

NLP and its application

- NLP is the set of methods for making human language accessible to computers.
- NLP is focused on the design and analysis of computational algorithms and representations for processing natural human language.
- Application examples: Automatic machine translation, spam/non-spam email classification, dialog systems, extracting information from texts, translating between languages, answering questions, holding a conversation, taking instructions



Themes and perspectives in NLP:

- 1. Learning and knowledge
- 2. Search and learning
- 3. Relational, compositional and distributional perspectives



NLP - Learning and Knowledge Perspective:

Using ML to...

Train **end-to-end systems** that transmute **raw text** into **output structure** like a **summary**, database, or translation.

Provide compositional Sentence organization \rightarrow ex: meaning of larger units gradually constructed from the meaning of their smaller constituents.

Using ML for...

Transforming **text** into a stack of general-purpose **linguistic structures**:

From **subword units** called morphemes:

- 1. to word-level parts-of-speech
- 2. to tree-structured representations of grammar
- 3. to logic-based representations of meaning.

Supervised ML systems can...

make use of features or methods like stemming, parsing, part-of-speech tagging

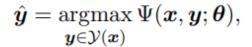


Combination of knowledge and Machine Learning in NLP

Search and Learning Perspective

- Looking at NLP problems from mathematical point of view, with two distinct modules as Search and Learning.
- Search module: This module <u>finds the output y</u> that gets the best score with respect to the **input x**. Because the outputs are usually discrete in NLP problems, it relies on combinatorial optimization.
- Learning module: This module is responsible for <u>finding the</u> parameters θ. Because the parameters are usually continuous, learning algorithms generally rely on numerical optimization.

Much of the work of NLP \rightarrow the design of the model Ψ



Machine learning

$\Psi(oldsymbol{x}^{(i)},y)$	the score for assigning label y to instance i
$oldsymbol{f}(oldsymbol{x}^{(i)},y)$	the feature vector for instance i with label y
$oldsymbol{ heta}$	a (column) vector of weights



Relational & Compositional Perspective

- The relational, compositional, and distributional perspectives all contribute to our understanding of linguistic meaning.
- The Relational perspective on meaning is the basis for semantic ontologies such as WORDNET → the relations that hold between words and other elementary semantic units.
- Compositional perspective : The meaning of a word is constructed from the constituent parts (journalists → journalist, journal → jour).
 This principle can be applied to larger units: phrases, sentences, and beyond