Compilers

Radan Ganchev

Compilers

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- Purpose
- Structure
- How to write a compiler?
- Real life examples

Purpose of compilers

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- Optimization

Structure of a compiler

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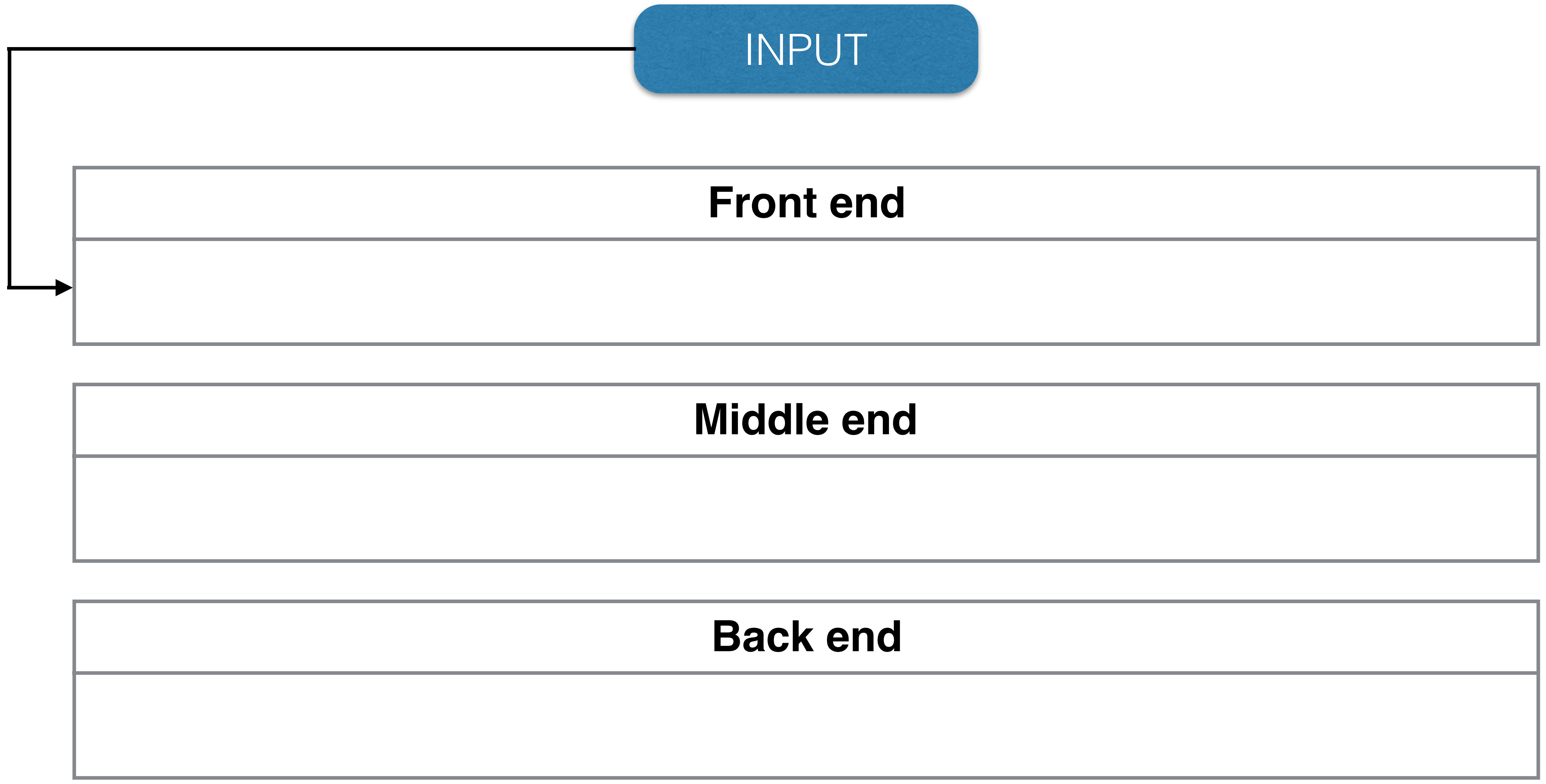
Front end

Middle end

Back end

Structure of a compiler



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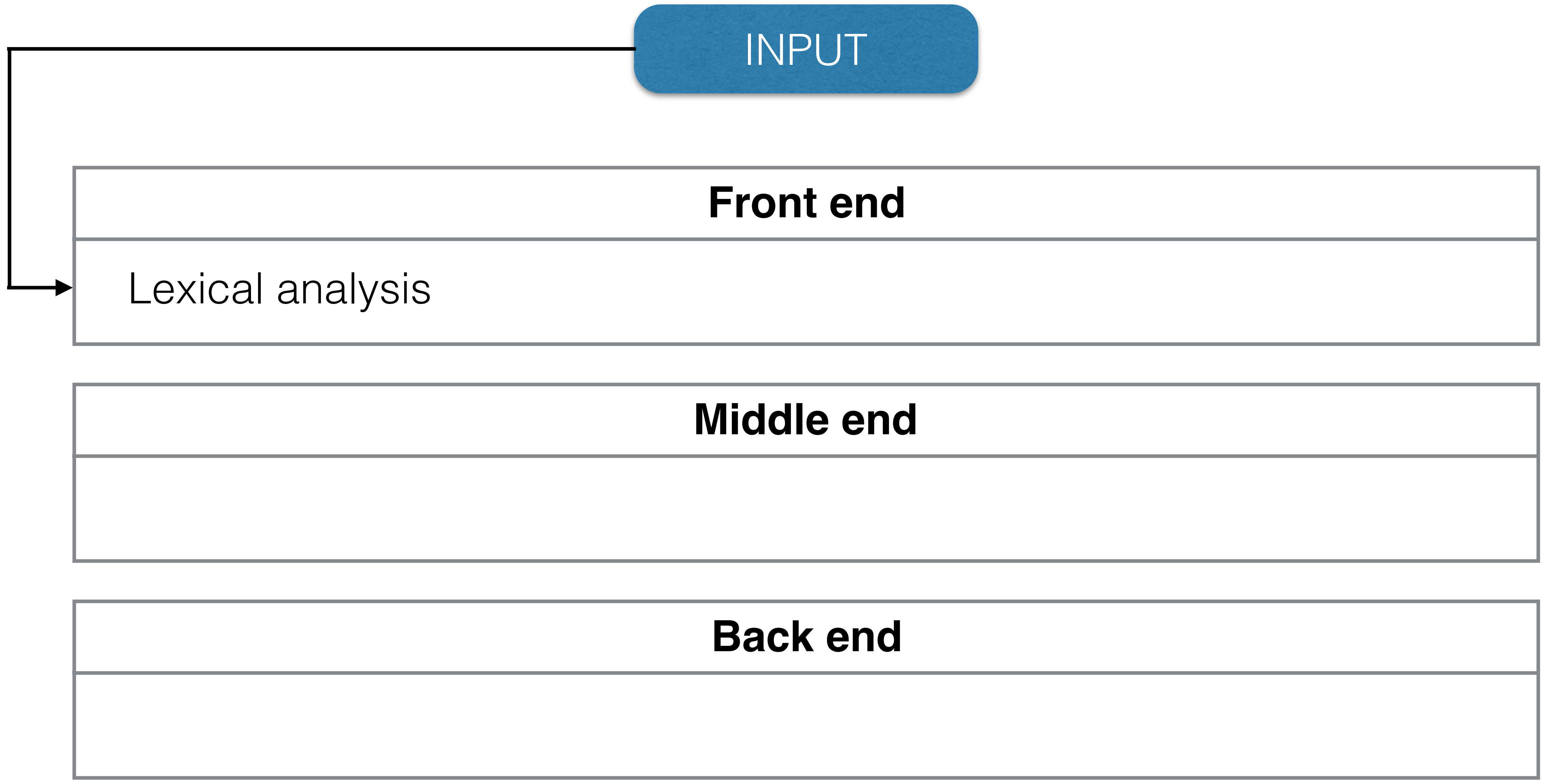

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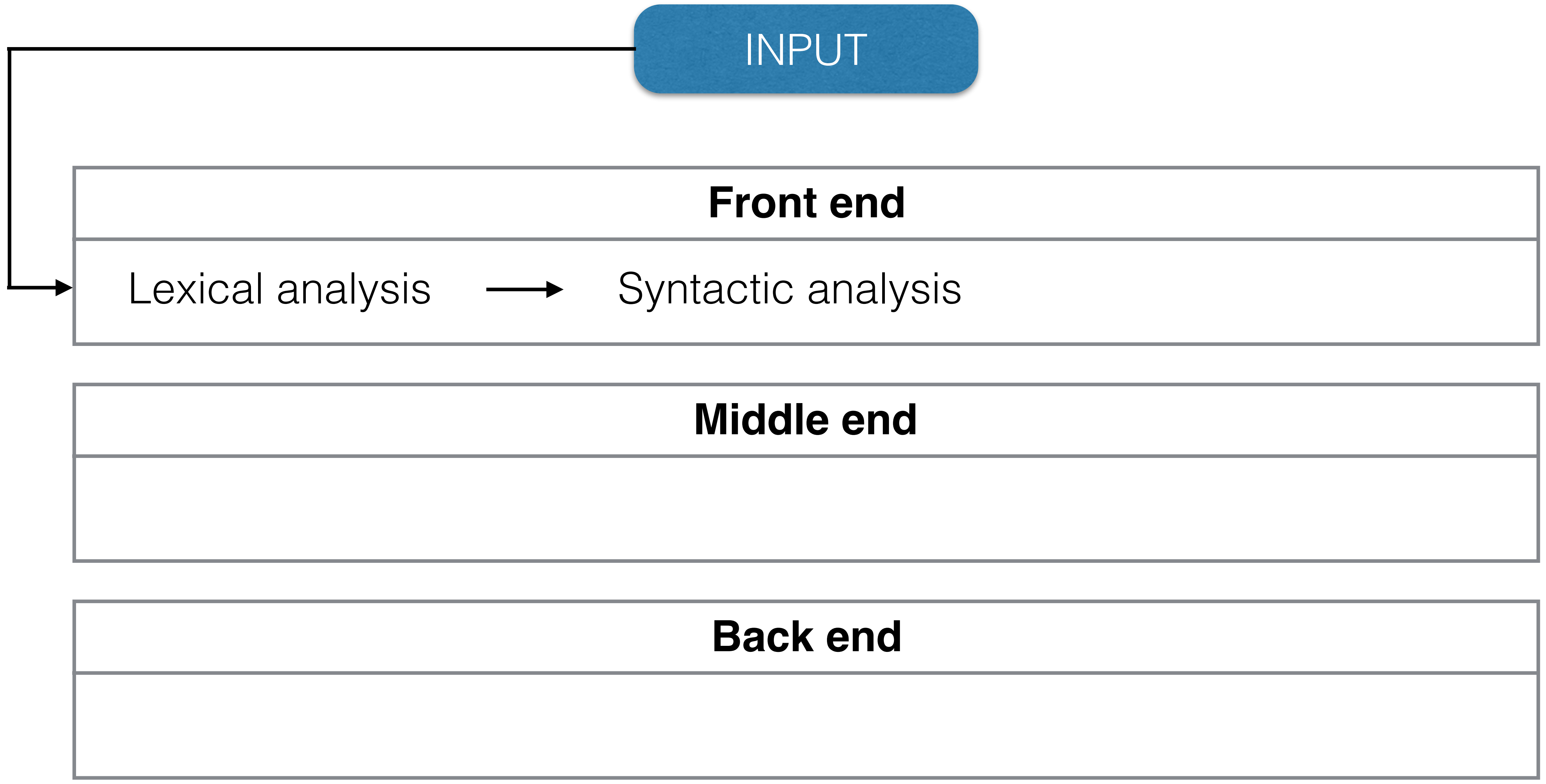

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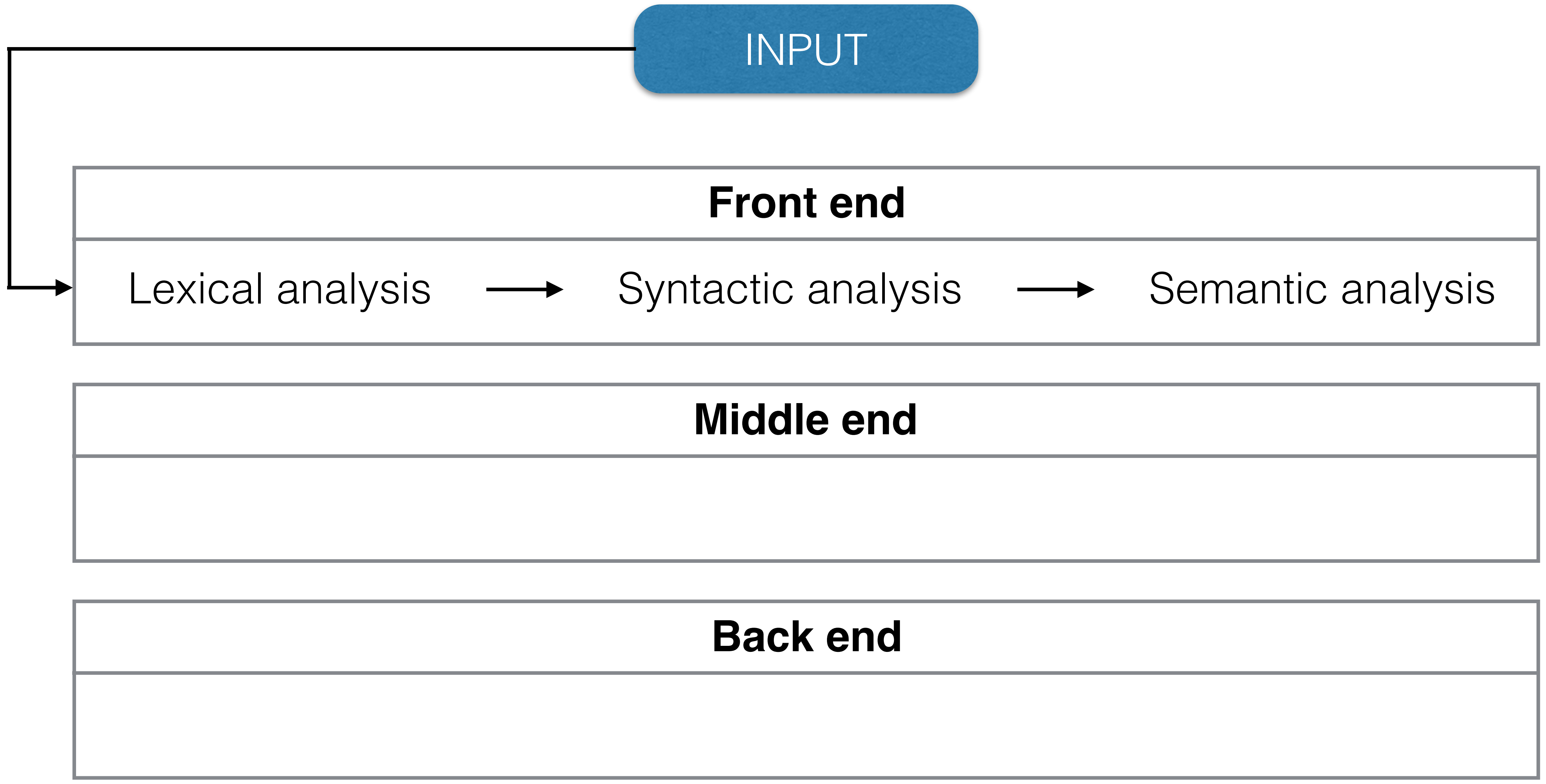

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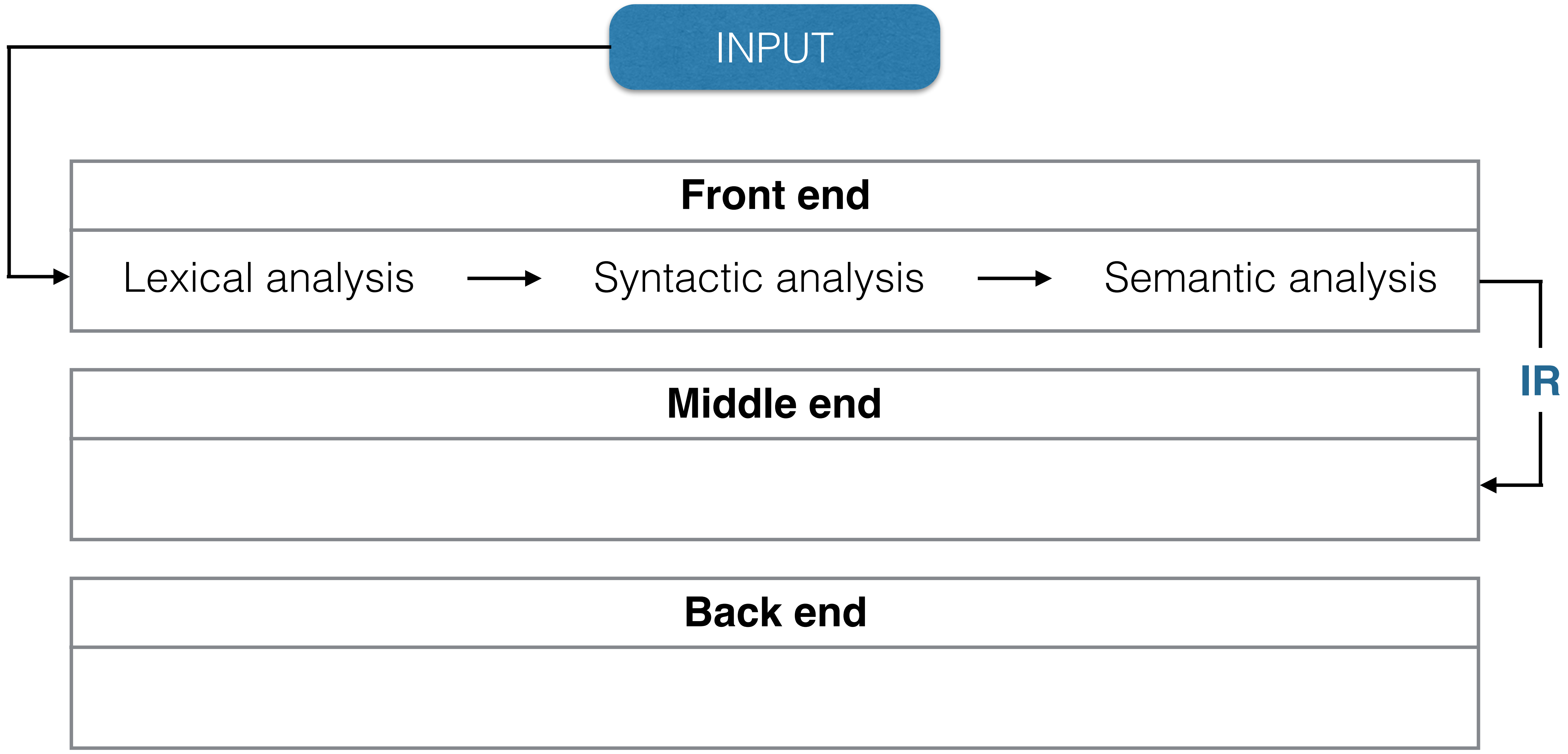

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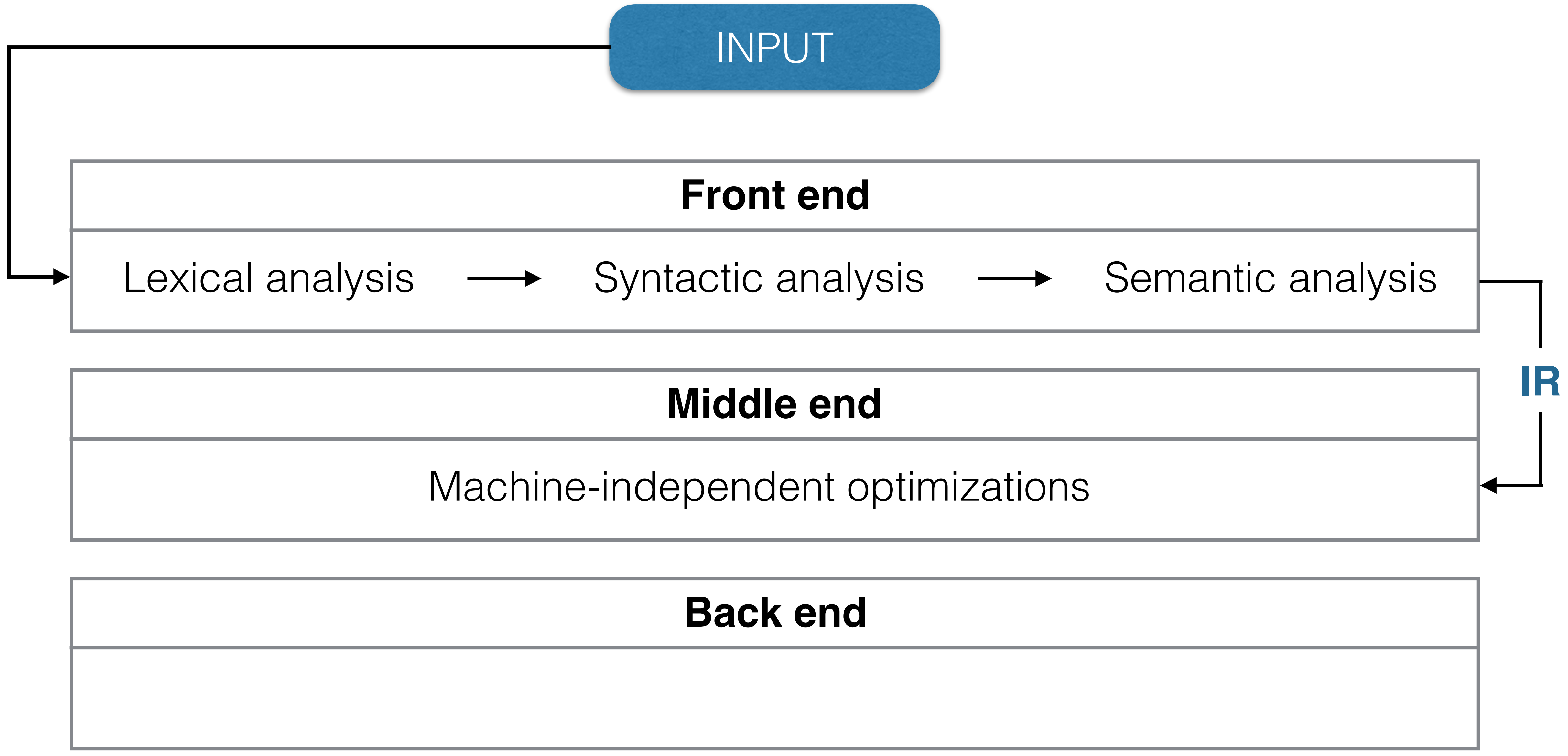

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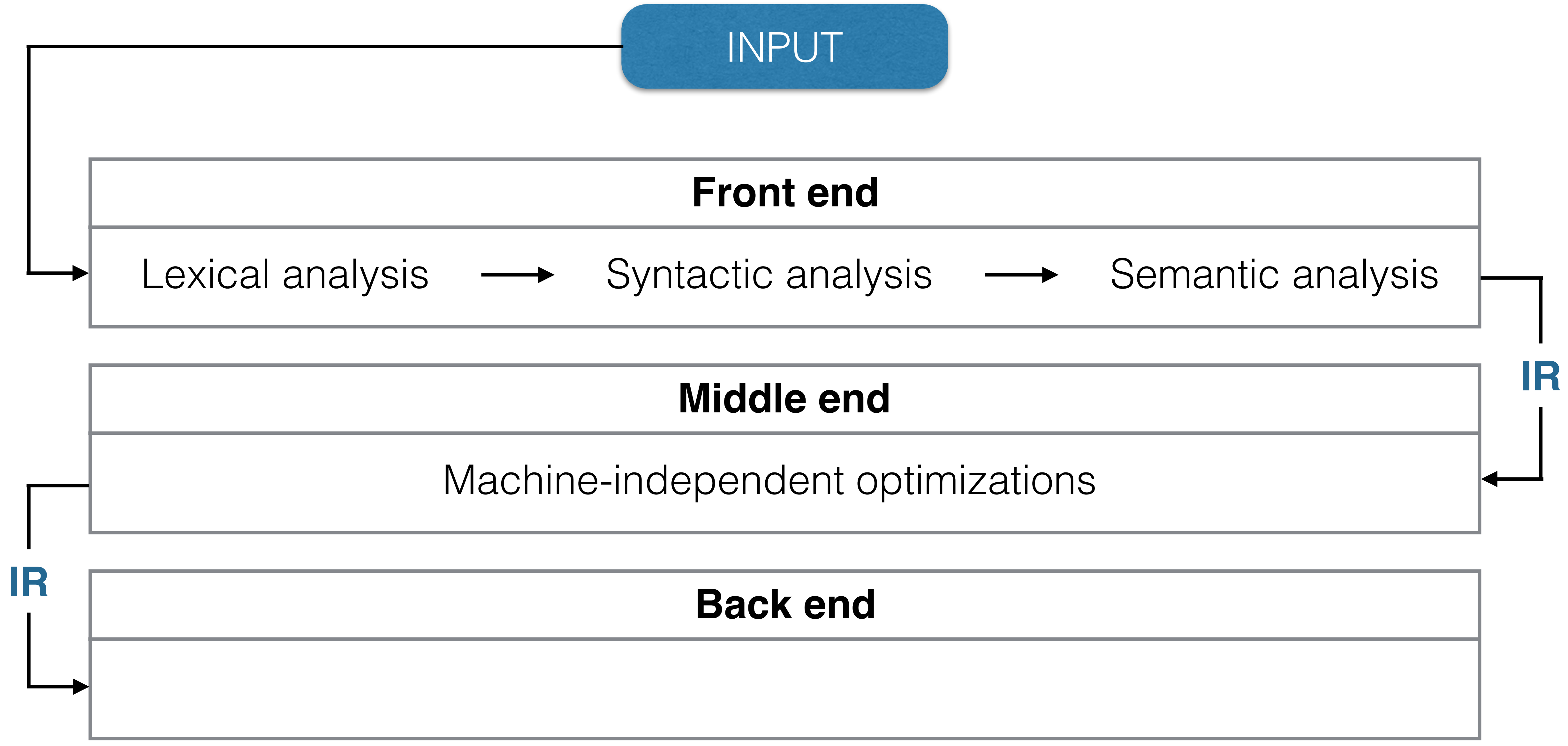

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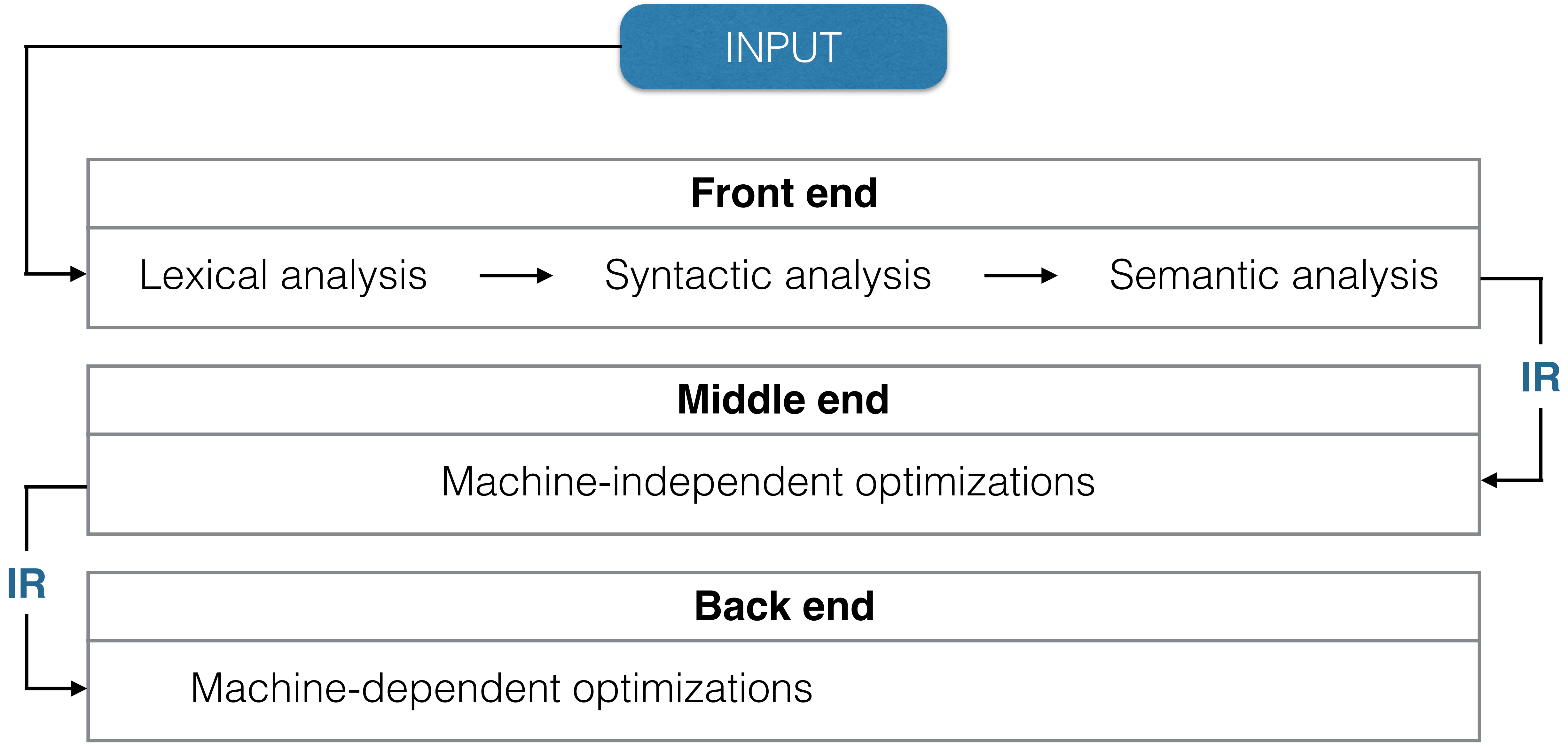

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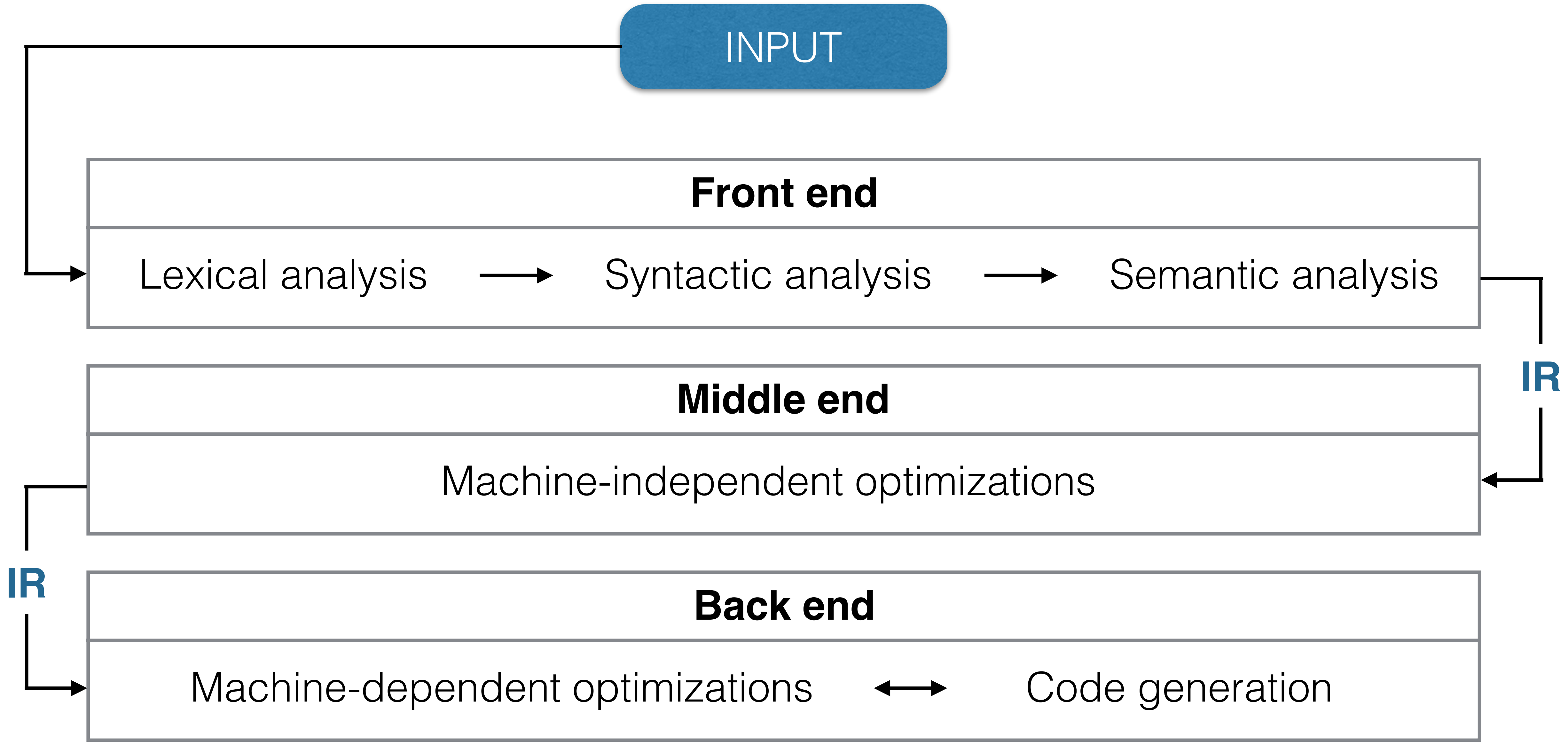

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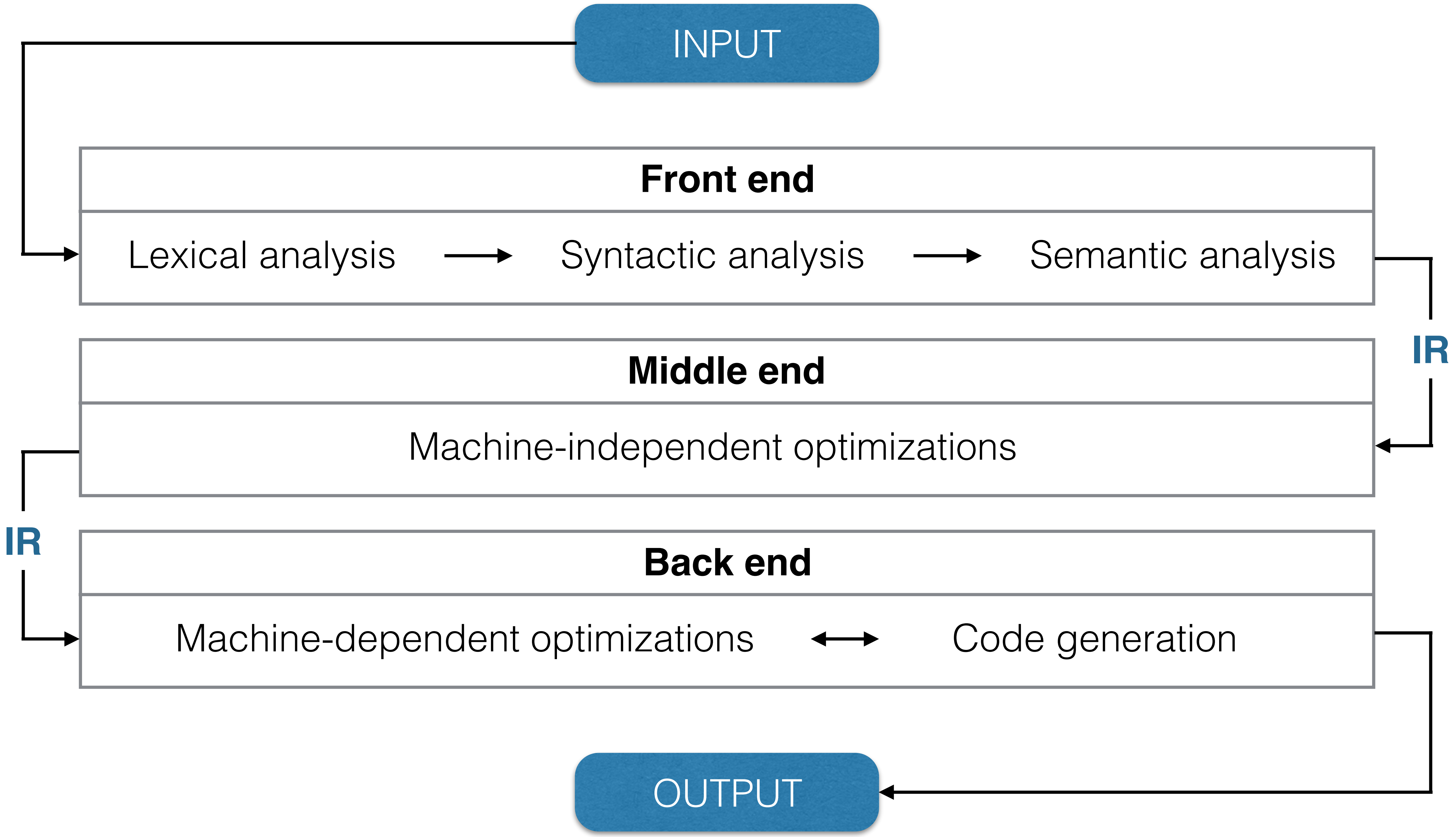

Lexical analysis

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- Regular definition:
  `token_class` $\longrightarrow$ *`regular_expression`*

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if, then, else, =, -,
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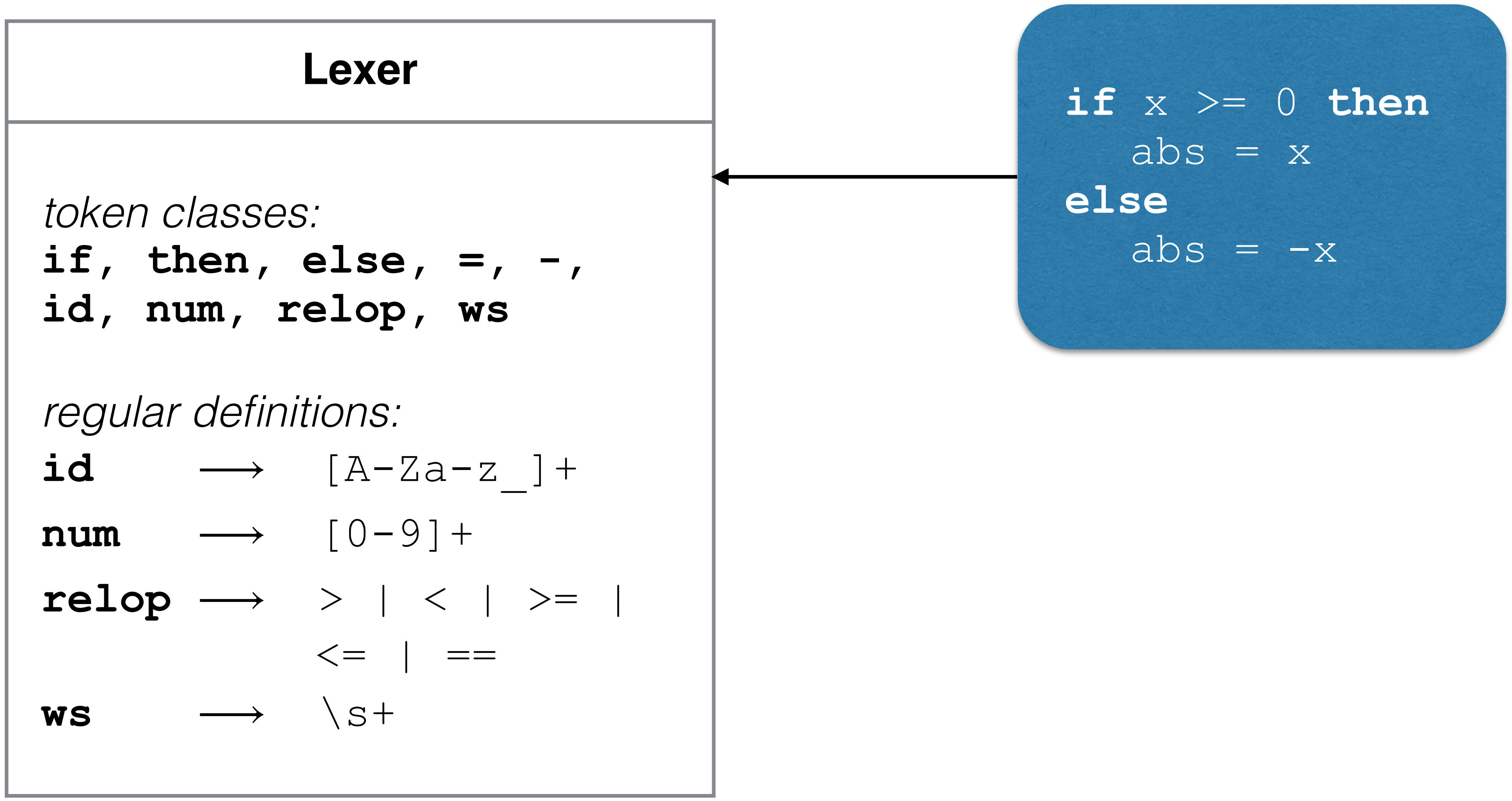

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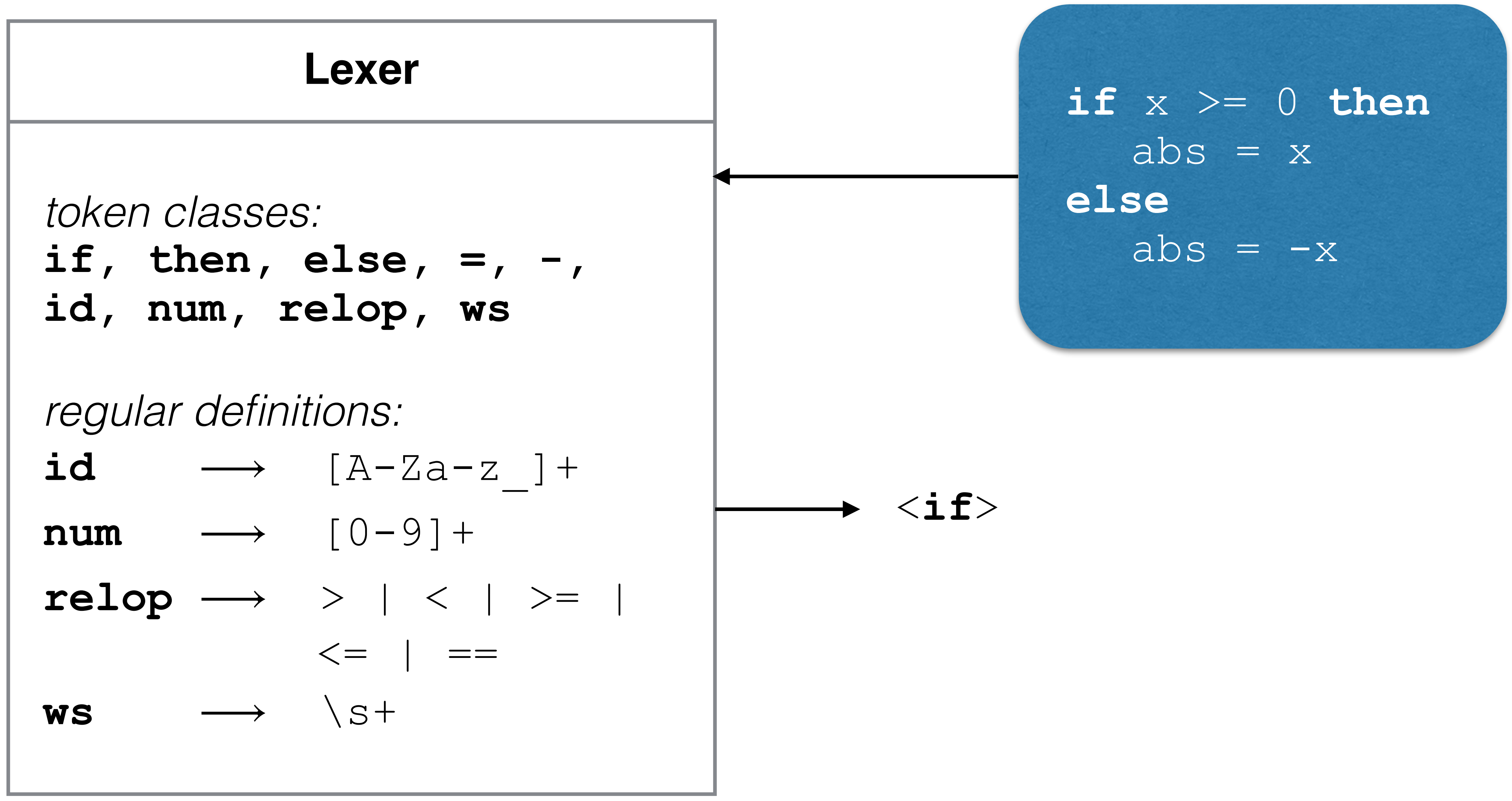

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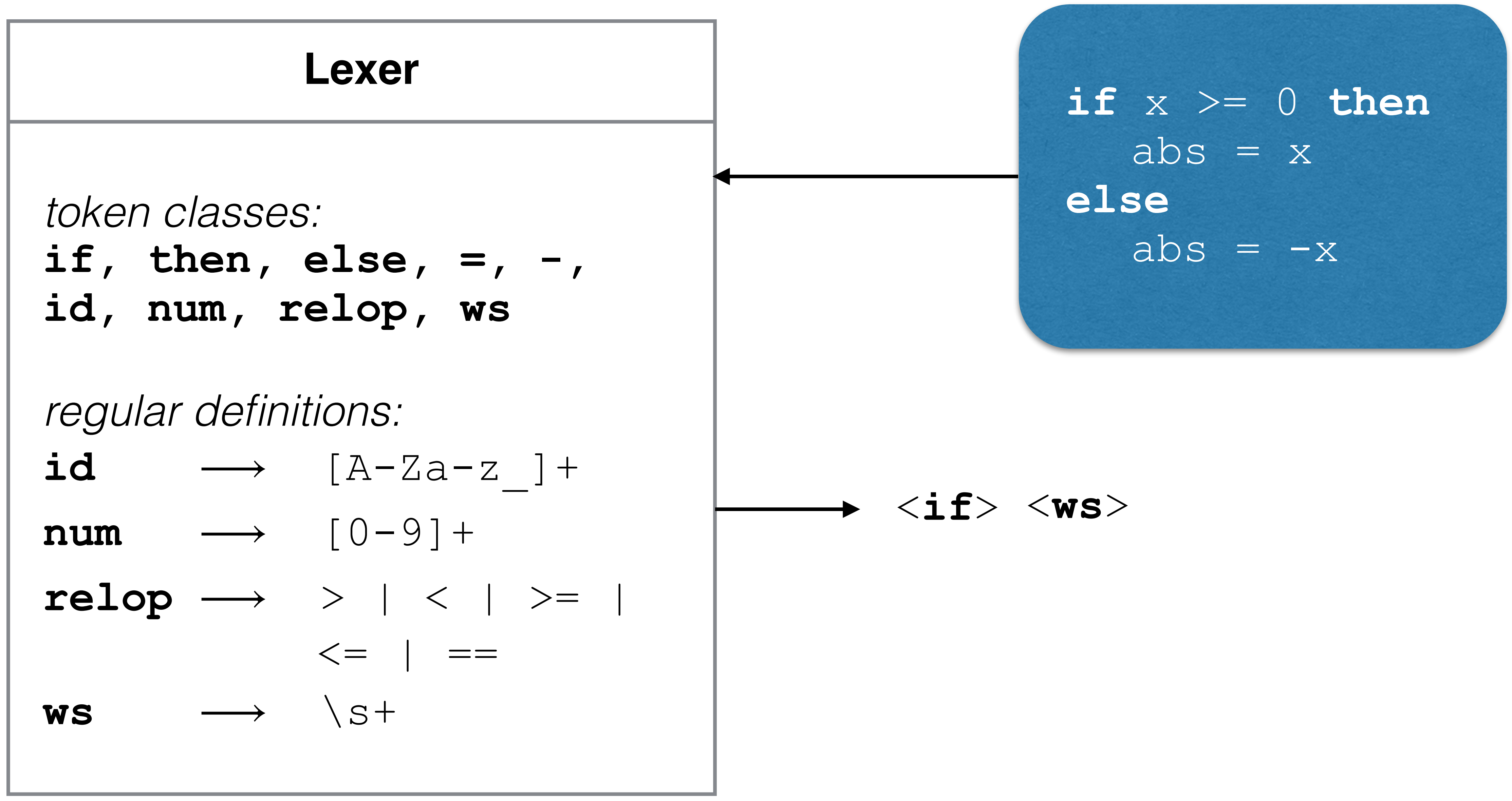

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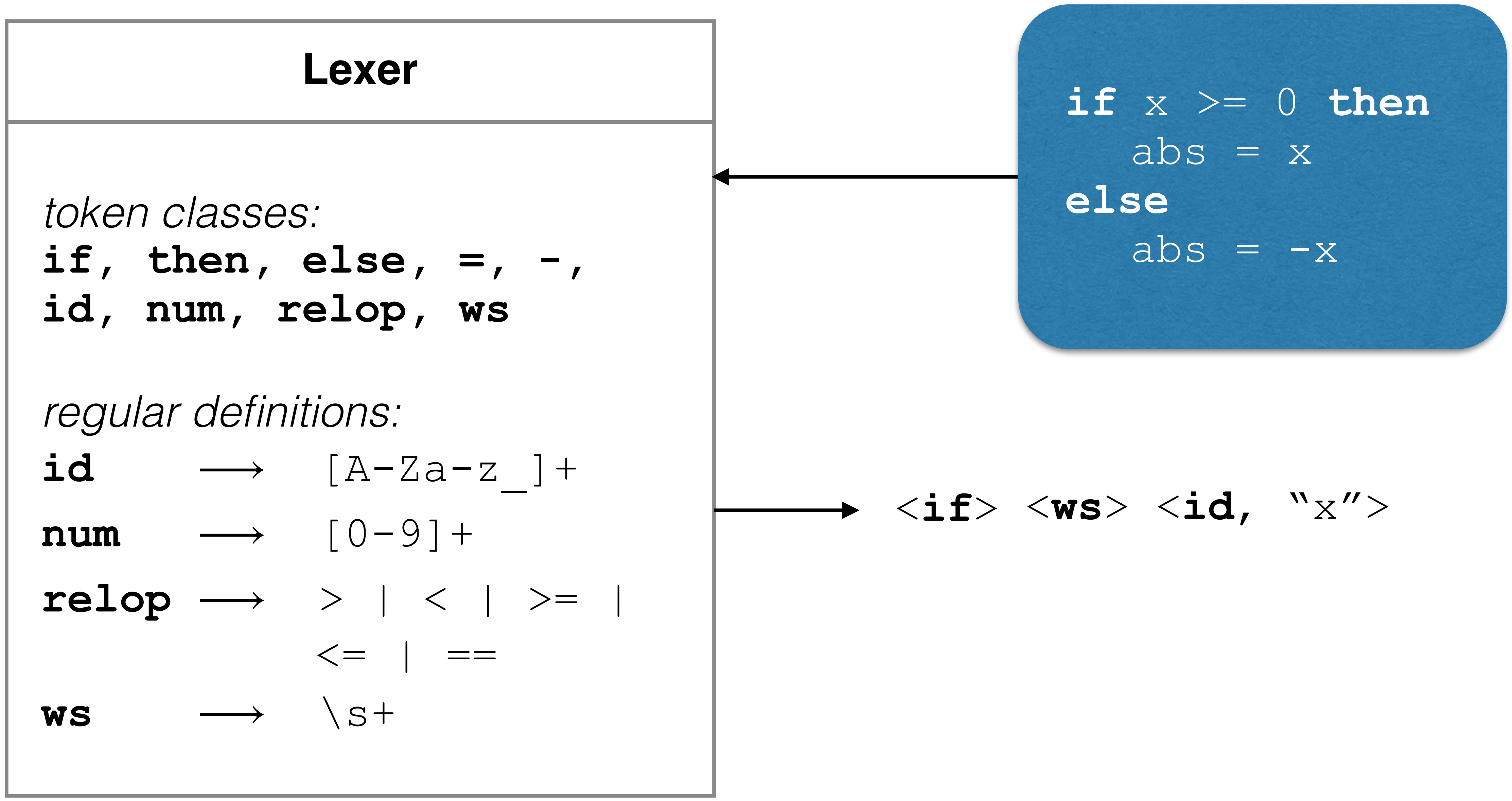

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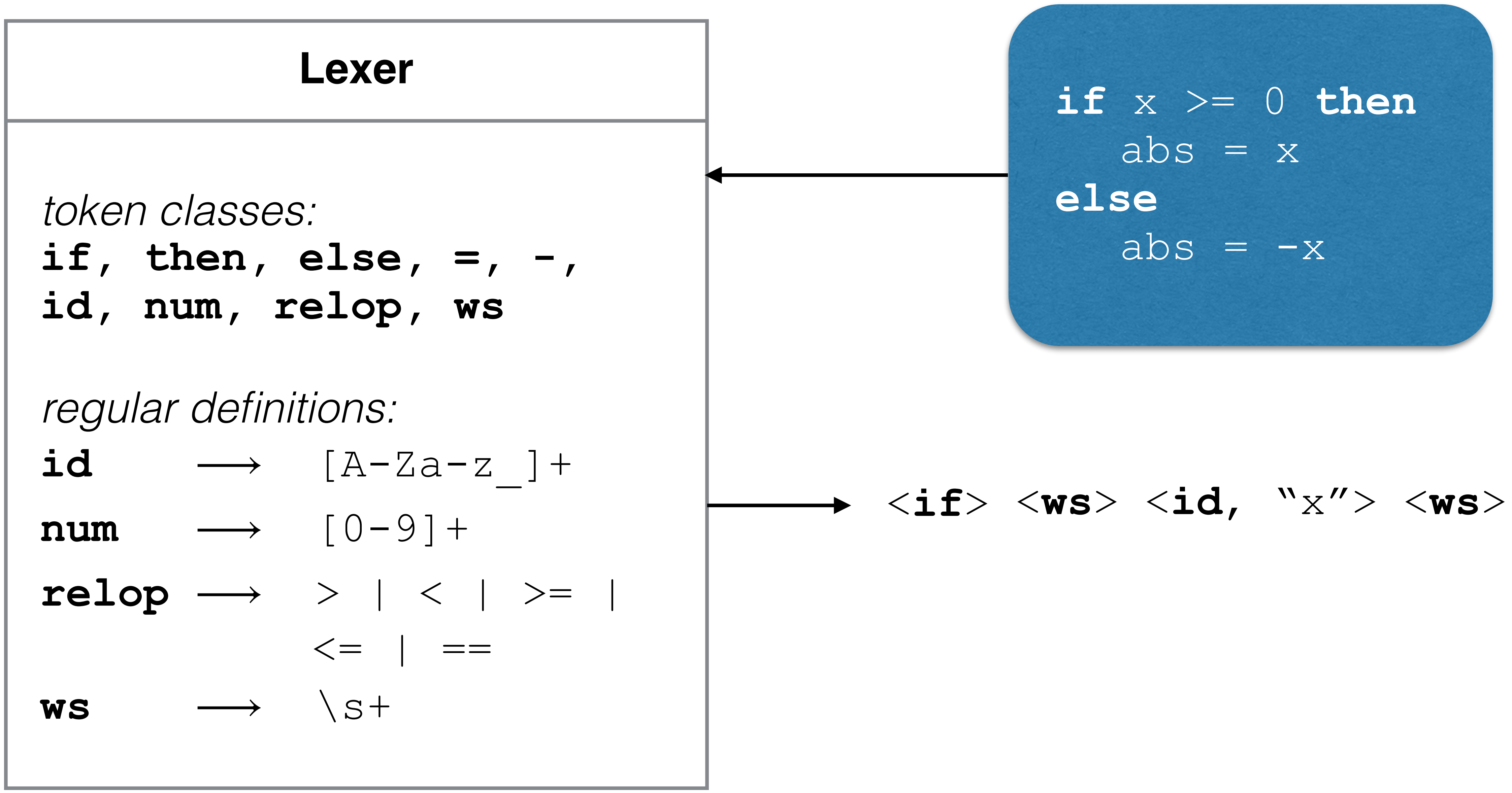

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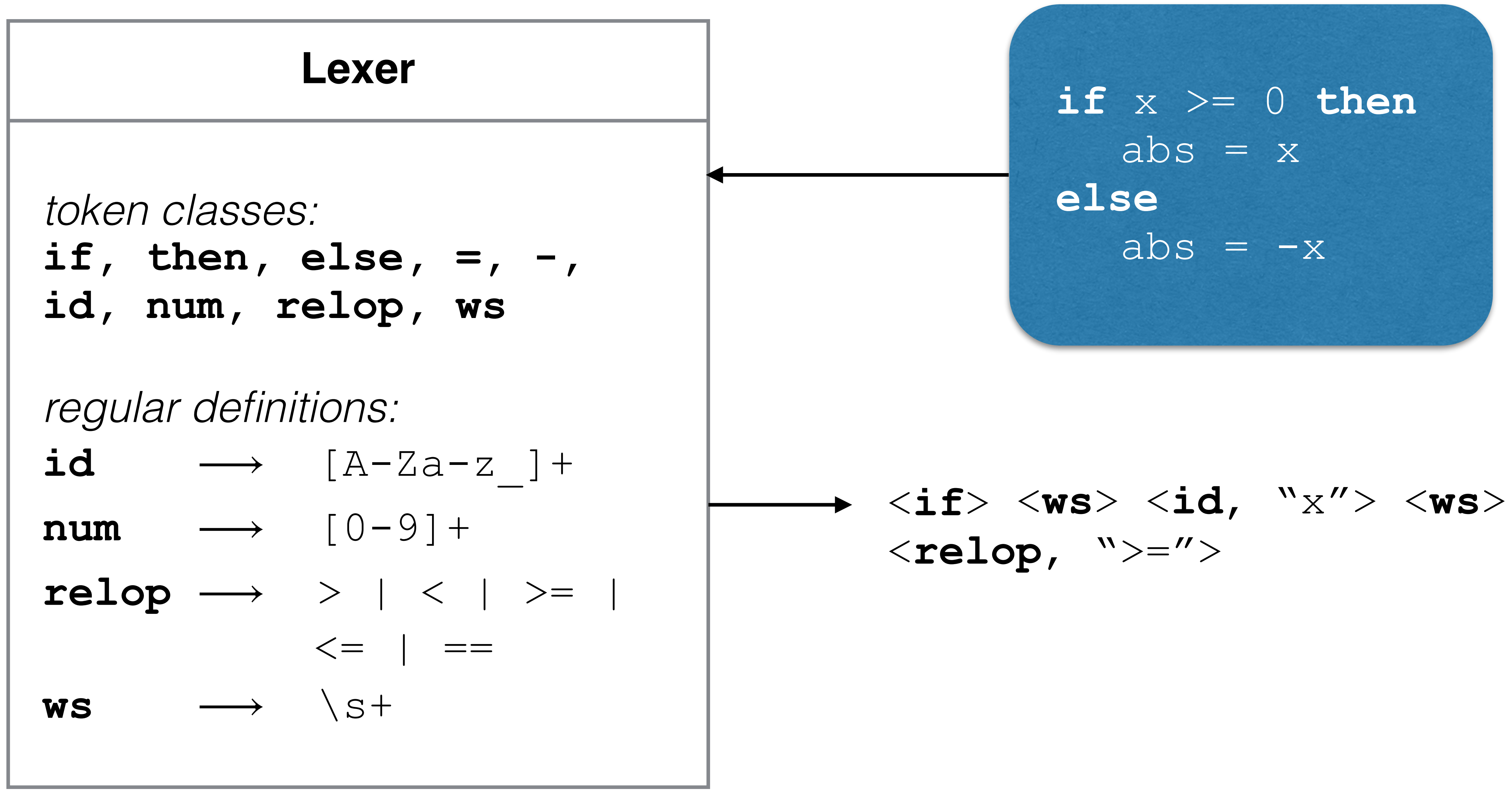

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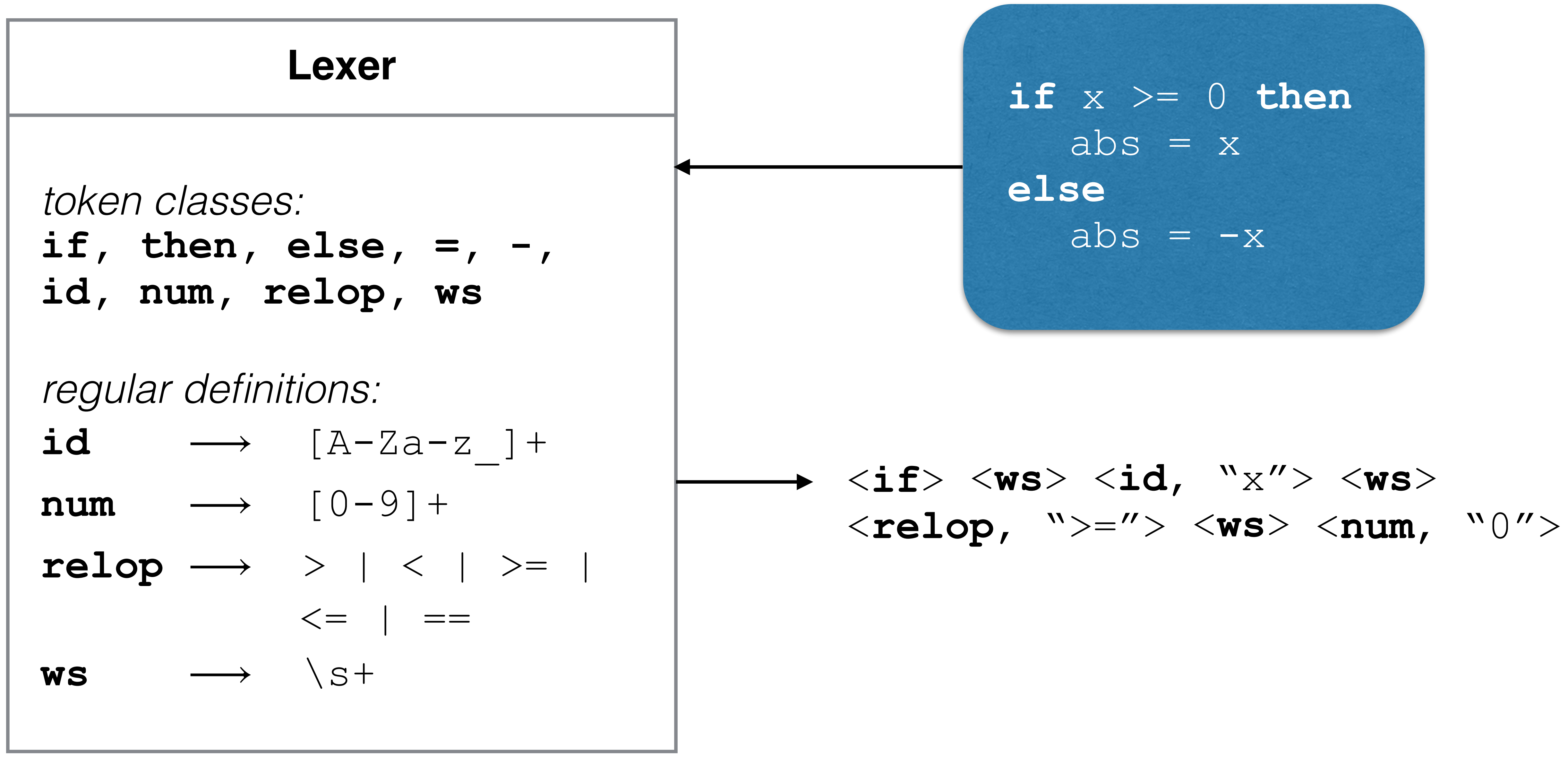

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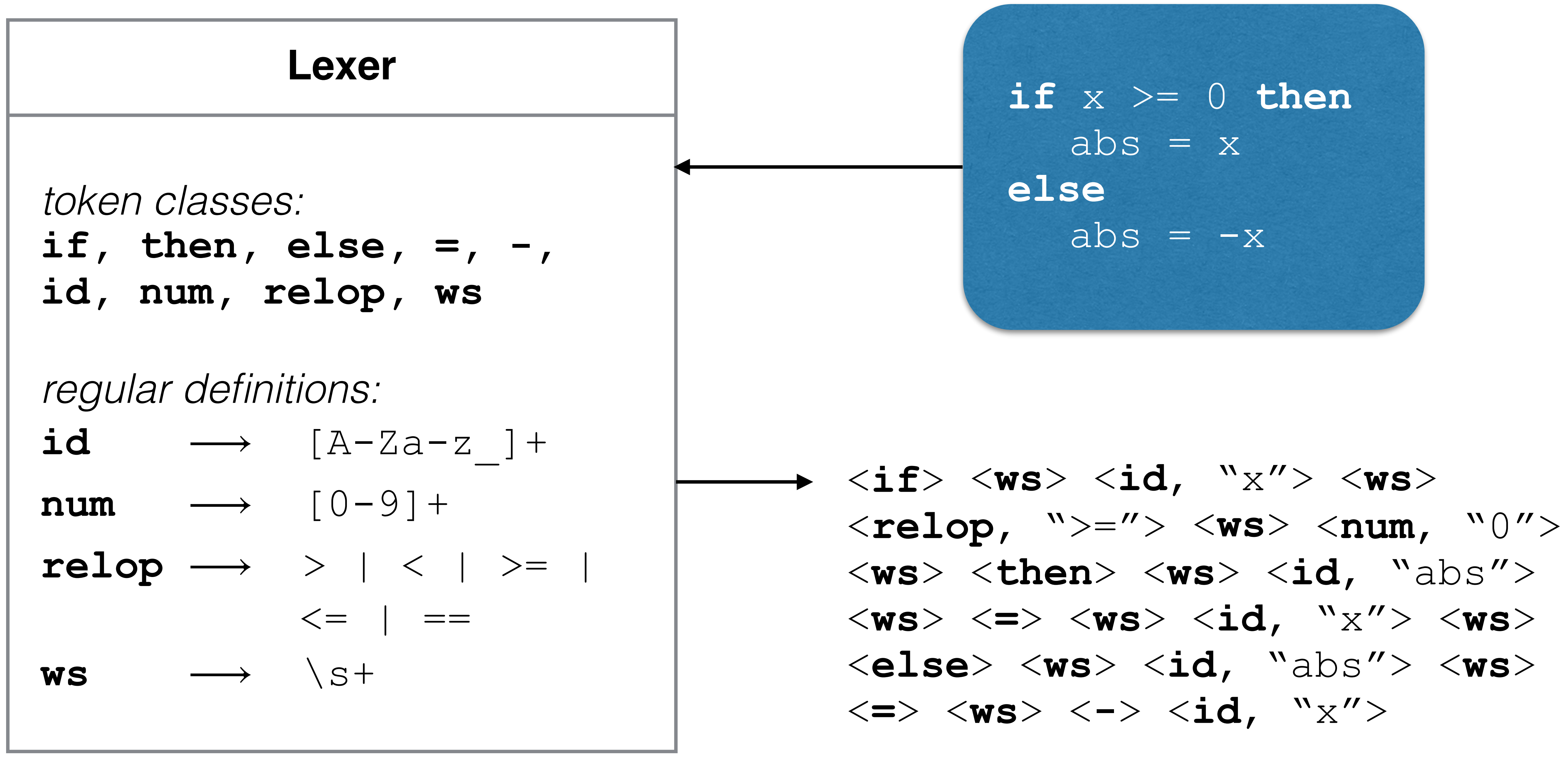

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- Derivations are described by *concrete syntax trees*
- Concrete syntax trees are usually transformed to *abstract syntax trees (AST)*

Syntactic analysis

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ifStmt	$\longrightarrow$	**if** *cond* **then** *stmt*
cond	$\longrightarrow$	*expr* **relop** *expr*
stmt	$\longrightarrow$	**id** **=** *expr*
expr	$\longrightarrow$	**id** | **num**

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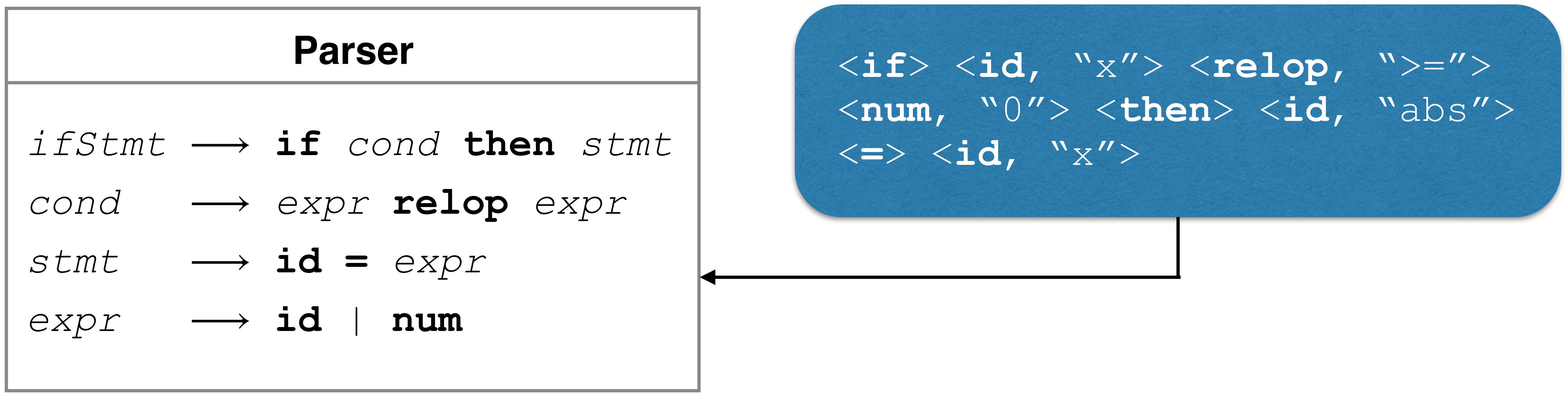

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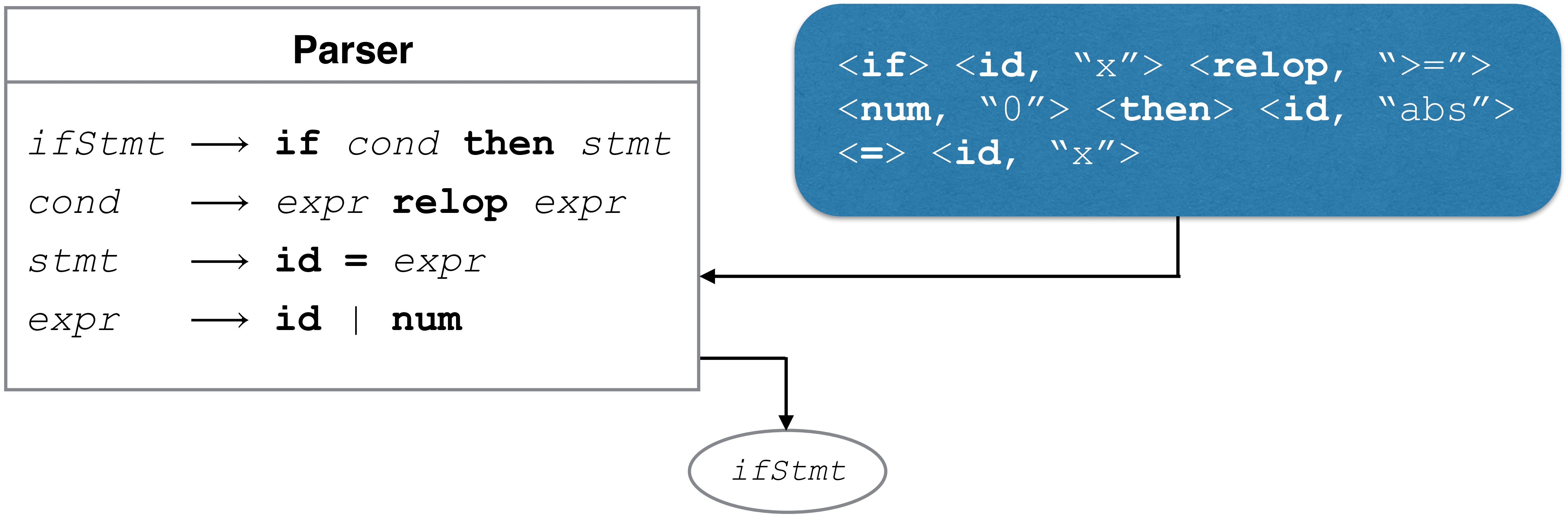

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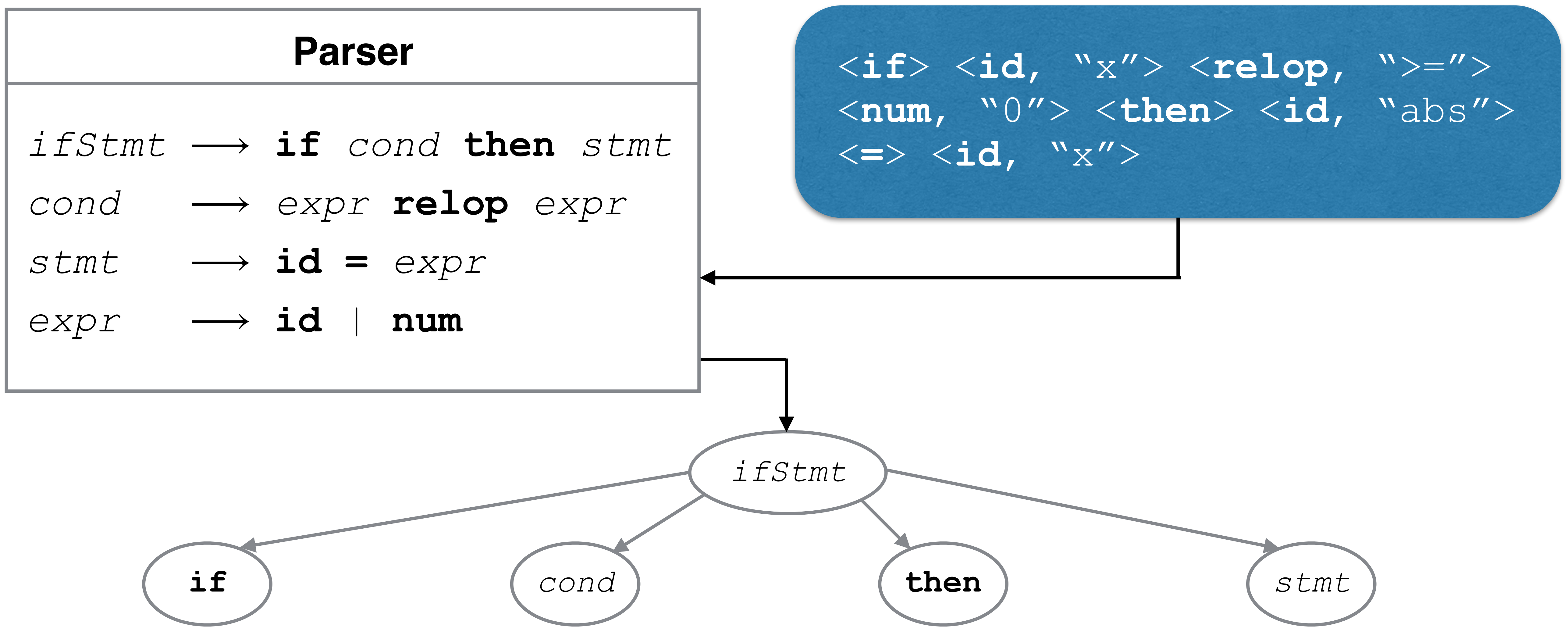

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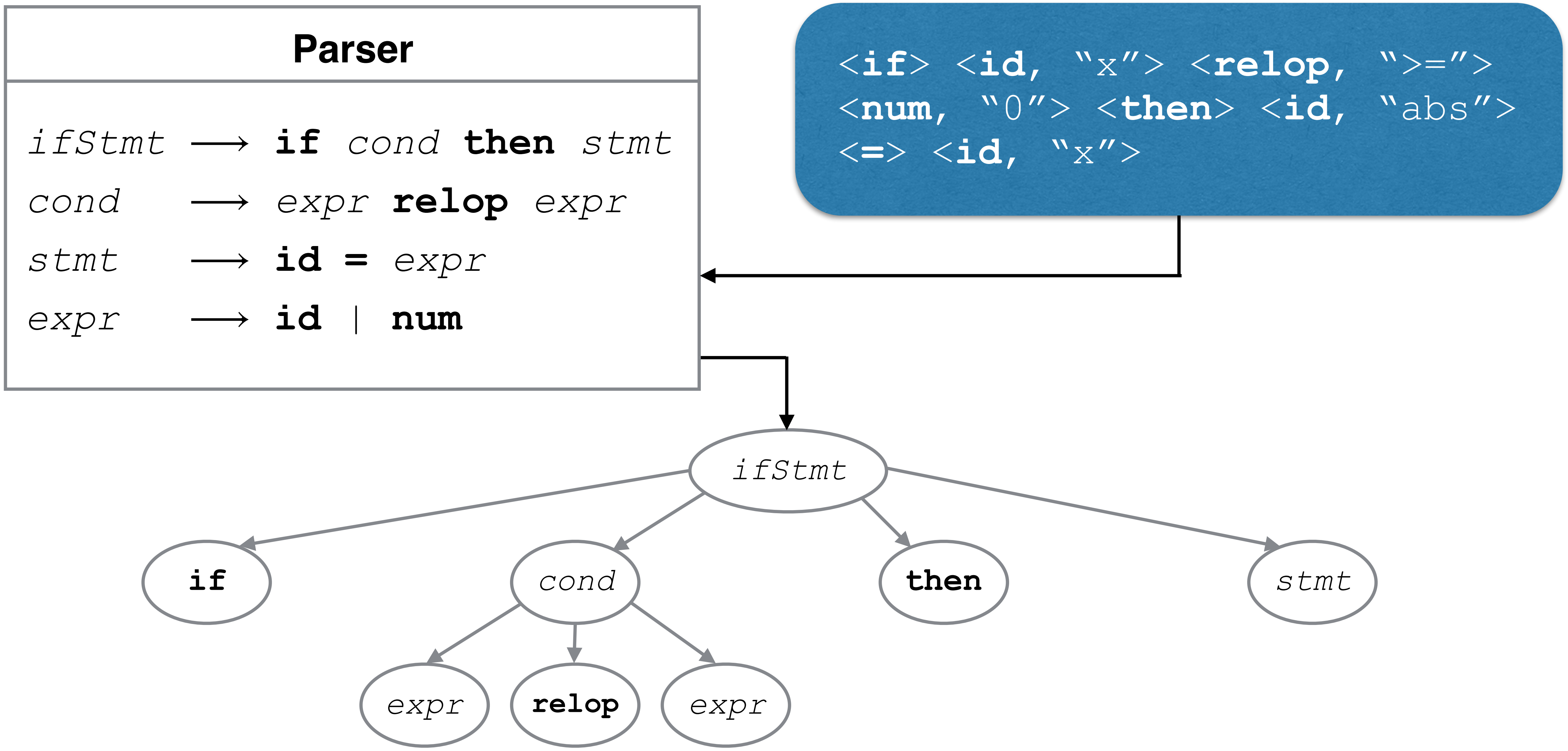

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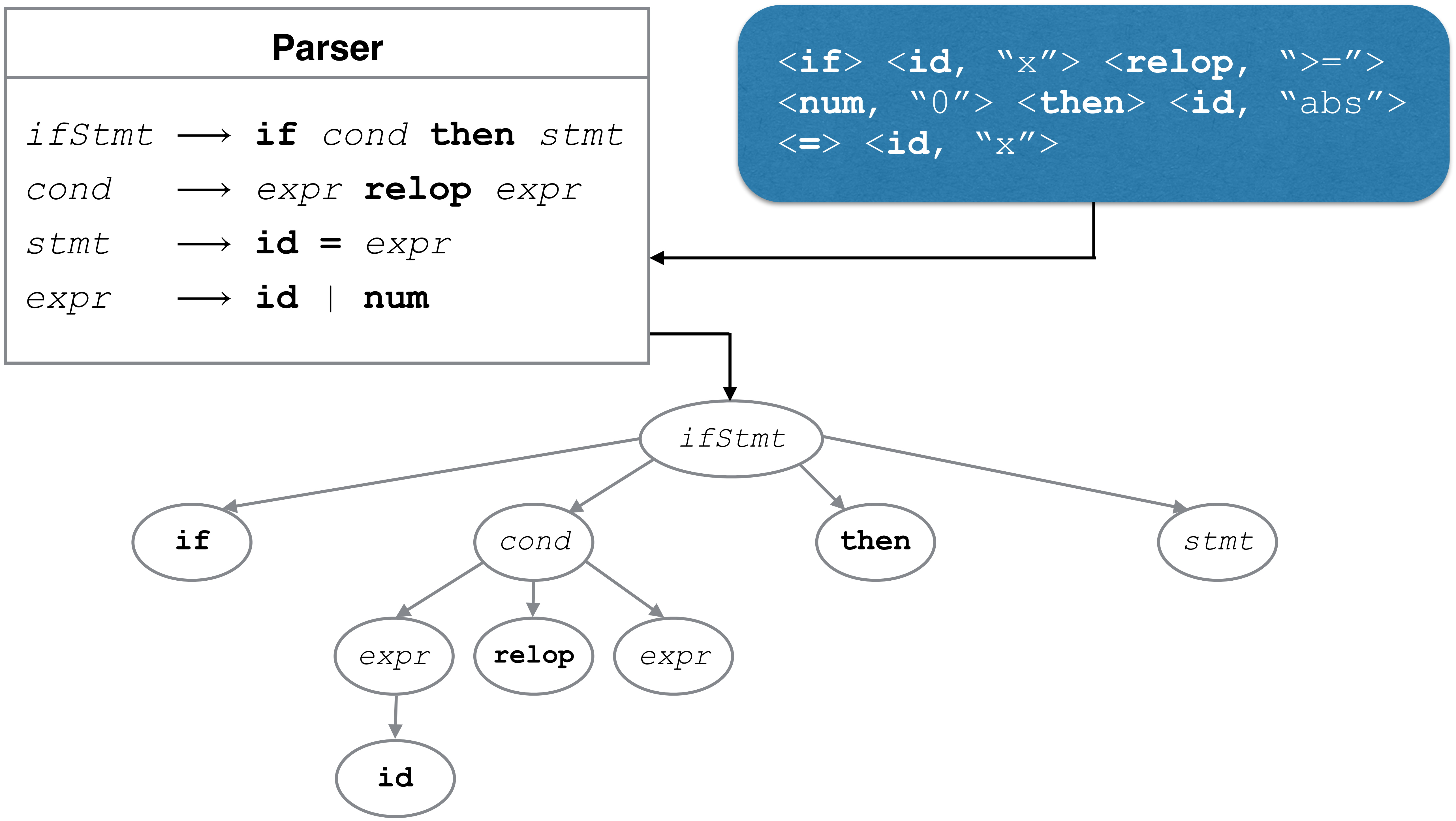

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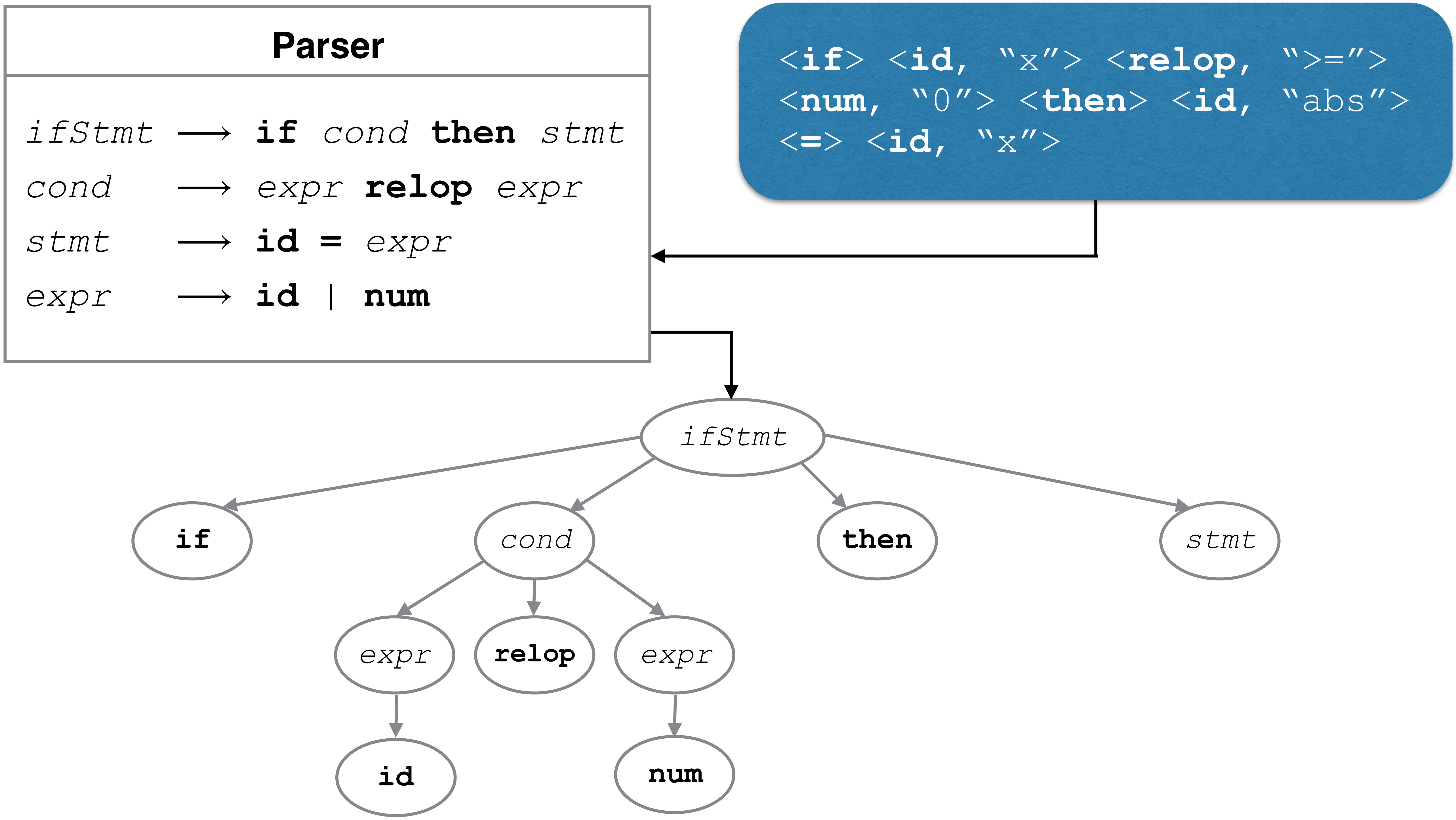

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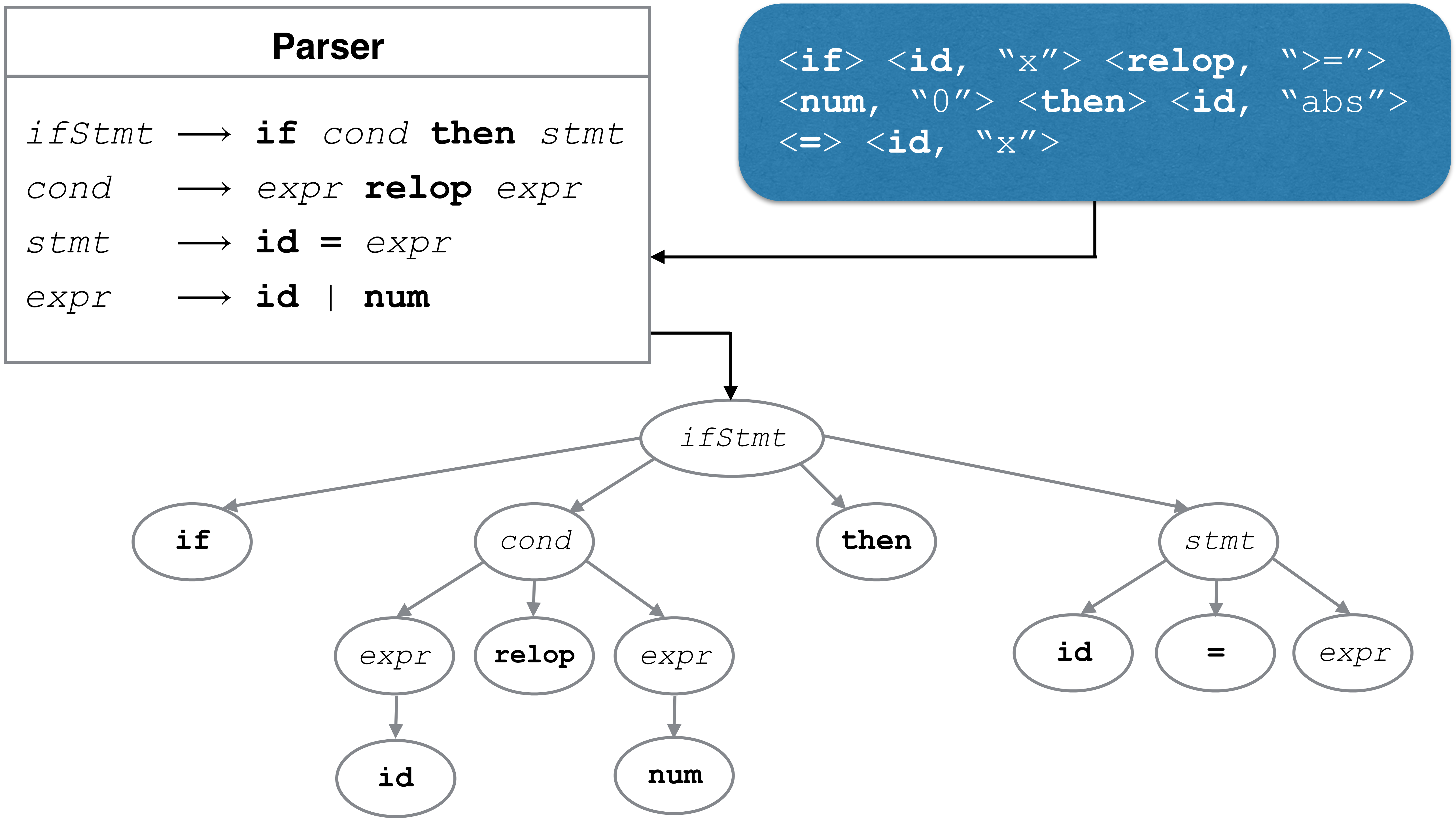

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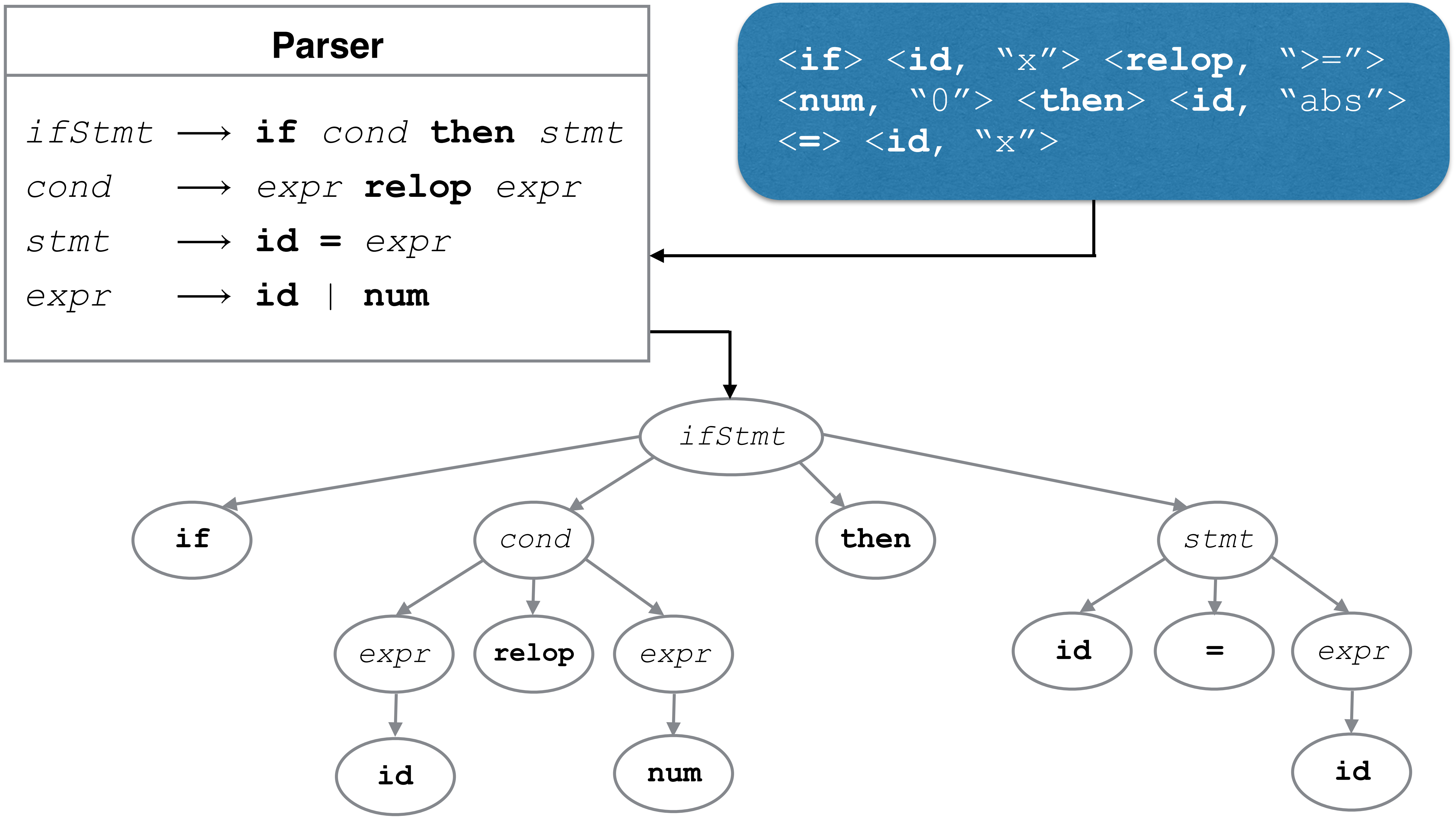

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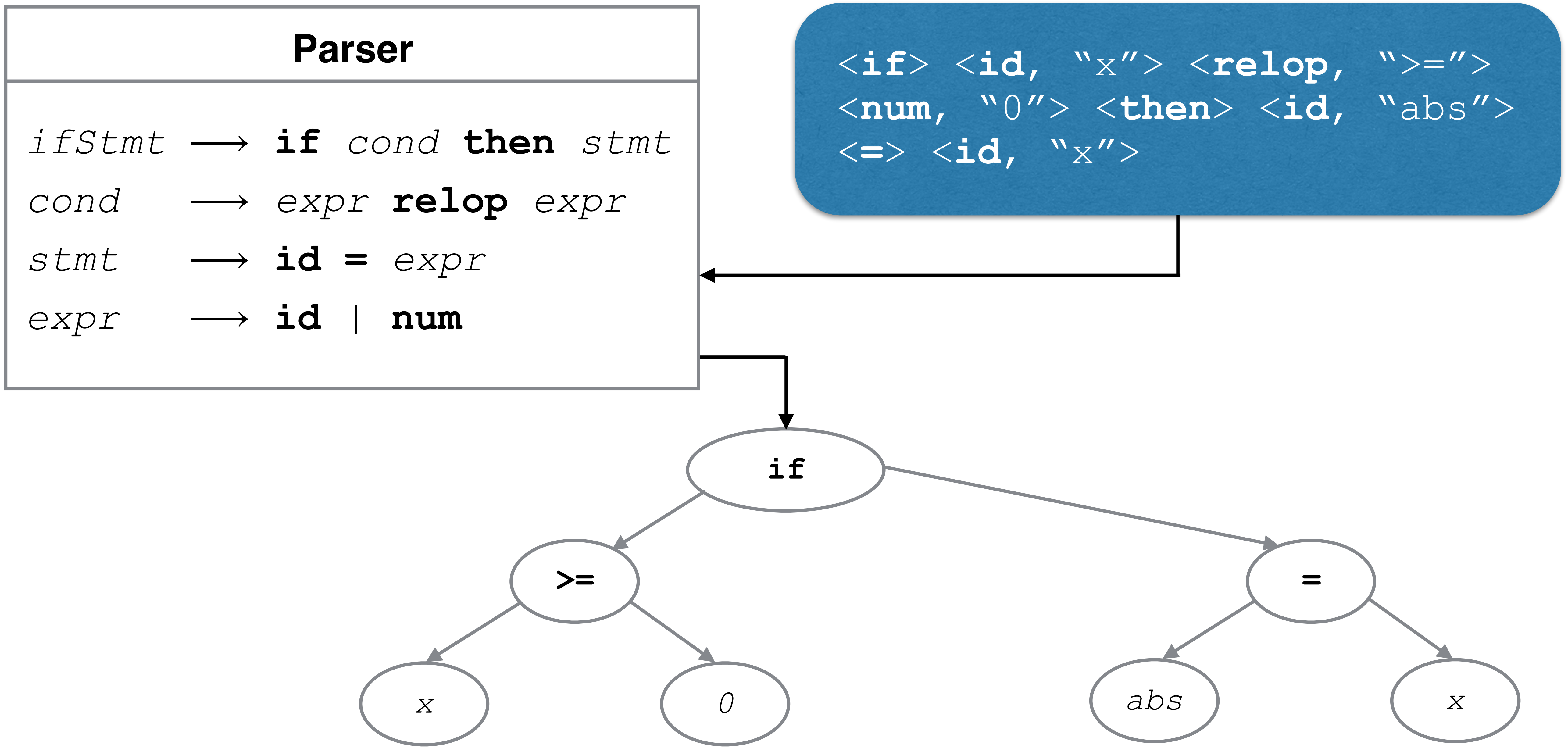

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- Definite assignment analysis

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- Most optimizations run in two phases:
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- Optimizations usually require specific code representation:
  - Static Single Assignment (SSA)
  - Control-Flow Graph (CFG)

Machine-independent optimizations

Machine-independent optimizations

- Redundancy elimination (CSE, GVN)
- Useless code elimination (DCE, DSE)
- Code motion (LICM, delayed allocation)
- Enabling transformations (inlining, loop unrolling, loop peeling)

Machine-dependent optimizations

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- Peephole optimizations
- Register allocation
- Instruction scheduling
- Trampolines

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4. Improvise!

Demo

Questions?