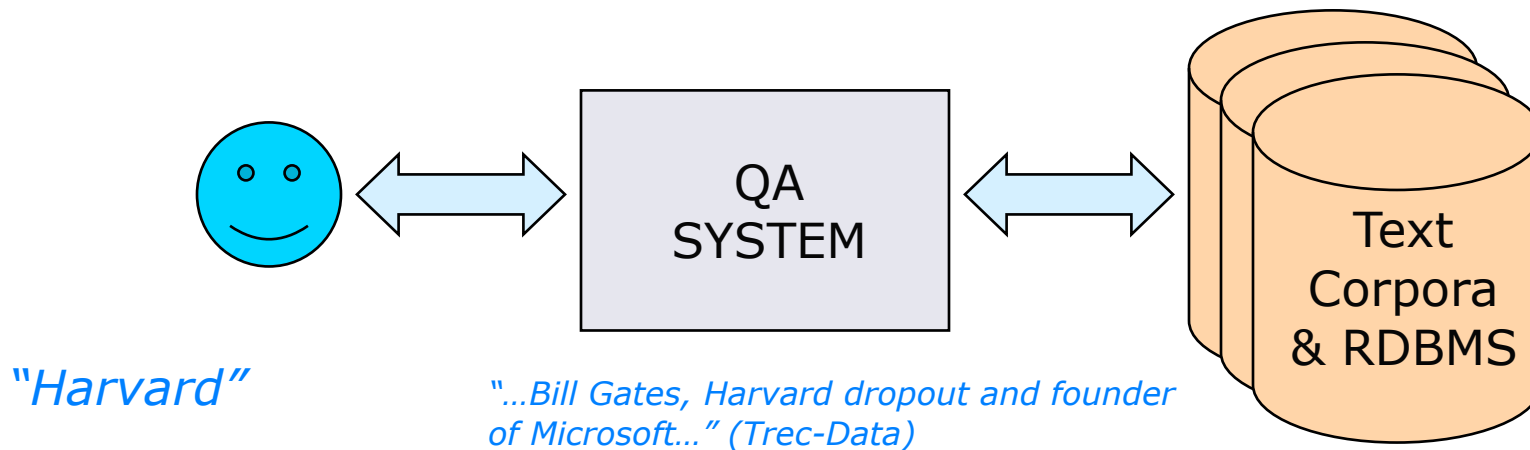
- Input: a question in NL; a set of text and database resources
- Output: a set of possible answers drawn from the resources



Question Answering

- Input: a question in NL; a set of text and database resources
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"Where did Bill Gates go to college?"

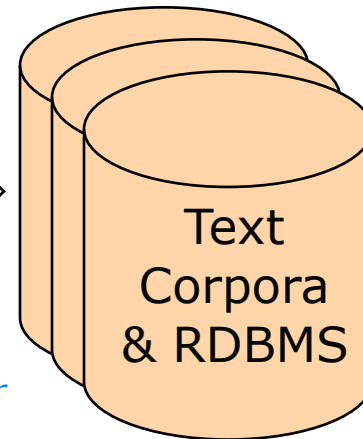
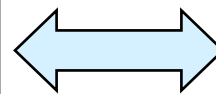
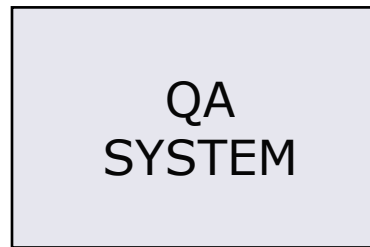
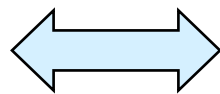


Question Answering

- Input: a question in NL; a set of text and database resources
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"Where did Bill Gates go to college?"

"What is the rainiest place on Earth?"



"Harvard"

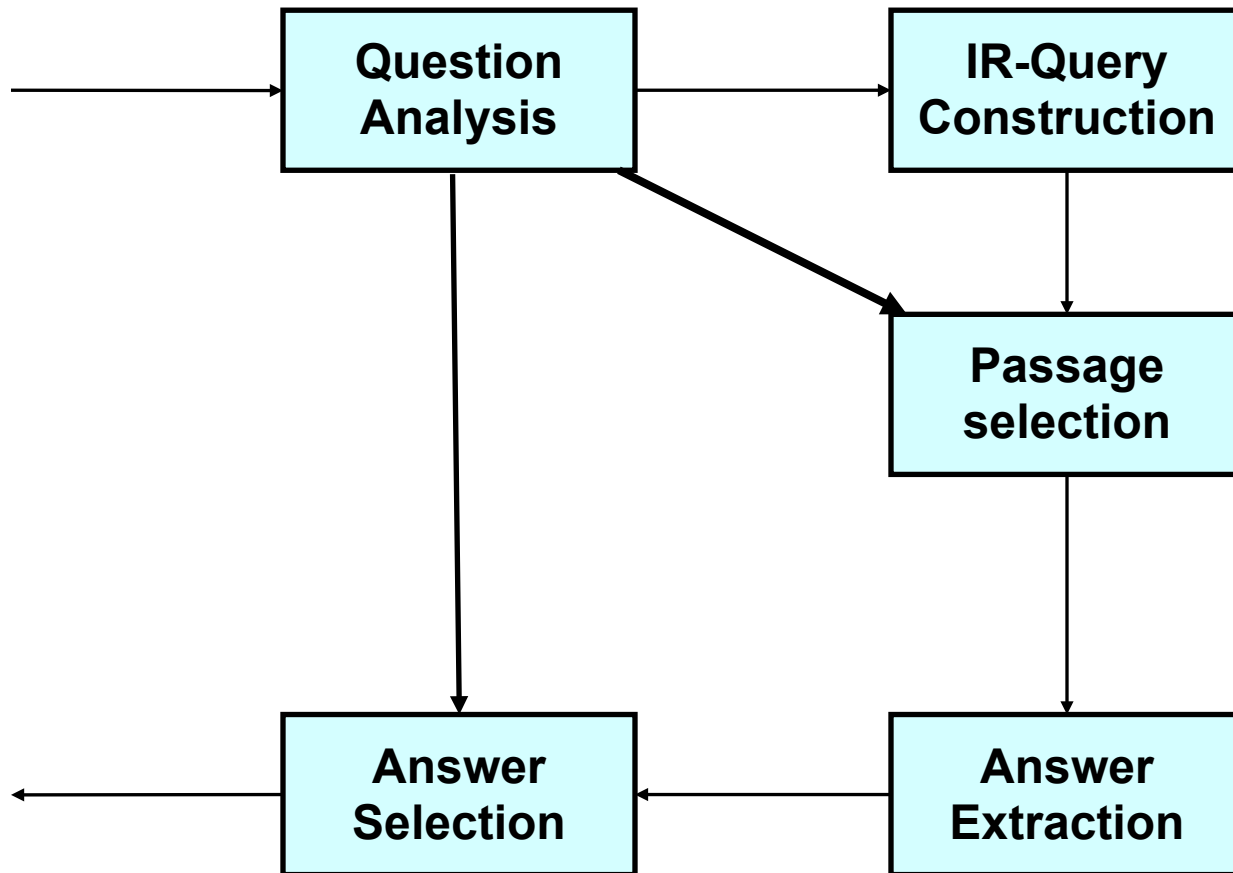
"Mount Waialeale"

"...Bill Gates, Harvard dropout and founder of Microsoft..." (Trec-Data)

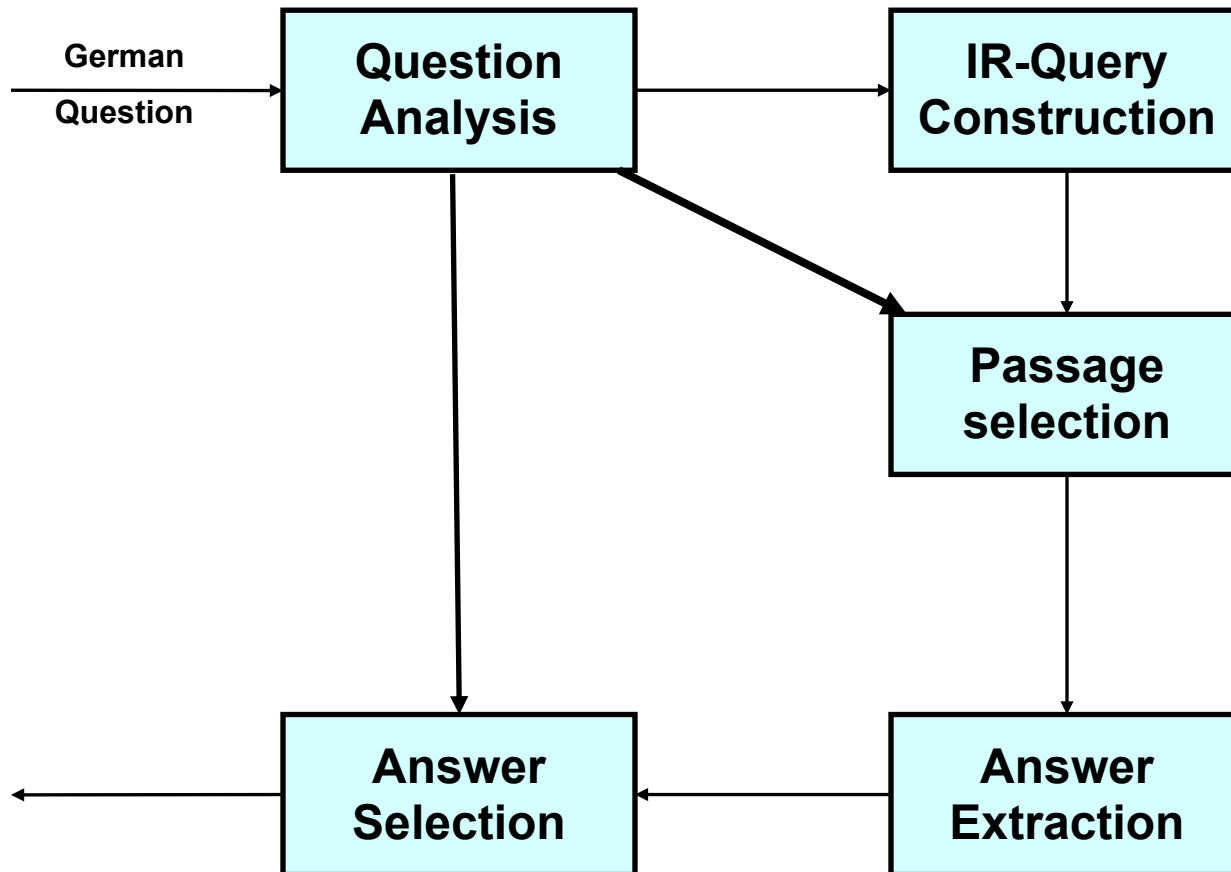
"... In misty Seattle, Wash., last year, 32 inches of rain fell. Hong Kong gets about 80 inches a year, and even Pago Pago, noted for its prodigious showers, gets only about 196 inches annually. (The titleholder, according to the National Geographic Society, ² is Mount Waialeale in Hawaii, where about 460 inches of rain falls each year.) ..." (Trec-Data; but see Google-retrieved Web page.)

Open-Domain Question Answering

- Open domain
 - No restriction for the domain and type of question
 - No restriction on document source
- Combines
 - Information retrieval
 - Information extraction
 - Text mining
 - Computational Linguistics
- Cross-lingual ODQA
 - Express query in language X
 - Answer from documents in language Y

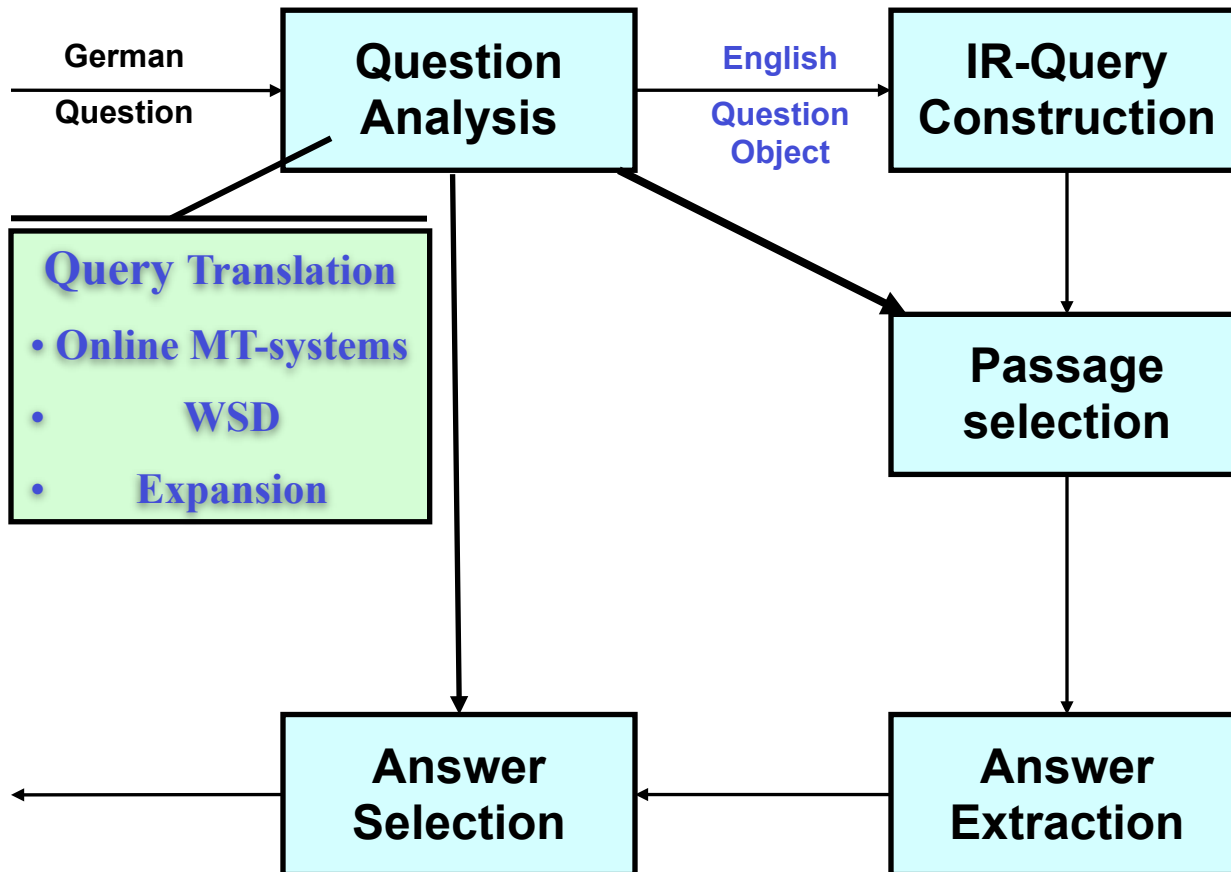


“Mit wem ist David Beckham verheiratet?”



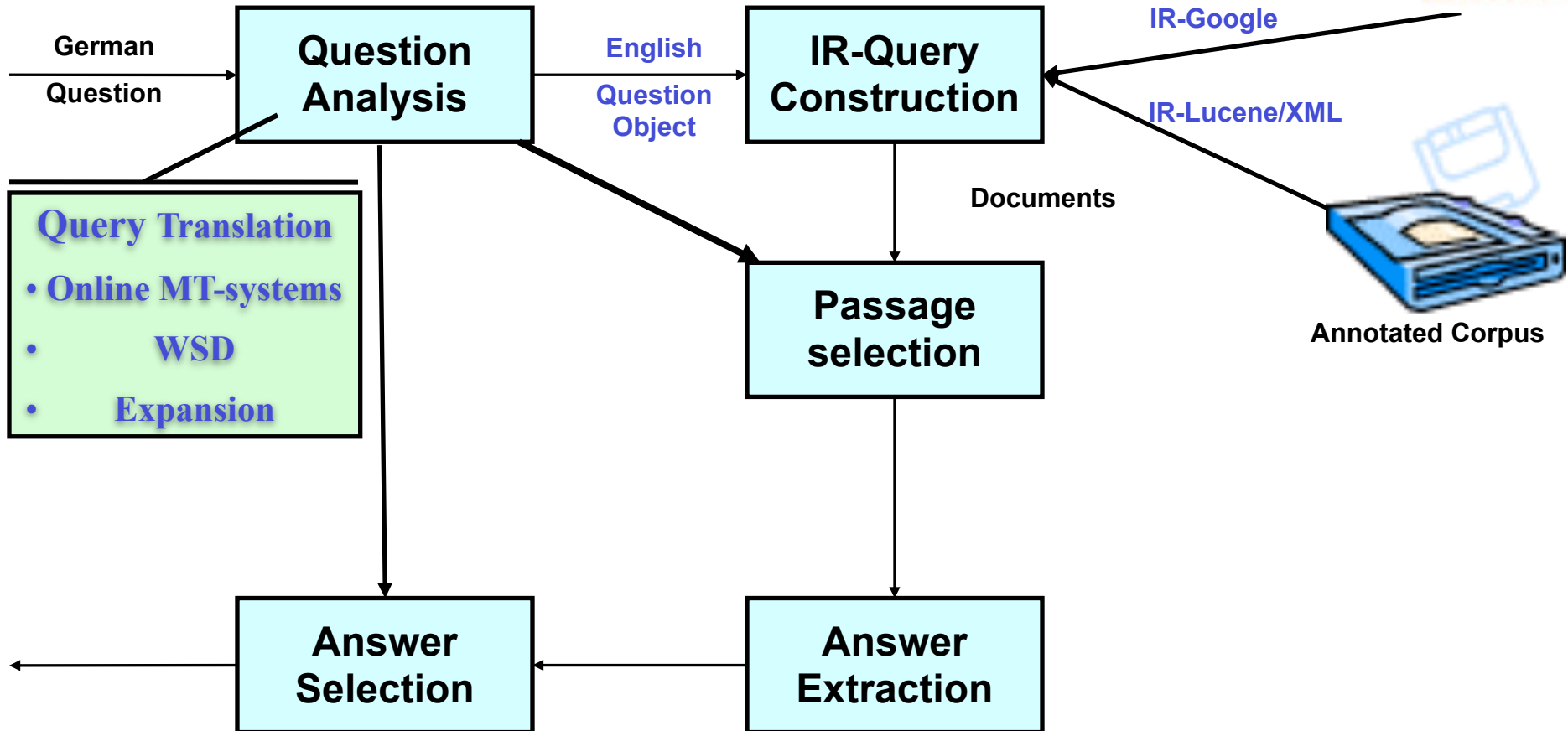
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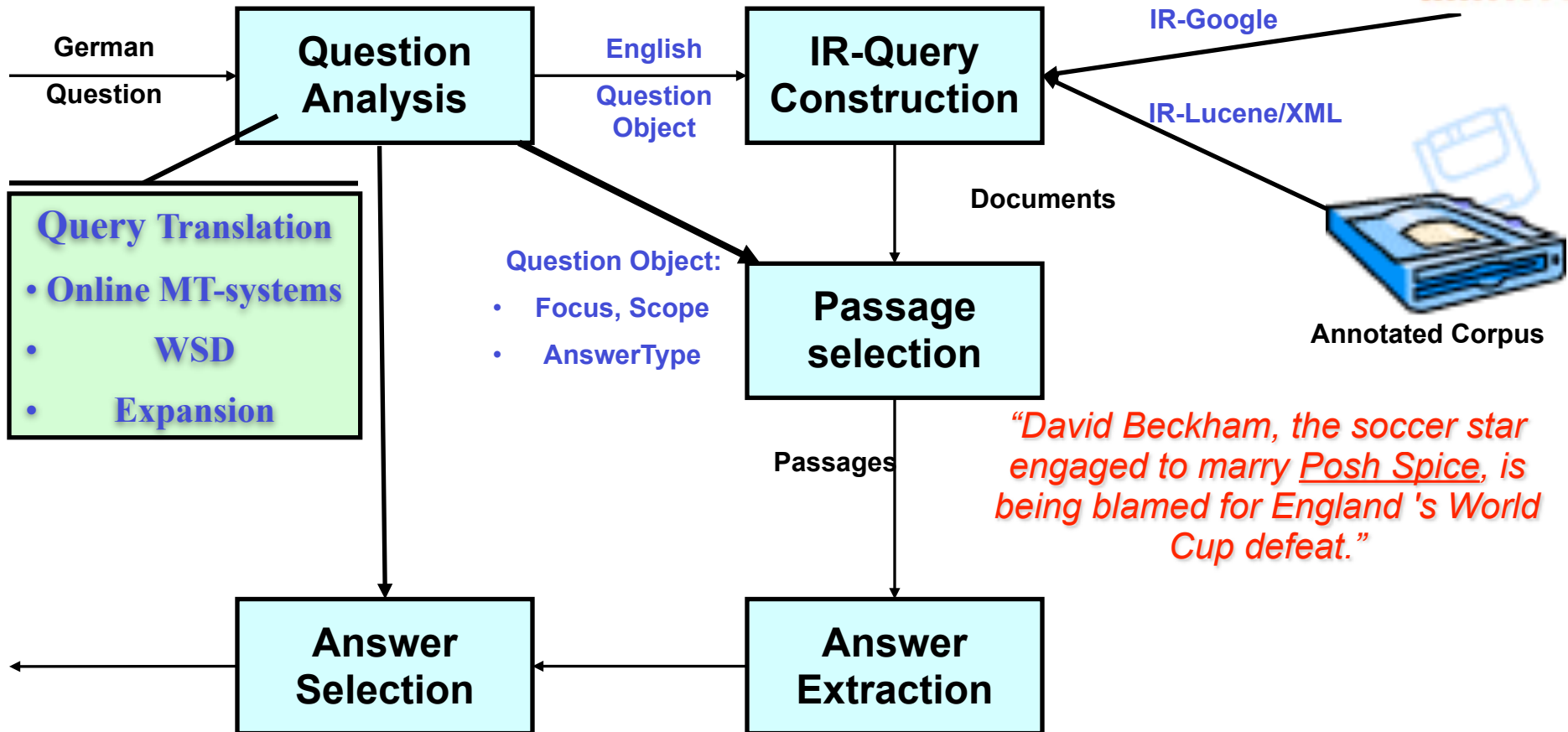
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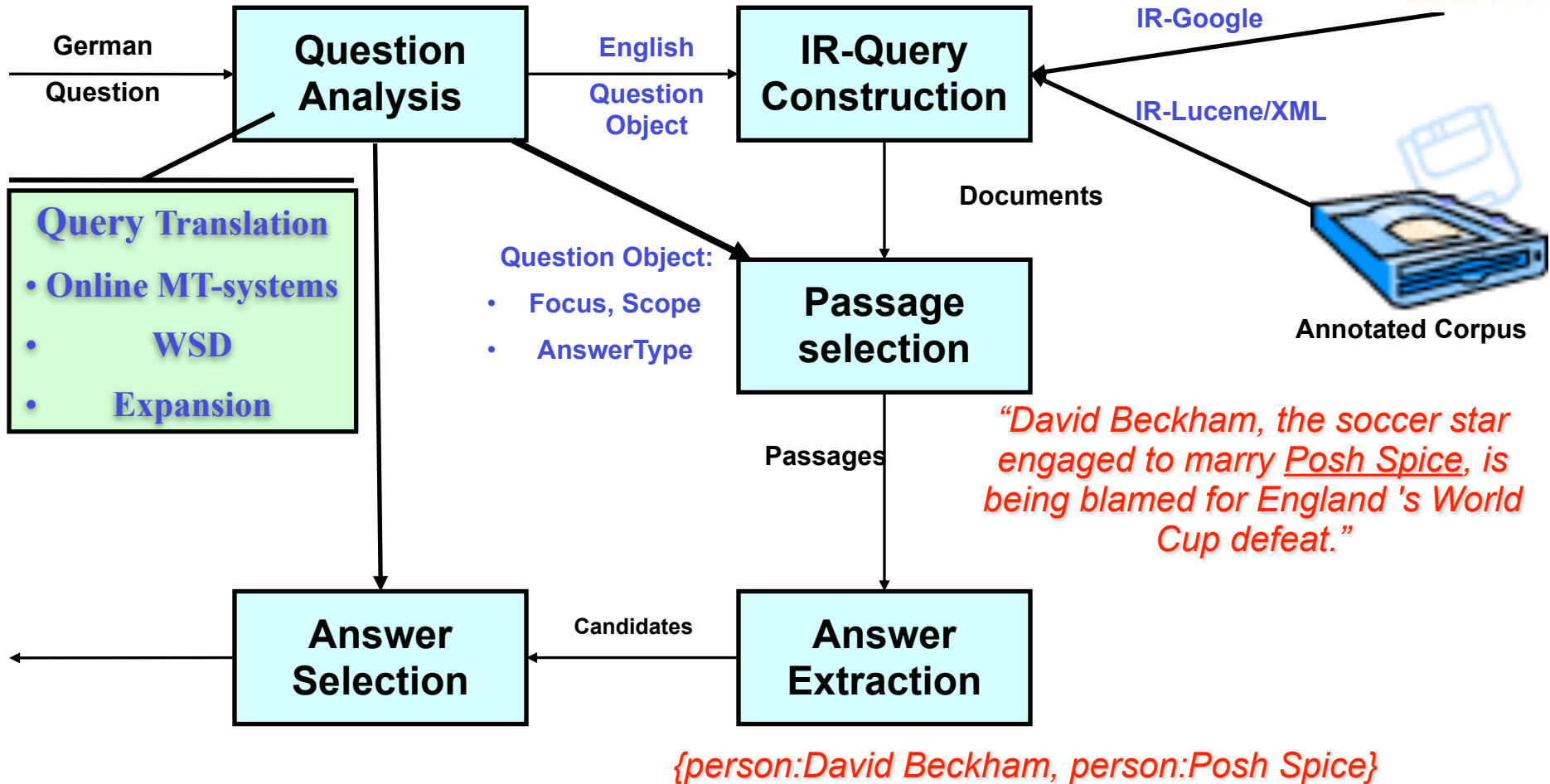
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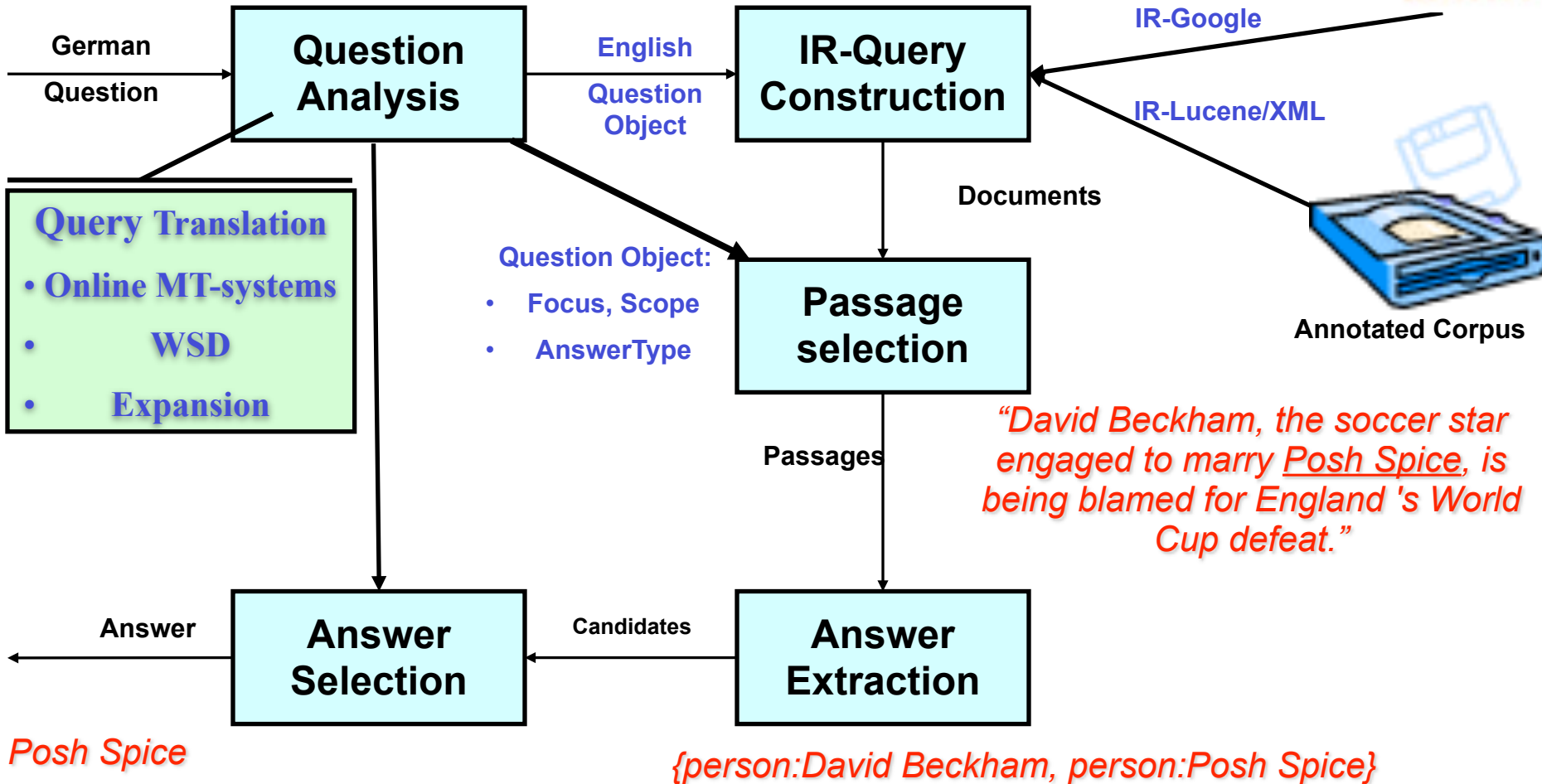
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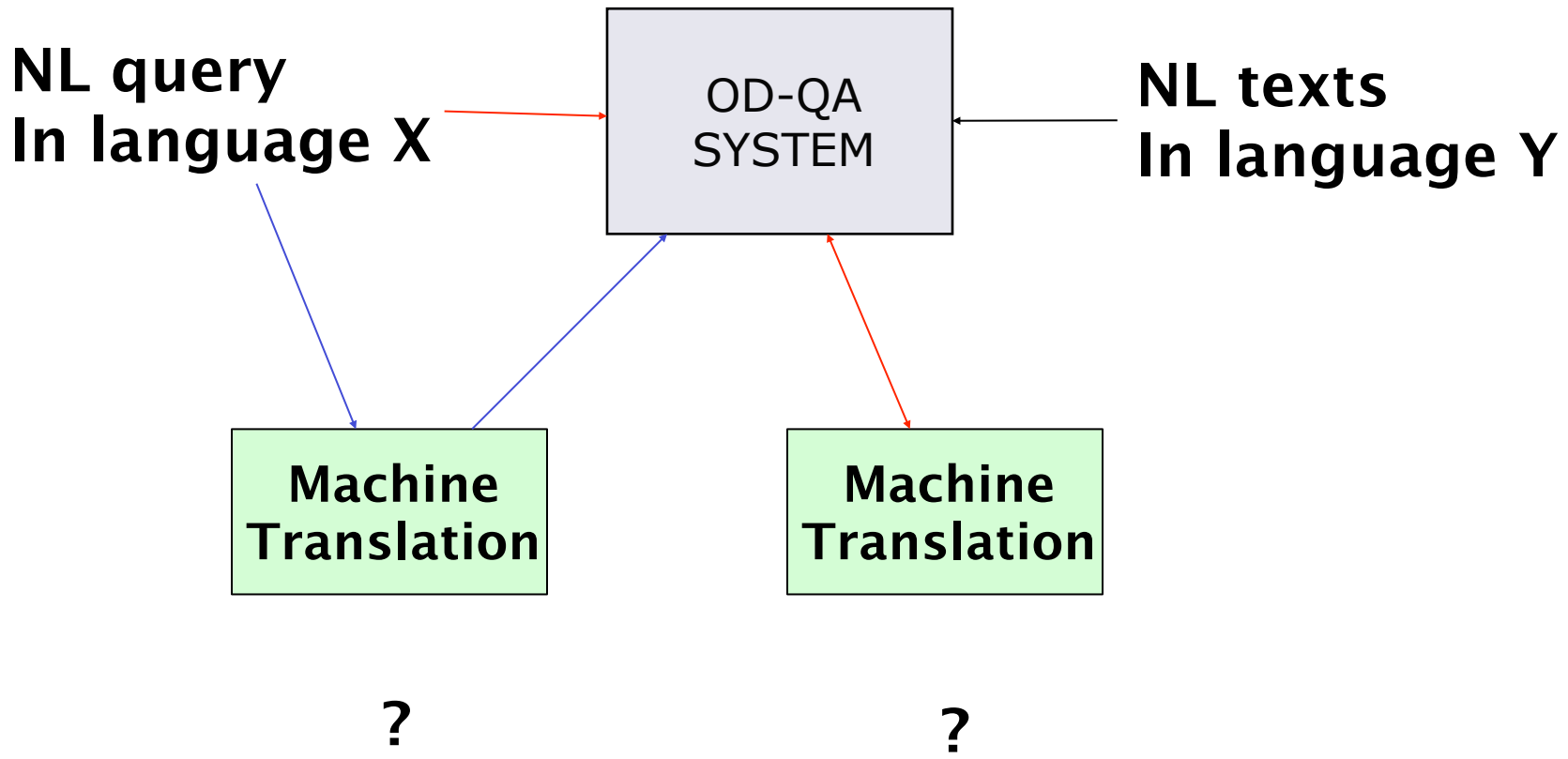


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Cross-Lingual ODQA



Approaches in CL QA

Two main different approaches used in Cross-Language QA systems:

1

translation of the question into the target language
(i.e. in the language of the document collection)

question processing

answer extraction

2

question processing in the source language to retrieve
information (such as keywords, question focus,
expected answer type, etc.)

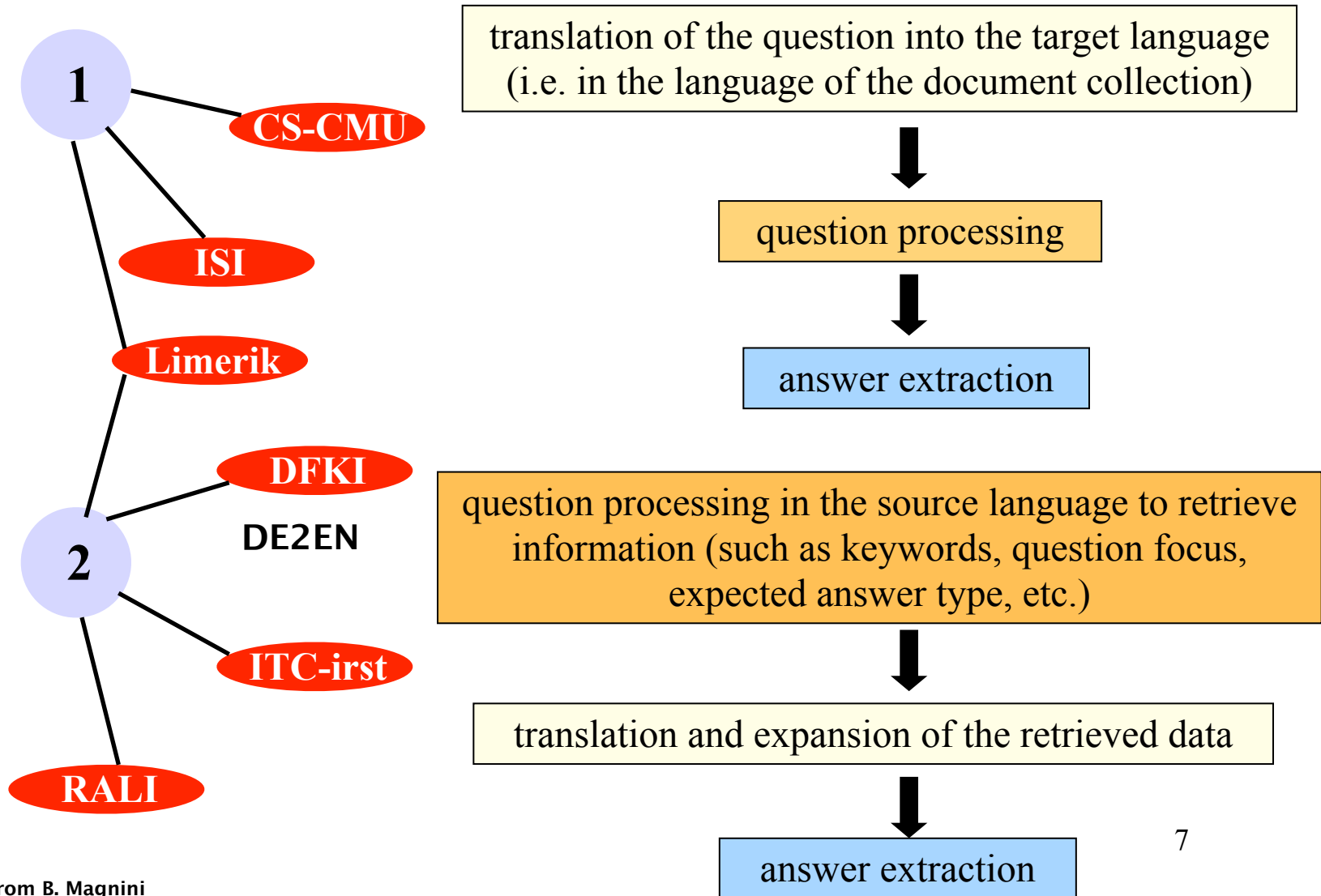
translation and expansion of the retrieved data

answer extraction

6

Approaches in CL QA

Two main different approaches used in Cross-Language QA systems:



Query Translation & Expansion

- First idea:
 - Only use EuroWordNet
 - Defines a word-based translation via synset offsets
- Experience
 - EuroWordNet too sparse on German side
 - Nevertheless introduced too much ambiguity
 - NE-translation is crucial
- So far, not very much of help

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 - Q-type & A-type from DE-Question Analysis

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 - Q-type & A-type from DE-Question Analysis
 - Synsets from EuroWN direct query expansion (**online alignment**)

Example

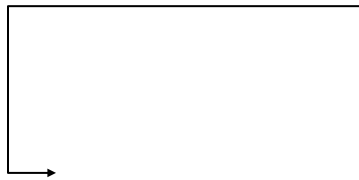
1. Translation services for Word Sense Disambiguation (WSD)

Wo wurde das Militärflugzeug Strike Eagles 1990 **eingesetzt**?

2. Query expansion using EuroWordNet

Example

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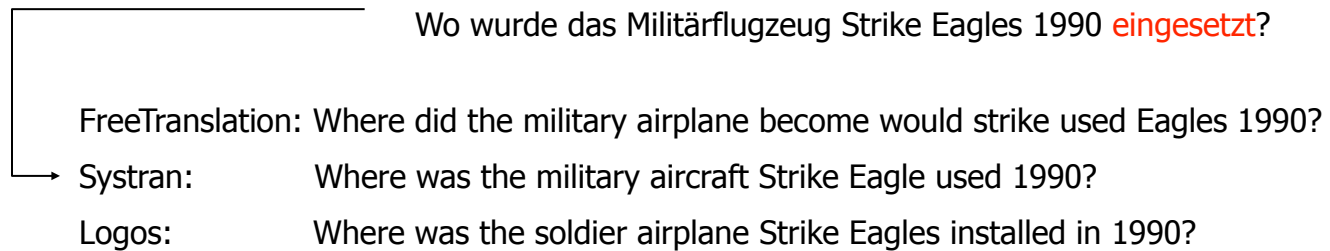


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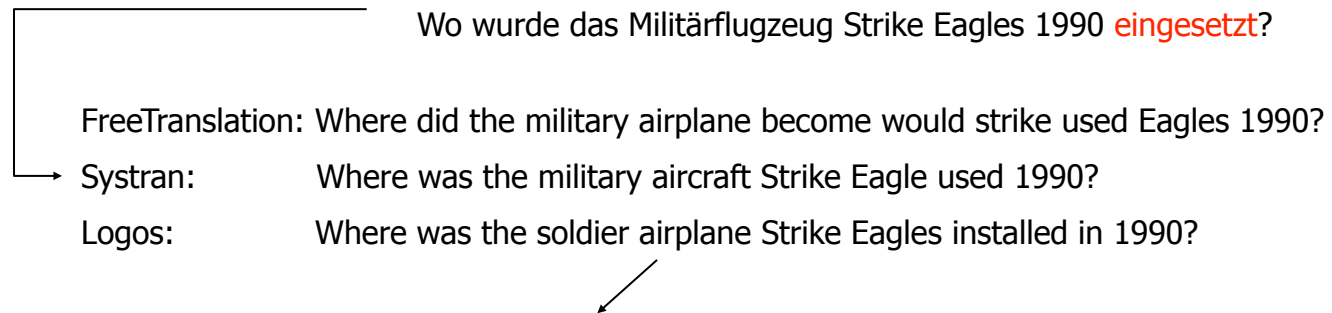
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Example

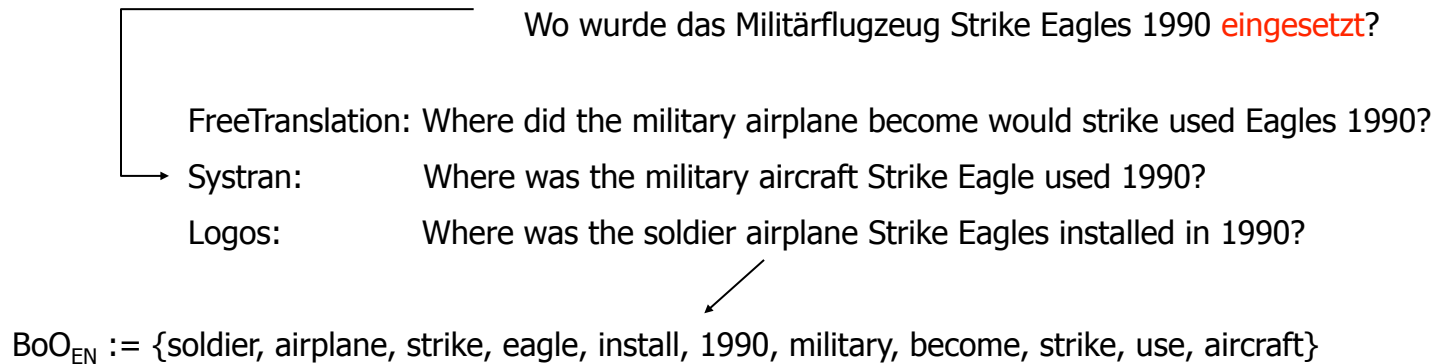
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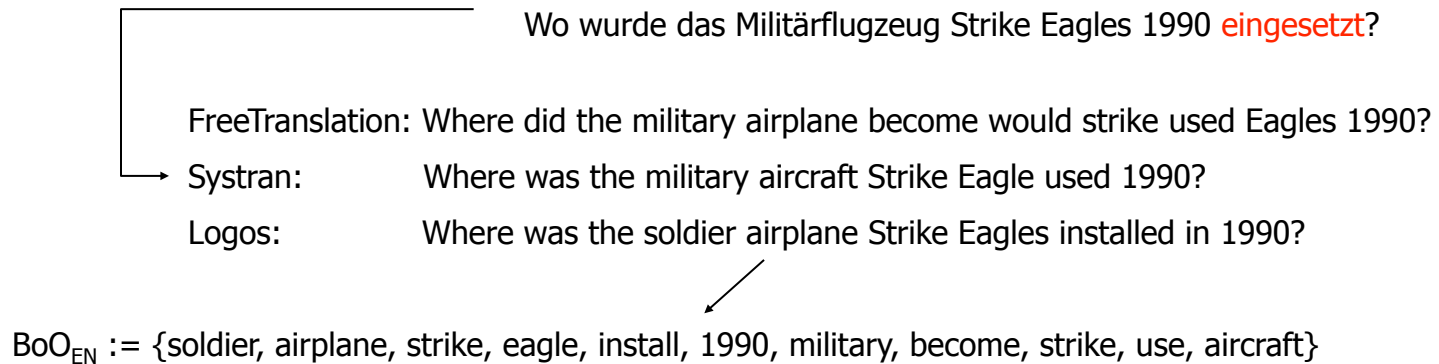
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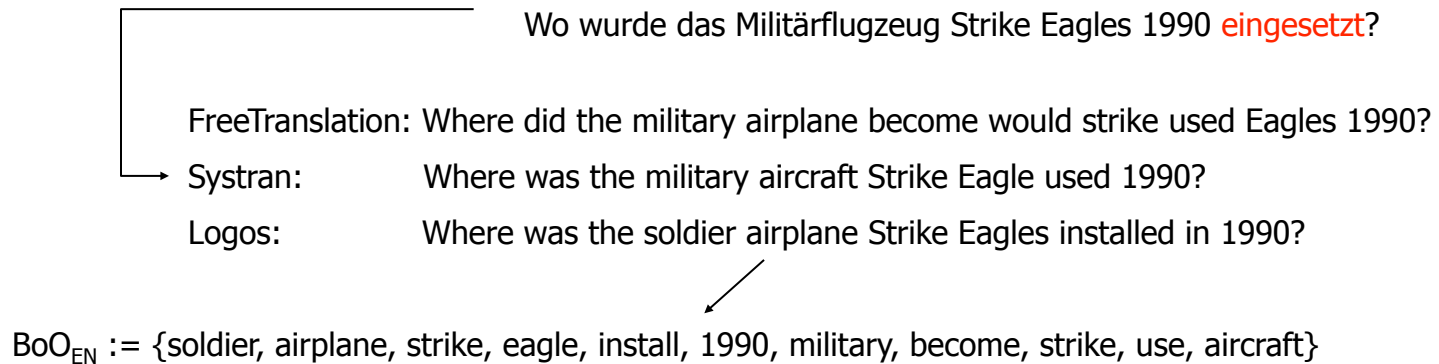


2. Query expansion using EuroWordNet

$\forall x \in \text{BoO}_{\text{EN}}: \text{lookup}(\text{EuroWN});$
If x is unambiguous: extend BoO_{EN}
Else $\forall \text{readings}(x):$
get its aligned German readings &
Look them up in BoO_{GN}
If successfully then add English terms to
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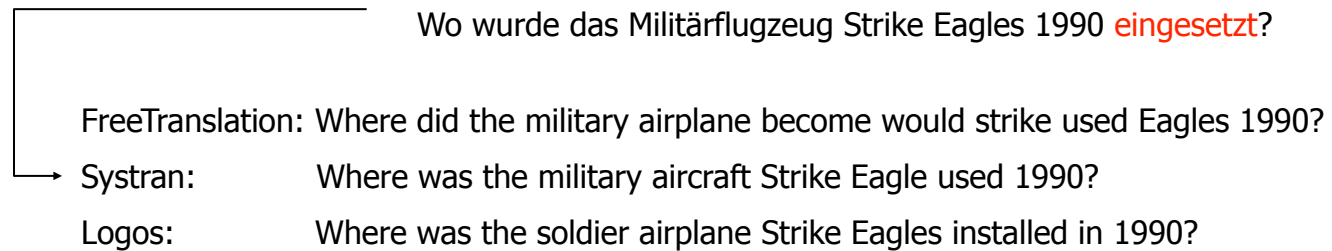
Reading-697925

EN: {handle, use, wield}

DE: {handhaben, hantieren}

Example

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$BoO_{EN} := \{\text{soldier, airplane, strike, eagle, install, 1990, military, become, strike, use, aircraft}\}$

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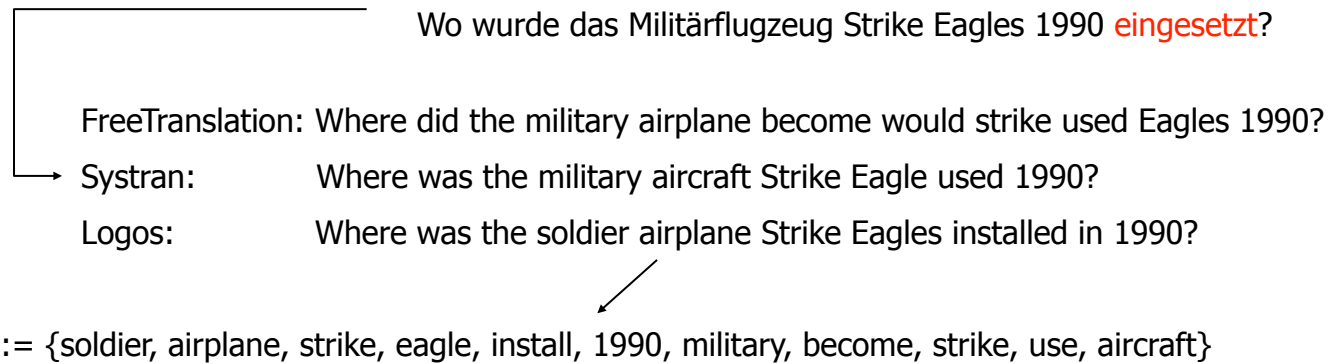
Reading-1453934:

EN: {behave toward, use}

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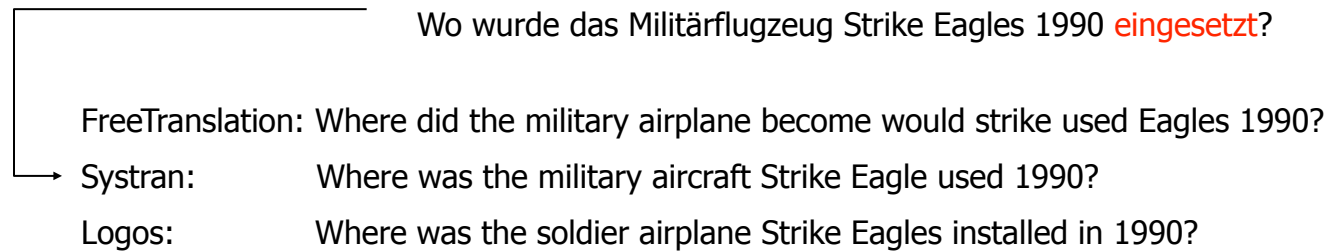
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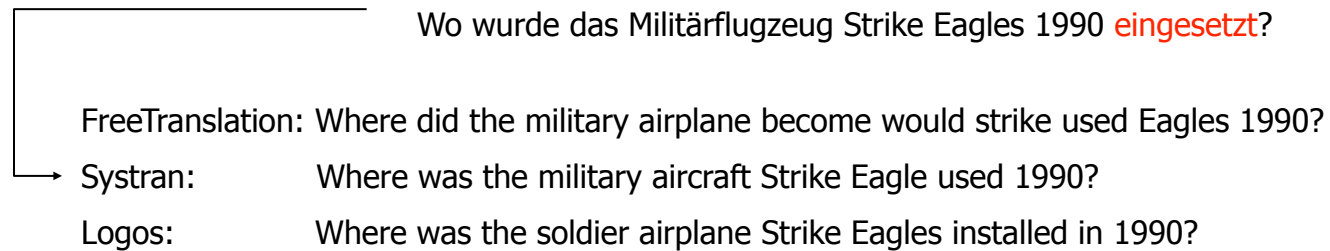
Reading-658243:

EN: {apply, employ, make use of, put to use, use, utilise, utilize}

DE: {anbringen, anwenden, bedienen, benutzen, **einsetzen**, ...}

Example

1. Translation services for Word Sense Disambiguation (WSD)



$BoO_{EN} := \{\text{soldier, airplane, strike, eagle, install, 1990, military, become, strike, use, aircraft}\}$

2. Query expansion using EuroWordNet

$\forall x \in BoO_{EN}$: lookup(EuroWN);
If x is unambiguous: extend BoO_{EN}
Else \forall readings(x):
get its aligned German readings &
Look them up in BoO_{GN}
If successfully then add English terms to
 BoO_{EN}

~~Reading-697925~~

~~EN: {handle, use, wield}~~

~~DE: {handhaben, hantieren}~~

~~Reading-1453934:~~

~~EN: {behave toward, use}~~

~~DE: not aligned~~

Reading-658243:

EN: {apply, employ, make use of, put to use, use, utilise, utilize}

DE: {anbringen, anwenden, bedienen, benutzen, einsetzen, ...}



Find documents written in any language

- Using queries expressed in a single language



يا ليلي يا عيني

Исследований



高等学校

att förstå

których można



- ☆ Cross Language Evaluation Forum (CLEF)
 - CLIR using European languages.
 - Bulgarian, Danish, Dutch, English, Finnish, French, German, Italian, Portuguese, Spanish, Swedish, Russian
 - <http://clef.iei.pi.cnr.it/>

- ☆ NTCIR (NII-NACSIS Test Collection for IR Systems) Project
 - CLIR in Asian Languages
 - Chinese, Japanese, and Korean
 - <http://research.nii.ac.jp/ntcir/index-en.html>



	2003	2004	2005	2006	2007/2008
Target languages	3	7	8	9	10
Collections	News 1994		+News 1995		+Wikipedia Nov. 2006
Type of questions	200 Factoid		+ temporal restrictions + Definitions	-Type of questions + Lists	+ Linked questions + Closed lists
Supporting information	Doc.	Doc.	Doc.	Snippet	Snippet
Pilots and exercises		-Temporal restrictions - Lists		-AVE - RealTime - WiQA	- AVE - QAST





- FACTOID (150): loc, mea, org, oth, per, tim
- DEFINITION (40): per, org, object, oth
 - Person: Who is Josef Paul Kleihues?
 - Object: What is a router?
 - Other: What is a tsunami?
- LIST (10): “Name works by Tolstoy.”
- Temporally restricted (40): by date, by period, by event
- NIL questions (without known answer in the collection)
- Input format: question type (F, D, L) not indicated



☆ Closed lists:

- Who were the components of the Beatles?
- Who were the **last three** presidents of Italy?

☆ Linked questions

- Topic: Otto von Bismarck
 - Who was called the “Iron-Chancellor”?
 - When was he born?
 - Who was his first wife?
- Topics
 - Person or Event
 - Not provided to participants
 - Only a portion of the questions (from 15% depending on the languages)



- Clef 2006:
 - Multiple answers: from one to ten *exact* answers per question
 - *exact* = neither more nor less than the information required
 - each answer has to be supported by
 - docid
 - one to ten text snippets justifying the answer (substrings of the specified document giving the actual context)
- Clef 2007:
 - News articles
 - Wikipedia dump from November 2006 (→ caused critical decrease of performance)



- 10 Source languages (11 in 2006, 10 in 2005)
- 9 Target languages (8 in 2006, 9 in 2005)

S \ T	BG	DE	EN	ES	FR	IN	IT	NL	PT	RO
BG										
DE										
EN										
ES										
FR										
IT										
NL										
PT										
RO										



- questions were not translated in all the languages
- **Gold Standard:** questions in multiple languages only for tasks were there was at least one registered participant

	MONOLINGUAL	CROSS-LINGUAL	TOTAL
CLEF 2003	3	5	8
CLEF 2004	6	13	19
CLEF 2005	8	15	23
CLEF 2006	7	17	24
CLEF 2007	8	29	37

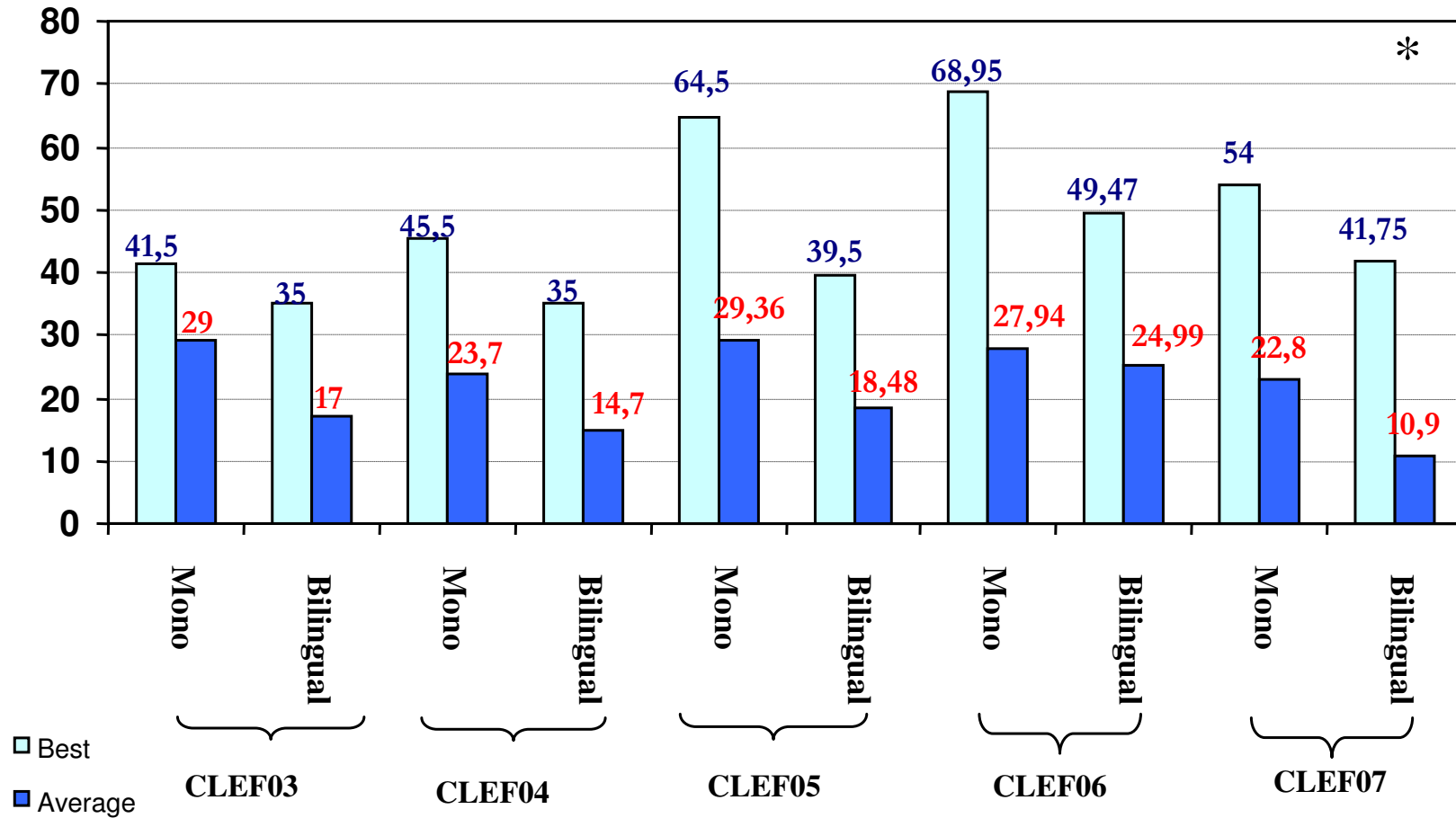


Acronym	NAME	Contry
SYNAPSE	SYNAPSE Developpement	France
Ling-Comp	U.Rome-La Sapienza	Italy
Alicante	U.Alicante- Informatica	Spain
Hagen	U.Hagen-Informatics	Germany
Daedalus	Daedalus Consortium	Spain
Jaen	U.Jaen-Intell.Systems	Spain
ISLA	U.Amsterdam	Netherlands
INAOE	Inst.Astrophysics,Optics&Electronics	Mexico
DEPOK	U.Indonesia-Comp.Sci.	Indonesia
DFKI	DFKI-Lang.Tech.	Germany
FURUI Lab.	Tokyo Inst Technology	Japan
Linguateca	Linguateca-Sintef	Norway
LIC2M-CEA	Centre CEA Saclay	France
LINA	U.Nantes-LINA	France
Priberam	Priberam Informatica	Portugal
U.Porto	U.Porto- AI	Portugal
U.Groningen	U.Groningen-Letters	Netherlands
	Univ. of Evora	Portugal
	Univ. Poli. De Catalunay	Spain

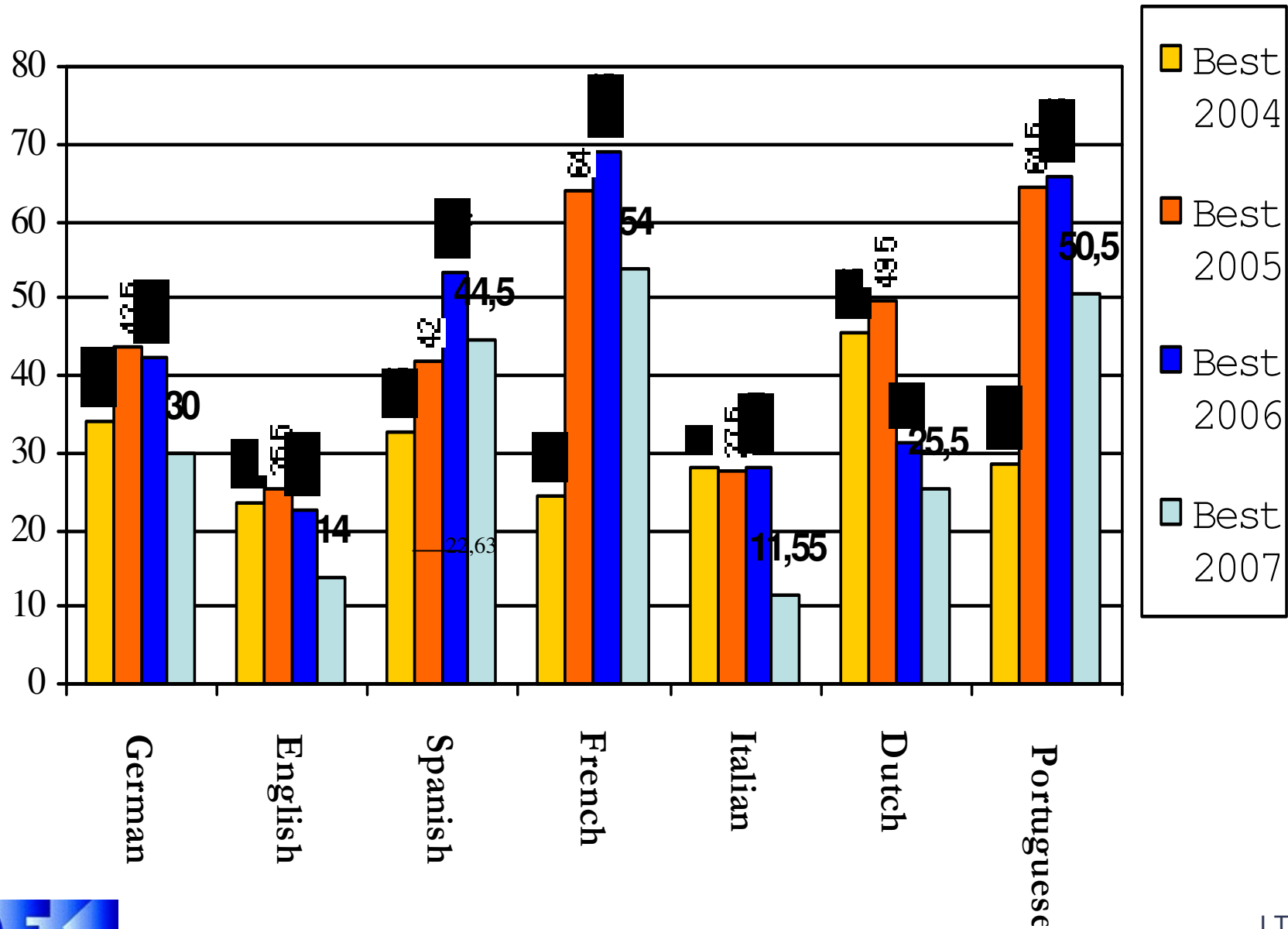
Acronym	NAME	Country
Lab.Inf.D' Avignon	Lab.Inf. D'Avignon	France
U.Sao Paulo	U.Sao Paulo – Math	Brazil
Vanguard	Vanguard Engineering	Mexico
LCC	Language Comp. Corp.	USA
UAIC	U.A.I.I Cuza" Iasi	Romania
Wroclaw U.	Wroclaw U.of Tech	Poland
RFIA-UPV	Univ.Politècnica de Valencia	Spain
LIMSI	CNRS Lab-Orsay Cedex	France
U.Stuttgart	U.Stuttgart-NLP	Germany
FBK	FBK-IRST	Italy
JRC-ISPRA	Institute for the Protection and the Security of the Citizen	Italy
BTB	BulTreeBank Project	Bulgaria
dltg	University of Limerick	Ireland
	INESC-ID	Portugal
	Univ. Wolverhampton	UK
	Cindi Group	Canada
	Macquarie University	Australia
	RACAI	Romania



BLUE=Industrial Companies, GREEN=2006 + 2007, RED=not 2007, BLACK=new 2007



* This result is still under validation.



LT-Lab Participants in 2004 - 2007: compared best results

