**Machine translation**

Machine translation technology enables the conversion of text or speech from one language to another using computer algorithms.

In fields such as marketing or technology, machine translation enables website localization, enabling businesses to reach wider clientele by translating their websites into multiple languages. Furthermore, it facilitates multilingual customer support, enabling efficient communication between businesses and their international customers. Machine translation is used in language learning platforms to provide learners with translations in real time and improve their understanding of foreign languages. Additionally, these translation services have made it easier for people to communicate across language barriers.

**Machine translation work**

Machine translation works by using advanced [algorithms](https://www.techtarget.com/searchenterpriseai/tip/Types-of-AI-algorithms-and-how-they-work) and machine learning models to automatically translate text or speech from one language to another. Here's how it generally happens:

1. First, the input text or speech is prepared via filtering, cleaning and organizing.

2. Then, the machine translation system is trained using examples of texts in multiple languages and their respective translations.

3. The system learns and analyzes examples to understand patterns and probabilities of how words or phrases are translated.

4. When a new text to translate is inputted, the system uses what it has learned to generate the translated version.

5. After generating the translation, some additional adjustments may be added to refine the results.

## Different approaches to machine translation

Here are some common approaches machine translation uses to translate one text or language into another.

**1. Rule-based machine translation (RBMT).** In rule-based machine translation, linguistic rules and dictionaries are used to generate translations based on established language rules and structures. These rules define how words and phrases in the source language should be transformed into the target language. RBMT requires human experts to create and maintain these rules, which can be time-consuming and challenging. It often performs better for languages with well-defined grammatical rules and less ambiguity and metaphors.

Example: A rule-based translation system might have a rule stating that the word "dog" in English should be translated to "perro" in Spanish.

**2. Statistical machine translation (SMT).** Statistical machine translation involves analyzing vast amounts of bilingual texts to identify patterns and probabilities for accurate translation. Instead of relying on linguistic rules, SMT uses statistical models to determine the most likely translations based on patterns observed in the training data. It aligns source and target language segments to learn translation patterns. SMT works well with larger training data and can handle diverse language pairs.

Example: In SMT, the system might learn that "cat" often appears in the same context as "gato" in parallel bilingual texts, leading to the translation of "cat" as "gato."

**3. Syntax-based machine translation (SBMT).** Syntax-based machine translation takes into account the syntactic structure of sentences to improve translation accuracy. It analyzes the grammatical structure of the source sentence and generates a corresponding structure in the target language. SBMT can capture more complex relationships between words and phrases, allowing for more accurate translations. However, it requires sophisticated parsing techniques and can be computationally expensive.

Example: SBMT learns the syntactic structure of a sentence and ensures that the subject and verb agreement is maintained in the translation for a more grammatically accurate output.

**4. Neural machine translation (NMT).** Neural machine translation utilizes deep learning models, particularly sequence-to-sequence models or [transformer models](https://www.techtarget.com/searchenterpriseai/definition/transformer-model), to learn translation patterns from training data. NMT learns to generate translations by processing the entire sentence, considering the context and dependencies between words. It has demonstrated significant improvements in translation quality and fluency. NMT can handle long-range dependencies and produce more natural-sounding translations.

Example: NMT takes an input sentence like "The cat is sleeping" and generates a translation like "El gato está durmiendo" in Spanish, capturing the context and idiomatic expression accurately.

**5. Hybrid machine translation (HMT).** Hybrid machine translation may incorporate rule-based, statistical and neural components to enhance translation quality. For example, a hybrid system might use rule-based methods for handling specific linguistic phenomena, statistical models for general translation patterns, and neural models for generating fluent and contextually aware translations.

Example: A hybrid system could use a rule-based approach for handling grammatical rules, statistical models for common phrases, and a neural model to generate fluent translations with improved context understanding.

**6. Example-based machine translation (EBMT).** Example-based machine translation relies on a database of previously translated sentences or phrases to generate translations. It searches for similar examples in the database and retrieves the most relevant translations. EBMT is useful when dealing with specific domains or highly repetitive texts but may struggle with unseen or creative language usage.

Example: If the sentence, "The cat is playing," has been previously translated as "El gato está jugando," EBMT can retrieve that translation as a reference to translate a new sentence, "The cat is eating."