Low resource machine translation and NLP - new advances

Alexandra Birch

Global Under-Resourced MEdia Translation

2019-2022

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Machine Learning for NLP

	<Input>	<Output>
Translation	**How are you?**	**Bawo ni? (Yoruba)**
Dialogue	**Can I book a flight?**	**What is your destination?**
Question Answering	**How old is Trump?**	**74 years**

Supervised learning: lots of labelled data <Input, Output>

Unsupervised learning: lots of unlabelled data <Input> <Output>

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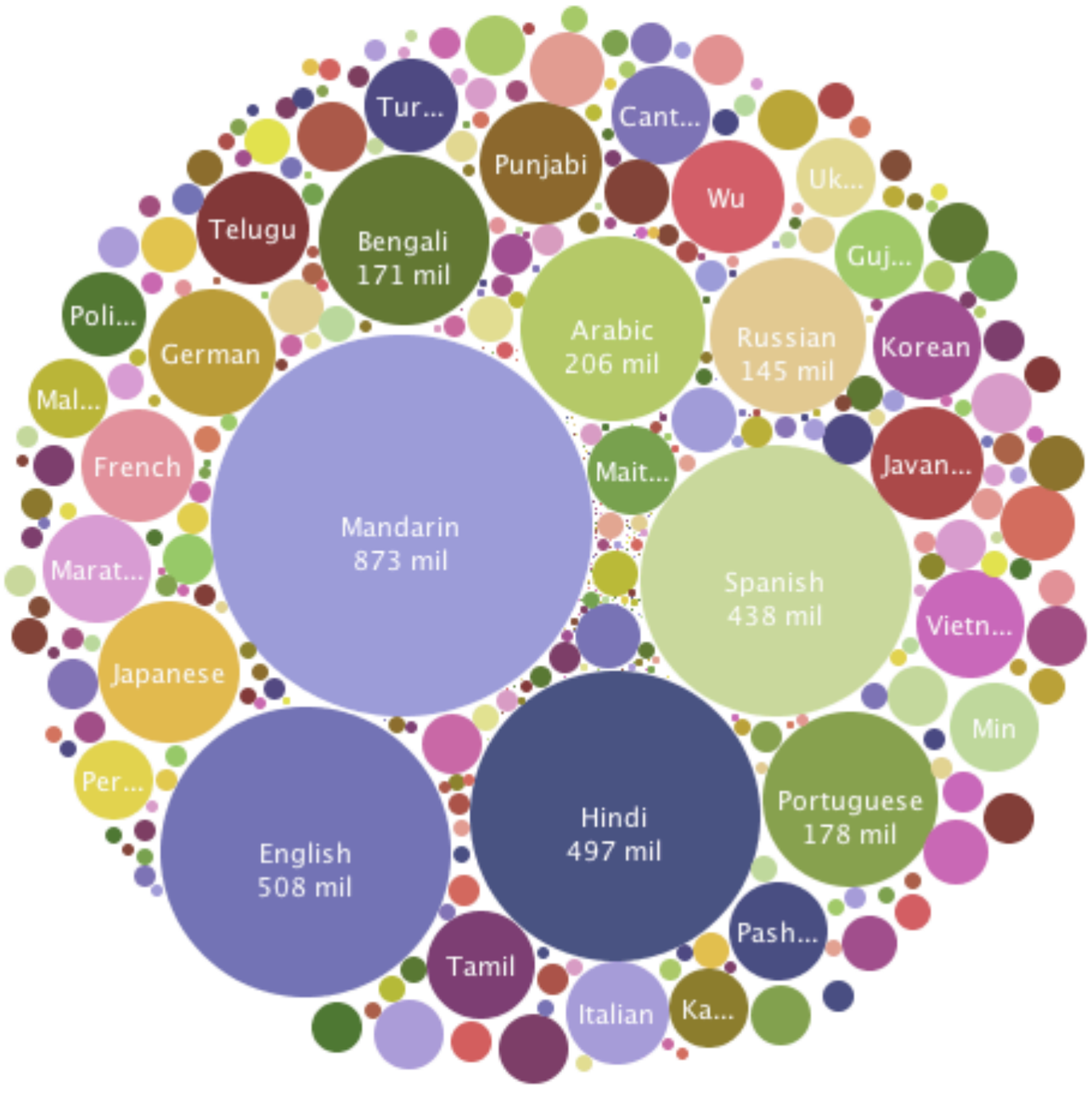
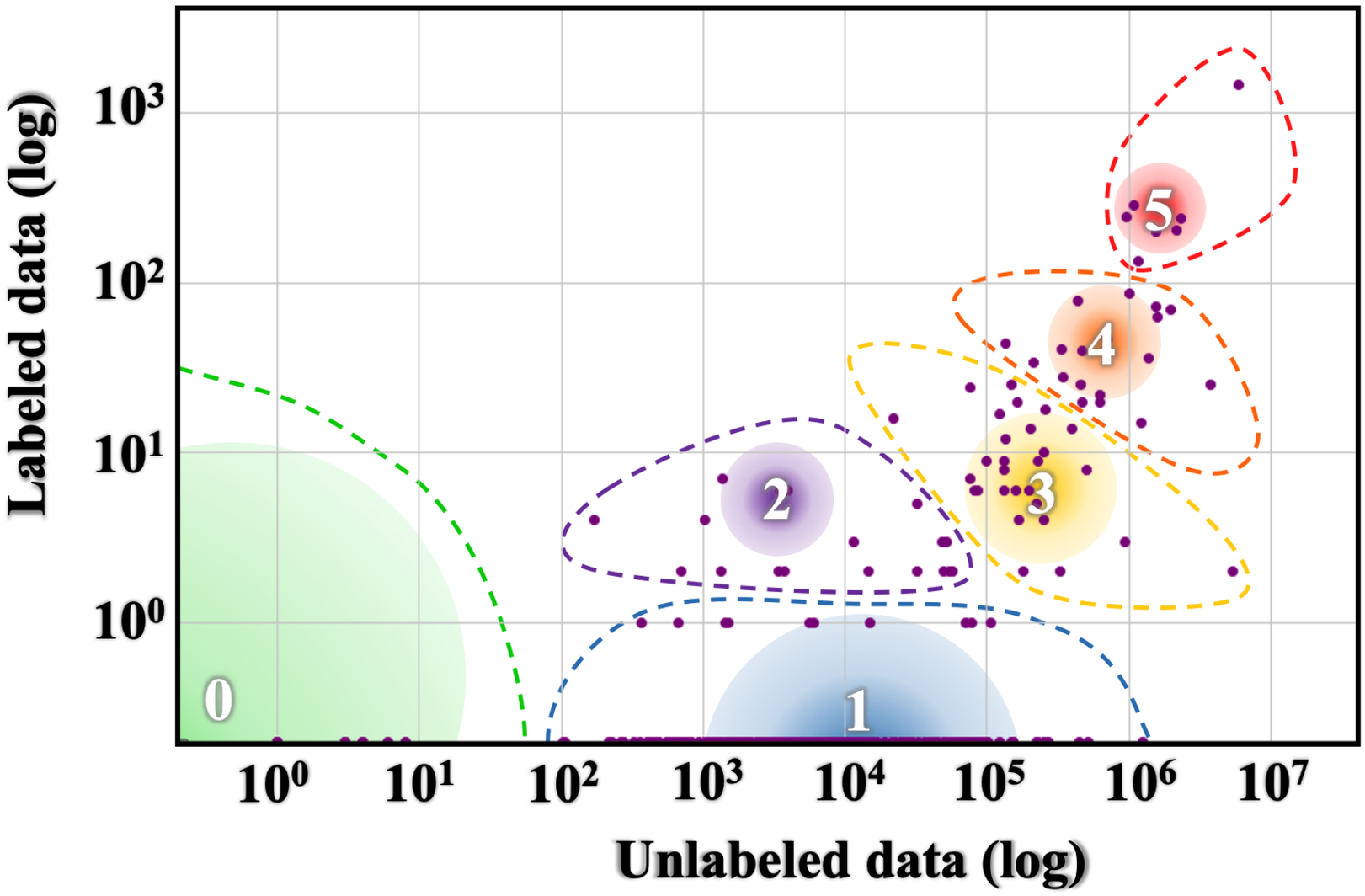
Diversity of Languages



What is low-resource?



The State and Fate of Linguistic Diversity and Inclusion in the NLP World Joshi et al. 2020

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What is low-resource?

Class	5 Example Languages	#Langs	#Speakers	% of Total Langs
0	Dahalo, Warlpiri, Popoloca, Wallisian, Bora	2191	1.2B	88.38%
1	Cherokee, Fijian, Greenlandic, Bhojpuri, Navajo	222	30M	5.49%
2	Zulu, Konkani, Lao, Maltese, Irish	19	5.7M	0.36%
3	Indonesian, Ukranian, Cebuano, Afrikaans, Hebrew	28	1.8B	4.42%
4	Russian, Hungarian, Vietnamese, Dutch, Korean	18	2.2B	1.07%
5	English, Spanish, German, Japanese, French	7	2.5B	0.28%

Most languages are low-resource
Almost all language pairs are low-resource

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Low Resource MT

- Creating More Data
- Monolingual Data
- Multilingual Data
- Model Centric Techniques
- Research Community

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Data

- OPUS > 500 languages Tiedemann et al. 2012
    - Bible, GNOME
- Paracrawl: large scale crawling, and internet archive Bañón et al. 2020
- WikiMatrix: 85 lang, using sentence embeddings Schwenk et al. 2019
- JW300: 54k lang pairs Agic and Vulic 2019

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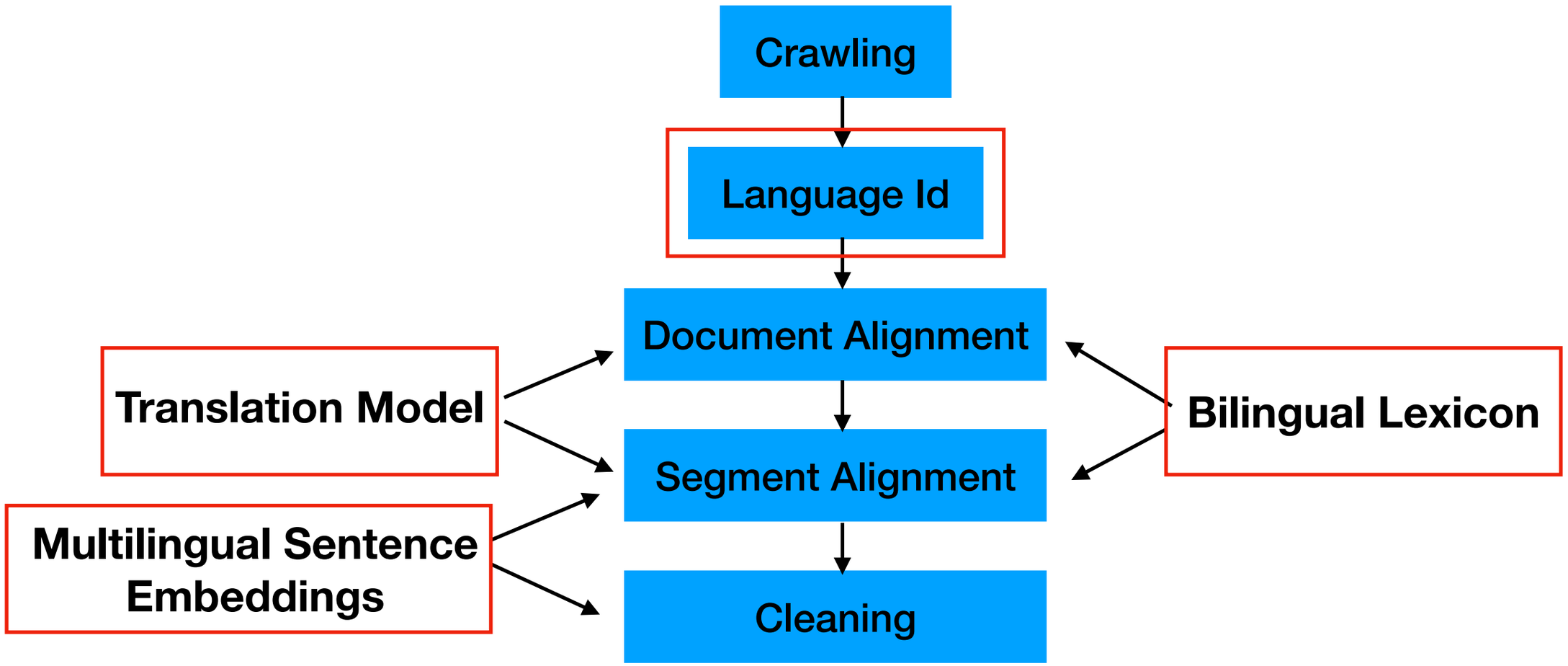
Data - Crawling



Data - Crawling

		Parallel		
		CCAligned	**ParaCrawl v7.1**	**WikiMatrix**
	#langs audited / total	65 / 119	21 / 38	20 / 78
	%langs audited	54.62%	55.26%	25.64%
	#sents audited / total	8037 / 907M	2214 / 521M	1997 / 95M
	%sents audited	0.00089%	0.00043%	0.00211%
macro	C	29.25%	76.14%	23.74%
	X	29.46%	19.17%	68.18%
	WL	9.44%	3.43%	6.08%
	NL	31.42%	1.13%	1.60%
	offensive	0.01%	0.00%	0.00%
	porn	5.30%	0.63%	0.00%

Caswell et al 2021

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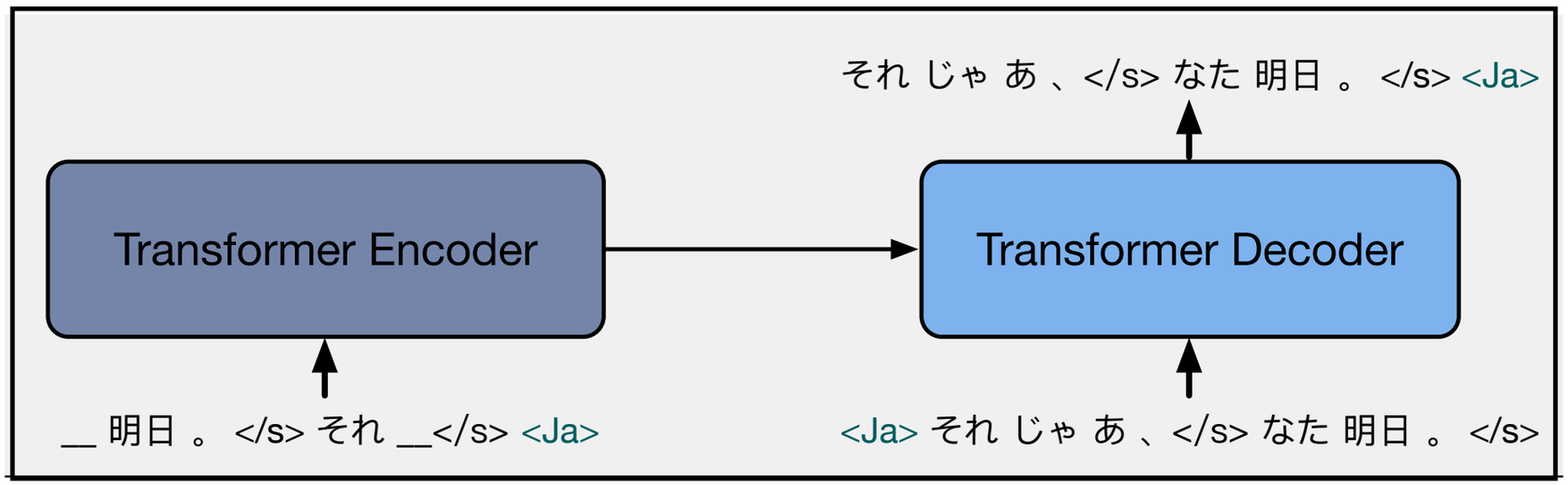
Monolingual Data - Pre-training

Use unlabelled <input> and/or <output> data, **pre-train** the model to predict the next or missing word

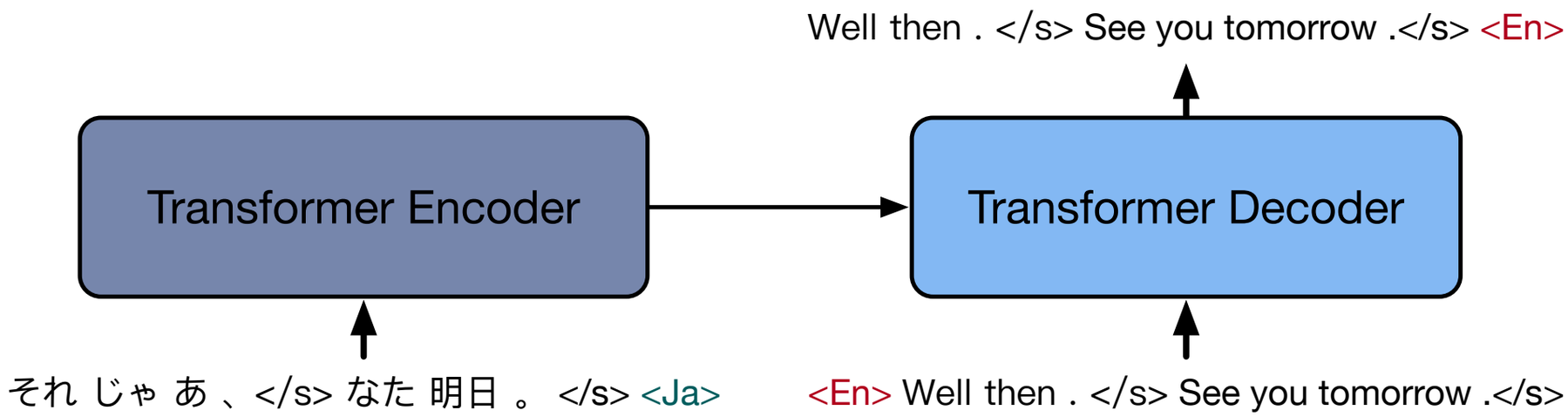


Multilingual denoising pre-training (mBART) Liu et al 2020

BERT, GPT2

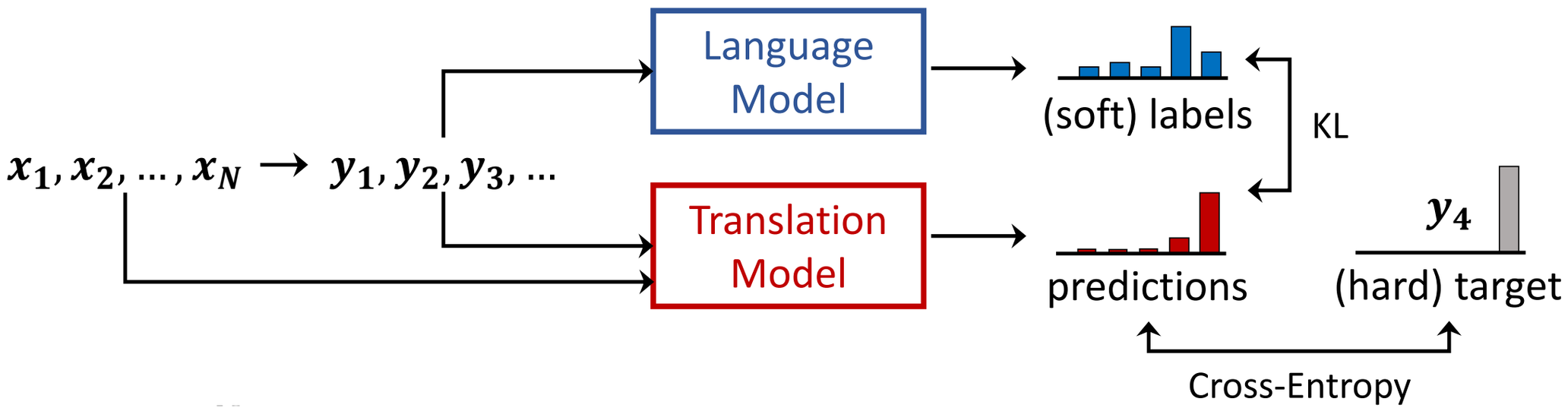
Monolingual Data - Pre-training

Use labelled <input, output> data, **fine-tune** the model to predict the translation



Monolingual Data - Pre-training

Baziiotis et al 2020



Monolingual Data - Synthetic

- back translation — Sennrich et al 2016
  - use English->Yoruba system to translate English
  - Train Yoruba->English system on <*Yoruba*, English>
- iterative translation - self learning — Hoang et al. 2018
  - Train Yoruba->English, English->Yoruba, English->Yoruba etc.
- Unsupervised MT — Lample et al. 2018

Monolingual Data - Synthetic

- Data augmentation using LMs

Arthaud et al 2021

=> s_1 = Cette centrale nucléaire menace d'exploser à tout moment !

This nuclear power plant could explode at any time!

=> masked context: This _____ power plant could explode at any time!

=> top matches = by context

A **coal** power plant produces carbon-intensive power.	That's a **solar**-powered ship.	They threatened to drop a **thermonuclear** bomb.
Sweden largely relies on **hydroelectric** power.	They have called for subsidies for **cleaner** electricity.	He's drinking **apple** juice. ···

=> s_2 = Une centrale charbon produit une électricité carbonée.

alignments

A coal power plant produces carbon-intensive power.

s_3 = Une centrale nucléaire produit une électricité carbonée.

A nuclear power plant produces carbon-intensive power.

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Low Resource MT

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- **Multilingual Data**
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Multilingual Data

French -> English

↓

Hausa -> English

English
German
Mandarin
Arabic
French
Hausa

→

English
German
Mandarin
Arabic
French
Hausa

Transfer Learning

Zoph et al. 2016

Multilingual Models

Johnson et al. 2016

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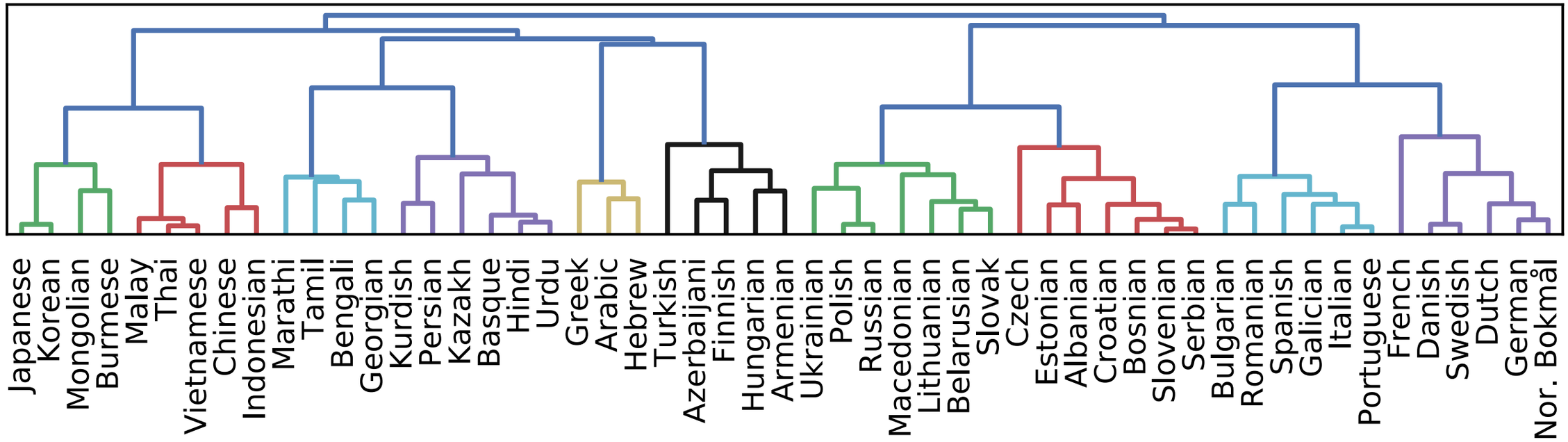
Multilingual Data

What languages to train together? Oncevay et al. 2020

Robust language representation:
World Atlas of Language Structure + language embedding



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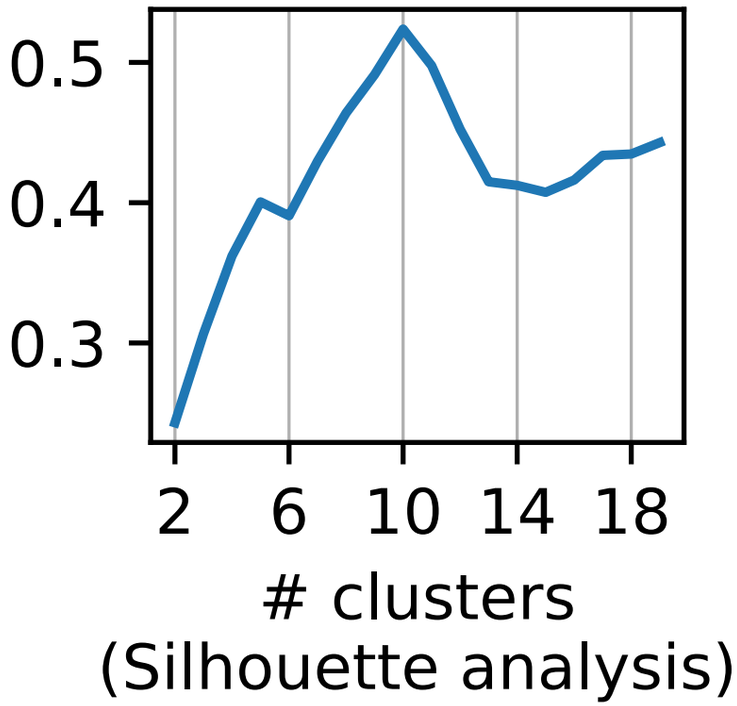
Multilingual Data

How many languages to train together?



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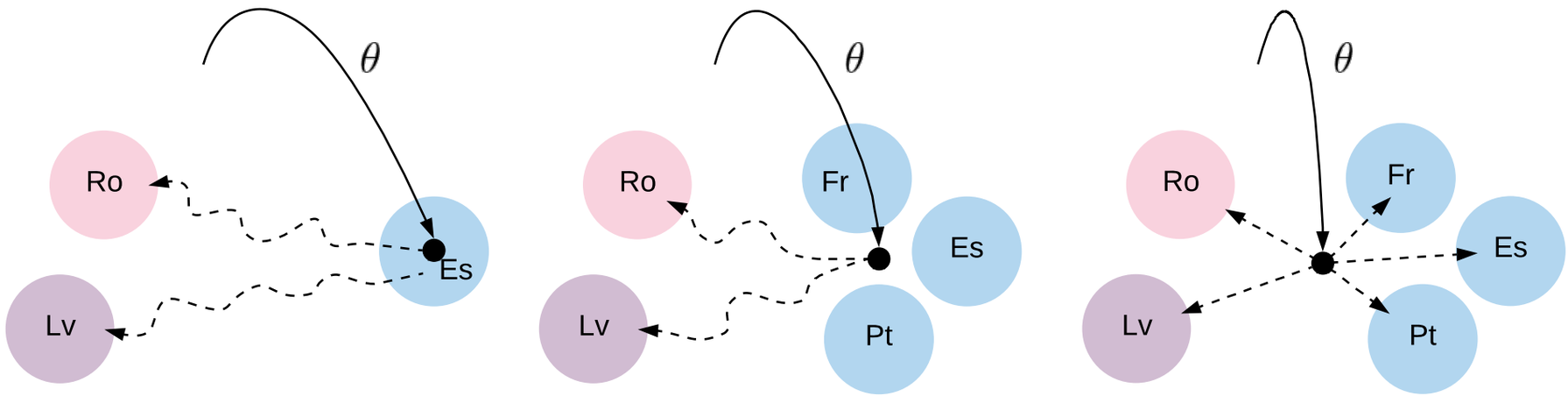
Model Centric Techniques

- Model-agnostic meta-learning (MAML) for machine translation



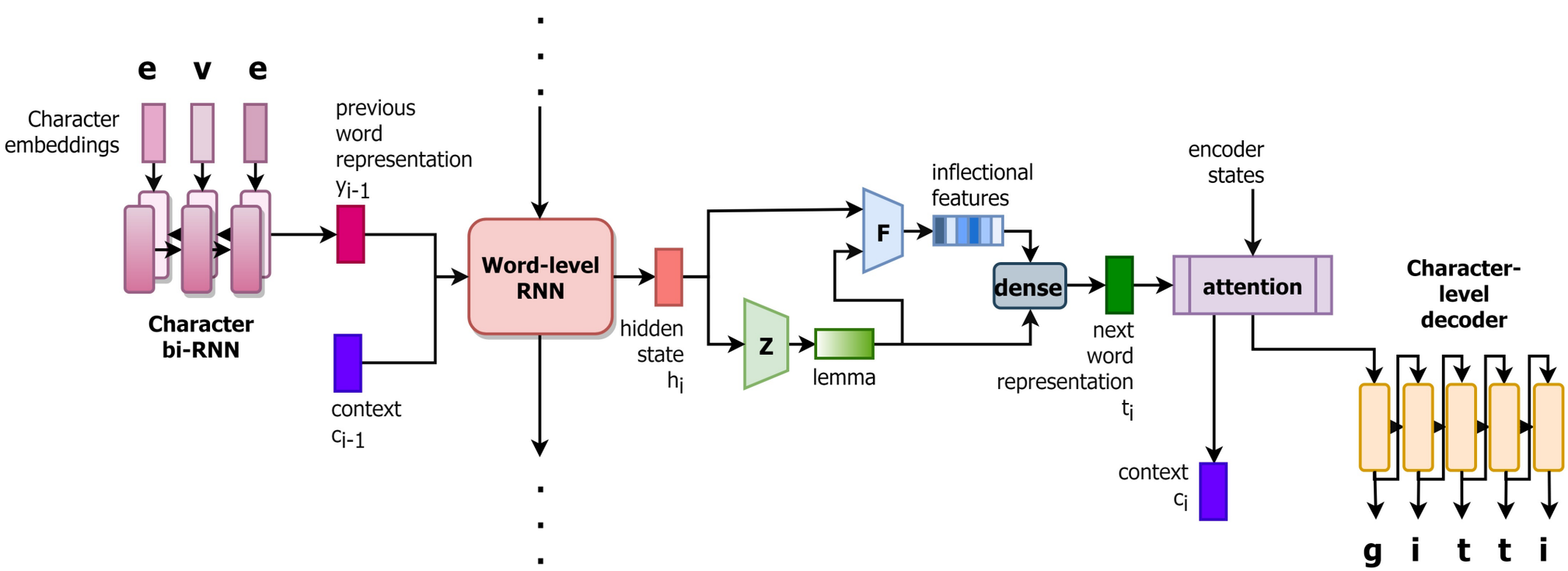
(a) Transfer Learning (b) Multilingual Transfer Learning (c) Meta Learning

Gu et al. 2018

Model Centric Techniques

- Latent Variable Models

Ataman et al. 2020



Research Community

Conference on Machine Translation (WMT): news shared task

Finnish	2015-2018
Romanian	2016
Latvian	2017
Estonian	2018
Turkish	2016-2018
Kazakh	2019
Gujarathi	2019
Tamil	2020
Inuktitut	2020
Pashto	2020
Khmer	2020

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Research Community

- LoResMT
- Workshop for Asian Translation
- African NLP
- Masekane

  https://github.com/masakhane-io/masakhane-mt/blob/master/MT4LRL.md
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Summary

- Find, Clean, Create Data
- Use all available resources:
    - monolingual
    - multilingual
- Better learning
- Build community interest and capability!

Thank you!

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Rachel Bawden

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Jindřich Helcl

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