# Reproducibility Report for Self-Supervised Quality Estimation for Machine Translation

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## MAIN TAKEAWAYS

**Quality estimation (QE)** is the task of estimating the quality of machine translated text. While the state-of-the-art machine translation systems have achieved surprising accuracy over the past years, it is still far from perfect and often need human evaluation and post-editing to reach sufficient quality. The quality estimation task aims to **locate sentences and words that are more likely to have errors**, direct the attention of human experts to specific words or sentences, and ultimately allow human experts to fix errors more efficiently.

The authors of **Self-Supervised Quality Estimation for Machine Translation** proposes a novel self-supervised approach to solving the QE task. To specify, the authors **fine-tune cased multilingual BERT (mBERT)**, a multilingual transformer model pretrained using a masked language modelling objective, by concatenating the text of the original sentence and the translated sentence, masking out 15% of the translated sentence's words, and training on the typical masked language modeling objective, i.e. maximizing the probability of recovering the masked tokens.

## RESULTS

| Models | En-De | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Sent-Level | | Word-Level | | | | | |
| | Dev | Test | Dev | | | Test | | |
| | Pear-Cor of HTER | | f1_ok | f1_bad | f1_mul | f1_ok | f1_bad | f1_mul |
| Paper's Single | 0.504 | 0.463 | x | x | 0.381 | x | x | 0.383 |
| Paper's Ensemble | 0.518 | 0.462 | x | x | 0.395 | x | x | 0.385 |
| SyntheticQE Baseline | 0.508 | 0.460 | x | x | 0.373 | x | x | 0.362 |
| Ours 1 (seed 42) | 0.534 | 0.460 | 0.925 | 0.423 | 0.391 | 0.907 | 0.4 | 0.363 |
| Ours 2 (seed 43) | 0.541 | 0.460 | 0.921 | 0.414 | 0.381 | 0.904 | 0.397 | 0.358 |
| Ours 3 (seed 44) | 0.536 | 0.462 | 0.919 | 0.413 | 0.38 | 0.902 | 0.399 | 0.359 |
| Ours 4 (seed 45) | 0.539 | 0.461 | 0.919 | 0.419 | 0.386 | 0.901 | 0.404 | 0.364 |
| Ours 5 (seed 46) | 0.544 | 0.464 | 0.917 | 0.414 | 0.38 | 0.899 | 0.395 | 0.355 |
| Mean | 0.539 | 0.461 | 0.920 | 0.4166 | 0.3836 | 0.9026 | 0.399 | 0.3598 |
| Standard Deviation | 0.003962 | 0.001673 | 0.003033 | 0.004278 | 0.004827 | 0.003050 | 0.003391 | 0.003701 |
| Ours Ensemble (1, 2) | 0.542 | 0.464 | 0.914 | 0.421 | 0.385 | 0.897 | 0.407 | 0.365 |
| Ours Ensemble (1 ~ 5) | 0.546 | 0.468 | 0.899 | 0.413 | 0.371 | 0.881 | 0.413 | 0.364 |

| Models | En-De | | | | | | | |
|---|---|---|---|---|---|---|---|---|
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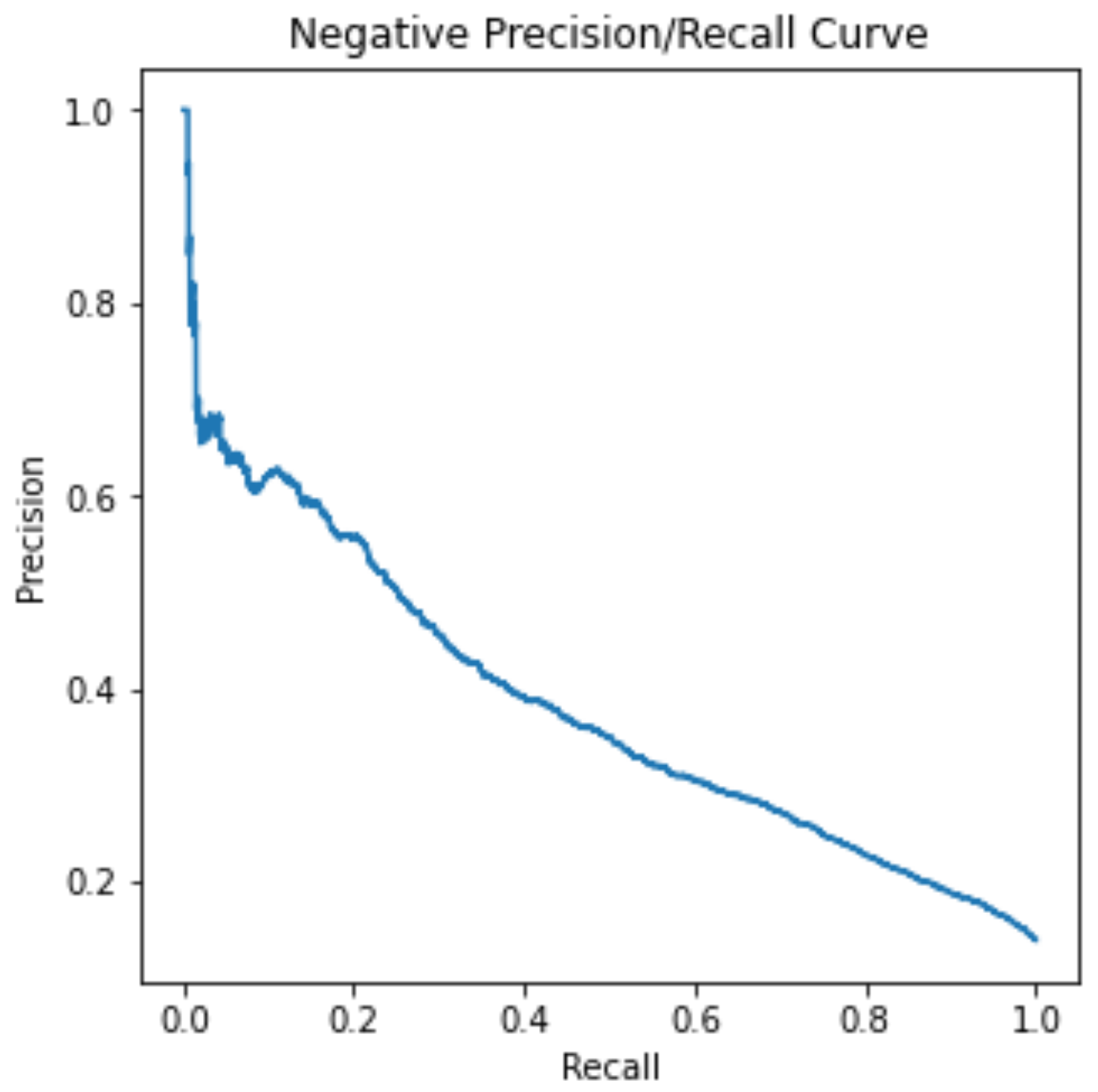
| | Dev | Test | Dev | | | Test | | |
| | Pear-Cor of HTER | | f1_ok | f1_bad | f1_mul | f1_ok | f1_bad | f1_mul |
| Paper's Single | 0.504 | 0.463 | x | x | 0.381 | x | x | 0.383 |
| Paper's Ensemble | 0.518 | 0.462 | x | x | 0.395 | x | x | 0.385 |
| Ours (n = 40, m = 2) | 0.525 | 0.439 | 0.921 | 0.406 | 0.374 | 0.902 | 0.396 | 0.357 |
| Ours (n = 40, m = 4) | 0.518 | 0.451 | 0.928 | 0.407 | 0.378 | 0.909 | 0.387 | 0.351 |
| Ours (n = 40, m = 6) | 0.533 | 0.460 | 0.925 | 0.422 | 0.391 | 0.906 | 0.400 | 0.363 |
| Ours (n = 40, m = 8) | 0.551 | 0.463 | 0.923 | 0.431 | 0.397 | 0.901 | 0.402 | 0.363 |
| Ours (n = 40, m = 10) | 0.544 | 0.487 | 0.923 | 0.435 | 0.402 | 0.905 | 0.417 | 0.378 |
| Ours (n = 40, m = 12) | 0.549 | 0.487 | 0.923 | 0.440 | 0.406 | 0.904 | 0.420 | 0.380 |
| Ours (n = 40, m = 14) | 0.533 | 0.482 | 0.918 | 0.434 | 0.399 | 0.899 | 0.421 | 0.378 |
| Ours (n = 40, m = 16) | 0.529 | 0.478 | 0.923 | 0.428 | 0.395 | 0.905 | 0.414 | 0.374 |
| Ours (n = 40, m = 18) | 0.523 | 0.475 | 0.911 | 0.430 | 0.392 | 0.893 | 0.425 | 0.379 |
| Ours (n = 40, m = 20) | 0.510 | 0.468 | 0.920 | 0.422 | 0.389 | 0.902 | 0.412 | 0.372 |
| Standard Deviation | 0.013 | 0.016 | 0.005 | 0.011 | 0.010 | 0.004 | 0.012 | 0.010 |
| stdev of baseline seeds(ref) | 0.004 | 0.002 | 0.003 | 0.004 | 0.005 | 0.003 | 0.003 | 0.004 |

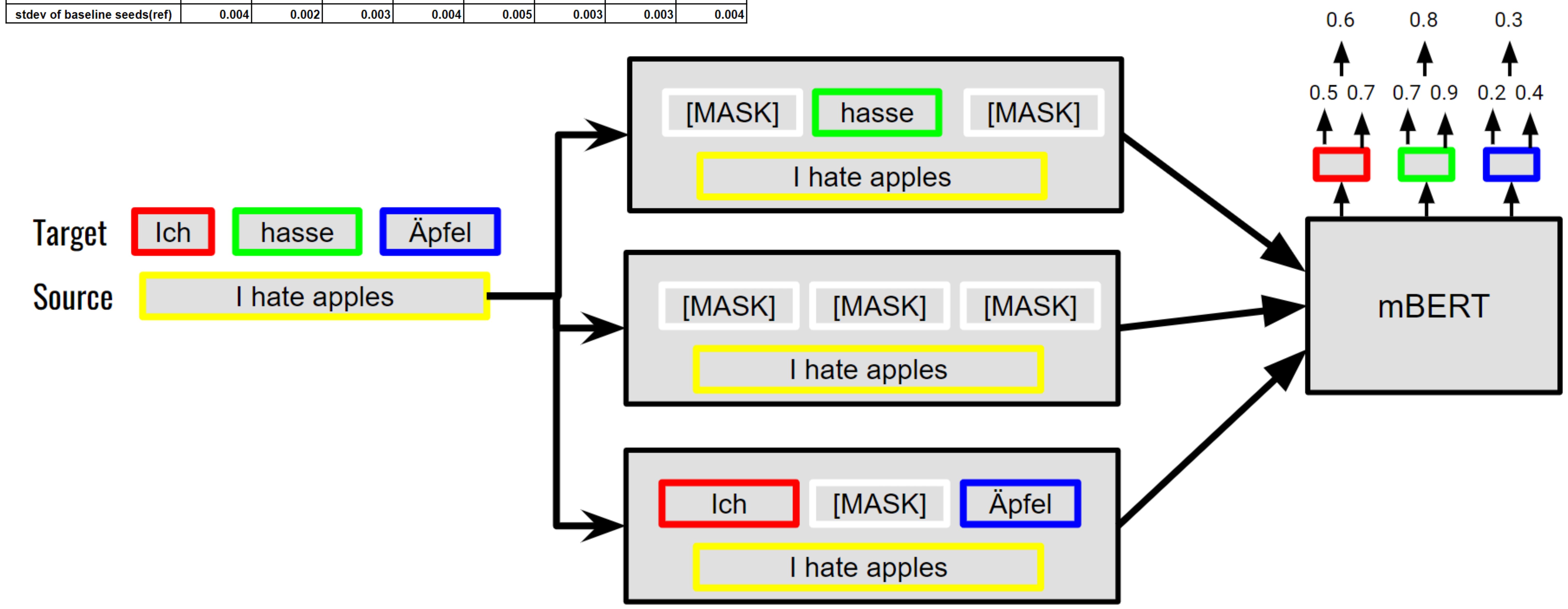
## EVALUATION METRICS



| Label | Prediction | |
|---|---|---|
| | *Bad* | *Ok* |
| *Bad* | 1114 | 1552 |
| *Ok* | 1751 | 14586 |

| **Negative Labels** | | |
|---|---|---|
| *Precision* | *Recall* | *F-Score* |
| 38.9 | 41.8 | 40.3 |

| Metric | Formula |
|---|---|
| Precision-OK | $\frac{TP}{TP+FP}$ |
| Recall-OK | $\frac{TP}{TP+FN}$ |
| Precision-BAD | $\frac{TN}{TN+FN}$ |
| Recall-BAD | $\frac{TN}{TN+FP}$ |
| F1-OK | Precision-OK × Recall-OK |
| F1-BAD | Precision-OK × Recall-OK |
| F1-MUL | F1-OK × F1-BAD |


0.6
0.8
0.3
0.5 0.7
0.7 0.9
0.2 0.4
[MASK]
hasse
[MASK]
I hate apples
Target
Ich
hasse
Äpfel
Source
I hate apples
[MASK]
[MASK]
[MASK]
I hate apples
mBERT
Ich
[MASK]
Äpfel
I hate apples