



Node-and-Edge Graphs

GC

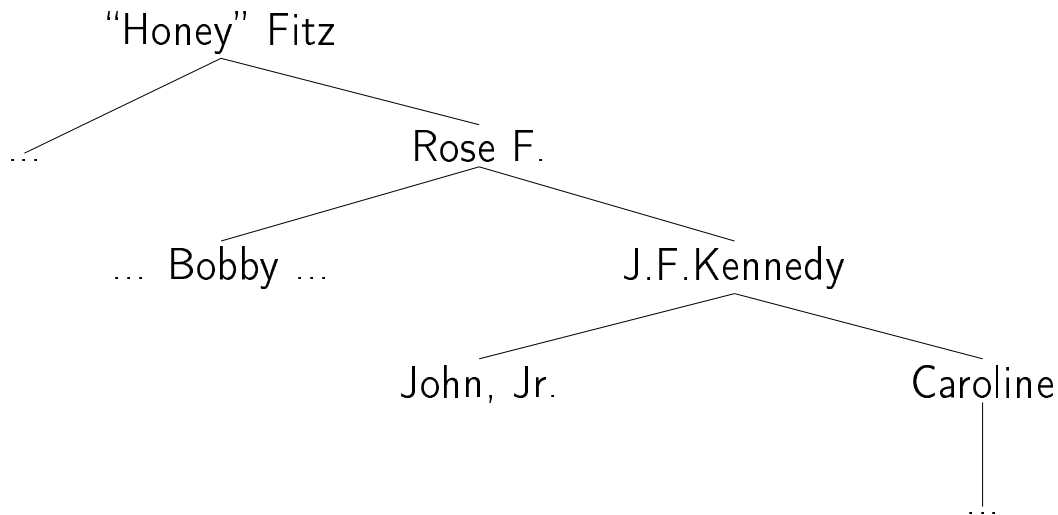
Motivation: effective information transmission

- family trees
 - terminology
 - individuals
 - species
 - languages, etc.
- hierarchical structures
 - syntactic structure
 - directories in file systems
- classification
 - dualism: properties/individuals
 - decision trees
- chemical structure — beyond trees!
- schematic maps
- state diagrams



Family Tree

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'Caroline' was a CHILD-OF JFK

Honey Fitz was a PARENT-OF Rose F.

NODES represent people, and are connected by EDGES which represent relation 'child-of'

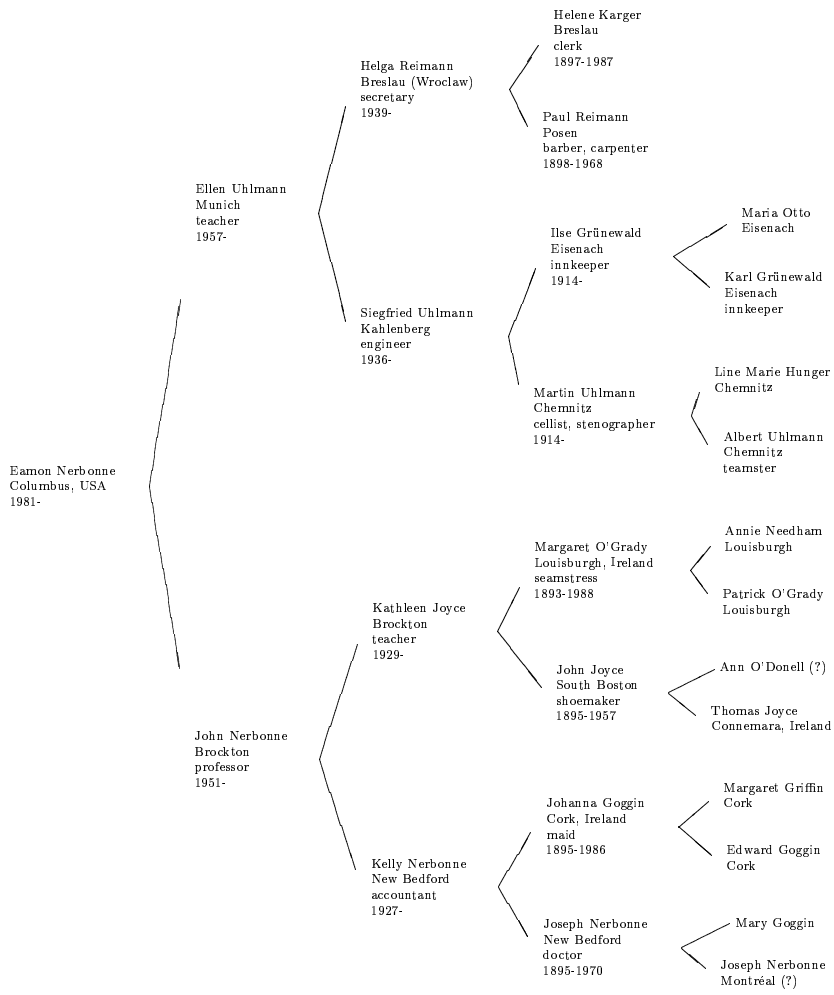
Terminology	child-of	daughter	son
	parent-of	mother	father

linguists prefer feminine terminology



Family Trees

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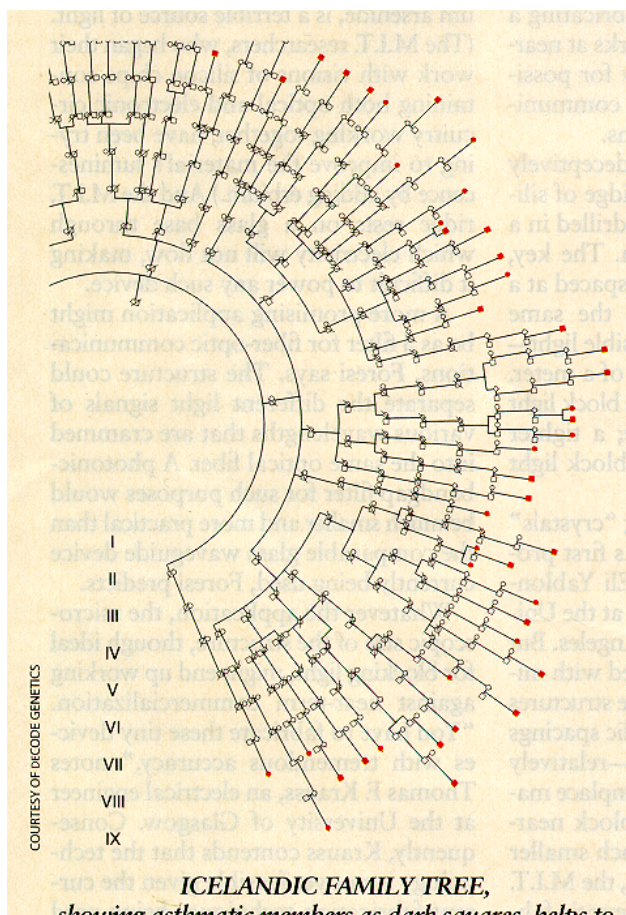


Family Trees

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- single descendant, many ancestors **vs.** single ancestor, many descendants
- left-right vs. top-down orientation
- simple vs. decorated nodes

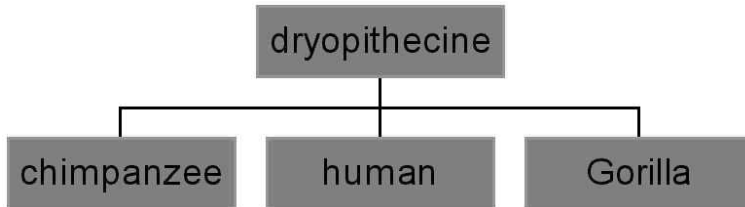
often used to inspect genetic relations (red → asthmatic)



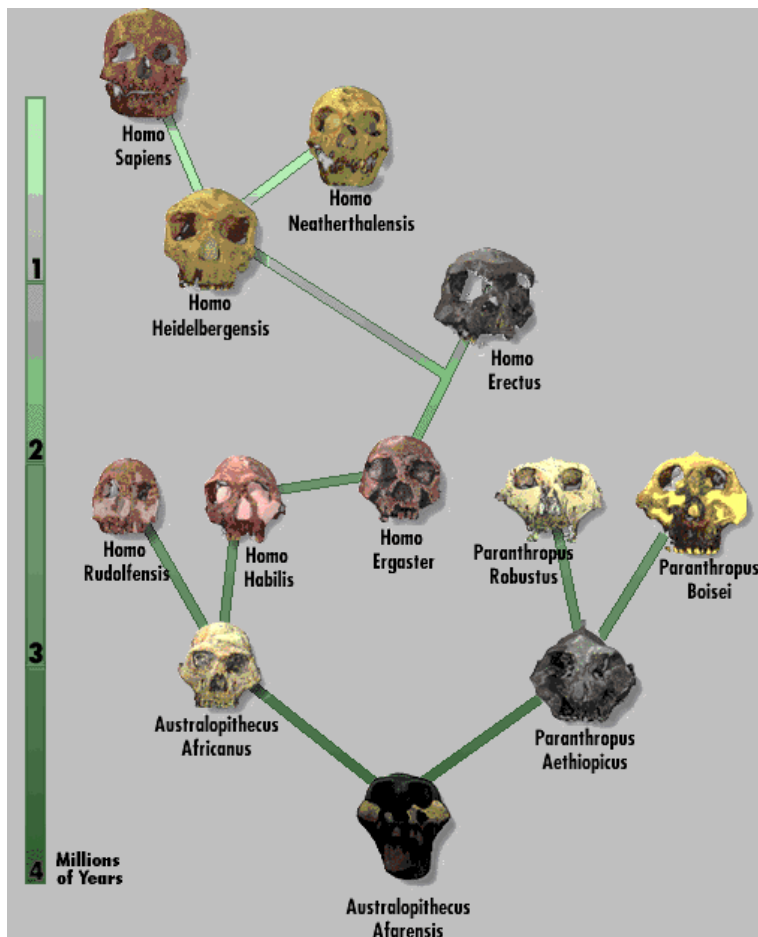


Biological Evolution

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humans, chimpanzees and gorillas have common ancestor
visual display differs, but it's still nodes connected by edges



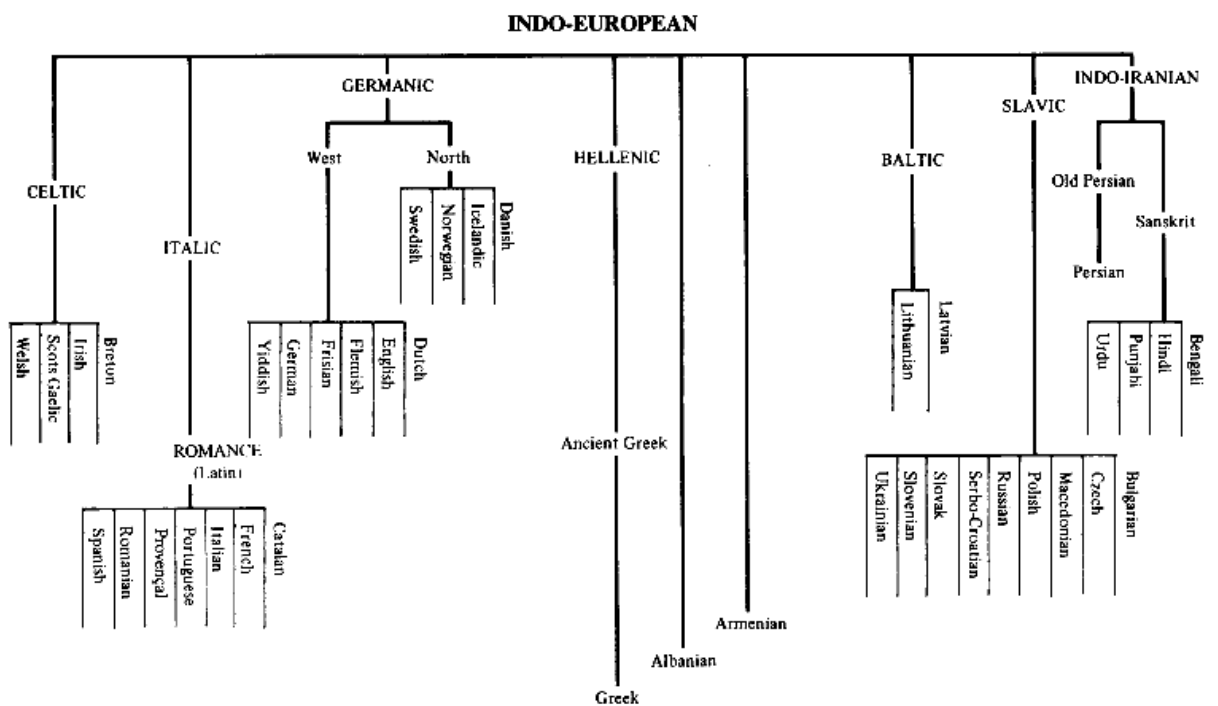


Family Trees

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easily extended to include evolutionary views

child-of → directly-descended from



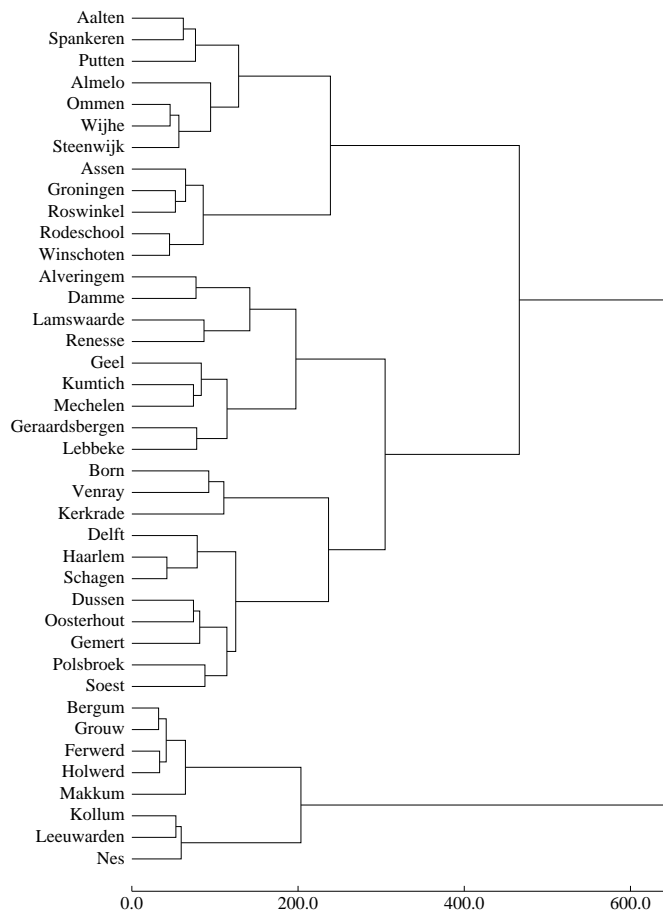
Dutch is descended from West-Germanic, which is descended from Germanic, which is descended from Indo-European



Dendrogram

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trees can also be used to show the results of clustering nearest elements. What's the difference?



introduced in section on maps



Phrase Structure

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Phrase Structure (Constituent Structure)

—hierarchical grouping of words

constituent: a group of words which functions as a unit (in a phrase or sentence)

example:

The puppy kept putting my slippers behind the couch

Compare, e.g.,

- *putting my*
- *slippers behind*



Constituents

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Indications

- constituents can stand alone

My slippers!

compare: **putting my!* or **slippers behind!*

- constituents mean something
- constituents can be questioned

– *What does the puppy keep putting behind the couch?*

- constituents can be conjoined

The puppy keeps putting my slippers and the paper behind ...

**The puppy keeps putting my and hiding your slippers behind ...*

N.b. some nonconstituents also conjoin:

He's going to New York on Monday and Boston on Tuesday

- constituents reappear in related constructions

– *The slippers keep getting put behind the couch.*

– *It's the slippers that the puppy keeps putting behind the couch.*

– *The slippers are likely to be put behind the couch.*

– *Jo saw the puppy put the slippers behind the couch.*



Notes on Constituents

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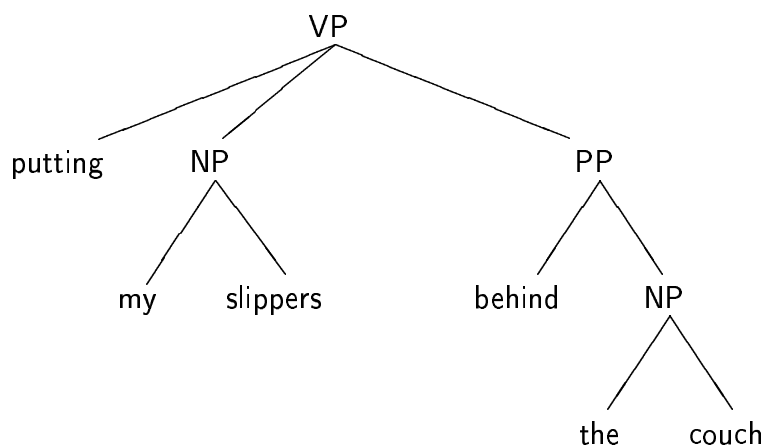
Two remarks:

- constituents are relative to (syntactic) context

constituent?	sentence
yes	<u>Tom and Mary</u> left.
no	Sue saw <u>Tom, and Mary</u> left.

- hierarchical structure arises naturally
constituents may themselves have constituents
example: *the couch* is a constituent of *behind the couch*, which is itself a constituent

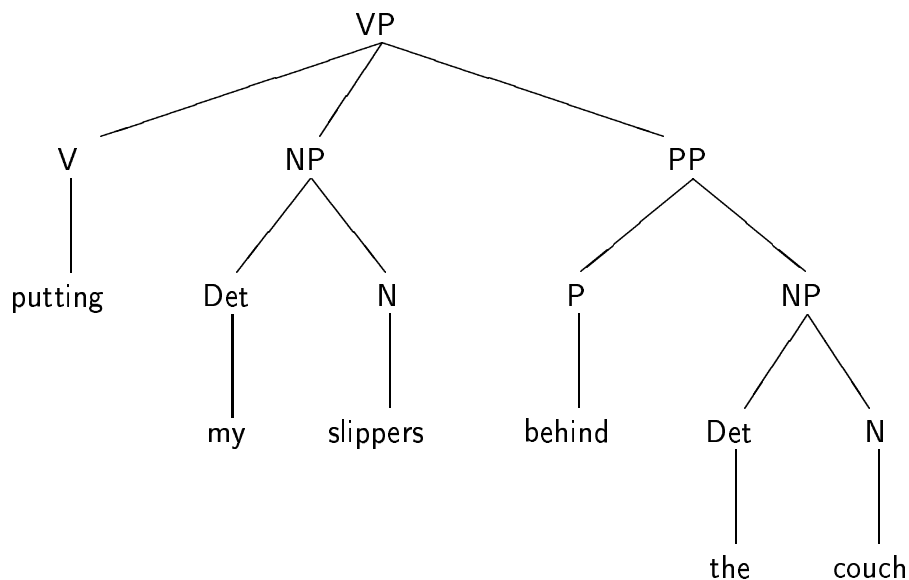
[putting [my slippers] [behind [the couch]]]





More Informative Trees

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Notes

- syntactic category on words—V, Det, N, P, etc.
“Parts-of-Speech” POS (Baker, *Intro to Syntax*, p.39)
- common alternatives, e.g.,

Det	Art, PossDet, Quant
V	Vsg, Vpl, V _{part} , ...
- constituent structure same
interpretation of edges from POS to word different
(≠ ‘has as part’)



Syntactic Heads

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linguists distinguish

internal properties how the phrase is made up: its constituents and its structure (Baker, p.38) **vs.**

external properties how the phrase combines with others

The person { wants to go out
* eager to go out
* proponents of going out

—only phrase based on verbs combine with subjects to form sentences

head of a phrase: the word which determines the external properties of the phrase

verb	Verb Phrase, VP
noun	Noun Phrase, NP
preposition	Prepositional Phrase, PP
adjective	Adjective Phrase, AP



“Features”, Other Properties

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important properties extend beyond ‘category’
particular head properties may be important to external syntax, e.g.
on verbs:

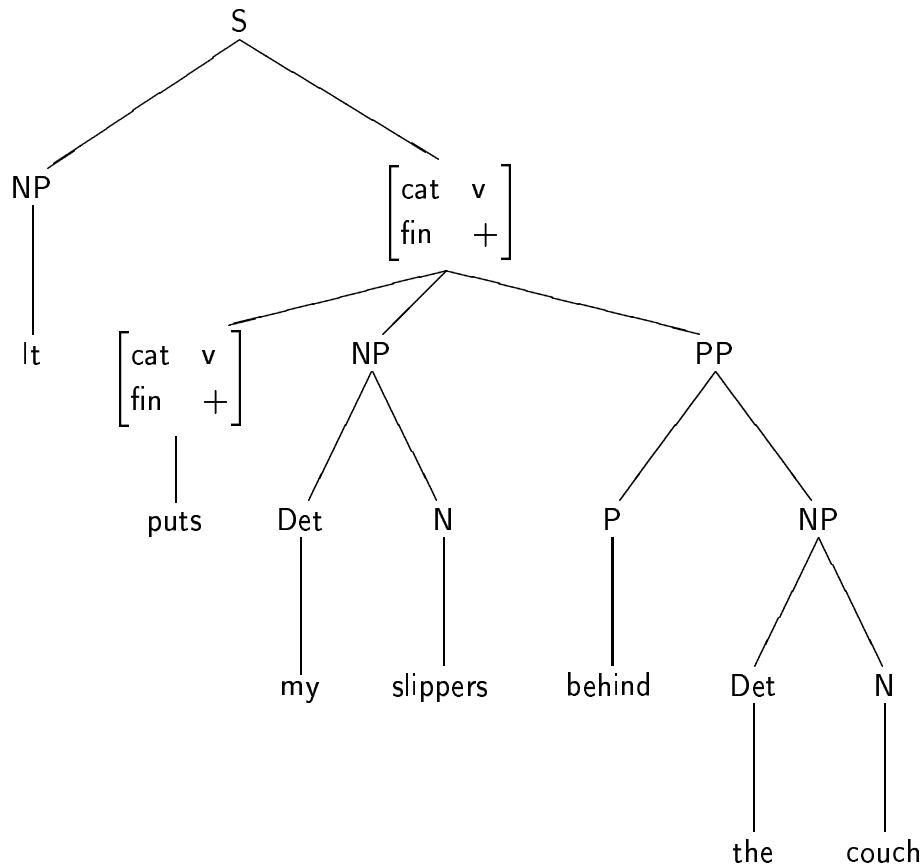
finite vs. nonfinite	He leaves He left * He leave (Tom made him leave)
bare infinitive vs. <i>to</i> -infinitive	Tom made him leave Tom forced him to leave
pres. vs. past part	Tom kept her waiting Tom had her served

linguistic theories nearly all agree that these properties are important for external syntax, and that they are basically **lexical** (determined by words, not phrases).



Noting Heads on Trees

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- external syntax includes category 'verb' (V), finiteness
—important in using VP's to make S's
- finiteness is expressed on head **word**, shared by phrase

assumption: prefer rules that don't refer to internal structure



“Displaced” Complements

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- tree structure works well for strict hierarchy
 - no overlap in “part-of” relation
- but linguists are agreed that syntax has more complicated elements

Tom asked what the dog put there

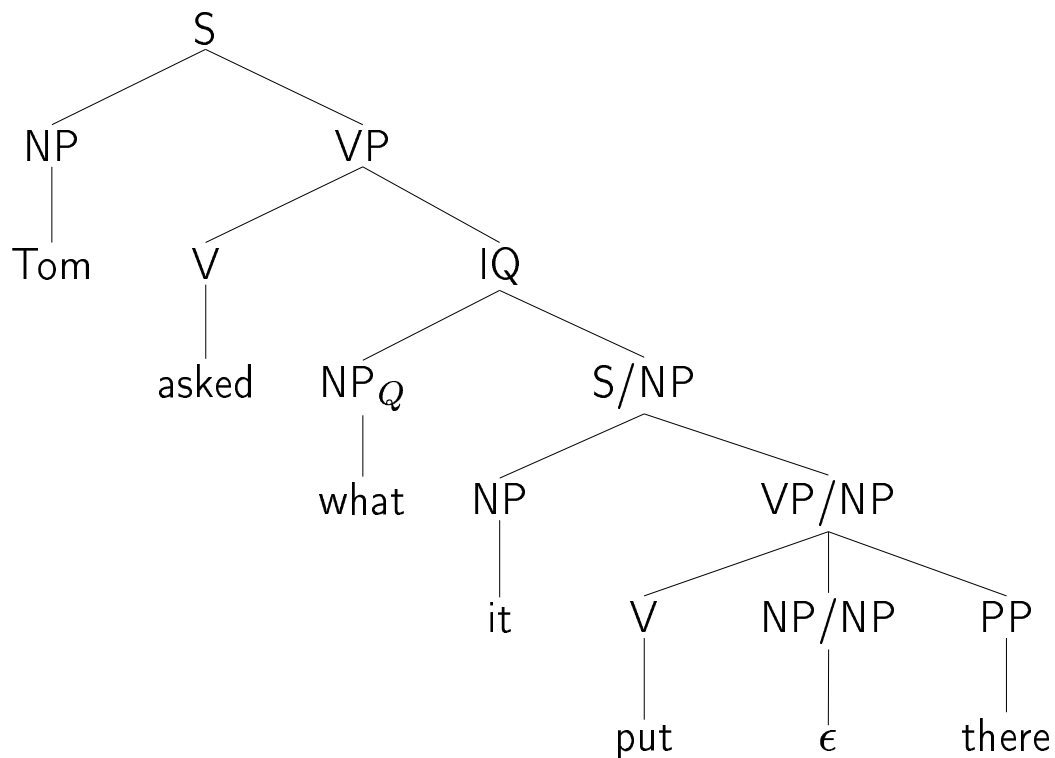
what is the direct object of the verb *put*, and must also be first (question) word in the subordinate clause

- overlap in “part-of” relation!



Graphing “Displacement”

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analyses controversial, but they agree on:

- need to show relation between indirect questions and other embedded clauses
- constituent structure shown (roughly)
- relation between “trace” (ϵ) and NP_Q



Analysis of “Displacement”

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Two general kinds

movement analyses material which surfaces in NP_Q originates in object position, and is moved by a “transformational rule”

a transformational rule doesn't describe a pattern within a single tree, but rather deforms one tree into another

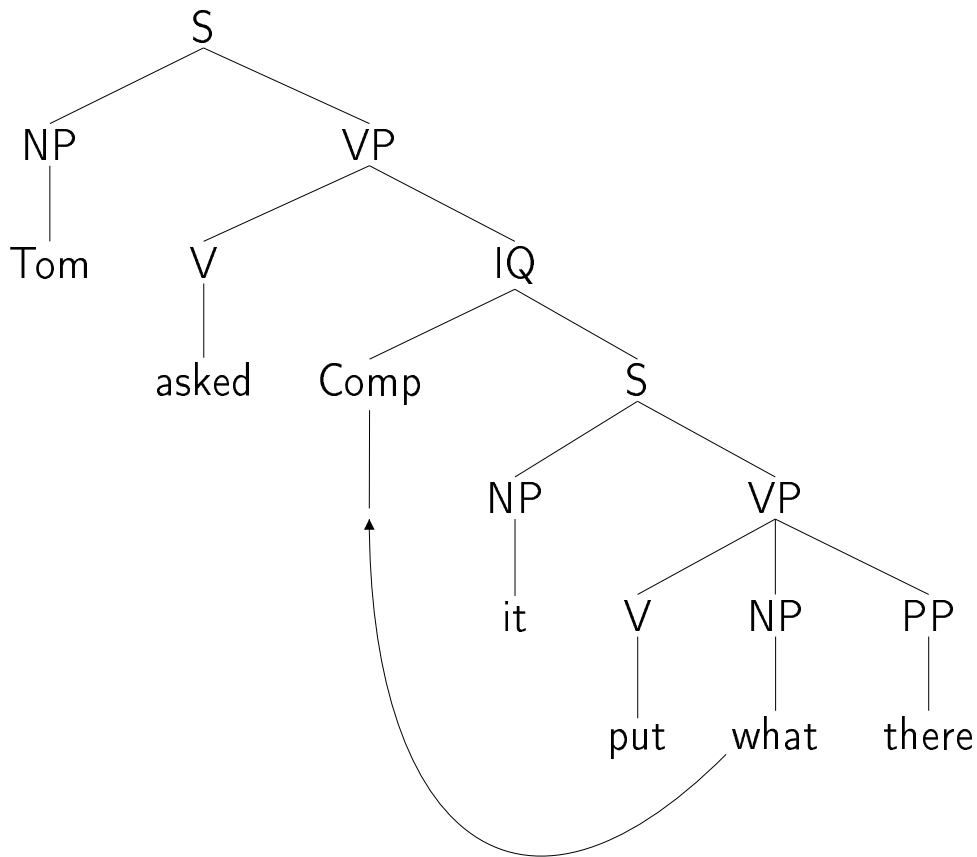
static analyses more complicated tree patterns

- gaps may occur
- if gap occurs, this information is available externally just as information about heads is
- special pattern combines “fillers” and gappy constituents



Movement Analysis

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note that the curved line may not have the same status as the “daughter-of” edge

if the status is the same, then the graph is no longer a *tree*, but rather, a DIRECTED, ACYCLIC GRAPH (DAG).

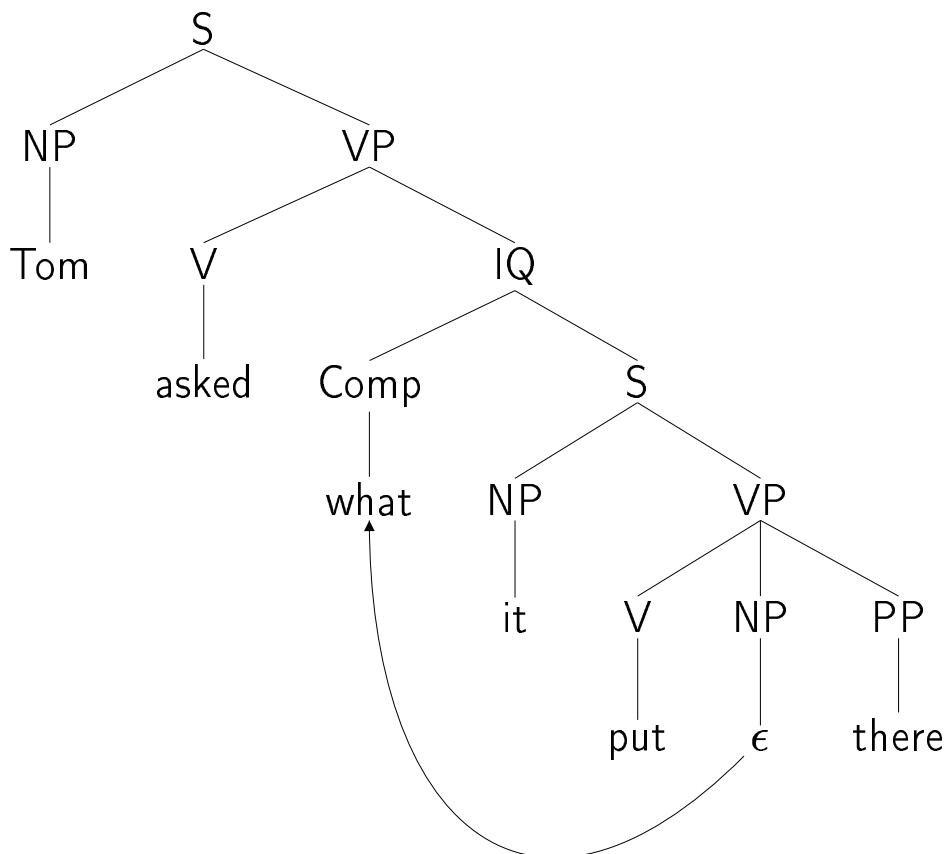
i.e., there is one node (daughter of Comp) which more than one mother points to



“Displaced” Complements

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Movement Analysis is sketched in different ways.



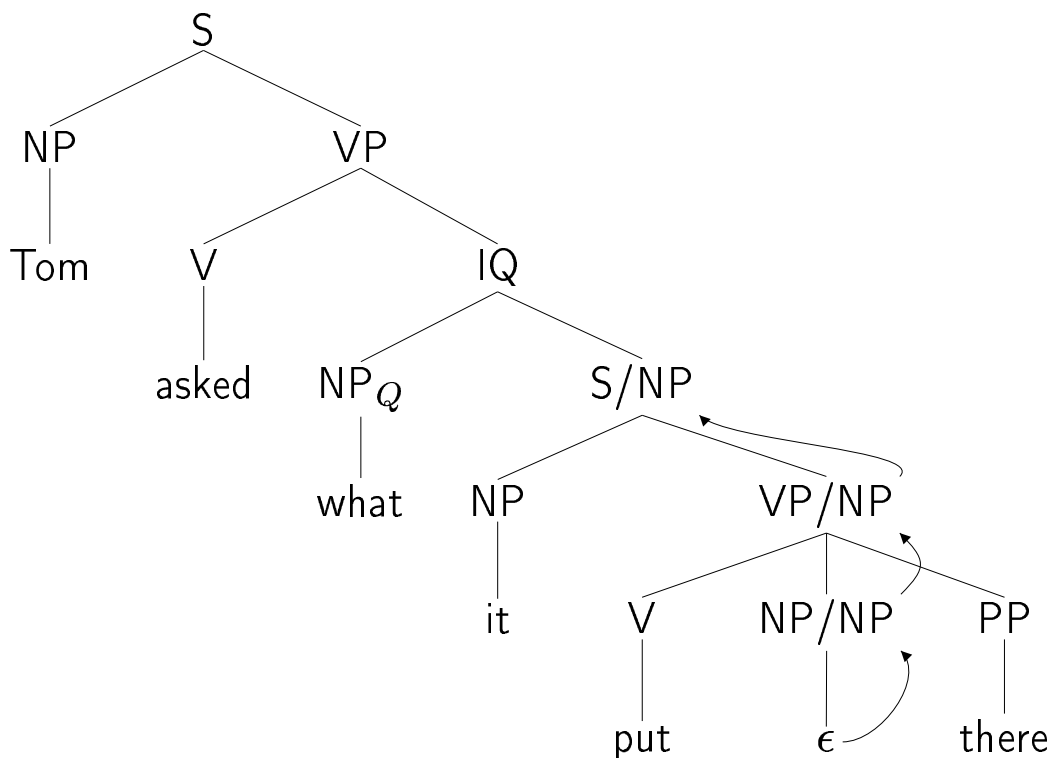
the object of *put* is MOVED to the beginning of the indirect question



Static Analysis

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Local patterns allow gaps to occur, treat information as external:



the curved lines do *not* have the same meaning as the daughter edges,

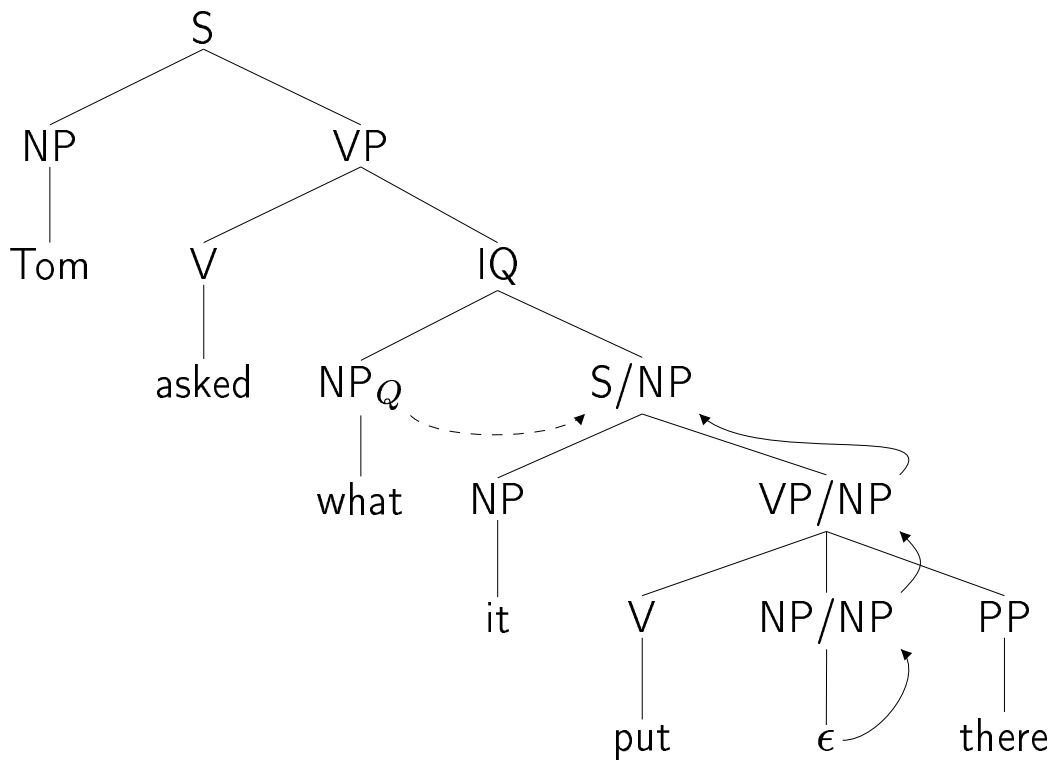
- not “part-of” in the full sense
- indicate source of external information



Static Analysis, II

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special pattern combines “fillers” and gappy constituents



the dotted curve indicates a relation between the NP_Q node and the “missing” NP



Syntax Trees

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- nearly universal representation
- nonetheless varying in meaning
- insufficient in pure form for representing the structure of “shared” information, e.g.,
 - features shared by phrases and heads
 - displaced constituentsrepresentation felt as so useful if continues, with “patches”