IST-Unbabel 2021 Submission for the Quality Estimation Shared Task

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Highlights

1) We incorporate **adapter layers** in the Openkiwi architecture [1].
2) We explore different types of **uncertainty.**
   a) **Glass-box** features [2] extracted from the NMT models
   b) **Aleatoric uncertainty** derived from the human annotations
   c) **Epistemic uncertainty** of our QE model(s).
3) We enhance our model with **out-of-domain** data from the Metrics shared tasks [3]

Tasks & Data

T1 Predict sentence level quality based on direct assessment **(DA)** scores
Score range: [-7.542, 3.178]

T2.1 Predict **sentence level** quality based on post-edit **HTER** scores
Score range: [0,1]

T2.2 Predict **word level binary tags**
Labels: **OK | BAD**

DATA

- **Multi-lingual** training and testing sets
- Mix of high, medium, low resource language pairs → Different score **distributions**
- **Zero-shot** (blind) language pairs

We train our models using multi-lingual encoders with **adapter layers (M1)** to obtain models that generalise better. Along the same lines, we experiment with pre-training the models on the he data provided for the past **Metrics shared tasks (M1, M2)**. This out-of-domain data encompasses 30 language pairs from the news domain (versus 7 in the QE dataset), including the zero-shot QE pairs.

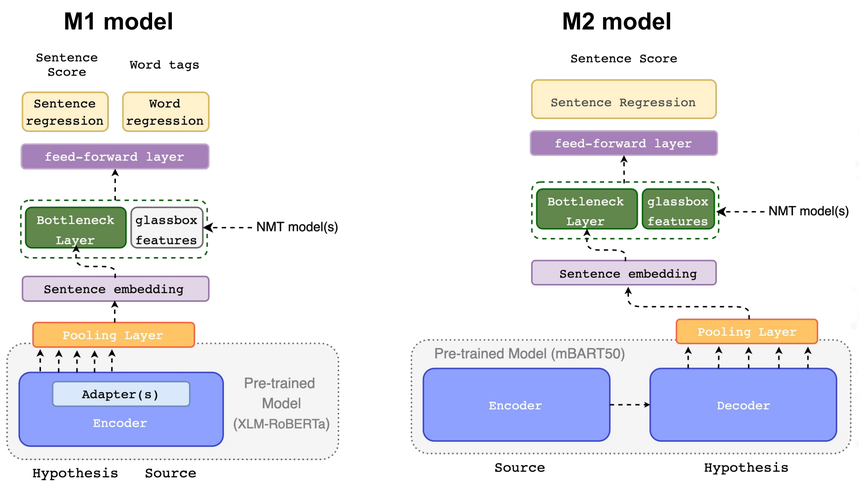
Official results

	Model	Multi	En-De	En-Zh	Ro-En	Et-En	Ne-En	Si-En	Ru-En	En-Cs	En-Ja	Ps-En	Km-En
Task 1	QEMind	0.68	0.57	**0.60**	**0.91**	**0.81**	**0.87**	**0.60**	**0.81**	**0.58**	**0.36**	**0.65**	**0.68**
	HW-TSC	0.67	**0.58**	0.58	0.90	**0.81**	0.86	0.58	0.88	**0.57**	**0.36**	0.62	0.66
	IST-Unbabel	0.665	**0.58**	0.59	0.90	0.80	0.86	**0.61**	0.792	**0.58**	**0.36**	0.63	0.65
	papago (IKT)	0.66	**0.57**	0.567	0.901	0.76	0.85	**0.60**	0.79	**0.57**	0.33	**0.64**	0.66
	TUDa	0.63	0.47	0.56	0.89	0.79	0.83	0.57	0.76	0.55	0.33	0.61	0.64
	Inmon‡	0.623	–	–	–	–	–	–	–	0.55	0.30	0.59	0.63
	papago (KD)	0.61	0.55	0.55	0.88	0.79	0.82	0.58	0.74	0.497	0.28	0.58	0.63
	BASELINE	0.54	0.41	0.53	0.82	0.66	0.74	0.51	0.68	0.35	0.23	0.48	0.56

	Model	Multi	En-De	En-Zh	Ro-En	Et-En	Ne-En	Si-En	Ru-En	En-Cs	En-Ja	Ps-En	Km-En
Task 2.1	HW-TSC	0.63	**0.65**	**0.37**	0.86	**0.81**	**0.80**	**0.87**	**0.56**	0.48	**0.26**	**0.53**	**0.75**
	IST-Unbabel	0.60	0.62	0.29	**0.88**	**0.81**	0.72	0.71	**0.54**	**0.53**	**0.28**	**0.56**	0.66
	BASELINE	0.50	0.53	0.28	0.83	0.71	0.63	0.61	0.45	0.31	0.10	0.50	0.58

	Model	Multi	En-De	En-Zh	Ro-En	Et-En	Ne-En	Si-En	Ru-En	En-Cs	En-Ja	Ps-En	Km-En
Task 2.2 MT words	HW-TSC	0.53	**0.51**	**0.35**	**0.66**	**0.60**	**0.67**	**0.84**	**0.45**	**0.38**	**0.25**	**0.45**	**0.63**
	IST-Unbabel	0.43	0.46	0.31	**0.65**	0.57	0.51	0.52	0.332	**0.37**	0.16	0.37	0.45
	BASELINE	0.35	0.37	0.25	0.54	0.46	0.44	0.43	0.26	0.27	0.13	0.31	0.35

Models



Uncertainty incorporation

During training | During inference

Annotator uncertainty

Training objective

- Assume each annotator score is a point in a distribution
- Assume a gaussian distribution of scores
- Calculate the mean (μ) and std (σ)
- Use a KL training objective: predict the mean and variance of quality scores

$$KL(p||q) = \log\frac{\sigma_2}{\sigma_1} + \frac{\sigma_1^2 + (\mu_1 - \mu_2)^2}{2\sigma_2^2} - \frac{1}{2}$$

NMT model uncertainty

Glass-box features

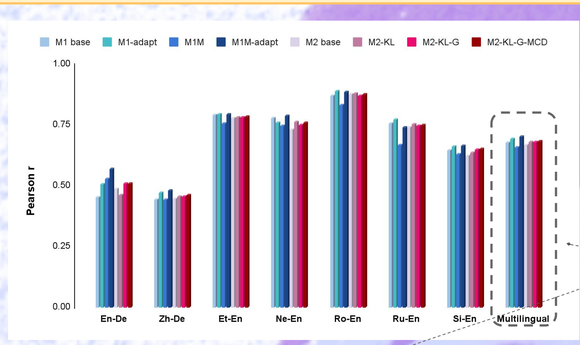
- **TP** avg of word translation probability
- **Softmax-Ent** avg of softmax output distribution entropy
- **Sent-Std** stdev of word probabilities
- **D-TP** average TP across N MCD forward-passes
- **D-Var** variance of TP across N MCD forward-passes
- **D-Combo** combination of D-TP and D-Var: $1 - \frac{D_{TP}}{D_{Var}}$
- **D-Lex-Sim** lexical similarity of MT output generated in different MCD passes.

QE model uncertainty

MC Dropout

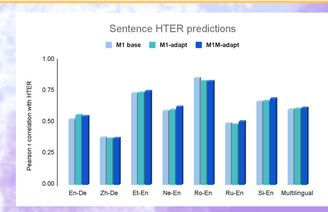
- Run N stochastic passes for each input
- Assume that the obtained estimates are drawn from a gaussian distribution
- Use the mean of predicted quality scores

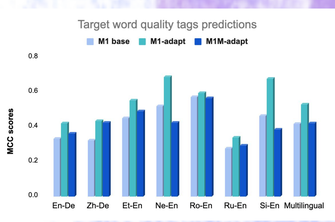
Task 1: Results

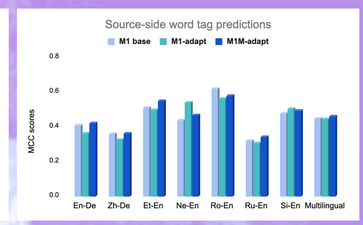


We ensemble checkpoints from the best **M1** and **M2** models

Task 2: Results







We ensemble checkpoints from **M1M** and **M1** models

References:

[1] Fabio Kepler, Jonay Trénous, Marcos Treviso, Miguel Vera, André F. T. Martins 2019. **OpenKiwi: An Open Source Framework for Quality Estimation**

[2] Marina Fomicheva, Shuo Sun, Lisa Yankovskaya,Frédéric Blain, Francisco Guzmán, Mark Fishel,Nikolaos Aletras, Vishrav Chaudhary, and Lucia Specia. 2020. **Unsupervised quality estimation forneural machine translation.**

[3] Mathur, Nitika, Johnny Wei, Markus Freitag, Qingsong Ma, and Ondřej Bojar. 2020. **Results of the wmt20 metrics shared task.**

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