Optimizing Large Language Models for Low-resource Quality Estimation

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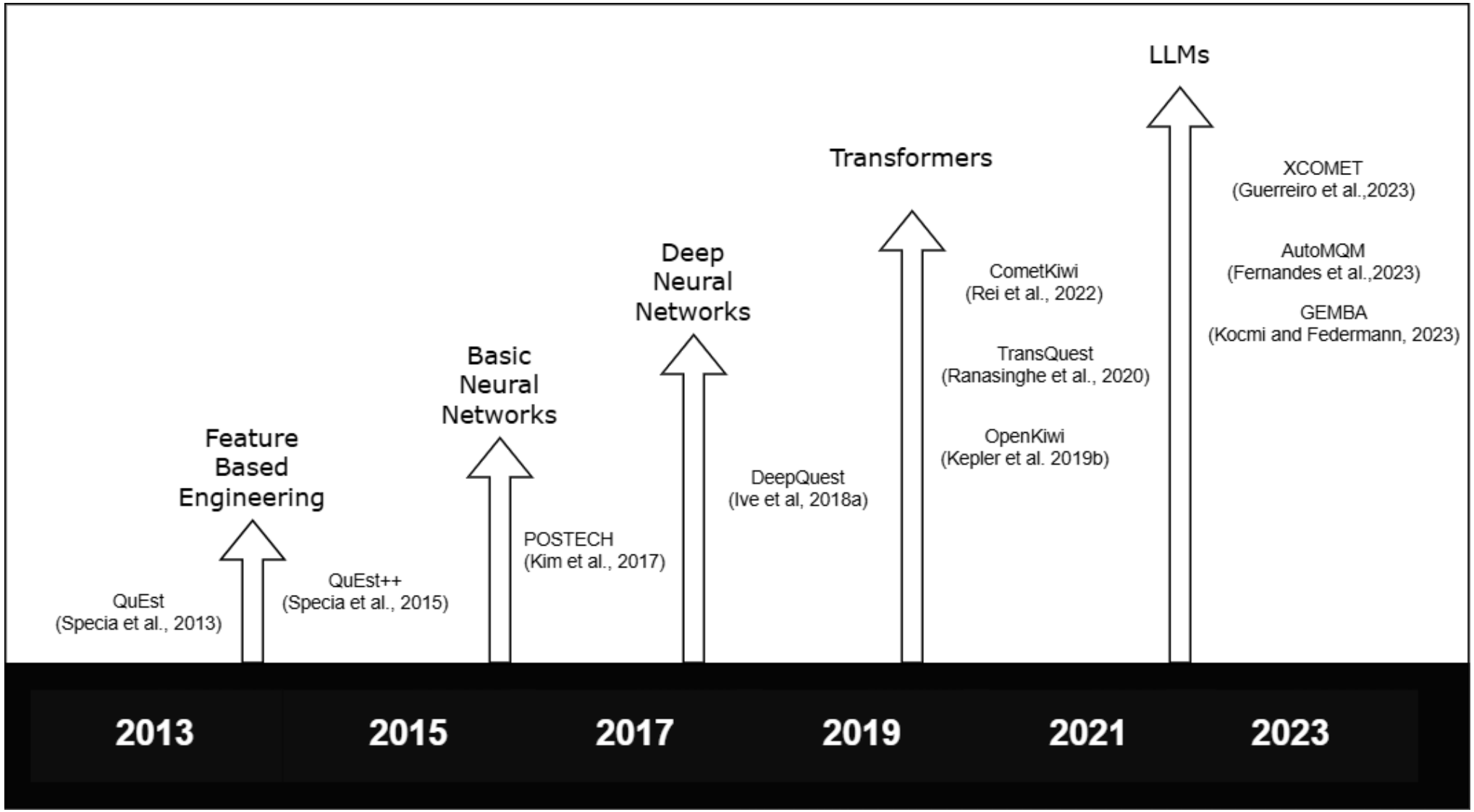
Introduction

- *Evaluating* machine translation is a challenging cross-lingual task
  - *helps identify the reliability* of the translation and towards improvement of translation systems.
- Traditional Machine Translation evaluation methods are Reference-based which are resource-intensive.
- Quality estimation (QE) aims to score the quality of a translated text without a reference translation
  - Reduces cost and effort.
  - At different granularity levels – Segment-level, Word-level, Error Span Annotation, MQM

Quality Estimation *vis-à-vis* Language Modelling



Segment-level Quality Estimation

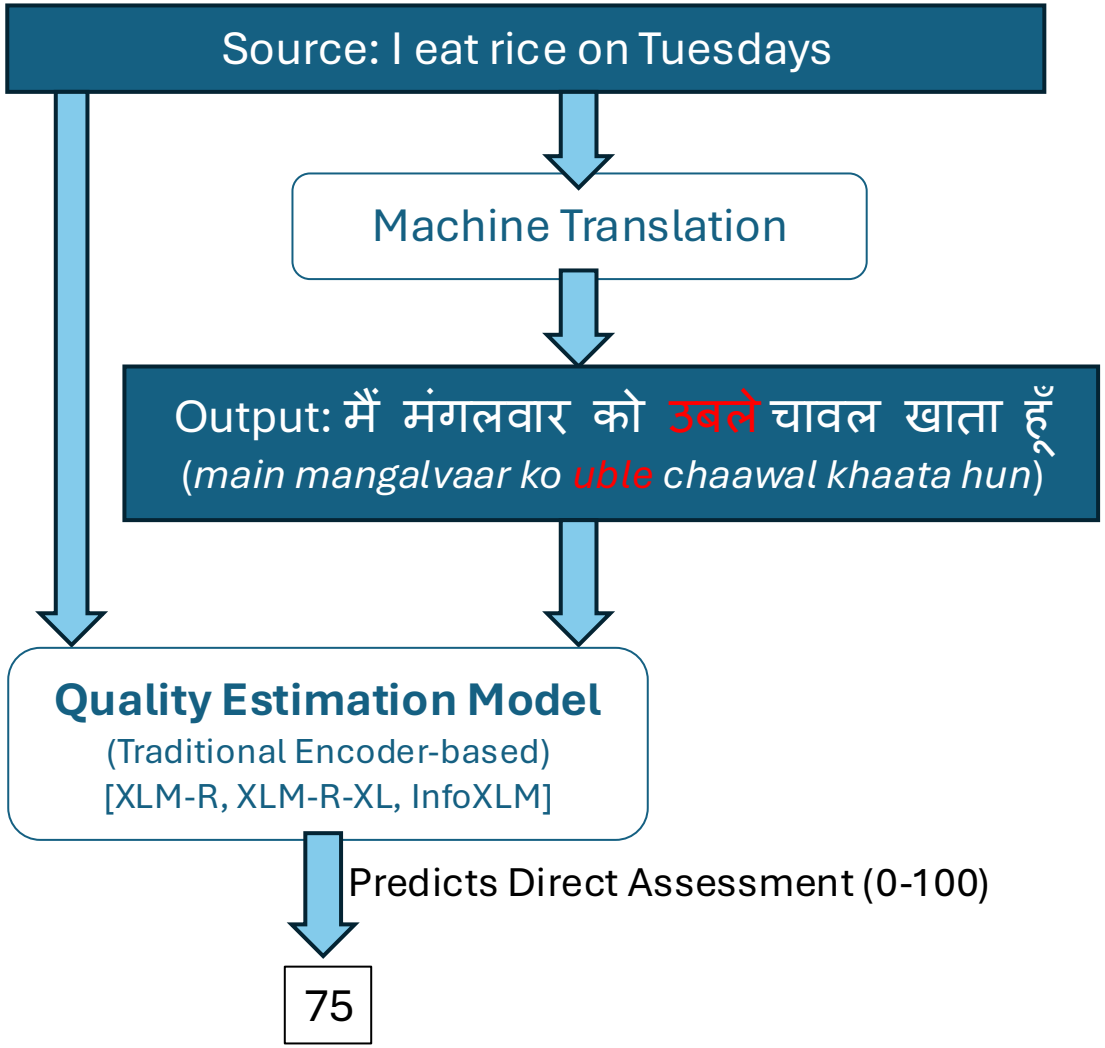
To provide a reliable, automatic measure of translation quality, crucial for system development and user-facing applications – without using a reference.

- Metrics like BLEU, chrF, MetricX **need a reference**.
- MT is subjective – multiple references – free order.

Quality Estimation (QE) is task of assessing the quality of machine-translated text in the absence of a human reference translation.

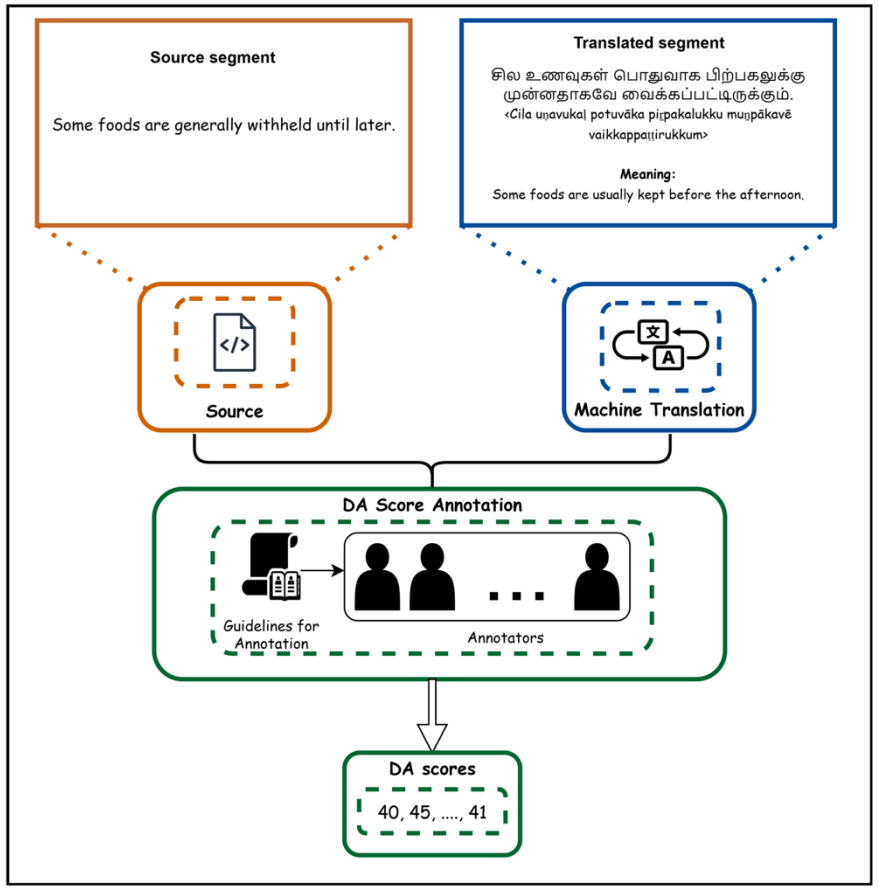
- **Segment-Level QE** focuses on assigning a quality score to a translated sentence, typically a Direct Assessment (DA) score from 0-100.

- **Word-Level QE** focuses on tagging each token in source and MT output with a OK/BAD tag, given the translation errors.



Direct Assessment (DA) score

Direct Assessment scores machine-translated content by having human assessors rate its quality (0 to 100)



Overall Score	Translation conveys source meaning?	How much translation conveys to source?
1 - 10	**Completely inaccurate.**	The MT output is unintelligible. Studying the meaning of the sentence is hopeless; even allowing for context, one feels that guessing would be too unreliable. ● The translation is incomprehensible, and machine translated output contains a mix of languages/dialects [which are not in the target language] (Adequacy) ● None of the keywords are translated in the target language. (Adequacy) ● There are major grammatical errors and typos (Fluency)
11 - 30	**Inaccurate but contains some keywords.**	● Incomprehensible translation (Fluency) ● Translation contains some keywords but not all (Adequacy) ● There are numerous grammatical errors and typos.
31 -50	**Partially. Target reflects partially the source.**	The general idea of the MT output is intelligible only after considerable study. ● Translation is only partially understandable, and the overall meaning is not conveyed. (Adequacy and Fluency) ● Translation contains some keywords (Adequacy) ● There are many grammatical errors and typos (Fluency)
51 - 70	**Yes. Target reflects the overall meaning.**	The MT output is generally clear and intelligible. Despite some inaccuracies or infelicities of the sentence, one can understand (almost) immediately what it means. ● Translation is understandable and reflects the source meaning. (Fluency) ● Translation contains most keywords (Adequacy) ● Only minor grammar errors (Fluency)
71 - 90	**Yes. Target reflects the source meaning without errors.**	The MT output is perfectly clear and intelligible. It is grammatical and reads like ordinary text. ● Translation is very closed to the source meaning (Fluency) ● Translation contains all keywords (Adequacy) ● No errors but there are better word choices in the target language. (Adequacy)
91 - 100	**Yes. Target reflects source meaning without errors.**	● Perfect translation (Adequacy and Fluency) ● Accurately reflects the meaning of the source (Fluency) ● No errors

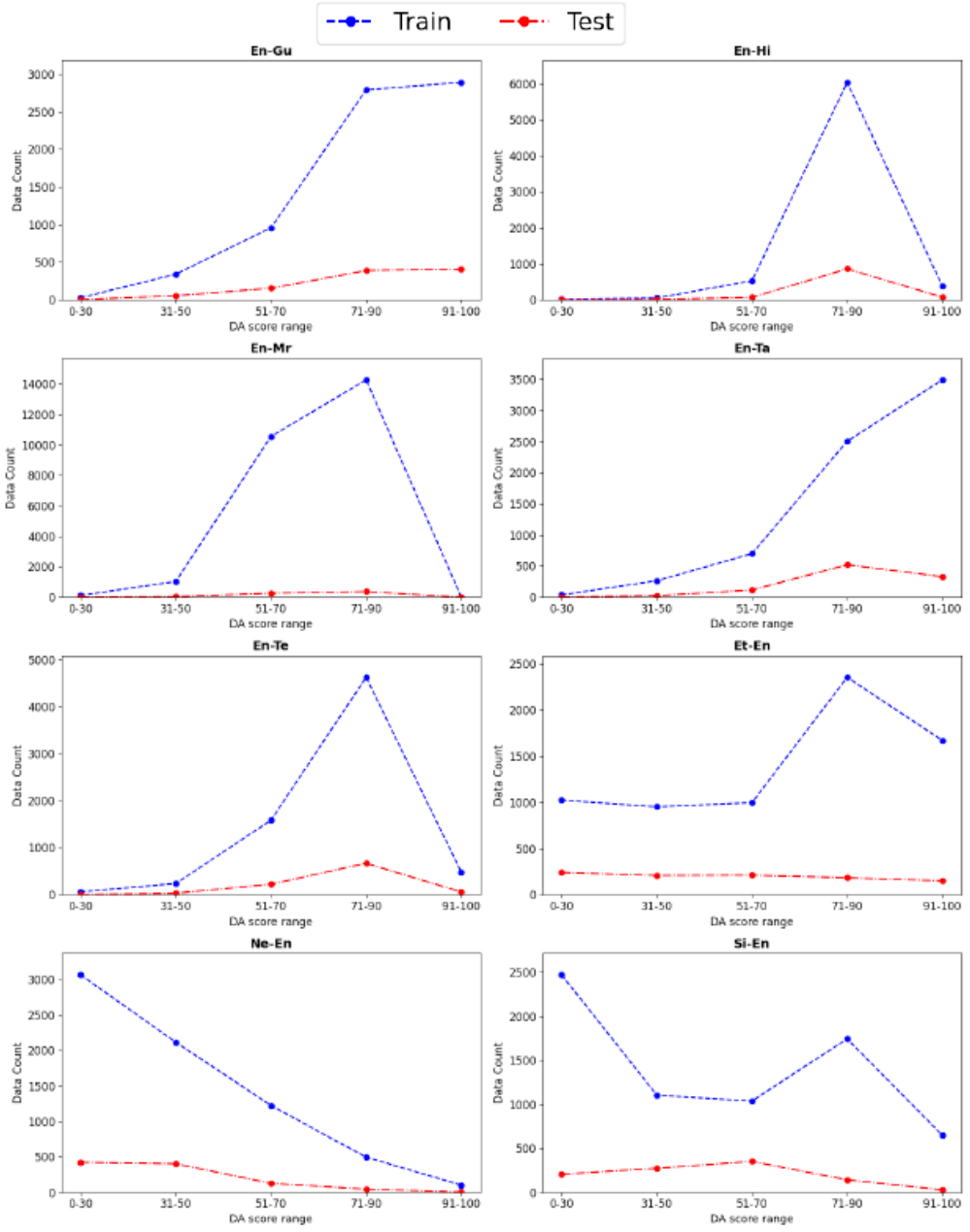
Dataset

- Focus on low-resource language pairs for QE.

- We utilize the DA score dataset from WMT QE shared task for our experiments.
  - En-Gu : English to ગુજરાતી (Gujarati)
  - En-Hi : English to **हिन्दी** (Hindi)
  - En-Mr : English to **मराठी** (Marathi)
  - En-Ta : English to **தமிழ்** (Tamil)
  - En-Te : English to **తెలుగు** (Telugu)

  - Et-En : **eesti keel** (Estonian) to English
  - Ne-En : **नेपाली** (Nepali) to English
  - Si-En : සිංහල (Sinhala) to English

Data Split	En-Gu	En-Hi	En-Mr	En-Ta	En-Te	Et-En	Ne-En	Si-En
Training	7000	7000	26,000	7000	7000	7000	7000	7000
Testing	1000	1000	699	1000	1000	1000	1000	1000



Meta-Evaluation for QE

- Spearman's Correlation **[Primary]**
- Pearson's Correlation
- Kendall's Tau
- Soft Pairwise Accuracy (SPA)

Applied **Williams test** to compare correlation significance between models and toidentify whether top models outperform others **statistically.**

Encoder-based QE

- **TransQuest** – Framework to fine-tune Transformers-based pre-trained language models for QE (Ranasinghe et al., 2020)
  - MonoTransQuest
  - SiameseTransQuest
- **COMETKiwi** – Continually pre-trained and fine-tuned models for QE (Rei et al., 2020; Unbabel)
  - COMETKiwi-22 [550M parameters]
  - COMETKiwi-23 [3.5B parameters]
- **xCOMET** – Multi-stage training to perform sentence-level and error-span detection

  [XL variant - 3.5B params].

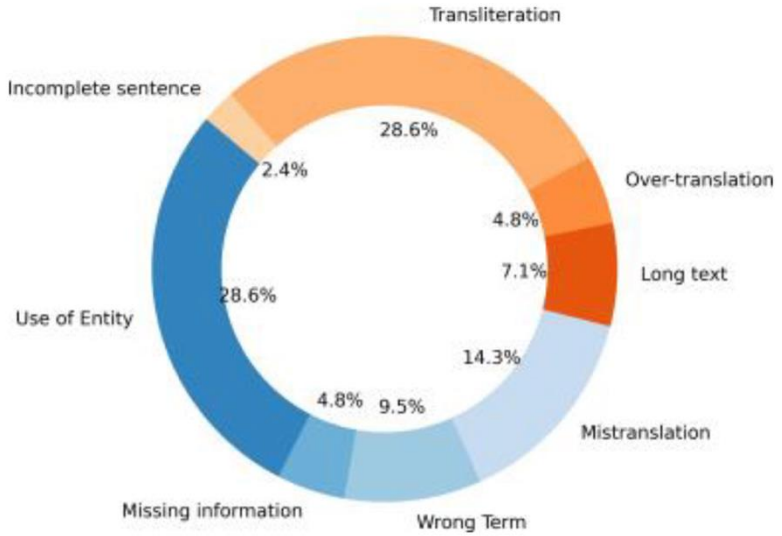
Encoder-based QE: *High- vs. Low-resource Languages*

Method	En-Gu	En-Hi	En-Mr	En-Ta	En-Te	Et-En	Ne-En	Si-En
MonoTQ-InfoXLM-Large	0.630	0.478	0.606	0.603	**0.358**	0.760	0.718	0.579
MonoTQ-XLM-V	0.552	0.446	0.556	0.607	0.358	0.766	0.705	0.595
MonoTQ-XLM-R-Large	0.599	0.491	0.457	**0.627**	0.339	0.737	0.700	0.575
CometKiwi-22 (InfoXLM)	0.574	0.408	0.627	0.567	0.231	0.827	0.755	0.648
CometKiwi-23 (XLM-R-XL)	**0.637**	**0.546**	**0.635**	0.616	0.338	**0.860**	**0.789**	**0.703**
xCOMET-XL	0.490	0.346	0.448	0.503	0.253	0.810	0.646	0.576

xCOMET-XL, and COMETKiwi use XLM-R-XL as the backbone while TransQuest fine-tunes on the chosen encoder model.

Performant for high-resource language pairs, however, target-side **low-resource languages suffer** due to:

- Morphological complexity (En-Ta, En-Te, En-Mr)
- *Meaningless* Tokenization
- Likely also, due to distribution of pre-training data for low-resource languages



Decoder / LLM-based QE

GEMBA (Kochmi et. al., 2023)

Score the following translation from **{Source Language}** to **{Target Language}** on a continuous scale from 0 to 100, where score of zero means "no meaning preserved" and score of one hundred means "perfect meaning and grammar".

{Source Language} source: **{Source Sentence}**

{Target Language} translation: **{Translated Sentence}**

Score:

Experimental Settings

- **Zero-Shot :** Model generates outputs using pre-trained knowledge and it's limited generalization ability.

- **Standard Instruction-Tuning :** Adapting a model using supervised fine-tuning that includes explicit instructions for QE task.

- **ALOPE :** Enhances fine-tuning by leveraging regression headers across multiple Transformer layers.

Models

- All experiments conducted with open-source LLMs with 8B parameters or less:
  - Llama-2-7B
  - Llama 3.1-8B
  - Llama 3.2-3B
  - Aya-expanse-8B

Challenges for LLM-based QE

- LLMs are **optimized for next-token prediction**, excelling at generative tasks but struggle with regression-based goals.
  - QE requires *numerical* and *cross-lingual reasoning*.
  - Limited ability to capture fine-grained relationships between language features and numerical scores.

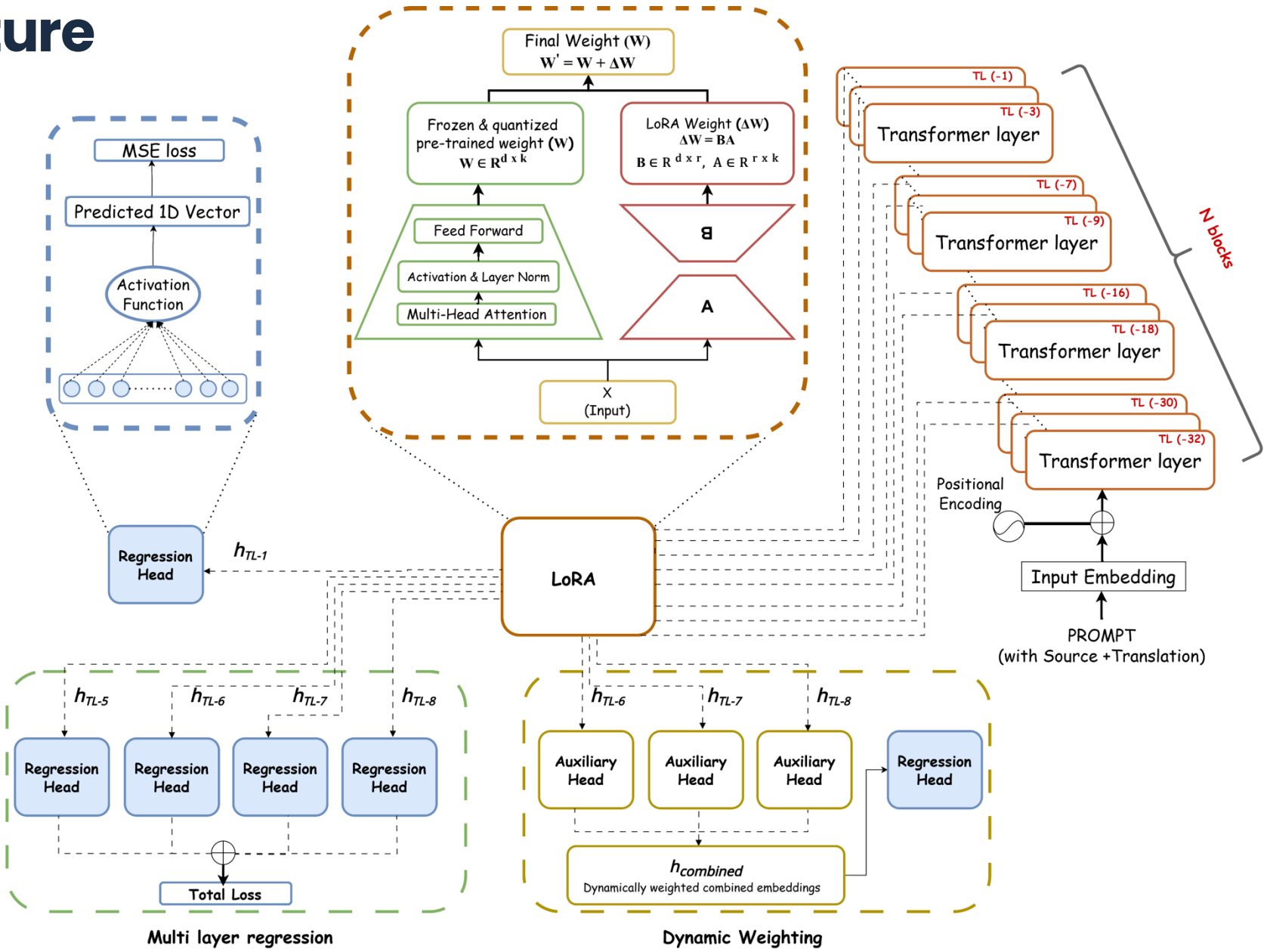
- Although LLMs refine context through multiple Transformer layers, standard practice usually predicts with the final layer for output.

ALOPE [Adaptive Layer Optimization for Translation Quality Estimation]

- ALOPE enables LLMs to
  - perform regression by integrating a novel head
  - uses a low-rank adapter with Transformer architecture.

- Helps analyze the impact of adaptive regression heads
  - to determine which Transformer's layers contribute most to LLM-based QE

Architecture



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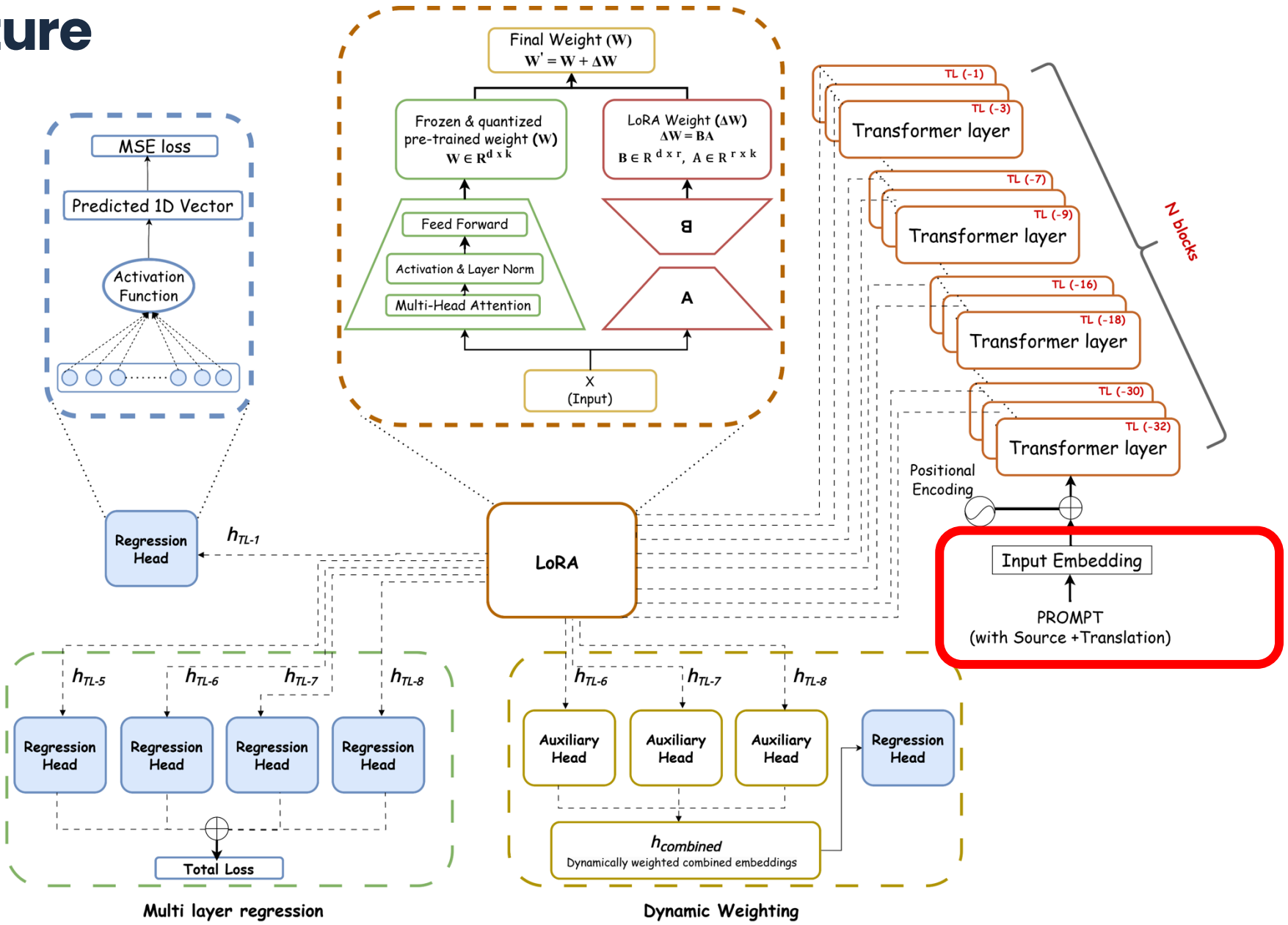

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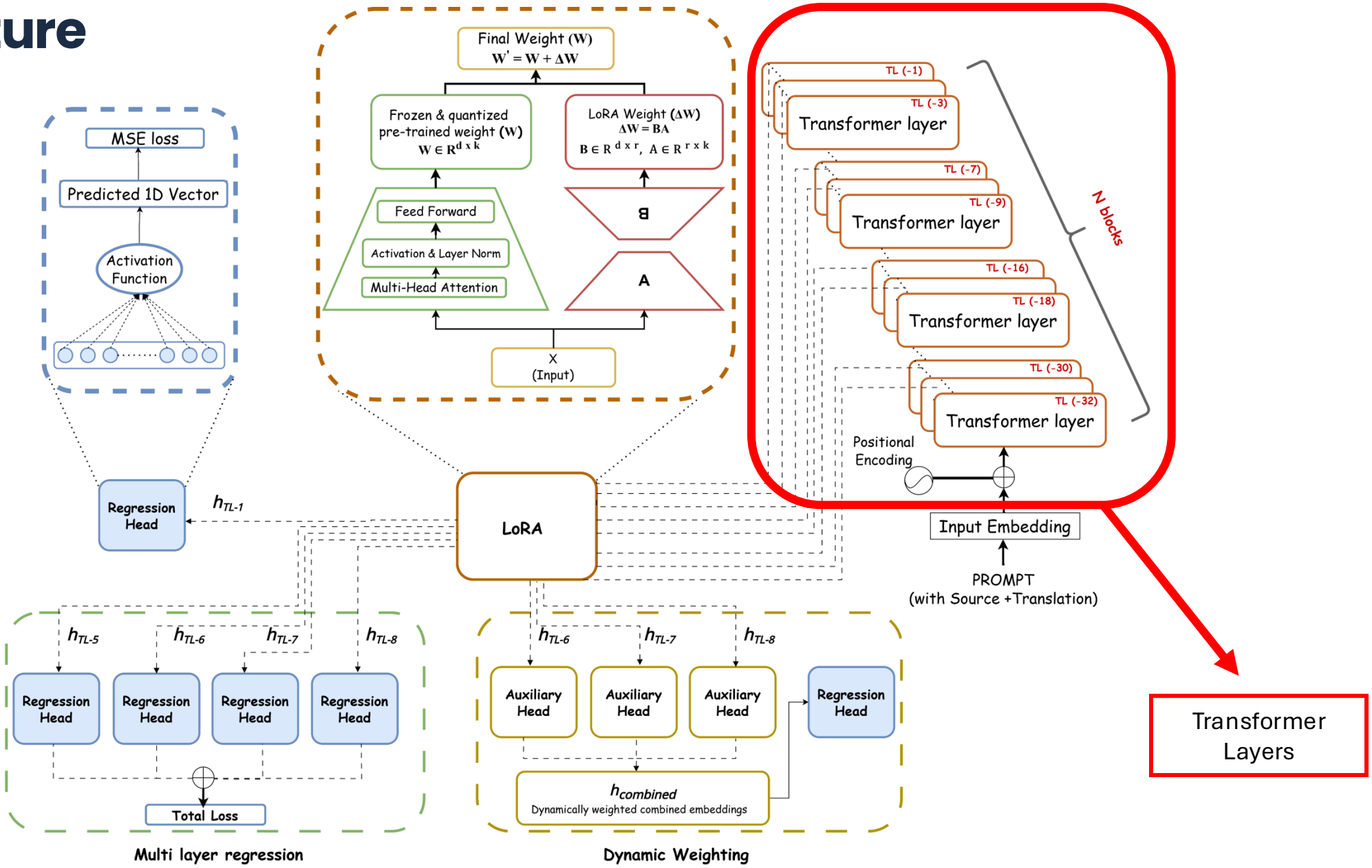

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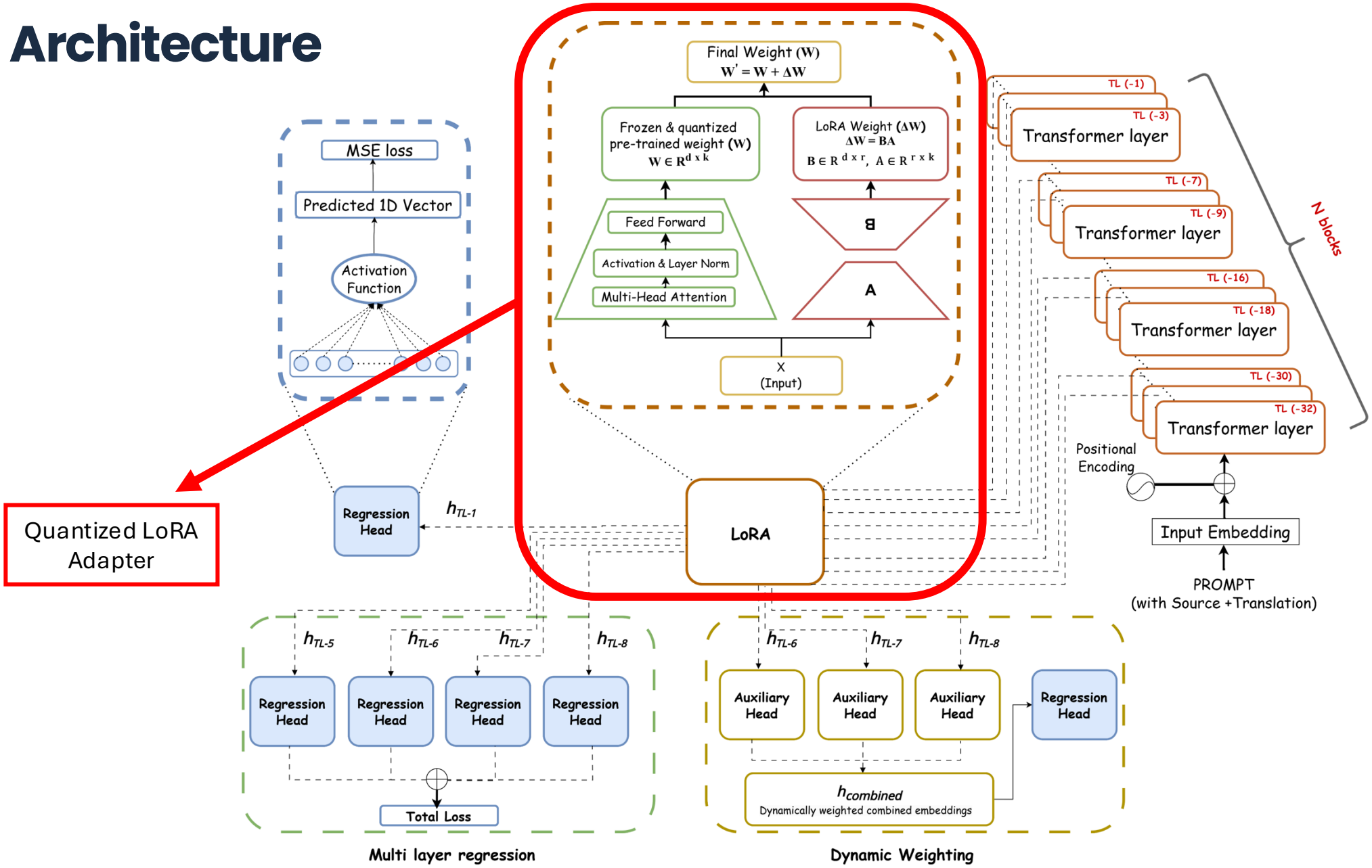

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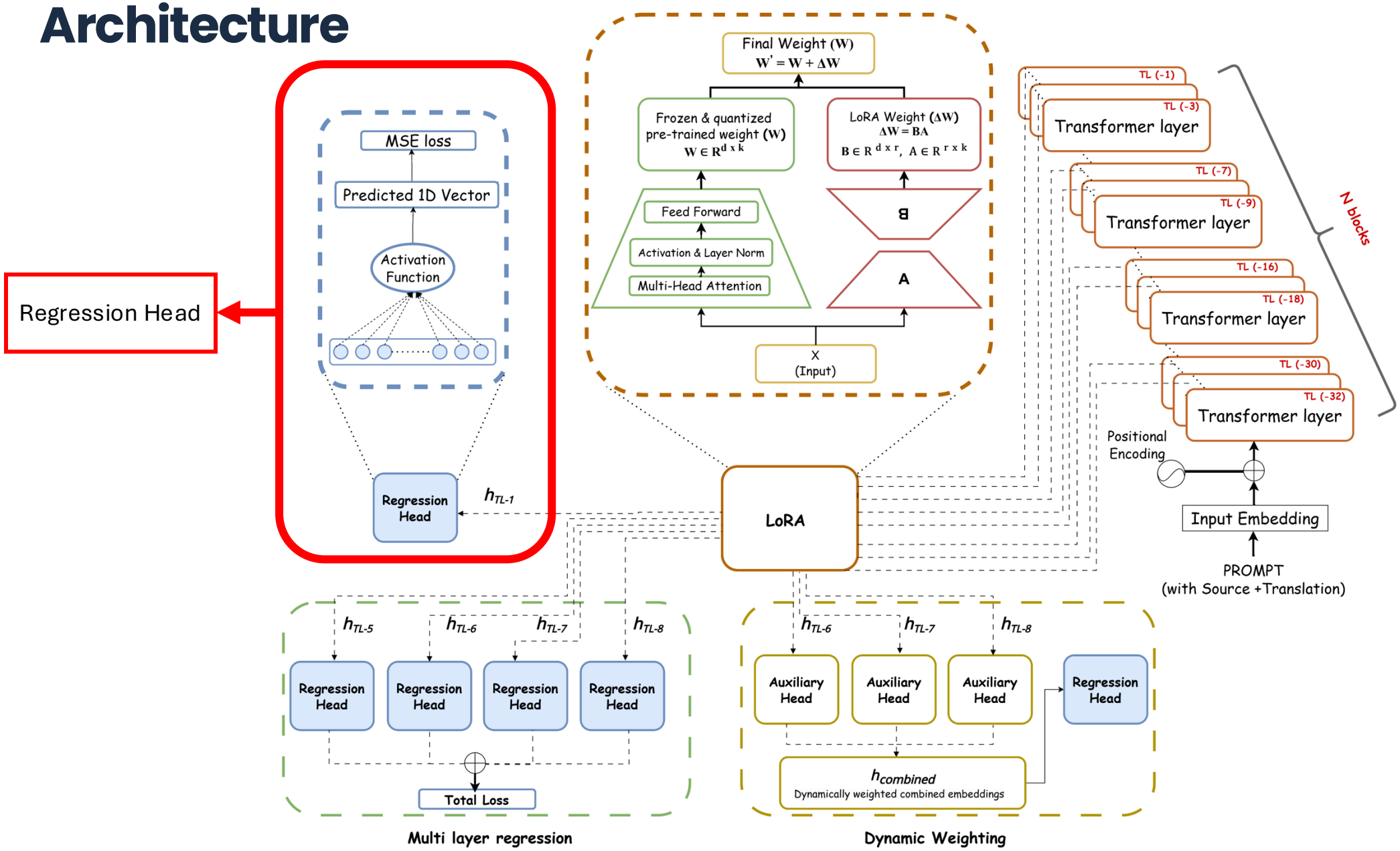

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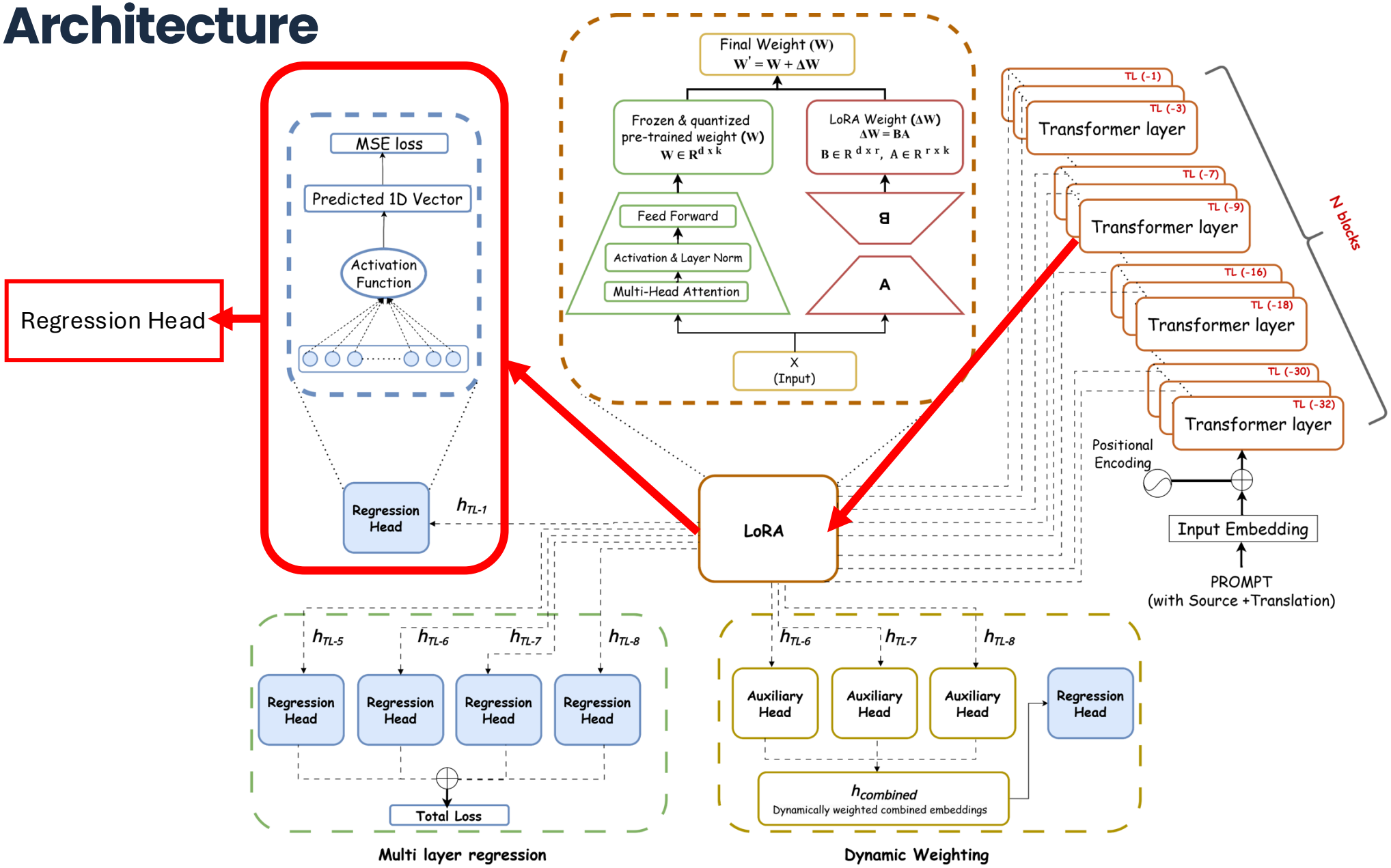

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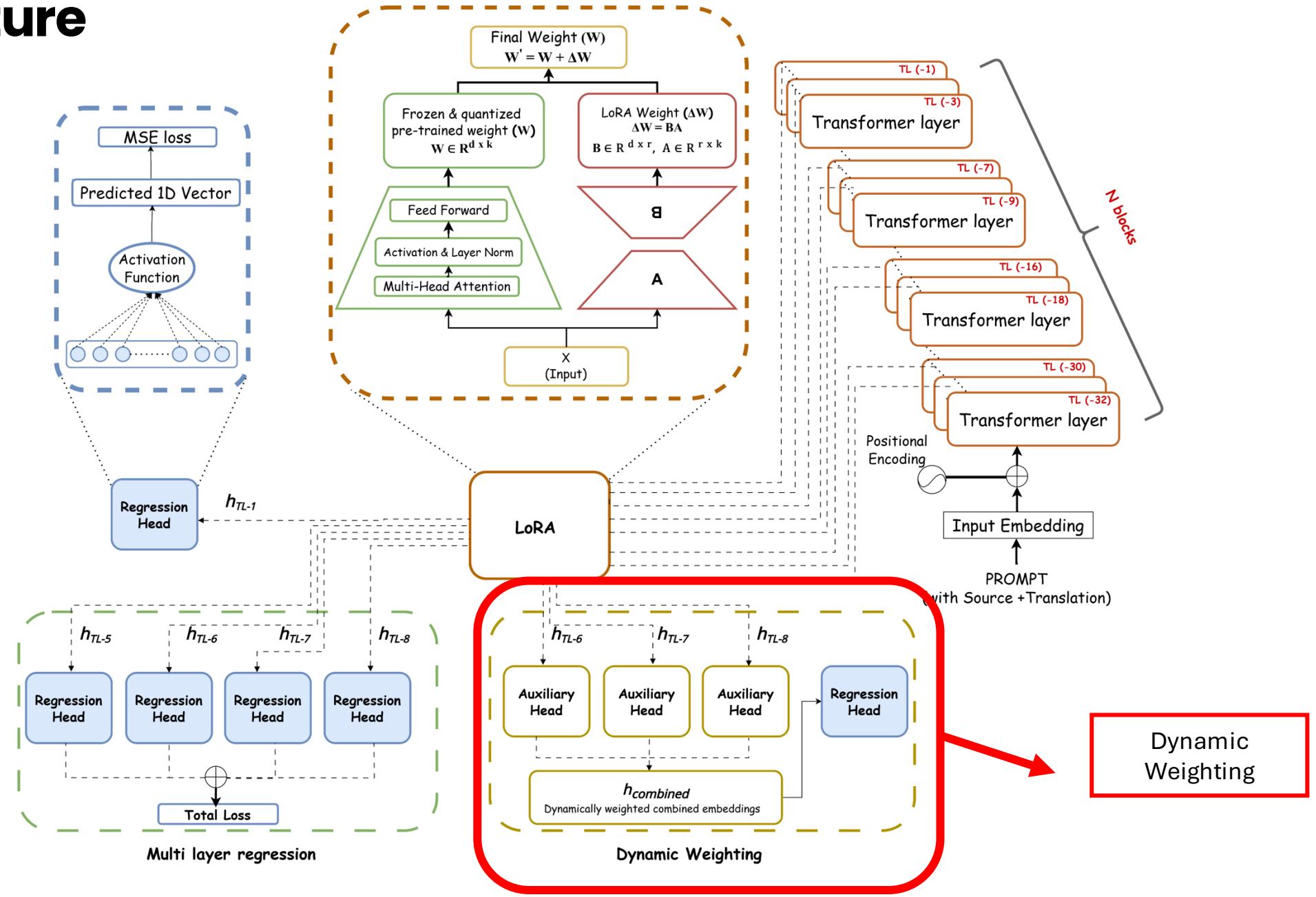

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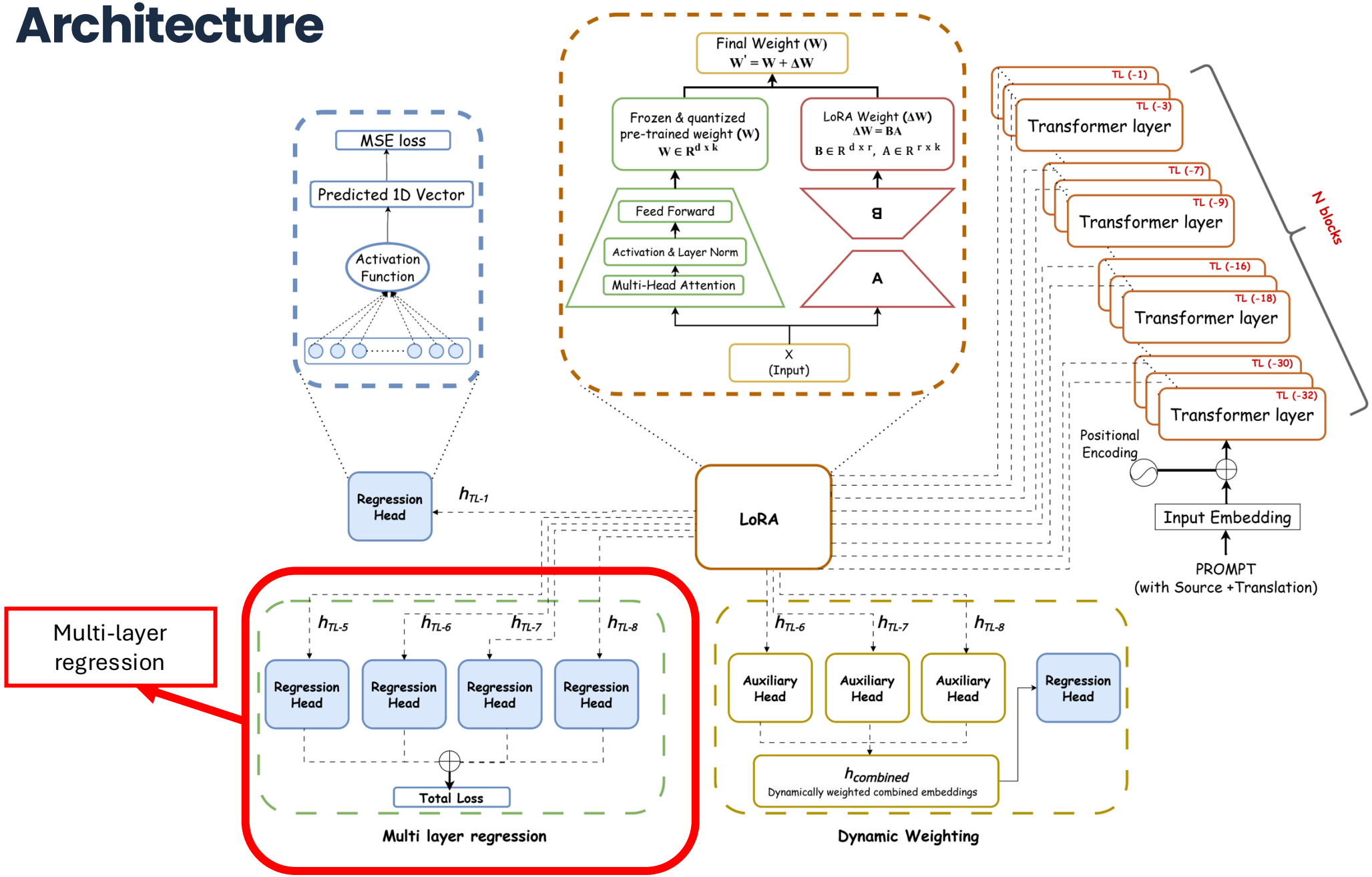

ALOPE

Final Transformer Layer

Intermediate Transformer Layer

Intermediate Transformer Layer

Intermediate Transformer Layer

Lower-level Transformer Layer

Lower-level Transformer Layer

	Model	En-Gu	En-Hi	En-Mr	En-Ta	En-Te	Et-En	Ne-En	Si-En
TL (-1)	**llama-2-7b**	0.563	0.414	0.609	0.525	0.356	0.742	0.596	0.565
	llama 3.1-8B	0.594	0.469	0.620	0.567	0.363	0.734	0.647	0.547
	llama 3.2-3B	0.604	0.477	**0.636**	0.580	0.348	0.735	0.674	0.543
	aya-expanse-8b	0.068	0.178	0.219	-0.006	0.275	0.115	0.012	0.077
TL (-7)	**llama-2-7b**	0.567	0.336	0.542	0.484	0.317	0.739	0.606	**0.573**
	llama 3.1-8B	0.590	0.477	0.625	0.528	**0.388**	0.744	0.638	0.544
	llama 3.2-3B	**0.606**	**0.479**	0.617	0.585	0.369	**0.751**	0.664	0.553
	aya-expanse-8b	0.538	0.447	0.597	0.528	0.347	0.741	0.646	0.544
TL (-11)	**llama-2-7b**	0.360	0.301	0.361	0.254	0.293	0.405	0.164	0.049
	llama 3.1-8B	0.514	0.412	0.609	0.438	0.304	0.148	0.554	0.493
	llama 3.2-3B	0.594	0.476	0.605	**0.610**	0.373	0.748	0.678	0.560
	aya-expanse-8b	0.490	0.411	0.572	0.445	0.336	0.569	0.453	0.439
TL (-16)	**llama-2-7b**	0.540	0.381	0.585	0.482	0.308	0.751	0.580	0.569
	llama 3.1-8B	0.558	0.453	0.602	0.523	0.350	0.737	0.652	0.513
	llama 3.2-3B	0.557	0.459	0.597	0.547	0.338	0.745	**0.682**	0.567
	aya-expanse-8b	0.467	0.390	0.557	0.481	0.314	0.727	0.576	0.540
TL (-20)	**llama-2-7b**	0.470	0.405	0.544	0.460	0.338	0.684	0.508	0.534
	llama 3.1-8B	0.484	0.394	0.553	0.321	0.172	0.649	0.524	0.494
	llama 3.2-3B	0.430	0.408	0.579	0.303	0.286	0.601	0.488	0.464
	aya-expanse-8b	0.437	0.300	0.488	0.263	0.287	0.483	0.438	0.395
TL (-24)	**llama-2-7b**	0.500	0.421	0.538	0.379	0.239	0.630	0.507	0.472
	llama 3.1-8B	0.421	0.378	0.552	0.330	0.290	0.515	0.530	0.464
	llama 3.2-3B	0.443	0.376	0.507	0.367	0.299	0.559	0.528	0.487
	aya-expanse-8b	0.375	0.319	0.440	0.337	0.220	0.393	0.407	0.345

ALOPE

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	aya-expanse-8b	0.375	0.319	0.440	0.337	0.220	0.393	0.407	0.345

ALOPE

	Model	En-Gu	En-Hi	En-Mr	En-Ta	En-Te	Et-En	Ne-En	Si-En	*Avg.*
TL (-1)	llama-2-7b	0.563	0.414	0.609	0.525	0.356	0.742	0.596	0.565	*0.546*
	llama 3.1-8B	0.594	0.469	0.620	0.567	0.363	0.734	0.647	0.547	*0.567*
	llama 3.2-3B	0.604	0.477	**0.636**	0.580	0.348	0.735	0.674	0.543	*0.575*
	aya-expanse-8b	0.068	0.178	0.219	-0.006	0.275	0.115	0.012	0.077	*0.117*
	Avg	*0.457*	*0.385*	*0.521*	*0.416*	*0.335*	*0.581*	*0.482*	*0.433*	
TL (-7)	llama-2-7b	0.567	0.336	0.542	0.484	0.317	0.739	0.606	**0.573**	*0.520*
	llama 3.1-8B	0.590	0.477	0.625	0.528	**0.388**	0.744	0.638	0.544	*0.567*
	llama 3.2-3B	**0.606**	**0.479**	0.617	0.585	0.369	**0.751**	0.664	0.553	*0.578*
	aya-expanse-8b	0.538	0.447	0.597	0.528	0.347	0.741	0.646	0.544	*0.549*
	Avg	*0.575*	*0.435*	*0.595*	*0.531*	*0.355*	*0.744*	*0.639*	*0.554*	
TL (-11)	llama-2-7b	0.360	0.301	0.361	0.254	0.293	0.405	0.164	0.049	*0.273*
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	aya-expanse-8b	0.490	0.411	0.572	0.445	0.336	0.569	0.453	0.439	*0.464*
	Avg	*0.489*	*0.400*	*0.537*	*0.437*	*0.327*	*0.467*	*0.462*	*0.385*	
TL (-16)	llama-2-7b	0.540	0.381	0.585	0.482	0.308	0.751	0.580	0.569	*0.524*
	llama 3.1-8B	0.558	0.453	0.602	0.523	0.350	0.737	0.652	0.513	*0.548*
	llama 3.2-3B	0.557	0.459	0.597	0.547	0.338	0.745	**0.682**	0.567	*0.561*
	aya-expanse-8b	0.467	0.390	0.557	0.481	0.314	0.727	0.576	0.540	*0.506*
	Avg	*0.530*	*0.421*	*0.585*	*0.508*	*0.327*	*0.740*	*0.622*	*0.547*	
TL (-20)	llama-2-7b	0.470	0.405	0.544	0.460	0.338	0.684	0.508	0.534	*0.493*
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	llama 3.2-3B	0.430	0.408	0.579	0.303	0.286	0.601	0.488	0.464	*0.445*
	aya-expanse-8b	0.437	0.300	0.488	0.263	0.287	0.483	0.438	0.395	*0.386*
	Avg	*0.455*	*0.377*	*0.541*	*0.337*	*0.271*	*0.604*	*0.490*	*0.472*	
TL (-24)	llama-2-7b	0.500	0.421	0.538	0.379	0.239	0.630	0.507	0.472	*0.461*
	llama 3.1-8B	0.421	0.378	0.552	0.330	0.290	0.515	0.530	0.464	*0.435*
	llama 3.2-3B	0.443	0.376	0.507	0.367	0.299	0.559	0.528	0.487	*0.446*
	aya-expanse-8b	0.375	0.319	0.440	0.337	0.220	0.393	0.407	0.345	*0.354*
	Avg	0.435	0.373	0.509	0.353	0.262	0.524	0.493	0.442	

ALOPE

	Model	En-Gu	En-Hi	En-Mr	En-Ta	En-Te	Et-En	Ne-En	Si-En	*Avg.*
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	llama 3.1-8B	0.594	0.469	0.620	0.567	0.363	0.734	0.647	0.547	*0.567*
	llama 3.2-3B	0.604	0.477	**0.636**	0.580	0.348	0.735	0.674	0.543	*0.575*
	aya-expanse-8b	0.068	0.178	0.219	-0.006	0.275	0.115	0.012	0.077	*0.117*
	Avg	*0.457*	*0.385*	*0.521*	*0.416*	*0.335*	*0.581*	*0.482*	*0.433*	
TL (-7)	llama-2-7b	0.567	0.336	0.542	0.484	0.317	0.739	0.606	**0.573**	*0.520*
	llama 3.1-8B	0.590	0.477	0.625	0.528	**0.388**	0.744	0.638	0.544	*0.567*
	llama 3.2-3B	**0.606**	**0.479**	0.617	0.585	0.369	**0.751**	0.664	0.553	*0.578*
	aya-expanse-8b	0.538	0.447	0.597	0.528	0.347	0.741	0.646	0.544	*0.549*
	Avg	*0.575*	*0.435*	*0.595*	*0.531*	*0.355*	*0.744*	*0.639*	*0.554*	
TL (-11)	llama-2-7b	0.360	0.301	0.361	0.254	0.293	0.405	0.164	0.049	*0.273*
	llama 3.1-8B	0.514	0.412	0.609	0.438	0.304	0.148	0.554	0.493	*0.434*
	llama 3.2-3B	0.594	0.476	0.605	**0.610**	0.373	0.748	0.678	0.560	*0.581*
	aya-expanse-8b	0.490	0.411	0.572	0.445	0.336	0.569	0.453	0.439	*0.464*
	Avg	*0.489*	*0.400*	*0.537*	*0.437*	*0.327*	*0.467*	*0.462*	*0.385*	
TL (-16)	llama-2-7b	0.540	0.381	0.585	0.482	0.308	0.751	0.580	0.569	*0.524*
	llama 3.1-8B	0.558	0.453	0.602	0.523	0.350	0.737	0.652	0.513	*0.548*
	llama 3.2-3B	0.557	0.459	0.597	0.547	0.338	0.745	**0.682**	0.567	*0.561*
	aya-expanse-8b	0.467	0.390	0.557	0.481	0.314	0.727	0.576	0.540	*0.506*
	Avg	*0.530*	*0.421*	*0.585*	*0.508*	*0.327*	*0.740*	*0.622*	*0.547*	
TL (-20)	llama-2-7b	0.470	0.405	0.544	0.460	0.338	0.684	0.508	0.534	*0.493*
	llama 3.1-8B	0.484	0.394	0.553	0.321	0.172	0.649	0.524	0.494	*0.449*
	llama 3.2-3B	0.430	0.408	0.579	0.303	0.286	0.601	0.488	0.464	*0.445*
	aya-expanse-8b	0.437	0.300	0.488	0.263	0.287	0.483	0.438	0.395	*0.386*
	Avg	*0.455*	*0.377*	*0.541*	*0.337*	*0.271*	*0.604*	*0.490*	*0.472*	
TL (-24)	llama-2-7b	0.500	0.421	0.538	0.379	0.239	0.630	0.507	0.472	*0.461*
	llama 3.1-8B	0.421	0.378	0.552	0.330	0.290	0.515	0.530	0.464	*0.435*
	llama 3.2-3B	0.443	0.376	0.507	0.367	0.299	0.559	0.528	0.487	*0.446*
	aya-expanse-8b	0.375	0.319	0.440	0.337	0.220	0.393	0.407	0.345	*0.354*
	Avg	0.435	0.373	0.509	0.353	0.262	0.524	0.493	0.442	

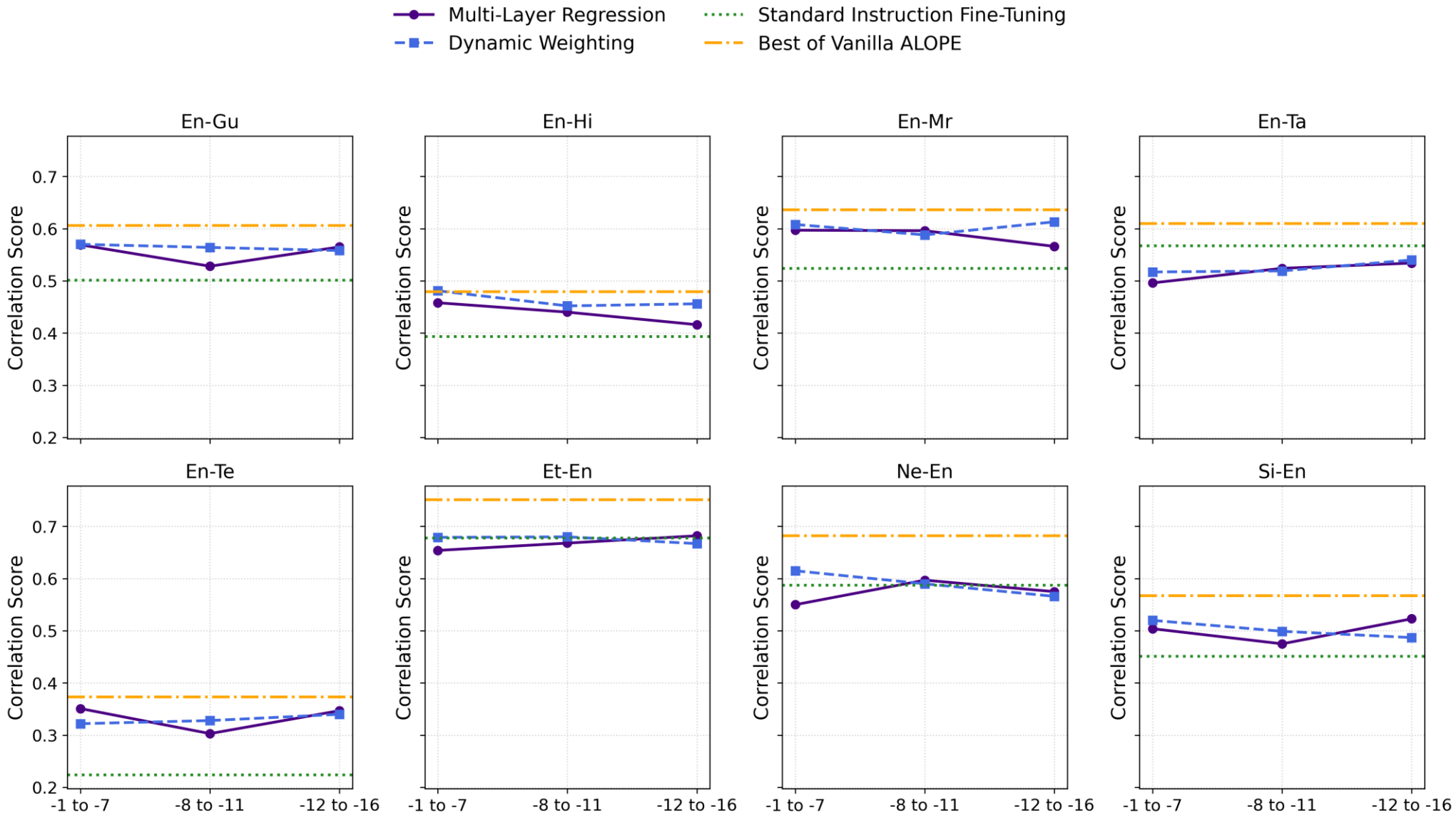
ALOPE

	Model	En-Gu	En-Hi	En-Mr	En-Ta	En-Te	Et-En	Ne-En	Si-En	*Avg.*
TL (-1)	llama-2-7b	0.563	0.414	0.609	0.525	0.356	0.742	0.596	0.565	*0.546*
	llama 3.1-8B	0.594	0.469	0.620	0.567	0.363	0.734	0.647	0.547	*0.567*
	llama 3.2-3B	0.604	0.477	**0.636**	0.580	0.348	0.735	0.674	0.543	*0.575*
	aya-expanse-8b	0.068	0.178	0.219	-0.006	0.275	0.115	0.012	0.077	*0.117*
	Avg	*0.457*	*0.385*	*0.521*	*0.416*	*0.335*	*0.581*	*0.482*	*0.433*	
TL (-7)	llama-2-7b	0.567	0.336	0.542	0.484	0.317	0.739	0.606	**0.573**	*0.520*
	llama 3.1-8B	0.590	0.477	0.625	0.528	**0.388**	0.744	0.638	0.544	*0.567*
	llama 3.2-3B	**0.606**	**0.479**	0.617	0.585	0.369	**0.751**	0.664	0.553	*0.578*
	aya-expanse-8b	0.538	0.447	0.597	0.528	0.347	0.741	0.646	0.544	*0.549*
	Avg	*0.575*	*0.435*	*0.595*	*0.531*	*0.355*	*0.744*	*0.639*	*0.554*	
TL (-11)	llama-2-7b	0.360	0.301	0.361	0.254	0.293	0.405	0.164	0.049	*0.273*
	llama 3.1-8B	0.514	0.412	0.609	0.438	0.304	0.148	0.554	0.493	*0.434*
	llama 3.2-3B	0.594	0.476	0.605	**0.610**	0.373	0.748	0.678	0.560	*0.581*
	aya-expanse-8b	0.490	0.411	0.572	0.445	0.336	0.569	0.453	0.439	*0.464*
	Avg	*0.489*	*0.400*	*0.537*	*0.437*	*0.327*	*0.467*	*0.462*	*0.385*	
TL (-16)	llama-2-7b	0.540	0.381	0.585	0.482	0.308	0.751	0.580	0.569	*0.524*
	llama 3.1-8B	0.558	0.453	0.602	0.523	0.350	0.737	0.652	0.513	*0.548*
	llama 3.2-3B	0.557	0.459	0.597	0.547	0.338	0.745	**0.682**	0.567	*0.561*
	aya-expanse-8b	0.467	0.390	0.557	0.481	0.314	0.727	0.576	0.540	*0.506*
	Avg	*0.530*	*0.421*	*0.585*	*0.508*	*0.327*	*0.740*	*0.622*	*0.547*	
TL (-20)	llama-2-7b	0.470	0.405	0.544	0.460	0.338	0.684	0.508	0.534	*0.493*
	llama 3.1-8B	0.484	0.394	0.553	0.321	0.172	0.649	0.524	0.494	*0.449*
	llama 3.2-3B	0.430	0.408	0.579	0.303	0.286	0.601	0.488	0.464	*0.445*
	aya-expanse-8b	0.437	0.300	0.488	0.263	0.287	0.483	0.438	0.395	*0.386*
	Avg	*0.455*	*0.377*	*0.541*	*0.337*	*0.271*	*0.604*	*0.490*	*0.472*	
TL (-24)	llama-2-7b	0.500	0.421	0.538	0.379	0.239	0.630	0.507	0.472	*0.461*
	llama 3.1-8B	0.421	0.378	0.552	0.330	0.290	0.515	0.530	0.464	*0.435*
	llama 3.2-3B	0.443	0.376	0.507	0.367	0.299	0.559	0.528	0.487	*0.446*
	aya-expanse-8b	0.375	0.319	0.440	0.337	0.220	0.393	0.407	0.345	*0.354*
	Avg	0.435	0.373	0.509	0.353	0.262	0.524	0.493	0.442	

ALOPE

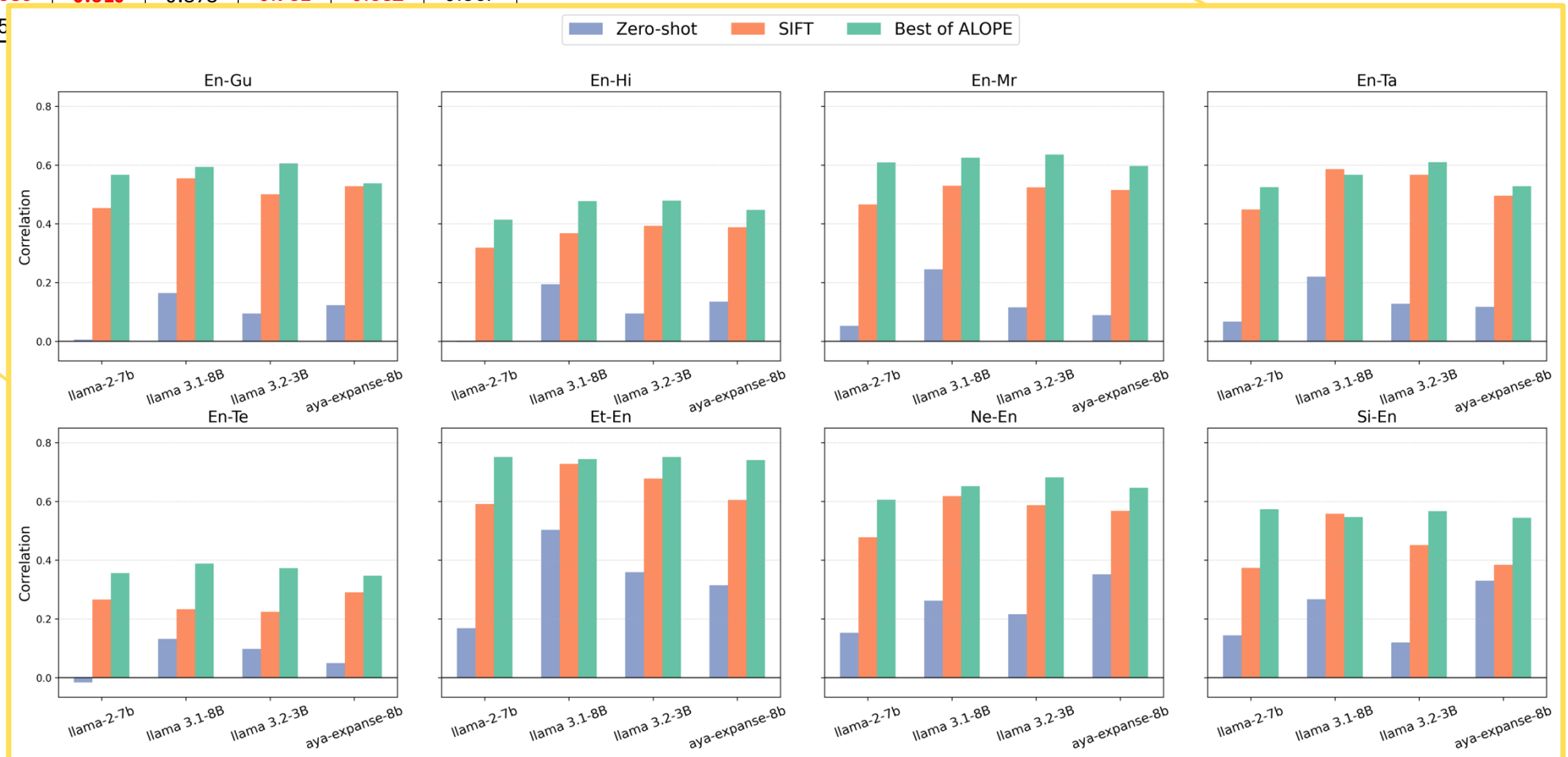
	Model	En-Gu	En-Hi	En-Mr	En-Ta	En-Te	Et-En	Ne-En	Si-En	*Avg.*
TL (-1)	llama-2-7b	0.563	0.414	0.609	0.525	0.356	0.742	0.596	0.565	*0.546*
	llama 3.1-8B	0.594	0.469	0.620	0.567	0.363	0.734	0.647	0.547	*0.567*
	llama 3.2-3B	0.604	0.477	**0.636**	0.580	0.348	0.735	0.674	0.543	*0.575*
	aya-expanse-8b	0.068	0.178	0.219	-0.006	0.275	0.115	0.012	0.077	*0.117*
	Avg	*0.457*	*0.385*	*0.521*	*0.416*	*0.335*	*0.581*	*0.482*	*0.433*	
TL (-7)	llama-2-7b	0.567	0.336	0.542	0.484	0.317	0.739	0.606	**0.573**	*0.520*
	llama 3.1-8B	0.590	0.477	0.625	0.528	**0.388**	0.744	0.638	0.544	*0.567*
	llama 3.2-3B	**0.606**	**0.479**	0.617	0.585	0.369	**0.751**	0.664	0.553	*0.578*
	aya-expanse-8b	0.538	0.447	0.597	0.528	0.347	0.741	0.646	0.544	*0.549*
	Avg	*0.575*	*0.435*	*0.595*	*0.531*	*0.355*	*0.744*	*0.639*	*0.554*	
TL (-11)	llama-2-7b	0.360	0.301	0.361	0.254	0.293	0.405	0.164	0.049	*0.273*
	llama 3.1-8B	0.514	0.412	0.609	0.438	0.304	0.148	0.554	0.493	*0.434*
	llama 3.2-3B	0.594	0.476	0.605	**0.610**	0.373	0.748	0.678	0.560	*0.581*
	aya-expanse-8b	0.490	0.411	0.572	0.445	0.336	0.569	0.453	0.439	*0.464*
	Avg	*0.489*	*0.400*	*0.537*	*0.437*	*0.327*	*0.467*	*0.462*	*0.385*	
TL (-16)	llama-2-7b	0.540	0.381	0.585	0.482	0.308	0.751	0.580	0.569	*0.524*
	llama 3.1-8B	0.558	0.453	0.602	0.523	0.350	0.737	0.652	0.513	*0.548*
	llama 3.2-3B	0.557	0.459	0.597	0.547	0.338	0.745	**0.682**	0.567	*0.561*
	aya-expanse-8b	0.467	0.390	0.557	0.481	0.314	0.727	0.576	0.540	*0.506*
	Avg	*0.530*	*0.421*	*0.585*	*0.508*	*0.327*	*0.740*	*0.622*	*0.547*	
TL (-20)	llama-2-7b	0.470	0.405	0.544	0.460	0.338	0.684	0.508	0.534	*0.493*
	llama 3.1-8B	0.484	0.394	0.553	0.321	0.172	0.649	0.524	0.494	*0.449*
	llama 3.2-3B	0.430	0.408	0.579	0.303	0.286	0.601	0.488	0.464	*0.445*
	aya-expanse-8b	0.437	0.300	0.488	0.263	0.287	0.483	0.438	0.395	*0.386*
	Avg	*0.455*	*0.377*	*0.541*	*0.337*	*0.271*	*0.604*	*0.490*	*0.472*	
TL (-24)	llama-2-7b	0.500	0.421	0.538	0.379	0.239	0.630	0.507	0.472	*0.461*
	llama 3.1-8B	0.421	0.378	0.552	0.330	0.290	0.515	0.530	0.464	*0.435*
	llama 3.2-3B	0.443	0.376	0.507	0.367	0.299	0.559	0.528	0.487	*0.446*
	aya-expanse-8b	0.375	0.319	0.440	0.337	0.220	0.393	0.407	0.345	*0.354*
	Avg	0.435	0.373	0.509	0.353	0.262	0.524	0.493	0.442	

Approaches with ALOPE vs SFIT



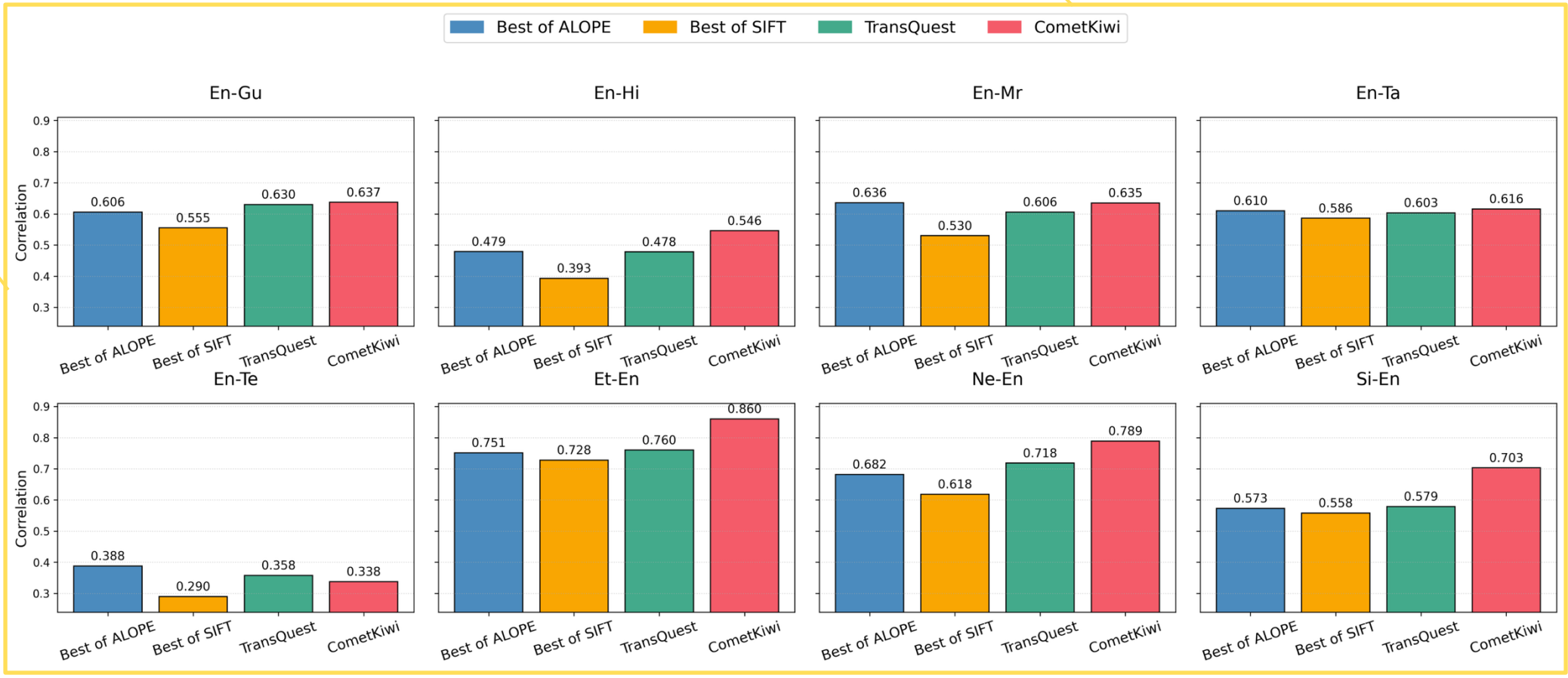
ALOPE *vs.* Zero-shot *vs.* SIFT

	Model	En-Gu	En-Hi	En-Mr	En-Ta	En-Te	Et-En	Ne-En	Si-En
Zero-shot	llama-2-7b	0.006	-0.002	0.053	0.067	-0.016	0.168	0.153	0.144
	llama 3.1-8B	**0.164**	**0.194**	**0.245**	**0.220**	**0.132**	**0.503**	0.262	0.267
	llama 3.2-3B	0.095	0.095	0.116	0.128	0.098	0.359	0.216	0.120
	aya-expanse-8B	0.123	0.135	0.089	0.117	0.049	0.315	**0.352**	**0.330**
SIFT	llama-2-7b	0.454	0.319	0.466	0.449	0.266	0.591	0.478	0.374
	llama 3.1-8B	**0.555**	0.368	**0.530**	**0.586**	0.233	**0.728**	**0.618**	**0.558**
	llama 3.2-3B	0.501	**0.393**	0.524	0.567	0.224	0.678	0.587	0.451
	aya-expanse-8B	0.528	0.388	0.515	0.496	**0.290**	0.605	0.568	0.384
Best of ALOPE	llama-2-7b	0.567	0.414	0.609	0.525	0.356	0.751	0.606	**0.573**
	llama 3.1-8B	0.594	0.477	0.625	0.567	**0.388**	0.744	0.652	0.547
	llama 3.2-3B	**0.606**	**0.479**	**0.636**	**0.610**	0.373	**0.751**	**0.682**	0.567
	aya-expanse-8B	0.538	0.447	0.5					

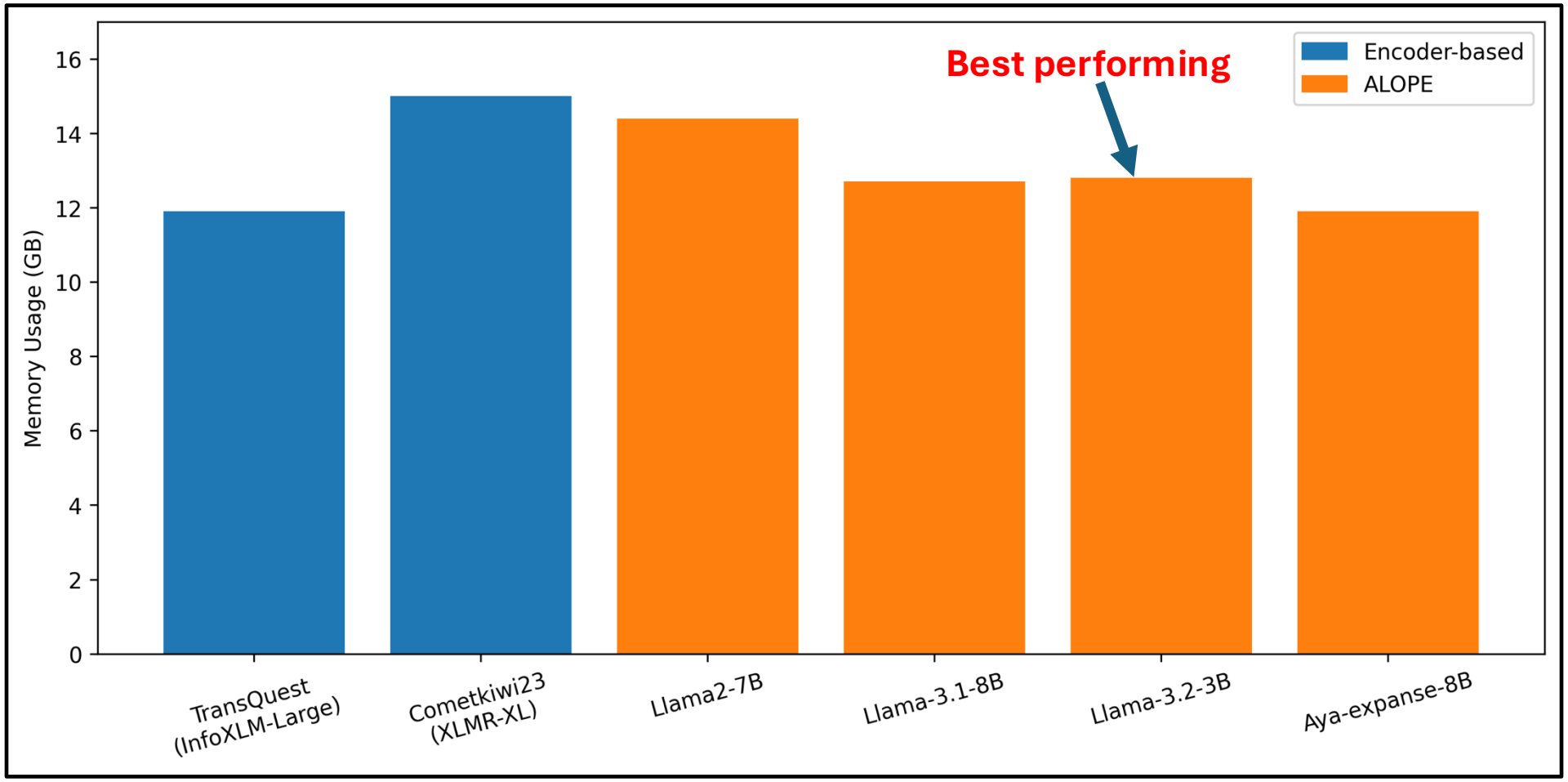


ALOPE *vs.* SIFT *vs.* SOTA Approaches

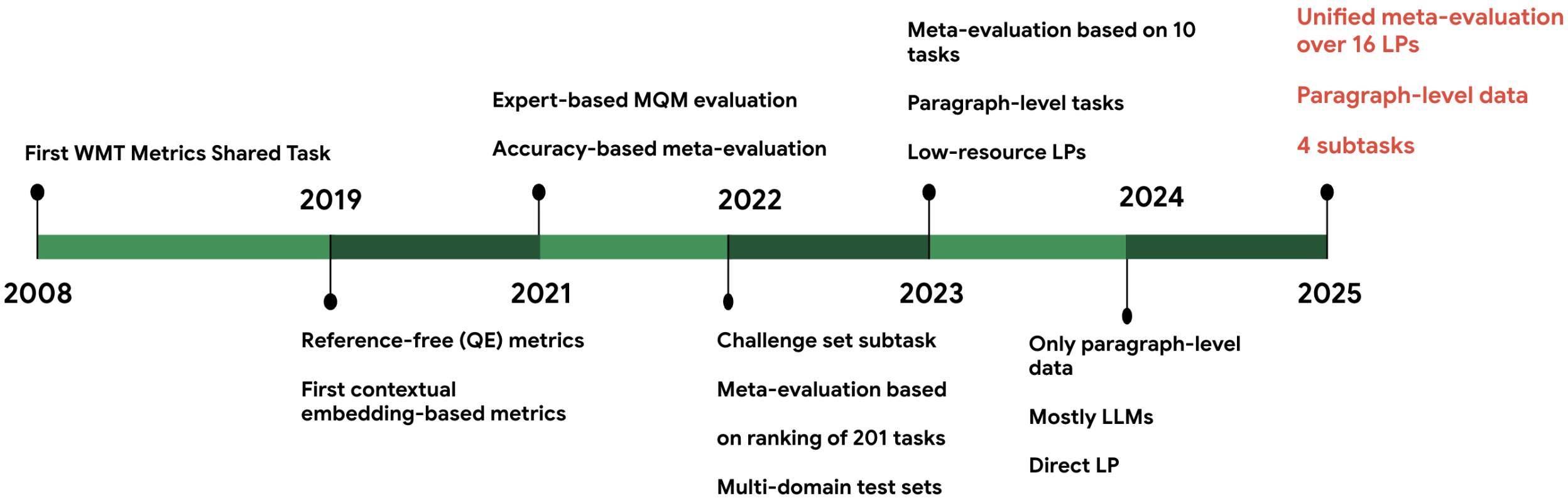
Approach	En-Gu	En-Hi	En-Mr	En-Ta	En-Te	Et-En	Ne-En	Si-En
Best ALOPE	0.606	0.479	**0.636**	0.610	**0.388**	0.751	0.682	0.573
Best from SIFT	0.555	0.393	0.530	0.586	0.290	0.728	0.618	0.558
TransQuest	0.630	0.478	0.606	0.603	0.358	0.760	0.718	0.579
CometKiwi	**0.637**	**0.546**	0.635	**0.616**	0.338	**0.860**	**0.789**	**0.703**



Computational Efficiency



A Unified Metrics/QE/APE Shared Task



Subtask 3 aims to correct translation based on QE score

Task 1: Segment-level quality score prediction
Given source-hypothesis pair and optionally a reference segment, predict a quality score for each example in the evaluation set

Task 2: Span-level error detection
Given source-hypothesis pair and optionally a reference segment, predict the precise span of each translation error along with its severity

Task 3: Quality-informed segment-level error correction
Given source-hypothesis pair, automatically generated error spans, and optionally a reference segment, improve the translation

Task 4: Challenge sets
External "breakers" provide challenging test sets and perform challenge-focused evaluation of the participants in tasks 1 and 2

Source: Non parliamo italiano.

Reference: We don't speak Italian.

Hypothesis: I don't speak Spanish!

Post-edit: We don't speak Italian.

Task 3 aims to correct based on QE score

Improvements made by correction systems measured using COMET (Rei et. al., 2020) via

- **ΔCOMET** = COMET(source, corrected translation) - COMET(source, original translation)

We also measure **efficiency of corrections** using

- **Gain-to-Edit Ratio (GER)** = ΔCOMET / TER(original translation, corrected translation)

Additionally, we measure system performance using

- **ΔBLEURT** (BLEURT; Sellam et. al., 2020) and **ΔChrF++*** (ChrF++; Popović, 2017) to observe **semantic,** and **lexical similarity** with the provided reference, and
- **Batchwise Significance Testing** observing system performance over random samples

*For En-Ja and En-Zh, we use ΔChrF

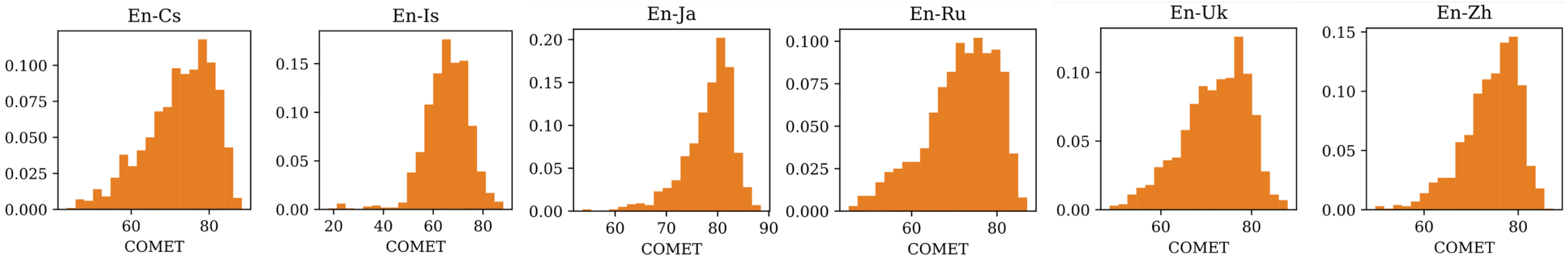
Task 3 Data and Baselines

We focus on **six language pairs** with **1,000 test instances *per* pair**.

- En-Cs, En-Is, En-Ja, En-Ru, En-Uk, En-Zh

Baselines

- **Translate from scratch** using Gemma3-IT-27B
- **Uses QE** output from XCOMET, **and post-edits** using Gemma3-IT-27B



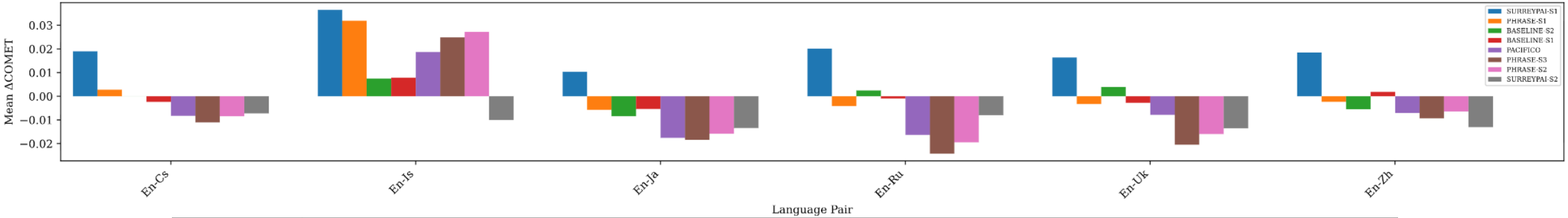
Task 3 Participants

Phrase (Hrabal et. al., 2025) leverage GPT-o3 and -o3 mini to correct outputs using *training-free approaches* based on *identifying fluency issues,* both, with and without reasoning steps (S1/S2), and *only via correcting errors* (S3).

SurreyPAI (Padmanabham et. al., 2025) used two training-free approaches, one which *leverages DA scores to identify an language-specific LLMs for re-translation*, and another which uses *fine-grained error-span information to post-edit* corrections.

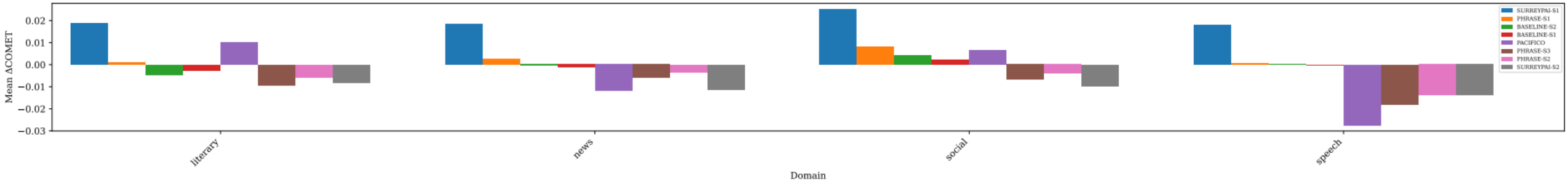
Pacifico (Sharma et. al., 2025) used explanations as an intermediate step in error detection and correction, using xTOWER to generate explanations, and then Gemini-1.5-pro for corrections.

Task 3: Primary Results



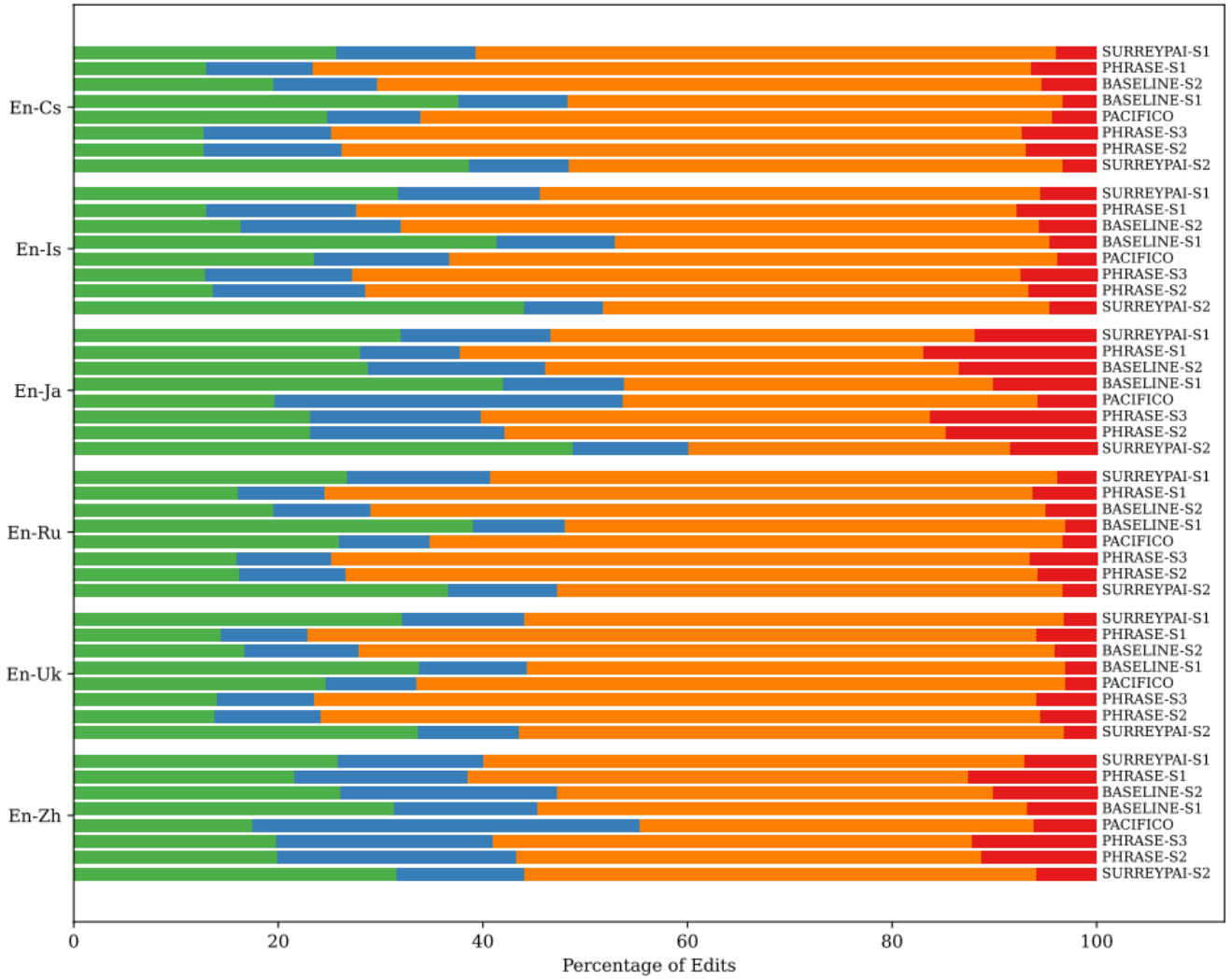
	ΔCOMET						GER					
	En-Cs	En-Is	En-Ja	En-Ru	En-Uk	En-Zh	En-Cs	En-Is	En-Ja*	En-Ru	En-Uk	En-Zh*
SurreyPAI-S1	**0.019**	**0.037**	**0.010**	**0.020**	**0.016**	**0.018**	**0.015**	0.027	**0.008**	**0.016**	**0.012**	**0.015**
Phrase-S1	0.003	0.032	-0.006	-0.004	-0.003	-0.002	0.006	0.058	-0.012	-0.007	-0.006	-0.005
Baseline-S1	0.000	0.007	-0.008	0.002	0.004	-0.005	0.000	0.026	-0.036	0.009	0.017	-0.023
Baseline-S2	-0.002	0.008	-0.005	-0.001	-0.003	0.002	-0.002	0.005	-0.004	-0.001	-0.002	0.002
Pacifico	-0.008	0.019	-0.018	-0.016	-0.008	-0.007	-0.032	0.054	-0.085	-0.061	-0.034	-0.036
Phrase-S3	-0.008	0.027	-0.016	-0.019	-0.016	-0.006	-0.030	**0.063**	-0.060	-0.056	-0.045	-0.023
Phrase-S2	-0.011	0.025	-0.018	-0.024	-0.020	-0.009	-0.027	0.050	-0.049	-0.050	-0.043	-0.026
SurreyPAI-S2	-0.007	-0.010	-0.013	-0.008	-0.014	-0.013	-0.005	-0.006	-0.008	-0.005	-0.009	-0.010

Task 3 Analysis: Domain, ΔCOMET, ΔBLEURT, and ΔChrF++



	ΔBLEURT						ΔChrF / ΔChrF++					
	En-Cs	En-Is	En-Ja	En-Ru	En-Uk	En-Zh	En-Cs	En-Is	En-Ja*	En-Ru	En-Uk	En-Zh*
SurreyPAI-S1	-0.002	0.053	0.003	0.009	0.002	-0.003	-3.460	0.000	0.000	0.000	0.000	0.000
Phrase-S1	-0.012	0.031	-0.033	-0.030	0.023	-0.045	2.256	2.856	-0.558	-11.636	13.758	-0.279
Baseline-S1	-0.027	0.025	-0.007	-0.006	-0.002	-0.007	0.059	0.264	-2.272	0.733	0.214	-1.086
Baseline-S2	-0.019	0.012	-0.009	0.011	0.018	0.007	8.902	2.199	4.358	0.954	7.267	-1.662
Pacifico	-0.035	-0.004	-0.030	-0.039	-0.024	-0.010	8.546	10.434	2.934	-42.936	6.791	5.989
Phrase-S3	-0.110	-0.075	-0.053	-0.210	-0.171	-0.090	6.550	7.117	-0.579	-14.537	8.471	0.331
Phrase-S2	-0.104	-0.076	-0.050	-0.206	-0.176	-0.083	4.810	5.120	-2.228	-16.787	3.223	4.760
SurreyPAI-S2	-0.015	0.002	-0.024	-0.007	0.002	-0.024	-1.219	-5.248	0.029	0.041	-22.708	0.000

Task 3 Analysis: Edit Operations



Substitution → Most frequent (>50%). Indicates that **lexical choice** is the main challenge for translation systems.

Deletion, **Insertion** → Next most common operations

Shift → Least frequent. Suggesting that models produce **syntactically coherent translations**.

Consistent **pattern** across all systems **Japanese & Chinese** show slightly **more insertions/deletions**

Task 3: Key Takeaways

Correcting LLM-based Translation is Challenging

This was the first task focused on correcting high-quality LLM translations.

APE systems struggled to improve them, similar to early struggles of enc-dec neural APE systems with NMT output.

Main Error: Word Choice, Not Fluency

Substitution was the dominant edit (>50%), as syntax was already plausible .

The key challenge is **lexical choice**.

Challenge Domain: Speech

Systems **struggled** most **with the speech domain**.

Correcting text from multimodal sources may require different methods.

Conclusion

- **Clear gap in performance** for high-resource language on the target side *vs*. low-resource languages.
- **ALOPE: Novel framework**
  - Regression heads + LoRA on LLMs
- **Performance**
  - Outperforms SIFT; matches / exceeds the performance of SOTA approaches QE
- **Findings**
  - Intermediate layers (TL-7, TL-11) => **most effective for low-resource cross-lingual QE**
  - Mid=> **layers stabilize earlier when English is target**
  - ALOPE w/ LLaMA-3.2 => **best overall despite small size**
- **Extension to the framework**
  - Dynamic weighting & multi-head regression improve baseline SFIT
- **Efficiency**
  - Competitive GPU memory , practical & scalable
- **Future vision**
  - Enhancing ALOPE for error reasoning and automatic post-editing
  - Look out for **ALOPE-RL**, and **ALOPE-APE** branches of this work! ☺

Thank You

Questions?

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