Noncanonical Parsing

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10 mai 2006

Java Declarations

Gosling et al. [1996]

Example

```
public class Declarations {
    public final static int FIELD = 10;
    public static int method (int i) {
        // ...
    }
}
```

Java Grammar

Gosling et al. [1996]

Example

```
public class Declarations {
    public final static int FIELD = 10;
    public static int method (int i) {
        // ...
    }
}
```

$$<FDecl> \rightarrow <FModS>\ <Type>\ <VDeclS>\ ;$$
$$<FModS> \rightarrow <FModS><FMod> \mid \varepsilon$$
$$<FMod> \rightarrow \texttt{public} \mid \texttt{final} \mid \texttt{static} \mid \texttt{transient} \mid \ldots$$
$$<Type> \rightarrow <NonVoidType>$$
$$<MHead> \rightarrow <MModS><ResType><MDecl><Throws>$$
$$<MModS> \rightarrow <MModS><MMod> \mid \varepsilon$$
$$<MMod> \rightarrow \texttt{public} \mid \texttt{final} \mid \texttt{static} \mid \texttt{abstract} \mid \ldots$$
$$<ResType> \rightarrow <NonVoidType> \mid \texttt{void}$$

Java Grammar

Gosling et al. [1996]

Example

```
public class Declarations {
    public final static int FIELD = 10;
    public static int method (int i) {
        // ...
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$$<FDecl> \rightarrow <FModS> \ <Type> \ <VDeclS> \ ;$$
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Java Grammar

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Java Grammar

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$$\langle ResType \rangle \rightarrow \langle NonVoidType \rangle \mid \texttt{void}$$

Parsing Java Declarations

Example

```
public final static int FIELD = 10 ;
```

$ ‖ public final static int FIELD = 10;$

Parsing Java Declarations

Example

FModS

ε public final static int FIELD = 10 ;

$ε ‖ public final static int FIELD = 10;$

$\vdash_{\text{reduce}}$ $<FModS> ‖ public final static int FIELD = 10;$

Parsing Java Declarations

Example

FModS

ε public final static int FIELD = 10 ;

$\$ <\mathit{FModS}> \parallel \texttt{public final static int FIELD = 10;}\$$

$\vdash_{\text{shift}} \$ <\mathit{FModS}> \texttt{public} \parallel \texttt{final static int FIELD = 10;}\$$

Parsing Java Declarations

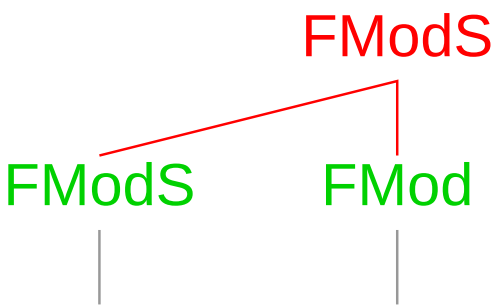
Example

$$\$ < FModS > \texttt{public} \parallel \texttt{final static int FIELD = 10;\$}$$

$$\vdash_{\text{reduce}} \$ < FModS > < FMod > \parallel \texttt{final static int FIELD = 10;\$}$$

Parsing Java Declarations

Example

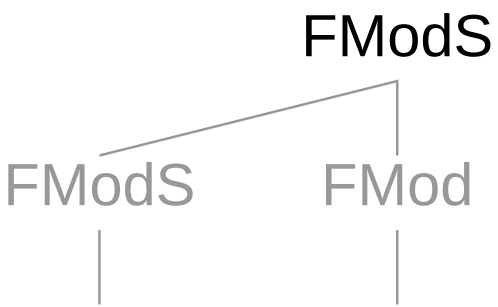


$$\$ < FModS > < FMod > \parallel \texttt{final static int FIELD = 10;} \$$$

$$\vdash_{\text{reduce}} \$ < FModS > \parallel \texttt{final static int FIELD = 10;} \$$$

Parsing Java Declarations

Example



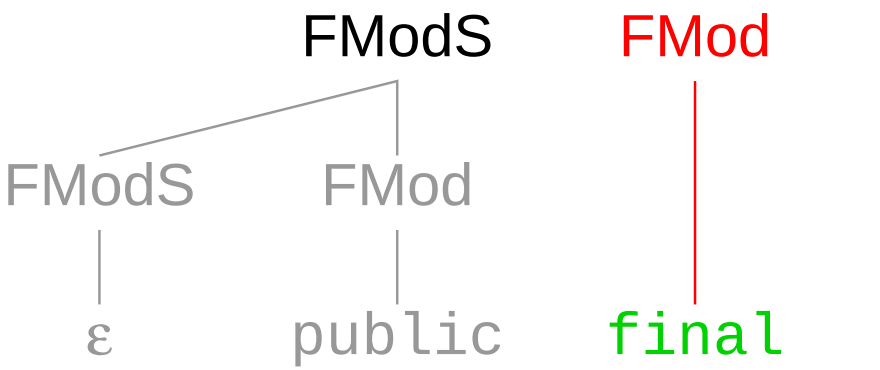
`public final static int FIELD = 10 ;`

$$\$ < FModS > \parallel \texttt{final static int FIELD = 10;} \$$$

$$\vdash_{\text{shift}} \$ < FModS > \texttt{final} \parallel \texttt{static int FIELD = 10;} \$$$

Parsing Java Declarations

Example

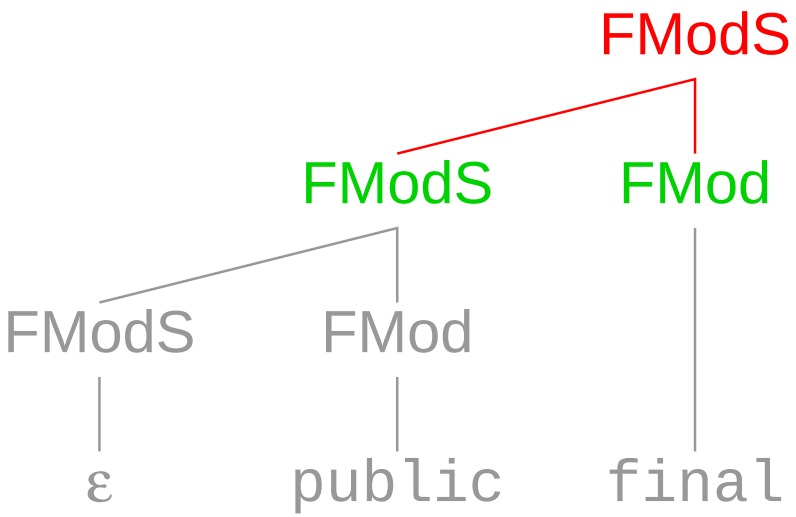


$$\$ < \mathit{FModS} > \texttt{final} \parallel \texttt{static int FIELD = 10;\$}$$

$$\models_{\text{reduce}} \$ < \mathit{FModS} > < \mathit{FMod} > \parallel \texttt{static int FIELD = 10;\$}$$

Parsing Java Declarations

Example

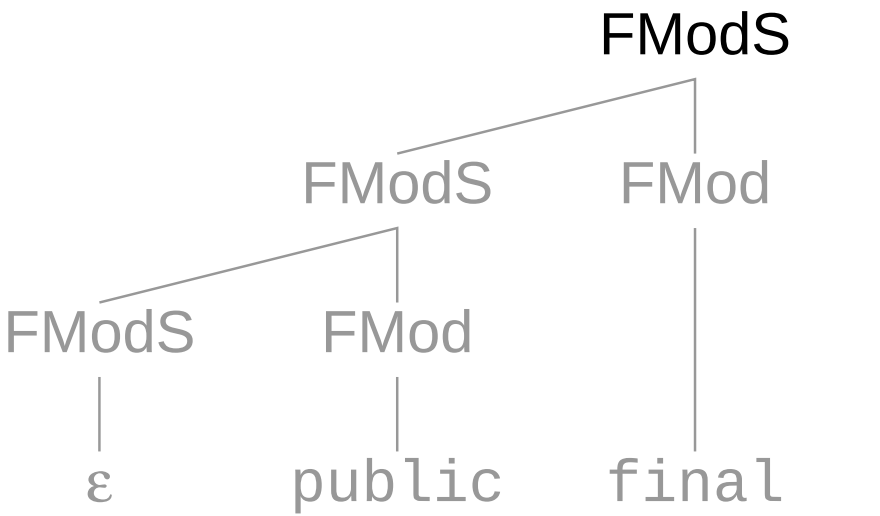


$$\$ < \mathit{FModS} > < \mathit{FMod} > \| \texttt{static int FIELD = 10;\$}$$

$$\models_{\text{reduce}} \$ < \mathit{FModS} > \| \texttt{static int FIELD = 10;\$}$$

Parsing Java Declarations

Example



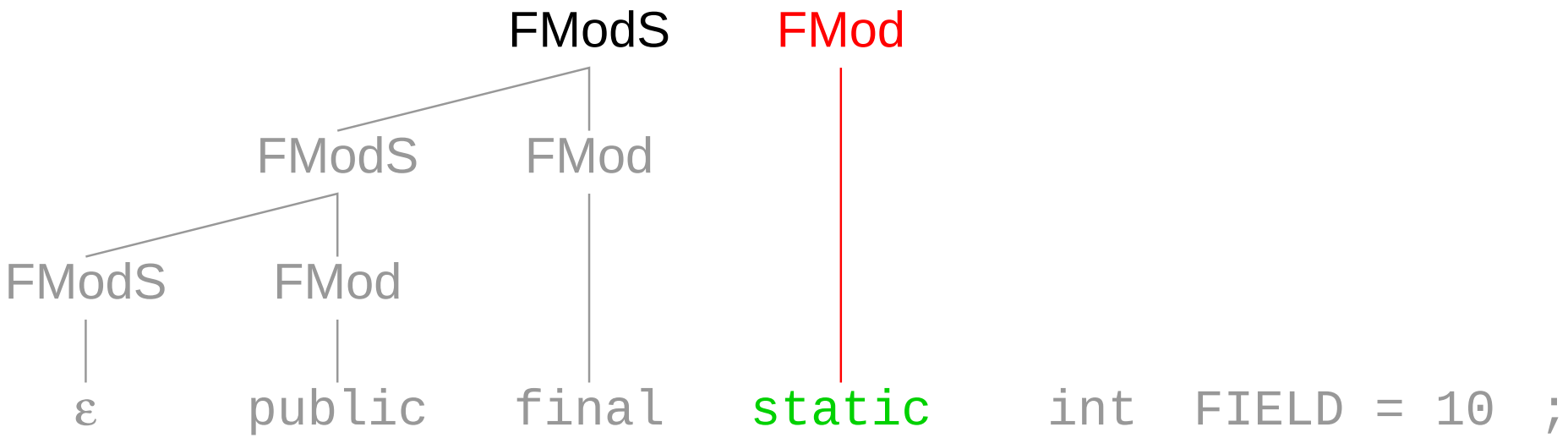
`static int FIELD = 10 ;`

$$\$ < FModS > \parallel \texttt{static int FIELD = 10;} \$$$

$$\vdash_{\text{shift}} \$ < FModS > \texttt{static} \parallel \texttt{int FIELD = 10;} \$$$

Parsing Java Declarations

Example

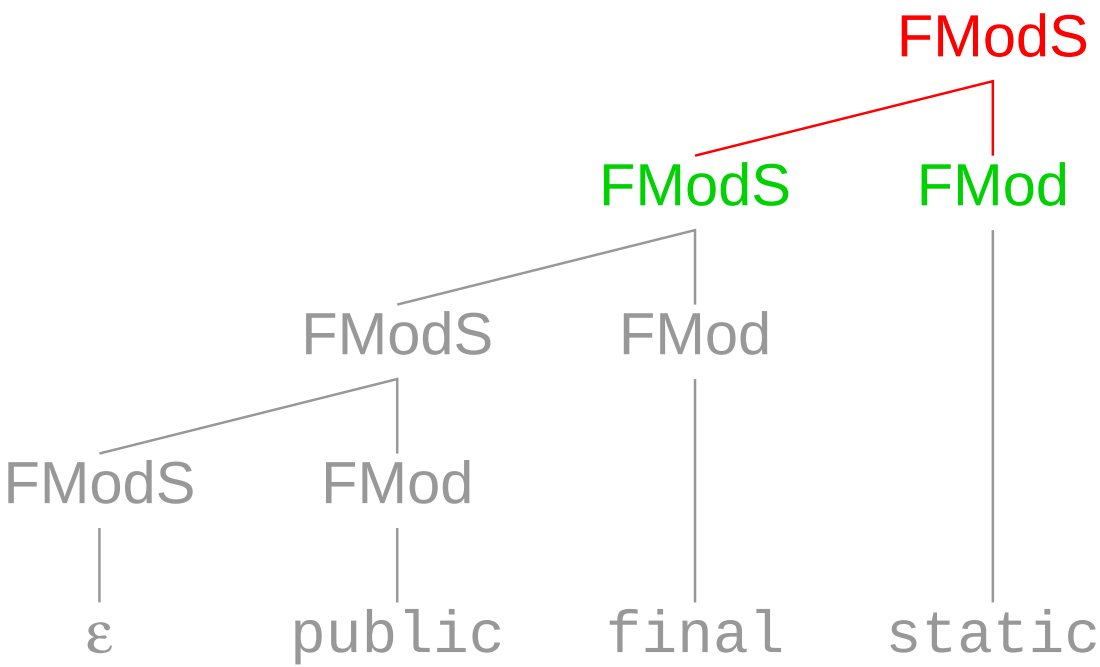


$$\$ < \mathit{FModS} > \texttt{static} \parallel \texttt{int FIELD = 10;\$}$$

$$\models_{\text{reduce}} \$ < \mathit{FModS} > < \mathit{FMod} > \parallel \texttt{int FIELD = 10;\$}$$

Parsing Java Declarations

Example



$$\$ < \mathit{FModS} > < \mathit{FMod} > \parallel \texttt{int FIELD = 10;\$}$$

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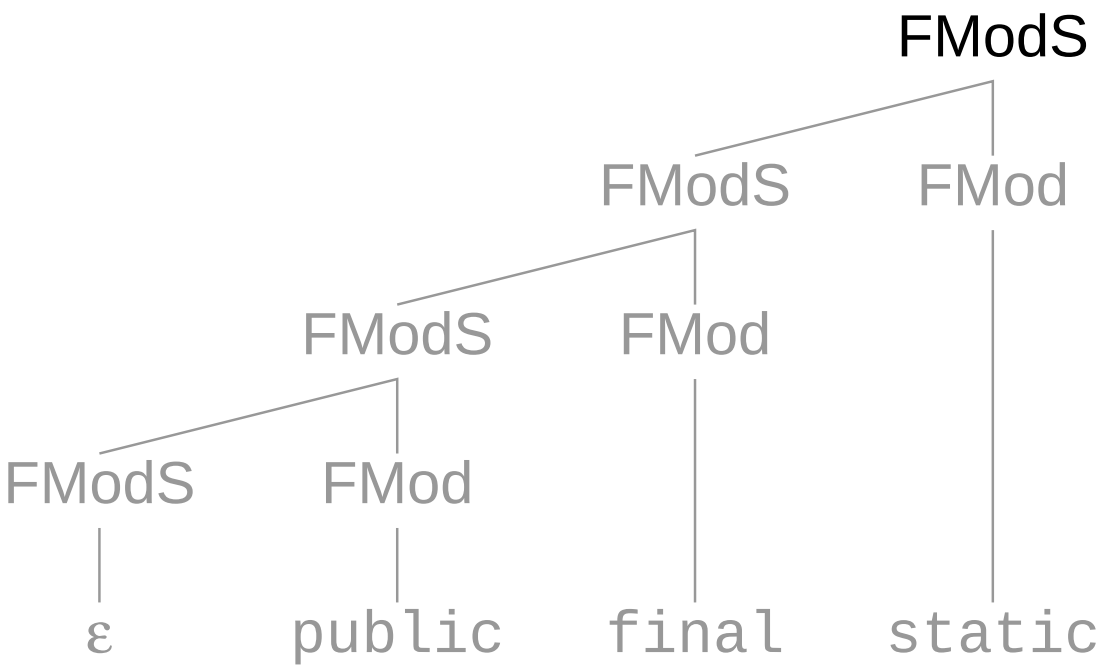
Parsing Java Declarations

Example



$$\$ < \mathit{FModS} > \parallel \texttt{int FIELD = 10;\$}$$

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Parsing Java Declarations

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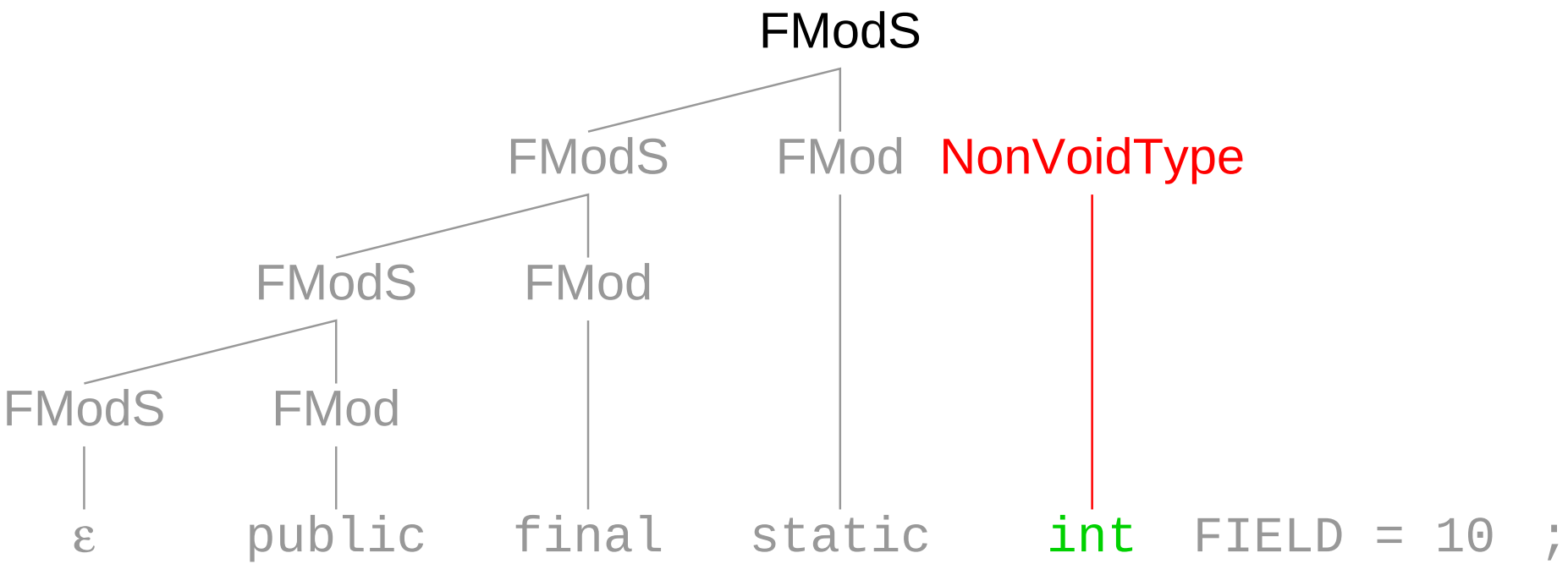
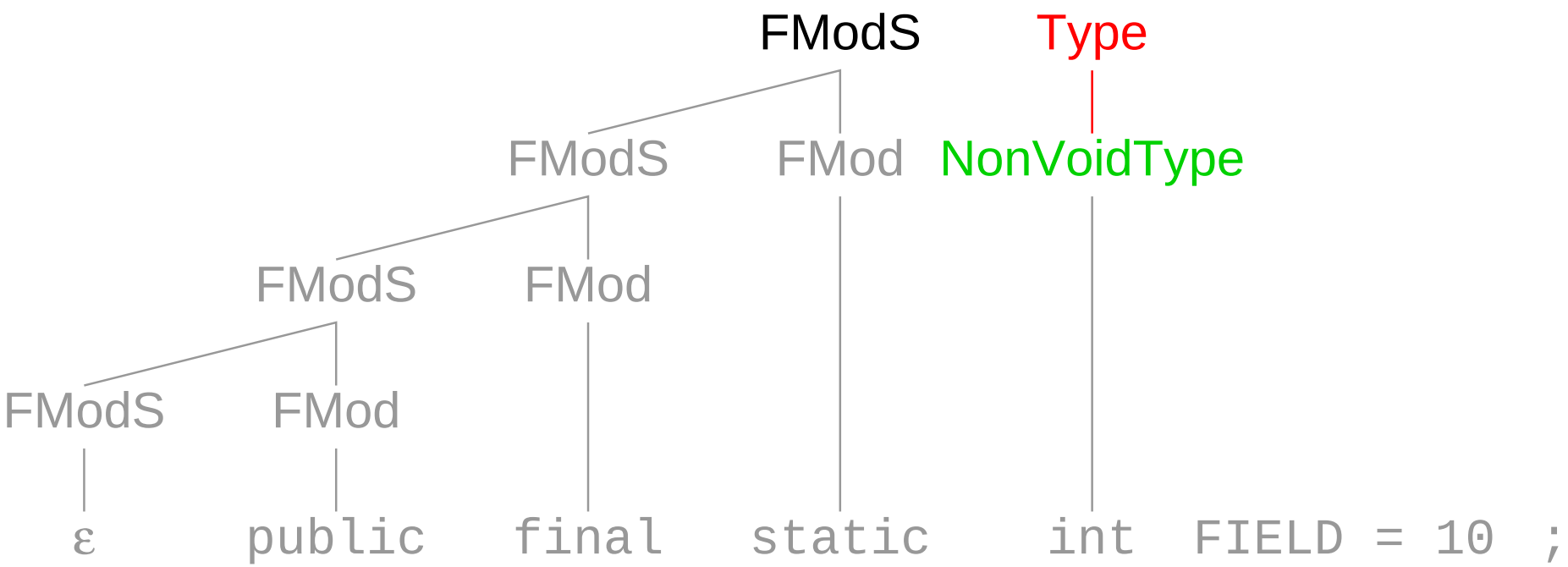


$$\$ < FModS > \texttt{int} \parallel \texttt{FIELD} = \texttt{10;}\$$$

$$\models_{\text{reduce}} \$ < FModS > < NonVoidType > \parallel \texttt{FIELD} = \texttt{10;}\$$$

Parsing Java Declarations

Example

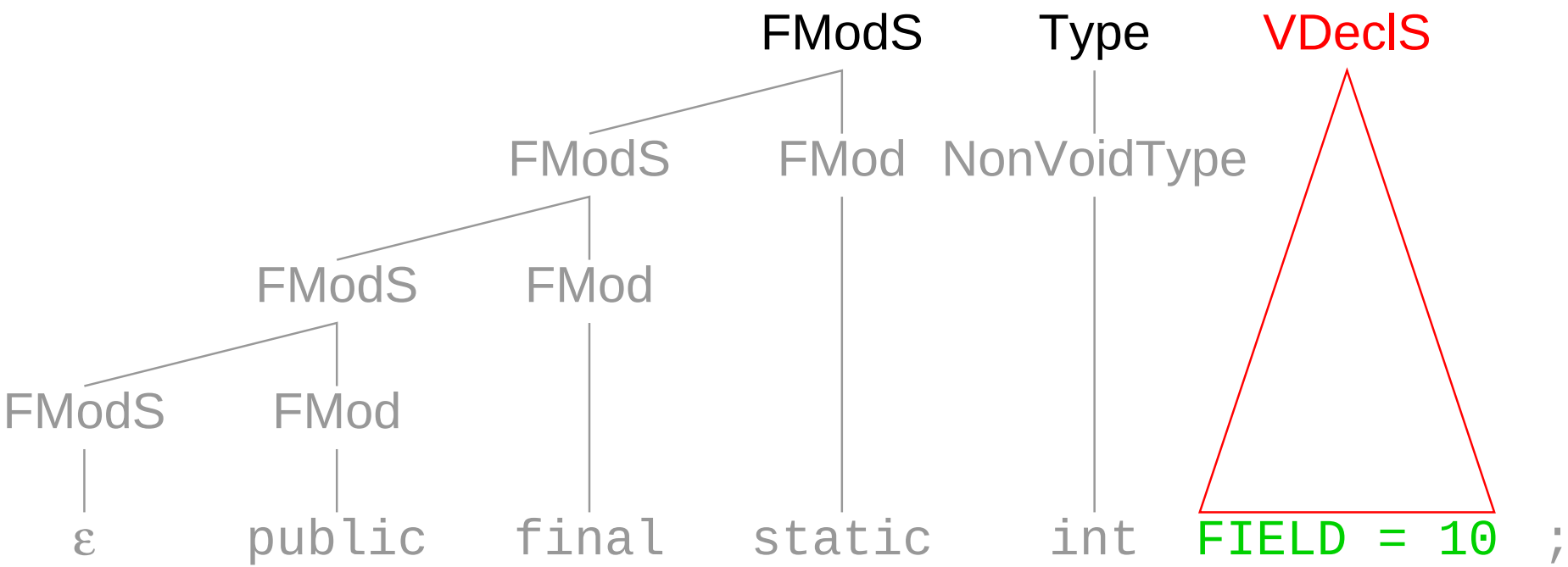


$$\$ < FModS > < NonVoidType > \| \texttt{FIELD} = \texttt{10;}\$$$

$$\models_{\text{reduce}} \$ < FModS > < Type > \| \texttt{FIELD} = \texttt{10;}\$$$

Parsing Java Declarations

Example

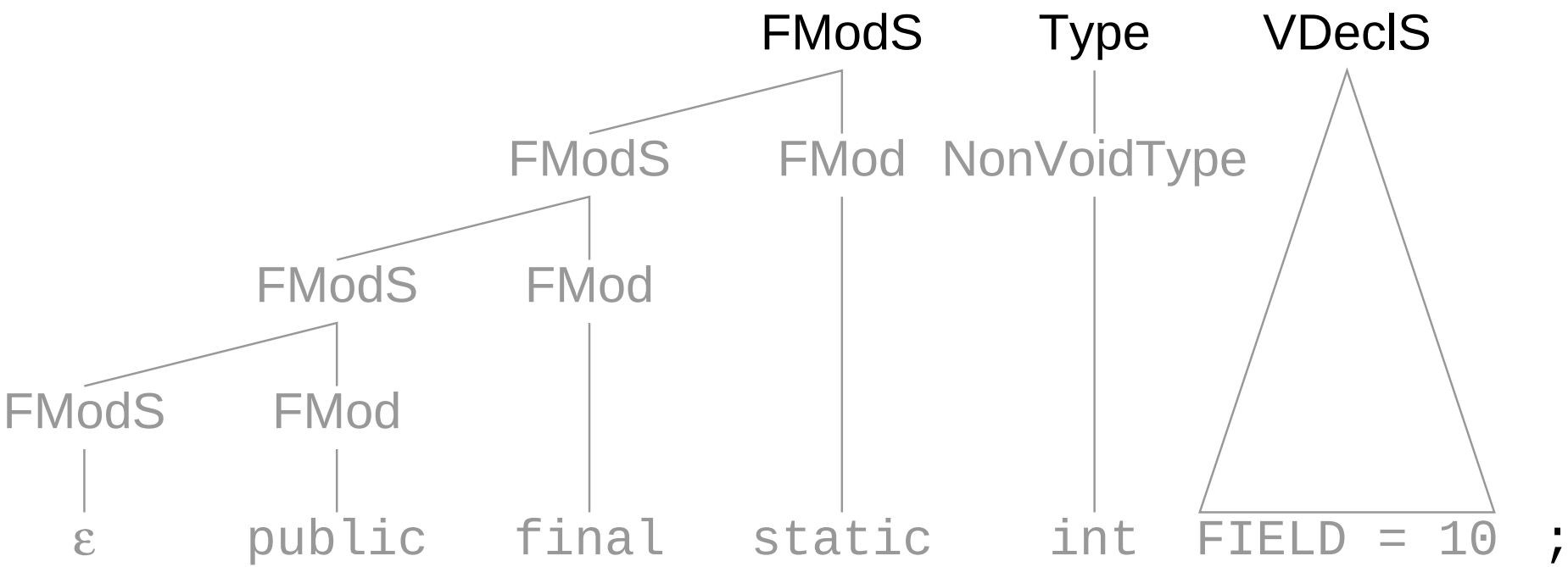


$$\$ < FModS > < Type > \texttt{FIELD} = 10 \parallel ;\$$$

$$\models_{\text{reduce}} \$ < FModS > < Type > < VDeclS > \parallel ;\$$$

Parsing Java Declarations

Example



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Parsing Java Declarations

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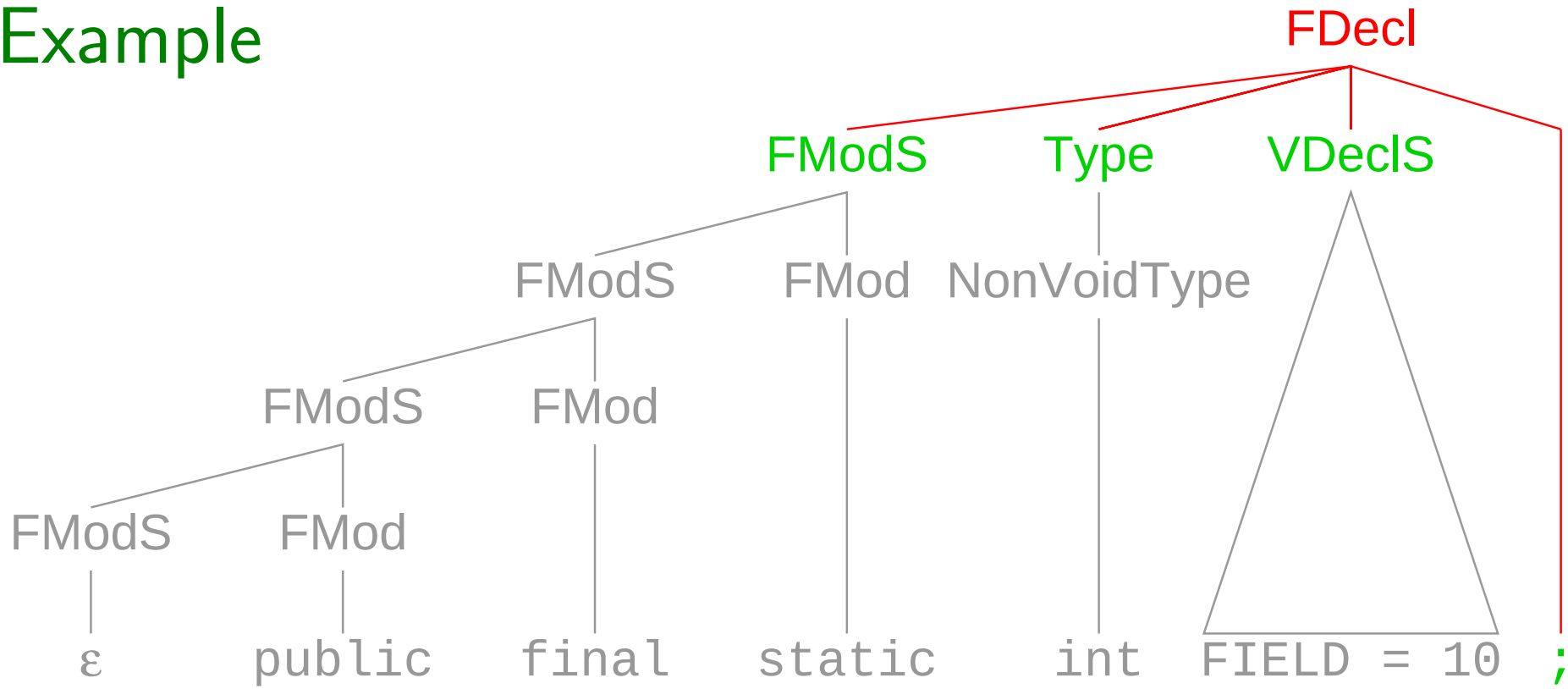

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Parsing Java Declarations

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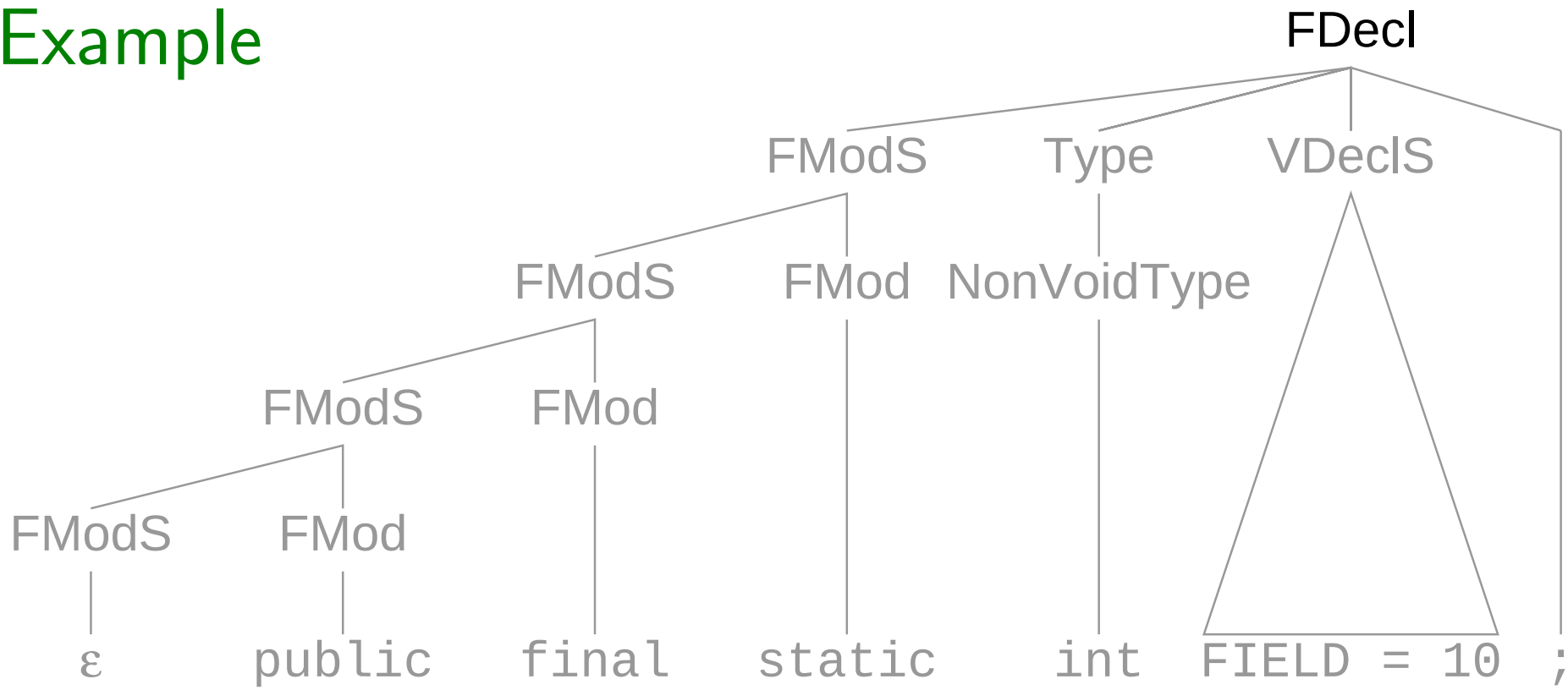

$$\$ < FDecl > \ \| \ \$$$

Nondeterminism

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```
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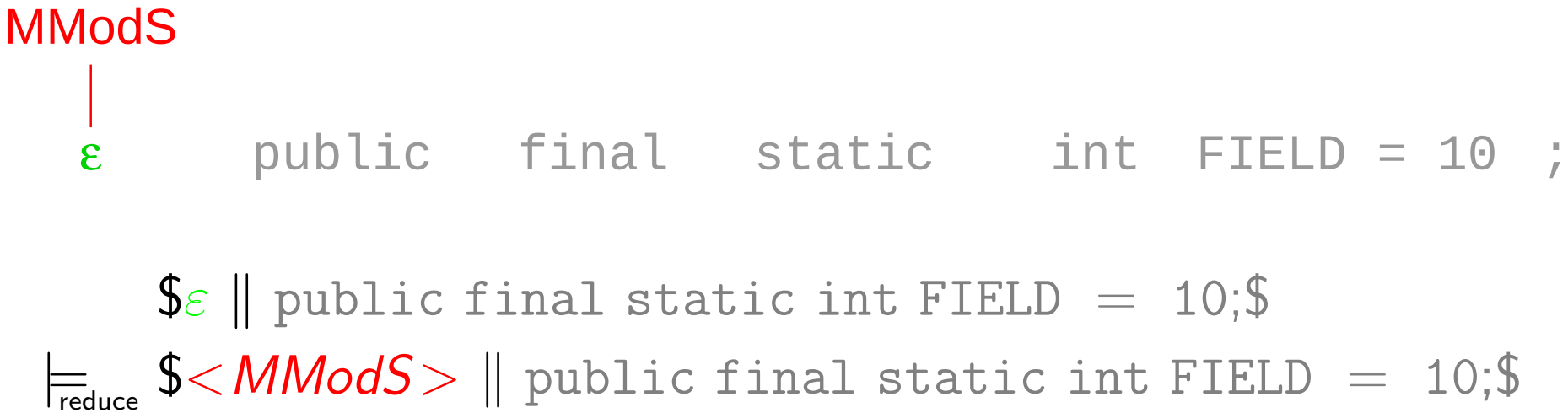

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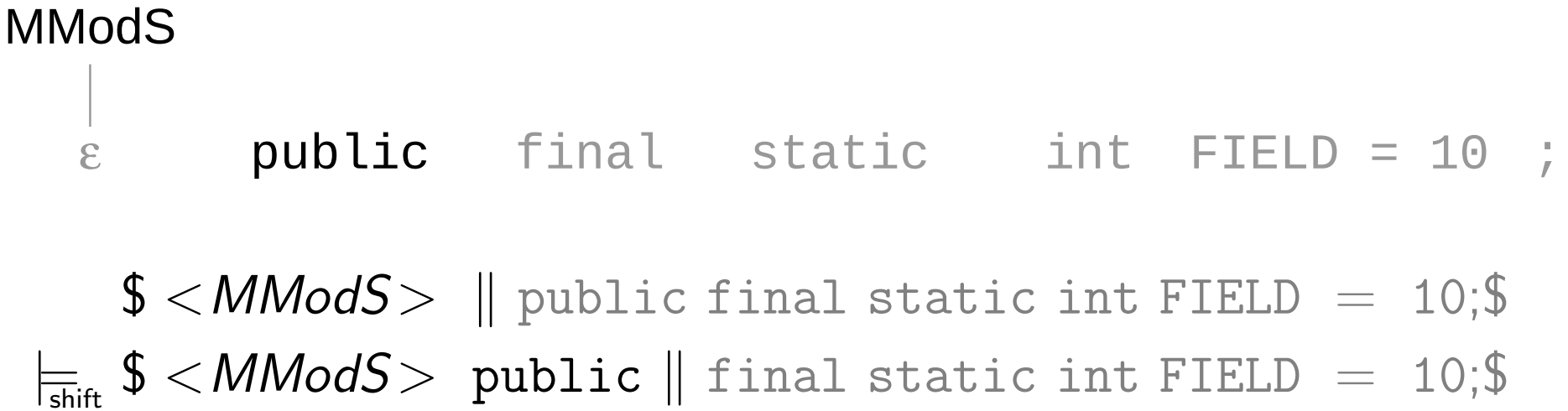

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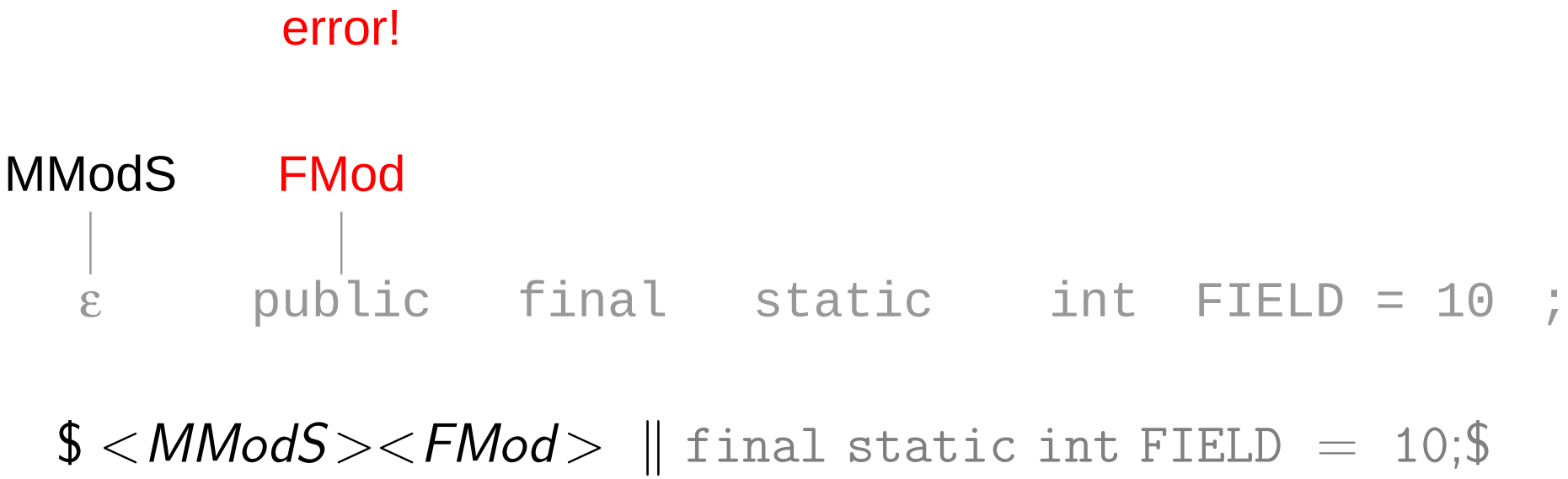
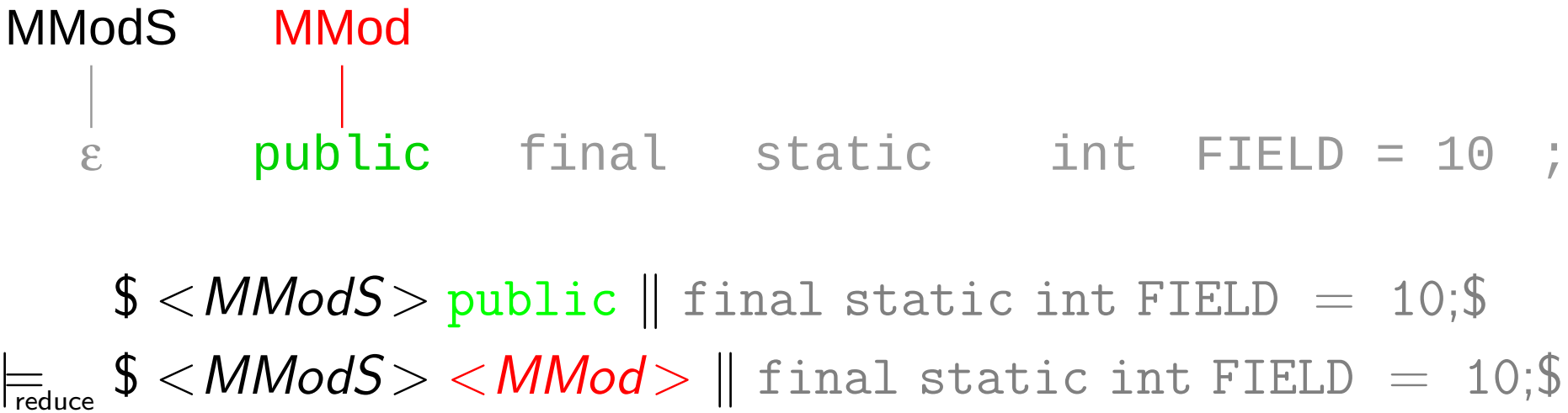


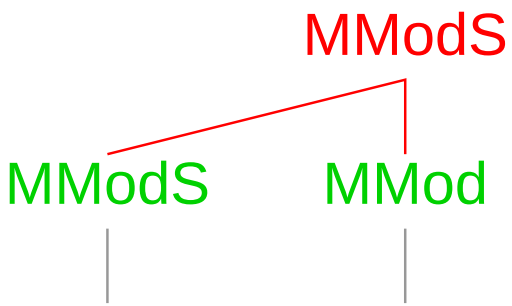
Nondeterminism

Example



Nondeterminism

Example

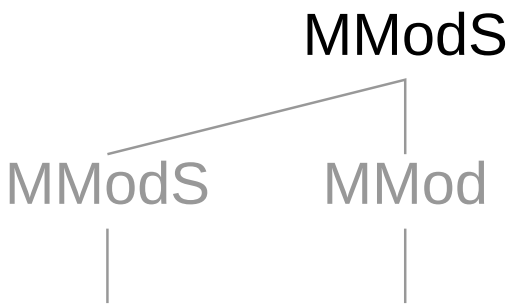


$$\$ \langle \mathit{MModS} \rangle \langle \mathit{MMod} \rangle \parallel \texttt{final static int FIELD = 10;\$}$$

$$\models_{\text{reduce}} \$ \langle \mathit{MModS} \rangle \parallel \texttt{final static int FIELD = 10;\$}$$

Nondeterminism

Example



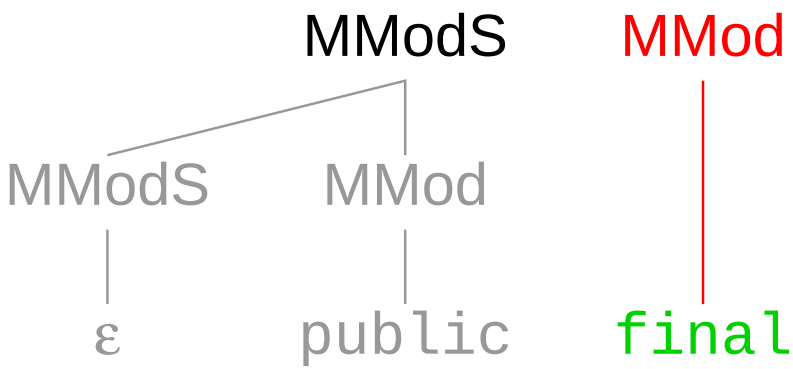

```
public final static int FIELD = 10 ;
```

$$\$ < \mathit{MModS} > \parallel \texttt{final static int FIELD = 10;\$}$$

$$\vdash_{\text{shift}} \$ < \mathit{MModS} > \texttt{final} \parallel \texttt{static int FIELD = 10;\$}$$

Nondeterminism

Example

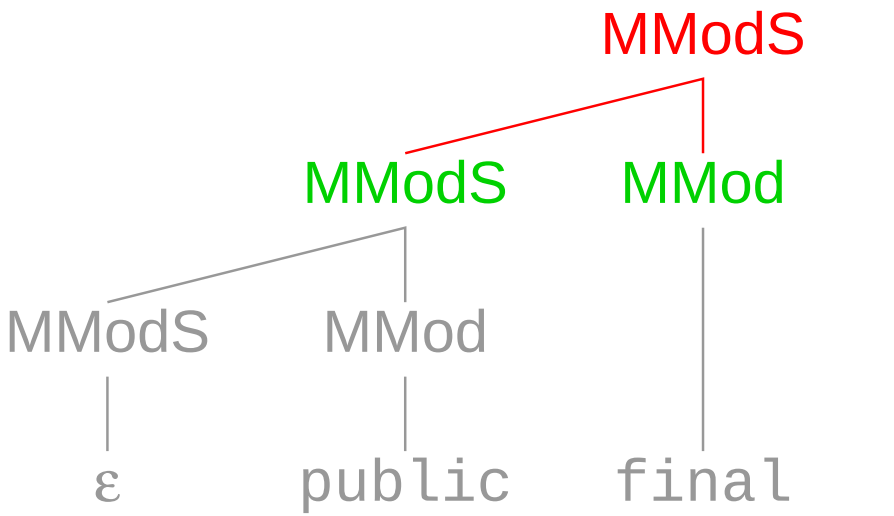


$$\$ < \mathit{MModS} > \texttt{final} \parallel \texttt{static int FIELD = 10;\$}$$

$$\vdash_{\text{reduce}} \$ < \mathit{MModS} > < \mathit{MMod} > \parallel \texttt{static int FIELD = 10;\$}$$

Nondeterminism

Example

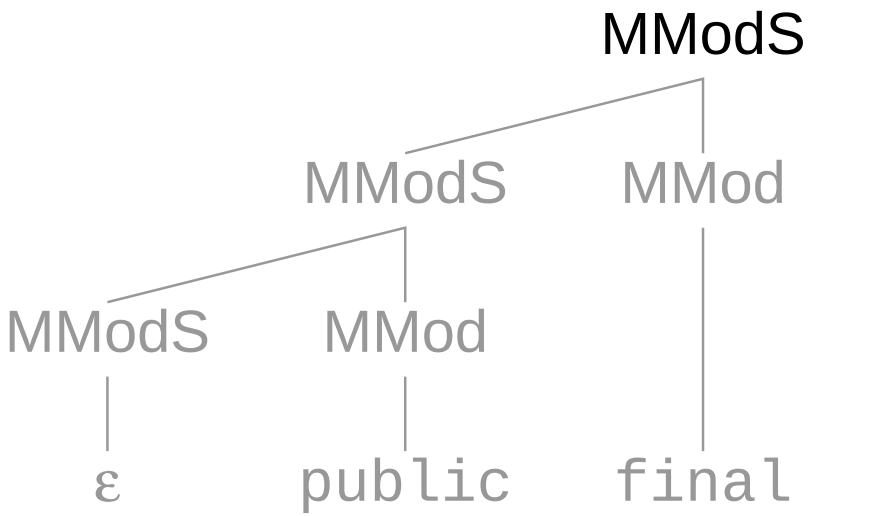


$$\$ < \mathit{MModS} > < \mathit{MMod} > \| \texttt{static int FIELD = 10;\$}$$

$$\vdash_{\text{reduce}} \$ < \mathit{MModS} > \| \texttt{static int FIELD = 10;\$}$$

Nondeterminism

Example



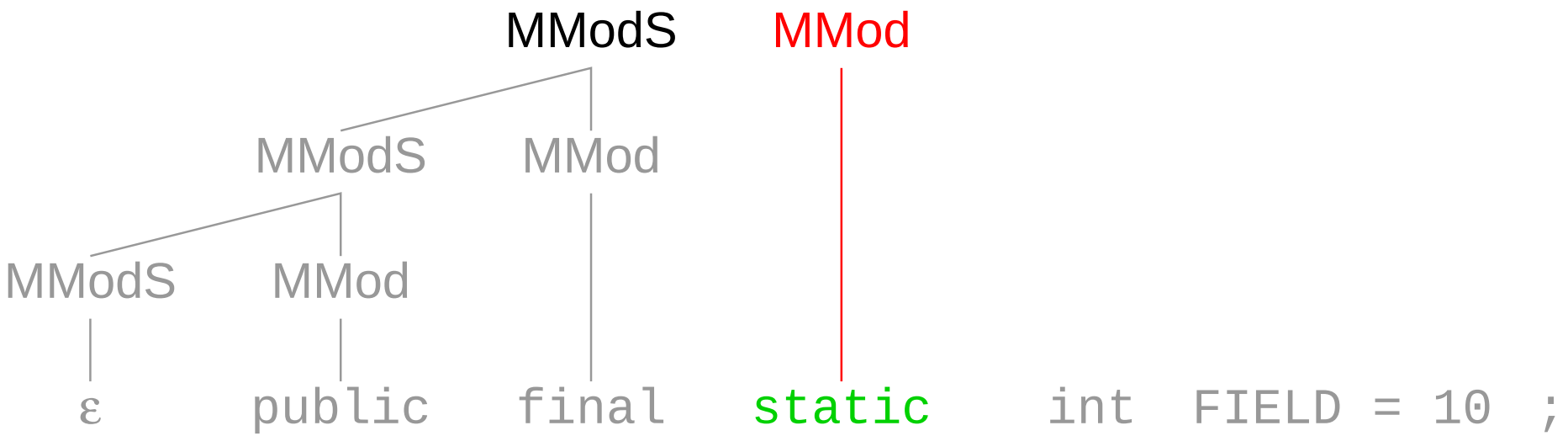
`static int FIELD = 10 ;`

$$\$ < MModS > \parallel \texttt{static int FIELD = 10;} \$$$

$$\vdash_{\text{shift}} \$ < MModS > \texttt{static} \parallel \texttt{int FIELD = 10;} \$$$

Nondeterminism

Example

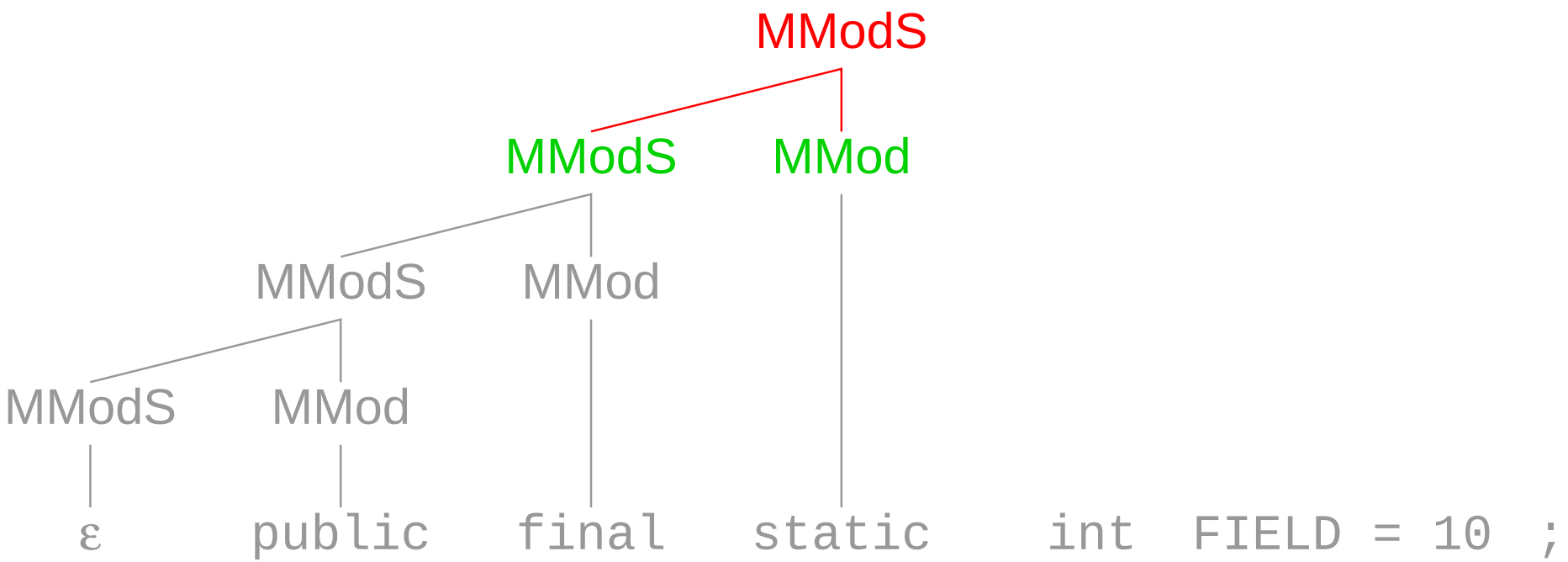


$$\$ < MModS > \texttt{static} \parallel \texttt{int FIELD = 10;\$}$$

$$\models_{\text{reduce}} \$ < MModS > < MMod > \parallel \texttt{int FIELD = 10;\$}$$

Nondeterminism

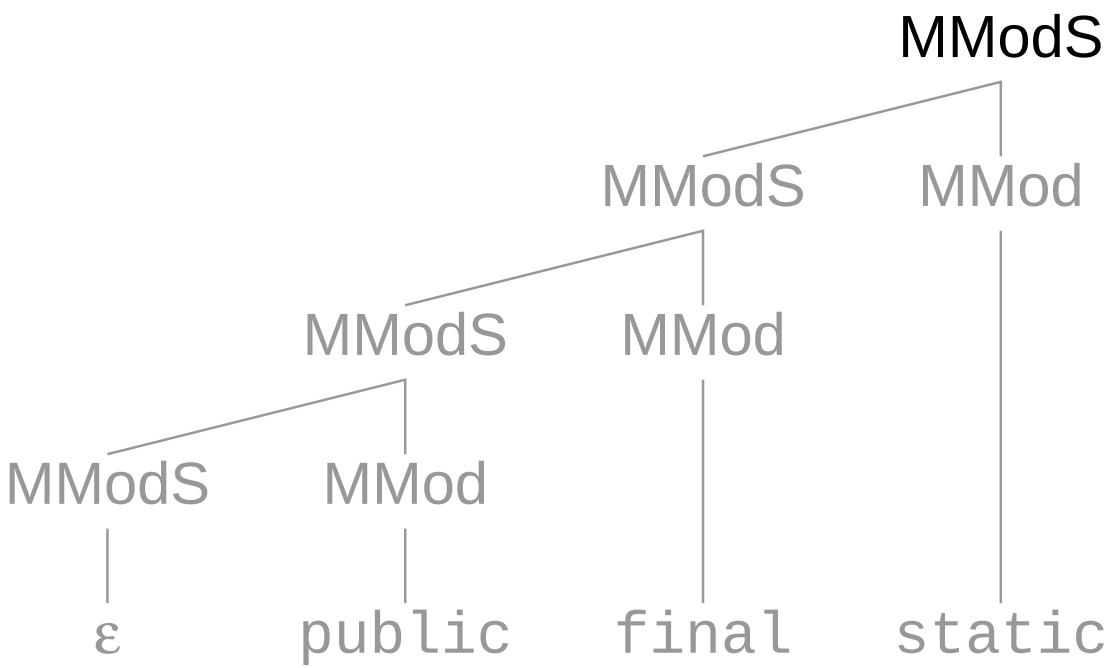
Example



$$\$ < \mathit{MModS} > < \mathit{MMod} > \| \texttt{int FIELD = 10;\$}$$
$$\models_{\text{reduce}} \$ < \mathit{MModS} > \| \texttt{int FIELD = 10;\$}$$

Nondeterminism

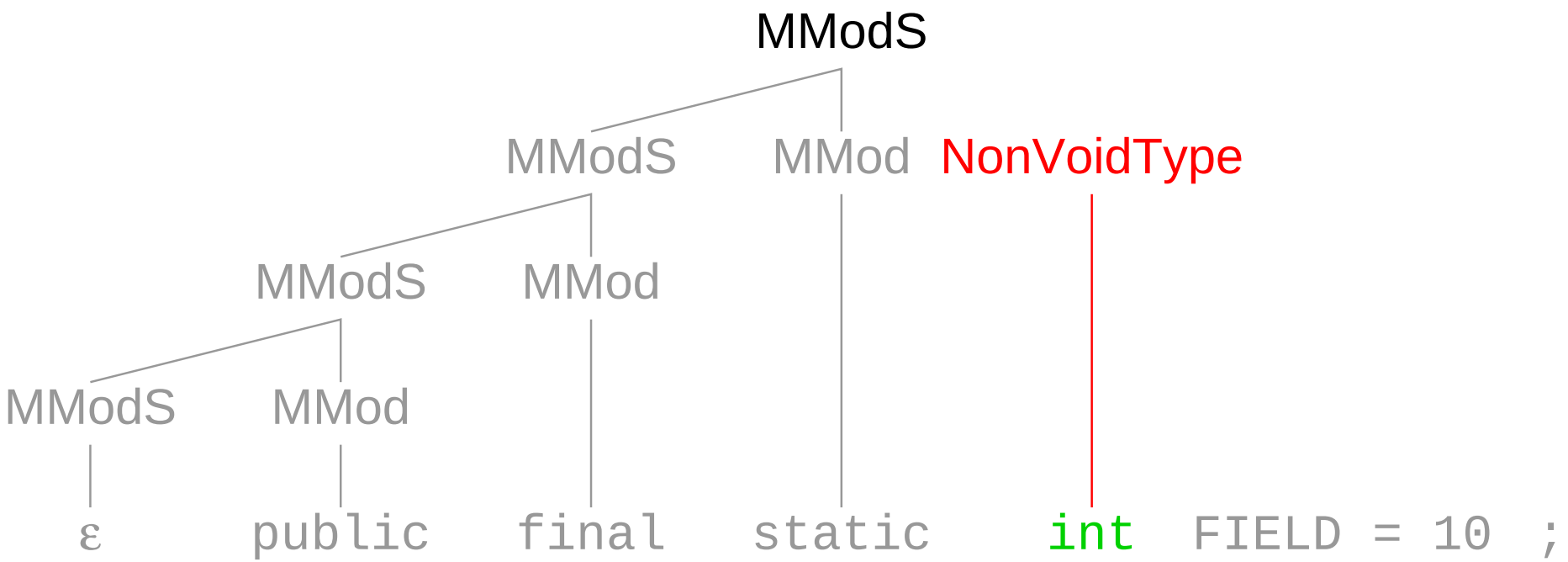
Example



$$\$ < \mathit{MModS} > \parallel \texttt{int FIELD = 10;\$}$$
$$\models_{\text{shift}} \$ < \mathit{MModS} > \texttt{int} \parallel \texttt{FIELD = 10;\$}$$

Nondeterminism

Example

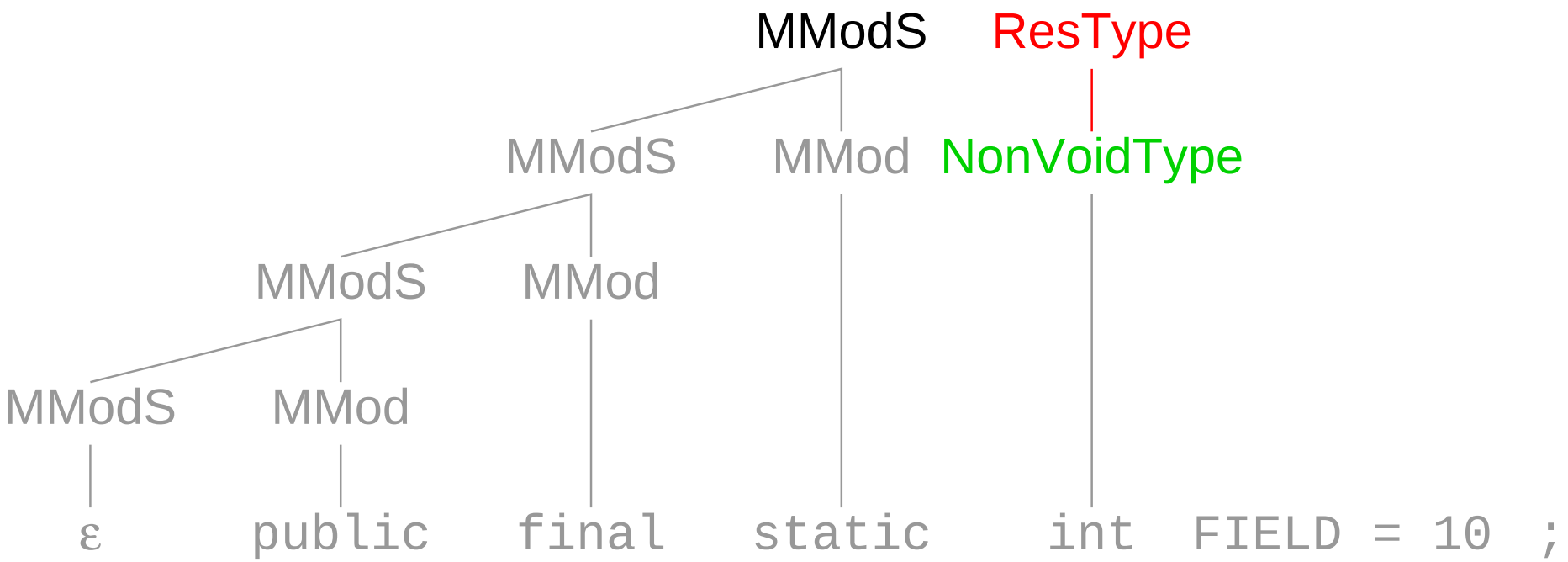


$$\$ < \mathit{MModS} > \texttt{int} \parallel \texttt{FIELD} = \texttt{10;}\$$$

$$\models_{\text{reduce}} \$ < \mathit{MModS} > < \mathit{NonVoidType} > \parallel \texttt{FIELD} = \texttt{10;}\$$$

Nondeterminism

Example

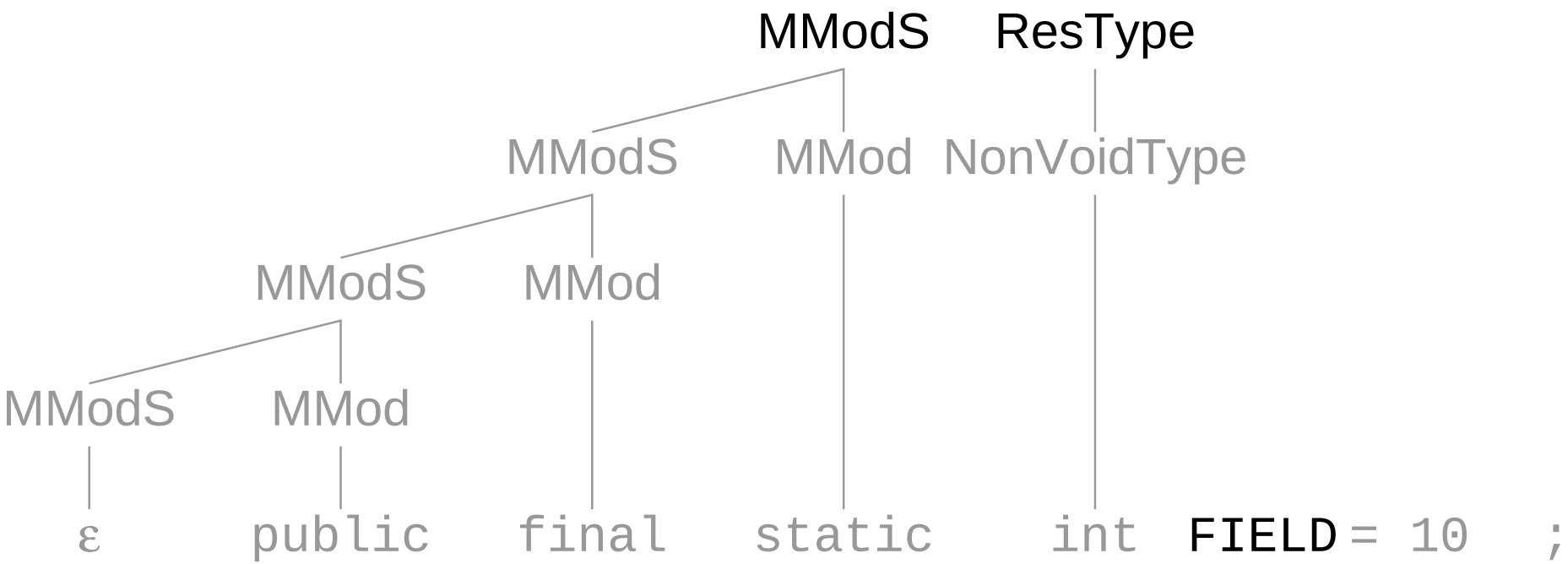


$$\$ < \mathit{MModS} > < \mathit{NonVoidType} > \| \texttt{FIELD} = \texttt{10;\$}$$

$$\models_{\text{reduce}} \$ < \mathit{MModS} > < \mathit{ResType} > \| \texttt{FIELD} = \texttt{10;\$}$$

Nondeterminism

Example

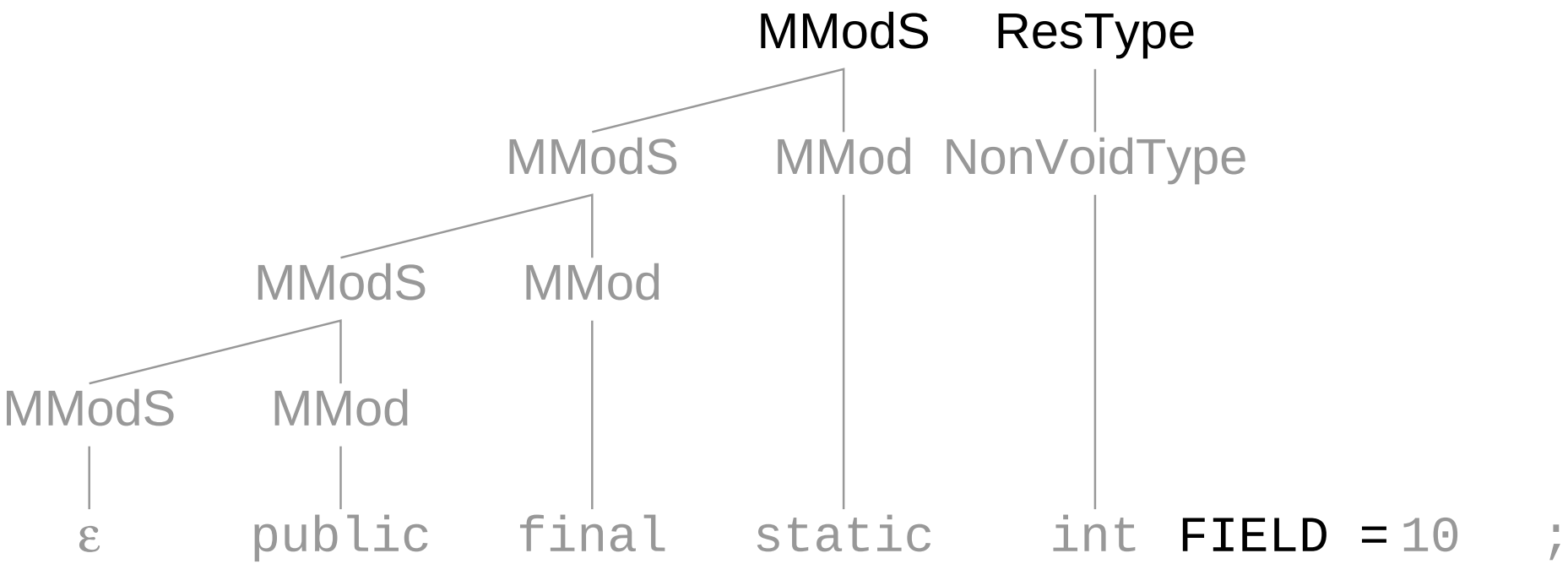


$$\$ < MModS >< ResType > \| \texttt{FIELD} = 10;\$$$

$$\models_{\text{shift}} \$ < MModS >< ResType > \texttt{FIELD} \| = 10;\$$$

Nondeterminism

Example

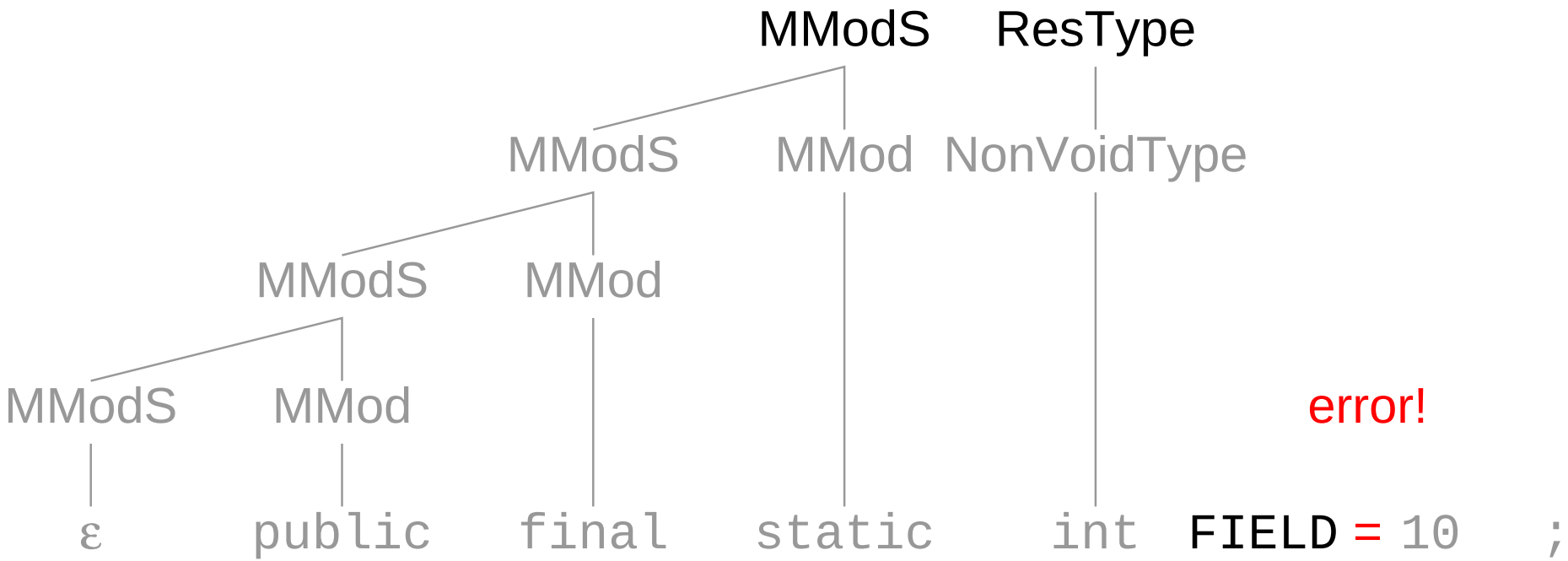


$$\$ < MModS >< ResType > \texttt{FIELD} \parallel = \ 10;\$$$

$$\models_{\text{shift}} \$ < MModS >< ResType > \texttt{FIELD} = \parallel 10;\$$$

Nondeterminism

Example



$$\$ < MModS > < ResType > \texttt{FIELD} = \| \texttt{10;} \$$$

Nondeterminism

Example

FModS
|
ε public final static int FIELD = 10 ;

$ε || public final static int FIELD = 10;$
$\vdash_{\text{reduce}}$ $<FModS> || public final static int FIELD = 10;$

Why Determinism Matters

+ Performance
+ Safety
− Generality

LR(k) Parsing

Knuth [1965]

- complete stack information
- k symbols of lookahead

Example

Choice between reductions $< FModS > \to \varepsilon$ and $< MModS > \to \varepsilon$:

```
public static final ... final static int l =
public static final ... final static int l (
```

- Infinite lookahead needed for better generality

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Knuth [1965]

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Choice between reductions $< FModS > \rightarrow \varepsilon$ and $< MModS > \rightarrow \varepsilon$:

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||public static final ... final static int l (
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- Infinite lookahead needed for better generality

Syntactic Predicates

Parr and Quong [1995]

- User defined lookahead pattern

Example

```
((MMod)* ResType MDecl)?
```

- Error-prone
- Exponential time complexity

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LR-Regular Parsing

Baker [1981], Bermudez and Schimpf [1990], Farré and Fortes Gálvez [2001]

- Finite State lookahead discrimination
- $\mathcal{O}(n^2)$ time complexity
- Only considers terminal symbols

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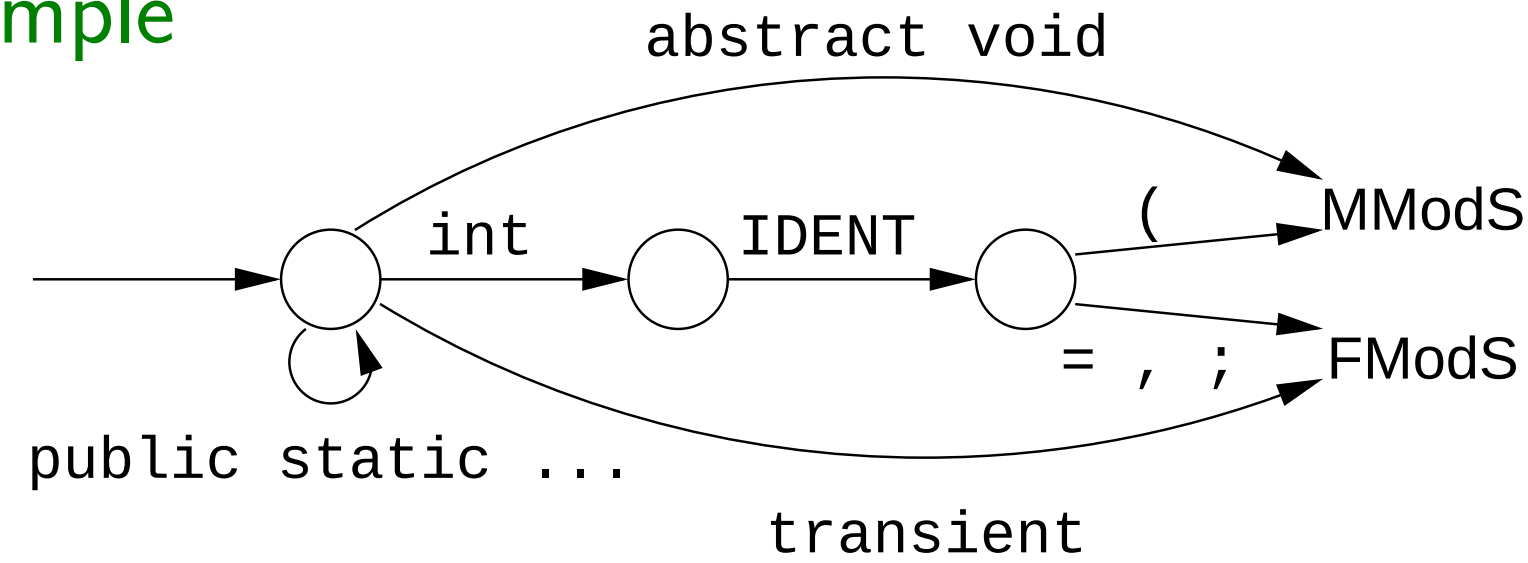
Baker [1981], Bermudez and Schimpf [1990], Farré and Fortes Gálvez [2001]

- Finite State lookahead discrimination

Example



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Baker [1981], Bermudez and Schimpf [1990], Farré and Fortes Gálvez [2001]

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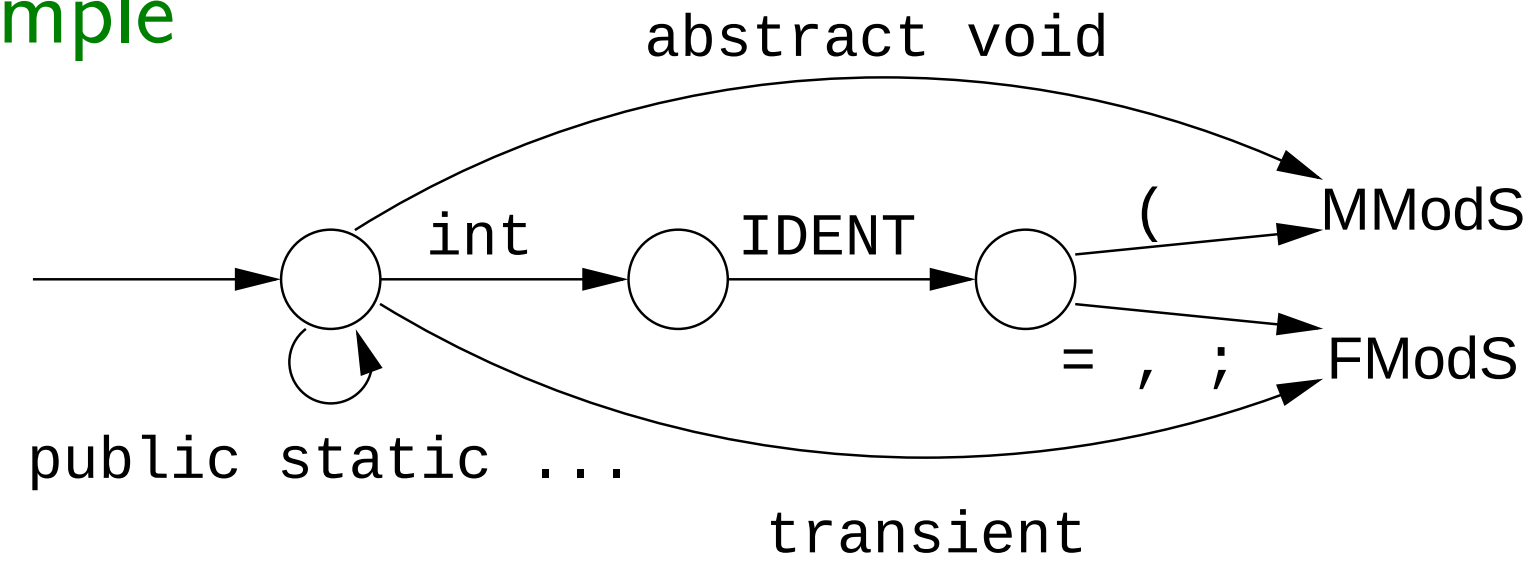

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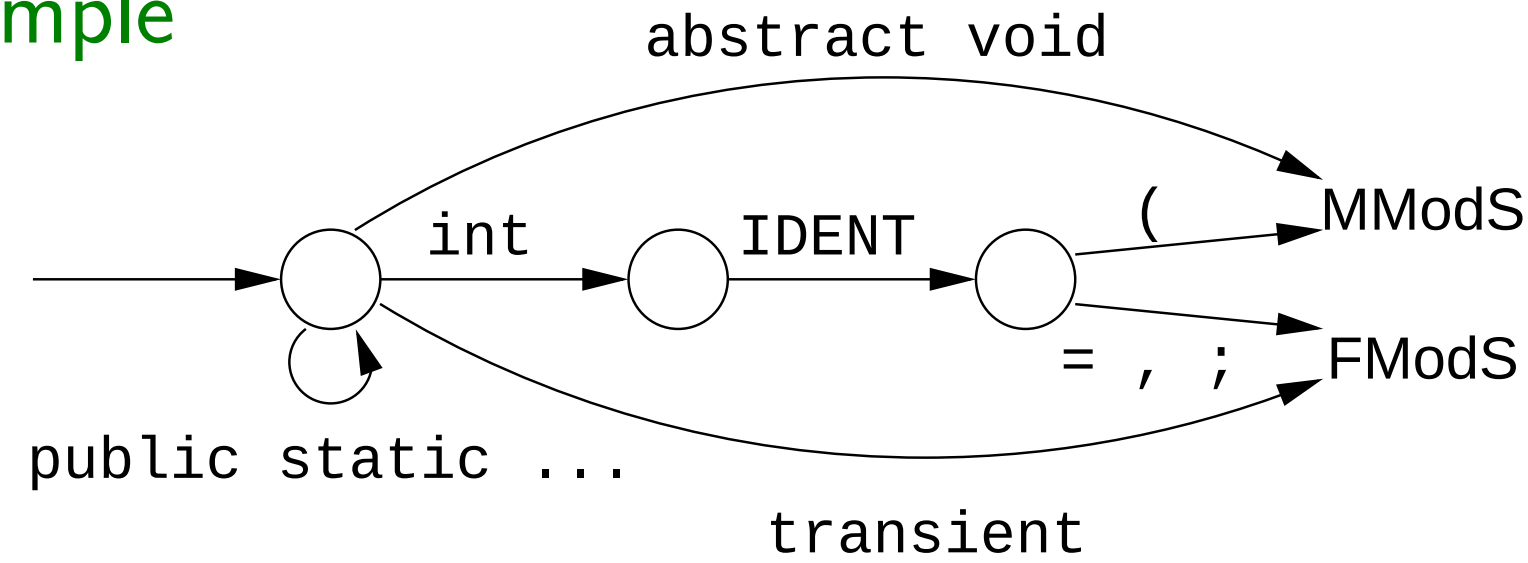

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Parsing a Program Source

- Good generality
- Determinism
- $\mathcal{O}(n)$ time complexity

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- Good generality
- Determinism
- $\mathcal{O}(n)$ time complexity

Noncanonical parsing

Noncanonical Parsing

Colmerauer [1970], Szymanski and Williams [1976], Tai [1979]

Example

```
public final static int FIELD = 10 ;
```

$ ‖ public final static int FIELD = 10;$

Noncanonical Parsing

Colmerauer [1970], Szymanski and Williams [1976], Tai [1979]

Example

```
public final static int FIELD = 10 ;
```

$$\$ \parallel \texttt{public final static int FIELD = 10;\$}$$

$$\models_{\text{shift}} \$\ \texttt{public} \parallel \texttt{final static int FIELD = 10;\$}$$

Noncanonical Parsing

Colmerauer [1970], Szymanski and Williams [1976], Tai [1979]

Example

```
public final static int FIELD = 10 ;
```

$$\$\texttt{public} \parallel \texttt{final static int FIELD = 10;}\$$$

$$\vdash_{\text{shift}} \$\texttt{public final} \parallel \texttt{static int FIELD = 10;}\$$$

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```
public final static int FIELD = 10 ;
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Colmerauer [1970], Szymanski and Williams [1976], Tai [1979]

Example

```
public final static int FIELD = 10 ;
```

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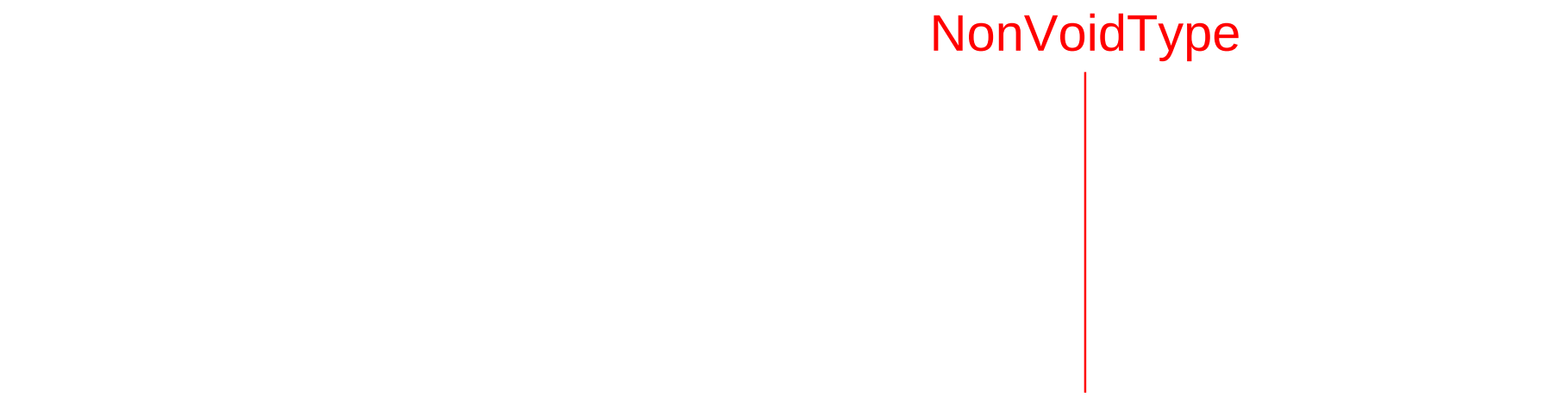
$$\vdash_{\text{shift}} \$\texttt{public final static int} \parallel \texttt{FIELD = 10;}\$$$

Noncanonical Parsing

Colmerauer [1970], Szymanski and Williams [1976], Tai [1979]

Example



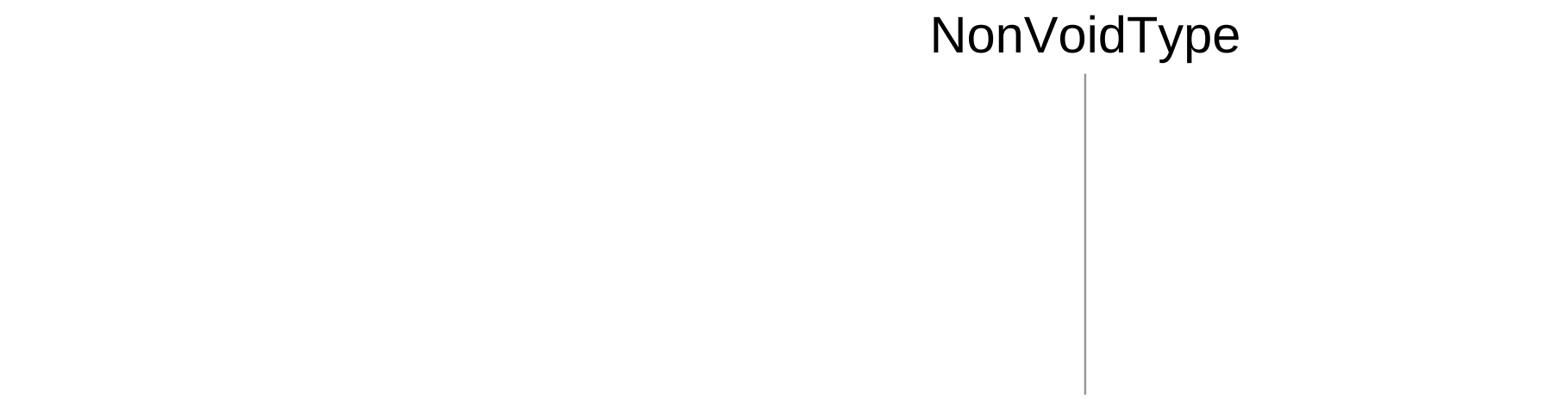
$$\$\texttt{public final static int} \parallel \texttt{FIELD = 10;}\$$$

$$\models_{\text{reduce}} \$\texttt{public final static} \parallel \langle \textit{NonVoidType} \rangle\ \texttt{FIELD = 10;}\$$$

Noncanonical Parsing

Colmerauer [1970], Szymanski and Williams [1976], Tai [1979]

Example



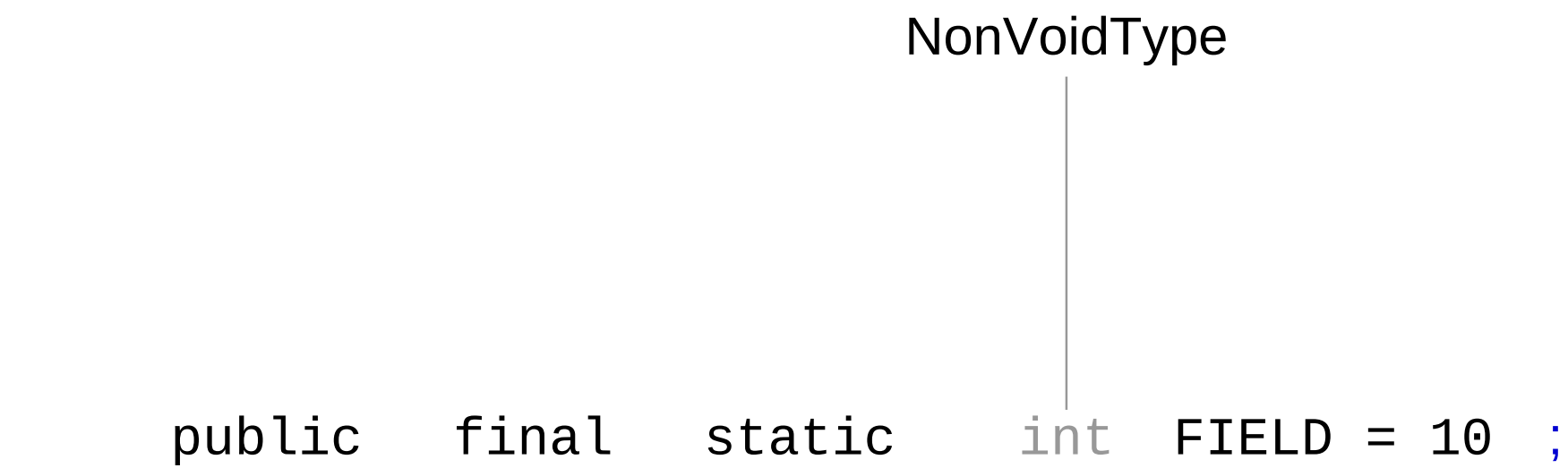
$$\$\texttt{public final static} \parallel \langle \textit{NonVoidType} \rangle\ \texttt{FIELD = 10;\$}$$

$$\vdash_{\text{shift}} \$\texttt{public final static}\ \langle \textit{NonVoidType} \rangle \parallel \texttt{FIELD = 10;\$}$$

Noncanonical Parsing

Colmerauer [1970], Szymanski and Williams [1976], Tai [1979]

Example



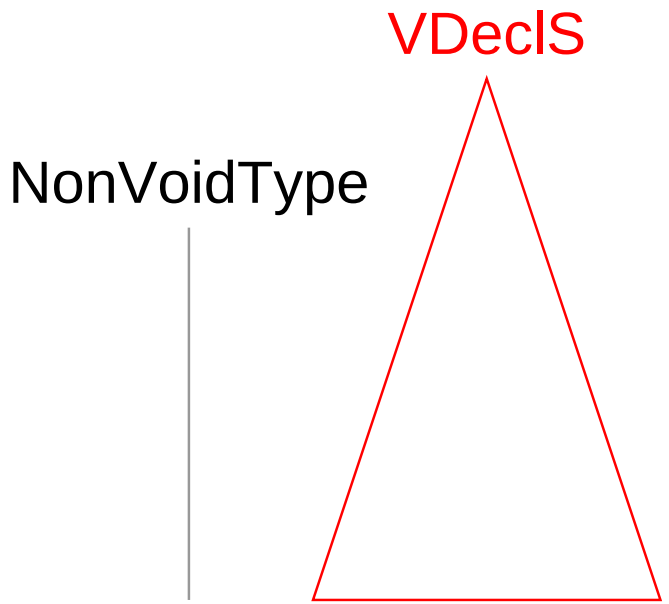
$$\$\texttt{public final static} \langle \textit{NonVoidType} \rangle \parallel \texttt{FIELD = 10 ;\$}$$

$$\vdash_{\text{shift}} \$\texttt{public final static} \langle \textit{NonVoidType} \rangle \texttt{ FIELD = 10} \parallel \texttt{;\$}$$

Noncanonical Parsing

Colmerauer [1970], Szymanski and Williams [1976], Tai [1979]

Example




```
public  final  static  int  FIELD = 10  ;
```

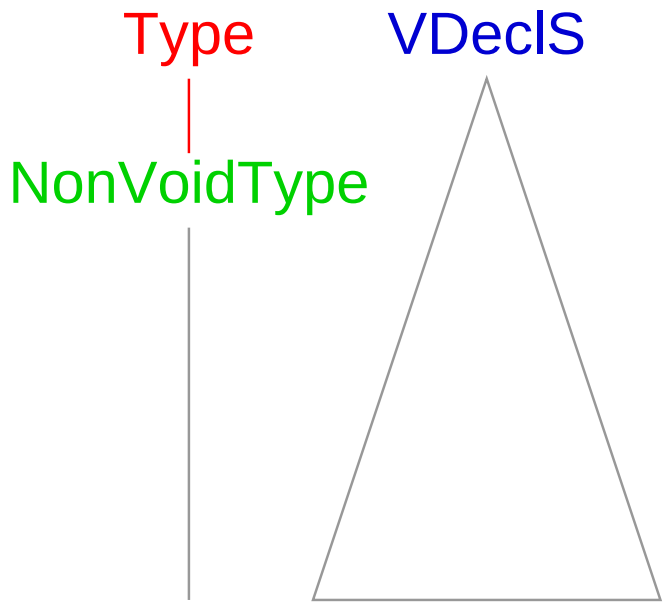
$$\$\texttt{public final static}\ \langle \textit{NonVoidType} \rangle\ \texttt{FIELD = 10}\ \|\ \texttt{;\$}$$

$$\models_{\text{reduce}}\ \$\texttt{public final static}\ \langle \textit{NonVoidType} \rangle\ \|\ \langle \textit{VDeclS} \rangle\ \texttt{;\$}$$

Noncanonical Parsing

Colmerauer [1970], Szymanski and Williams [1976], Tai [1979]

Example




```
public  final  static  int  FIELD = 10  ;
```

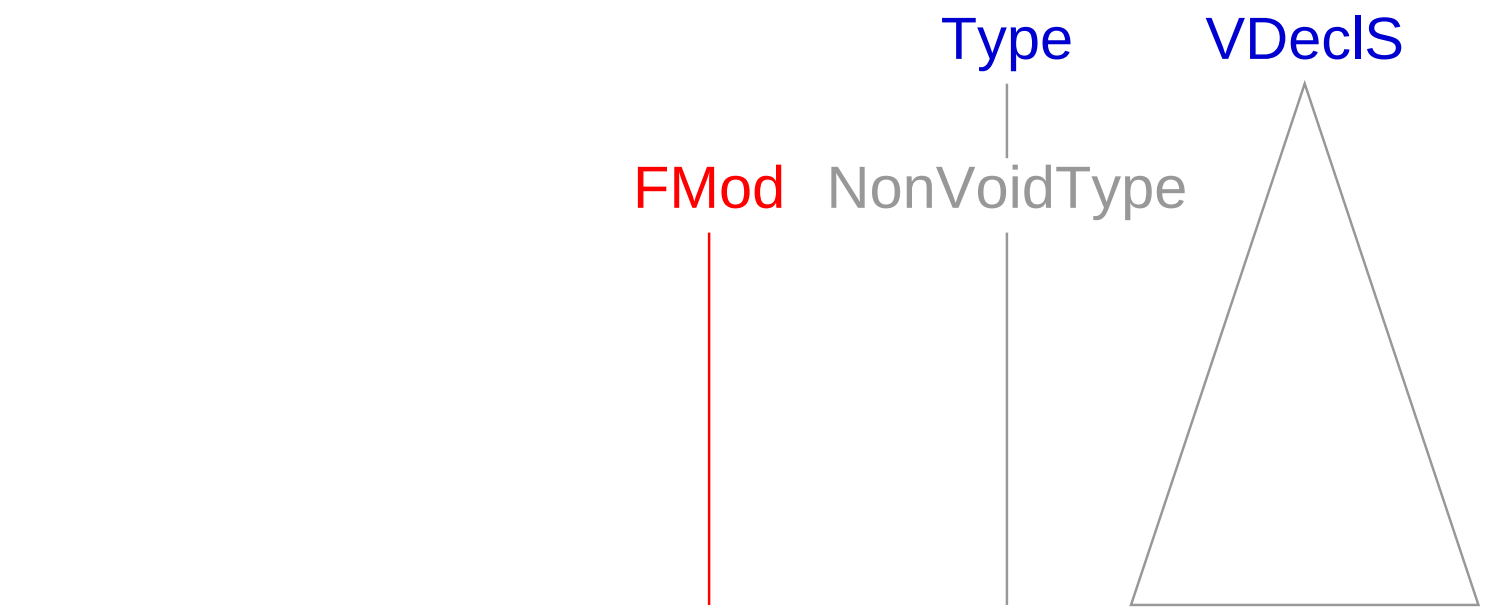
$$\$\texttt{public final static} \langle \textit{NonVoidType} \rangle \parallel \langle \textit{VDeclS} \rangle \ \texttt{;\$}$$

$$\models_{\text{reduce}} \ \$\texttt{public final static} \parallel \langle \textit{Type} \rangle \ \langle \textit{VDeclS} \rangle \ \texttt{;\$}$$

Noncanonical Parsing

Colmerauer [1970], Szymanski and Williams [1976], Tai [1979]

Example



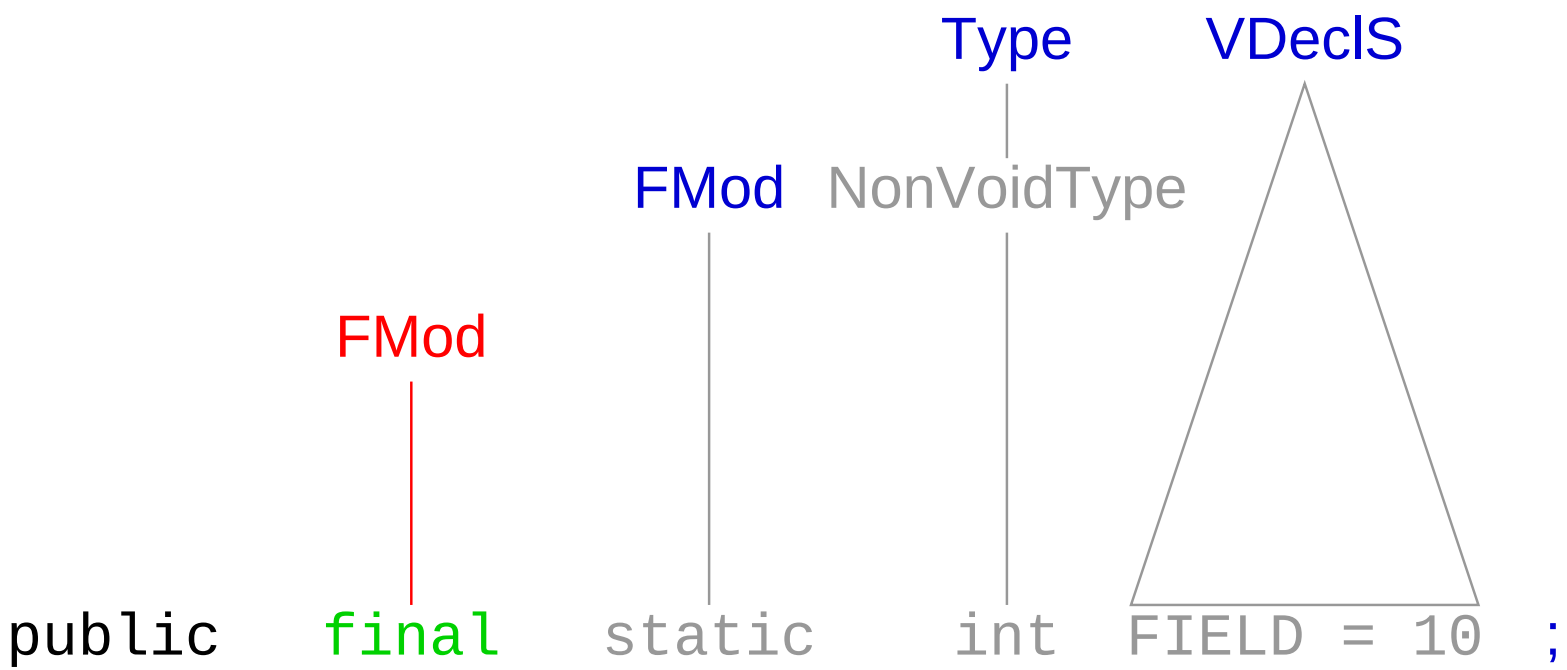
$$\$\texttt{public final static} \parallel \langle \mathit{Type} \rangle \langle \mathit{VDeclS} \rangle \ \texttt{;}\$$$

$$\models_{\text{reduce}} \ \$\texttt{public final} \parallel \langle \mathit{FMod} \rangle \ \langle \mathit{Type} \rangle \langle \mathit{VDeclS} \rangle \ \texttt{;}\$$$

Noncanonical Parsing

Colmerauer [1970], Szymanski and Williams [1976], Tai [1979]

Example



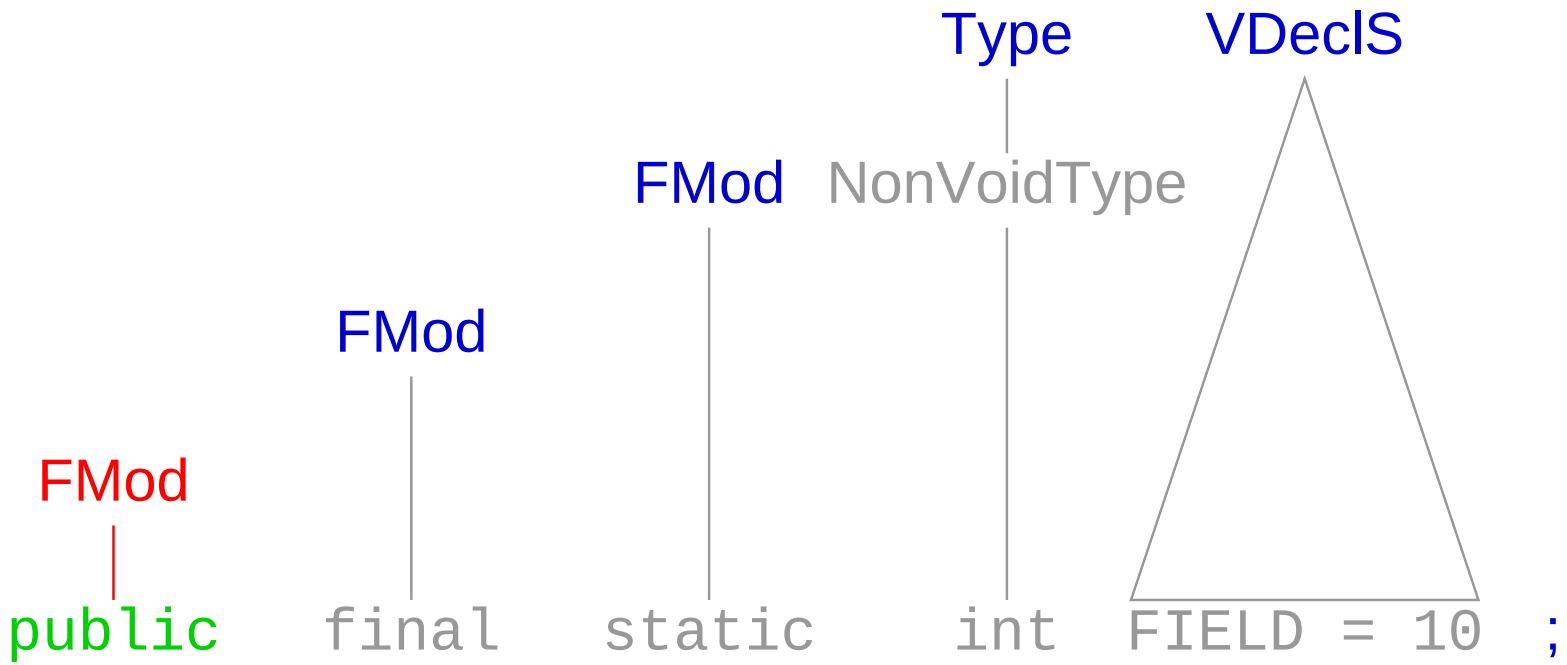
$$\$\texttt{public final} \parallel \langle \mathit{FMod} \rangle \langle \mathit{Type} \rangle \langle \mathit{VDeclS} \rangle \ \texttt{;\$}$$

$$\models_{\text{reduce}} \ \$\texttt{public} \parallel \langle \mathit{FMod} \rangle \ \langle \mathit{FMod} \rangle \langle \mathit{Type} \rangle \langle \mathit{VDeclS} \rangle \ \texttt{;\$}$$

Noncanonical Parsing

Colmerauer [1970], Szymanski and Williams [1976], Tai [1979]

Example



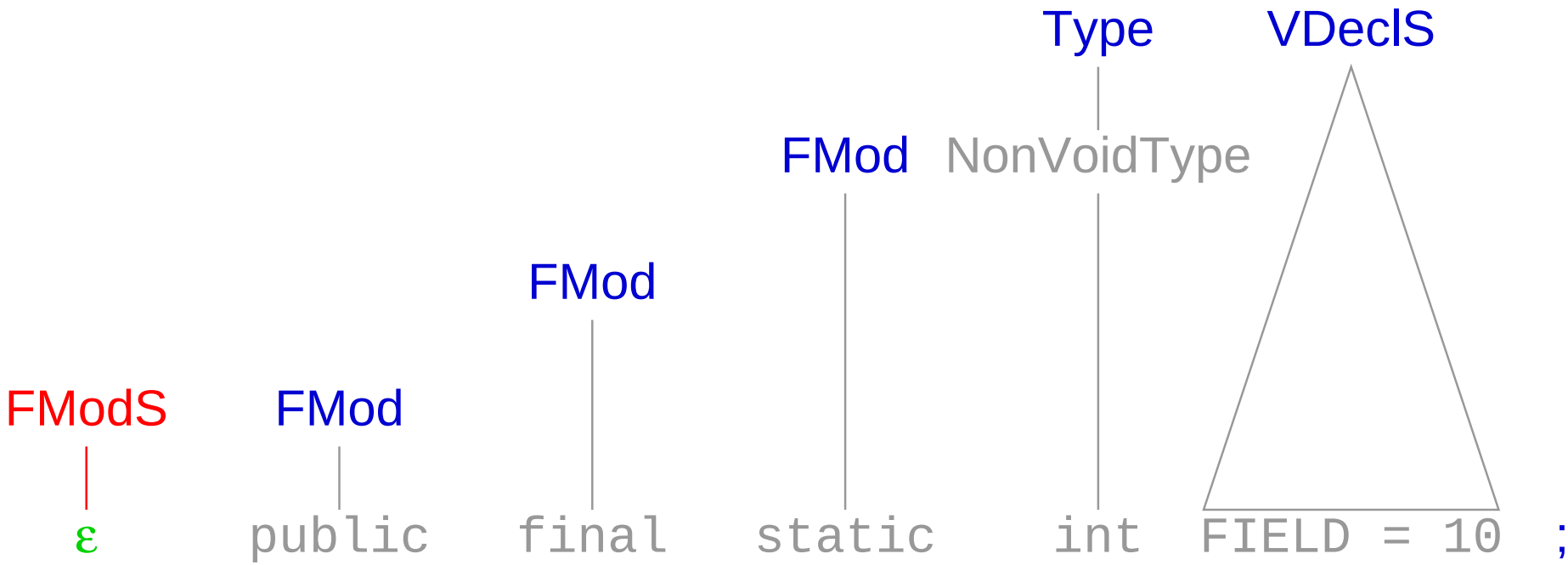
$ public ‖ <*FMod*><*FMod*><*Type*><*VDeclS*> ;$

$\vdash_{\text{reduce}}$ $ ‖ <*FMod*> <*FMod*><*FMod*><*Type*><*VDeclS*> ;$

Noncanonical Parsing

Colmerauer [1970], Szymanski and Williams [1976], Tai [1979]

Example



$$\$\ \varepsilon \parallel \langle FMod \rangle \langle FMod \rangle \langle FMod \rangle \langle Type \rangle \langle VDeclS \rangle\ ;\$$$

$$\models_{\text{reduce}} \$ \parallel \langle FModS \rangle\ \langle FMod \rangle \langle FMod \rangle \langle FMod \rangle \langle Type \rangle \langle VDeclS$$

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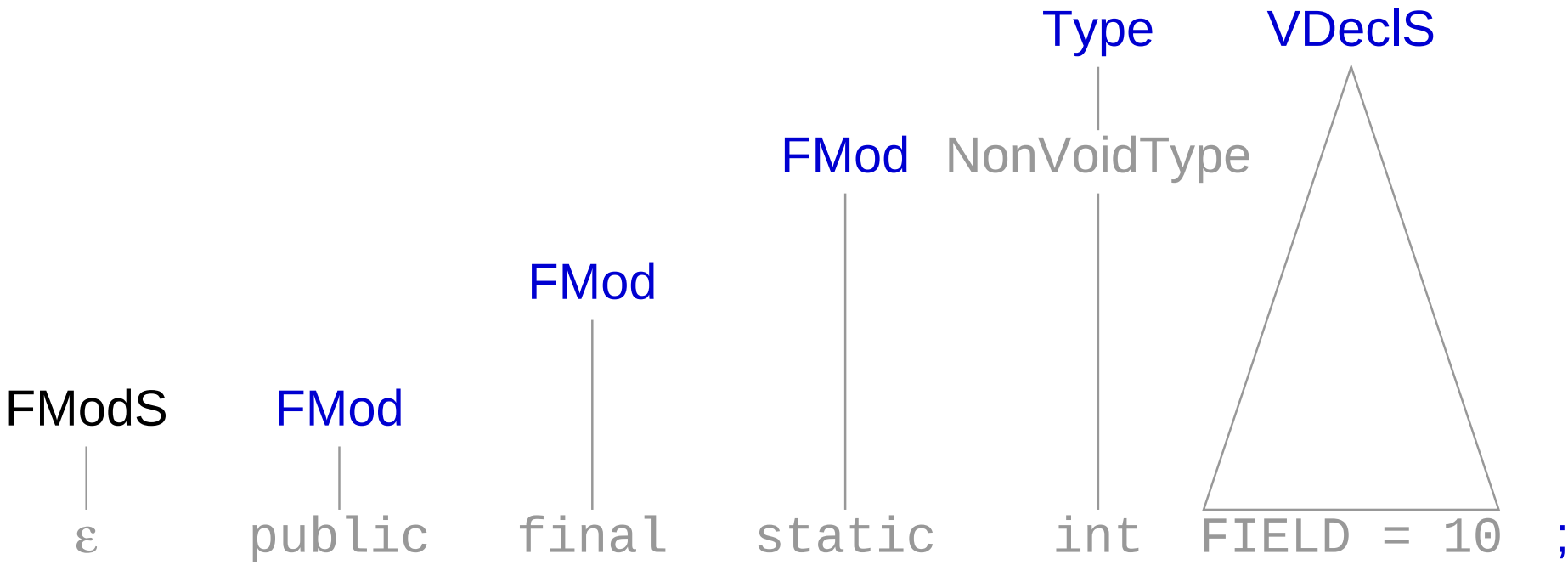
Colmerauer [1970], Szymanski and Williams [1976], Tai [1979]

Example



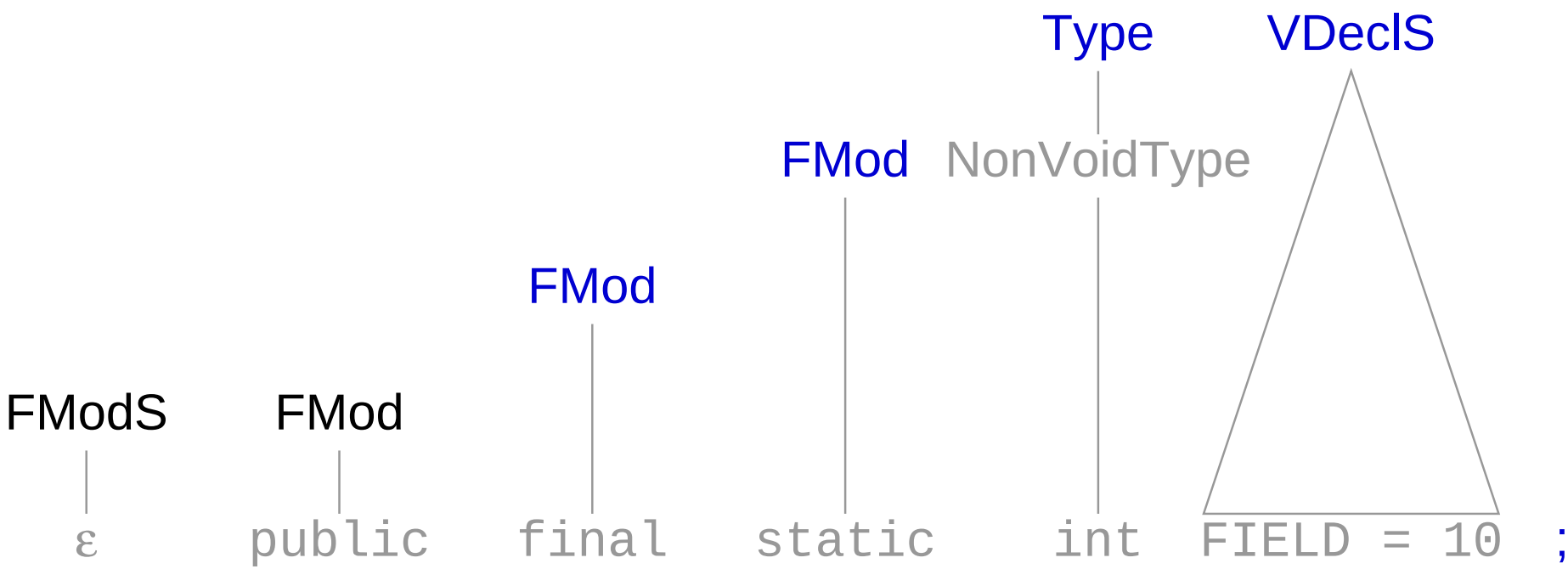
$$\$ \parallel \langle FModS \rangle \quad \langle FMod \rangle \langle FMod \rangle \langle FMod \rangle \langle Type \rangle \langle VDeclS \rangle$$

$$\vdash_{\text{shift}} \$ \ \langle FModS \rangle \parallel \langle FMod \rangle \langle FMod \rangle \langle FMod \rangle \langle Type \rangle \langle VDeclS \rangle$$

Noncanonical Parsing

Colmerauer [1970], Szymanski and Williams [1976], Tai [1979]

Example



$$\$ < FModS > \ \| < FMod > \quad < FMod >< FMod >< Type >< VDecl S$$

$$\models_{\text{shift}} \$ < FModS > \quad < FMod > \ \| < FMod >< FMod >< Type >< VDecl S$$

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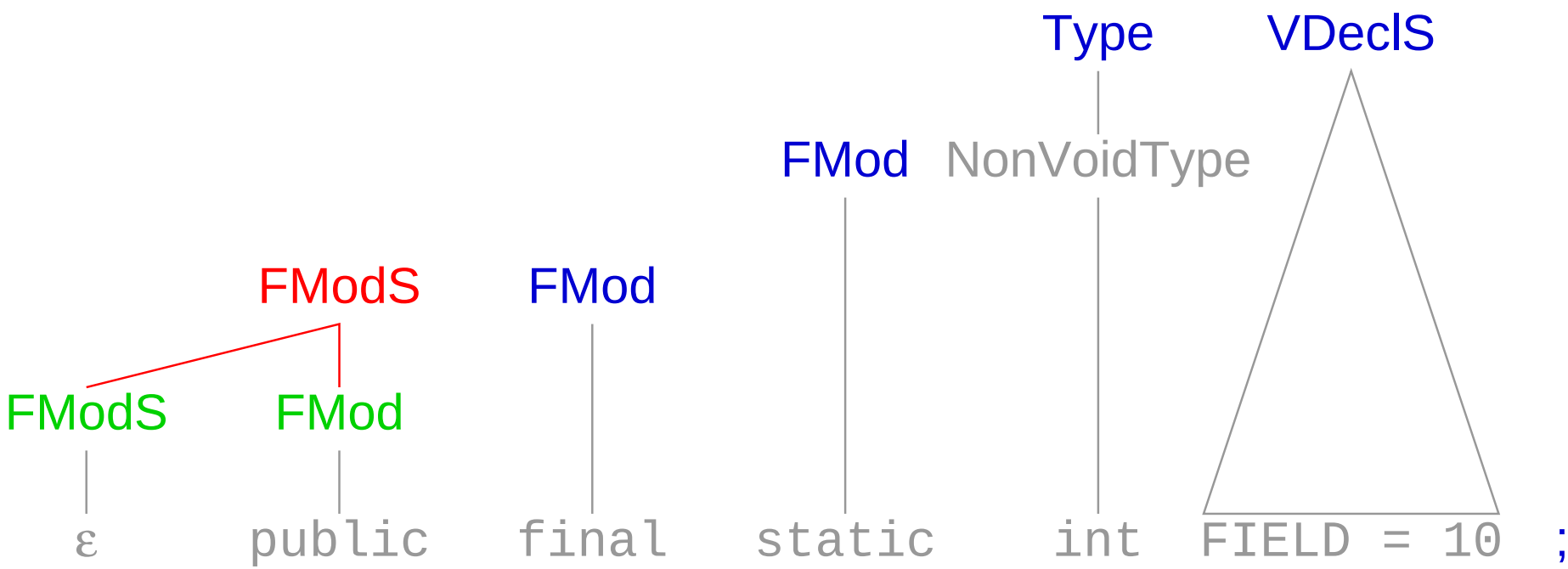
Example



$ $\langle FModS \rangle \langle FMod \rangle \parallel \langle FMod \rangle \langle FMod \rangle \langle Type \rangle \langle VDeclS \rangle$

$\models_{\text{reduce}}$ $ $\parallel \langle FModS \rangle \langle FMod \rangle \langle FMod \rangle \langle Type \rangle \langle VDeclS \rangle$;$

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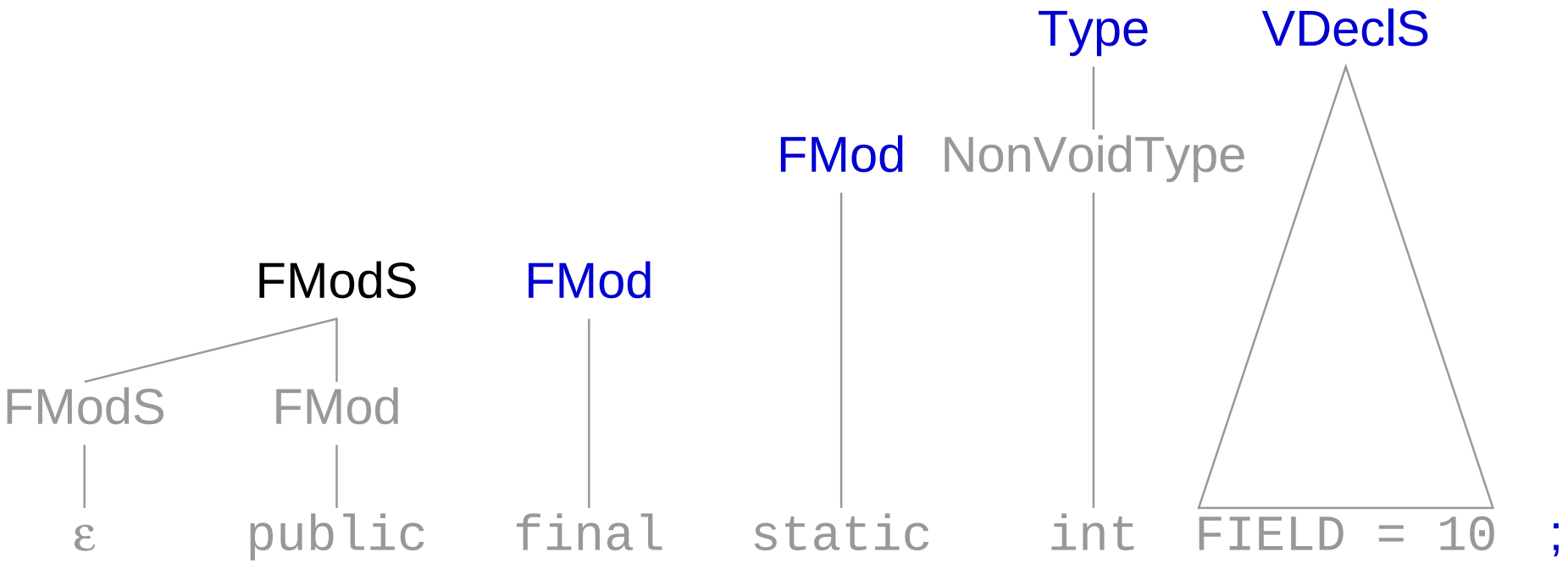

$$\$ \parallel \langle FModS \rangle \quad \langle FMod \rangle \langle FMod \rangle \langle Type \rangle \langle VDeclS \rangle \; ;\$$$

$$\models_{\text{shift}} \$ \; \langle FModS \rangle \parallel \langle FMod \rangle \langle FMod \rangle \langle Type \rangle \langle VDeclS \rangle \; ;\$$$

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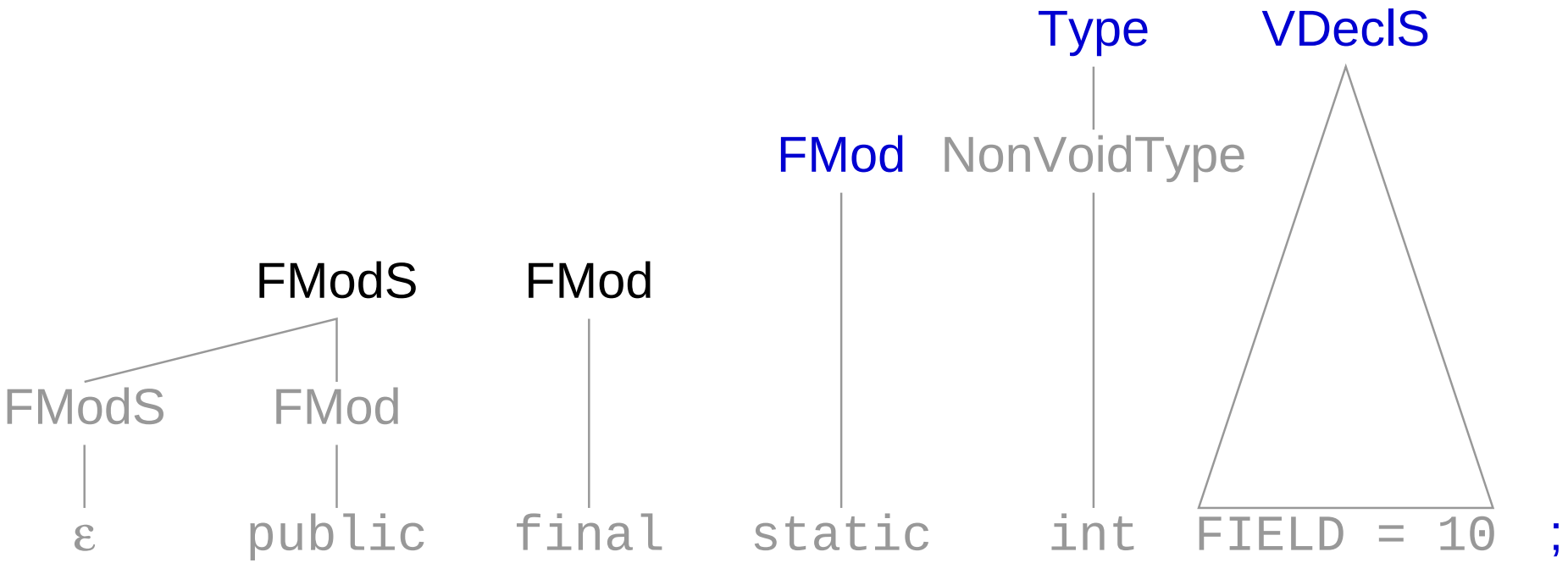

$$\$ < FModS > \ \| < FMod > \quad < FMod >< Type >< VDeclS > \ ;\$$$

$$\models_{\text{shift}} \$ < FModS > \quad < FMod > \ \| < FMod >< Type >< VDeclS > \ ;\$$$

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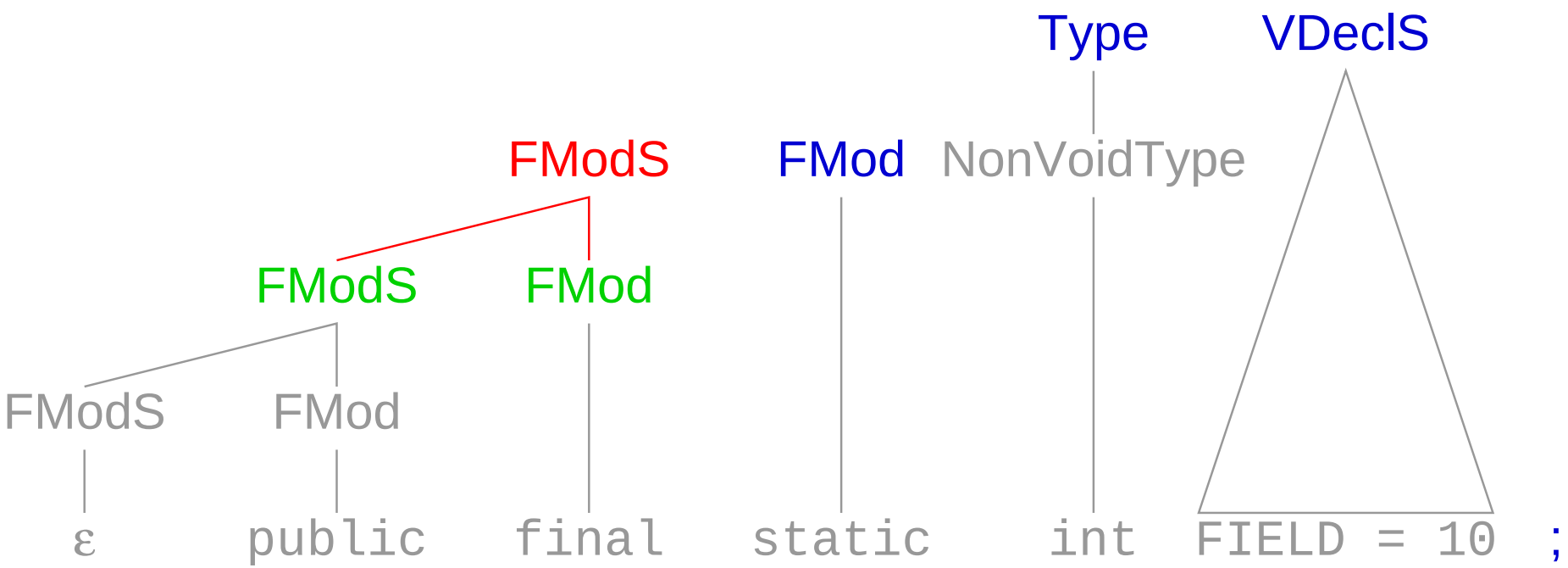
Colmerauer [1970], Szymanski and Williams [1976], Tai [1979]

Example



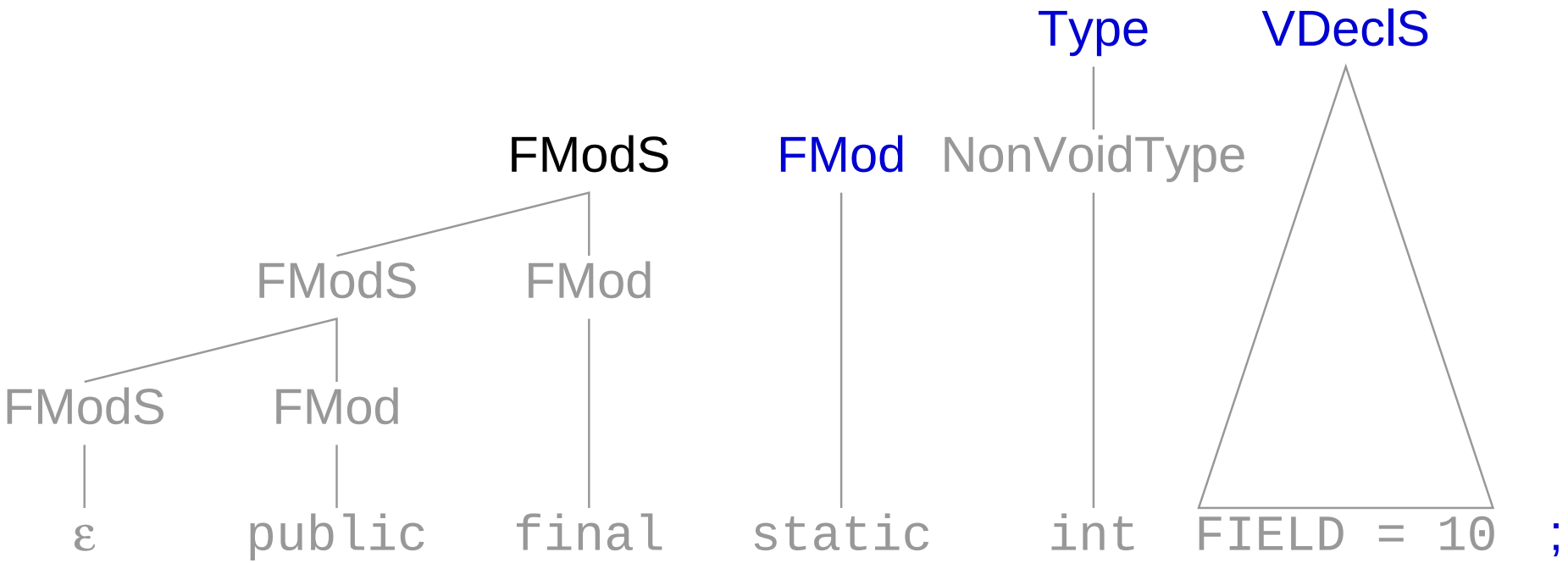
$ $\langle FModS \rangle \langle FMod \rangle \parallel \langle FMod \rangle \langle Type \rangle \langle VDeclS \rangle$;$

$\models_{\text{reduce}}$ $ $\parallel \langle FModS \rangle \langle FMod \rangle \langle Type \rangle \langle VDeclS \rangle$;$

Noncanonical Parsing

Colmerauer [1970], Szymanski and Williams [1976], Tai [1979]

Example



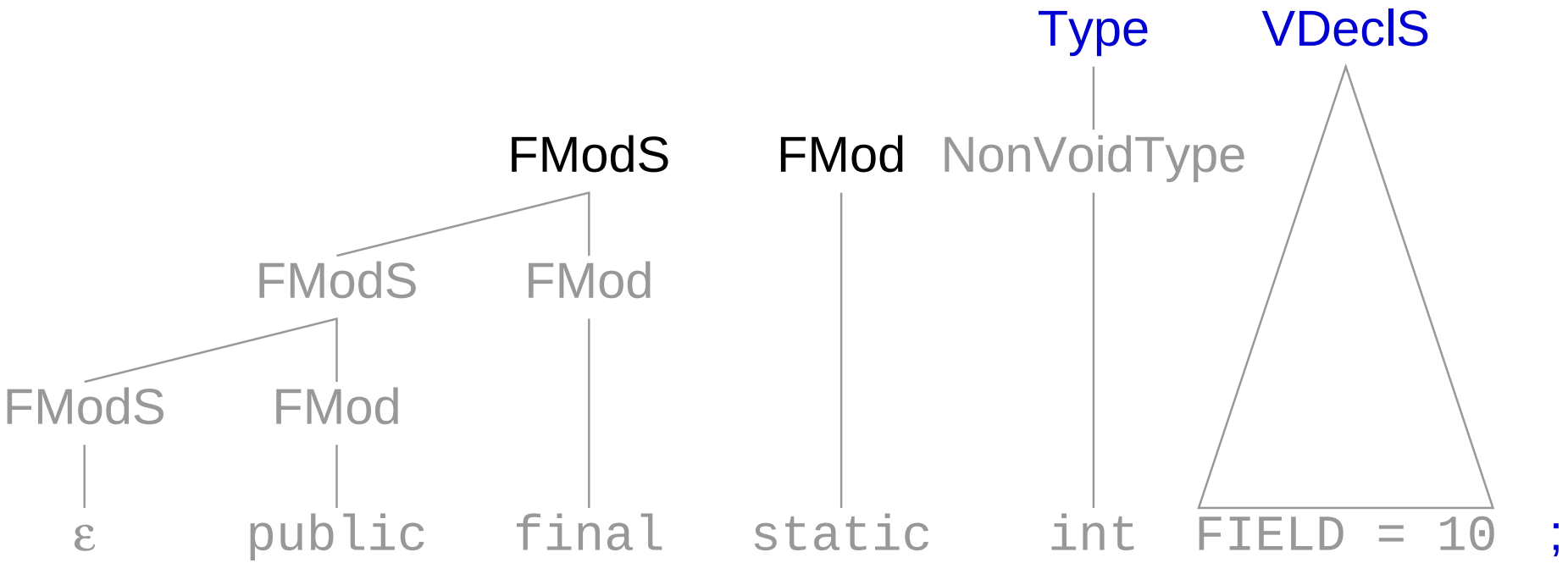
$$\$ \parallel \langle FModS \rangle \quad \langle FMod \rangle \langle Type \rangle \langle VDeclS \rangle \; ;\$$$

$$\models_{\text{shift}} \$ \; \langle FModS \rangle \parallel \langle FMod \rangle \langle Type \rangle \langle VDeclS \rangle \; ;\$$$

Noncanonical Parsing

Colmerauer [1970], Szymanski and Williams [1976], Tai [1979]

Example



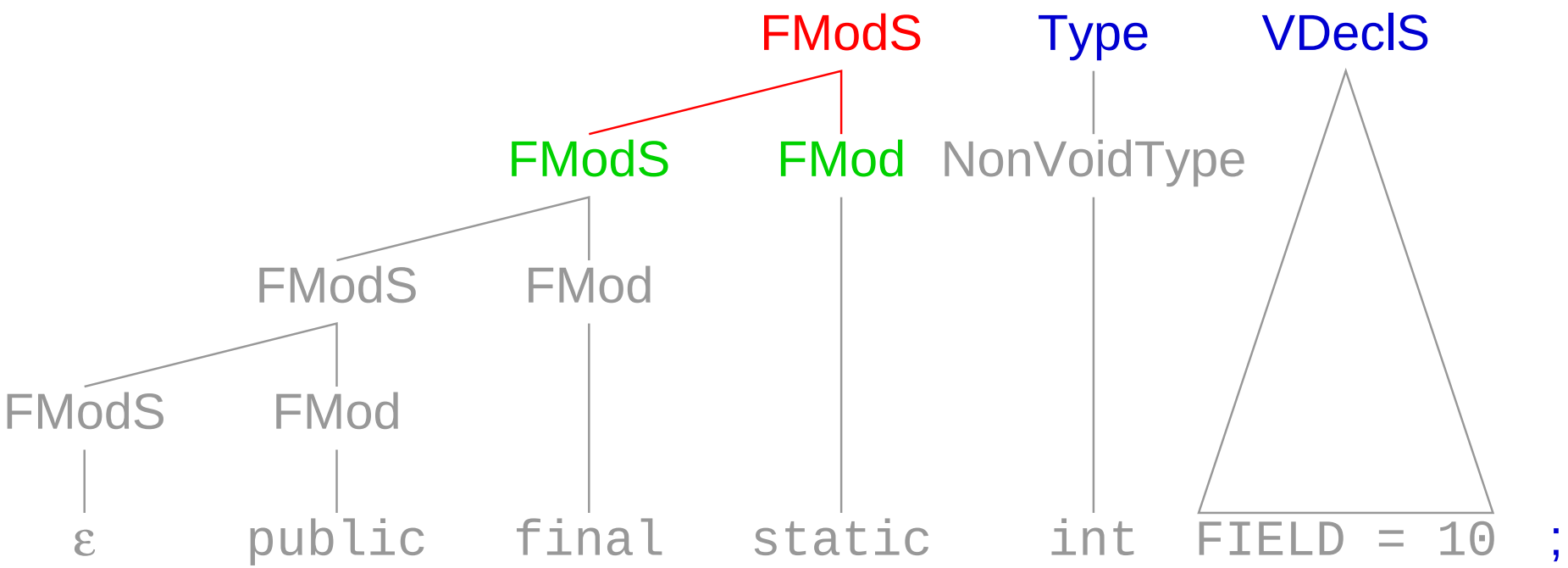
$$\$ < FModS > \ \| < FMod > \ < Type >< VDeclS > \ ;\$$$

$$\models_{\text{shift}} \$ < FModS > \ < FMod > \ \| < Type >< VDeclS > \ ;\$$$

Noncanonical Parsing

Colmerauer [1970], Szymanski and Williams [1976], Tai [1979]

Example



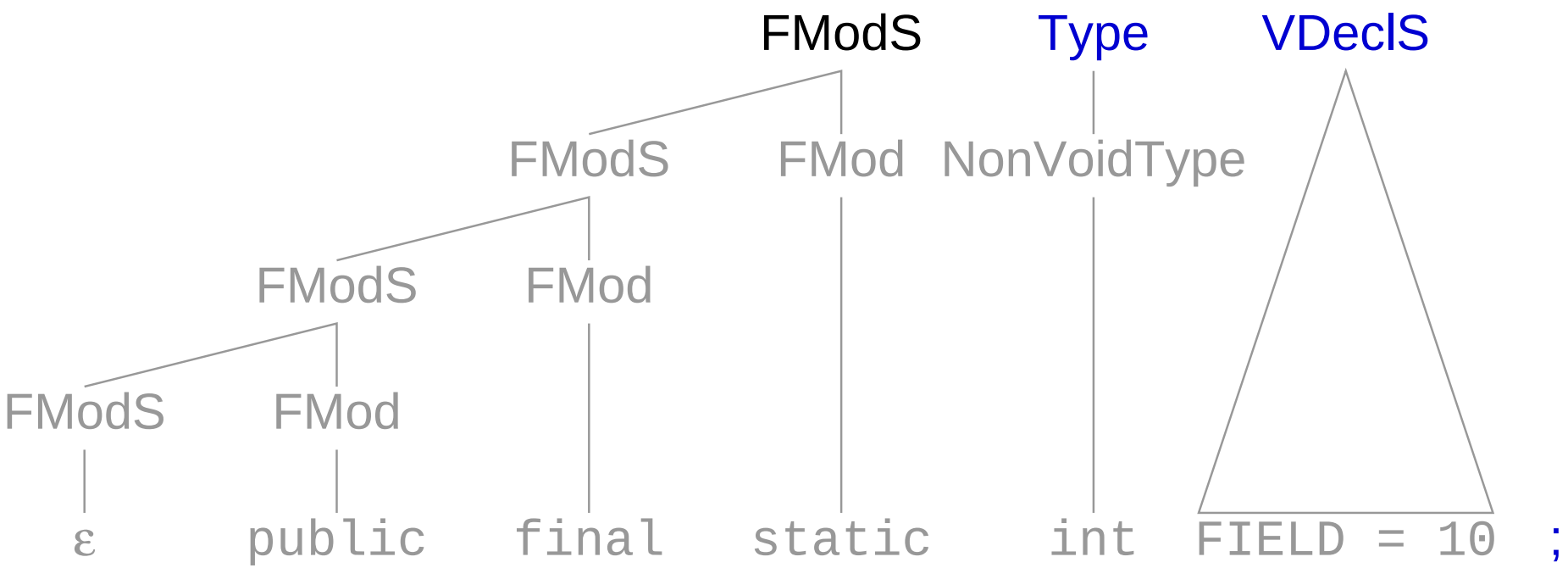
$ $\langle FModS \rangle \langle FMod \rangle \parallel \langle Type \rangle \langle VDeclS \rangle$;$

$\models_{\text{reduce}}$ $ $\parallel \langle FModS \rangle \langle Type \rangle \langle VDeclS \rangle$;$

Noncanonical Parsing

Colmerauer [1970], Szymanski and Williams [1976], Tai [1979]

Example



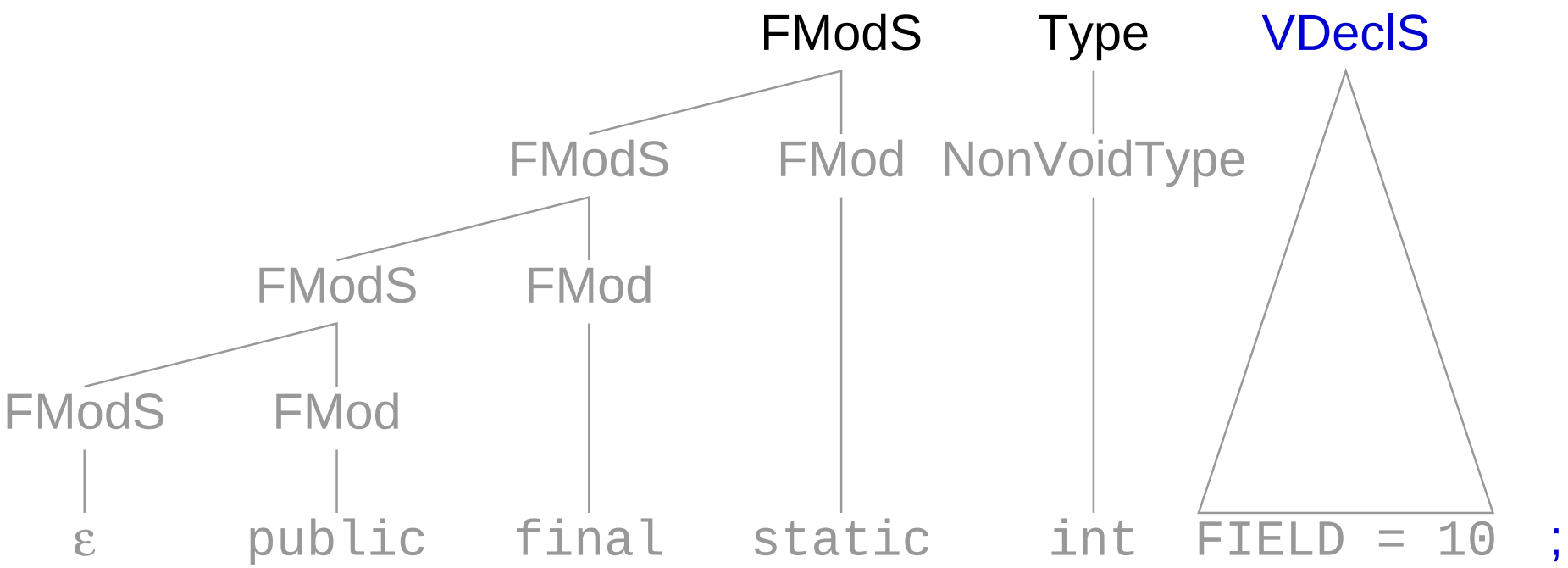
$$\$ \parallel \langle FModS \rangle \quad \langle Type \rangle \langle VDeclS \rangle \; ;\$$$

$$\models_{\text{shift}} \$ \; \langle FModS \rangle \parallel \langle Type \rangle \langle VDeclS \rangle \; ;\$$$

Noncanonical Parsing

Colmerauer [1970], Szymanski and Williams [1976], Tai [1979]

Example



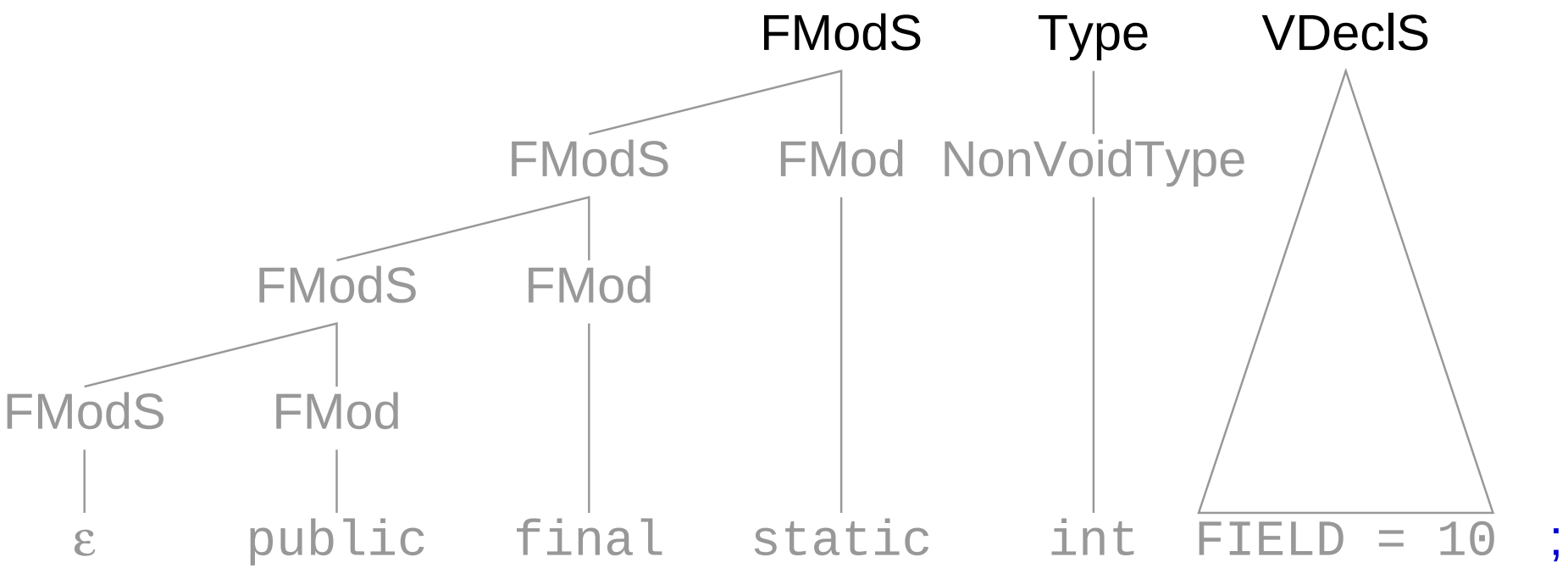
$$\$ < FModS > \ \| < Type > \ < VDeclS > \ ;\$$$

$$\models_{\text{shift}} \$ < FModS > \ < Type > \ \| < VDeclS > \ ;\$$$

Noncanonical Parsing

Colmerauer [1970], Szymanski and Williams [1976], Tai [1979]

Example



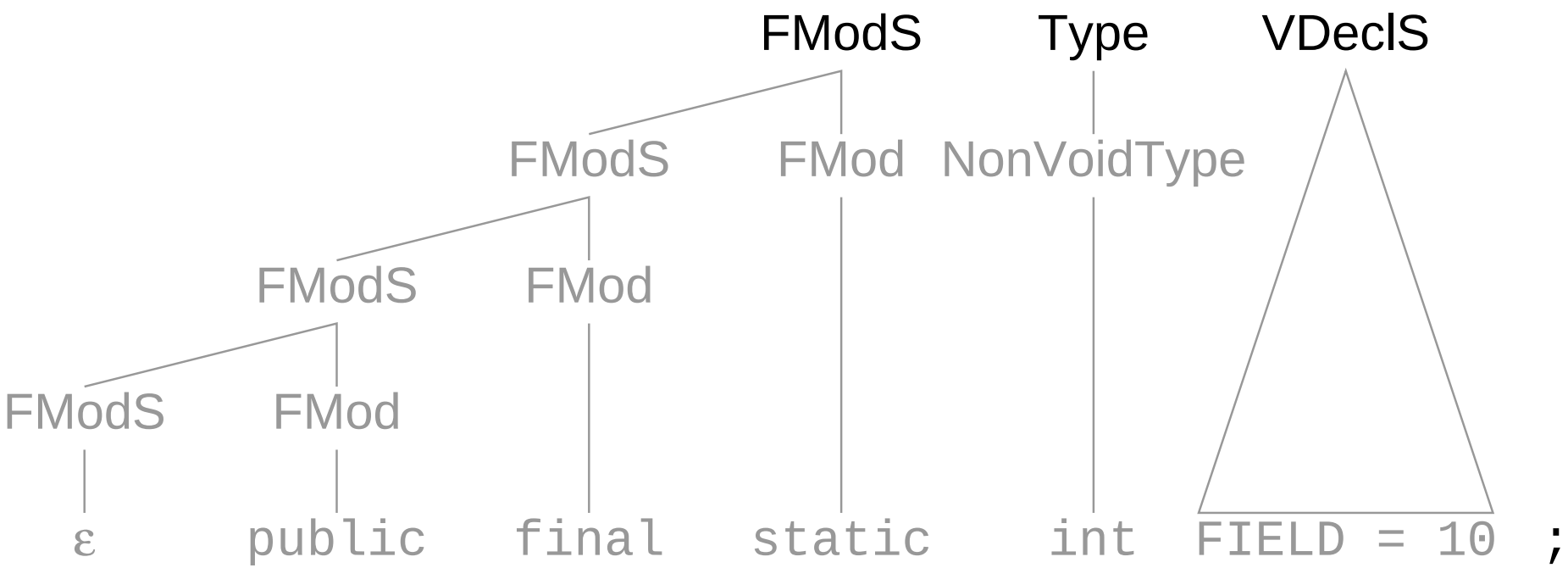
$$\$ < FModS > < Type > \ \| < VDeclS > \ ;\$$$

$$\models_{\text{shift}} \$ < FModS > < Type > \ < VDeclS > \ \| \ ;\$$$

Noncanonical Parsing

Colmerauer [1970], Szymanski and Williams [1976], Tai [1979]

Example



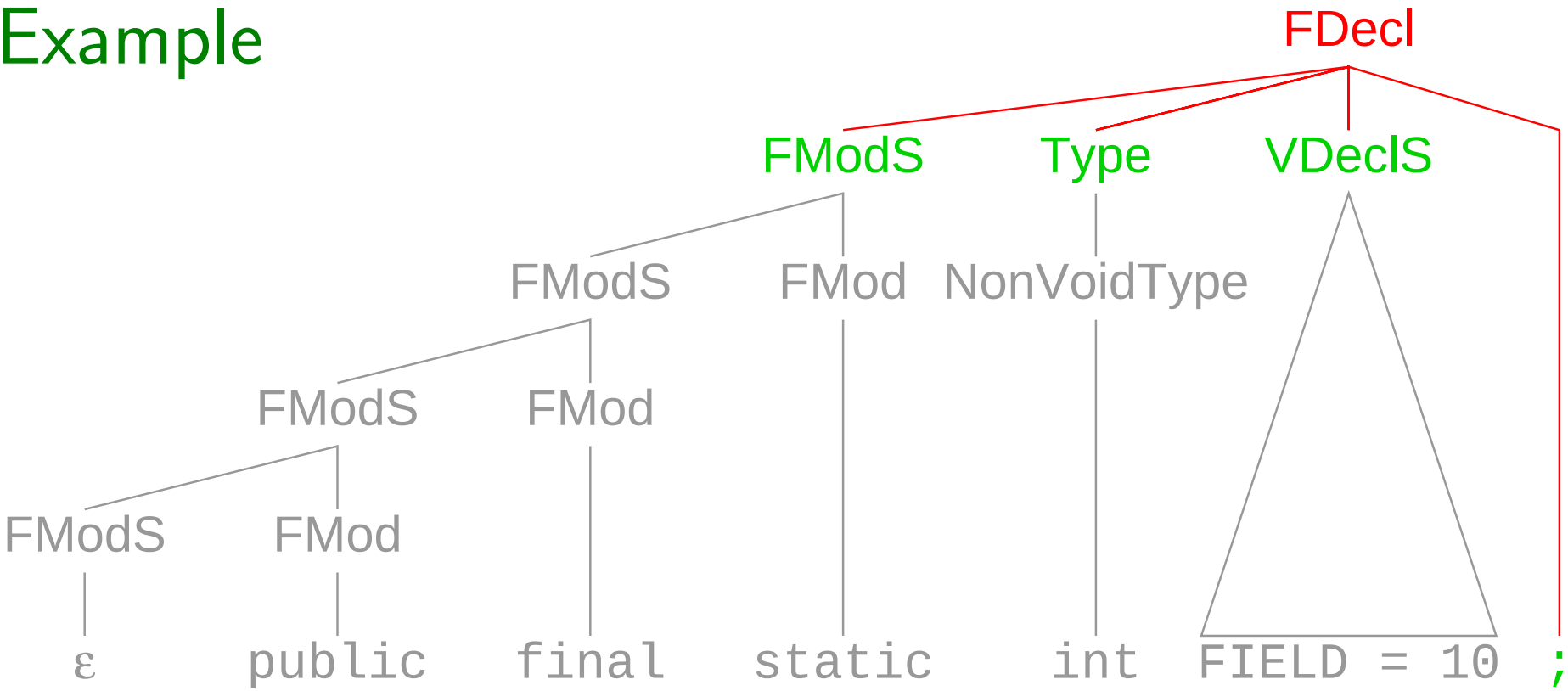
$$\$ < FModS >< Type >< VDeclS > \parallel ; \$$$

$$\vdash_{\text{shift}} \$ < FModS >< Type >< VDeclS > ; \parallel \$$$

Noncanonical Parsing

Colmerauer [1970], Szymanski and Williams [1976], Tai [1979]

Example



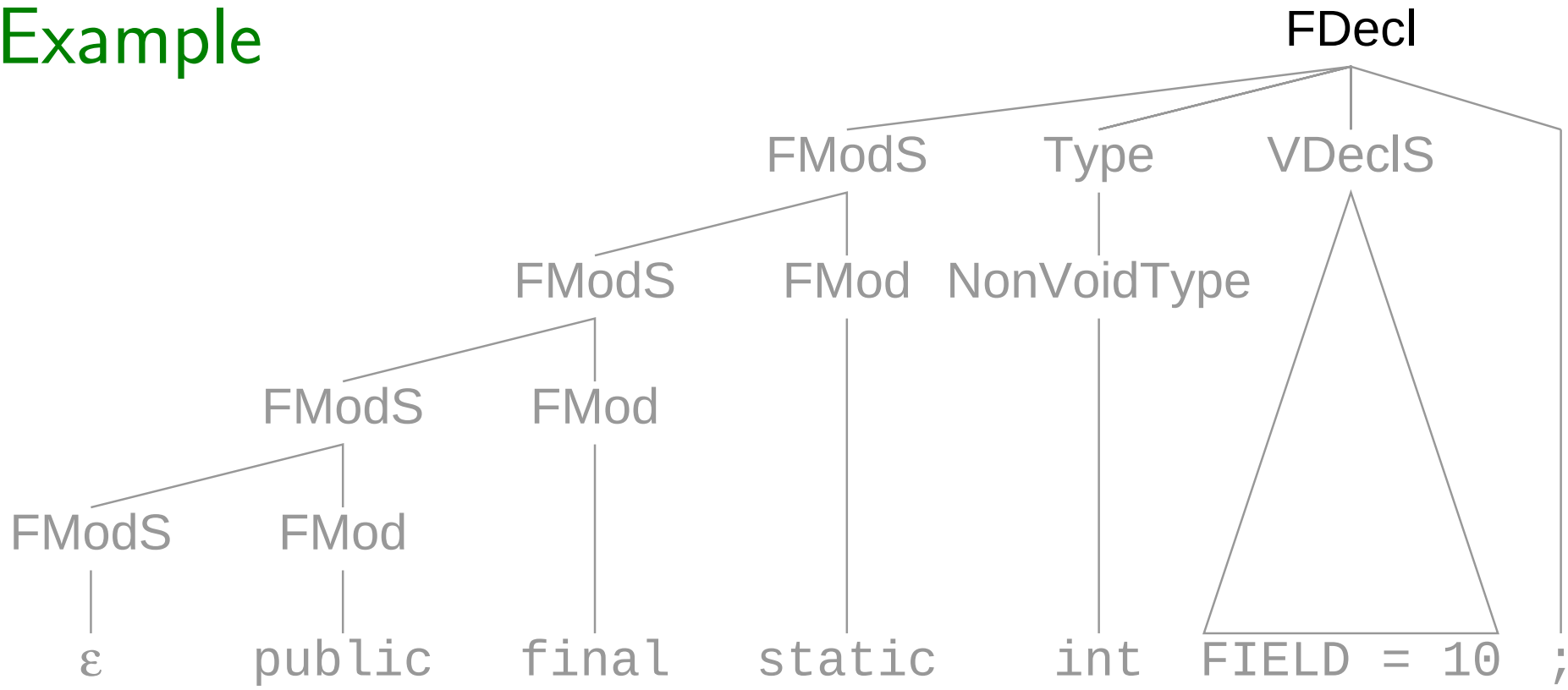
$$\$ < FModS >< Type >< VDeclS > \; ; \parallel \$$$

$$\vdash_{\text{reduce}} \$ \parallel < FDecl > \$$$

Noncanonical Parsing

Colmerauer [1970], Szymanski and Williams [1976], Tai [1979]

Example

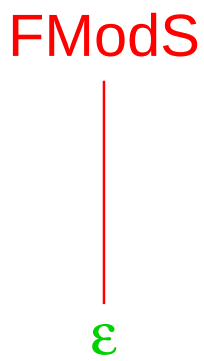


$$\$ \parallel \langle FDecl \rangle \ \$$$

$$\models_{\text{shift}} \$ \ \langle FDecl \rangle \parallel \$$$

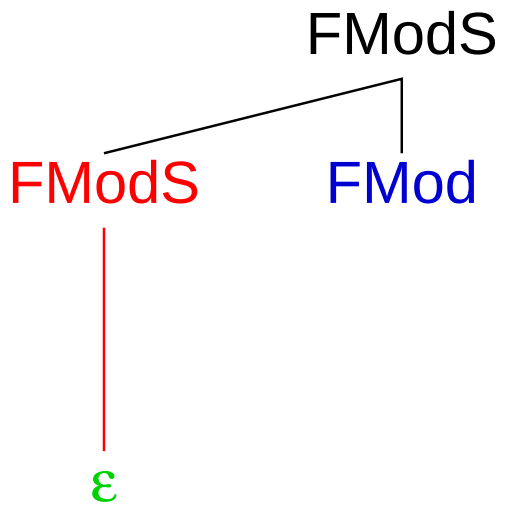
Noncanonical Lookaheads

Example



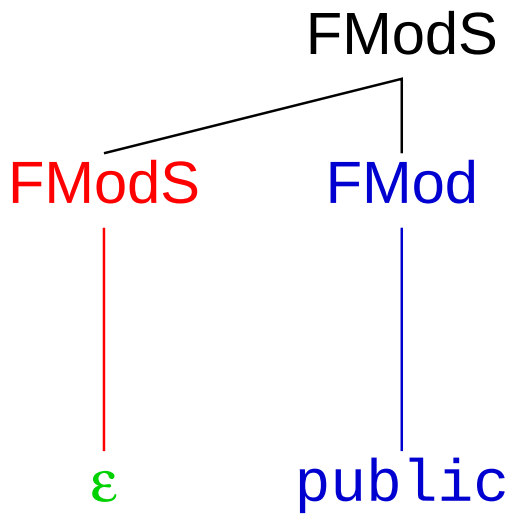
Noncanonical Lookaheads

Example



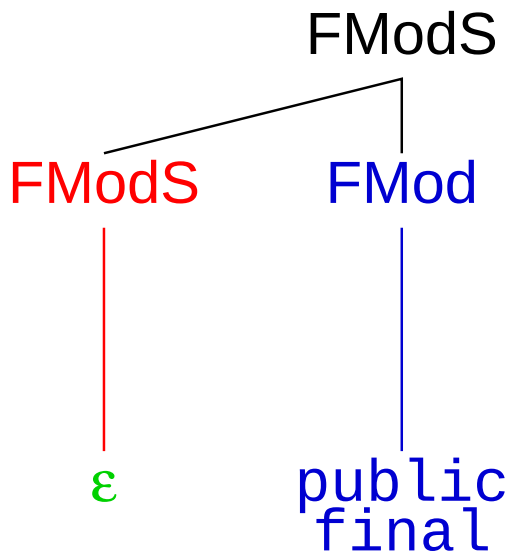
Noncanonical Lookaheads

Example



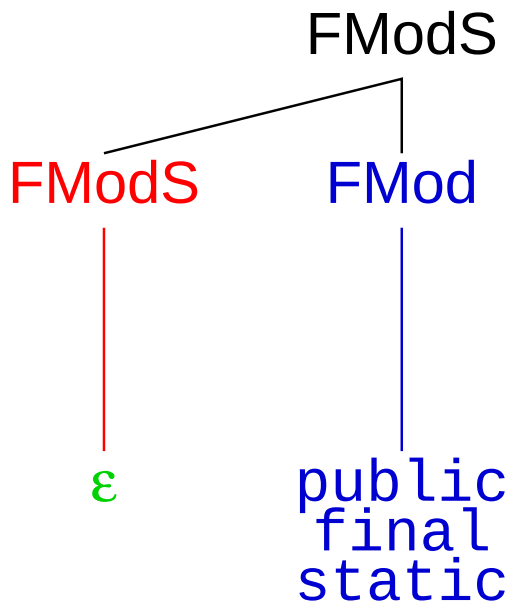
Noncanonical Lookaheads

Example



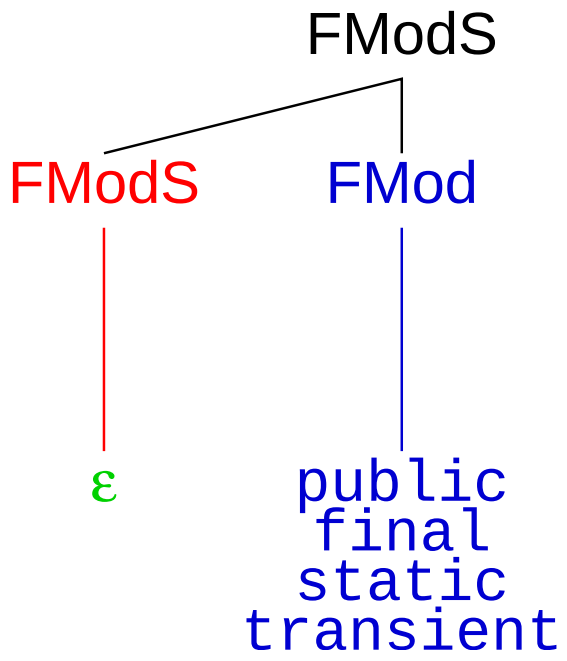
Noncanonical Lookaheads

Example



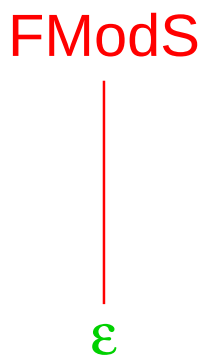
Noncanonical Lookaheads

Example



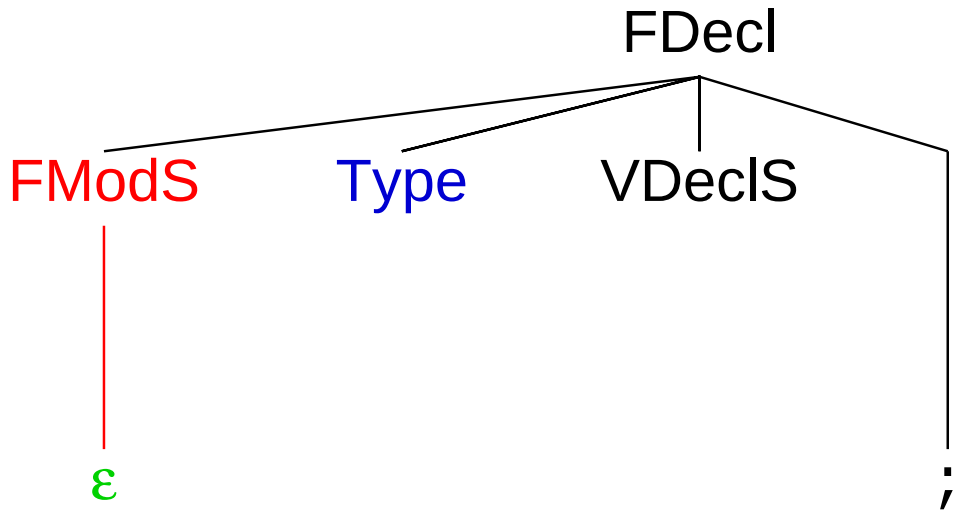
Noncanonical Lookaheads

Example



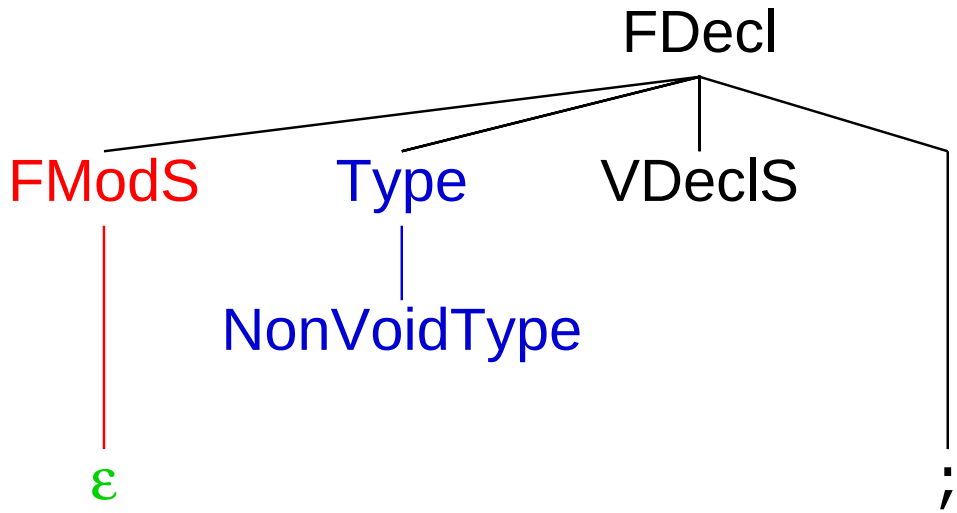
Noncanonical Lookaheads

Example



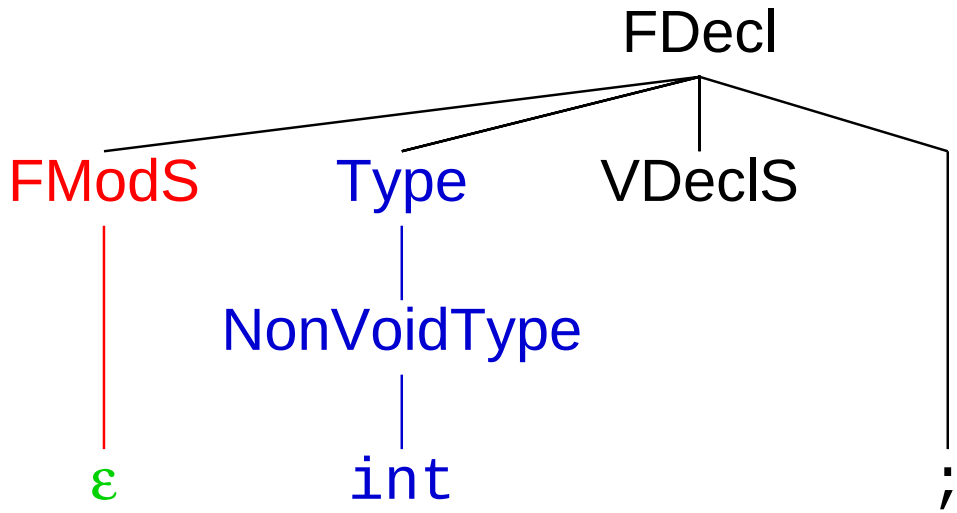
Noncanonical Lookaheads

Example



Noncanonical Lookaheads

Example



Noncanonical Lookaheads

Notation

$<FModS> \longrightarrow \varepsilon$ $\{\texttt{public}, \texttt{final}, \texttt{static}, \texttt{int}, \texttt{transient}, <FMod>, <Type>, <NonVoidType>\}$

Noncanonical Lookaheads

Comparison

$$<FModS> \to \varepsilon \qquad \{\texttt{public}, \texttt{final}, \texttt{static}, \texttt{int}, \texttt{transient}, <FMod>, <Type>, <NonVoidType>\}$$

$$<MModS> \to \varepsilon \qquad \{\texttt{public}, \texttt{final}, \texttt{static}, \texttt{int}, \texttt{abstract}, <MMod>, <ReturnType>, <NonVoidType>\}$$

Noncanonical Lookaheads

Conflicts

$<FModS> \longrightarrow \varepsilon$ $\{\texttt{public}, \texttt{final}, \texttt{static}, \texttt{int}, \texttt{transient}, <FMod>, <Type>, <NonVoidType>\}$

$<MModS> \longrightarrow \varepsilon$ $\{\texttt{public}, \texttt{final}, \texttt{static}, \texttt{int}, \texttt{abstract}, <MMod>, <ReturnType>, <NonVoidType>\}$

Noncanonical Lookaheads

Decisions

$$<FModS> \longrightarrow \varepsilon \qquad \{\texttt{public}, \texttt{final}, \texttt{static}, \texttt{int}, \texttt{transient}, <FMod>, <Type>, <NonVoidType>\}$$

$$<MModS> \longrightarrow \varepsilon \qquad \{\texttt{public}, \texttt{final}, \texttt{static}, \texttt{int}, \texttt{abstract}, <MMod>, <ReturnType>, <NonVoidType>\}$$

Noncanonical LALR(1)

Schmitz [2006]

NLALR(1) Construction

- Easy: computations on the LR(0) automaton
- Fast: relational expressions

Closing Comments

Noncanonical Parsing

Good generality, Determinism, $\mathcal{O}(n)$ time complexity

Improvements

Better generality: no preset lookahead length

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