Hindi and Marathi to English Cross Language Information Retrieval at CLEF 2007

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Joint work with

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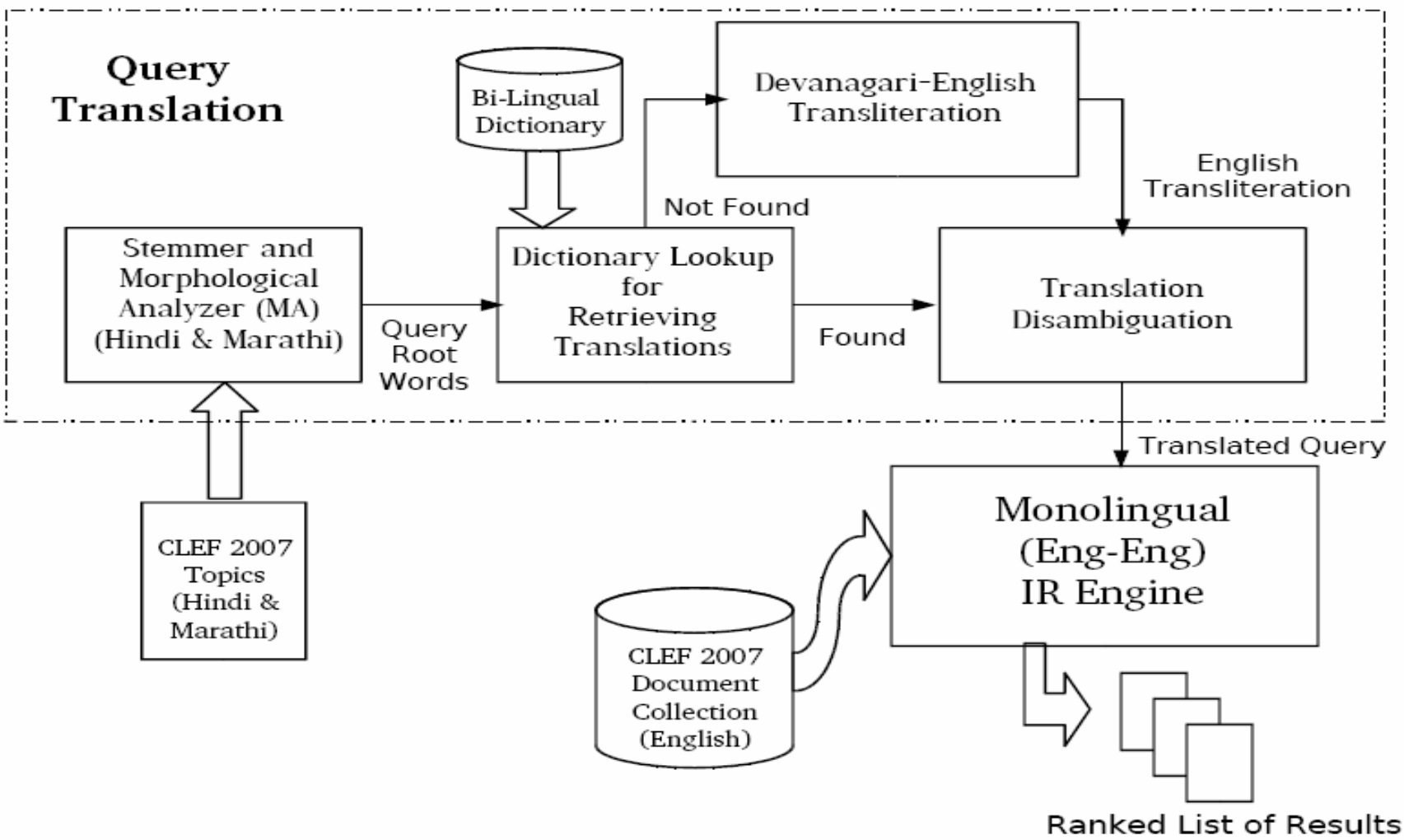
Motivation

- English still the most dominant language on the web – contributes 72% of the content
- Number of non-English users steadily rising on the web
- English penetration in India
  - Estimated to be less than 3-4%
  - Presence mostly in the urban educated sections
- CLIR systems key to enable access to English content through non-English languages

Hindi and Marathi

- Hindi
  - Official language of India
  - Spoken by almost 40% of population
- Marathi
  - Widely spoken language in Western India
  - Spoken by almost 7% of population
- Both of them
  - Written in Devanagari – A phonetic script
  - Derive vocabulary from Sanskrit

System Architecture



Language Resources

- Developed at Center for Indian Language Technologies (CFILT), IIT Bombay
- Stemmer and Morphological Analyzer
  - Rule-Based Stemmer and MA
- Bi-lingual Dictionaries
  - Hindi→English
    - 1,15,571 entries
    - Available online

    http://www.cfilt.iitb.ac.in/~hdict/webinterface_user/dict_search_user.php
  - Marathi→English
    - Relatively less coverage
    - 6110 entries

Devanagari-English Transliteration

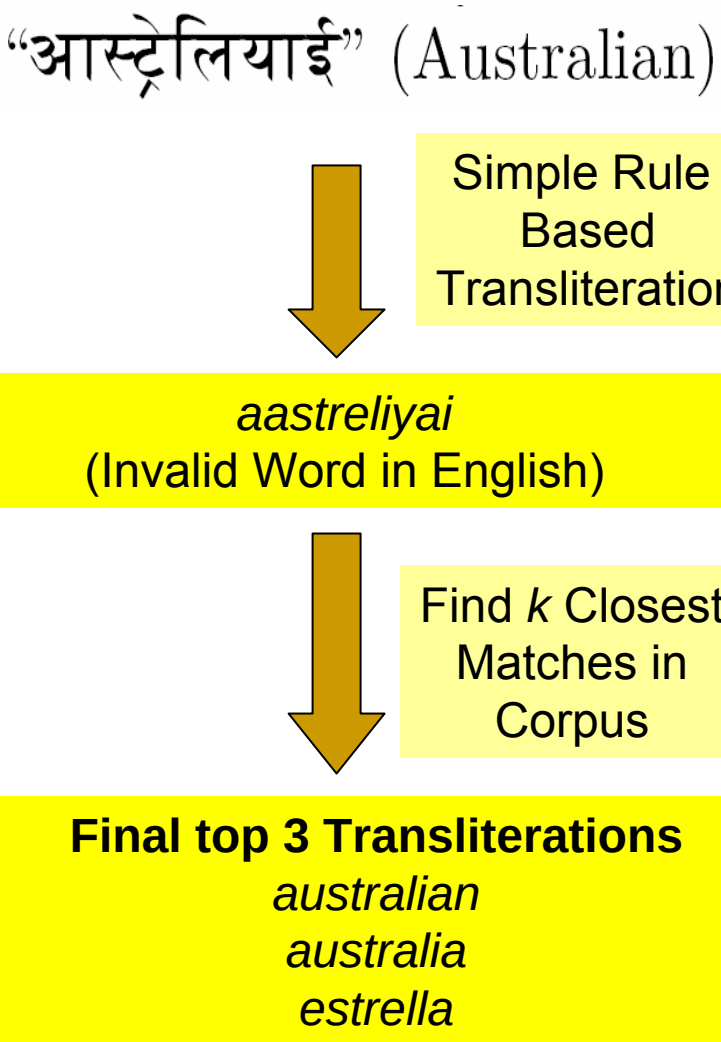
- A simple rule based transliteration scheme
- Manually created Devanagari to English transliteration mapping table for each Devanagari letter
- Given a string start from left->right and transliterate each letter using above table

Input Letter	Output String
ग़	ga
	gan
ग	ganga
ओ	gango
त्री	gangotri

Transliteration Example

Devanagari-English Transliteration (Contd..)

- Sometimes leads to invalid English words
- Resulting transliteration compared with unique words in corpus to find *'k'* closest matches
- Closeness defined in terms of string edit-distance (Levenshtein Distance)
- In current experiments, *k* set to 3



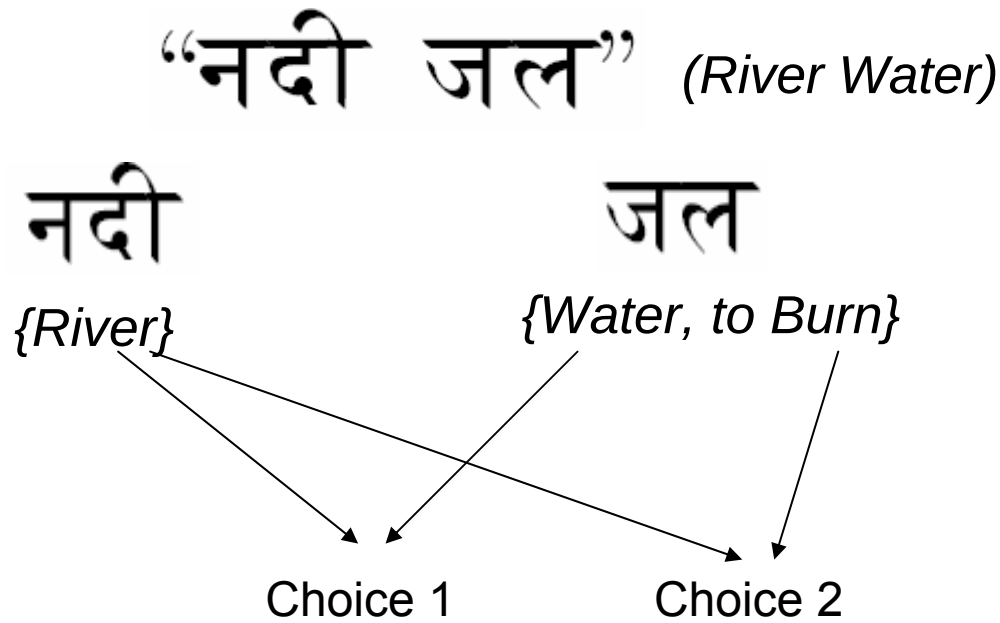
Translation Disambiguation

- Disambiguates various translation choices for each source word based word-word association measures
- For example

Hindi Query

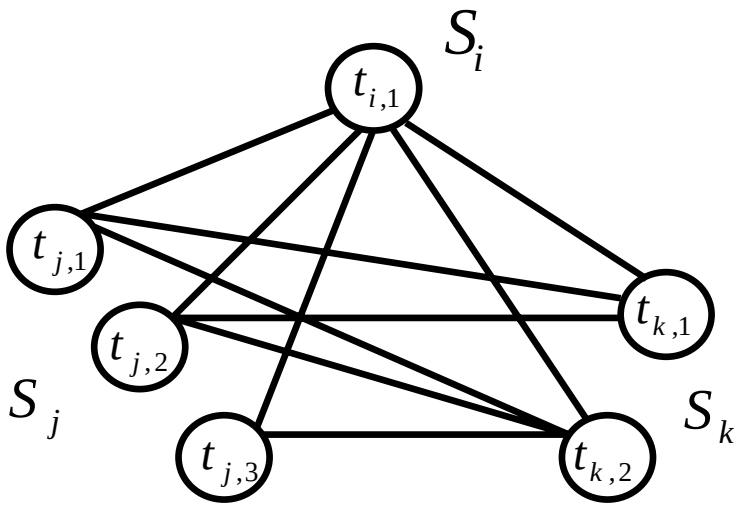
Translation Choices

Choose Based on Word-Word Association Strength



Iterative Translation Disambiguation Algorithm

- Proposed by Christof Monz *et. al.* (SIGIR 2005)
- Construct Graph
  - Nodes – Translation Choices for given source word
  - Links – Between different source word translations
- Initialize node weights assuming all translations of given source word equally likely



Iterative Translation Disambiguation Algorithm (Contd..)

- Link strength between two nodes computed based on term-term co-occurrence statistics
  - Dice Coefficient (Dice)

$$DC(t,t') = \frac{2 * freq(t,t')}{freq(t) + freq(t')}$$

  - Point-wise Mutual Information (PMI)

$$PMI(t,t') = log_2 \frac{p(t,t')}{p(t) * p(t')}$$

- The weight updation equation

$$w^n(t|s_i) = w^{n-1}(t|s_i) + \sum_{t' \in inlink(t)} l(t,t') * w^{n-1}(t'|s)$$

Previous Weight

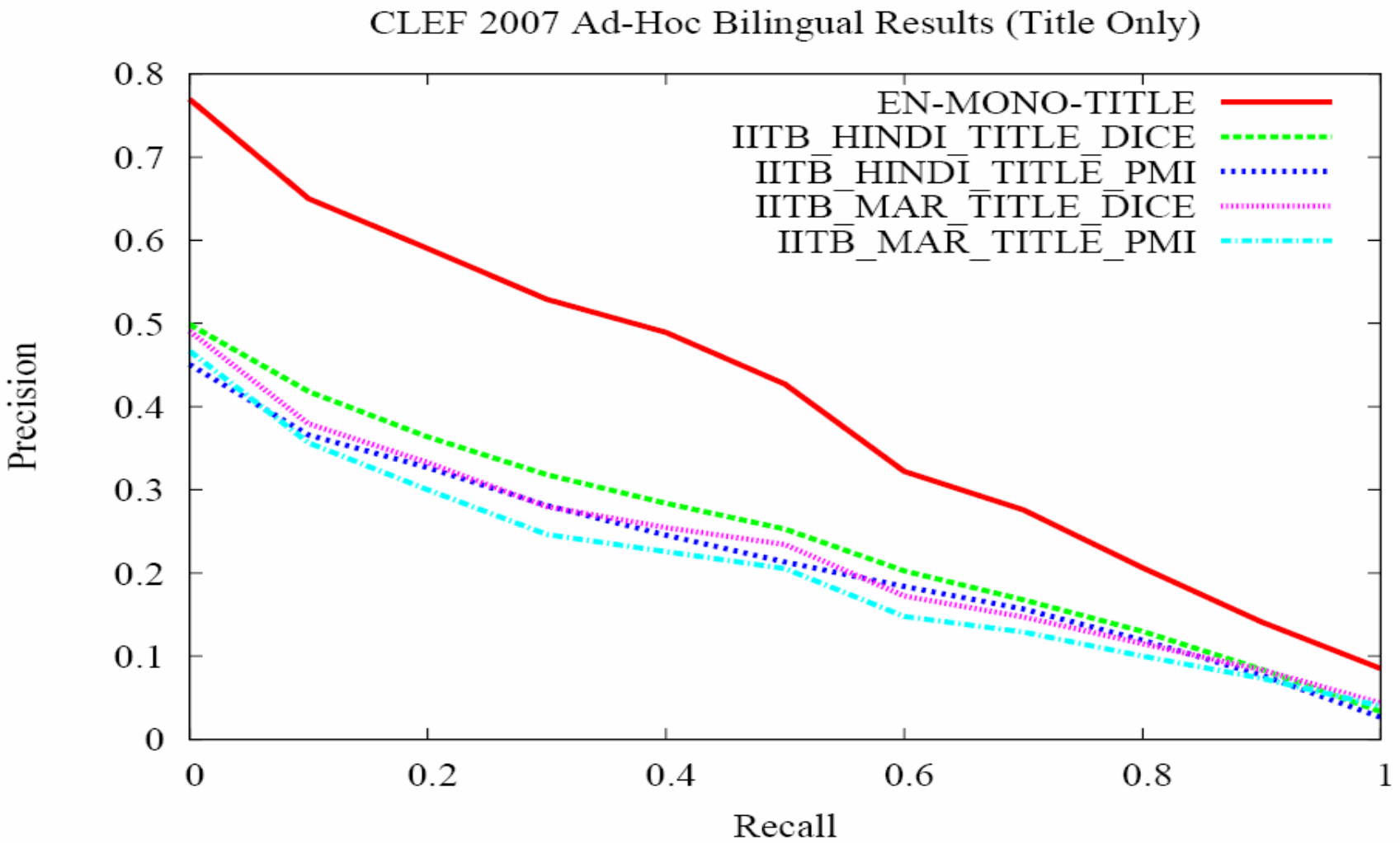
Link Strength

Weight of Neighbour

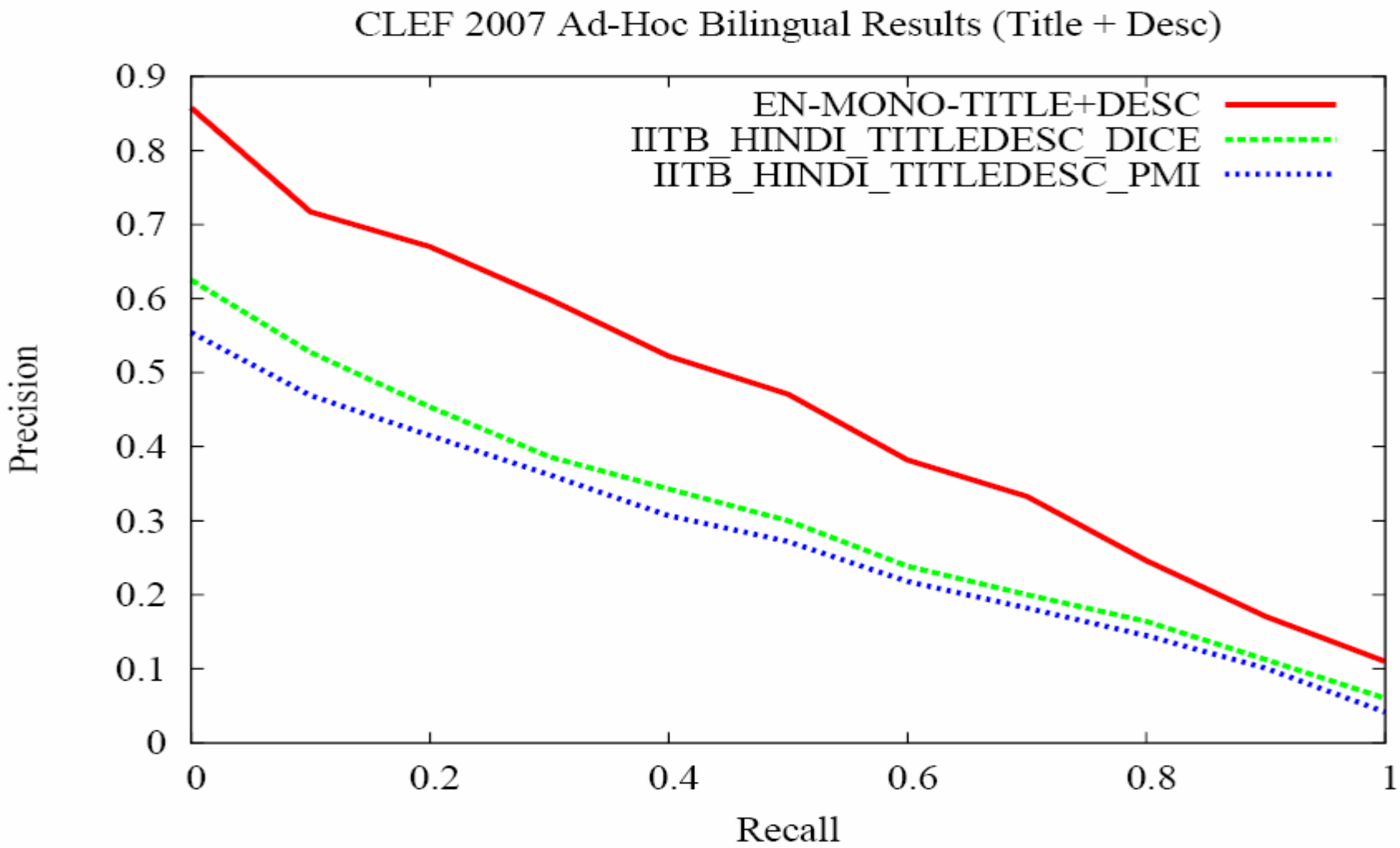
Results (Summary)

Experiment		MAP	Recall	P@20
Hindi Title	Dice	0.2366 (61.36%)	72.58% (89.16%)	0.2700 (69.05%)
	PMI	0.2089 (54.17%)	68.53% (84.19%)	0.2390 (61.12%)
Hindi Title + Desc	Dice	0.2952 (67.06%)	76.55% (87.32%)	0.3150 (73.77%)
	PMI	0.2645 (60.08%)	72.76% (82.99%)	0.2950 (69.09%)
Marathi Title	Dice	0.2163 (56.09%)	62.44% (76.70%)	0.2510 (64.19%)
	PMI	0.1935 (50.18%)	54.07% (66.42%)	0.2280 (58.31%)

Results (P-R Curves) – Title Only



Results (P-R Curves) – Title + Desc



Conclusion

- A query translation based approach taken for Hindi and Marathi to English CLIR using bi-lingual dictionaries
- Results quite encouraging – 67.06% of Monolingual baseline for Hindi, 56.09% of Monolingual baseline for Marathi
- Simple rule based transliteration taking closest edit-distance based matches from corpus performs well
- Translation disambiguation helps in selecting correct translation choices

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