

Adjunction in Minimalist Grammars

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Overview

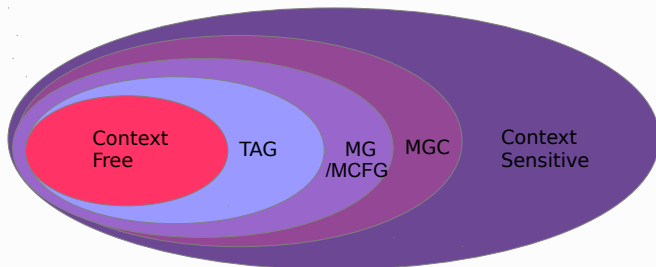
- Problem: properties of adjunction to model
- Minimalist Grammars
- Two Existing Models of Adjunction
 - Traditional Minimalist Grammar
 - “Syntactic Cartography”
- My model (MGAs)

Properties of adjuncts to be captured

- (1)
- a. The (bad) wolf *optional*
 - b. The bad wolf *transparent to selection*
 └───┬───┘
 └───┘
 - c. The big bad wolf
 - d. *The bad big wolf *strictly ordered*
 - e. The Alliance officer shot Kaylee in the cargo hold with a gun
 - f. The Alliance officer shot Kaylee with a gun in the cargo hold
Unordered
 - g. [bright blue] balloon *Adjuncts of adjuncts*
 └───┬───┘ └───┘
 └───┘
 - h. Kaylee is clever. *Selectable*

Minimalist Grammars

MGs are weakly and strongly equivalent to Multiple Context Free Grammars, putting them in the right general place for human languages

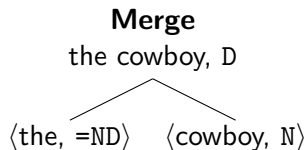


Minimalist Grammars (Stabler, 1997)

MGs are weakly and strongly equivalent to Multiple Context Free Grammars, putting them in the right general place for human languages

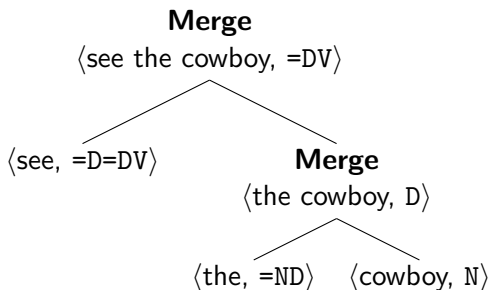
- Features on Lexical Items drive the derivation via **Merge** and **Move**
- **Features: sel** (for **Merge**): =X (positive), X (negative)

Example: Merge



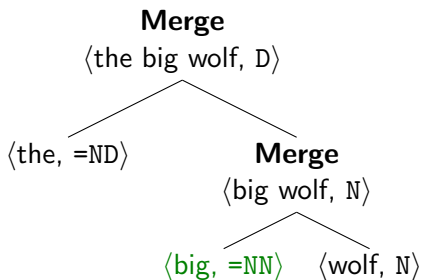
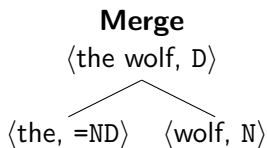
Minimalist Grammars (Stabler, 1997)

Example: Merge



Traditional MG/Categorial Grammar approach

- X-Modifier features: (Categorial Grammar: X/X or $X \setminus X$) = XX ; Verbal modifier: = VV ; Nominal modifier: = NN etc.
- ✓ Optionality
- ✗ Ordering



Traditional MG/Categorial Grammar approach

- ✓ Optional
- ✗ Transparent to selection
- ✓ Unordered
- ✗ Ordering
- ✗ Adjunct of adjunct
- ✗ Selection of adjunct

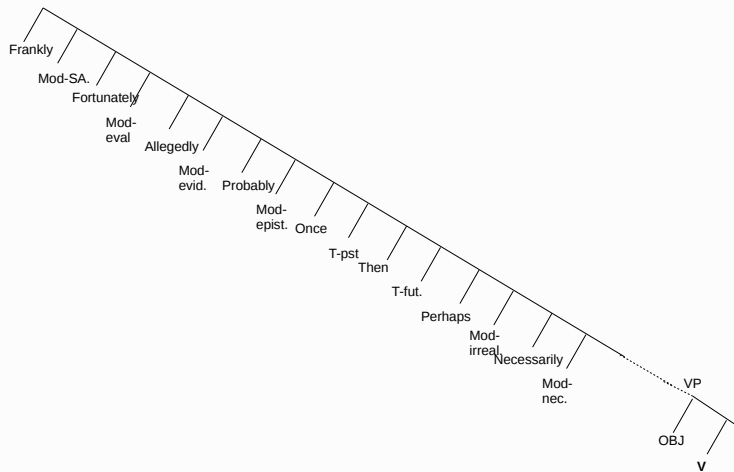
Cartography: default adjunct orders

- Using the same architecture, how can we capture ordering?
- (2)
- a. Wear the enormous ugly green hat
Wear the hat that is enormous, ugly, and green
 - b. #Wear the ugly enormous green hat
Of your enormous green hats, wear the ugly one.

Cartography (Cinque, 1999)

- (3)
- a. The **small ancient triangular green Irish pagan metal** artifact was lost.
- b. *The **metal green small** artifact was lost. **Adjectives**
- c. **Frankly**, John **probably once usually** arrived **early**.
- d. ***Usually**, John **early frankly once** arrived **probably**. **Adverbs**
- e. **[Il premio Nobel]_{top}**, **[a chi]_{wh}** lo daranno?
 [the prize Nobel]_{top}, [to whom]_{wh} it give.fut
 'The Nobel Prize, to whom will they give it?' **Left periphery**
- f. DP **zhe** [NumP **yi** [CIP **zhi** [NP **bi**]]]
 DP this [NumP one [CIP Cl [NP pen]]]
 'this pen' **Functional DP projections**

Cartography: adverbs

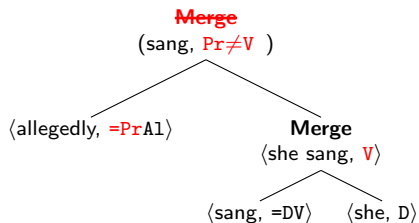


More on cartography: Problem

Allegedly, she sang

Lexicon:

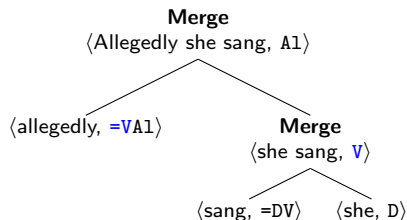
- (Allegedly, =PrAl)
- (probably, =T_{pst}Pr)
- (ε, =T_{fut}T_{pst})
- ...
- (completely, =VCo)
- (she, D)
- (sang, =D V)



Solution 1: multiplication of the lexicon

Lexicon:

- (Allegedly, =PrA1)
- (Allegedly, =T_{pst}A1)
- (Allegedly, =T_{fut} A1)
- (Allegedly, =Per A1)
- (Allegedly, =Nec A1)
- (Allegedly, =Pos A1)
- (Allegedly, =Us A1)
- (Allegedly, =Ag A1)
- ...about 20 more...
- (Allegedly, =V A1)
- (she, D)
- (sang, =D V)

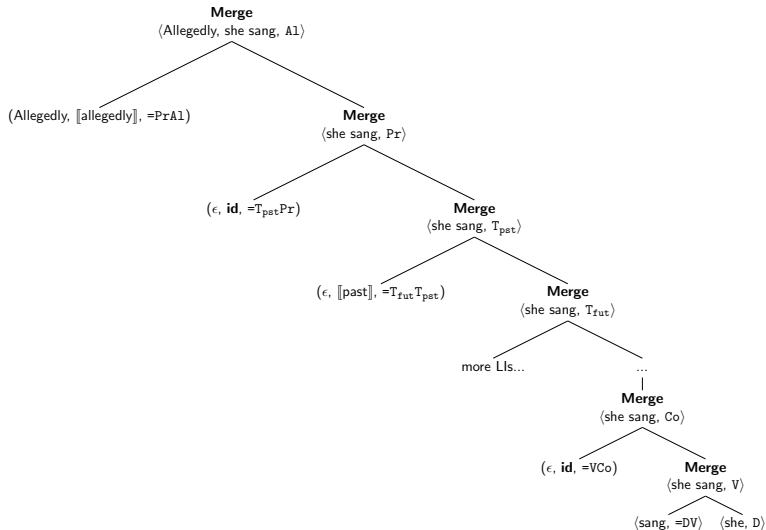


Solution 2: silent, meaningless LIs

Lexicon:

- (Allegedly, $\llbracket \text{allegedly} \rrbracket$, =PrAl)
- (ϵ , **id**, =PrAl)
- (probably, $\llbracket \text{prob} \rrbracket$, =T_{pst}Pr)
- (ϵ , **id**, =T_{pst}Pr)
- (ϵ , $\llbracket \text{past} \rrbracket$, =T_{fut}T_{pst})
- (ϵ , **id**, =T_{fut}T_{pst})
- ...
- (completely, $\llbracket \text{compl} \rrbracket$, =VCo)
- (ϵ , **id**, =VCo)
- (she, D)
- (sang, =D V)

Solution 2: silent, meaningless LIs



Cartography – Properties

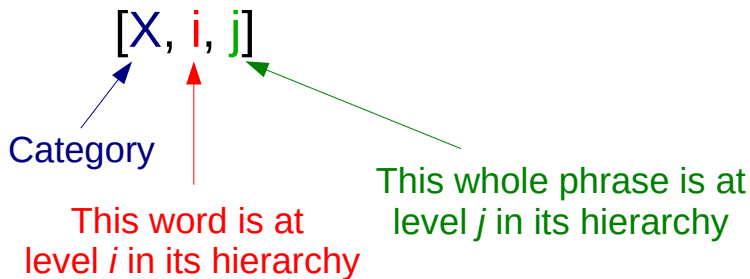
- ? **Optional**
- **X Transparent**
- ✓ **Ordering**
- **X Free ordering**
- **X Adjuncts of adjuncts** $=A_i A_{i+1}$, A_{i+1} and $=A_{i+1} Adv_j$, $=N Adv_j$
- **X Selectability**

Minimalist Grammars with Adjunction (MGAs)

Proposal

- Set of adjuncts for each category (Stabler, 2013)
- Categories are triples of $[\text{Cat}, i, j]$ with $i, j \in \mathbb{N}$. i and j encode hierarchy levels
- Add an operation **Adjoin**

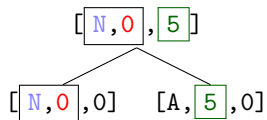
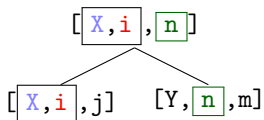
Triples



$[X, i, j]$

(for w)

Example



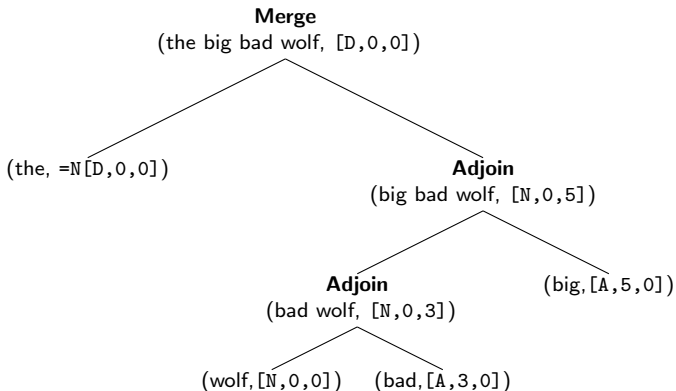
Adjoin example

The big bad wolf

$\text{ad}(N) = \{A, P\}$

Lexicon:

- $\langle \text{bad}, [A, 3, 0] \rangle$,
- $\langle \text{big}, [A, 5, 0] \rangle$,
- $\langle \text{the}, =N[D, 0, 0] \rangle$,
- $\langle \text{wolf}, [N, 0, 0] \rangle$,



Adjoin

If NP adjoins to some XP,
XP must be at level 0,
and the resulting XP will
remain at level 0

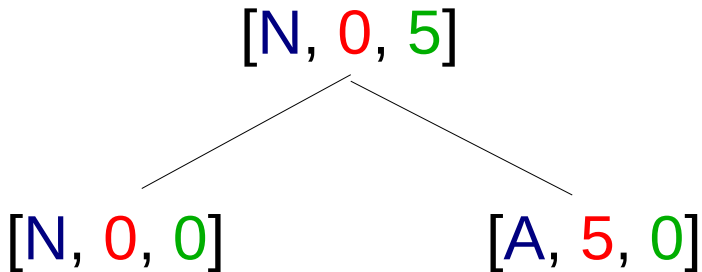
[N, 0, 0]

When AP adjoins to NP,
NP must be at level 5 or lower,
and the resulting NP will
be at level 5

[A, 5, 0]

NP and AP are at level 0
so any adjunct may adjoin to them

Adjoin



if $A \in \mathbf{Ad}(N)$

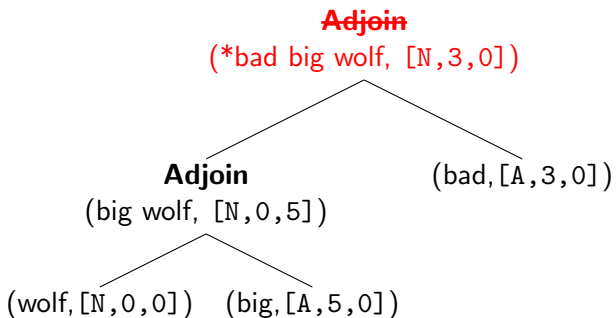
Failed example: bad adjunct order

*The bad big wolf

$\text{ad}(N) = \{A, P, C\}$

Lexicon:

- $\langle \text{bad}, [A, 3, 0] \rangle$,
- $\langle \text{big}, [A, 5, 0] \rangle$,
- $\langle \text{the}, =N[D, 0, 0] \rangle$,
- $\langle \text{wolf}, [N, 0, 0] \rangle$,



Adjoin: formal definition

Definition (Adjoin)

Let $s, t \in \Sigma$ be strings, $Y, X \in \mathbf{sel}$ be categories, $i, j, n, m \in \mathbb{N}$, $mvs \in (\Sigma^* \times F)^*$ be a mover list, and $\alpha, \beta \in F^*$.

$$\mathbf{Adjoin}(\langle s, [X, i, j]\alpha :: mvs \rangle, \langle t, [Y, n, m]\beta \rangle) = \begin{cases} \langle ts, [X, i, n]\alpha \rangle :: mvs & \text{if } n \geq j \text{ \& } Y \in \mathbf{Ad}(X) \text{ \& } \beta = \epsilon \\ \langle s, [X, i, n]\alpha \rangle :: \langle t, \beta \rangle :: mvs & \text{if } n \geq j \text{ \& } Y \in \mathbf{Ad}(X) \text{ \& } \beta \neq \epsilon \end{cases}$$

Merge: new formal definition

Definition (Merge)

For $\alpha, \beta \in F^*$; s, t strings:

Merge($\langle s, =X\alpha \rangle :: \text{mvr}_s, \langle t, [X, i, j]\beta \rangle :: \text{mvr}_t$) =

$$\begin{cases} \langle st, \alpha \rangle :: \text{mvr}_s \cdot \text{mvr}_t & \text{if } \beta = \epsilon \\ \langle s, \alpha \rangle :: \langle t, \beta \rangle :: \text{mvr}_s \cdot \text{mvr}_t & \text{if } \beta \neq \epsilon \end{cases}$$

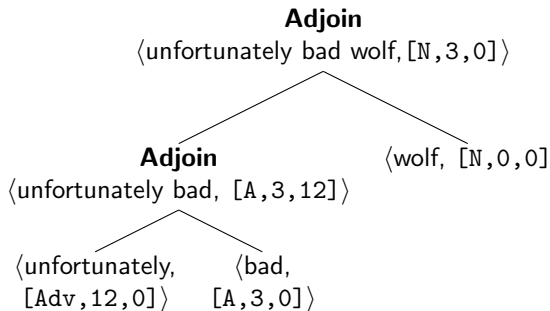
Adjuncts of adjuncts

$\text{ad}(N) = \{A, P, C\}$

$\text{ad}(V) = \{\text{Adv}, P, C\}$

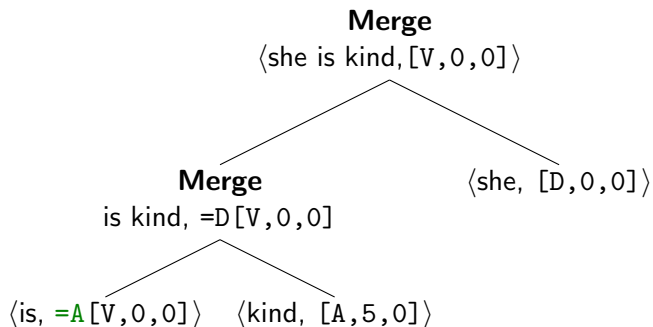
$\text{ad}(A) = \{\text{Adv}\}$

- $\langle \text{frankly}, [\text{Adv}, 12, 0] \rangle$
- $\langle \text{unfortunately}, [\text{Adv}, ,] \rangle$
- $\langle \text{allegedly}, [\text{Adv}, 10, 0] \rangle$
- $\langle \text{bad}, [A, 3, 0] \rangle$
- $\langle \text{wolf}, [N, 0, 0] \rangle$



Selecting adjuncts

She is kind



Fowlie (2013) model: Adjuncts of adjuncts

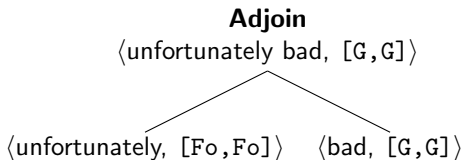
- Possible but inelegant/missing generalisations

$Fr \geq Fo \geq A1 \geq V, S \geq G \geq N, P$

$ad(N) = \{S, G, P\}$

$ad(V) = ad(S) = ad(G) = \{Fr, Fo, A1\}$

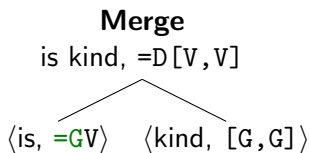
- \langle frankly,
[Fr, Fr] \rangle
- \langle unfortunately,
[Fo, Fo] \rangle
- \langle allegedly,
[A1, A1] \rangle
- \langle bad, [G, G] \rangle
- \langle wolf, [N, N] \rangle



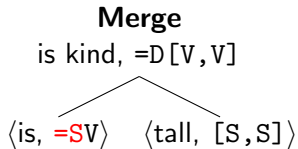
Fowlie 2013: Selecting adjuncts

- Possible but inelegant/missing generalisations

(4) She is kind



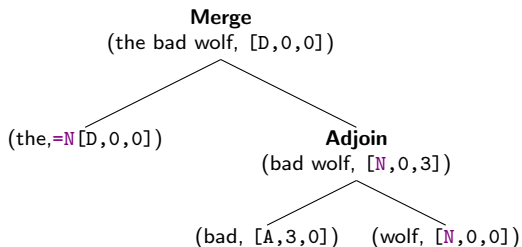
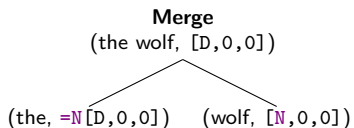
(5) She is tall



⟨is, =ad(N)V⟩

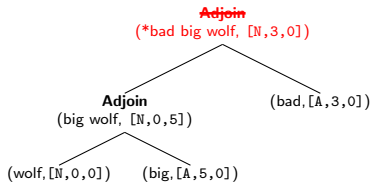
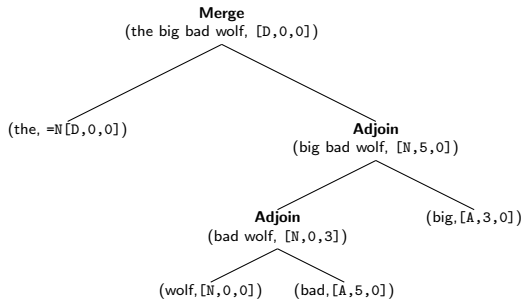
MGA – properties

Optional Transparent to selection



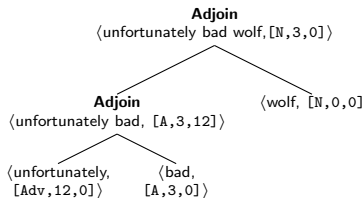
MGA – properties

✓ Ordering

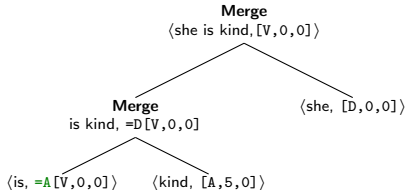


MGA - properties

✓ Adjuncts of adjuncts



✓ Selection of adjuncts



Comparison

	Trad. (=XX)	Cart. (=A ₅ A ₆)	MGAs ([X, i, j])
Optionality	✓	✗	✓
Selector selects expected category	✓	✗	✓
Adjunct does not become head	✗	✗	✓
Unordered adjuncts possible	✓	✗	✓
Ordered adjuncts possible	✗	✓	(✓)
Adjuncts of adjuncts	✗	✗	✓
Selectability	✗	✗	✓

MGA – formal properties

- Not strongly equivalent to traditional MGs: has an extra function
- Weakly equivalent to traditional MGs
- **Proof outline:**
 - $L(MG) \subseteq L(MGA)$ since you can just take out **Adjoin** and remove the indicies, and you're left with an MG
 - $L(MG) \subseteq L(MCFG) = L(MGA)$:
 - Convert each featural instance of Adjoin and Merge to a set of Multiple Context Free rules

MGA – formal properties

Merge($\langle s, =X\alpha \rangle :: \text{mvr}_s, \langle t, [X, m, n] \rangle :: \text{mvr}_t$) = $\langle st, \alpha \rangle :: \text{mvr}_s \cdot \text{mvr}_t$

$\text{mvr}_1 = \langle \langle s_1, \delta_1 \rangle, \langle s_2, \delta_2 \rangle, \dots, \langle s_i, \delta_i \rangle \rangle$

$\text{mvr}_2 = \langle \langle t_1, \gamma_1 \rangle, \langle t_2, \gamma_2 \rangle, \dots, \langle t_j, \gamma_j \rangle \rangle$

$\langle \alpha, \delta_1, \dots, \delta_i, \gamma_1, \dots, \gamma_j \rangle (st, s_1, \dots, s_i, t_1, \dots, t_j)$

$\text{:- } \langle = X\alpha, \delta_1, \dots, \delta_i \rangle (s, s_1, \dots, s_i) \langle [X, m, n], \gamma_1, \dots, \gamma_j \rangle (t, t_1, \dots, t_j)$

$\forall X \in \mathbf{sel}, \forall n, m \leq h$

Conclusion

- MGAs capture linguistic properties of adjuncts
- Generate same sentences as an MG, but more efficiently, capturing more generalisations
- Improvement over previous model (Fowlie, 2013): captures adjuncts of and selection of adjuncts efficiently
- Can be expanded to capture unordered adjuncts, functional heads, and obligatory adjuncts (**Ask me how!**)

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- Thomas Graf, Kathleen O'Flynn, Floris van Vugt, Jesse Zymet, Lisa Travis

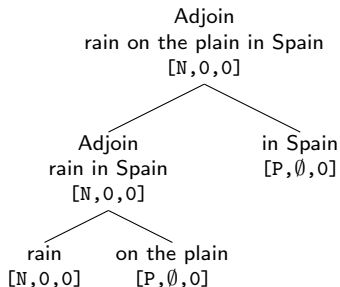
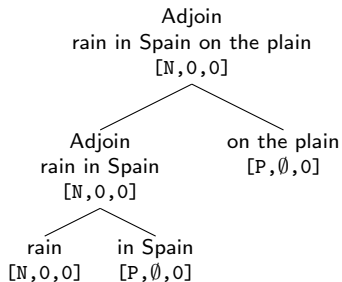
Unordered adjuncts

? Unordered

- Could make them all one level
- Or at every level
- Better: expand index set to include non-number, \emptyset
 - When **Adjoin** sees \emptyset , *asymmetrically* checks features
 - Hierarchy level of phrase doesn't change

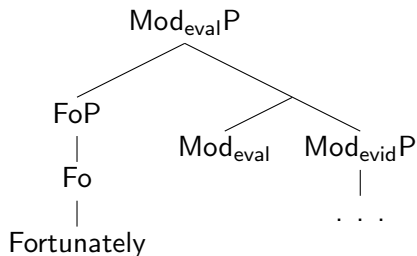
Unordered adjuncts

✓ Unordered



✓ Adjuncts on either side of head

Functional heads



- $\langle \text{fortunately}, [\text{Adv}, 27, 0] \rangle$
- $\langle \epsilon, [\text{F}, 27, 27] \rangle$

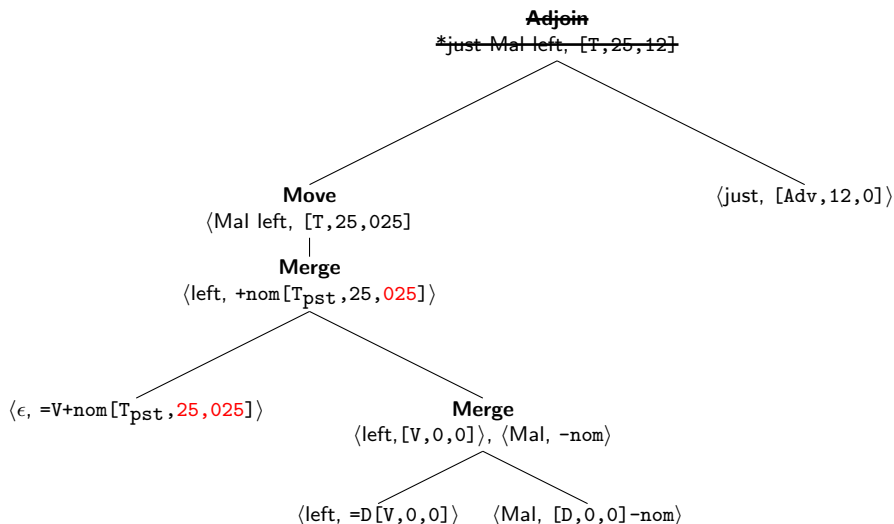
Functional heads

- Functional heads are different from adverb in that sometimes they are obligatory
- E.g. *I saw a cat* / **I saw cat*
- D is a functional head, but it is required
- Enforce requirement with **Merge**: V selects D, not N.
- E.g. T (tense) is required in English to make a sentence
- Enforce with **Merge**: C selects T, not V (or T as start category)

Functional Heads – Solution

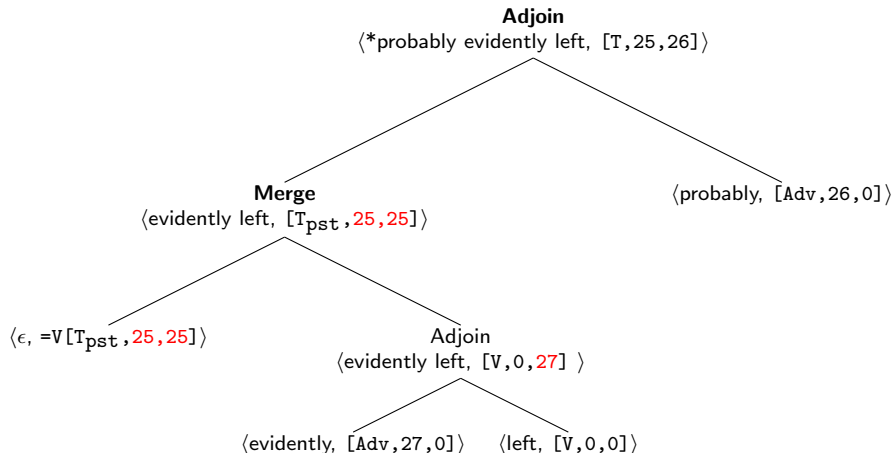
- We want functional heads to use the adjunct hierarchy, but to be able not just to adjoin, but to Merge in exactly the right place
- **Part 1:** Functional heads have category $[X, i, i]$
 - → Even after Merge, phrase is at level i
 - → Can't Adjoin lower adjunct

Functional Heads – Solution



Functional heads

Not enough: we can sneak high adjuncts under low functional heads



Functional Heads – Solution?

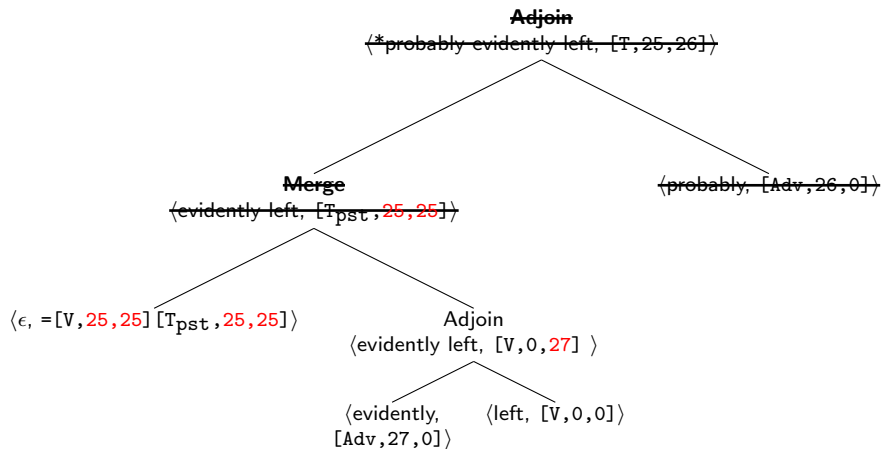
We expand Merge to exploit hierarchy:

$$\begin{array}{c}
 \text{Merge} \quad \iff j \leq i, k \leq n \\
 \alpha \\
 \swarrow \quad \searrow \\
 = [F, i, n] \alpha \quad [F, j, k]
 \end{array}$$

We restrict the lexicon: functional heads select things below them

$\text{Cat}(x) = [F, i, i]$ for some $F \in \mathbf{sel}$ and $i > 0 \iff$ feature stack of x is headed by $= [G, i, i]$ for some $G \in \mathbf{sel}$

Functional Heads

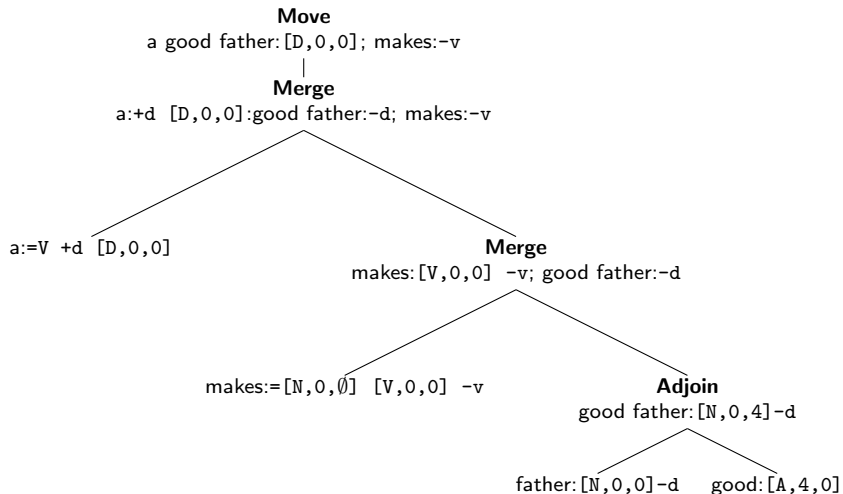


Obligatory adjuncts

- (6) a. He makes a **good** father.
b. *He makes a father.

- Noun with no adjuncts: $[N, 0, 0]$
- Noun with adjunct: $[N, 0, 3]$
- \rightarrow Expand Merge to require last element to be non-zero
- $= [N, 0, \emptyset]$ can Merge with $[N, i, j]$ for $j > 0$

Obligatory adjuncts



Note: Sportiche (2005) proposes that verbs select NPs, and the NPs move to their Ds, which are functional heads on the spine.