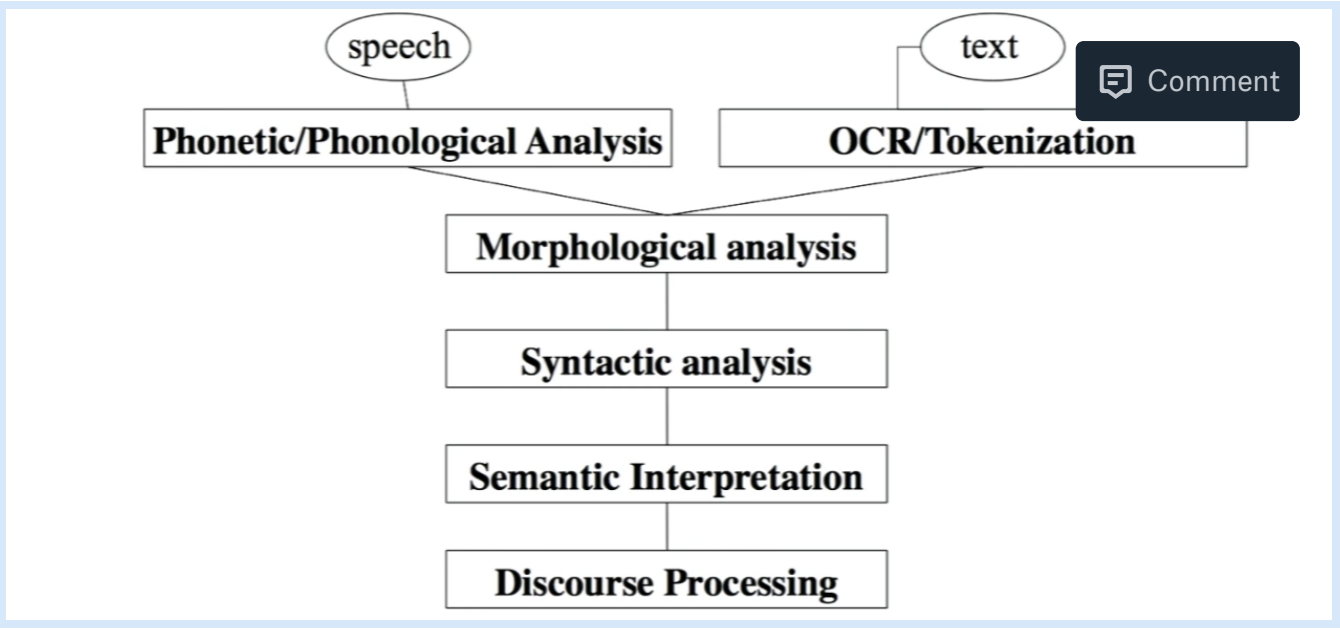
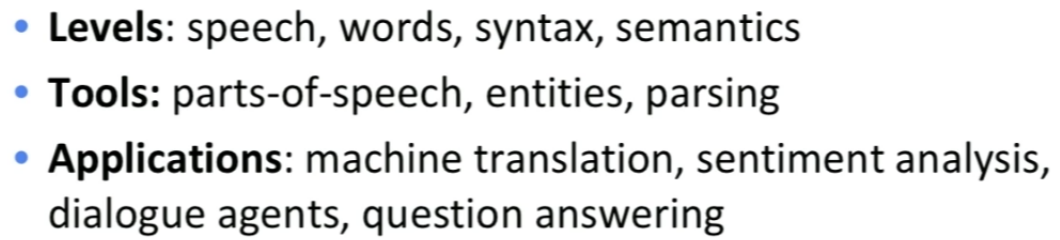
# introduction

- NLP = computer science + linguistics + ai/ml
- the big tech companies are all interested in nlp powered language assistants → mobile has blown up the availability of language data and the need for good language based assistants
- parts of NLP




  - the first step is extracting the words from either speech or text.
  - next is analyzing what each word is like incomprehensible means the opposite of comprehensible
  - next is analysis of what part of the sentence each word forms and part of speech tagging etc
  - next is semantic interpretation of the meaning of the sentence
  - and then semantic understanding of the paragraph/the whole text
- some common nlp tasks:
  - auto completion that understands the context to suggest next words
  - speech to text (speech recognition)
  - machine translation
  - grammatical correction
  - question answering from a given set of wiki + google drive + email + wikipedia + other documents
  - extracting information like address, phone number, product details, pricing etc from text
  - chatbots and google assistant like things
- under the hood, language is really symbols for feelings and concepts and things and happenings. so language = symbols with meaning.
- notice how this symbol system is discrete. most combinations of letters don't mean anything really. but our brains have continuous activations so there is some transformation there that seems valuable for language understanding.
- also children pick up these symbol meanings quite quickly so seems like something is working out really well in children's brains, maybe priors?

- so what is with this continuous signal in the speaker's mind → discrete symbol → continuous in the listener's mind
- up until the dawn of deep learning in NLP, NLP systems were built with hand designed features. engineer would get together to try to solve a specific problem and hypothesize what set of features would be important for a given problem, they would write code to extract those features from text and feed that into some kind of decision tree, random forest, logistic regression or SVM model. over time they would see what worked well.
- this is how google search worked for a while → they would introduce new "signals" that were essentially new features.
- in other words, the right features and feature extraction was a large part of the puzzle, in addition to the right model.
- deep learning is more about learning the right representations from large amounts of raw data or from good pre-trained priors or both.
- so instead of humans deciding what features are important, in deep learning, we let the computer decide the right representations to learn based on giving it some loss signal
- why do learnt representations work a lot better than hand designed features?
  - may the hand designed features are incomplete information
  - learnt features are flexible and adaptable for the task (or family of tasks) while being easy to learn
- "in the length of my life time, I haven't seen a field progress this rapidly in terms of being able to do new things month over month"
- but a lot of techniques aren't new: they were invented in 80s and 90s. so why now?
  - GPUs and hardware
  - more data
  - a lot more people working on these problems have progressed the algorithms and models too
- the first big breakthrough was of deep learning in NLP was in speech recognition
- A lot of speech recognition before deep learning was gaussian mixture models:
  - A Gaussian mixture model is a probabilistic model that assumes all the data points are generated from a mixture of a finite number of Gaussian distributions with unknown parameters.
  - the first breakthroughs were in deep learning for speech recognition were ~2010 in geoff hinton's group.
- why is nlp hard:
  - natural language is ambiguous and contextual!
  - in order to be efficient at communicating, human's leave out a lot of things or communicate by body language, tone and voice modulation
  - "I could care less" when you actually mean "I couldn't care less"
  - "The Pope's baby steps on gays" → is it the pope's baby or about baby steps?
  - "Boy paralyzed after tumor fights back to win black belt"
- from lower level to higher level



- the interesting thing about the above levels is that the same set of key principles and techniques in deep learning have been applied to tasks across these levels