The Johns Hopkins University 2003 Chinese-English Machine Translation System

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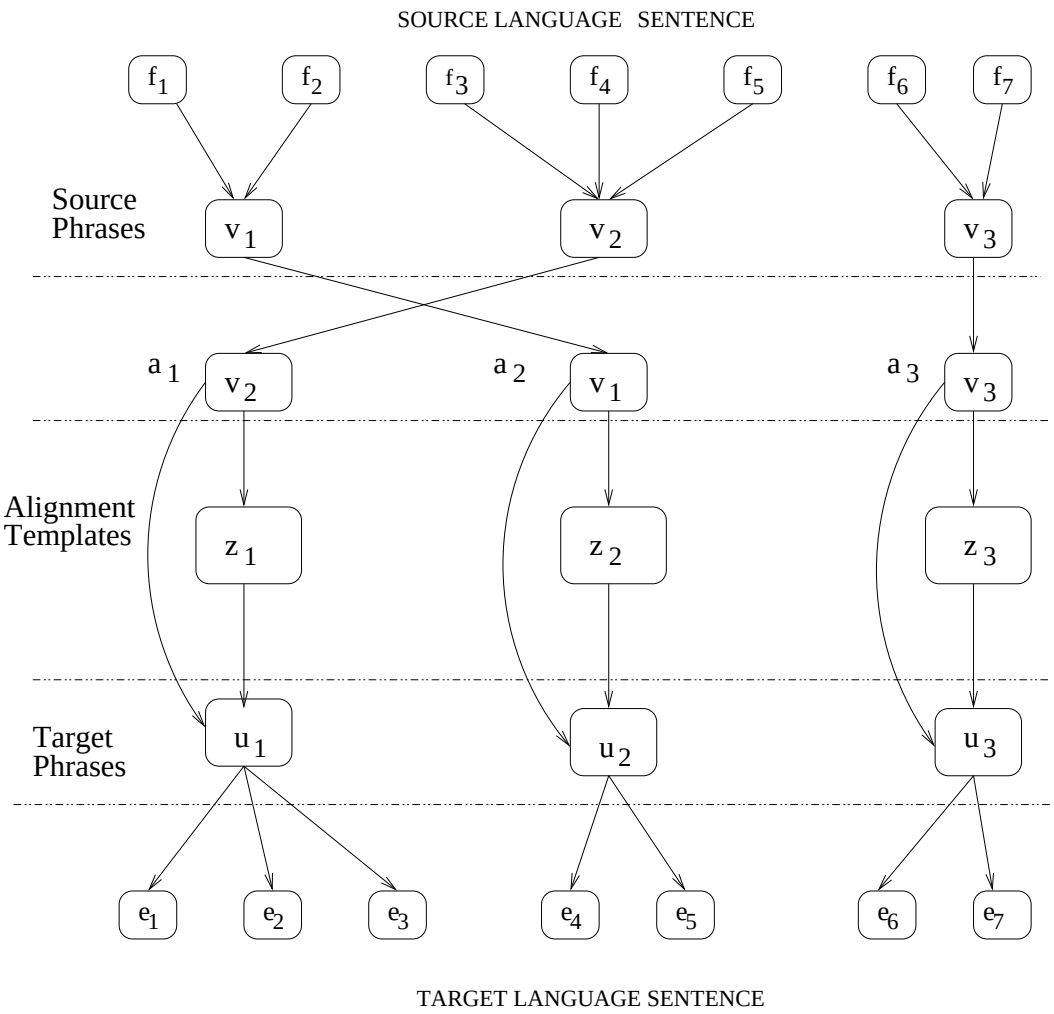
Outline of Chinese-English Systems

- Weighted Finite State Transducer (WFST) - Alignment Template Translation Model (ATTM) for Statistical Machine Translation
  - WFST-ATTM model (Kumar and Byrne : HLT-NAACL '03)
- Two MT systems
  - Baseline system
  - Document specific translation
    - Motivated by acoustic and language model adaptation in ASR
    - Goal is to build a translation system for each test document
    - Given a large heterogenous bitext collection, find the portion that is most similar to the test document; use this for testing
- Performance on Development and Evaluation Sets

Alignment Template Translation Model (ATTM): Architecture



Component Models

Segmentation Model

Phrase Permutation Model

Template Sequence Model

Phrasal Translation Model

Target Language Model

Alignment Template Translation Model (ATTM) : Summary

- Statistical models are trained for each model component and implemented as WFSTs
- Overall decoding is implemented using standard and optimized FSM operations
  - Uses the AT&T FSM toolkit
- No specialized search procedures
  - No decoder!
  - Easy generation of N-best Lists & lattices of translation hypotheses
- FSM architecture provides support for generating bitext word alignments and alignment lattices
  - These will form the basis for ATTM parameter estimation procedures

Baseline System : Bitext and Word Alignments

- Training Data
  - Primary bitext: FBIS Chinese-English data
  - Sentence Alignment using Danyu Liu's aligner (JHU WS'01)
  - Word Segmentation of Chinese text using LDC segmenter
  - Aligner Output not uniformly good
    - Rank sentence-pairs using a lexical co-occurrence score
    - Select top-100k sentence pairs
- Word Alignments
  - Obtain word alignments using IBM-4 models (trained with GIZA++) in both translation directions (E $\rightarrow$ C and C $\rightarrow$ E), and form their union (following Och '02).

Baseline System : Translation and Language Models

- Alignment Templates
  - Use phrase-extract algorithm (Och '02) to extract an alignment template library from word alignments
  - Additional templates are added to those learnt from bitext
    - Phrasal entries from the LDC lexicon
    - Rule based Chinese-English translations for numbers, dates and times to cover test set
    - Insertions of selected zero-fertility English words
  - Augment templates to produce inflected forms of English words (abide $\rightarrow$ abide,abiding,abided)
- Language Model
  - Training Data:
    - Online archives of *The People's Daily* - 16.9M words
    - English side of Xinhua corpus - 4.3M words
  - Trigram LM with Modified Kneser-Ney smoothing (SRILM toolkit)

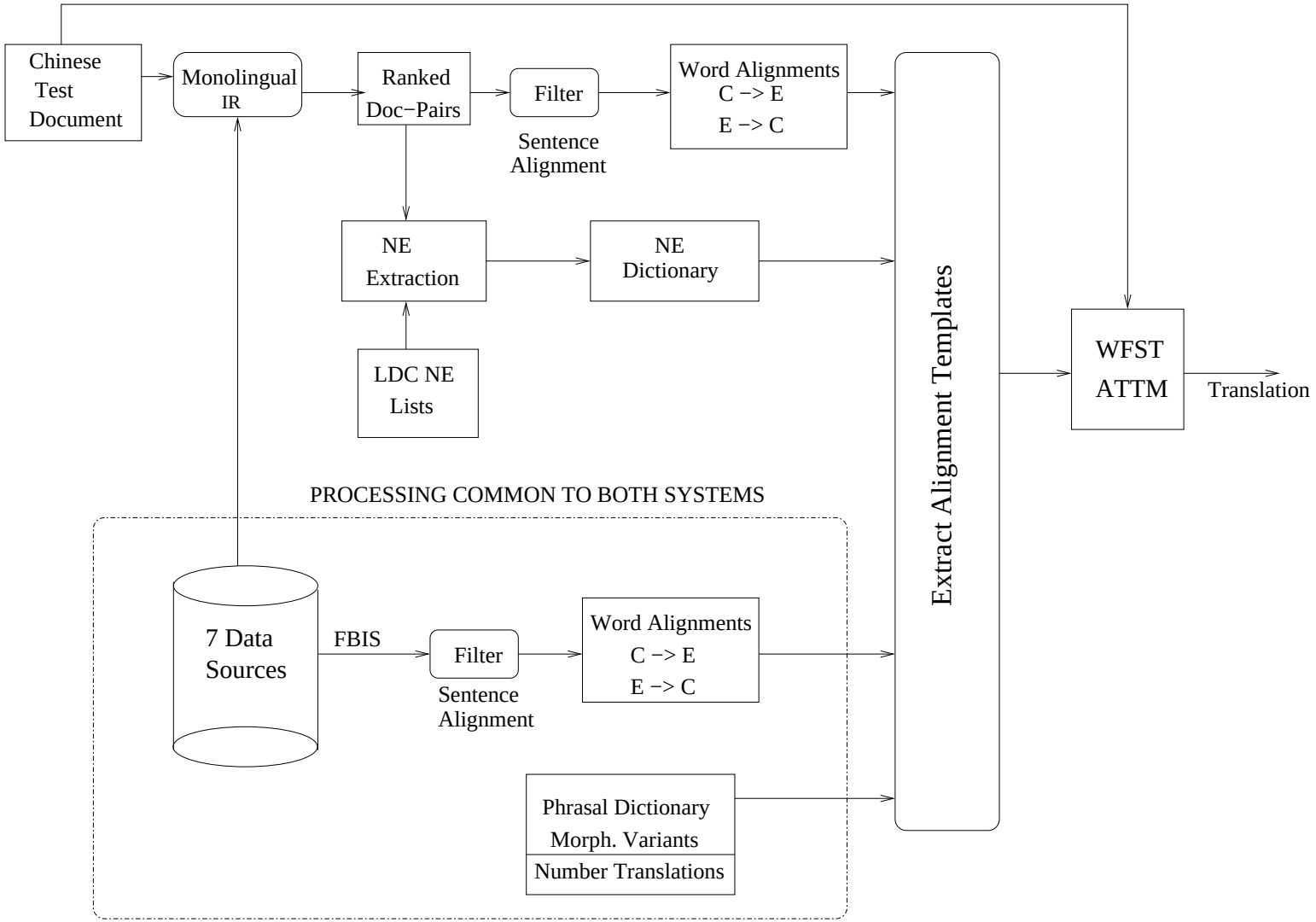
Document Specific MT system

- Goal: To build Specialized Translation Models for each individual test document
- For each test document, create a
  - Document-specific training bitext
  - Refined set of named entities with translations
- The use of IR in MT to create a document specific training bitext For each test document
  - Use standard IR vector model to rank the training set docs using cosine similarity scores
  - Select the top 100k sentence-pairs using both IR scores and sentence-alignment quality measures
  - Generate word alignments using document-specific IBM-4 models.

Document Specific MT system : Summary

- Document Specific Translation Models
  - Created at test time
  - Merge document specific word alignments with baseline word alignments
  - Extract document specific alignment template libraries (and translation vocabularies)

Block Diagram of the Baseline and Document Specific MT systems



Incorporation of Named Entities (NEs)

- Motivation: A straightforward experiment showed that adding the entire LDC NE list to IBM-4 training hurt translation performance
- Alternative Approach using ATTM & Document Specific training
  - Identify all English names that appear in the English side of the retrieved Chinese documents using LDC NE list
  - Filter the list by discarding any entry whose Chinese side does not appear in the test document
  - Add these NE translations to the alignment template library
- Allows picking NEs that were not segmented as a single Chinese word.

Translation Performance

- Test Sets:
  - ZBN-Eval02 (30 documents) : Zaobao-News portion of eval02
  - Eval03 (100 documents)

System	ZBN-Eval02		Eval03
	BLEU	NIST	NIST
Baseline (Contrast)	0.1600	6.6272	6.7892
Doc-Specific-Bitext	0.1660	6.8628	*
Doc-Specific-NE	0.1622	6.7081	*
Doc-Specific-Bitext-NE (Primary)	0.1758	7.0052	7.0519

- Document Specific approach for selecting MT training data & name entities improves performance over a baseline system
- Gains from Doc-Specific-Bitext and Doc-Specific-NE are more than additive

Conclusions and Future Work

- First use of our WFST translation model in an MT evaluation
  - MT System in development for less than 9 months
- Modular FSM approach allows for modular development of model components and plug-and-play evaluation
- In-house model training procedures based on GIZA++ alignments
- Decoder supports lattice/N-best list generation and rescoring.
- First large-scale integration of IR for MT in order to refine translation model training data and incorporate name entities
- Future Work
  - Full EM style retraining of WFST-ATTM model
  - Refinements to IR approach
  - Better integration of constituents in the ATTM framework