

# Error Rates

(AI notes)

**WER**, **CER** and **MER** are essential metrics used in the evaluation of speech recognition and natural language processing systems.

From a high level, they each *quantify* the similarity between reference and candidate texts, with zero being a perfect score.

WER, CER - can be infinitely high

MER - between 0 and 1

- **Word Error Rate (WER)**

- is a **fundamental metric** that measures the accuracy of a candidate text by considering three types of errors: substitutions, deletions and insertions.

$$\text{WER} = \frac{\text{Substitutions} + \text{Deletions} + \text{Insertions}}{\# \text{ of Words in Reference}}$$

*Example:*

**Reference:** The bard sang ancient melodies of nature, transforming tranquil meadows into sonnets for enhanced soulful grace.

**Candidate:** The poetic bard echoed ancient melodies, transcending meadows into sonnets for enhanced soulful grace.

Highlighting the **substitution**, **deletion**, and **insertion** errors, we can count each type of error:

The **poetic** bard **echoed** ancient melodies **of nature**, **transcending tranquil** meadows into sonnets for enhanced soulful grace.

In our candidate text, we have 2 substitutions, 3 deletions, and 1 insertion.

- **Character Error Rate (CER)**

- is a **fundamental metric** that measures the accuracy of a candidate text through substitutions, deletions and insertions.
- unlike word-level errors, character-level errors are useful in surfacing mispronunciations and erroneous phonemes.

$$\text{CER} = \frac{\text{Substitutions} + \text{Deletions} + \text{Insertions}}{\# \text{ of Characters in Reference}}$$

*Example:*

**Reference:** The bard sang ancient melodies of nature, transforming tranquil meadows into sonnets for enhanced soulful grace.

**Candidate:** The poetic bard echoed ancient melodies, transcending meadows into enhanced sonnets for soulful grace.

Highlighting the substitution, deletion, and insertion errors, we can count each type of error:

The poetic bard echoed ancient melodies of nature, transcending tranquil meadows into sonnets for enhanced soulful grace.

In our candidate text, we have 13 substitutions, 16 deletions, and 6 insertions.

- **Match Error Rate (MER)**

- places more emphasis on correct matches.
- uses word-level substitutions, deletions and insertions.

$$\text{MER} = \frac{\text{Substitutions} + \text{Deletions} + \text{Insertions}}{\text{Substitutions} + \text{Deletions} + \text{Insertions} + \# \text{ of Correct Matches}}$$

*Example:*

**Reference:** The bard sang ancient melodies of nature, transforming tranquil meadows into sonnets for enhanced soulful grace.

**Candidate:** The poetic bard echoed ancient melodies, transcending meadows into sonnets for enhanced soulful grace.

Highlighting the substitution, deletion, and insertion errors, we can count each type of error:

The poetic bard echoed ancient melodies of nature, transcending tranquil meadows into sonnets for enhanced soulful grace.

In our candidate text, we have 2 substitutions, 3 deletions, and 1 insertion.

## **Bibliography:**

<https://docs.kolena.com/metrics/wer-cer-mer/>