

# coreference resolution

- The task is to identify the nouns that mentions each mention refers to. Mentions could be pr-nouns but also could be nouns. basically the output of this must be a hashmap mapping each entity's mention to an entity ID (de-duped)
- Example, look at all the entities here

A couple of years later, Vanaja met Akhila at the local park. Akhila's son Prajwal was just two months younger than her son Akash, and they went to the same school. For the pre-school play, Prajwal was chosen for the lead role of the naughty child Lord Krishna. Akash was to be a tree. She resigned herself to make Akash the best tree that anybody had ever seen. She bought him a brown T-shirt and brown trousers to represent the tree trunk. Then she made a large cardboard cutout of a tree's foliage, with a circular opening in the middle for Akash's face. She attached red balls to it to represent fruits. It truly was the

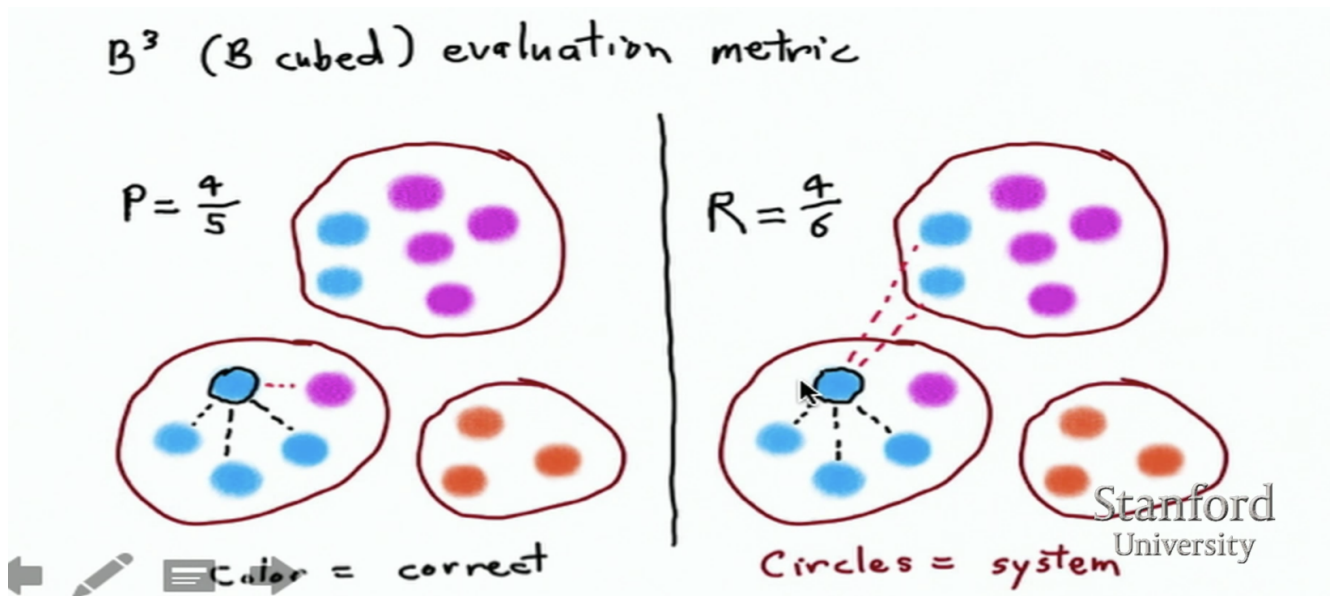
- Note that some pronouns like "they" could also be referring to two or more people/entities.
- People have constructed datasets for coreference resolution with labels of what each entity/entities each mention points to.
- Two words are said to be co-referent if they refer to the same entity.
- Applications of coreference resolution




## Applications

- Full text understanding:
  - understanding an extended discourse
- Machine translation (if languages have different features of gender, number, etc.)
- Text summarization, including things like web snippets
- Tasks like information extraction and question answering
  - Correctly answering often involves resolving anaphora
  - *He married Claudia Ross in 1971.*

- How do we measure accuracy of coref systems? with something like precision and recall (is this thing I classified as this entity actually this entity? how many of the things that are this entity in fact classified as kthis entity?)



- Kinds of references

 **Kinds of Reference**

- Referring expressions
  - John Smith*
  - President Smith*
  - the president*
  - the company's new executive*
- Free variables
  - Smith saw *his* pay increase
- Bound variables
  - The dancer hurt *herself*.

More common in newswire, generally harder in practice

More interesting grammatical constraints, more linguistic theory, easier in practice

"anaphora resolution"

Stanford

- Kinds of mentions: coreference, anaphor, cataphor (opposite of anaphor → comes after)



## Coreference, anaphors, cataphors

- Coreference is when two mentions refer to the same entity in the world
  - The relation of anaphora is when a term (anaphor) refers to another term (antecedent) and the interpretation of the anaphor is in some way determined by the interpretation of the antecedent  
... and traditionally the antecedent came first
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- There was a popular very mechanistic rule based algorithm for coreference resolution called Hobb's algorithm. It involves constructing parse trees and when you find a mention, you traverse up and down the branches of a tree following some rules etc. Bunch of heuristics. Manning doesn't go into the details on this → not used anymore
  - what work has been done in deep learning with coreference resolution? not much. grand total of 4 known papers.
  - one approach with neural coreference resolution is to take a dataset of sentences where each mention gives a score to every other word in the sentence or a new reference. this score is the likelihood (goodness) of that mention referring to each of the words. people have used a straightforward feedforward neural network to this. doesn't work super well but its one of the few works we have now.
  - one of the few other works in this field is to use deep RL here. why deep RL? because they frame the problem as reading the sentence sequentially and assigning each mention to a word as an action. at the end of the sentence (episode) you want to have maximized the score you got. which deep RL algorithm? we can start with REINFORCE and apply some of the improvements to policy gradient methods that have been worked on (see deep RL notes)