

anaphor resolution

pragmatics

summer 09

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15 July 09

Slides based on Ivana Kruijff-Korbayova's (UdS), Carloline Sporleder's (UdS), Andrew Rosenberg's (Columbia)

anaphor resolution

Truman and Cooper walk down the hallway and speak with Ed whose head is hurting from the previous night's fight.

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Who explains?

Who thinks?

Who drugged whom?

anaphor resolution

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anaphor resolution

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anaphor resolution

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The UN Ambassador offers **her** a job but **she** declines (**it**).

Who offers a job to whom?

(What is declined?)

anaphor resolution

BERLIN (Reuters) - A badger in Germany got so drunk on over-ripe cherries it staggered into the middle of a road and refused to budge, police said on Wednesday.

A motorist called police near the central town of Goslar to report a dead badger on a road – only for officers to turn up and discover the animal alive and well, but drunk.

Police discovered the nocturnal beast had eaten cherries from a nearby tree which had turned to alcohol and given the badger diarrhoea. Having failed to scare the animal away, officers eventually chased it from the road with a broom.

Reuters UK, Wed Jul 8, 2009 6:51pm BST

anaphor resolution

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pronouns

nouns

noun phrases

named entities, ...

anaphor resolution

referring expressions refer to entities

(pronouns, nouns, noun phrases, named entities;

the UN Ambassador, the hallway, a secretary, a badger, the animal, the nocturnal beast, it, ...)

anaphor resolution

anaphora/cataphora: belong to **indexical phenomena** (also includes deixis)
which involve referring to entities (outside of the linguistic realm
of sentences)

anaphor: an instance of an expression which refers to another expression

antecedent: the expression to which an anaphor refers

anaphor resolution

the relation of **coreference** is said to hold between two (noun) phrases if they „refer to the same entity”

NPs α and β corefer if $\text{ref}(\alpha) = \text{ref}(\beta)$

anaphor resolution

the relation of **coreference** is said to hold between two (noun) phrases if they „refer to the same entity”

NPs α and β corefer if $\text{ref}(\alpha) = \text{ref}(\beta)$

equivalence relation (symmetrical, transitive and reflexive)
partitions NPs into a set of equivalence classes

coreference chain: a set of coreferring expressions
in an equivalence class

anaphor resolution

coreference vs. anaphora:

cross-document coreference → not anaphoric

anaphor and antecedents doesn't have to be coreferent

anaphor resolution

coreference vs. anaphora:

cross-document coreference → not anaphoric

anaphor and antecedents doesn't have to be coreferent

(e.g. Everybody should mind his own business)

anaphor resolution

problems

different form doesn't mean different referent

(badger, the animal, the nocturnal beast)

anaphor resolution

problems

different form doesn't mean different referent

(badger, the animal, the nocturnal beast)

same form doesn't mean same referent

(Madonna...)

anaphor resolution

what factors play a role?

anaphor resolution

what factors play a role?

syntax

agreement: gender, number, person, case

syntactic parallelism

syntactic role

selectional restrictions

anaphor resolution

what factors play a role?

syntax

agreement: gender, number, person, case

syntactic parallelism

syntactic role

selectional restrictions

Jane told **Peter** **he** was in danger

Peter told John that he hates **himself** for what he did

The cat sat on the mat. **It** was scared.

anaphor resolution

what factors play a role?

syntax

agreement: gender, number, person, case

syntactic parallelism

syntactic role

selectional restrictions

lexical factors

type of reference: inferable, discontinuous set, generic, one anaphora, pronouns, etc.

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verb semantics, thematic role, semantic parallelism

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semantic

verb semantics, thematic role, semantic parallelism

The city council denied the demonstrators a permit because they feared violence.

The city council denied the demonstrators a permit because they advocated violence

anaphor resolution

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verb semantics, thematic role, semantic parallelism

prosodic

Jane told **Mary SHE** was in danger.

anaphor resolution

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syntactic role

selectional restrictions

lexical factors

type of reference: inferable, discontinuous set, generic, one anaphora, pronouns, etc.

semantic

verb semantics, thematic role, semantic parallelism

prosodic

discourse

recency, topic/focus structure, digression, repeated mention

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pragmatic/world knowledge

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recency, topic/focus structure, digression, repeated mention

pragmatic/world knowledge

Tony Blair met **President Yeltsin**. **The old man** had just recovered from a heart attack.

anaphor resolution

what factors play a role?

syntax

agreement: gender, number, person, case

syntactic parallelism

syntactical role

selectional restrictions

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type of reference: inferable, discontinuous set, generic, one anaphora, pronouns, etc.

semantic

verb semantics, thematic role, semantic parallelism

prosodic

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recency, topic/focus structure, digression, repeated mention

pragmatic/world knowledge

are these **constraints** or **preferences**?

anaphor resolution

computational anaphor resolution

research question:

given these types of factors, can we construct an algorithm that will compute and apply the information, so that the correct referents of anaphors and other referring expressions can be found?

anaphor resolution

computational anaphor resolution

research question:

given these types of factors, can we construct an algorithm that will compute and apply the information, so that the correct referents of anaphors and other referring expressions can be found?

which factors/features can/should be used?

how should they be ordered? (i.e., which override which?)

what should be stored in the discourse model?

(i.e., what information do we need to keep track of?)

how to evaluate?

anaphor resolution

three examples of computational algorithms

Hobbs 78: syntax tree-based referential search

Lappin & Leas 94: weighting via recency and syntactic preferences

Grosz, Joshi, Weinstein 95: centering (other discourse-based searches)

anaphor resolution

Hobbs: syntax-based reference resolution

→ search for the antecedent in the parse tree of current sentence,
then prior sentences in order of recency

resolution algorithm outline

for current S,

search for NP nodes to the left of a path **p** from the pronoun
up to the first NP or S node (**X**) above it L2R, breadth-first

propose as antecedent any NP you find
as long as it has an NP or S node between itself and **X**

if **X** is highest node in sentence, search prior sentences, L2R breadth-first
otherwise, continue searching current tree by going to next S or NP above **X**
before going to prior sentences

anaphor resolution

Hobbs: syntax-based reference resolution

→ search for the antecedent in the parse tree of current sentence,
then prior sentences in order of recency

resolution algorithm in detail

for current S,

Step 1: start at NP node immediately dominating pronoun

Step 2: up to the first NP or S node above it L2R, breadth-first, call the node X

Step 3: search for NP nodes to the left of a path p from the pronoun
propose as antecedent any NP you find as long as it has
an NP or S node between itself and X

Step 4: if X is highest node in sentence, search prior sentences, L2R breadth-first;
if X is not highest node, goto 5

Step 5: from X go up to first NP or S, now call the new one X and the path to traverse it p

Step 6: if X is an NP and if path to it didn't pass through the N' (N-bar) node that it immediately dominates,
propose X as antecedent

Step 7: traverse all branches below X to the left of p L2R, breath-first
propose any found NP as antecedent

Step 8: if X is an S, traverse all its branches to the right of p L2R breadth-first, but don't step down below any
NP or S, propose any found NP as antecedent

Step 9: goto 4

anaphor resolution

Lappin & Leass: syntax + recency

weight candidates by recency (**salience**) and syntactic preference (86% accuracy)

dynamically updated discourse model

when an NP that evokes a new entity is found in the text,
compute the salience of this entity for future resolution

consider the candidate's salience value in deciding coreference

anaphor resolution

Lappin & Leass: syntax + recency

how to decide about salience?

anaphor resolution

Lappin & Leass: syntax + recency

how to decide about salience?

sentence recency (in current sentence?)

subject emphasis (is subject?)

existential emphasis (is part of existential construction?)

accusative emphasis (is direct object?)

indirect object/oblique

non-adverbial emphasis (not in PP)

head noun emphasis (is head noun?)

anaphor resolution

Lappin & Leass: syntax + recency

how to decide about salience?

sentence recency (in current sentence?)	100
subject emphasis (is subject?)	80
existential emphasis (is part of existential construction?)	70
accusative emphasis (is direct object?)	50
indirect object/oblique	40
non-adverbial emphasis (not in PP)	50
head noun emphasis (is head noun?)	80

anaphor resolution

Lappin & Leass: syntax + recency

implicit ordering of arguments:

subject > existential > object > indirect obj-oblique > demonstr-adv-PP

anaphor resolution

Lappin & Leass: syntax + recency

implicit ordering of arguments:

subject > existential > object > indirect obj-oblique > demonstr-adv-PP

The cat sat on the mat.

saliency(cat) = 100+80+50+80 = 310

saliency(mat) = 100+40+80 = 220

anaphor resolution

Lappin & Leass: syntax + recency

implicit ordering of arguments:

subject > existential > object > indirect obj-oblique > demonstr-adv-PP

update:

weights accumulate over time

after each sentence processed, half the weight

salience values for subsequent referents accumulate for equivalence class of co-referential items (exceptions, e.g. multiple references in same sentence)

anaphor resolution

Lappin & Leass: syntax + recency

example:

The cat sat on the mat.

anaphor resolution

Lappin & Leass: syntax + recency

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example:

The cat sat on the mat.

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The cat was hungry.

anaphor resolution

Lappin & Leass: syntax + recency

example:

The cat sat on the mat.

$$\text{saliency}(\text{cat}) = 100+80+50+80 = 310$$

$$\text{saliency}(\text{mat}) = 100+40+80 = 220$$

The cat was hungry.

$$\text{saliency}(\text{cat}) = 310/2 + 100+80+50+80$$

$$\text{saliency}(\text{mat}) = 220/2$$

anaphor resolution

Lappin & Leass: syntax + recency

additional salience weights for pronouns:

syntactic parallelism	35
cataphora	-175

additional constraints on gender/number agreement, syntax

anaphor resolution

Lappin & Leass: syntax + recency

pronoun resolution algorithm:

- collect potential referents (up to four sentences back)

- remove those that don't agree in number/gender with pronoun

- remove those that don't pass intra-sentential syntactic coreference constraints

 - (e.g. c-command constraints)

anaphor resolution

Lappin & Leass: syntax + recency

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(e.g. **c-command** constraints)

aside on c-command...

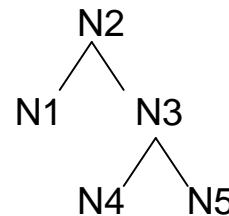
c-command is a relationship between tree nodes
in a certain constituent tree configuration:

node N c-commands node M iff

N does not dominate M

M does not dominate N

every node that dominates N dominates M



anaphor resolution

Lappin & Leass: syntax + recency

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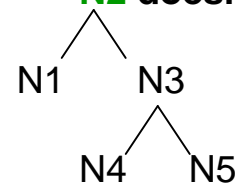
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N2 doesn't c-command any nodes



anaphor resolution

Lappin & Leass: syntax + recency

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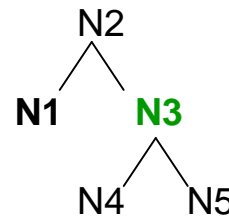
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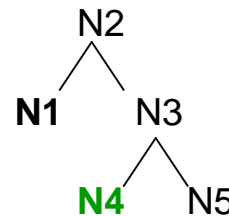
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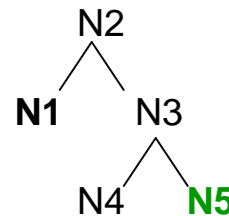
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anaphor resolution

Lappin & Leass: syntax + recency

pronoun resolution algorithm:

- collect potential referents (up to four sentences back)

- remove those that don't agree in number/gender with pronoun

- remove those that don't pass intra-sentential syntactic coreference constraints

 - (e.g. c-command constraints)

- for each candidate

 - add applicable values for syntactic parallelism (+35) to current salience value

 - add up all the values

- select referent with highest salience

- if tie, select **the most recent** candidate to the anaphor

anaphor resolution

Grosz et al: centering

interactions between local coherence
and the choice of referring expressions

anaphor resolution

Grosz et al: centering

interactions between local coherence
and the choice of referring expressions

A pretty woman entered the ice-cream parlour. **The intriguing person** sat at the table next to mine.

anaphor resolution

Grosz et al: centering

interactions between local coherence
and the choice of referring expressions

A pretty woman entered the ice-cream parlour. **The intriguing person** sat at the table next to mine.

A pretty woman entered the ice-cream parlour. **She** sat at the table next to mine.

anaphor resolution

Grosz et al: centering

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A pretty woman entered the ice-cream parlour. **The intriguing person** sat at the table next to mine.

A pretty woman entered the ice-cream parlour. **She** sat at the table next to mine.

A pretty woman entered the ice-cream parlour. **They** like ice cream.

anaphor resolution

Grosz et al: centering

interactions between **local coherence**
and the **choice of referring expressions**

pronouns and definite descriptions are not equivalent
with respect to their effect on coherence

different inference demands on the hearer/reader

anaphor resolution

Grosz et al: centering

interactions between **local coherence**
and the **choice of referring expressions**

centers of an utterance are discourse entities
serving to link the utterance to other utterances

forward looking centers: a ranked list

a **backward looking center:** the entity currently 'in focus' or salient

anaphor resolution

Grosz et al: centering

interactions between **local coherence**
and the **choice of referring expressions**

centers of an utterance are discourse entities
serving to link the utterance to other utterances

forward looking centers: a ranked list

a **backward looking center:** the entity currently 'in focus' or salient

centers are *semantic objects*, not words, phrases, or syntactic forms but
they are realized by those in an utterance
their realization can give us clues about their likely salience

anaphor resolution

Grosz et al: centering

interactions between **local coherence**
and the **choice of referring expressions**

U_n : an utterance

forward-looking centers $C_f(U_n)$:

ordered list of **potential focii** referred to in U_n

a **backward-looking** center $C_b(U_n)$:

current focus after U_n interpreted

anaphor resolution

Grosz et al: centering

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U_n : an utterance

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$C_b(U_{n+1})$: highest ranked member of $C_f(U_n)$

C_f may be ordered : subj < exist. nom < obj < indir obj, oblique < dem., advPP

$C_p(U_n)$: **preferred** (highest ranked) center of $C_f(U_n)$

anaphor resolution

Grosz et al: centering

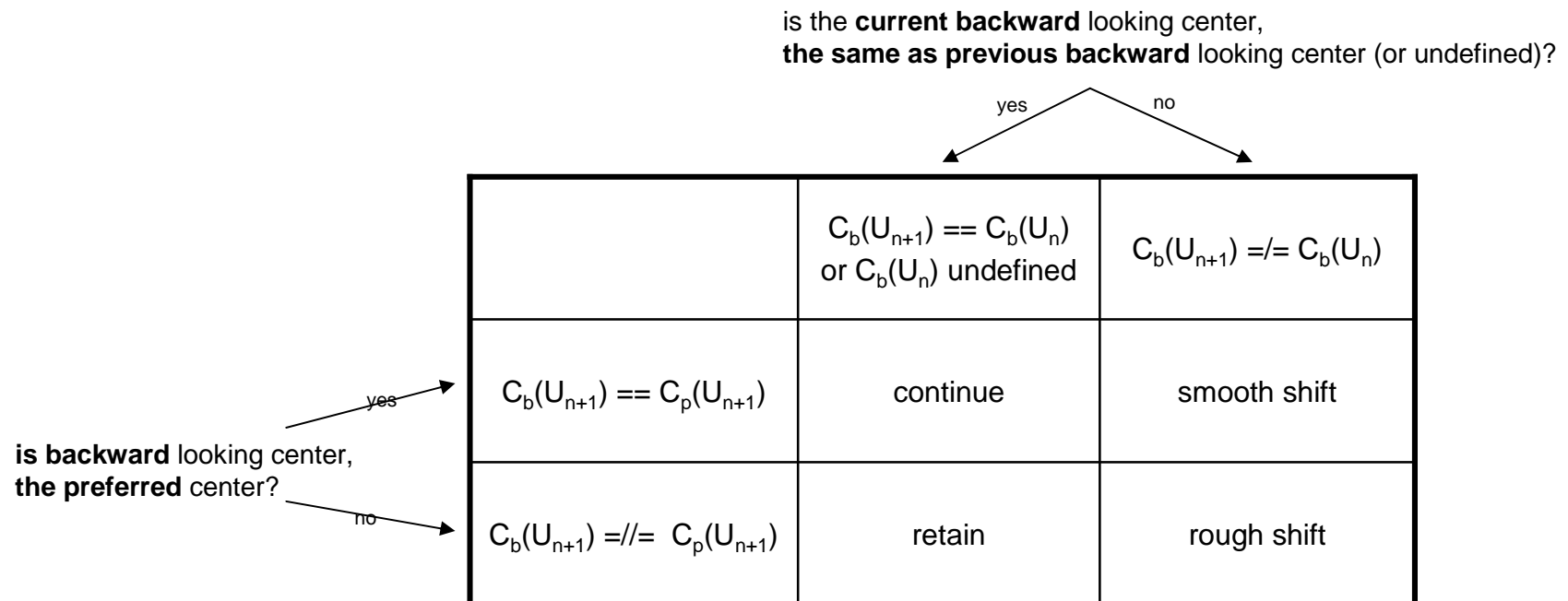
interactions between **local coherence**
and the **choice of referring expressions**

	$C_b(U_{n+1}) == C_b(U_n)$ or $C_b(U_n)$ undefined	$C_b(U_{n+1}) \neq C_b(U_n)$
$C_b(U_{n+1}) == C_p(U_{n+1})$	continue	smooth shift
$C_b(U_{n+1}) \neq C_p(U_{n+1})$	retain	rough shift

anaphor resolution

Grosz et al: centering

interactions between **local coherence**
and the **choice of referring expressions**



anaphor resolution

Grosz et al: centering

interactions between **local coherence**
and the **choice of referring expressions**

if any element of $C_f(U_n)$ is pronominalised in U_{n+1} ,
then $C_b(U_{n+1})$ must also be pronominalised

preference:

continue > retain > smooth shift > rough shift

anaphor resolution

Grosz et al: centering

interactions between **local coherence**
and the **choice of referring expressions**

if any element of $C_f(U_n)$ is pronominalised in U_{n+1} ,
then $C_b(U_{n+1})$ must also be pronominalised

preference:

continue > retain > smooth shift > rough shift

resolution algorithm:

generate C_b and C_f assignments for all possible reference assignments

filter by constraints (syntactic, selectional restrictions,...)

rank by preference among transition orderings

anaphor resolution

Grosz et al: centering

example:

U_1 : Peter gave John a book.

U_2 : He bought the book on Thursday.

U_3 : He read the book overnight.

anaphor resolution

Grosz et al: centering

example:

U_1 : Peter gave John a book.

U_2 : He bought the book on Thursday.

U_3 : He read the book overnight.

U_1 $C_i(U_1)$: {Peter, John, book}
 $C_p(U_1)$: Peter
 $C_b(U_1)$: undefined

anaphor resolution

Grosz et al: centering

example:

U_1 : Peter gave John a book.

U_2 : He bought the book on Thursday.

U_3 : He read the book overnight.

U_1 $C_f(U_1)$: {Peter, John, book}

$C_p(U_1)$: Peter

$C_b(U_1)$: undefined

U_2 $C_f(U_1)$: {Peter, John, book}

$C_p(U_2)$: Peter

$C_b(U_2)$: Peter

Continue $C_p(U_2)=C_b(U_2)$; $C_b(U_1)$ undefined

anaphor resolution

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U_1 : Peter gave John a book.

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U_1 $C_f(U_1)$: {Peter, John, book}
 $C_p(U_1)$: Peter
 $C_b(U_1)$: undefined

U_2 $C_f(U_2)$: {Peter, John, book}
 $C_p(U_2)$: Peter
 $C_b(U_2)$: Peter
 Continue $C_p(U_2)=C_b(U_2)$; $C_b(U_1)$ undefined

U_3 $C_f(U_3)$: {Peter?, book}
 $C_p(U_3)$: Peter
 $C_b(U_3)$: Peter?
 Continue $C_p(U_3)=C_b(U_3)$; $C_b(U_3) = C_b(U_2)$

anaphor resolution

Grosz et al: centering

example:

U_1 : Peter gave John a book.

U_2 : He bought the book on Thursday.

U_3 : He read the book overnight.

U_1 $C_f(U_1)$: {Peter, John, book}
 $C_p(U_1)$: Peter
 $C_b(U_1)$: undefined

U_2 $C_f(U_2)$: {Peter, John, book}
 $C_p(U_2)$: Peter
 $C_b(U_2)$: Peter
 Continue $C_p(U_2)=C_b(U_2)$; $C_b(U_1)$ undefined

U_3 $C_f(U_3)$: {Peter?, book}
 $C_p(U_3)$: Peter
 $C_b(U_3)$: Peter?
 Continue $C_p(U_3)=C_b(U_3)$; $C_b(U_3) = C_b(U_2)$

OR

$C_f(U_3)$: {John?, book}
 $C_p(U_3)$: John?
 $C_b(U_3)$: John?
Smooth-Shift $C_p(U_3)=C_b(U_3)$; $C_b(U_3) \neq C_b(U_2)$

anaphor resolution

Grosz et al: centering

example:

U_1 : Peter gave John a book.

U_2 : He bought the book on Thursday.

U_3 : He read the book overnight.

U_1 $C_f(U_1)$: {Peter, John, book}
 $C_p(U_1)$: Peter
 $C_b(U_1)$: undefined

U_2 $C_f(U_2)$: {Peter, John, book}
 $C_p(U_2)$: Peter
 $C_b(U_2)$: Peter
 Continue $C_p(U_2)=C_b(U_2)$; $C_b(U_1)$ undefined

U_3 $C_f(U_3)$: {Peter, book}
 $C_p(U_3)$: Peter
 $C_b(U_3)$: Peter?
 Continue $C_p(U_3)=C_b(U_3)$; $C_b(U_3) = C_b(U_2)$

OR

$C_f(U_3)$: {John?,book}
 $C_p(U_3)$: John?
 $C_b(U_3)$: John?
Smooth-Shift $C_p(U_3)=C_b(U_3)$; $C_b(U_3) \neq C_b(U_2)$

anaphor resolution

Evaluation

centering only recently specified enough to be tested automatically on real data
parameters of Centering Theory: A Corpus-Based Evaluation using Text from
Application-Oriented Domains (Poesio et al., ACL 2000)

Walker 89 manual comparison of Centering vs. Hobbs 78

only 281 examples from 3 genres

assumed correct features given as input to each

centering 77.6% vs. Hobbs 81.8%

LappinLeass 86% accuracy on test set from computer training manuals

anaphor resolution

Hobbs' algorithm vs. LappinLeass vs. Grosz et al.

centering sometimes prefers an antecedent
which LappinLeass or Hobbs would consider to have low salience

centering always prefers a single pronominalisation strategy
prescriptive, assumes discourse coherent

constraints too simple: grammatical role, recency, repeated mention

assumes correct syntactic information available as input

anaphor resolution

bit of history

till 90s

anaphor resolution == pronoun resolution

rule-based

Winograd's SHRDLU (1972), Hobbs (1976, 78), Centering (Brennan et al. 1987)

later

corpus-based (cooccurrence statistics, machine learning

also non-pronominal (definite NPs, bridging (Vieira and Poesio 2000))

anaphor resolution

bit of history

till 90s

anaphor resolution == pronoun resolution

rule-based

Winograd's SHRDLU (1972), Hobbs (1976, 78), Centering (Brennan et al. 1987)

later

corpus-based (cooccurrence statistics, machine learning)

e.g. Dagan and Itai (1990, 1991)

extract selectional preferences from corpora

They held **tax money** aside on the basis that **the government** said **it** was going to collect **it**.

subject(it, collect) vs. object(it, collect)

cooccurrence stats:

subject(money, collect) << subject(government, collect)

object(money, collect) >> object(government, collect)

anaphor resolution

bit of history

till 90s

anaphor resolution == pronoun resolution

rule-based

Winograd's SHRDLU (1972), Hobbs (1976, 78), Centering (Brennan et al. 1987)

later

corpus-based (cooccurrence statistics, machine learning)

Soon, Ng and Lim (1999)

supervised learning

features:

string similarity

grammatical congruence

semantic WordNet class (same?)

type of referent

anaphor resolution

bit of history

till 90s

anaphor resolution == pronoun resolution

rule-based

Winograd's SHRDLU (1972), Hobbs (1976, 78), Centering (Brennan et al. 1987)

later

corpus-based (cooccurrence statistics, machine learning)

also non-pronominal (definite NPs, bridging (Vieira and Poesio 2000))

approaches

rule-based vs statistical

(Kennedy & Boguraev 1996), (Lappin & Leass 1994) vs (Ge, Hale & Charniak 1998)

use full syntactic parse vs. shallow syntactic parse

(Lap 1994), (Ge 1998) vs (Ken 1996)

genre-specific/type of text used for the evaluation

(Lap 1994) computer manual texts (86% accuracy)

(Ge 1998) WSJ articles (83% accuracy)

(Ken 1996) different genres (75% accuracy)

anaphor resolution

applications

- ir/ie
- qa
- summarisation
- mt
- ...

anaphor resolution

references

(additional slides follow)

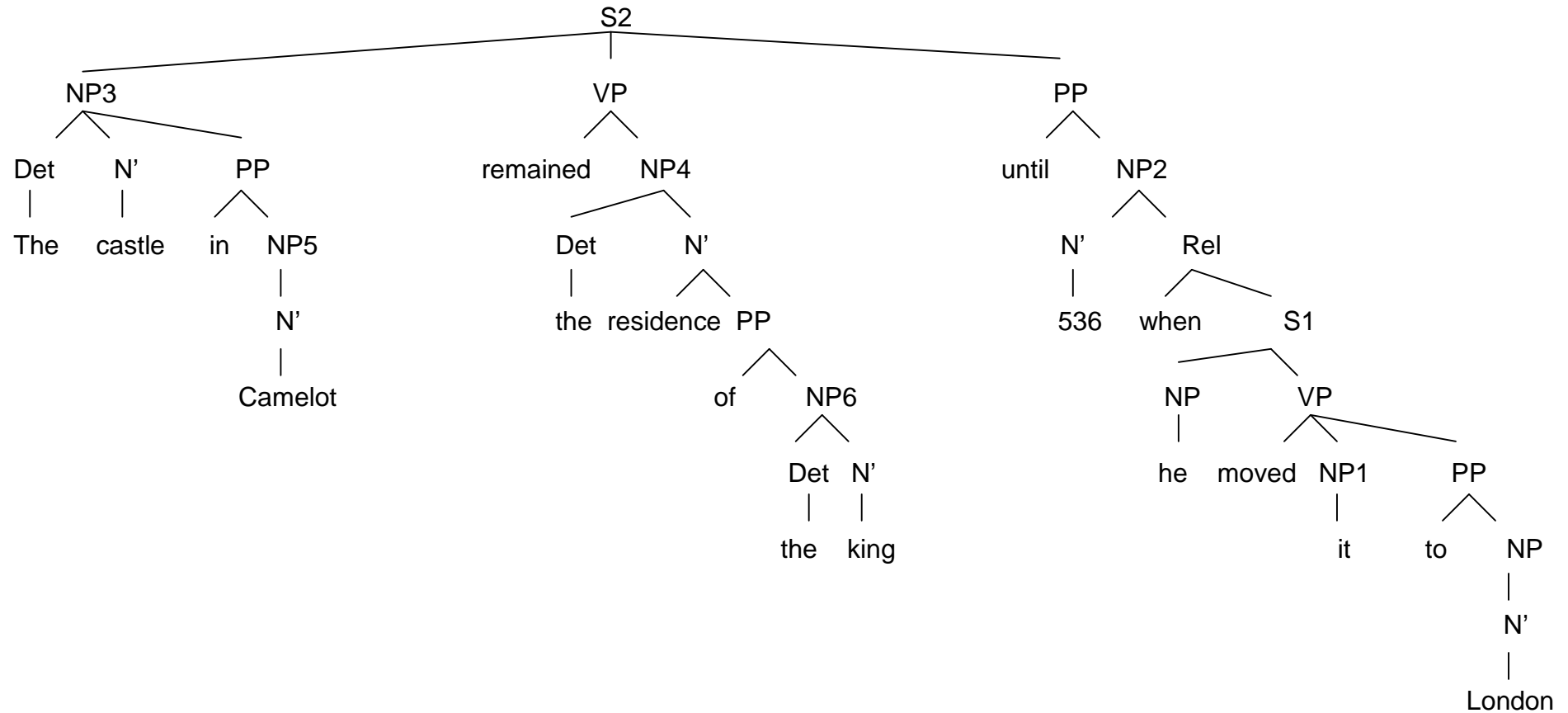
anaphor resolution

Hobbs and Lappin and Leass walk-through

(see a new added slide with Hobbs' algorithm steps)

centering walk-through on the centering slide

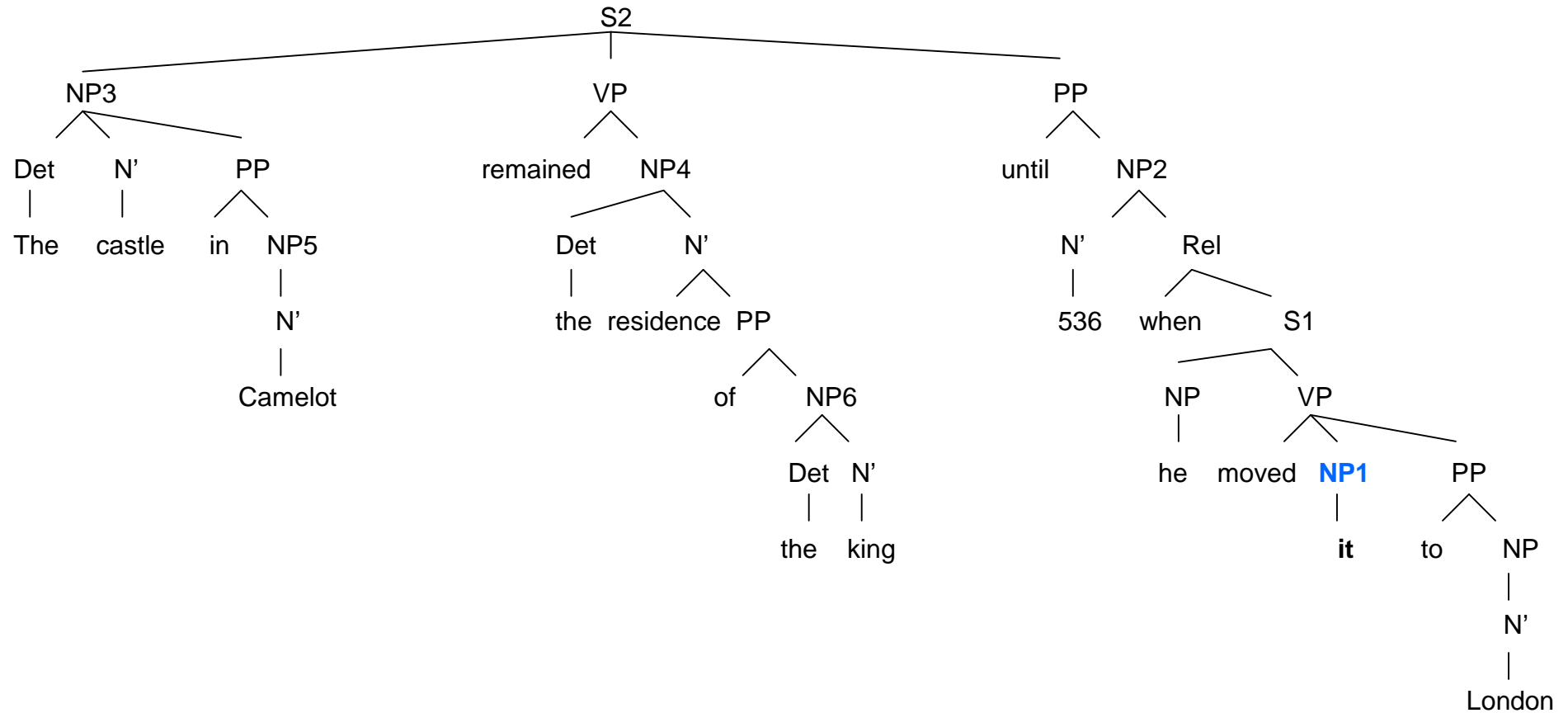
anaphor resolution: Hobbs' algorithm



The castle in Camelot remained the residence of the king until 536 when he moved it to London.

anaphor resolution: Hobbs' algorithm

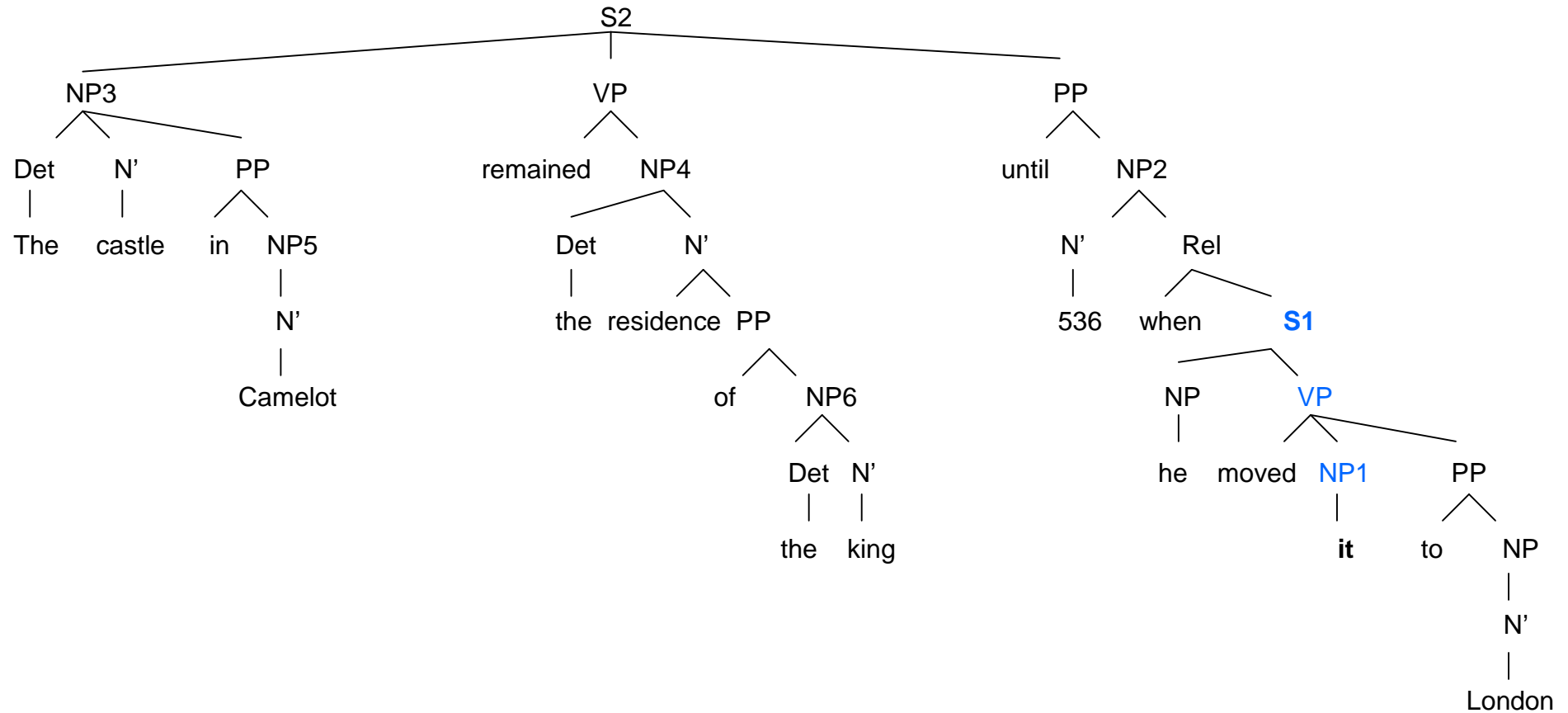
begin at the pronoun's NP node



The castle in Camelot remained the residence of the king until 536 when he moved it to London.

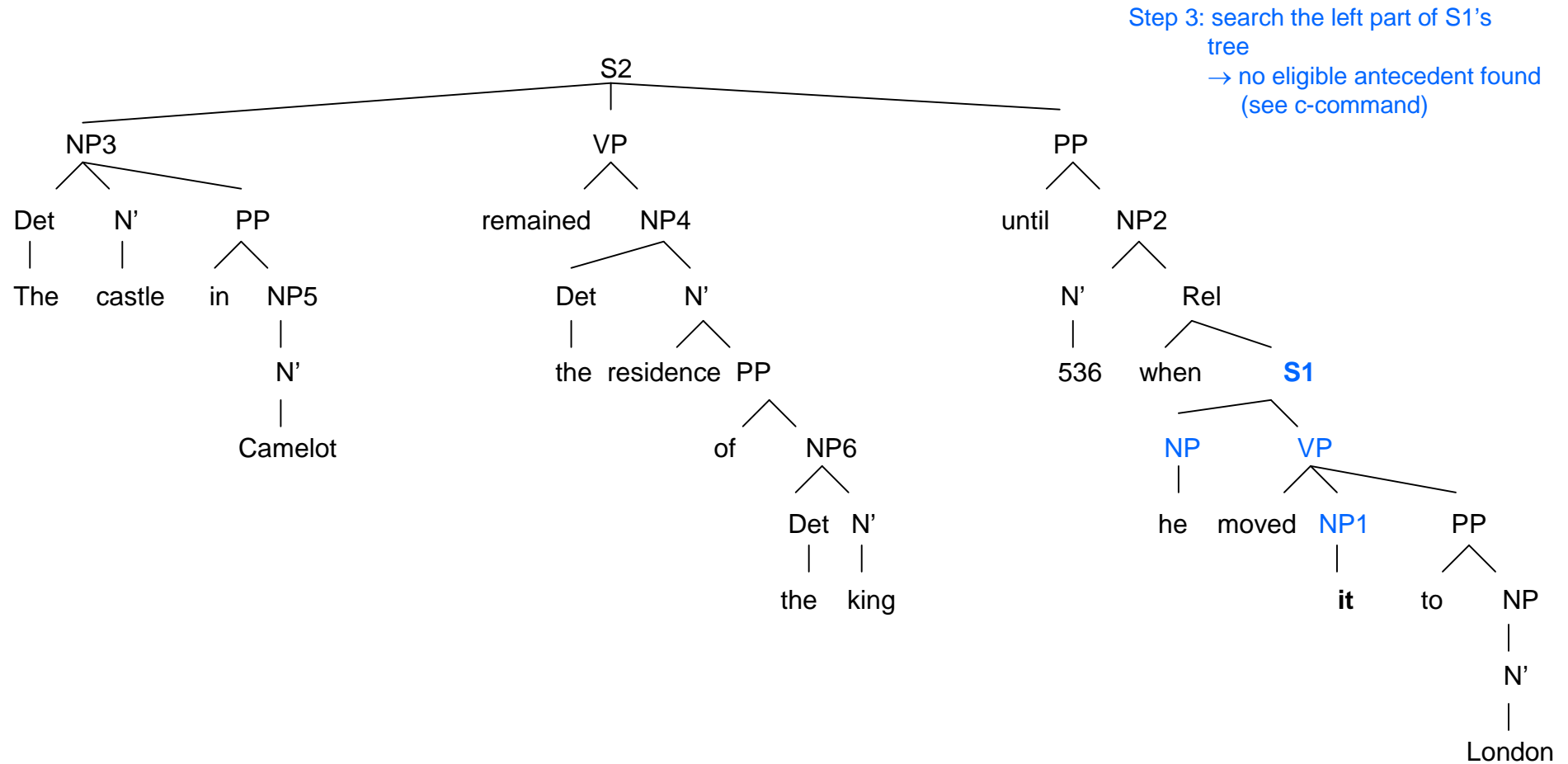
anaphor resolution: Hobbs' algorithm

Step 2: up to S1



The castle in Camelot remained the residence of the king until 536 when he moved it to London.

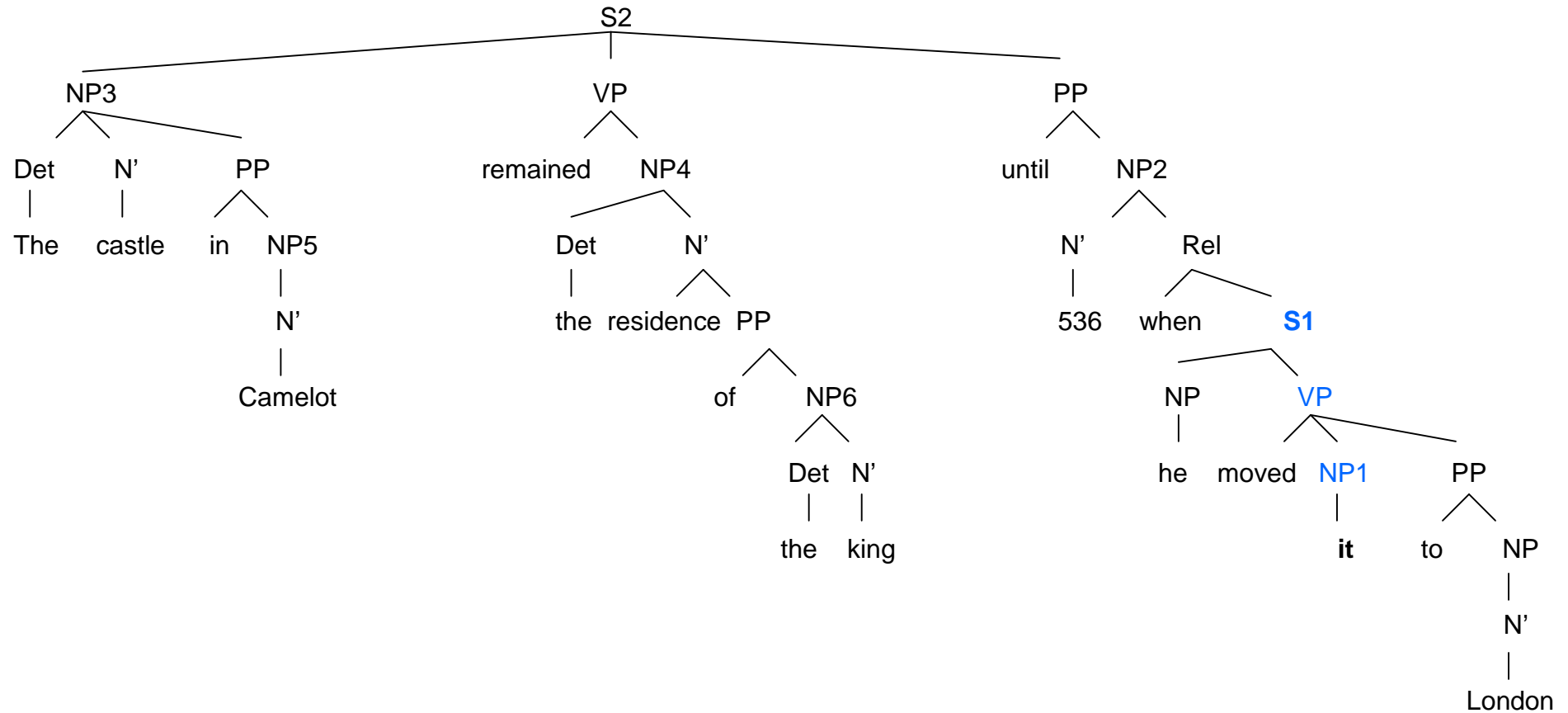
anaphor resolution: Hobbs' algorithm



The castle in Camelot remained the residence of the king until 536 when he moved it to London.

anaphor resolution: Hobbs' algorithm

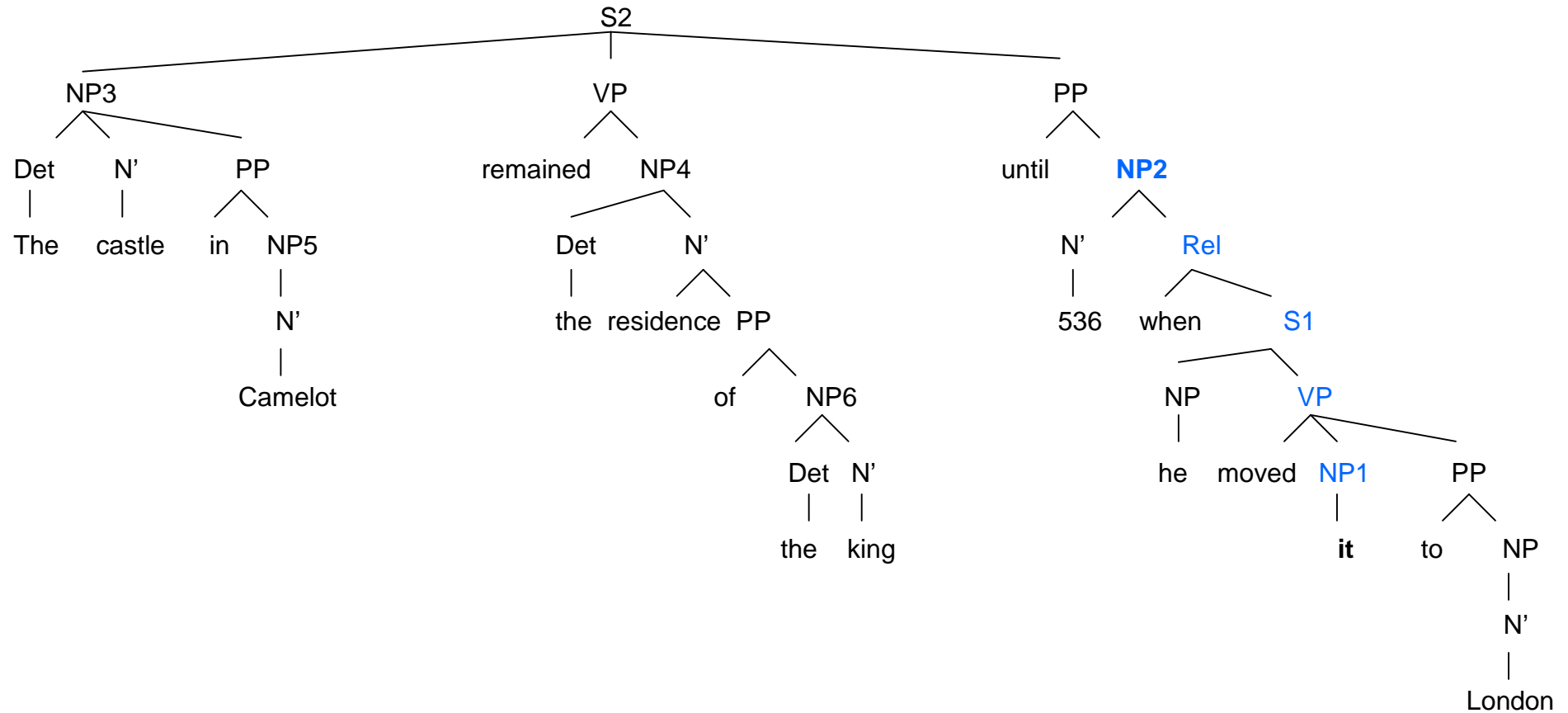
Step 4: does not apply



The castle in Camelot remained the residence of the king until 536 when he moved it to London.

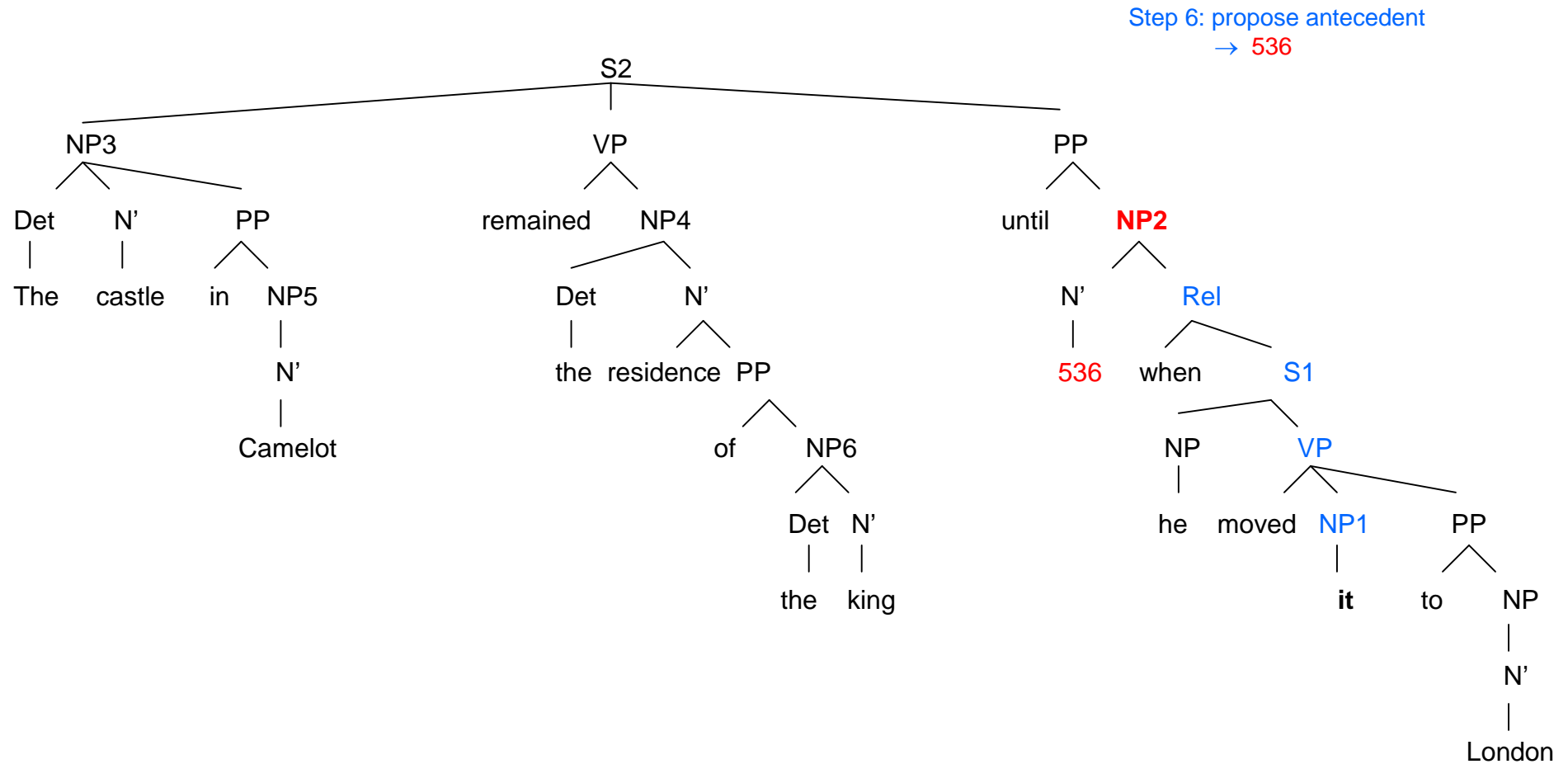
anaphor resolution: Hobbs' algorithm

Step 5: up to NP2



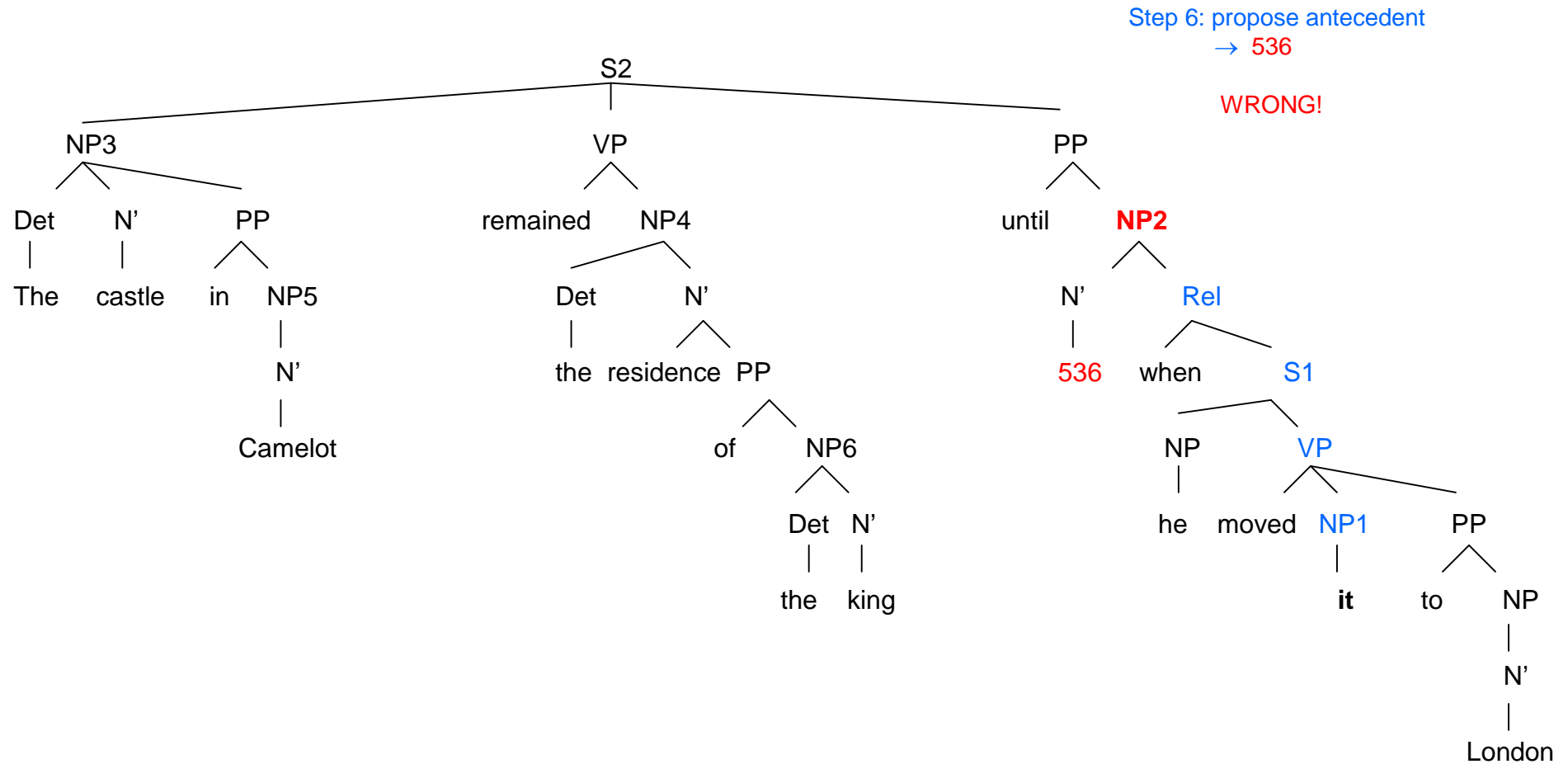
The castle in Camelot remained the residence of the king until 536 when he moved it to London.

anaphor resolution: Hobbs' algorithm



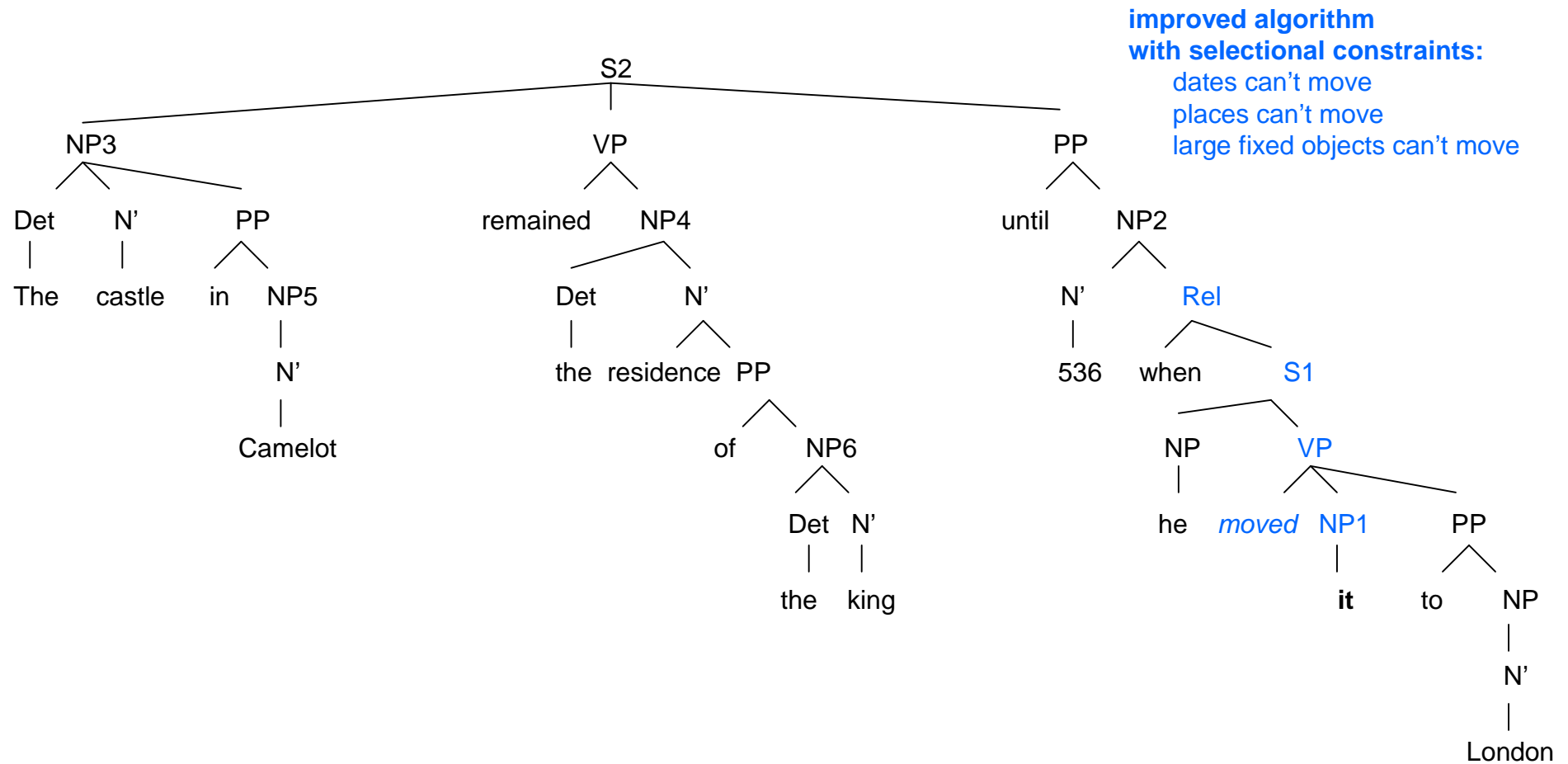
The castle in Camelot remained the residence of the king until 536 when he moved it to London.

anaphor resolution: Hobbs' algorithm



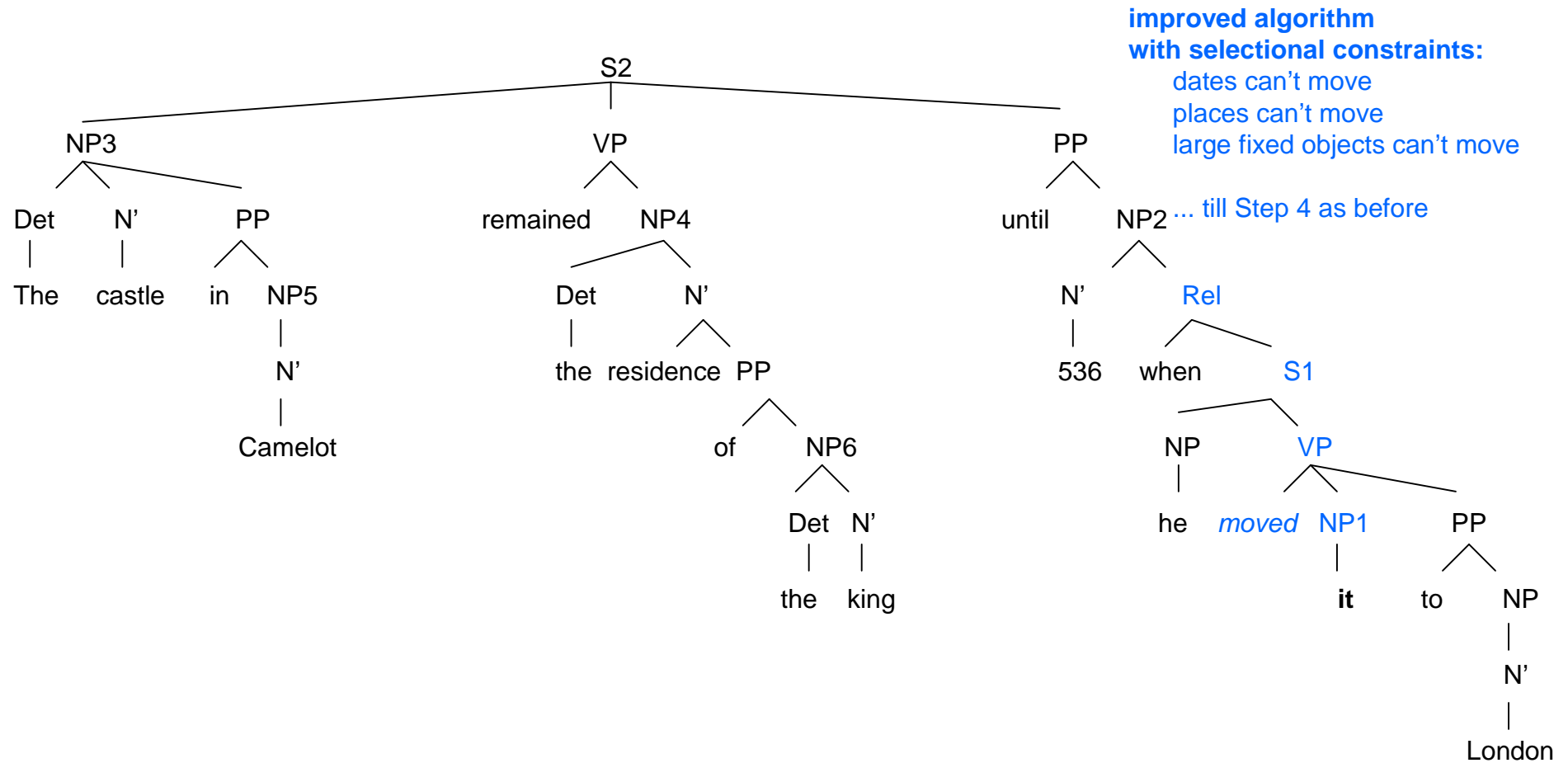
The castle in Camelot remained the residence of the king until 536 when he moved it to London.

anaphor resolution: Hobbs' algorithm



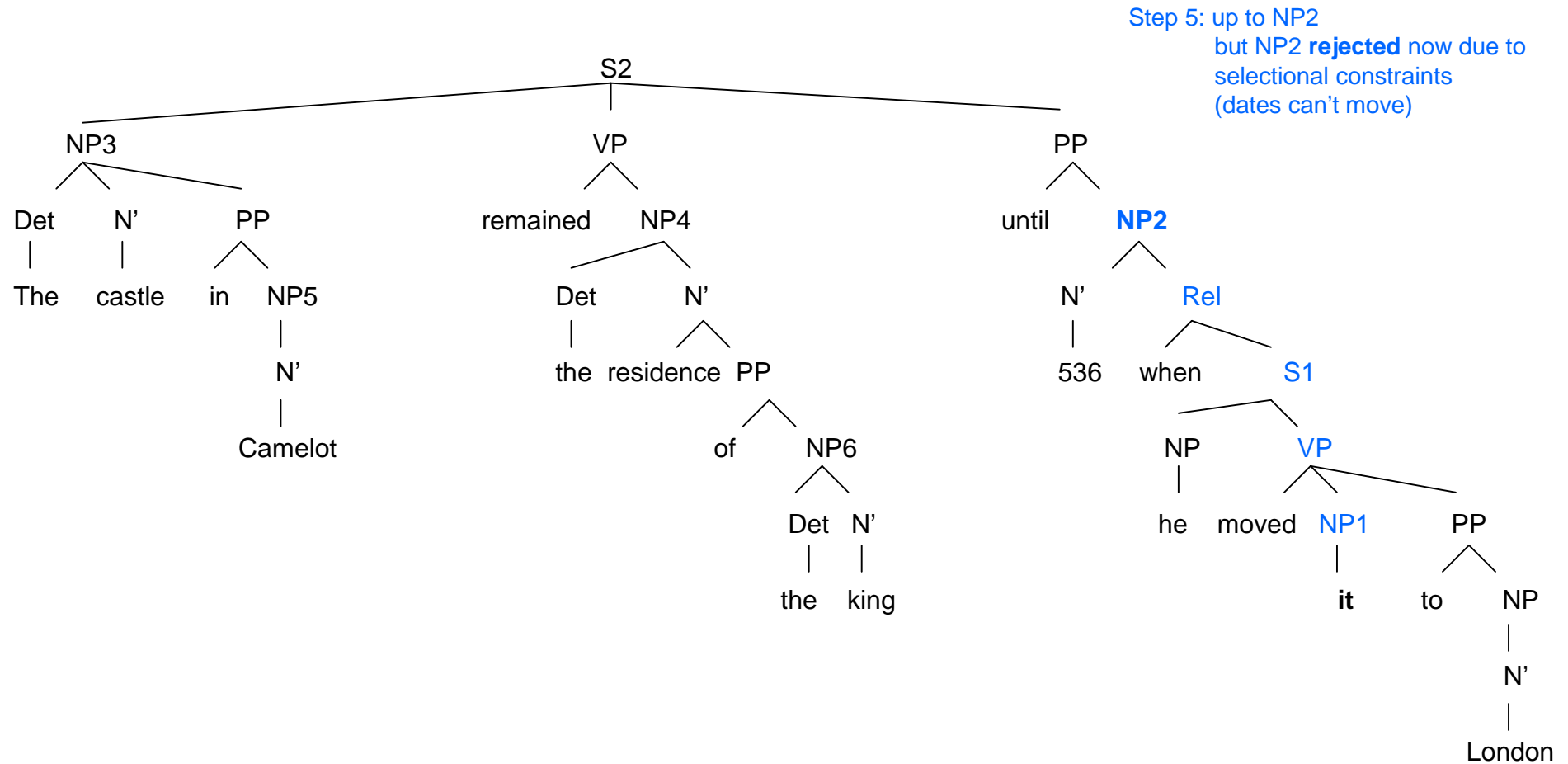
The castle in Camelot remained the residence of the king until 536 when he moved it to London.

anaphor resolution: Hobbs' algorithm



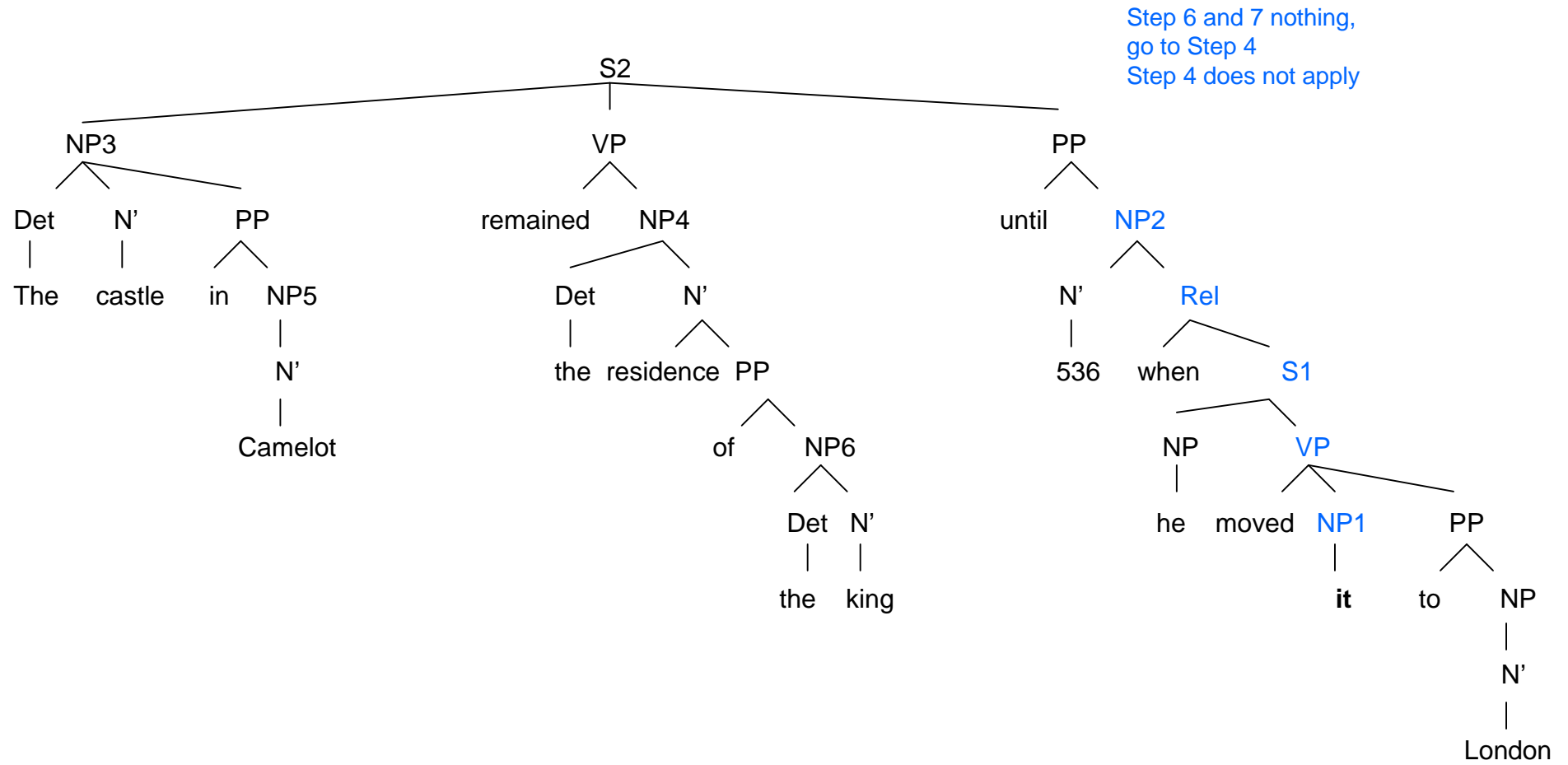
The castle in Camelot remained the residence of the king until 536 when he moved it to London.

anaphor resolution: Hobbs' algorithm



The castle in Camelot remained the residence of the king until 536 when he moved it to London.

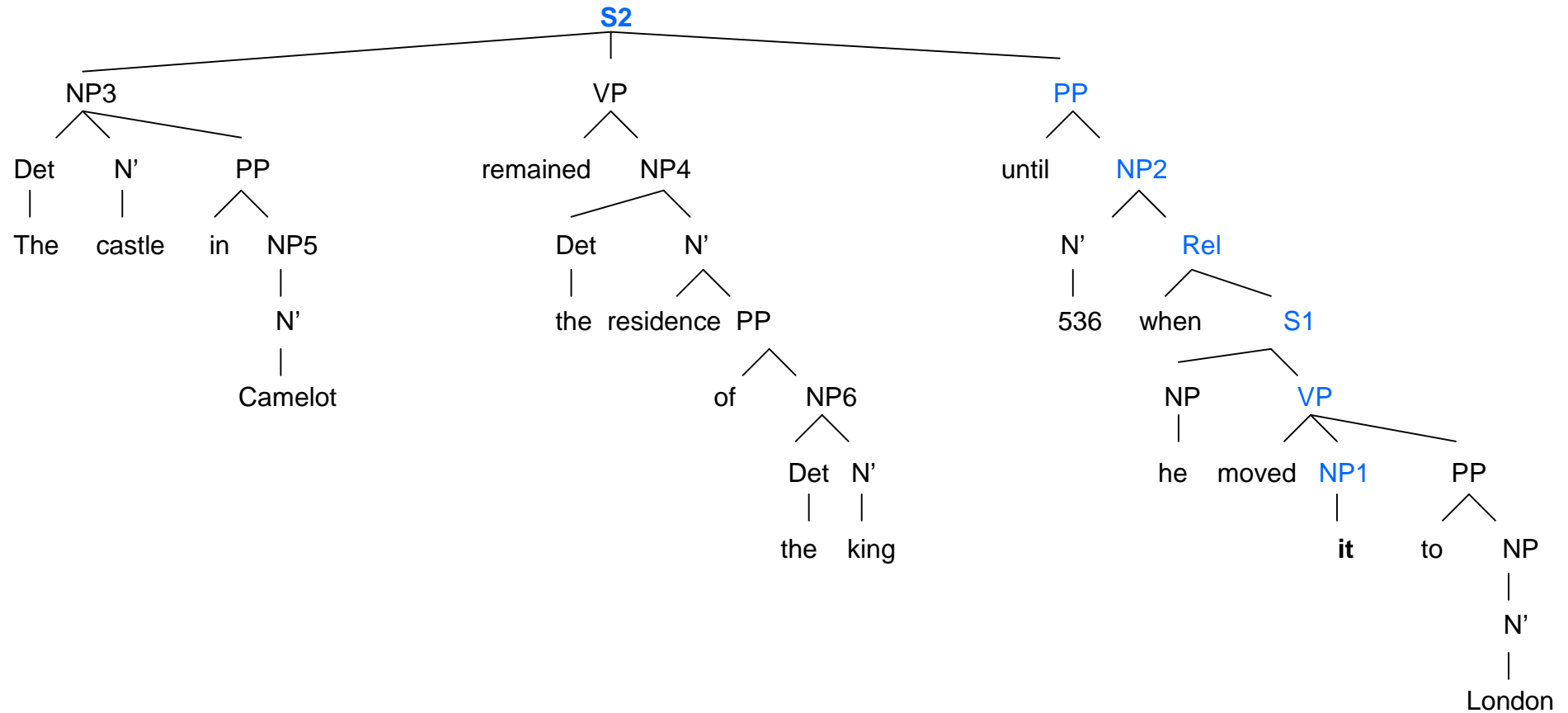
anaphor resolution: Hobbs' algorithm



The castle in Camelot remained the residence of the king until 536 when he moved it to London.

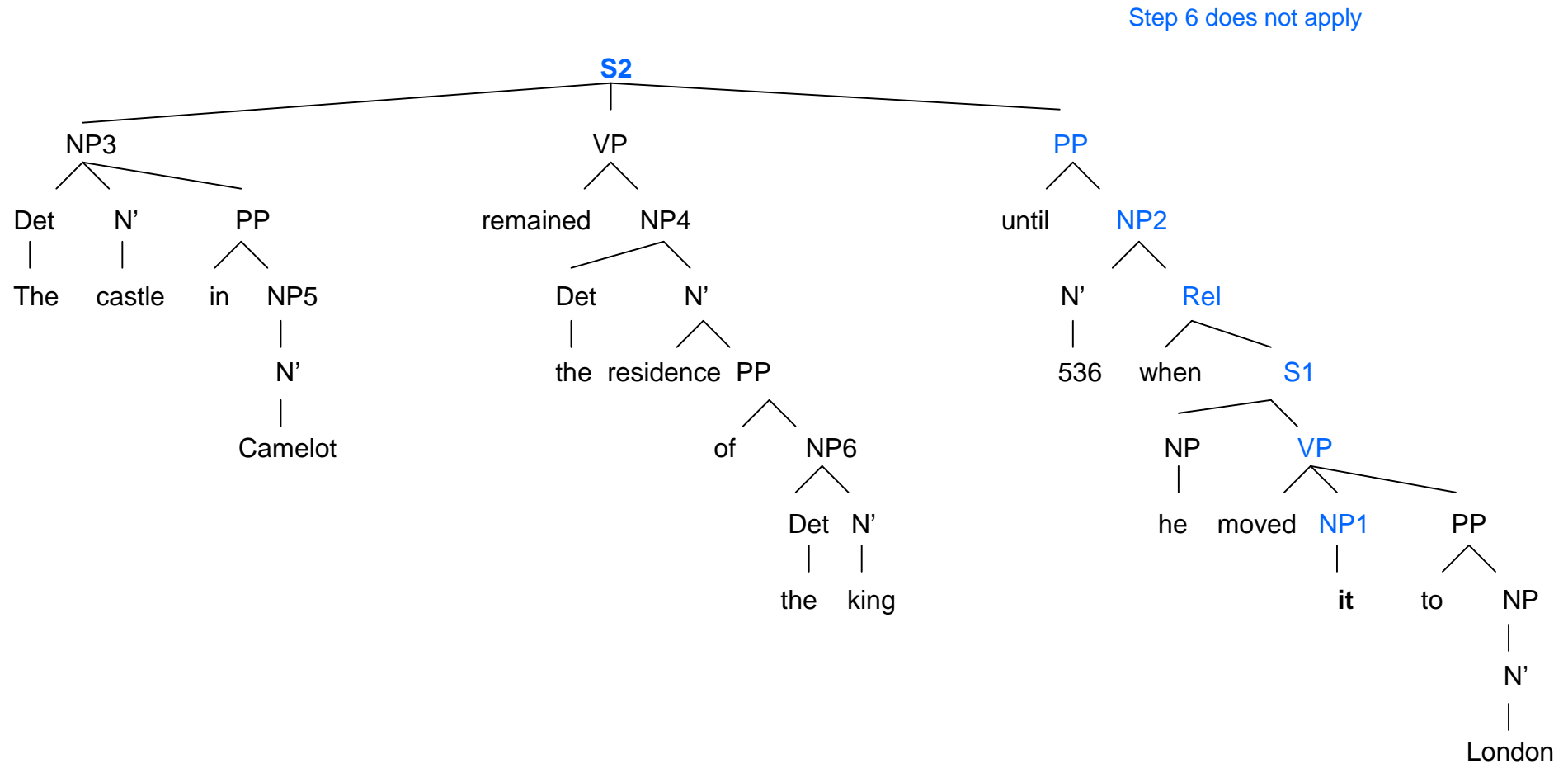
anaphor resolution: Hobbs' algorithm

Step 5: up to S2



The castle in Camelot remained the residence of the king until 536 when he moved it to London.

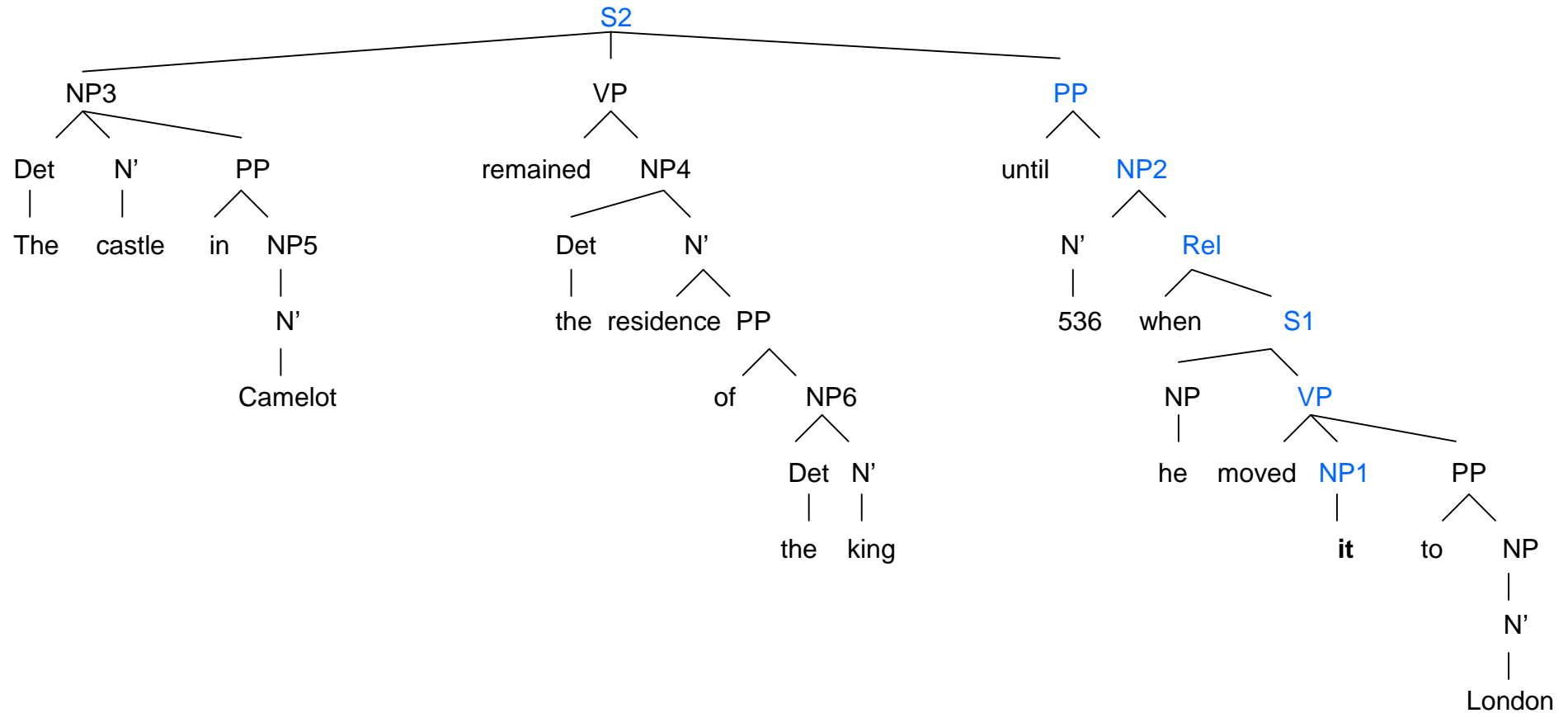
anaphor resolution: Hobbs' algorithm



The castle in Camelot remained the residence of the king until 536 when he moved it to London.

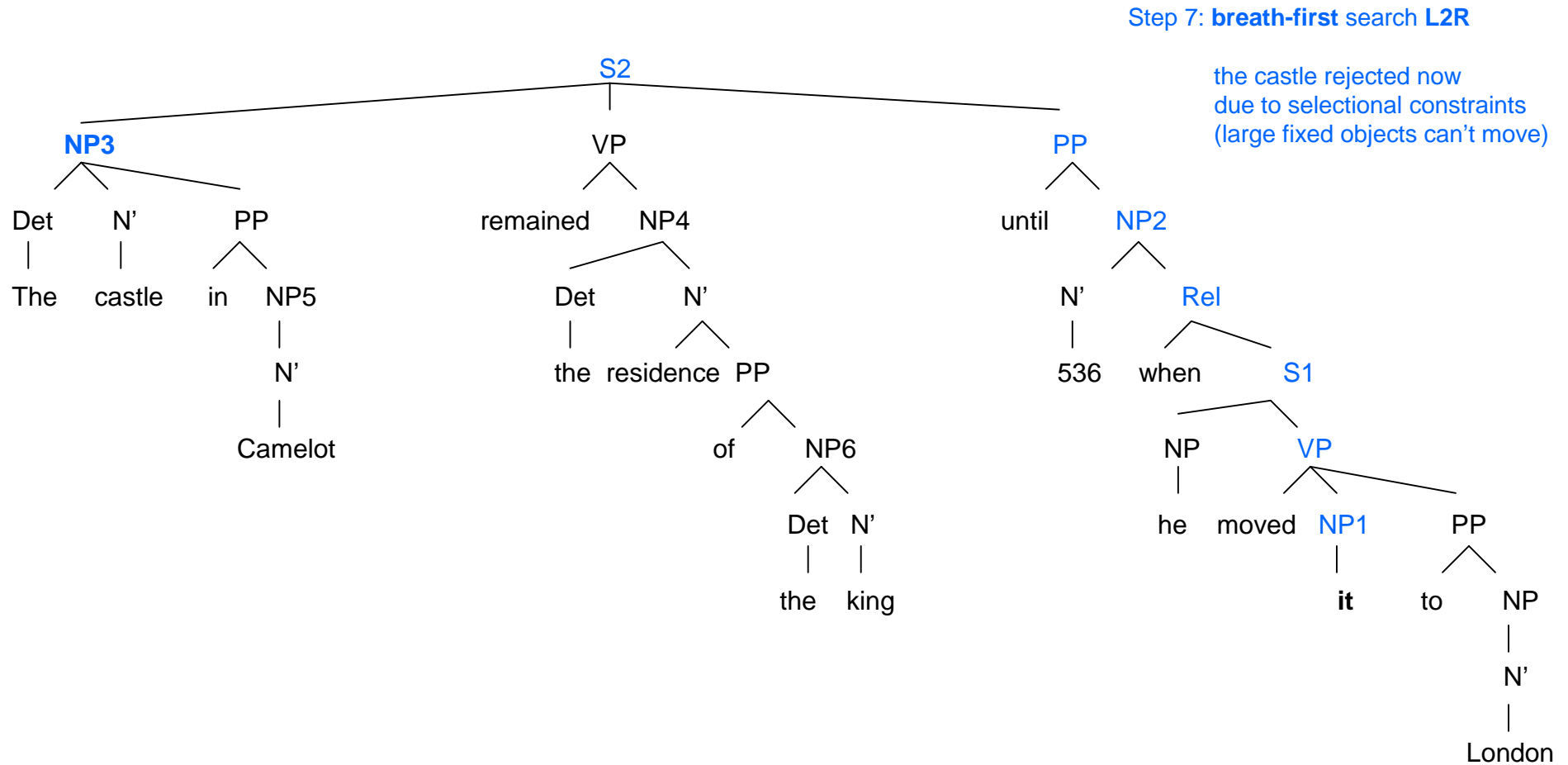
anaphor resolution: Hobbs' algorithm

Step 7: **breath-first** search **L2R**



The castle in Camelot remained the residence of the king until 536 when he moved it to London.

anaphor resolution: Hobbs' algorithm

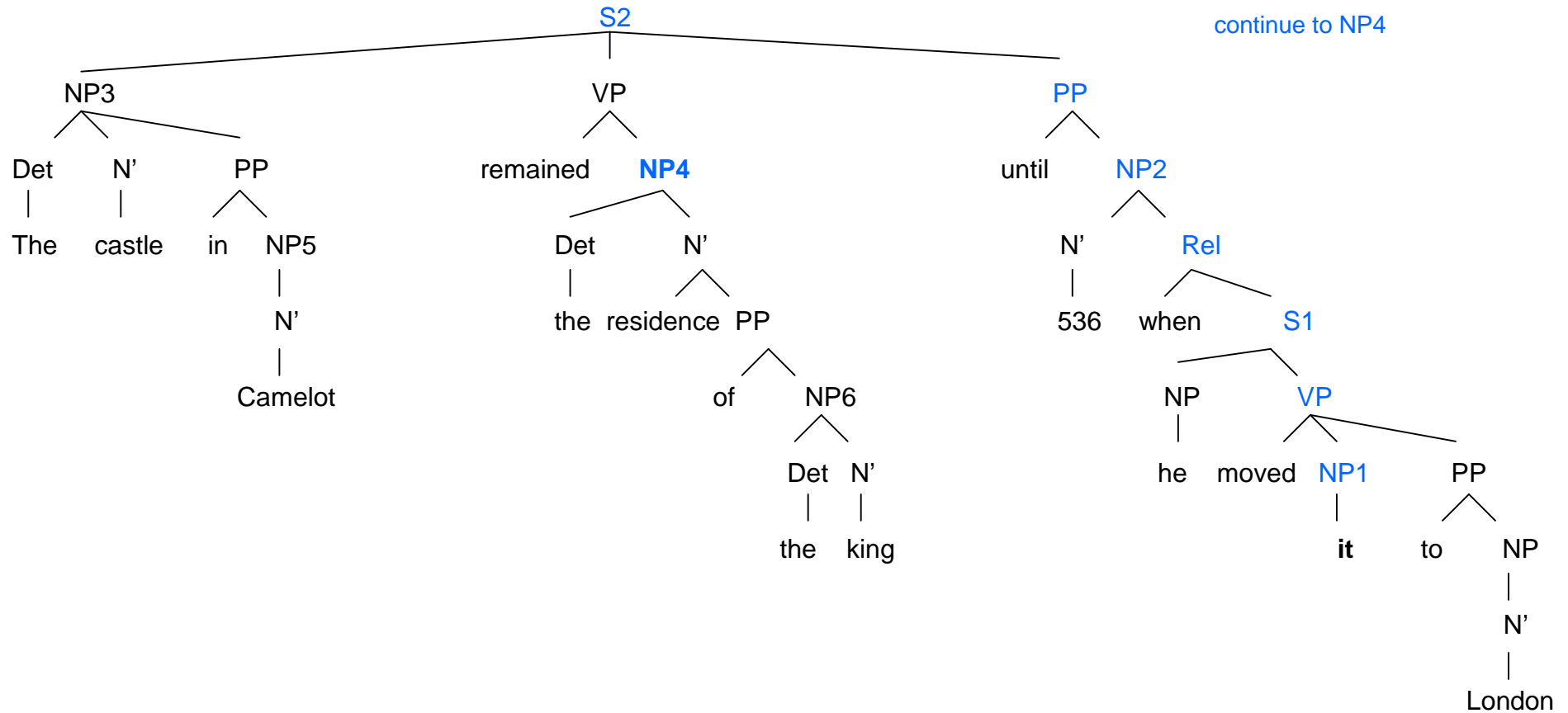


The castle in Camelot remained the residence of the king until 536 when he moved it to London.

anaphor resolution: Hobbs' algorithm

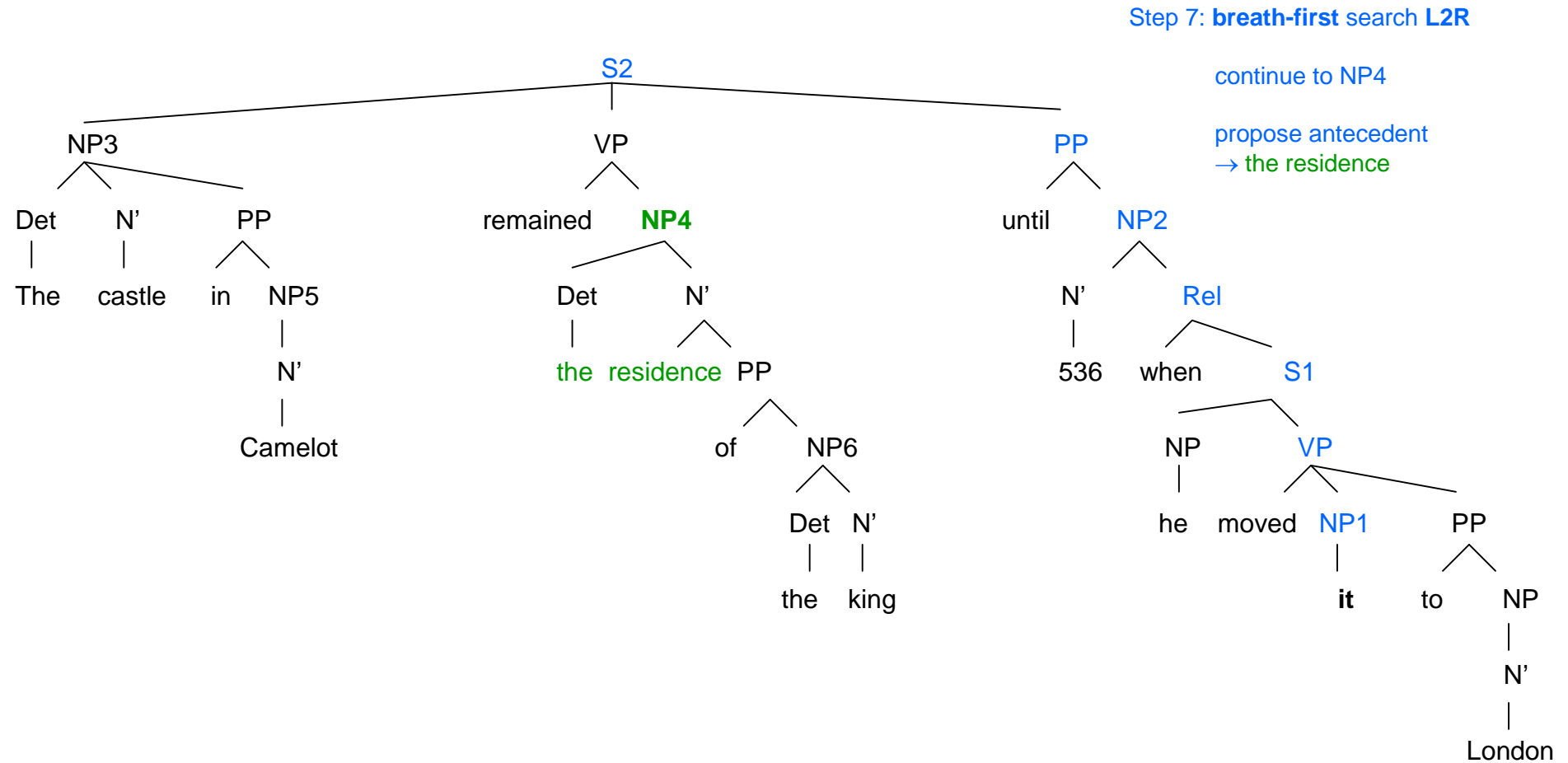
Step 7: **breath-first** search **L2R**

continue to NP4



The castle in Camelot remained the residence of the king until 536 when he moved it to London.

anaphor resolution: Hobbs' algorithm



The castle in Camelot remained the residence of the king until 536 when he moved it to London.

anaphor resolution: Lappin and Leass

The **castle** in **Camelot** remained the **residence** of the **king** until **536** when he moved **it** to London.

anaphor resolution: Lappin and Leass

The **castle** in **Camelot** remained the **residence** of the **king** until **536** when he moved **it** to London.

saliency(castle)	→ current sent + subject + non-PP + head = 100+80+50+80	= 310
saliency(Camelot)	→ current sent + subject = 100+80	= 180
saliency(residence)	→ current sent + dir obj + non-PP + head = 100+50+50+80	= 280
saliency(king)	→ current sent + non-PP = 100+50	= 150
saliency(536)	→ current sent + indir obj + head = 100+40+80	= 220

anaphor resolution: Lappin and Leass

The **castle** in **Camelot** remained the **residence** of the **king** until **536** when he moved **it** to London.

saliency(castle)	→ current sent + subject + non-PP + head = 100+80+50+80	= 310
saliency(Camelot)	→ current sent + subject = 100+80	= 180
saliency(residence)	→ current sent + dir obj + non-PP + head = 100+50+50+80	= 280
saliency(king)	→ current sent + non-PP = 100+50	= 150
saliency(536)	→ current sent + indir + head = 100+40+80	= 220

the algorithm fails because semantic/pragmatic information is needed to resolve correctly

anaphor resolution: Lappin and Leass

The **castle** in **Camelot** remained the **residence** of the **king** until **536** when he moved **it** to London.

saliency(castle)	→ current sent + subject + non-PP + head = 100+80+50+80	= 310
saliency(Camelot)	→ current sent + subject = 100+80	= 180
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saliency(king)	→ current sent + non-PP = 100+50	= 150
saliency(536)	→ current sent + indir + head = 100+40+80	= 220

however if the additional weight for syntactic parallelism is added, ...

anaphor resolution: Lappin and Leass

The **castle** in **Camelot** remained the **residence** of the **king** until **536** when he moved **it** to London.

saliency(castle)	→ current sent + subject + non-PP + head = 100+80+50+80	= 310
saliency(Camelot)	→ current sent + subject = 100+80	= 180
saliency(residence)	→ current sent + dir obj + non-PP + head + synt parallel. = 100+50+50+80+ 35	= 315
saliency(king)	→ current sent + non-PP = 100+50	= 150
saliency(536)	→ current sent + indir + head = 100+40+80	= 220

however if the additional weight for syntactic parallelism is added, the result is correct
(in the article it is not *explicitly* stated that syntactic parallelism applies to intrasentential cases)

anaphor resolution

points to note (i.e. learn):

- what is anaphor resolution

- what factors play a role

- Hobbs' resolution algorithm

- Lappin and Leass algorithm

- Centering algorithm