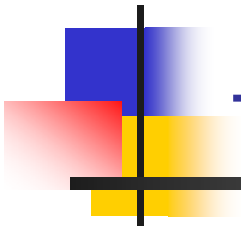

# Translating Words You've Never Seen


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Language Technologies Institute
Student Research Symposium
September 2006

Joint work with

**Bing Zhao, Ian Lane, and Stephan Vogel**

# Translating Words You've Never Seen

- Vietnamese news:

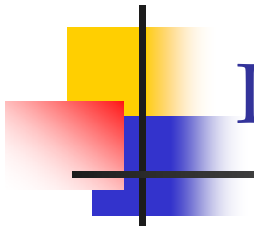
  "**Rô-ma-nô Prô-đi đang đối mặt với thử thách thực sự đầu tiên trong cương vị của mình** "

- VN-EN Machine Translation:

  "**is facing the first real battle of the premiership** "

- Translating Words You've Never Seen

  "**Romano Prodi is facing the first real battle of the premiership** "



# Problem

- Machine Translation systems have a **limited vocabulary** , yet human language has an **unlimited vocabulary**
- Out-of-vocabulary (OOV) words are guaranteed to produce errors
- OOV words contains **names**.
- **Challenge**:

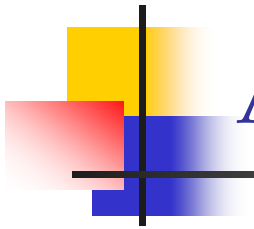
Can we **translate unseen names**?

# Examples

- Name pairs: source and target languages
  - GE: **K**onstantino**polis** – En: **C**onstantino**ple**
  - AR: K**w**m**A**r**A**t**w**n**j**A – En: K**u**m**a**r**a**t**u**n**g**a
  - SP: Adelaid**a** – En: Adelaid**e**
  - FN: Tariff**i** – En: Tariff
- Conjecture: *Names can be transformed from spelling in one language to spelling in other languages*
- Let's try with Arabic-English.

# Severe Issues in Arabic Names

- Arabic is romanized by BAMA toolkit
  - خفاجي xfAjy
- Romanized Arabic names:
  - **Missing vowels in writing**:
    - خفاجي **xfAjy**
  - **Possible correct translations**:
    - mHSn Mahasin / Muhasan / Mahsan



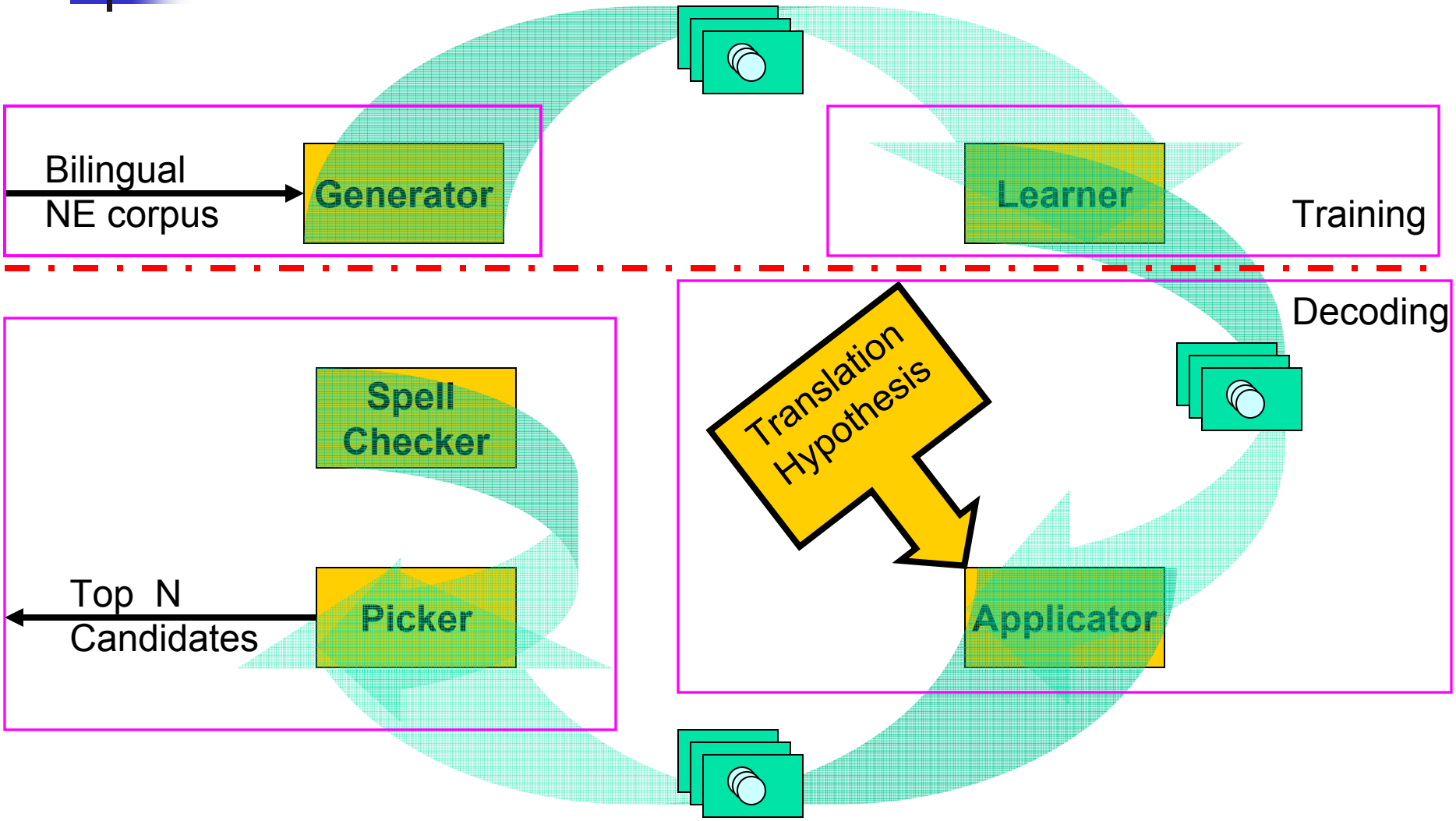
# Approaches

- Rule-based Transliteration
- Transliteration as Translation

# Rule-based Transliteration - Examples

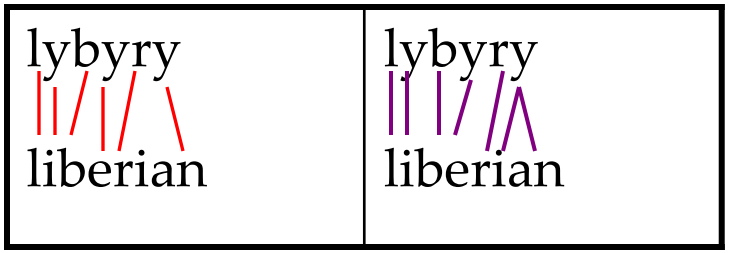
- Examples
  - AR: KwmArAtwnjA – En: Kumaratunga
- Rules
  - If source Begins with "**Kwm**" then Begin of target is "**Kum**"
  - If source Ends with "**ja**" then End of target is "**ga**"
  - If Middle of source is "**A**" then Middle of target is "**a**"
  - If Middle of source is "**twn**" then Middle of target is "**tun**"
- Templates
  - Source Target Position Score
    - Kwm Kum Begin 1.4324

# Rule-based Architecture Overview



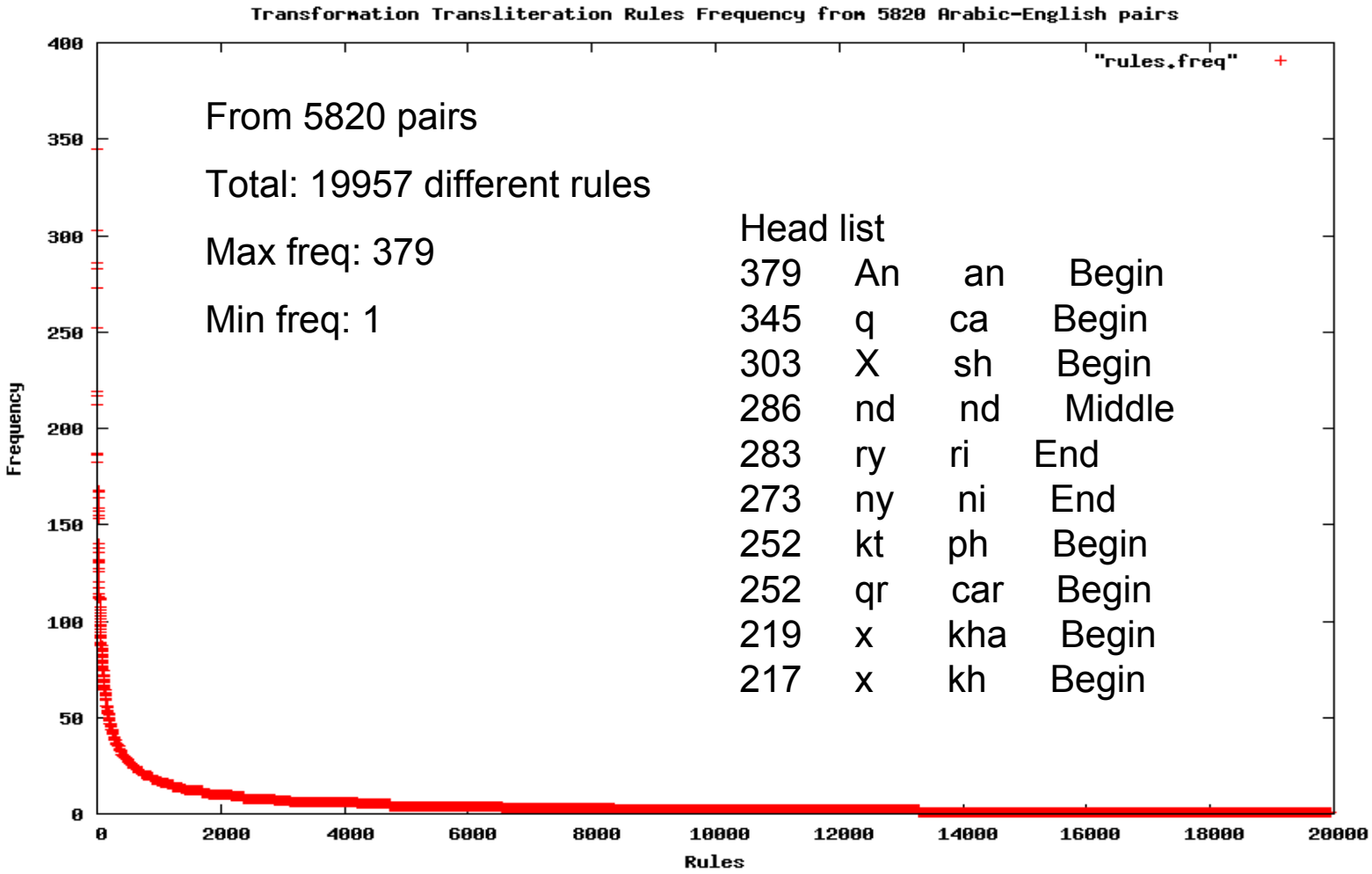
# Rule-based Architecture Overview

- Training - Generator:
  - Given “lybyry” & “liberian” how many possible rules?
  - A: Alignment by calculating edit distance




  - Use all optimal paths to extract rules according to alignment paths
  - Distinguish rules for begin, middle, and end
  - Use consonants to anchor rule

# Rule-based Architecture Overview




From 5820 pairs

Total: 19957 different rules

Max freq: 379

Min freq: 1

Head list

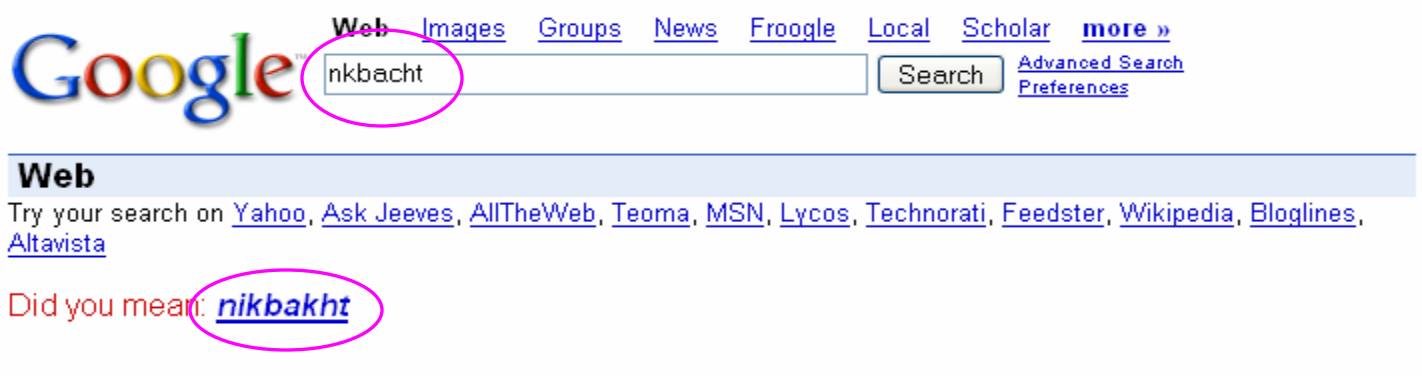
| | | | |
|---|---|---|---|
| 379 | An | an | Begin |
| 345 | q | ca | Begin |
| 303 | X | sh | Begin |
| 286 | nd | nd | Middle |
| 283 | ry | ri | End |
| 273 | ny | ni | End |
| 252 | kt | ph | Begin |
| 252 | qr | car | Begin |
| 219 | x | kha | Begin |
| 217 | x | kh | Begin |

# Rule-based Architecture Overview

- Training - Learner:
  - How to know which rule is good or bad?
  - For each rule, apply it to the held-out data & use reduction of character errors as figure of merit
- Decoding - Applicator:
  - Application order: Begin -> End -> Middle
  - Confidence threshold: filter out unreliable rules
  - Application strategy: for each source word, find all possible rules, and apply them in order

# Rule-based Architecture Overview

- Decoding - Picker:
  - Many possible transliteration candidates
  - Phonetic similarity to select top N candidates
- Decoding - Spell checker:
  - Google Suggest
  - Web frequency



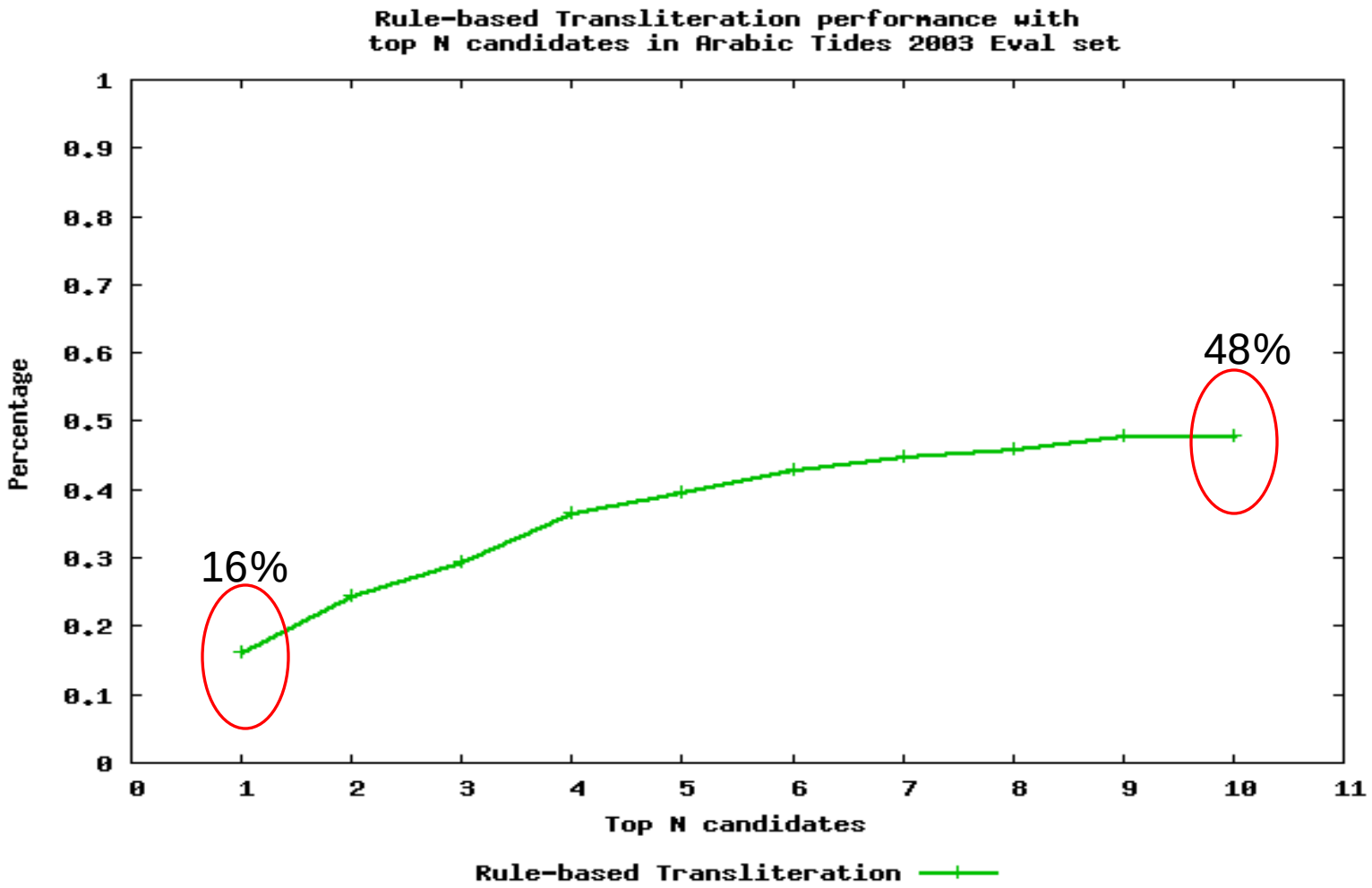
# Evaluation Setup

- Training data:
  - CMU Ar-En SMT: Vocabulary: 470K Arabic, 179K English; LM: 6-gram, 800 million words
  - 80K Arabic-English name pairs (GALE FOUO)
- Blind test set: Arabic-English Tides 2003
  - 286 unique tokens were left **un-translated**
  - Among them: 97 un-translated unique person, location names

| Arabic | BAMA | Reference |
|---|---|---|
| غرابو | grAbw | Grabo |
| قشطة | qXTp | Qishta |
| ايتساخرف | fAytsAxr | Weizsacker |
| والدهاني | wAldHmAny | al-Dahmani |
| يلويغيز | zylwygyr | Zellweger |
| ثاكسين | vAksyn | Thaksin |

- Evaluation method: Edit distance between hyp against possibly multiple references
  - Src = "mHmd"  Ref = Muhammad / Mohammed
  - Accept translation if edit distance = 1

# Rule-based Performance

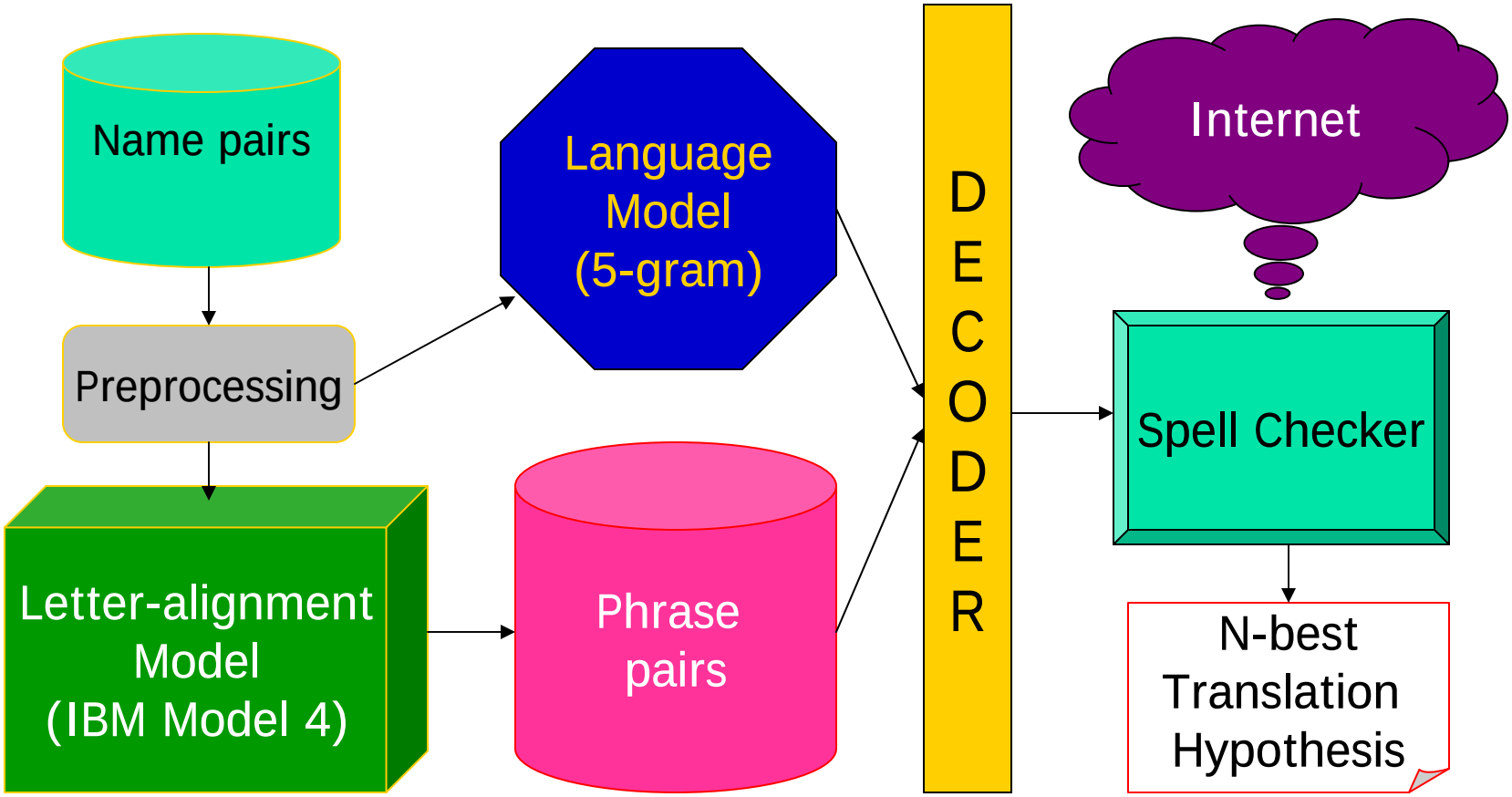



- Baseline is 0%

# Transliteration-as-Translation (T.a.T)

- Borrow Statistical Machine Translation (SMT) framework
- Ideas
  - Name pairs as sentence pairs in letter level.
  - Train n-gram letter Language Model
  - Train IBM models 4
  - Decode with InterACT decoder
  - Web spell checker

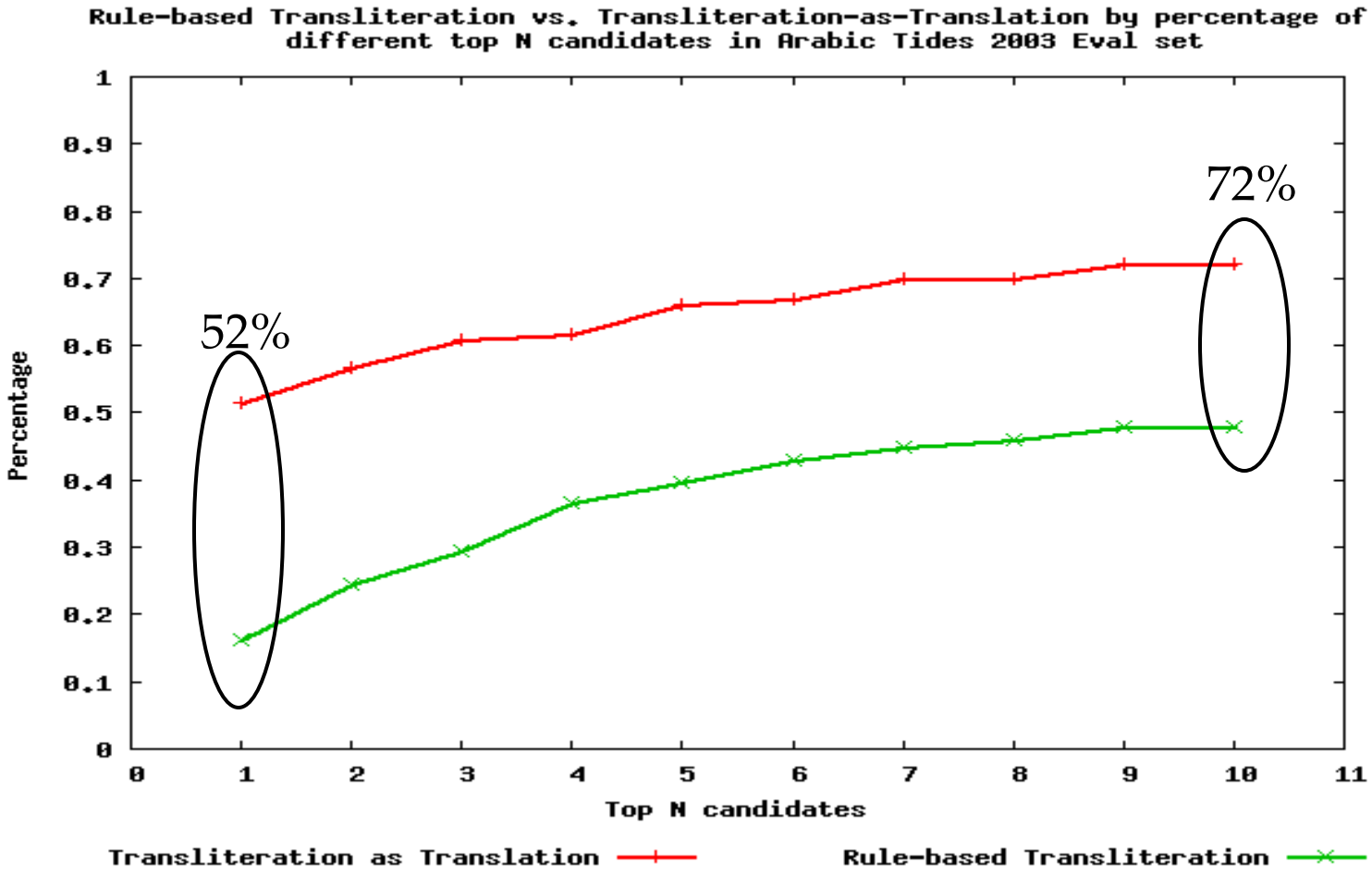
# T.a.T Architecture



# T.a.T: Key Points

- Alignment:
  - GIZA + +
  - Fertility: restricted to 4
  - Letter classes:  vowel, consonant, unknown
  - Monotone alignment
  - Log-linear model for phrase alignment with 13 features are computed for each n-gram
- Decoding
  - Monotone
- Web spell checker (same as Rule-based)
  - Web statistics and Google suggestions

# Evaluation (Rule-based vs. T.a.T)




- Significantly outperform rule-base

# Evaluation (Google vs. T.a.T)

- The Arabic-English Google Web Translation (Google)
- Accuracy **45%** (as in June 20) for the 1-best hypothesis while T.a.T archives **52%**

| Source | Reference | T.a.T | Google |
|---|---|---|---|
| سومای | *Sumaye* | *Sumaye* | *Somai* |
| هازومیتسو | Hazumitsu | Hazumitsu | Hazoumitso |
| یلاه | *Yalahow* | *Ylahu* | *Elaho* |
| نکباخت | Nikbakht | Nkbakht | Nkbacht |
| میکویاس | Mikulas | Mikulas | Mikoias |
| کومارانونج | Kumaratunga | Kumaratunga | Kumaratung |
| همدان | *Hamdan* | *Hamdan* | *Hamedan* |
| لمازاندران | Mazandaran | Mazandaran | Mazandaran |
| ویکرمسینغه | Wickremasinghe | Wikramsinghe | The Ekermsingh |

# Incorporating T.a.T to SMT (GALE)

**Arabic text source sentence**

كولمبو 4 يناير / شينخوا/ حذر رئيس الوزراء السريلانكى رانيل ويكرمسينغه
الرئيسة تشاندريكا كوماراتونجا من مغبة تدمير عملية السلام التى ترعاها النرويج

**SMT *hypothesis***

- in colombo 4 january 1997 , the xinhua / warned by the prime minister {**UNK** رانيل ويكرمسينغه السريلانكى } chairperson {**UNK** تشاندريكا كوماراتونج } cautioned the destruction of the peace process sponsored by norway

**SMT with *T.a.T***

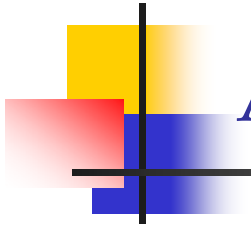
- in colombo 4 january 1997 , the xinhua / warned by the prime minister **Srilankan Ranil Wikramsinghe** charperson **Chandrika Kumaratunga** cautioned the destruction of the peace process sponsored by norway

***Reference* translation**

- Colombo 04/01 (Xinhua) **Sri Lankan** Prime Minister **Ranil Wickremasinghe** warned the country's President **Chandrika Kumaratunga** of the consequences of destroying the peace process sponsored by the Norwegians

# Conclusion & Future Work

- Unseen names convey key information.
- We can translate unseen names for Arabic-English MT system
- Our system performance is comparable with the state-of-the-art system
- Future
  - Configure to other languages pairs ( Italian – English, Chinese –English, …)
  - Incorporate to cross-lingual IR systems
  - Translating OOV words from Speech Recognition



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Thank you