The Meta-ACG Preprocessor

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My situation

My PhD goal : **ACG grammar** of French interrogatives in discourse and dialogue

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- Using ACGtk
- Using **feature structures** (FS) :
  - agreement
  - anaphora resolution
- Deep syntax inspired by HPSG [**?**]
  - SLASH feature for wh-phrase extraction

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Proposal : **Meta-ACG preprocessor** to automate this process

Building a preprocessor

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Usefulness :

1. **Reduce redundancy**
2. **Simulate feature structures**

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Standard ACGtk grammar :

deep syntax

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signature Deep =
  n : type ;
  PARK : n ;
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  string = o -> o : type ;
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lexicon syntax (Deep) : Surface =
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(and similar for semantics)

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- Expected parts (conventional)
- Predictable parts
- **What really matters**

Syntax of input file

MACG syntax :

```
Command: param
  declaration
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Command: param
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```

Available commands :

- **Type** : mandatory `param` (the type name)
- **Constant**
- **Rule** : CFG rule

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Example :

```
Type: np
Type: vp
Type: s


Constant:
  John, Mary : np
  slept : vp


Rule:
  np -> vp -> s
```

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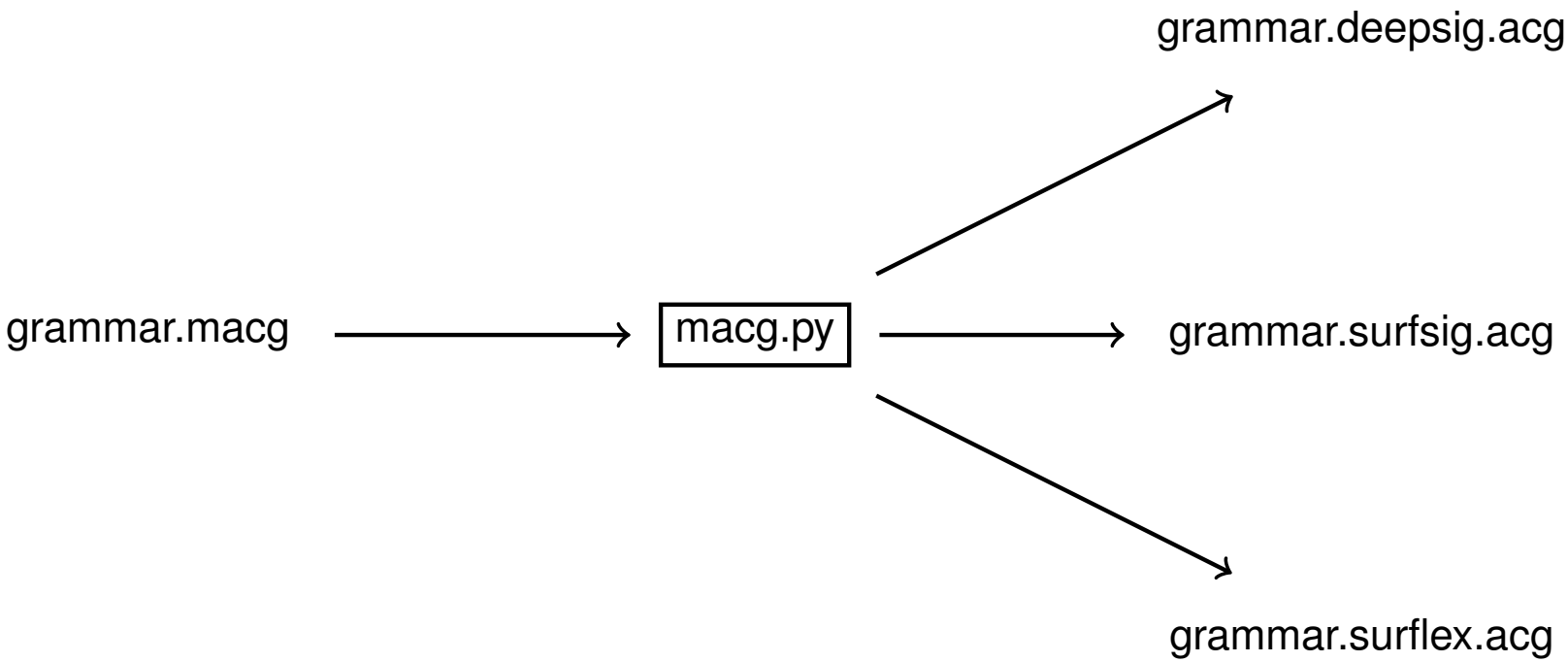
Preprocessing



Python program

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How much should be able to be customized ?

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- ? Customizable signature / lexicon names

Typed feature structures

Feature structure (FS) = set of pairs **attribute-value**

$$\text{sleeps} : \begin{bmatrix} \textit{verb} & \\ \text{AGR} & \begin{bmatrix} \textit{agreement} & \\ \text{PERSON} & 3 \\ \text{NUMBER} & \textit{singular} \end{bmatrix} \\ \text{TENSE} & \textit{present} \end{bmatrix} \tag{1}$$

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- **Typed** : each FS has predefined set of possible attributes and values

FS class :

$$\begin{bmatrix} \textit{agreement} & \\ \text{PERSON} & \{1, 2, 3\} \\ \text{NUMBER} & \{\textit{singular}, \textit{plural}\} \end{bmatrix} \quad (2)$$

FS instance :

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- **Underspecification** : some attributes may lack

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Subsumption and unification

Operations on FSs f, f'

f **subsumes** f' is they have the same type and f' specifies f more

e.g.

$$\begin{bmatrix} \textit{agreement} \\ \text{PERSON} \quad 1 \end{bmatrix} \sqsubseteq \begin{bmatrix} \textit{agreement} \\ \text{PERSON} \quad 1 \\ \text{NUMBER} \quad \textit{singular} \end{bmatrix},$$

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The **unification** of f and f' is the less specific FS g such that $f \sqsubseteq g$ and $f' \sqsubseteq g$ (if it exists)

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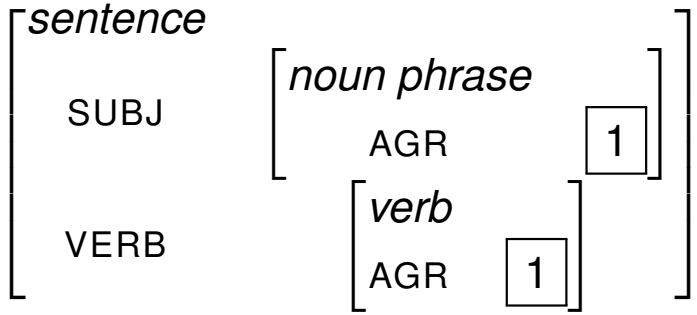
but $\begin{bmatrix} \textit{agreement} \\ \text{PERSON} \quad 1 \end{bmatrix}$ and $\begin{bmatrix} \textit{agreement} \\ \text{PERSON} \quad 2 \end{bmatrix}$ can't unify

Unification in rules

E.g. The AGR values of the subject and the verb have to unify



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$$\begin{bmatrix} \textit{sentence} & & \\ \text{SUBJ} & \begin{bmatrix} \textit{noun phrase} & \\ \text{AGR} & \boxed{1} \end{bmatrix} \\ \text{VERB} & \begin{bmatrix} \textit{verb} & \\ \text{AGR} & \boxed{1} \end{bmatrix} \end{bmatrix}$$

$$\begin{bmatrix} \textit{noun phrase} & & \\ \text{AGR} & \boxed{2} & \begin{bmatrix} \textit{agreement} & \\ \text{PERSON} & 2 \end{bmatrix} \end{bmatrix}$$

you

$$\begin{bmatrix} \textit{verb} & & \\ \text{AGR} & \boxed{3} & \begin{bmatrix} \textit{agreement} \\ \textit{past} \end{bmatrix} \\ \text{TENSE} & & \end{bmatrix}$$

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Parsing is **findind** $\boxed{1}$ such that $\boxed{1} = \boxed{2} \sqcup \boxed{3}$

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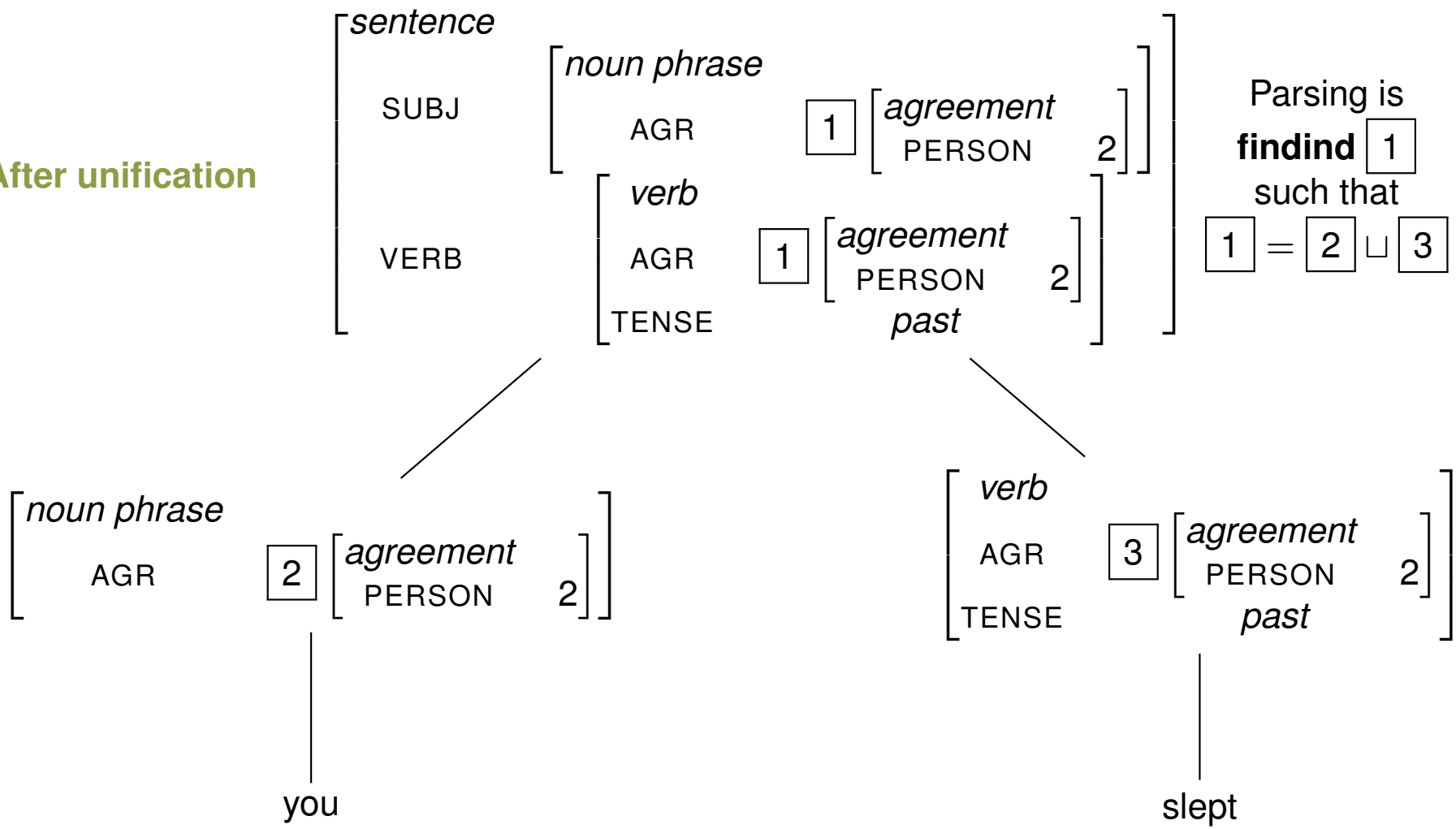

Simulating FSs with simple types

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As many atomic types as possible FSs : **full instances**

FS class

$$\begin{bmatrix} v & \\ \text{AGR} & \begin{bmatrix} agr & \\ \text{P} & \{1,2,3\} \\ \text{N} & \{sg, pl\} \end{bmatrix} \\ \text{T} & \{prst, past\} \end{bmatrix}$$

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Fully specified FSs

$$\begin{bmatrix} v & \\ \text{AGR} & \begin{bmatrix} agr & \\ \text{P} & 1 \\ \text{N} & sg \end{bmatrix} \\ \text{T} & prst \end{bmatrix} \quad \begin{bmatrix} v & \\ \text{AGR} & \begin{bmatrix} agr & \\ \text{P} & 2 \\ \text{N} & sg \end{bmatrix} \\ \text{T} & prst \end{bmatrix} \quad \cdots \quad \begin{bmatrix} v & \\ \text{AGR} & \begin{bmatrix} agr & \\ \text{P} & 3 \\ \text{N} & pl \end{bmatrix} \\ \text{T} & past \end{bmatrix}$$

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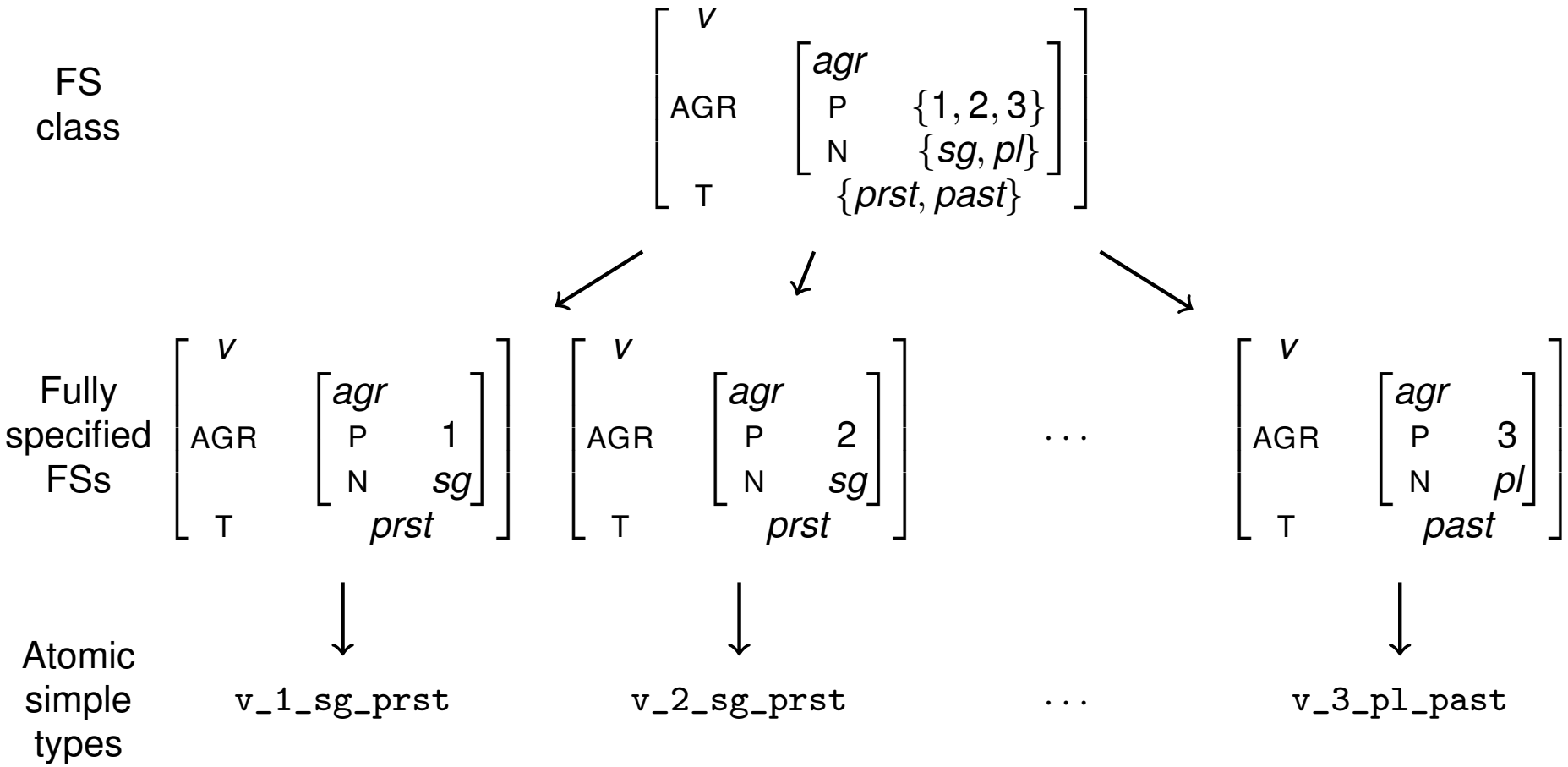

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MACG syntax like NLTK (python)

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Type classes must be defined before !

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Type: agr
  P : 1, 2, 3
  N : sg, pl
Type: vp
  AGR : agr
  T : prst, past
Type: s
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Additional functionalities :

- boolean features, e.g. `is : v[+AUX]`
- Absence of a feature, e.g. no agreement `be : v[-AGR, T=inf]`

Formal proof of work

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Property

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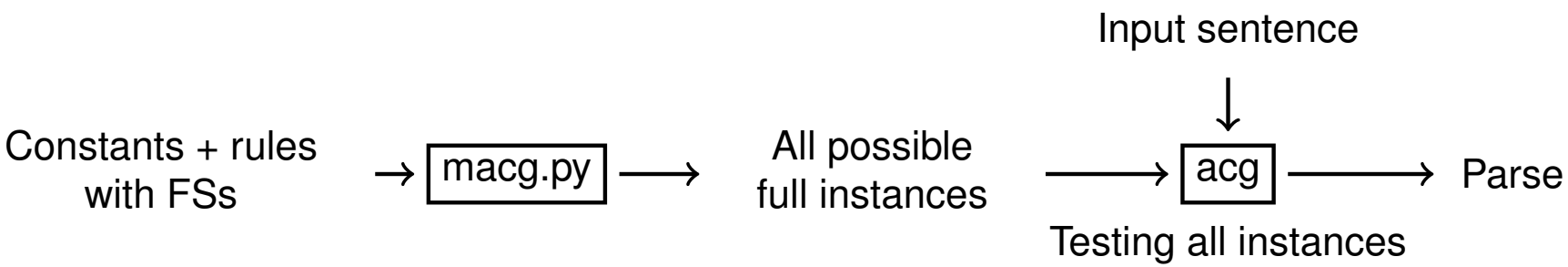

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Future prospects :

- □ Higher-order types
- □ (Concatenative) morphological rules
- ? Type hierarchy and inheritance
- ? Reentrancy