Script and Orthographic Normalization

The Pandora's Box of Low-Resource Language Technology

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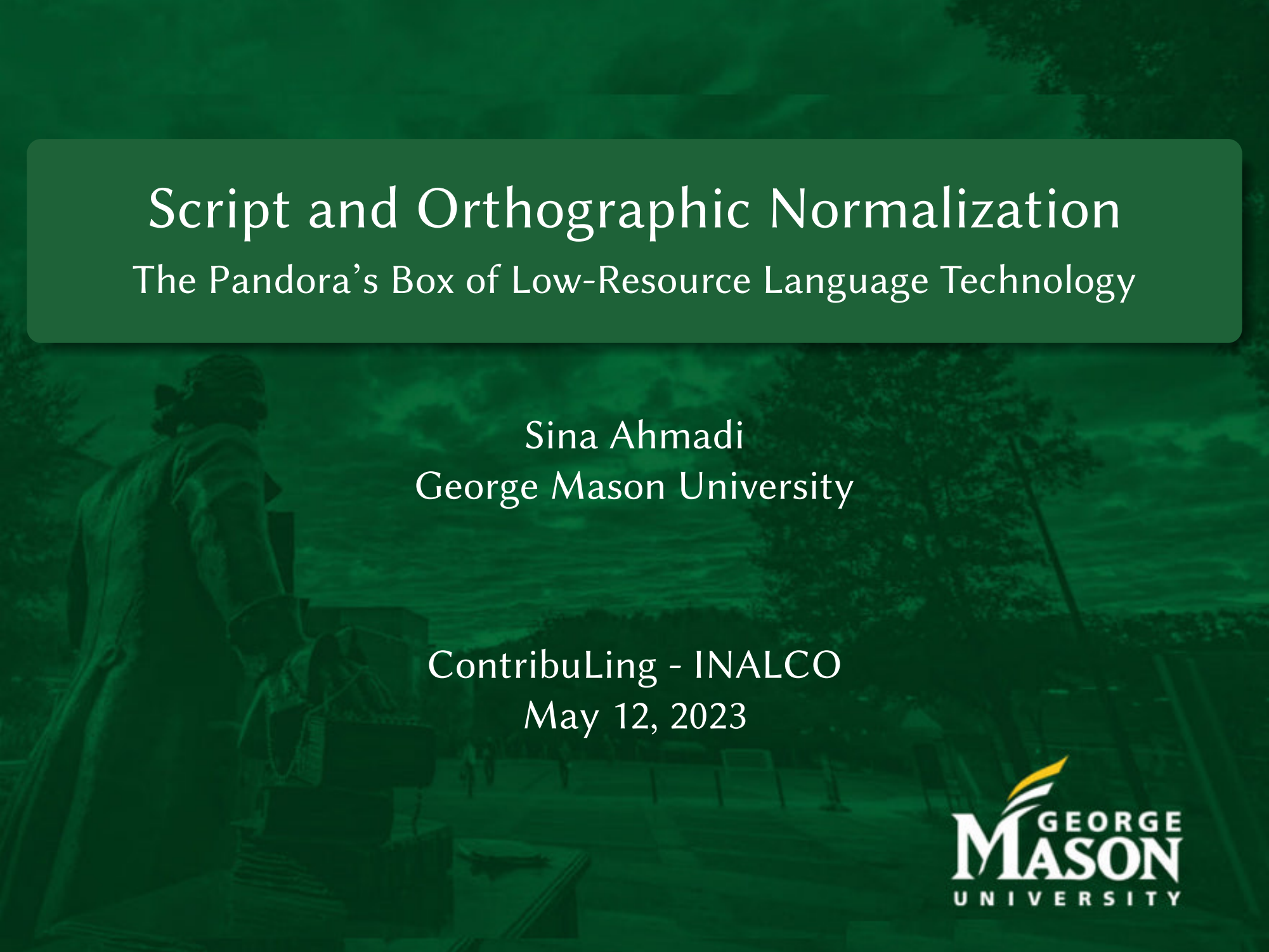
ContribuLing - INALCO
May 12, 2023



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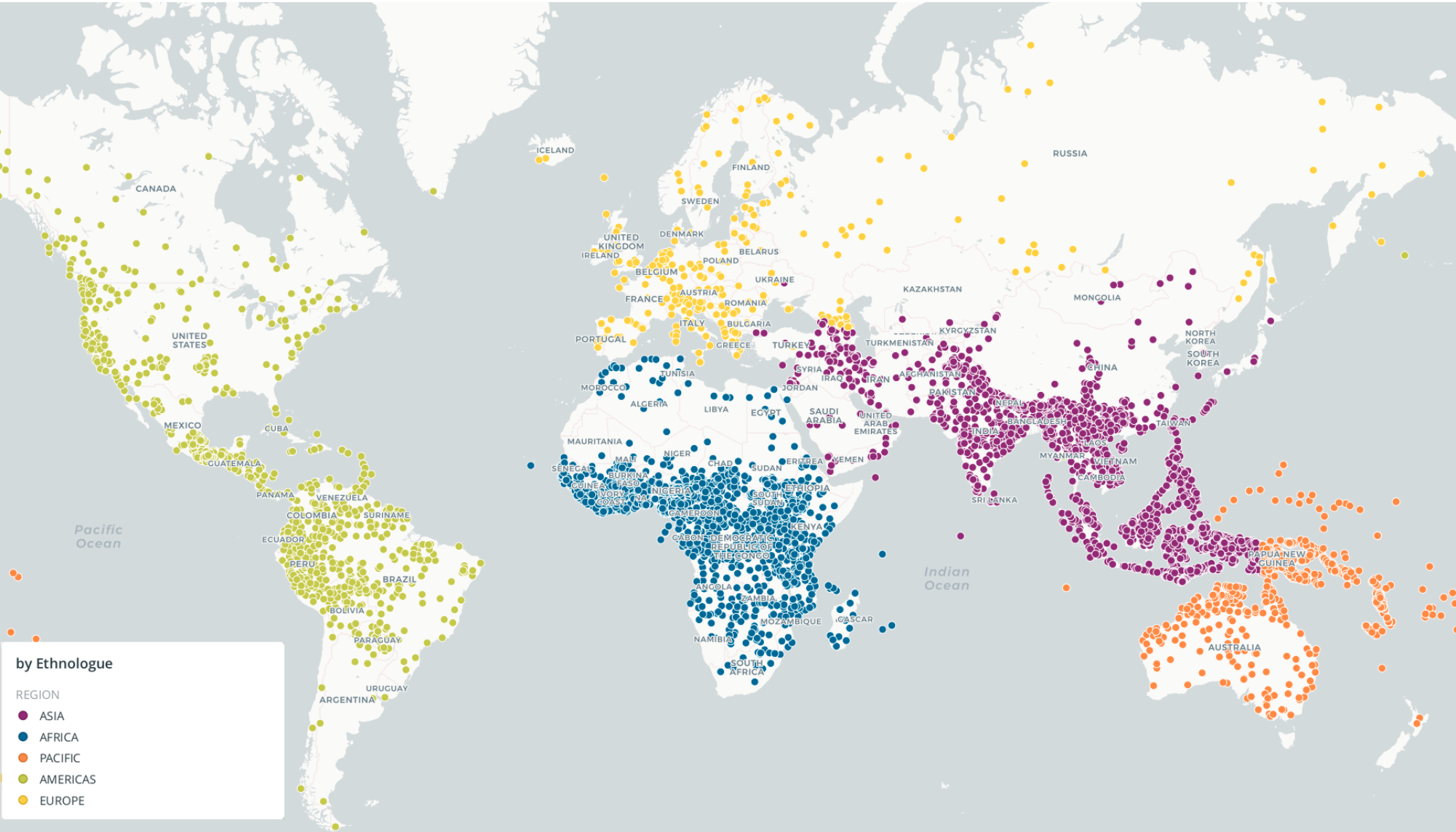
Context: Languages and Writing Systems

- More than 7,000 “languages” are spoken (Ethnologue, 2023).



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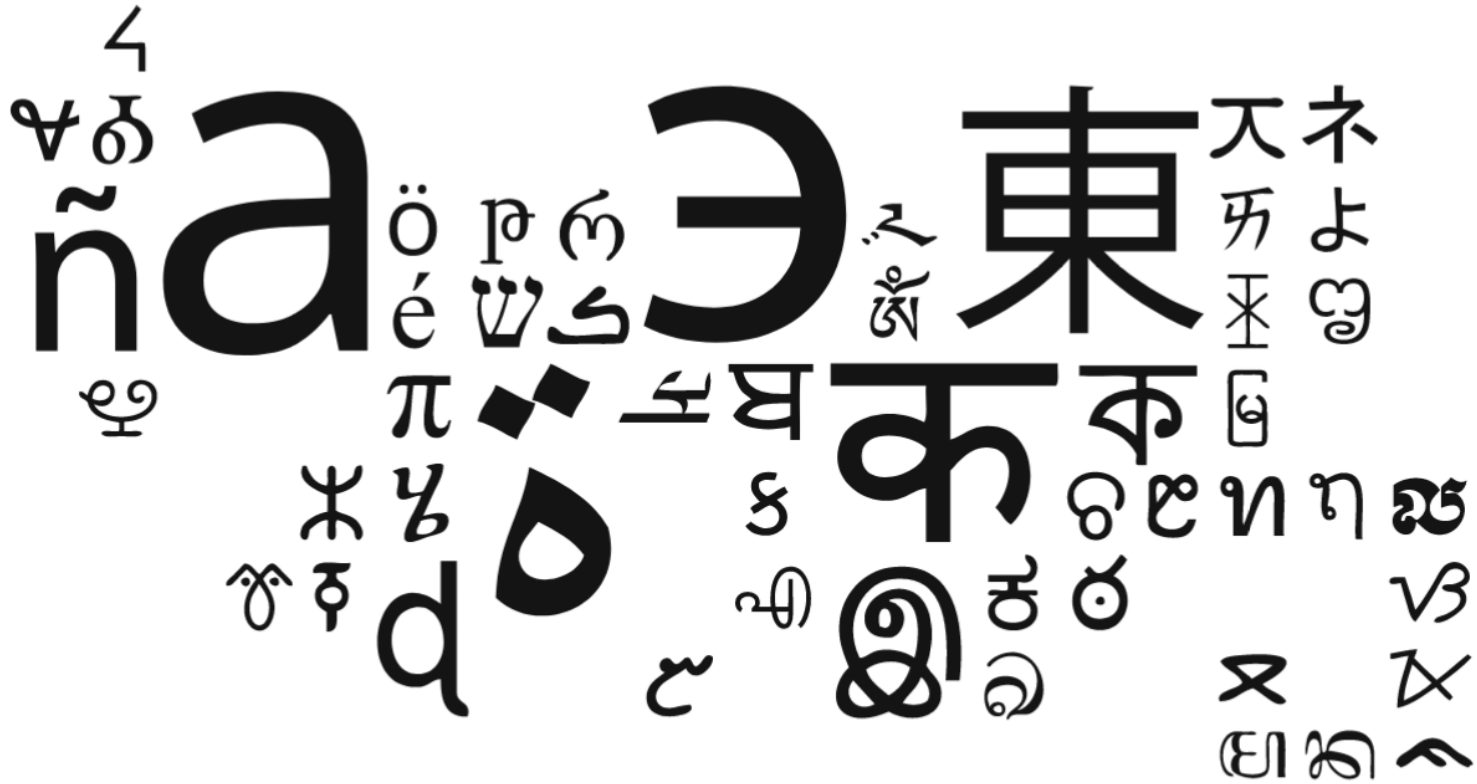

Context: Languages and Writing Systems

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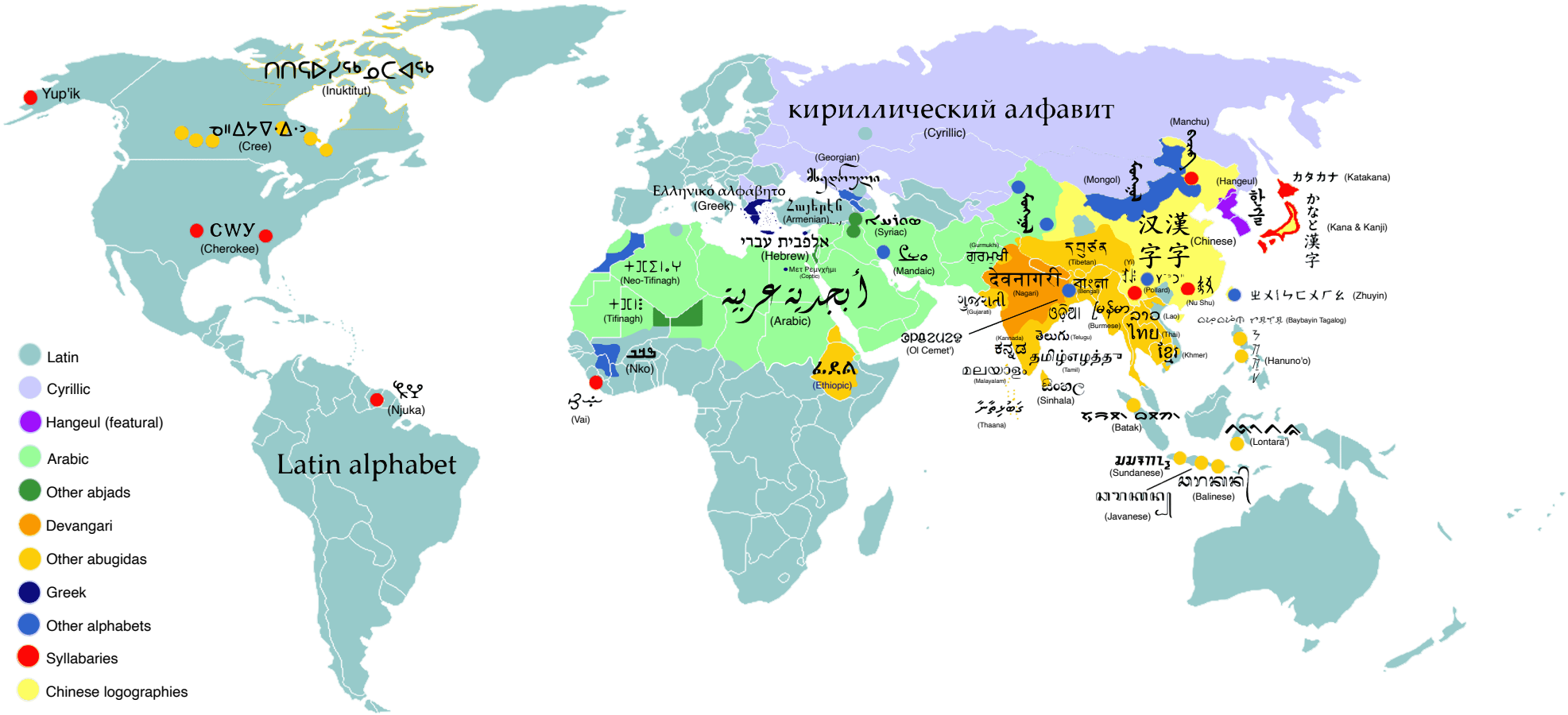
- Almost 300 writing systems exist (and many adopted ones)
- Less than 4,000 languages have a written form



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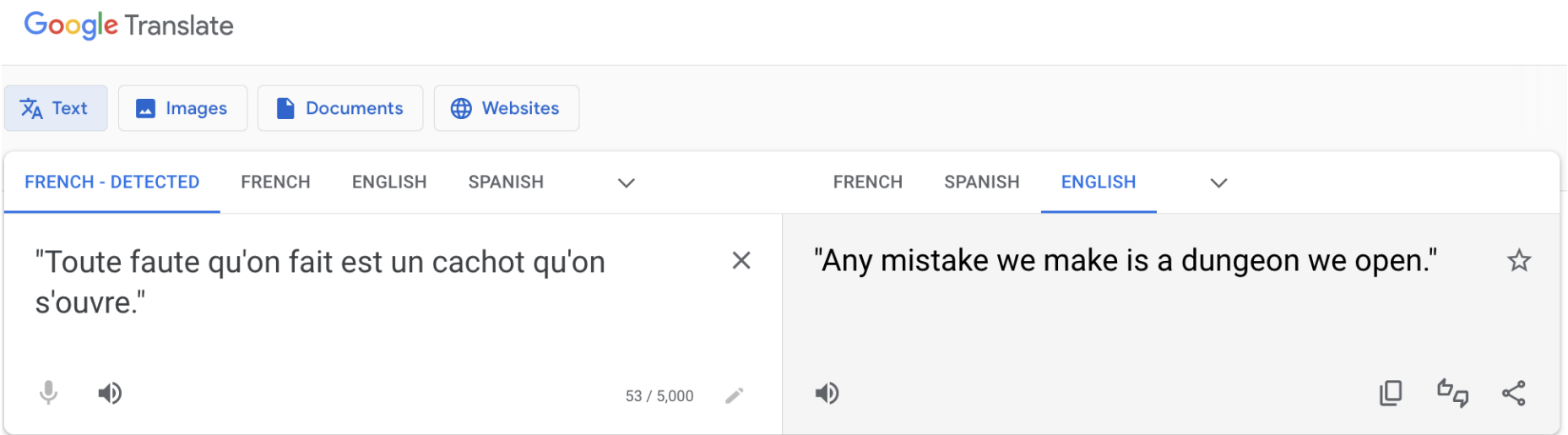

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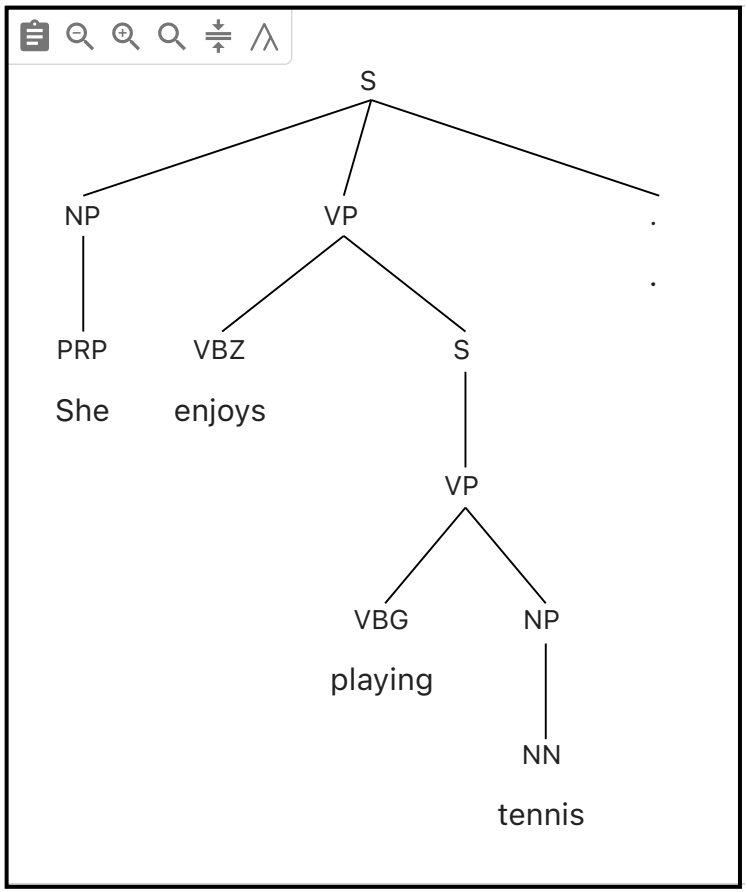
- Syntactic parsing

Berkeley Neural Parser

Sentence:

She enjoys playing tennis.

Parse tree:



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- Syntactic parsing
- Large language models

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Most countries are X-lingual, but not all officially!

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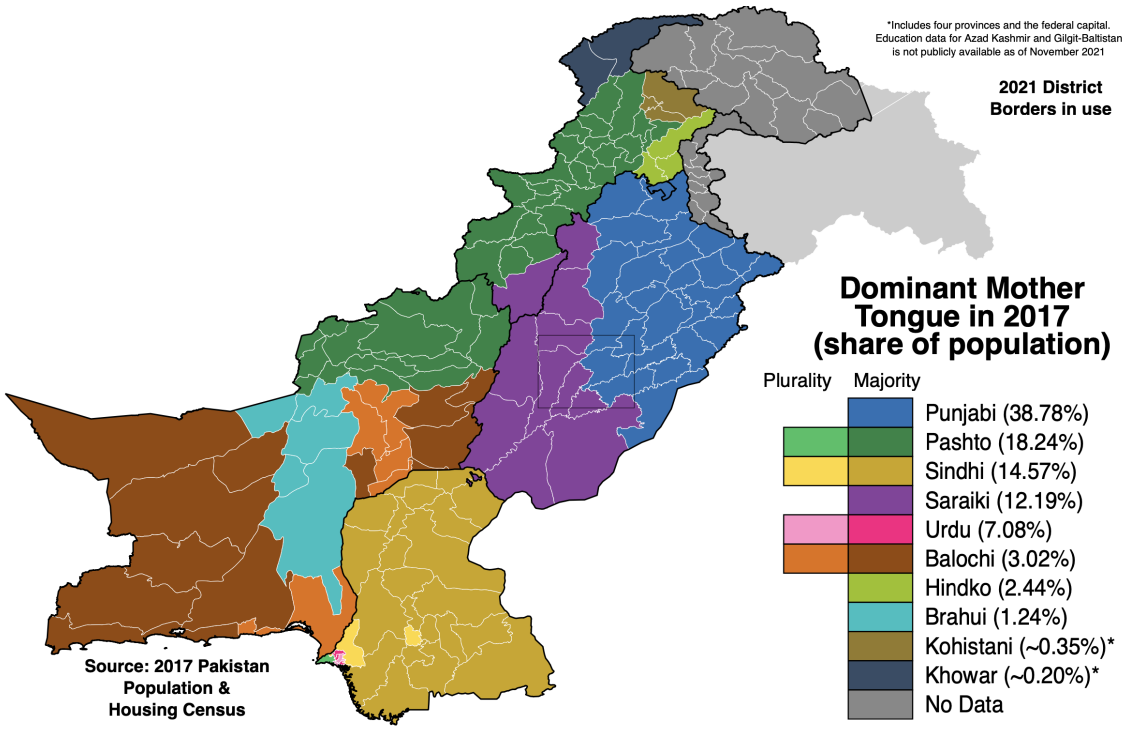
  $\rightarrow$ Urdu and English



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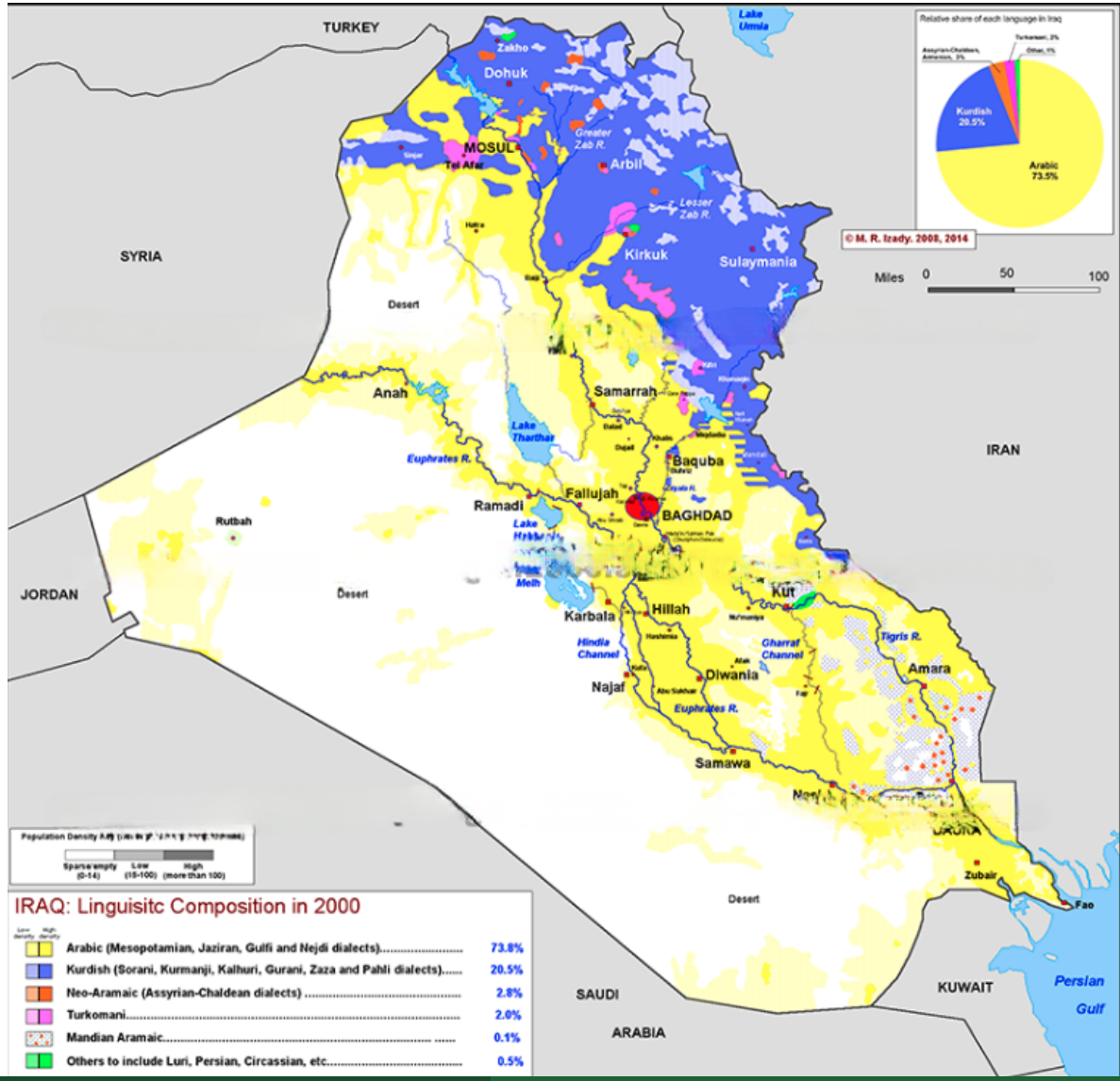

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- Iran:
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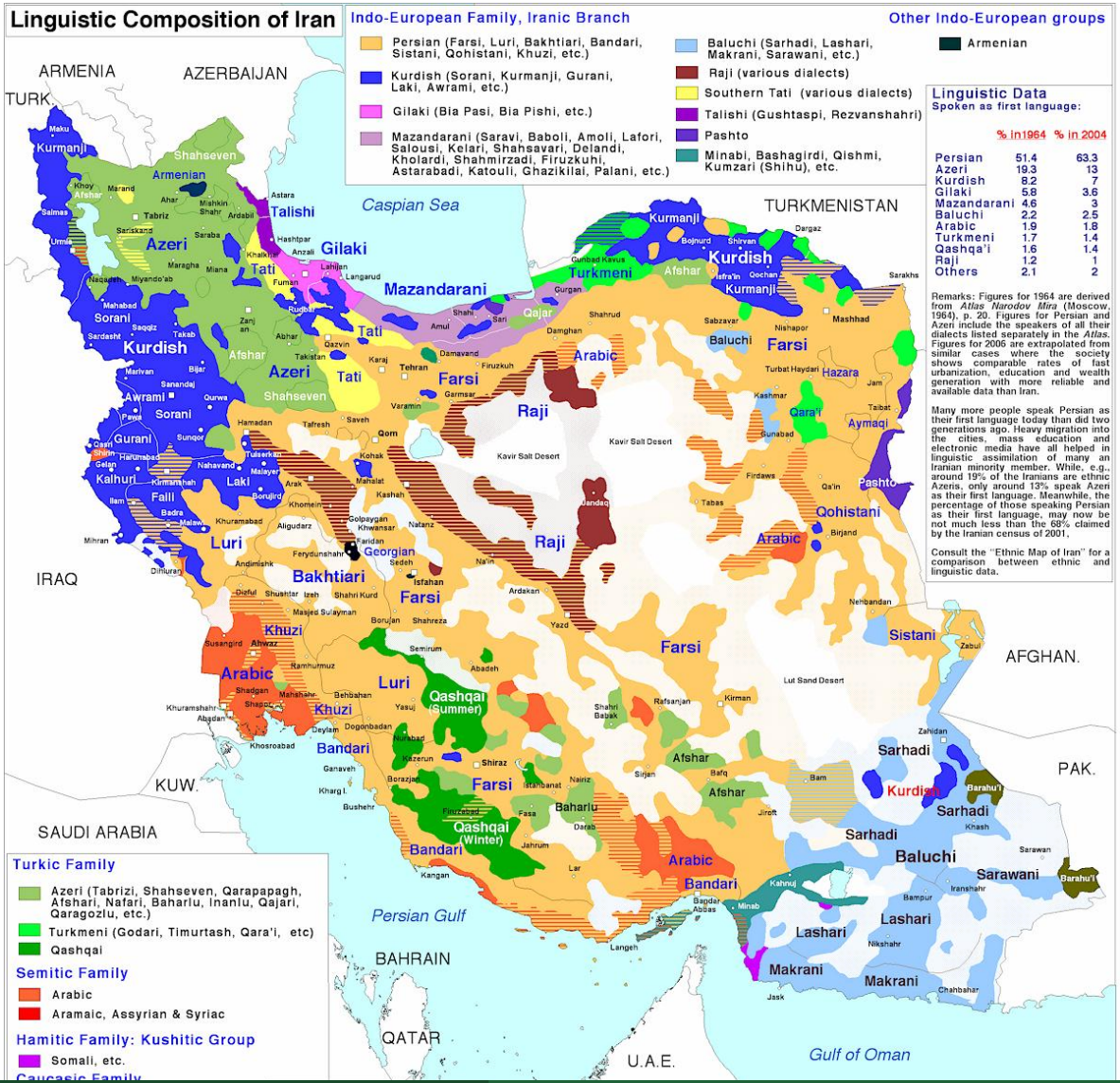

Context

And what if these languages are written in the dominant language's script?

Unconventional Writing

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- *mer6 pr tn mess pr mn anif* (French SMS language)

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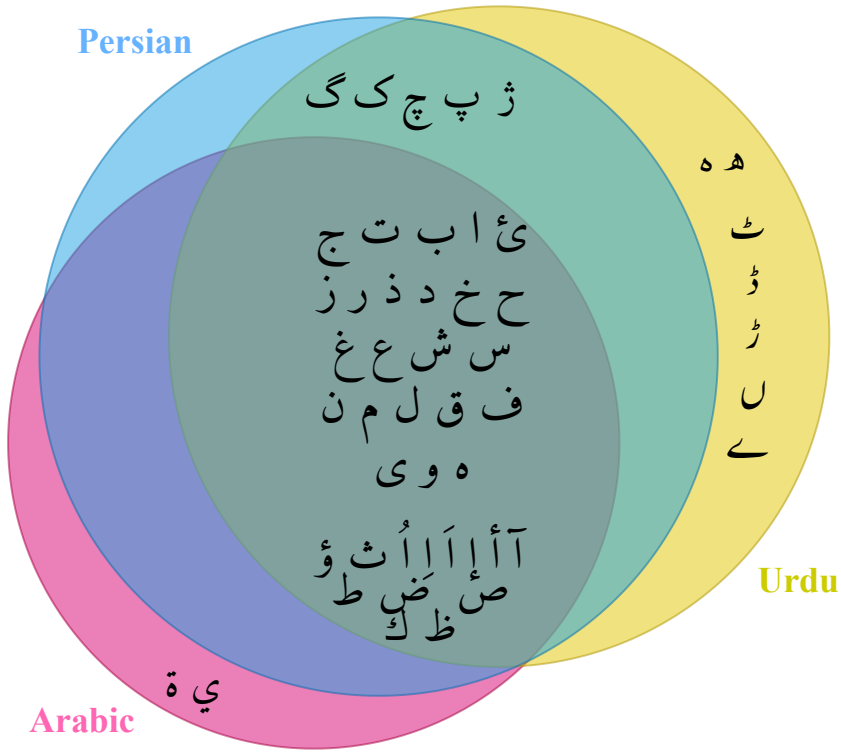

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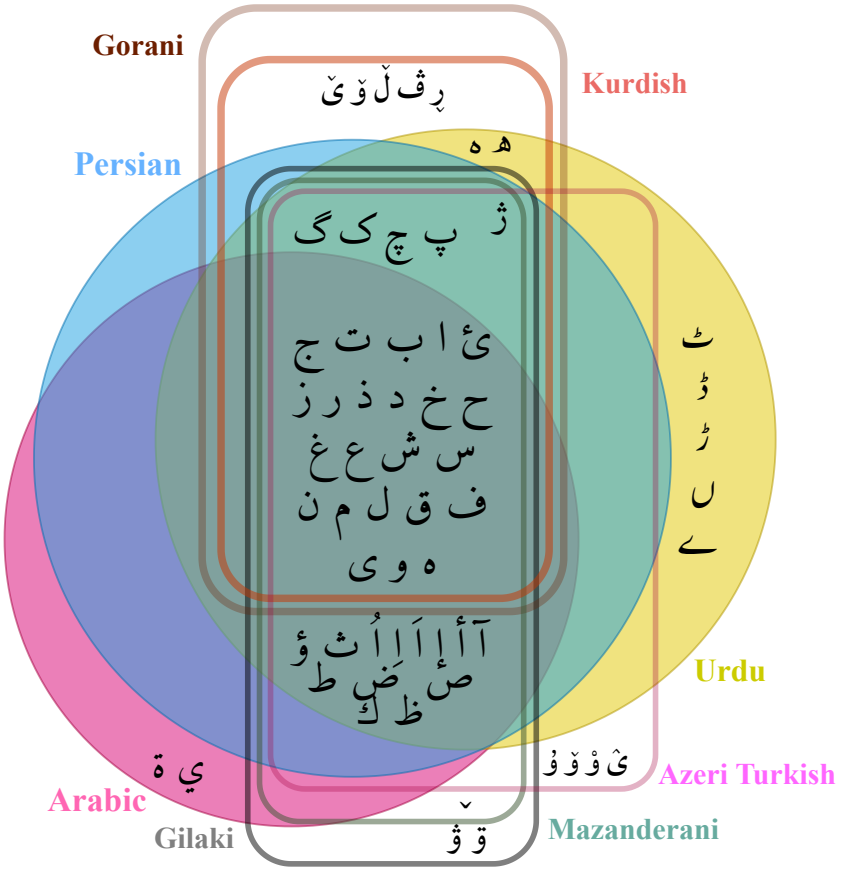

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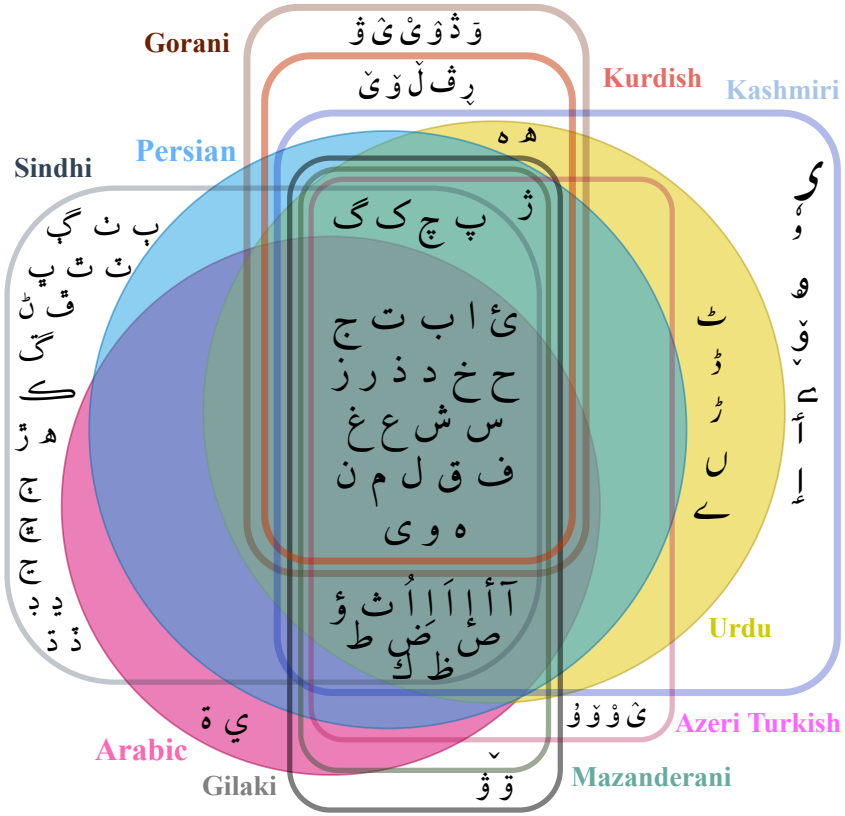
  - Languages in Pakistan and India



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- Persian, Urdu, Kurdish, Uyghur, Kashmiri etc.
- 400M speakers in the Middle East and the Subcontinent
- Discriminatory language policies (Sheyholislami, 2012)
  $\rightarrow$ pernicious sociolinguistic effects on language attitudes

Unconventional Writing: Perso-Arabic scripts

Language	Unconventional script	Unconventional writing	Conventional writing
Gilaki	Persian	یته زون نم هیسه گه گیلکن اون جی گب زنن	یته زوؤنْ نؤم هیسه گه گیلکؤن اوَنْ جي گب زنن
Kashmiri	Urdu	برور چھ اکھ وراسے جانور۔	برٕور چھُ اَکھ وُرأسۍ جانوَر۔
Kurmanji	Arabic	قایمقام اامدي بةرثوا پارزکار دهوك دا	قایمقامێ ئامێدیێ بەرسڤا پارێزگارێ دهۆکێ دا
Sorani	Arabic	هةر لة یةکةم شانؤوة دیارة فهدیان دةویت	هەر لە یەکەم شانۆوە دیارە فەهەدیان دەوێت
Sindhi	Urdu	مديني ڏانهن هجرت وقت فقط هيءَ گهرواري ساڻ گڏ هئي	مديني ڏانهن هجرت وقت فقط هيءَ گهرواري ساڻ گڏ هئي

Unconventional Writing: the Pandora's Box

Unconventional Writing: Questions

Some questions to think about:

1. How does unconventional writing affect NLP?

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1. How does unconventional writing affect NLP?
2. How can this phenomenon be effectively remediated?
3. Do we always need to write a language?

Script Normalization

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Normalization of a text written in an unconventional script based on the conventional script and orthography

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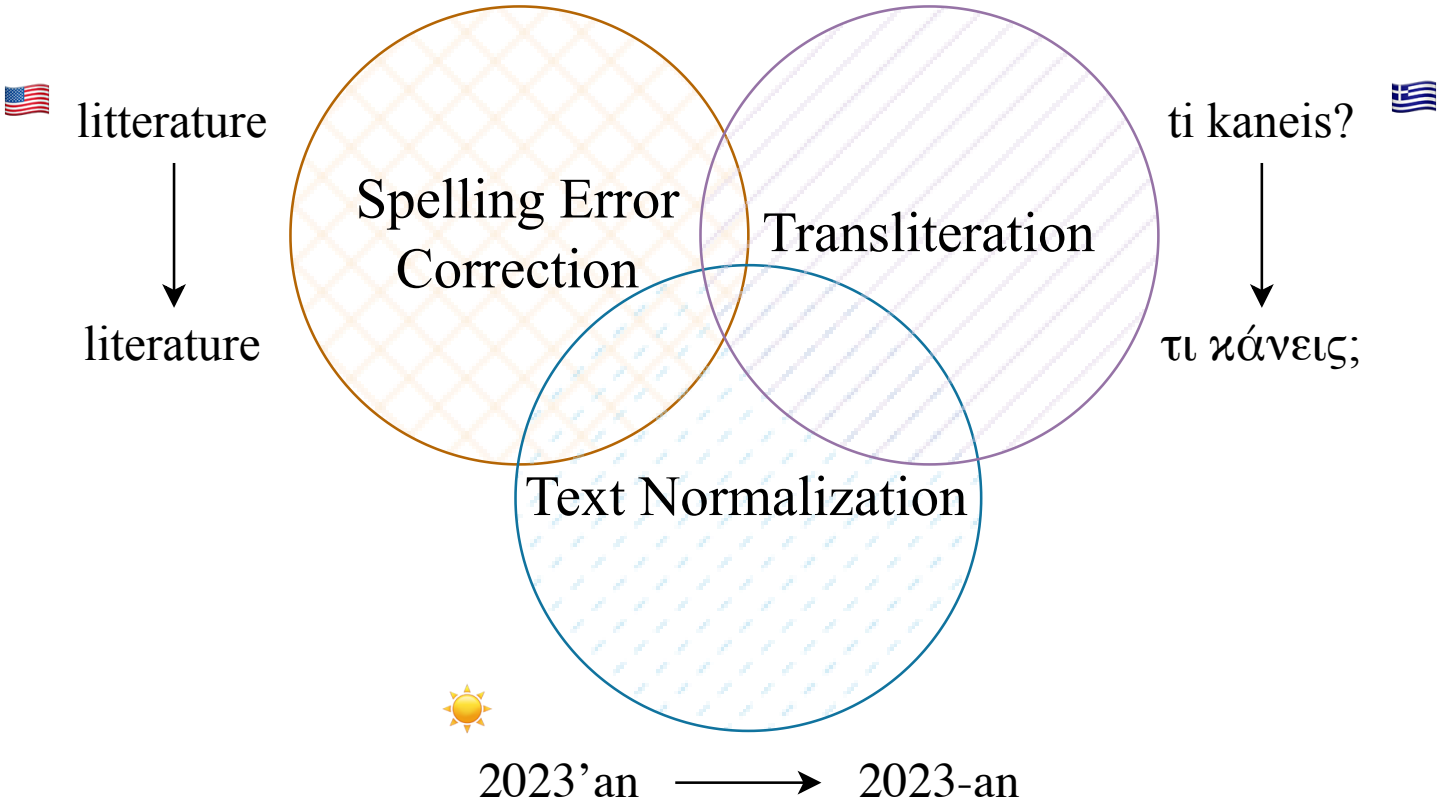

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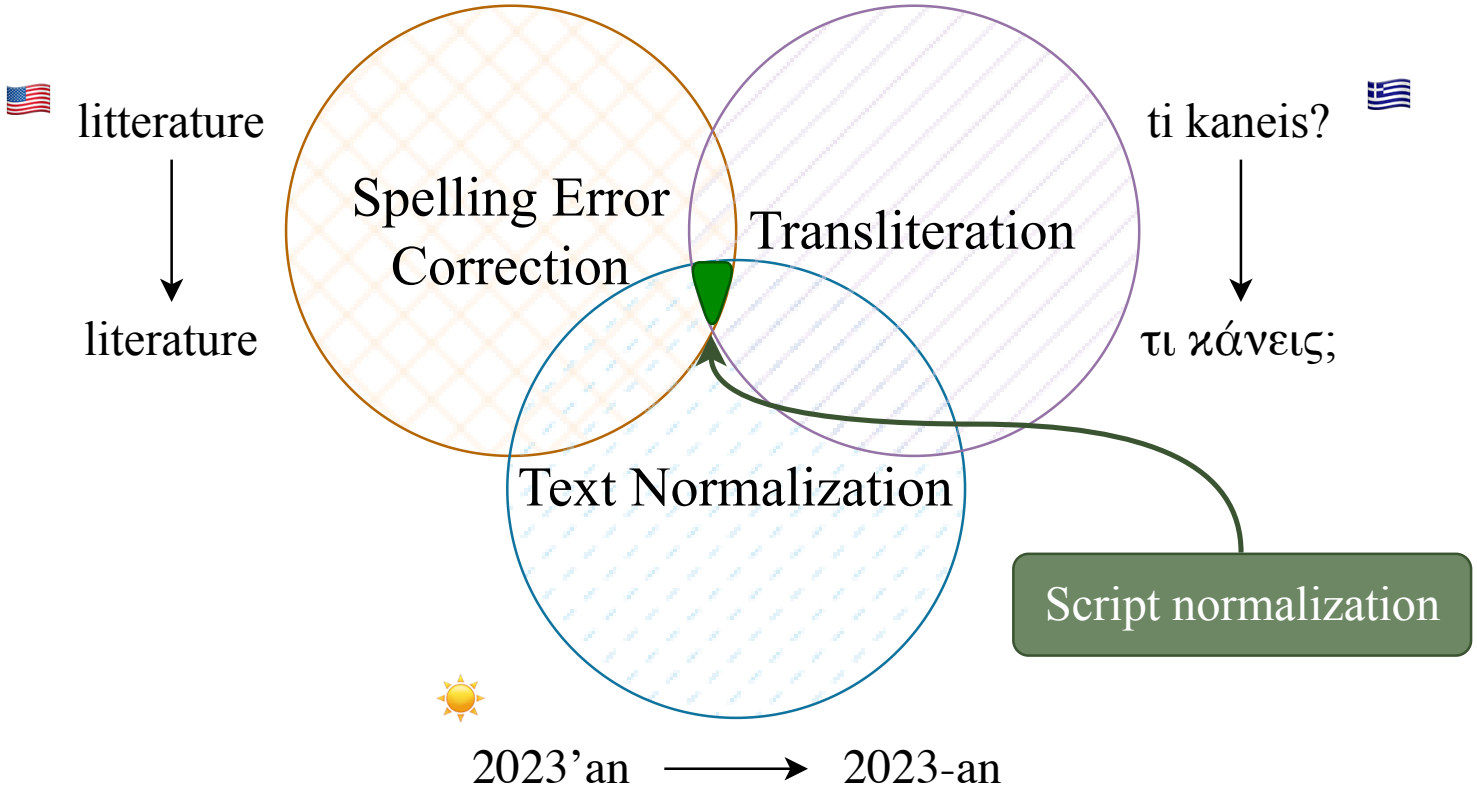
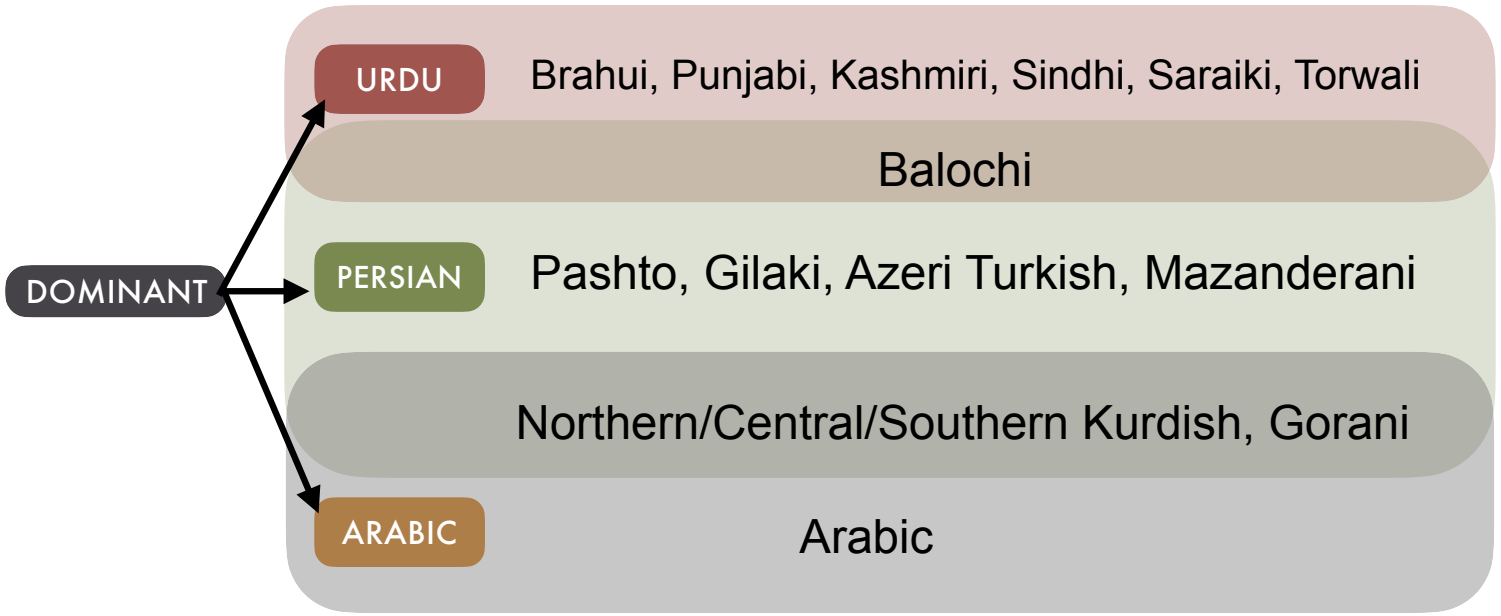


Script Normalization: Selected Languages



Script Normalization: Approach

1. Data collection – Not easy!

Language	639-3	WP	script type	diacritics	ZWNJ	Dominant
Azeri Turkish	azb	azb	Abjad	✓	✓	Persian
Kashmiri	kas	ks	Alphabet	✓	✗	Urdu
Gilaki	glk	glk	Abjad	✓	✓	Persian
Gorani	hac	-	Alphabet	✗	✗	Persian, Arabic, Sorani
Kurmanji	kmr	-	Alphabet	✗	✗	Persian, Arabic
Sorani	ckb	ckb	Alphabet	✗	✗	Persian, Arabic
Mazanderani	mzn	mzn	Abjad	✓	✓	Persian
Sindhi	snd	sd	Abjad	✓	✗	Urdu
Persian	fas	fa	Abjad	✓	✓	-
Arabic	arb	ar	Abjad	✓	✗	-
Urdu	urd	ur	Abjad	✓	✓	-

Script Normalization: Approach

1. Data collection – Not easy!
2. Script mapping
   - Common characters
   - Visual resemblance
   - Orthographic rules

Language	**Unconventional script**	**Source**	**Target**
Azeri Turkish	Persian	چ	چ
Sorani	Arabic	ز	ذ / ض / ظ / ز
Kashmiri	Urdu	أ	ا / اُ
Sindhi	Urdu	ي	ے / ي / ى

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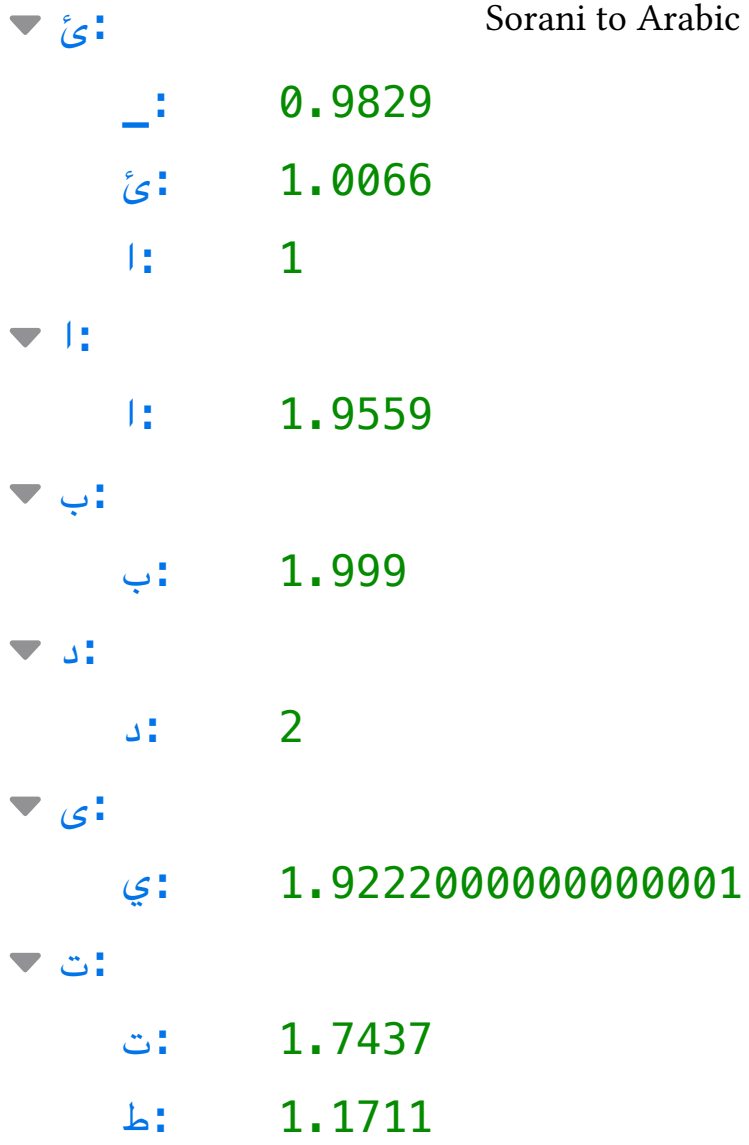
3. Character-alignment matrix
   → sequence alignment based on dictionaries

Sorani to Arabic



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4. Synthetic data generation
   → randomly generate pairs
   → inject noise

Noise %	Sentence
Clean	دووەمین پێشانگەها فۆتۆگرافەرێن کورد ل بەلجیکا Second Kurdish photographers' exhibition in Belgium
20	دووهمین پێشانکهها فۆتۆکرافهرێن کورد ل بهلجیکا
40	دووه مین بشانکه ها فطکرافه رن کورد ل به لجیکا
60	دووة مین بشانکة ها فوتوکرافة رن کورد ل بة لجیکا
80	دووةمین بیشانکةها فؤتؤکرافةرین کورد ل بةلجیکا
100	دووهمین بیشانکهها فوتوکرافهرین کورد ل بهلجیکا

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4. Synthetic data generation
   → randomly generate pairs
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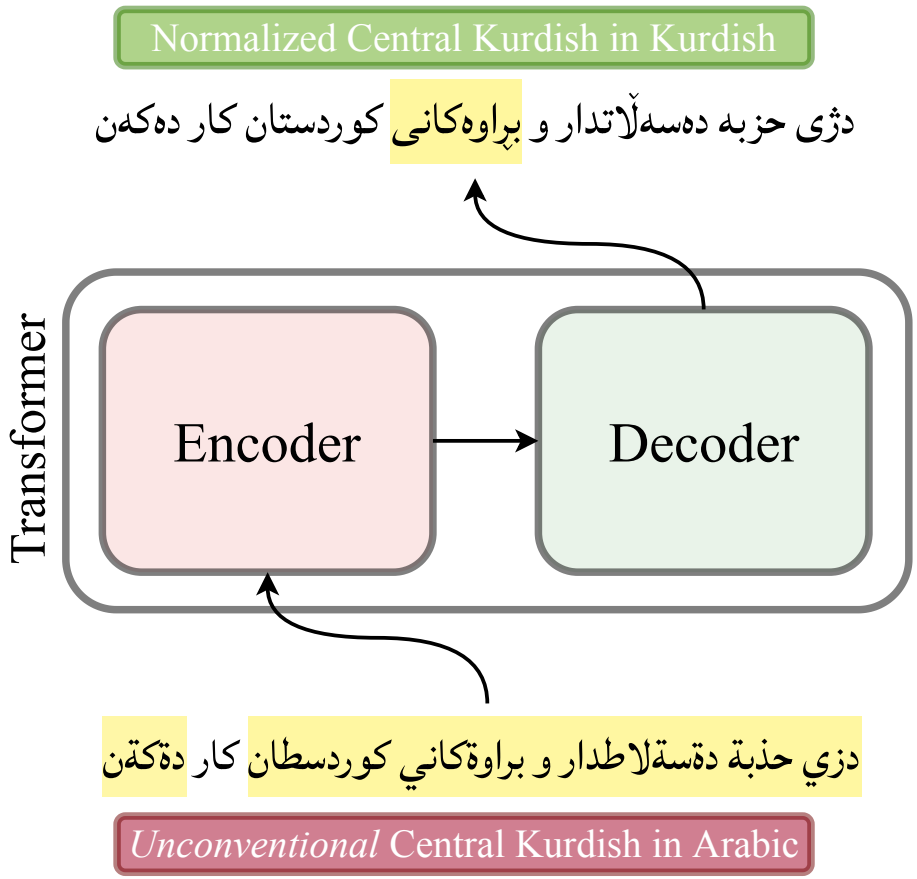
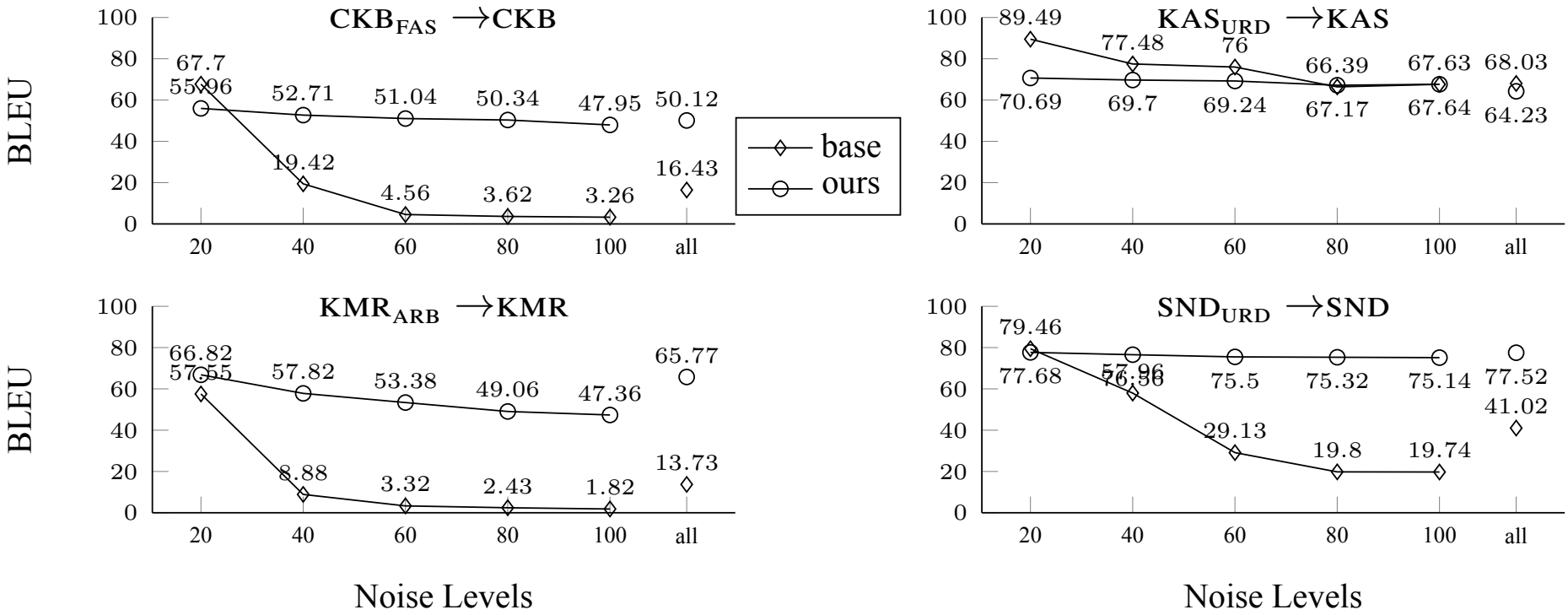
5. Model
   → encoder-decoder with self-attention



Script Normalization: Intrinsic Experiments

- Baseline: a naive "copy" system



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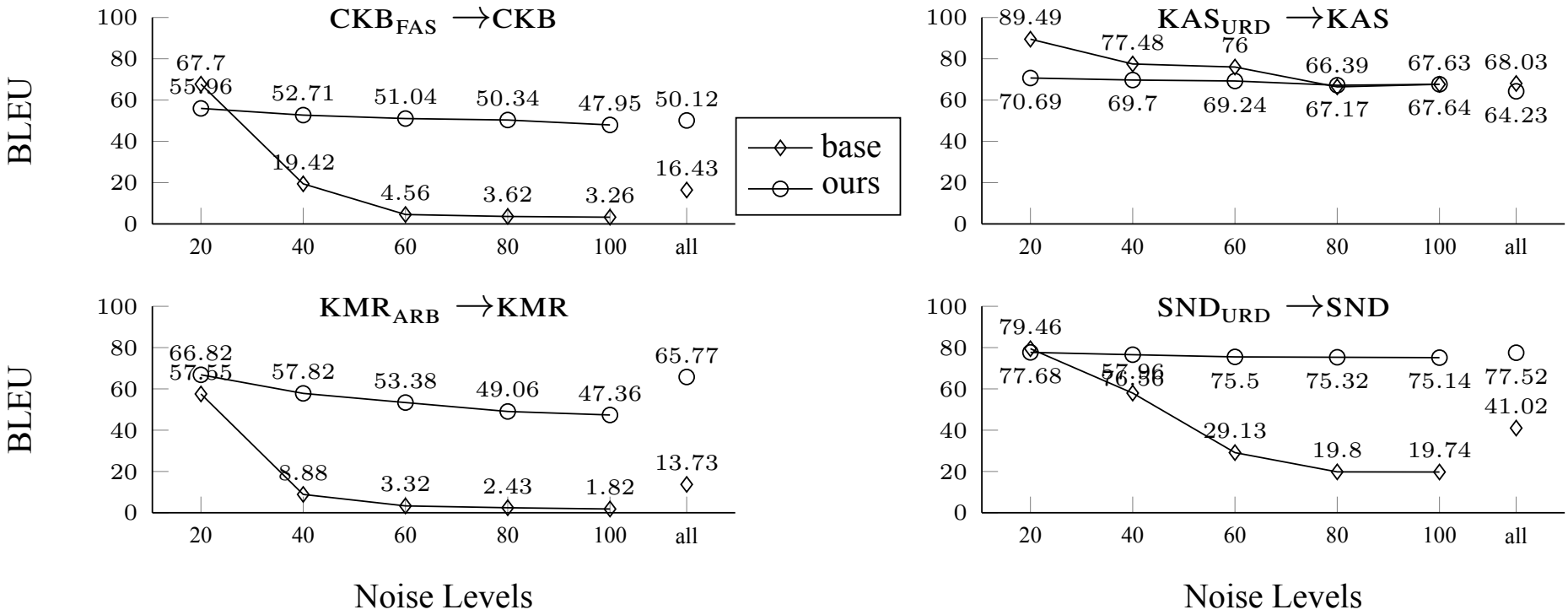

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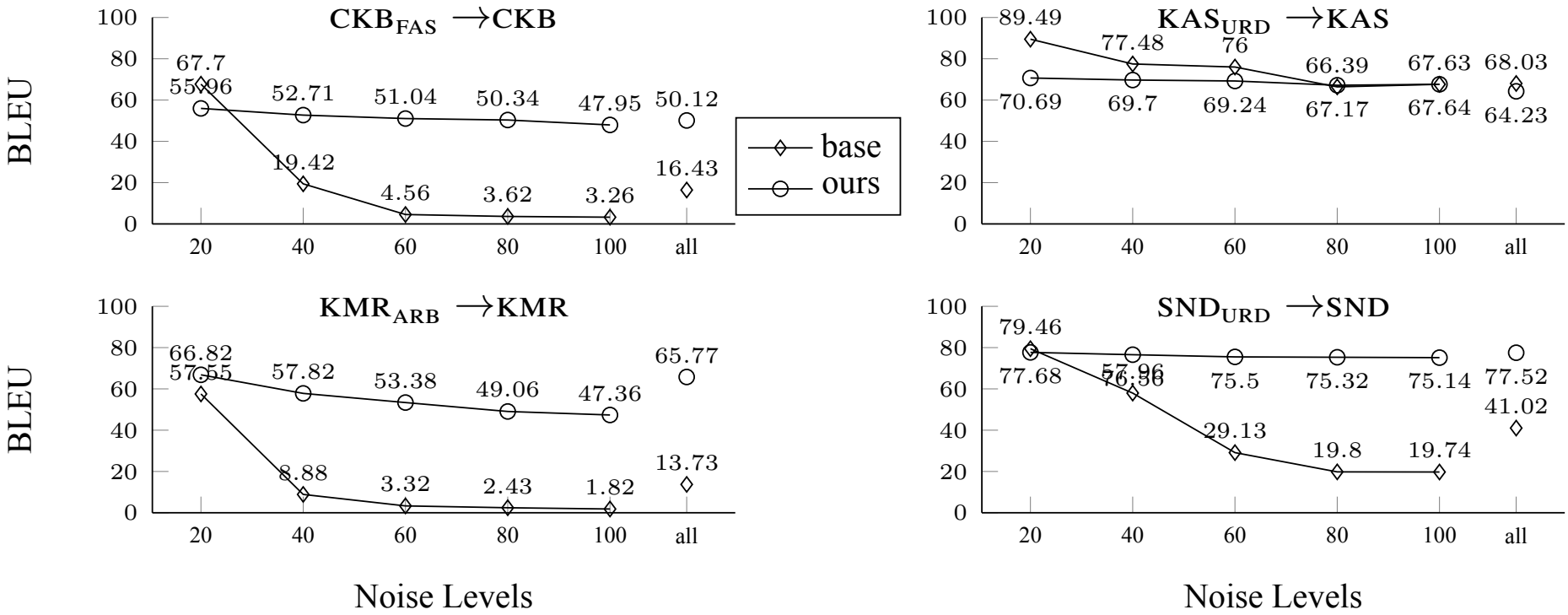

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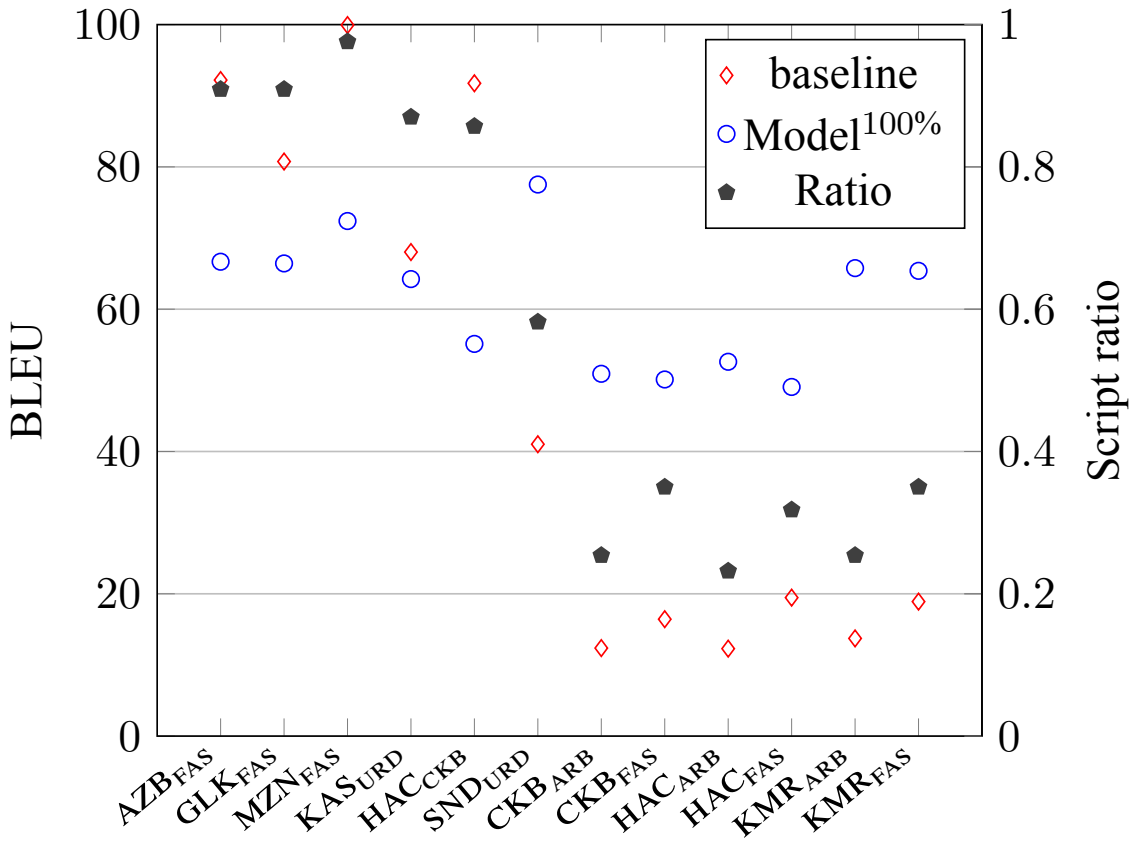
- **Our models dramatically improve over the baseline**
- The more similar the scripts, the more difficult the normalization!



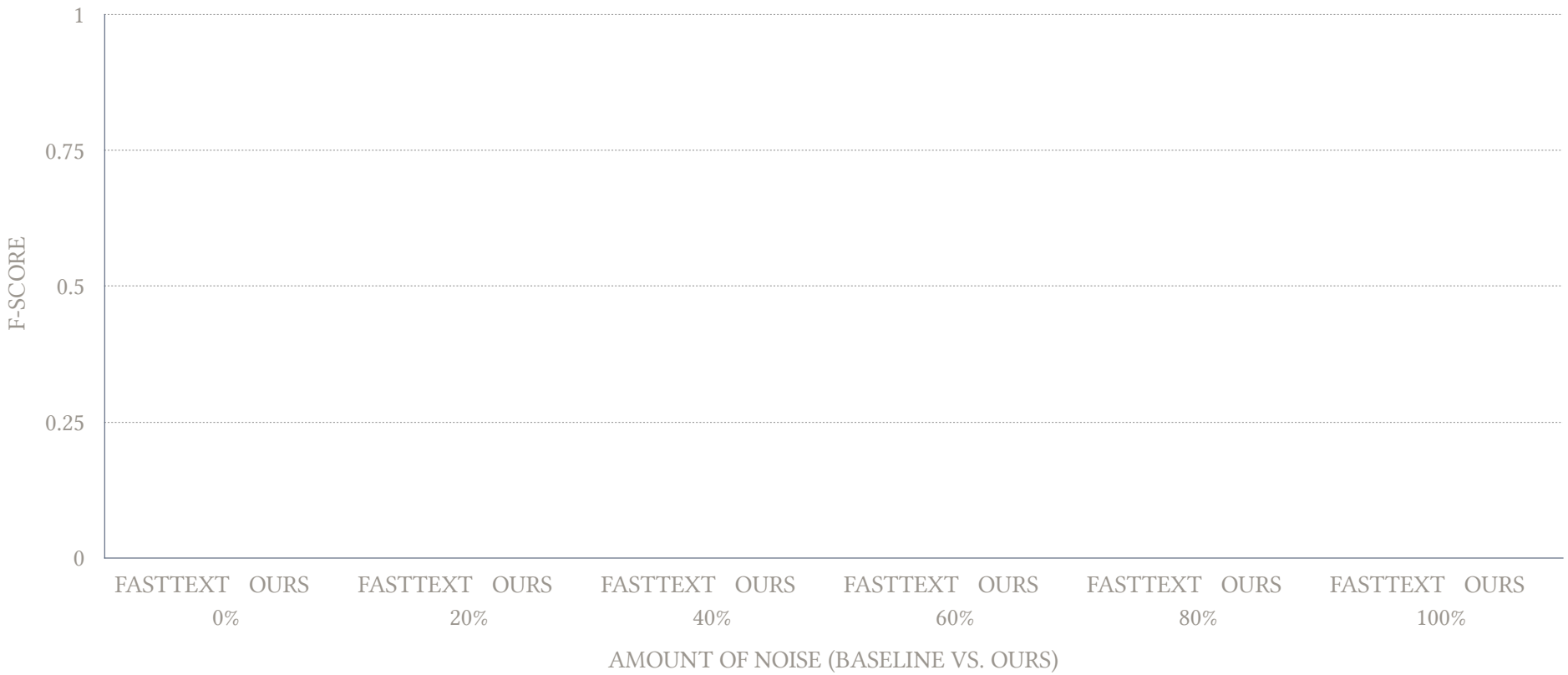
Script Normalization: Extrinsic Experiments

1. **Language identification (LID)**

Sentence	Language
اور لادینیت واشتراکیت کو جمہوریت کے حسین لبادہ میں پیش کردیا گیا ۔	Punjabi
کہیں وی زبان وادب تے تحقیق زیادہ تر کیفیتی	Saraiki
گھٹا دفعا هک عورت ساڻياڻي جنهن سان کوئي افلاطوني	Sindhi
آیانی راہا کہ تئی مہر بوتگ اَنت گنجّ گْوار	Balochi
قوزئی و دوغو سوریه موختار ایداره‌ائتمه‌سی	Azeri
شوراب ایسم ایته روستا ایسه جه راستوپی دهستان	Gilaki
جوانی زمان فرا گرفتن دانایی است. پیری زمان تمرین کردن آن است.	Persian

Script Normalization: Extrinsic Experiments

1. **Language identification (LID)**
   - Compare LID with and without normalization



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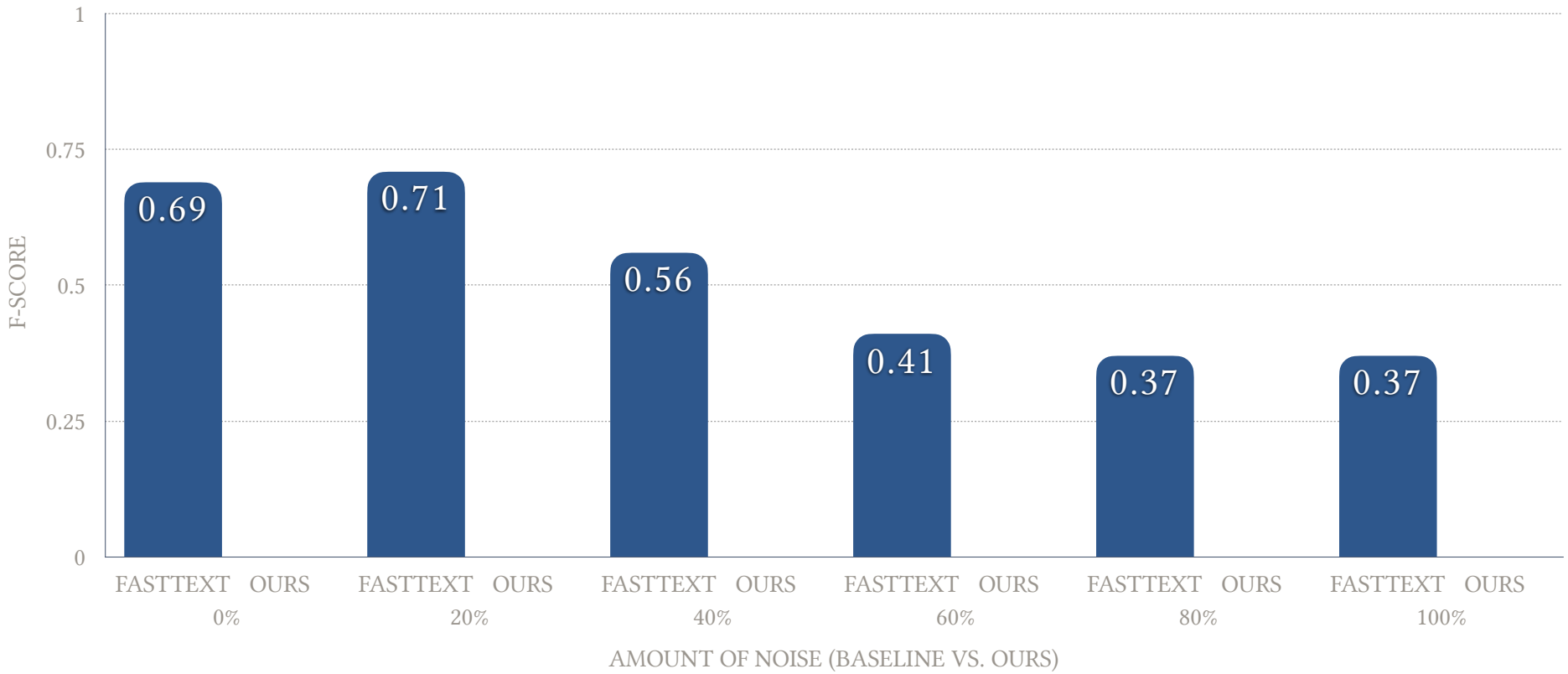

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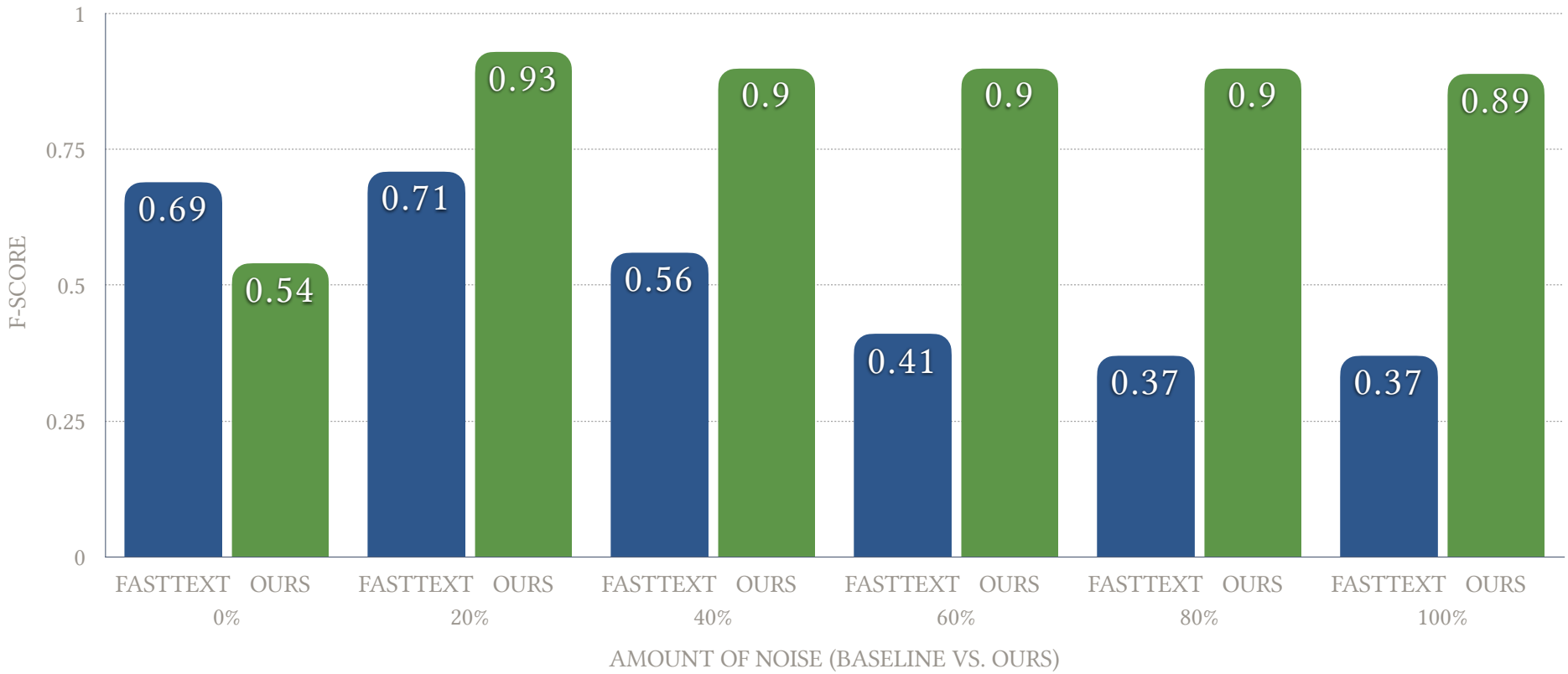

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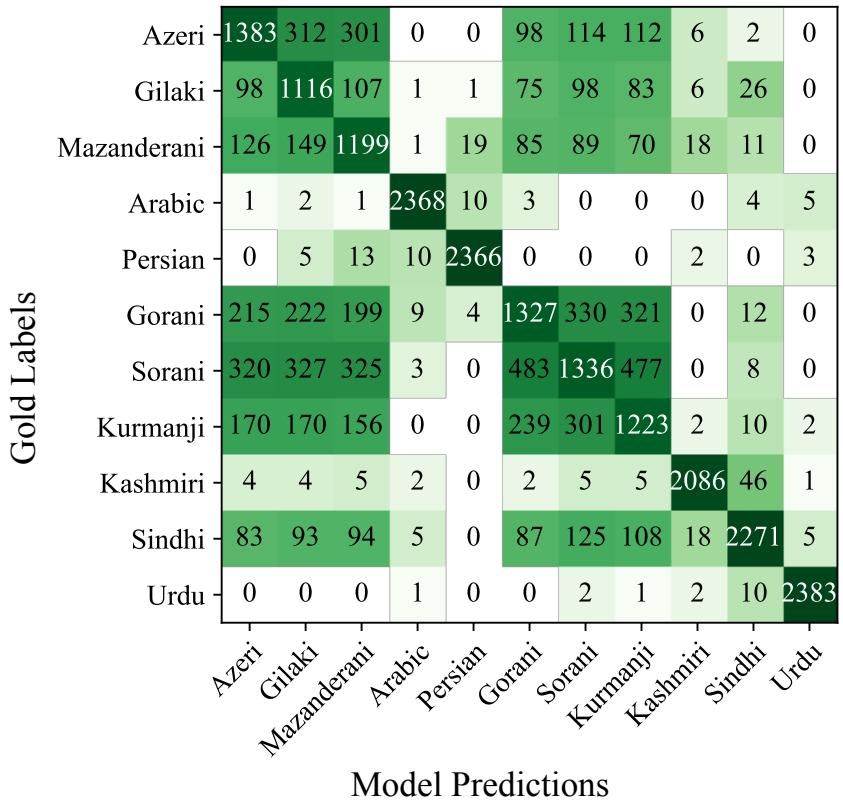
   - Closely-related languages (scripts) are confused!



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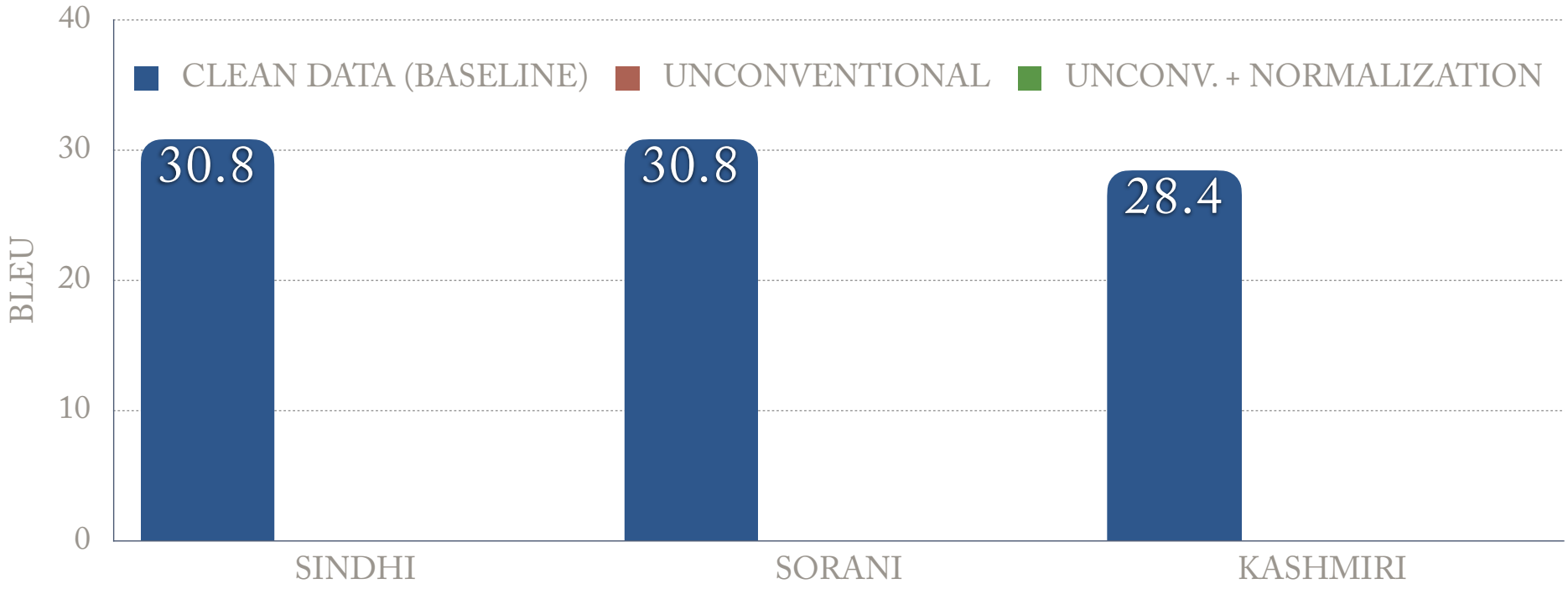
1. Language identification (LID)
2. **Machine Translation (MT)**
   - Evaluate MT with and without normalization



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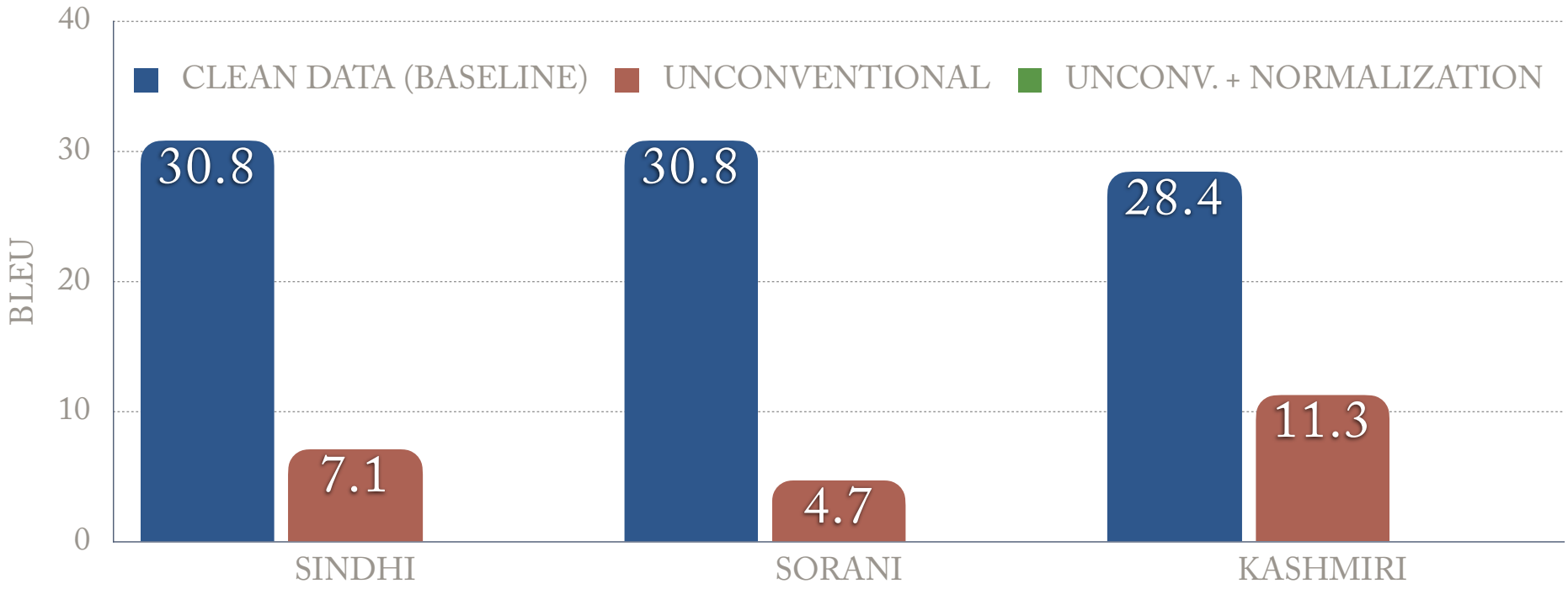
   - Terrible performance on noisy data (NLLB as baseline)



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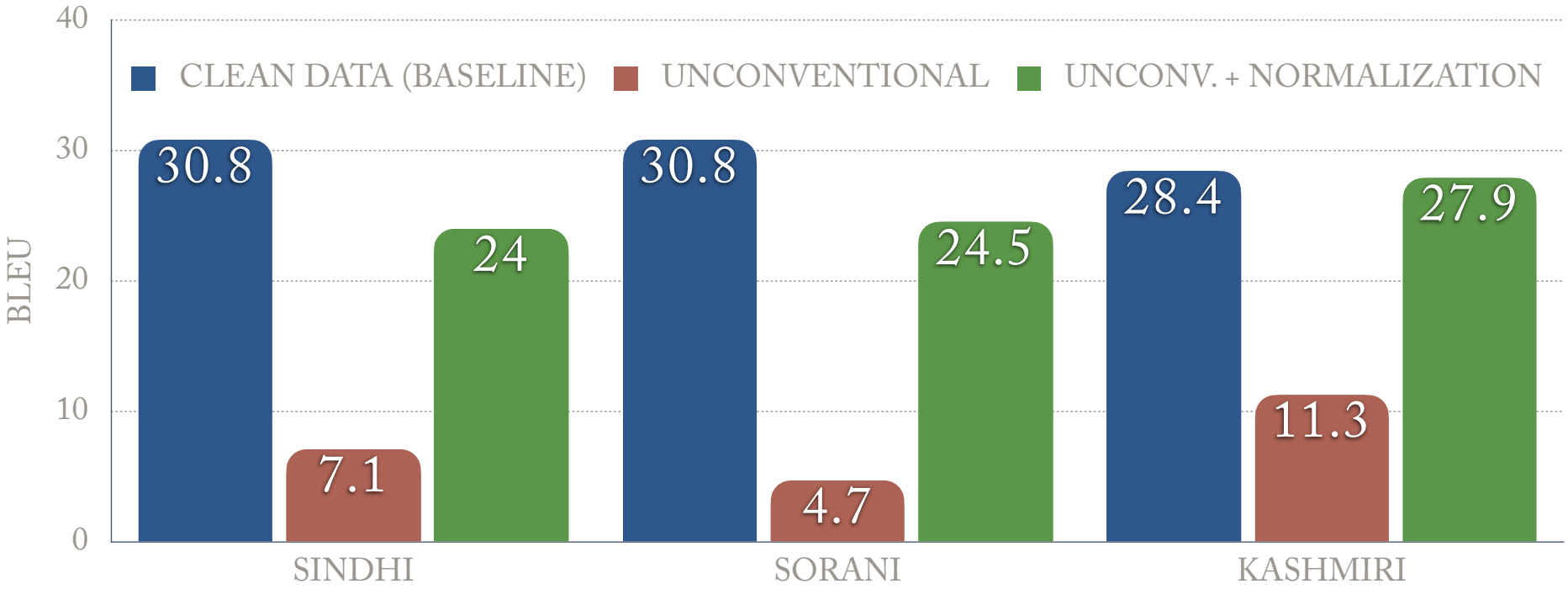

Conclusion

Key Takeaways

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5. Do we always need to write a language?
   - Multi-modal NLP
   - Multi-lingual NLP
   - Multi-task NLP
   - Better adaptation in NLP

   We don't know yet.

Any questions?

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