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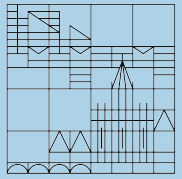

Grammar Development with LFG and XLE

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Last Time

- Verbal Complements: COMP and XCOMP
  - Finite Complements
  - Subject vs. Object Control in XCOMPs
  - Control Equations in lexical entries
- Regression Testing, Debugging

This Time: Lesson 9

1. Functional Uncertainty
   - Long Distance Dependencies (LDD)
   - Defining a functional uncertainty path (e.g. for Topic)
2. Inside-Out Functional Uncertainty
   - Anaphora
   - “Constructive” Case
3. Free Word Order (Shuffle Operator)

Long-Distance Dependencies

- Arguments are not always found in the clausal domain of the verb that subcategorizes for them.
- Example: English topicalization

  Hoppers, Kim likes.

  Hoppers, Kim wants Sandy to like.

  Hoppers, Kim thinks that Sandy likes.

  Hoppers, Kim persuaded Sandy to want to eat.

  Hoppers, Kim wanted Sandy to believe that the gorilla likes.

- Phenomena of this type are known as Long-Distances Dependencies (LDD).

Functional Uncertainty

- In LFG, LDDs are dealt with via Functional Uncertainty (FU).
- That is, one takes the displaced argument and specifies a **functional uncertainty path** for it.
- Essentially, one specifies what kind of LDD it could be involved in.
- For example:

```
(^{XCOMP|COMP}* {OBJ|OBJ2}) = !
```

Long-Distance Dependencies

- The FU path is implemented as an annotation on the relevant c-structure node.
- For example, in English we could assume an optional NP before the subject.
- We also add an annotation that this is the topic.

```
S --> (NP: (^ TOPIC) = !
       (^{XCOMP|COMP}* {OBJ|OBJ2}) = !);
        NP: (^ SUBJ) = !;
        VP.
```

Long-Distance Dependencies

- Does this Functional Uncertainty Path provide the right results?

Hoppers, Kim likes.

```
S --> NP: (^ TOPIC) = !
      (^{XCOMP|COMP}* {OBJ|OBJ2}) = !;
       NP: (^ SUBJ) = !;
       VP.
```

Long-Distance Dependencies

- Does this Functional Uncertainty Path provide the right results?

Hoppers, Kim wants Sandy [_XCOMP to like _].

```
S --> NP: (^ TOPIC) = !
      (^{XCOMP|COMP}* {OBJ|OBJ2}) = !;
       NP: (^ SUBJ) = !;
       VP.
```

Long-Distance Dependencies

- Does this Functional Uncertainty Path provide the right results?

Hoppers, Kim thinks [_COMP that Sandy likes _].

```
S --> NP: (^ TOPIC) = !
      (^{XCOMP|COMP}* {OBJ|OBJ2}) = !;
       NP: (^ SUBJ) = !;
       VP.
```

Long-Distance Dependencies

- Does this Functional Uncertainty Path provide the right results?

Hoppers, Kim persuaded Sandy [_XCOMP to want
[_XCOMP to eat _]].

LDD Path: **XCOMP XCOMP OBJ**

```
S --> NP: (^ TOPIC) = !
      (^{XCOMP|COMP}* {OBJ|OBJ2}) = !;
       NP: (^ SUBJ) = !;
       VP.
```

Long-Distance Dependencies

- Does this Functional Uncertainty Path provide the right results?

Hoppers, Kim wanted Sandy [_XCOMP to believe
[_COMP that the gorilla likes _]].

LDD Path: **XCOMP COMP OBJ**

```
S --> NP: (^ TOPIC) = !
      (^{XCOMP|COMP}* {OBJ|OBJ2}) = !;
       NP: (^ SUBJ) = !;
       VP.
```

Long-Distance Dependencies

- Does the Functional Uncertainty Path provide the right results?

  Hoppers, Kim likes.

  Hoppers, Kim wants Sandy to like.

  Hoppers, Kim thinks that Sandy likes.

  Hoppers, Kim persuaded Sandy to want to eat.

  Hoppers, Kim wanted Sandy to believe that the gorilla likes.

  ....

- Yes!

Outside-In vs. Inside-Out FU

- The English topicalization data provided an example of “outside-in” functional uncertainty.
- However, functional uncertainty paths can also be defined from the “inside-out”.
- Within LFG, this has been used for
  - Anaphora (reference resolution of pronouns and reflexives)
  - “Constructive” case (implemented in Urdu ParGram)

Outside-In vs. Inside-Out FU

Functional uncertainty defines a search path over an attribute-value matrix (AVM).

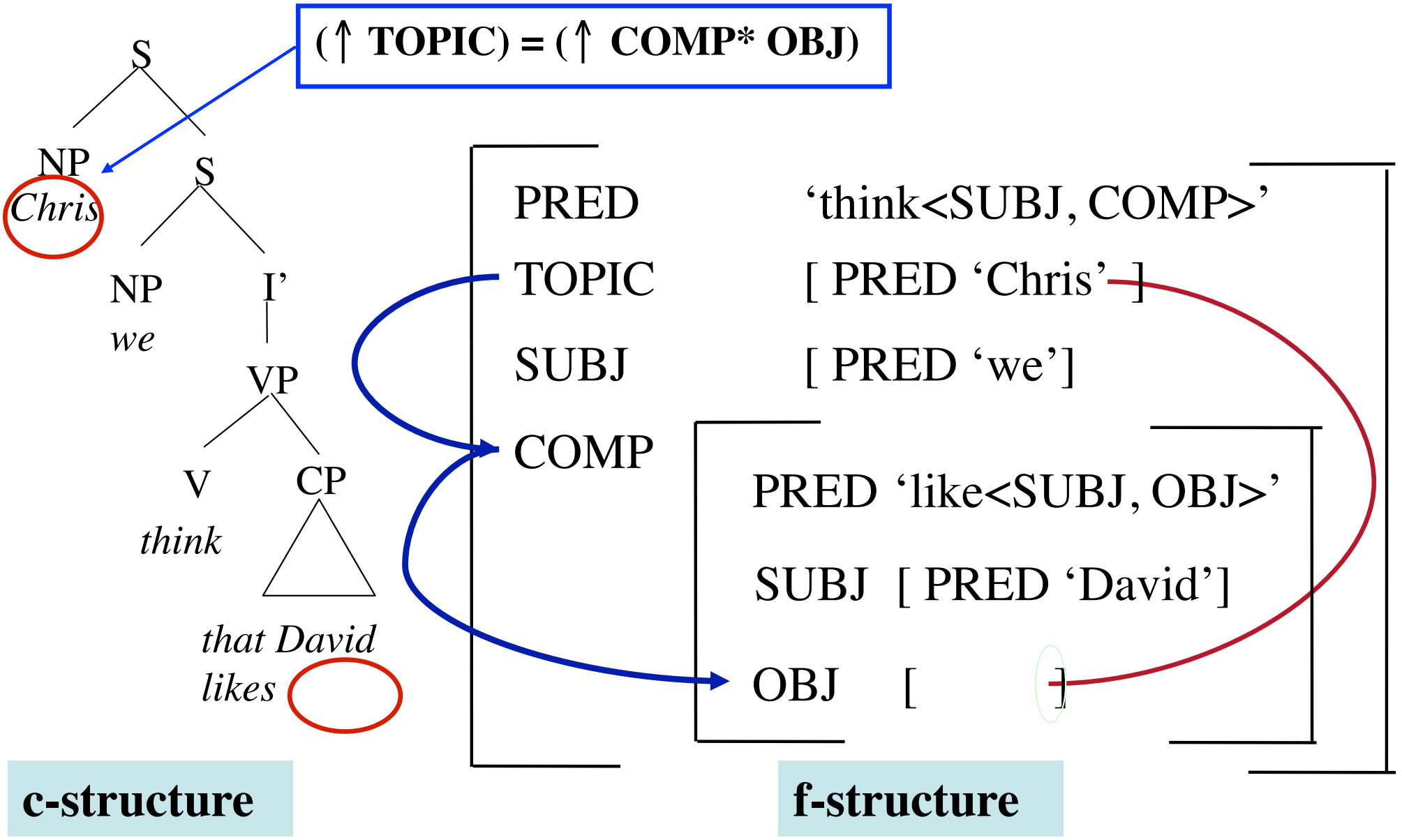
Outside-In (long-distance dependencies, Kaplan and Zaenen 1989)

$(f\ \alpha) = v$ holds iff f is an f-structure, α is a set of strings, and for some s in α, $(f\ s) = v$.

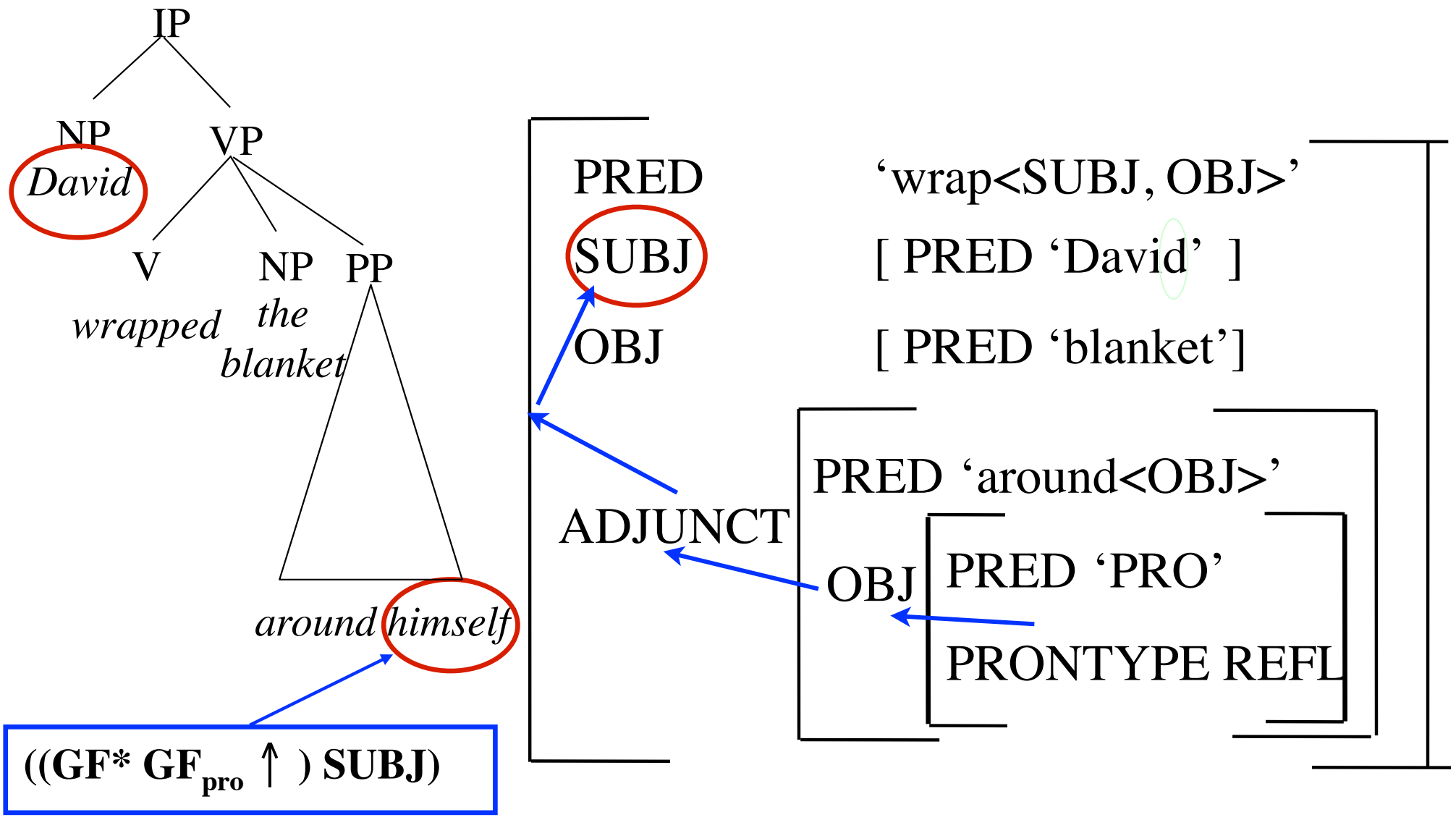
Inside-Out (first used for an analysis of anaphora, Dalrymple 1993)

$(\alpha\ f) \equiv g$ iff g is an f-structure, α is a set of strings, and for some s in α, $(s\ f) \equiv g$.

(Outside-In) Functional Uncertainty

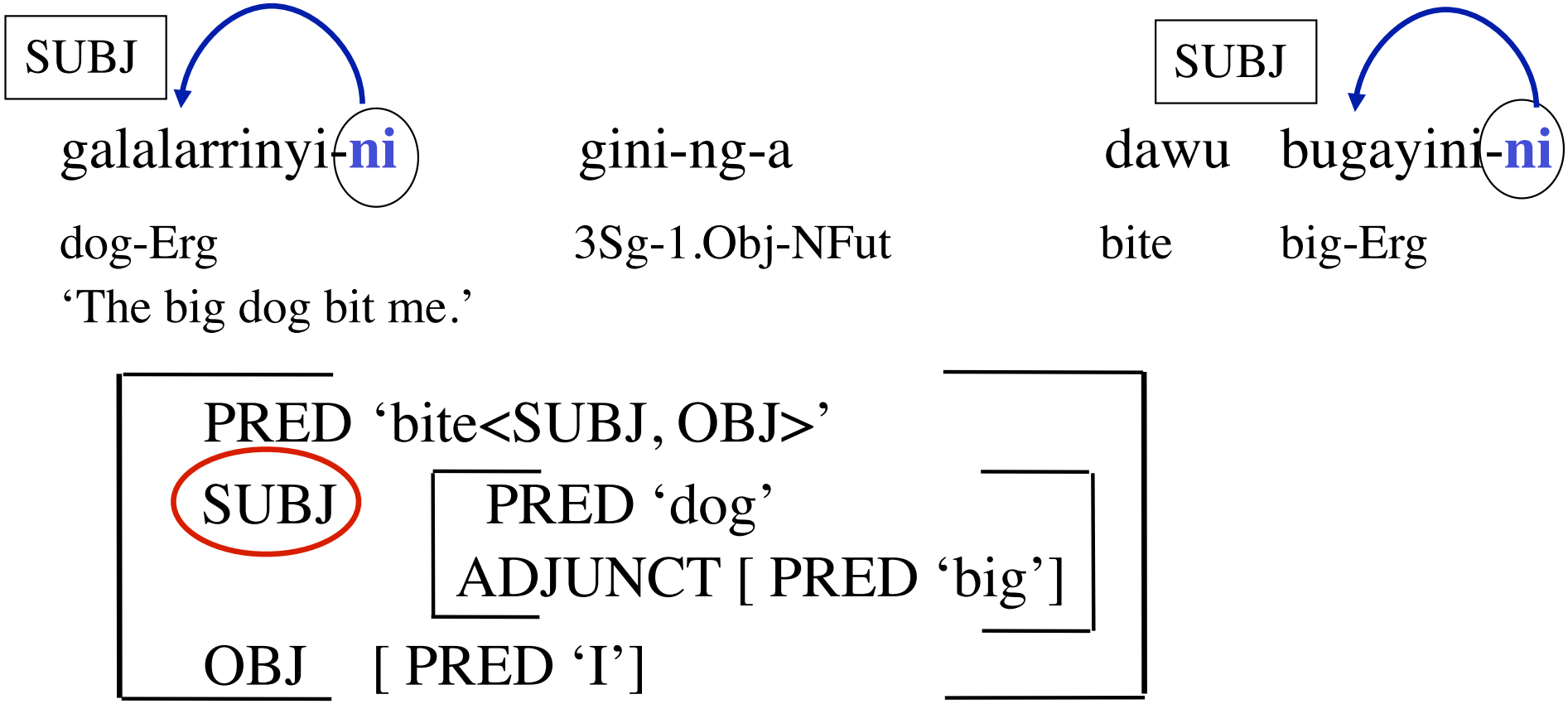


Inside-Out Functional Uncertainty



Example of IO-FU: Constructive Case

- Nordlinger (1998) shows that grammatical relations in Wambaya are determined by the case marking on the nouns.
- Called this “constructive” case.



Word Order

- English is an SVO language with fairly fixed word order.
- Many languages tend to be SOV with fairly free word order.
- More precisely: major constituents (e.g., NPs, APs) can scramble.
- The separation between c-structure and f-structure in LFG allows a very straight-forward treatment of free word order.
- The implementation with XLE is extremely simple: use the **shuffle operator**.

The Shuffle Operator

- The shuffle operator looks very insignificant.
  - It is represented by a comma.
  - It is used between the items that are meant to shuffle among one another.
- Example:

  S --> NP*, PP*, VC.

- This allows for at least the following strings:
  - NP PP VC
  - VC PP NP
  - PP PP NP VC NP
  - NP VC PP NP PP
  - ...

Practical Work

- This concludes Lesson 9.
- The practical work you should do now is detailed in Exercise 9.
- You will practice with
  - implementing a long distance dependency
  - working with the shuffle operator