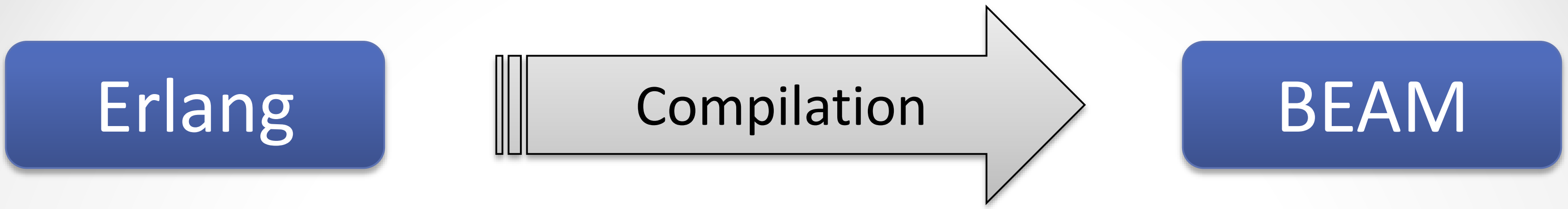
Extending Erlang by Utilizing RefactorErl

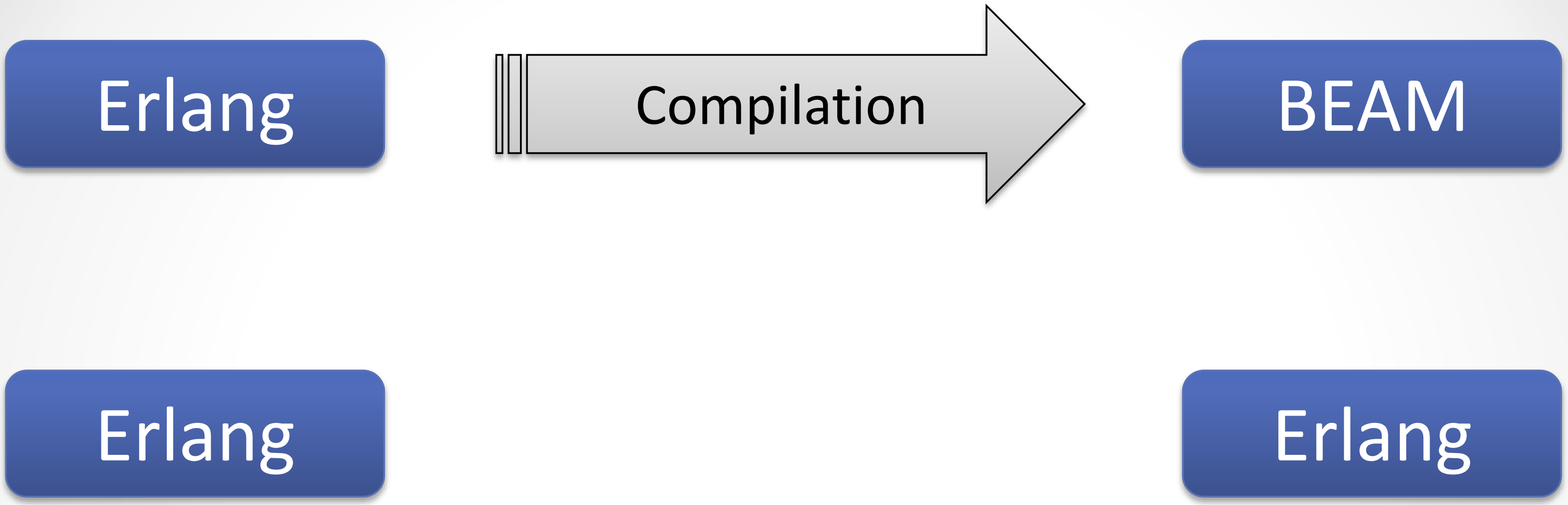
Dániel Horpácsi

Erlang Factory Lite 2013 Budapest

Erlang

BEAM


Erlang
Compilation
BEAM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Compilation
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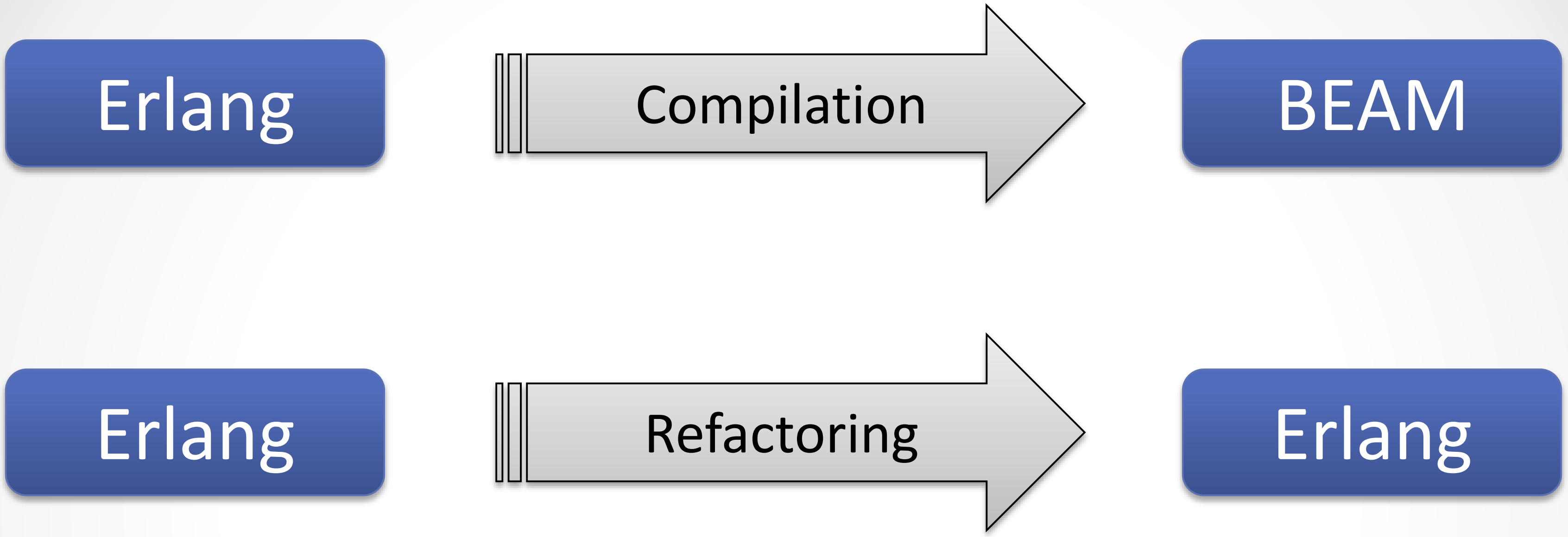
Erlang
Compilation
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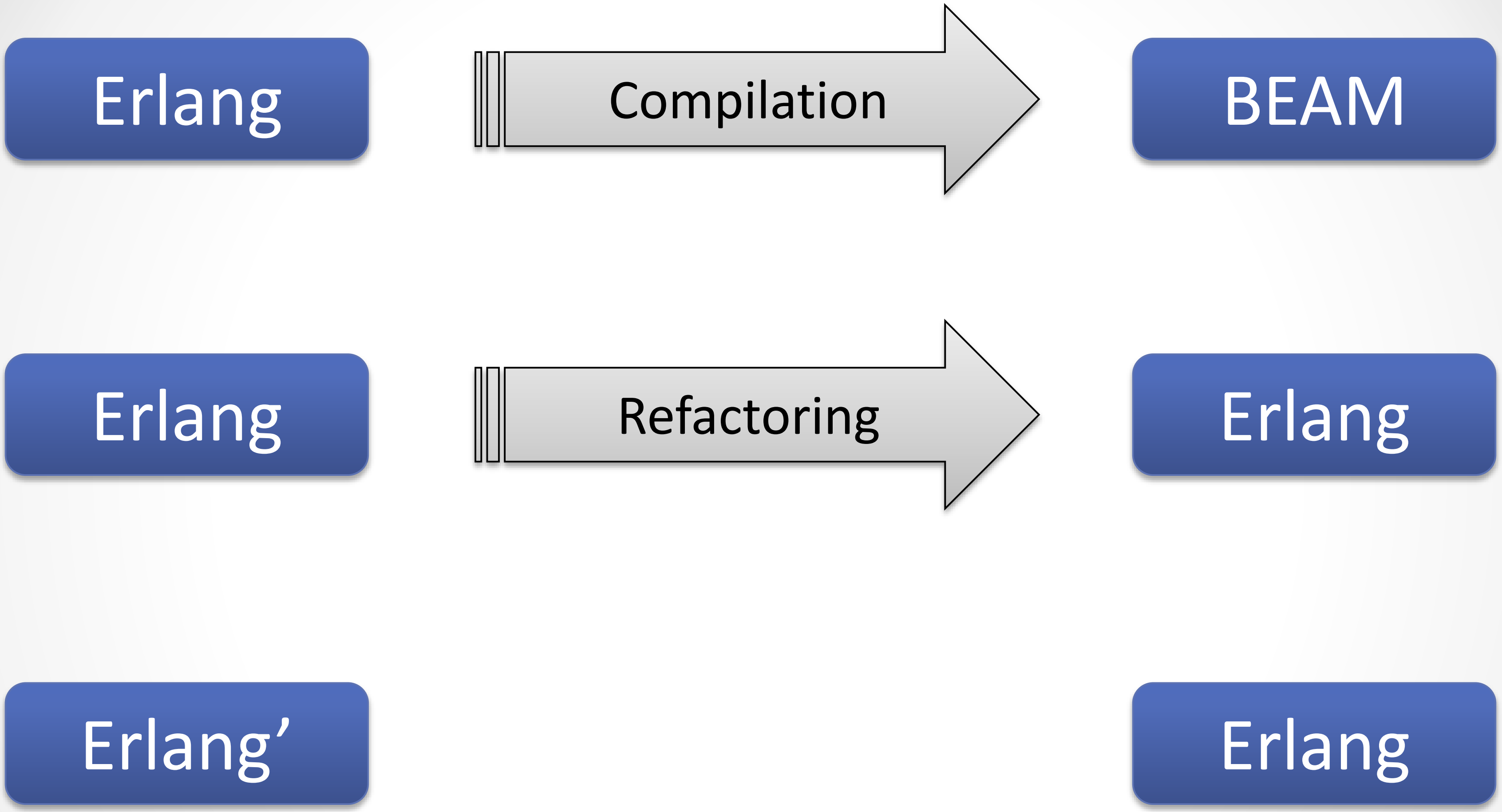
Refactoring
Erlang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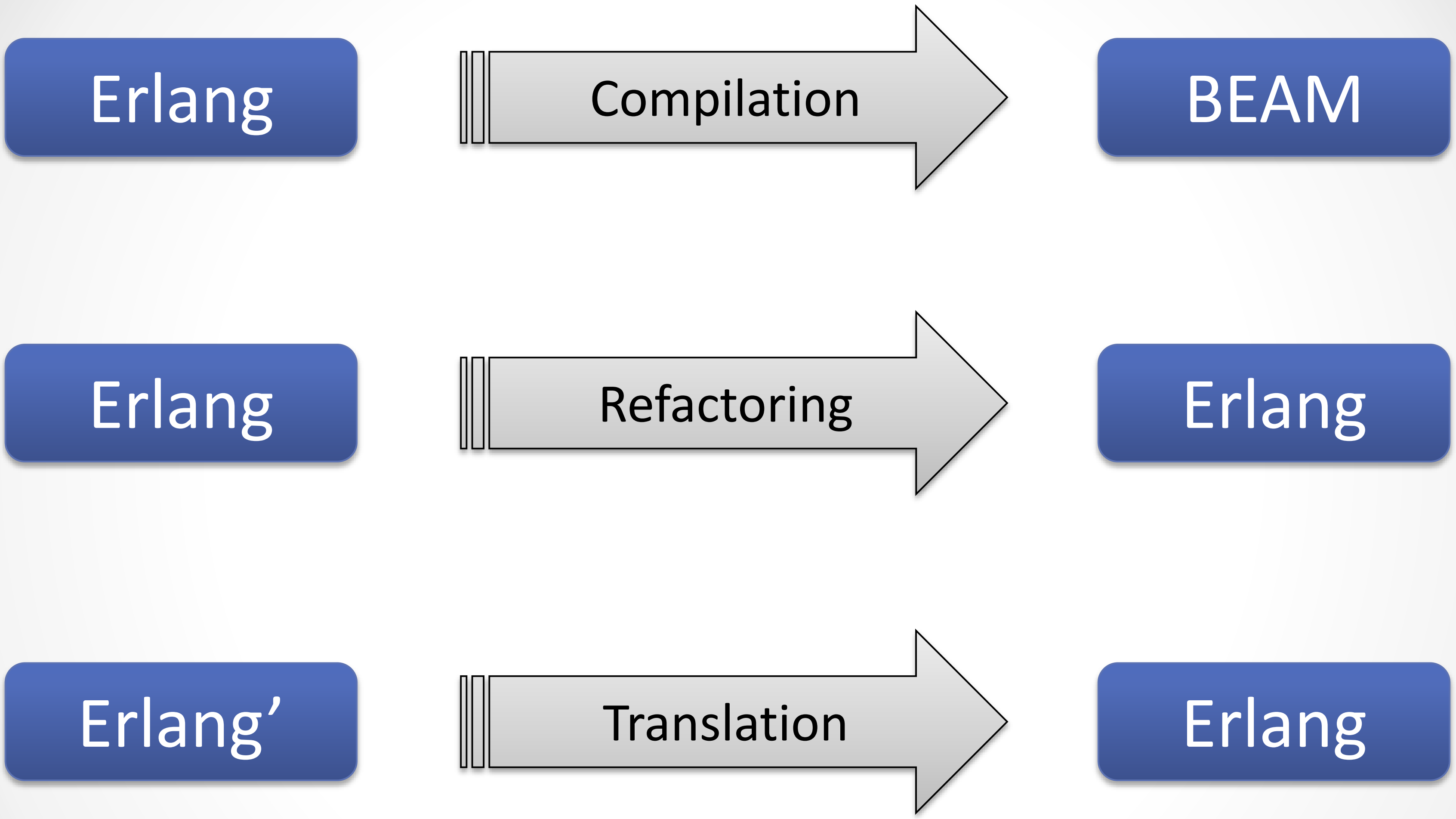
Erlang
Compilation
BEAM
Erlang
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Erlang
Erlang’
Translation
Erlang

Program transformations

Translation

- Compilation
- Migration
- Code synthesis

Rephrasing

- Desugaring
- Refactoring
- Obfuscation

Program transformations

Translation

Higher-level language to lower-level language

- Compilation
- Migration
- nthesis

Rephrasing

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Program transformations

Translation

Higher-level language to lower-level language

- Compilation
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Rephrasing

„Translation” to the same language

- Desugaring
- Refactoring
- ation

Program transformations

- „Program as Data”
- Generative programming
- Meta-programming

Translation

Higher-level language to lower-level language

nthesis

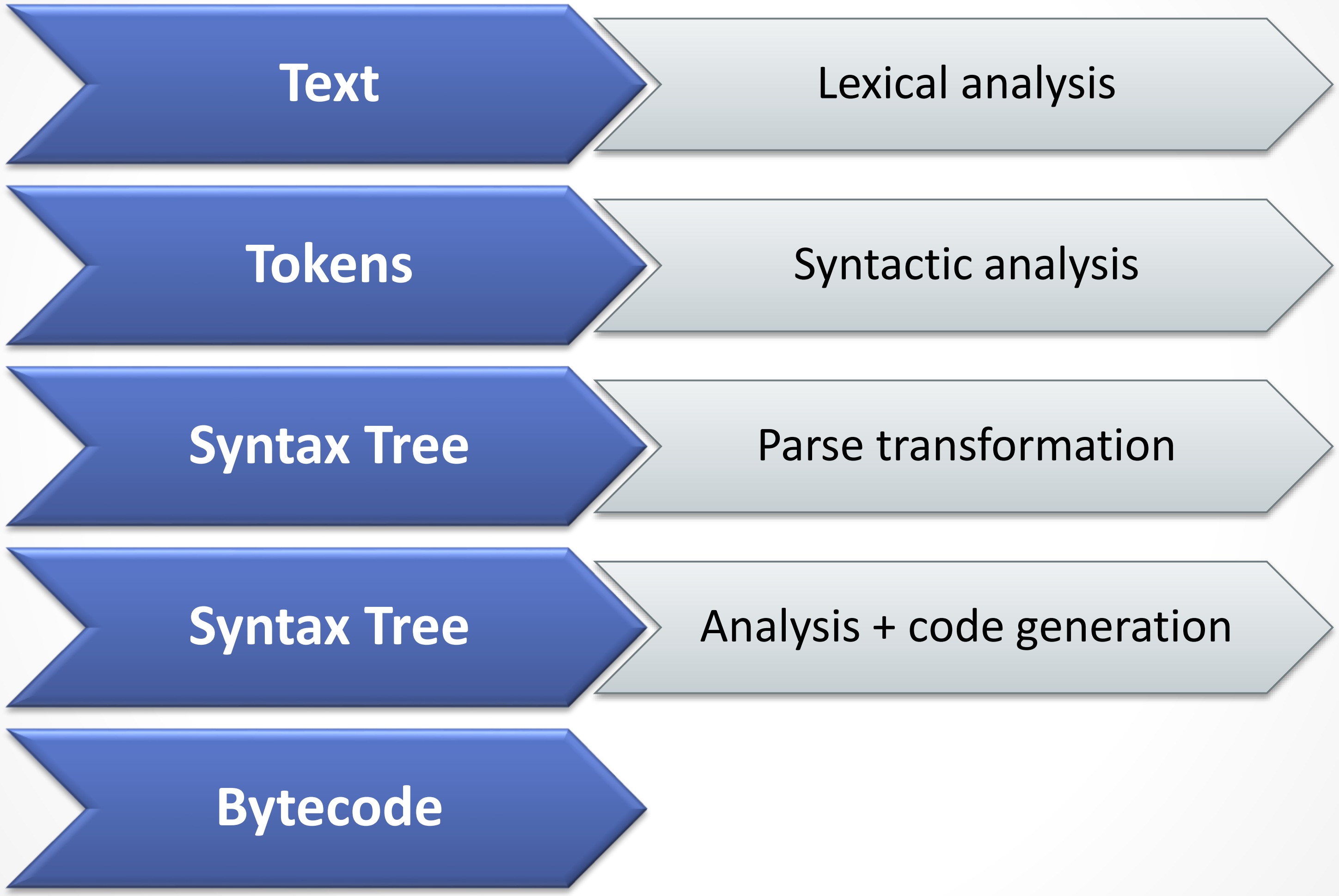
- Desugaring
- Refactoring

ation

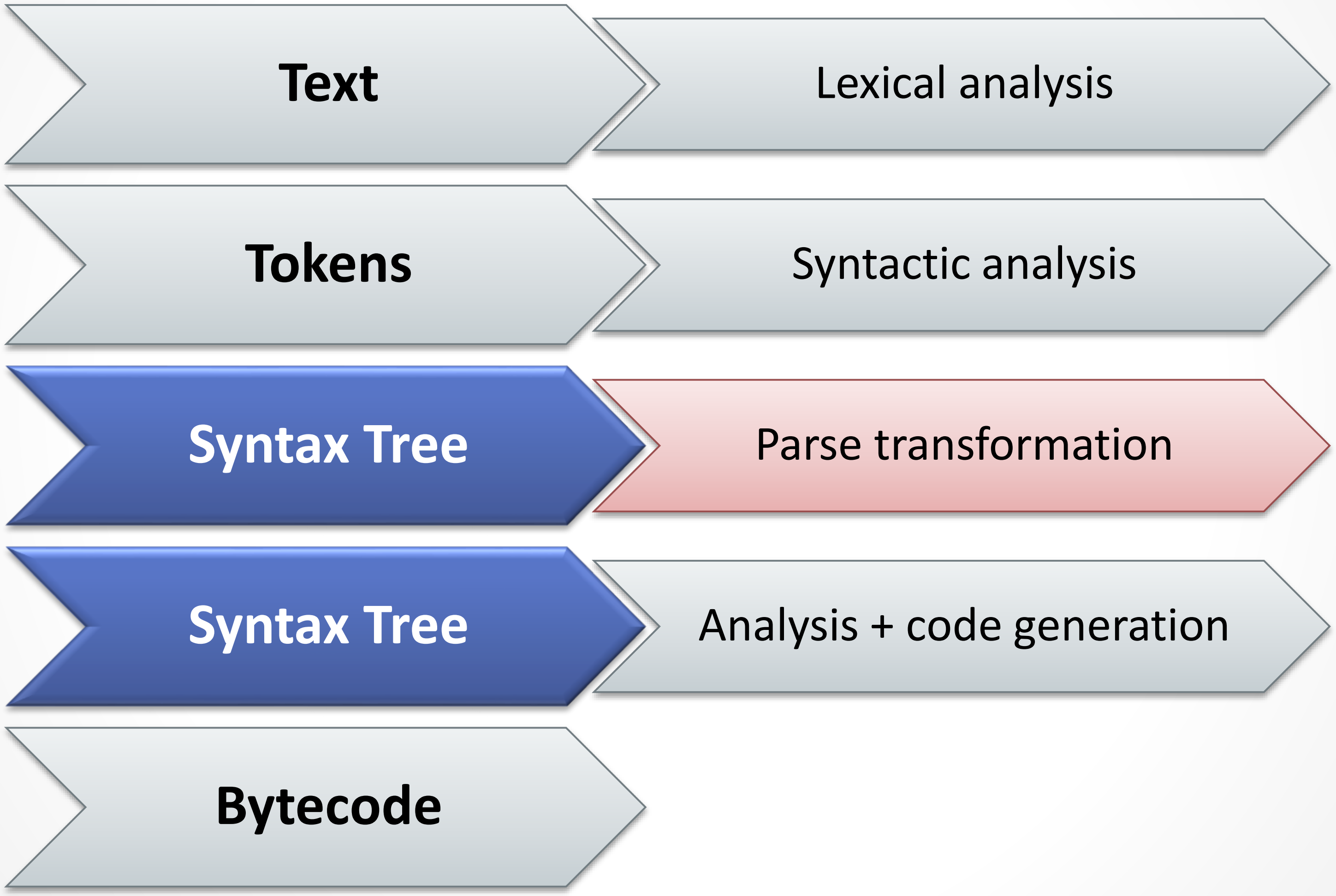
Rephrasing

„Translation” to the same language

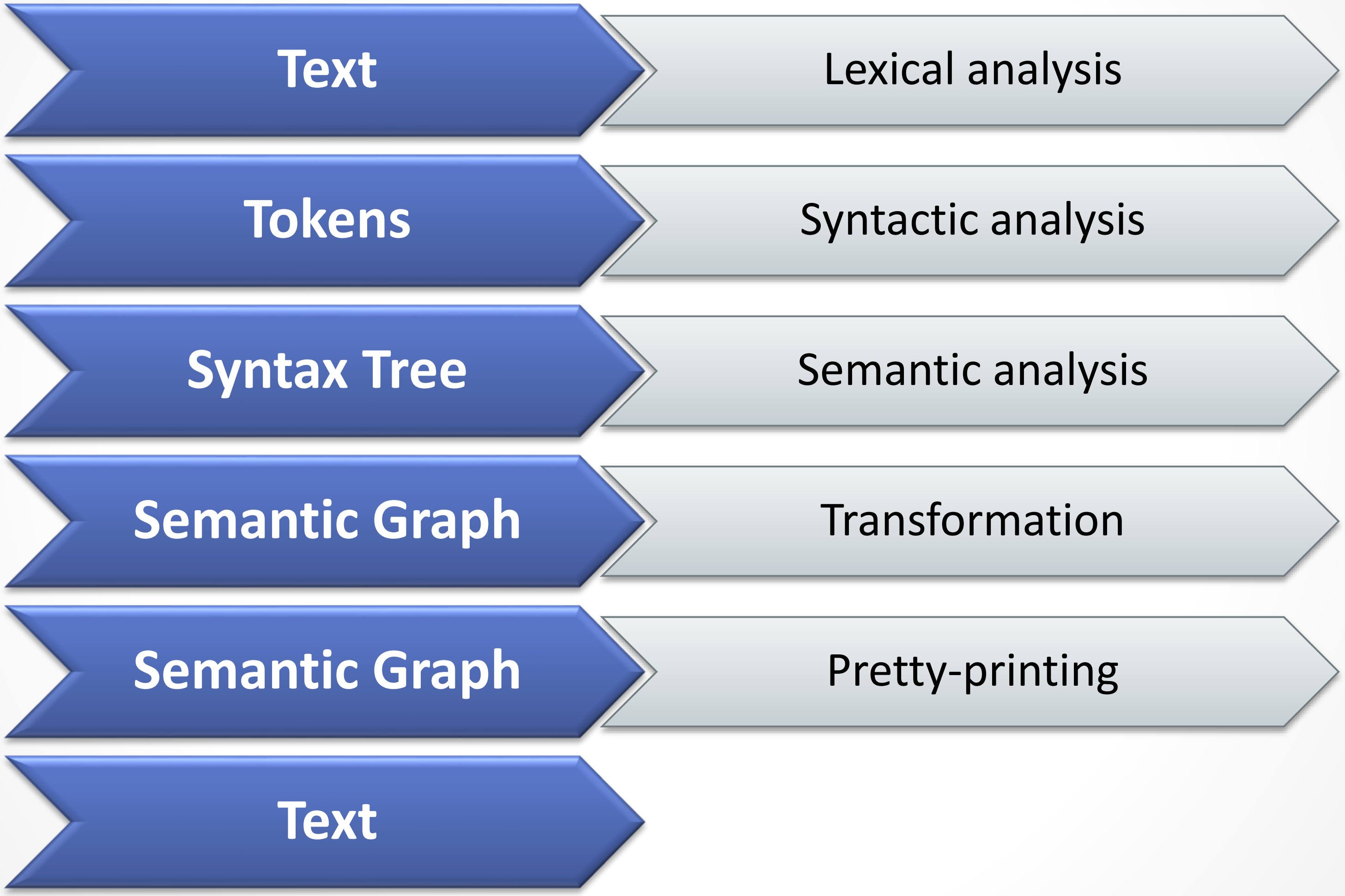
Erlang Compiler



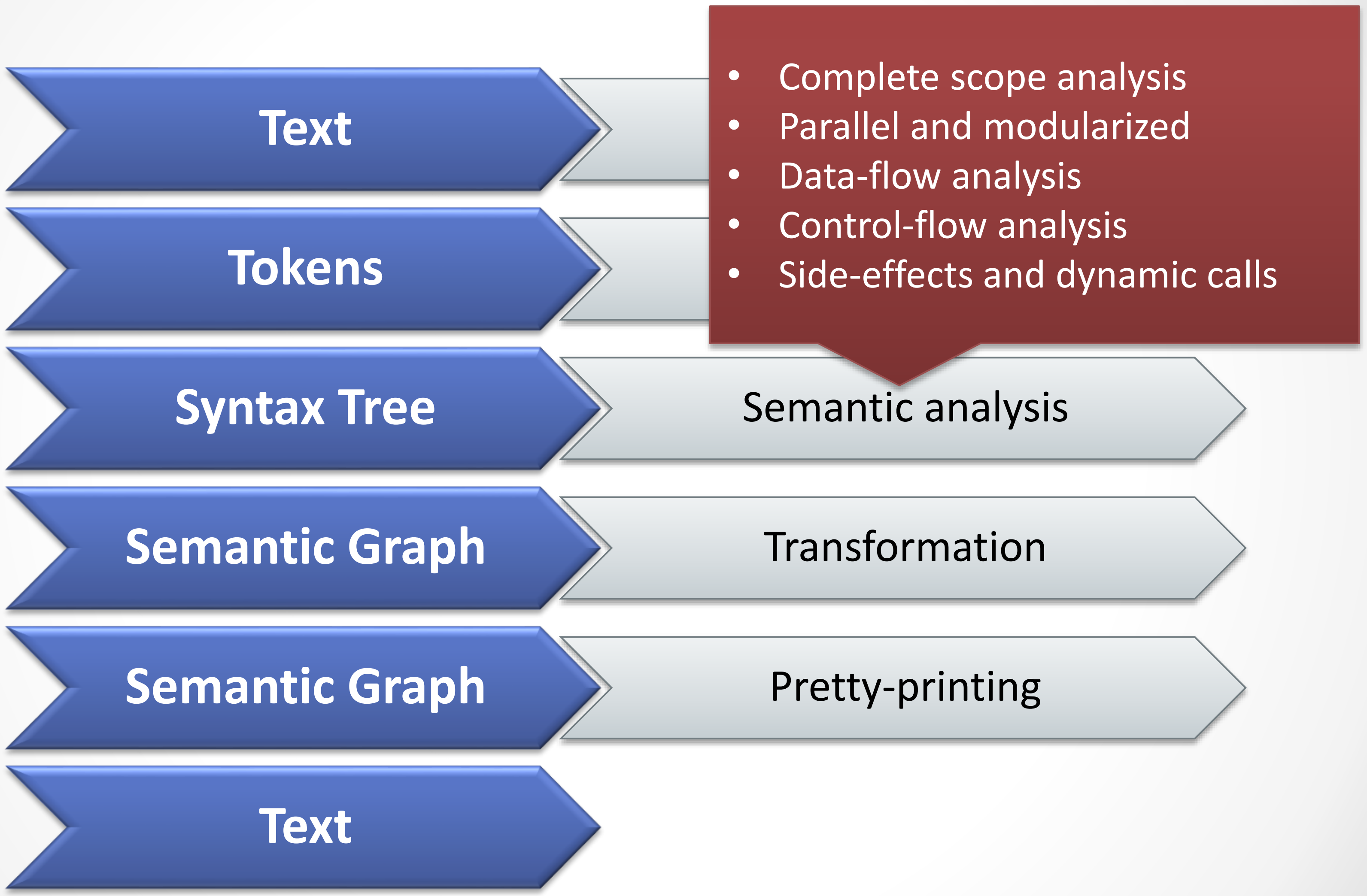
Erlang Parse Transformation



Erlang refactoring tool

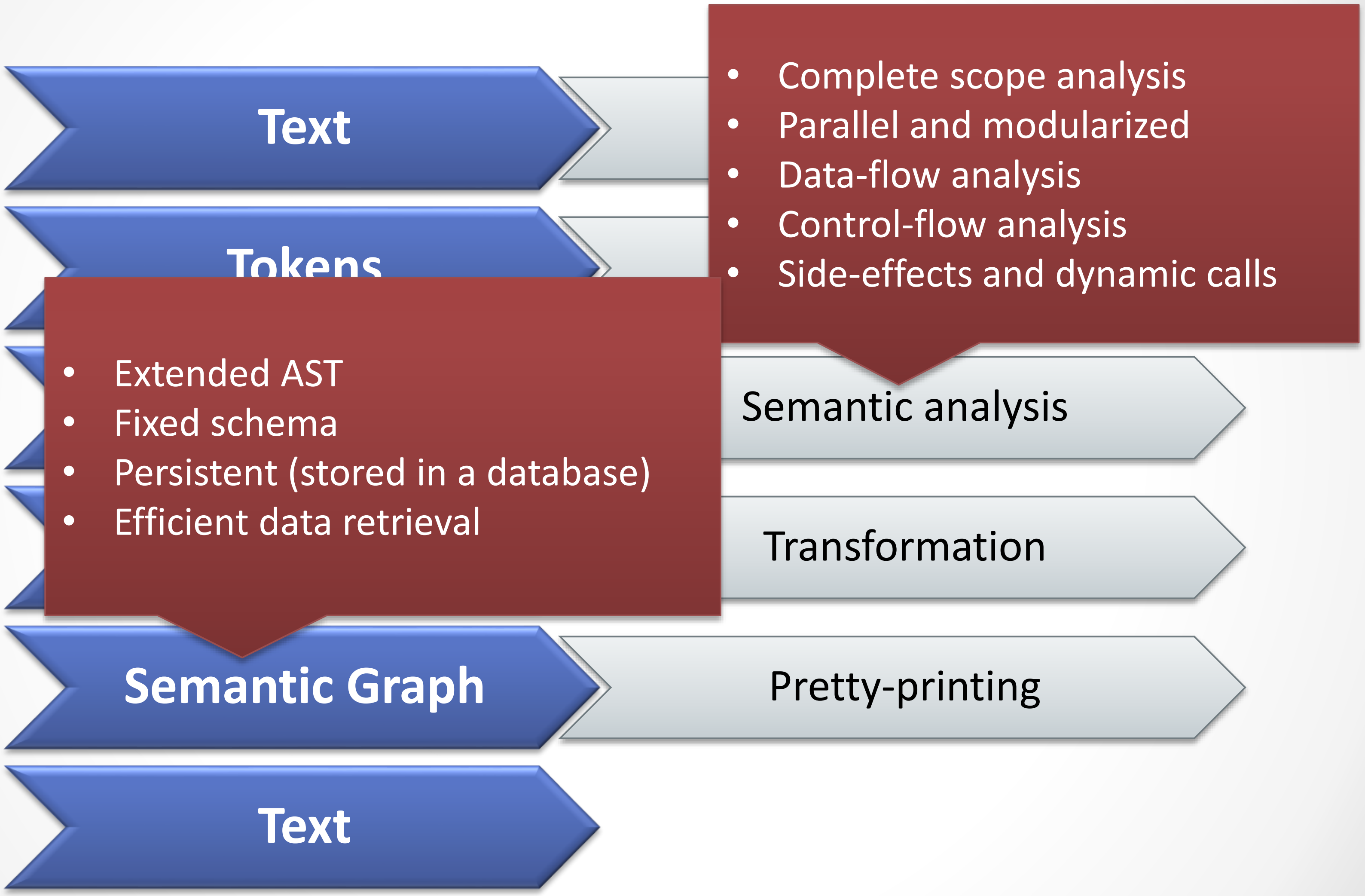


Erlang refactoring tool



- Complete scope analysis
- Parallel and modularized
- Data-flow analysis
- Control-flow analysis
- Side-effects and dynamic calls

Erlang refactoring tool



- Complete scope analysis
- Parallel and modularized
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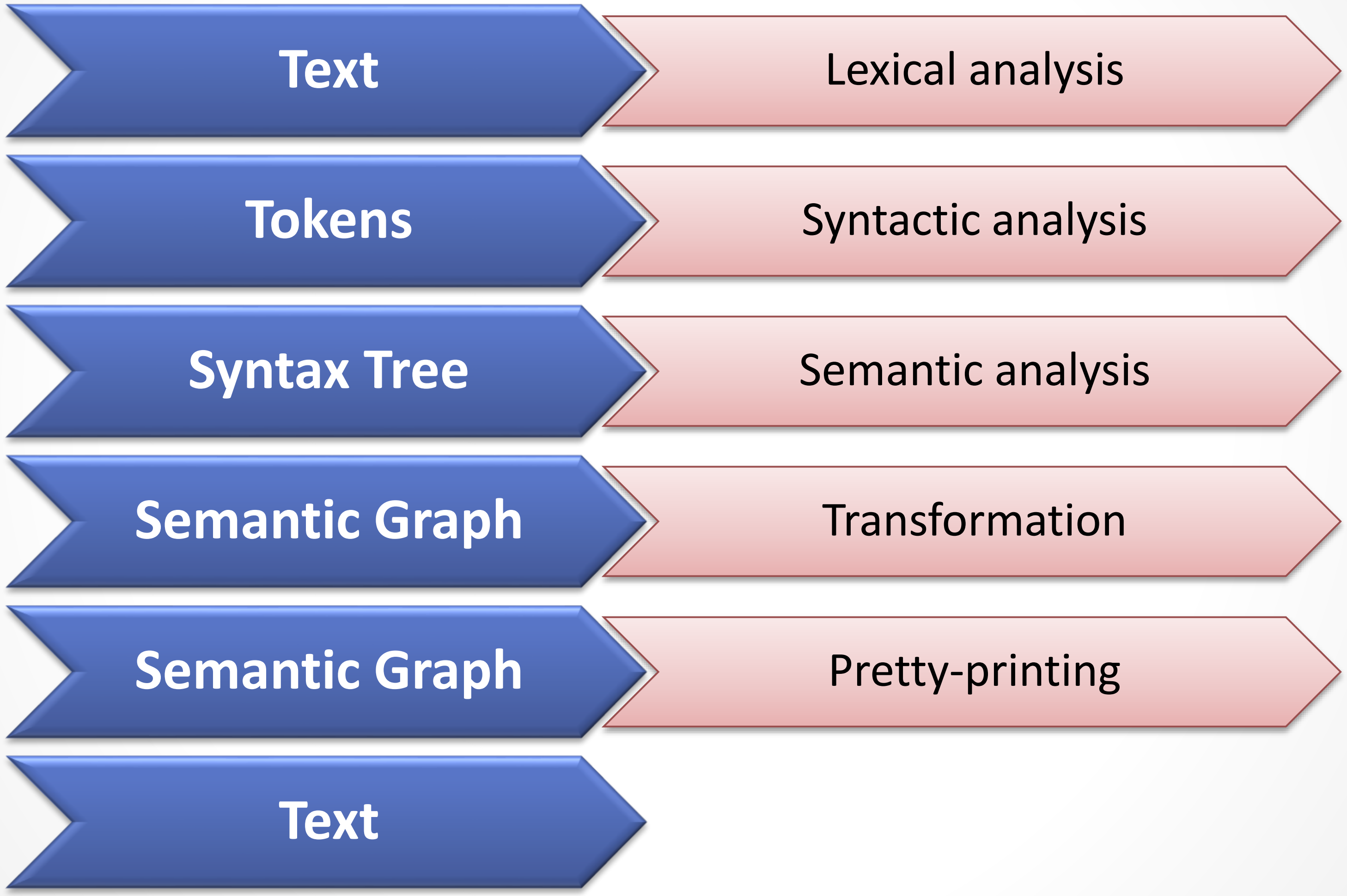
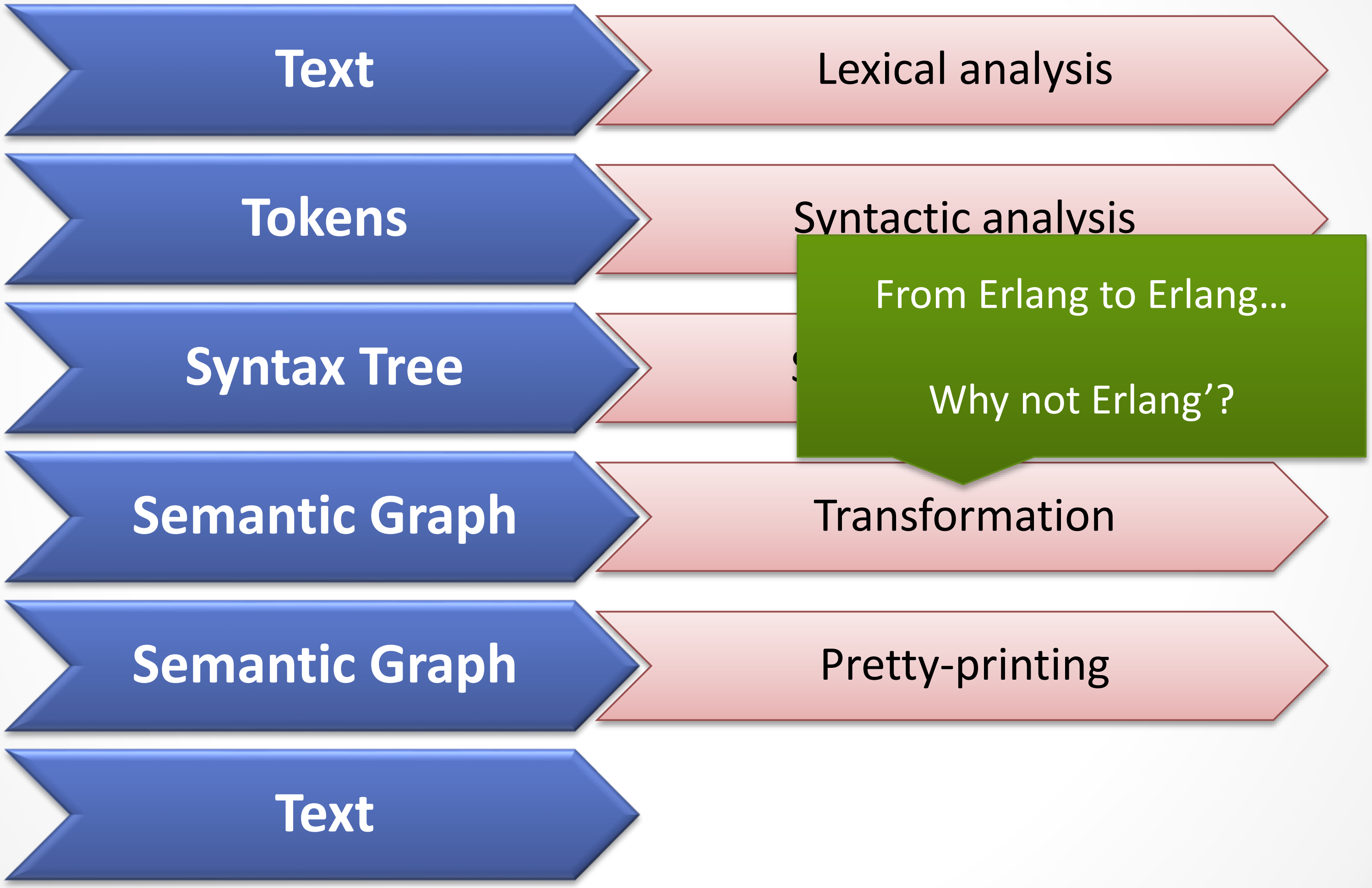
- Extended AST
- Fixed schema
- Persistent (stored in a database)
- Efficient data retrieval

Refactoring tool vs. compiler



Refactoring tool vs. compiler



What would Erlang' be?

EEP 0012	Extensions to comprehensions
EEP 0013	-enum declarations
EEP 0015	Portable funs
EEP 0019	Comprehension multigenerators
EEP 0021	Optional trailing commas for lists and tuples
EEP 0027	Multi-parameter type-checking BIFs
EEP 0037	Funs with names
EEP ?	User-defined operators

Implementing transformations

Analysis and Queries

- Complete semantic analysis
- Graph traversal library
- Semantic Query library

Transformation

- Aided construction of subtrees
- Automatically generated tokens
- On-the-fly calculated semantic layer

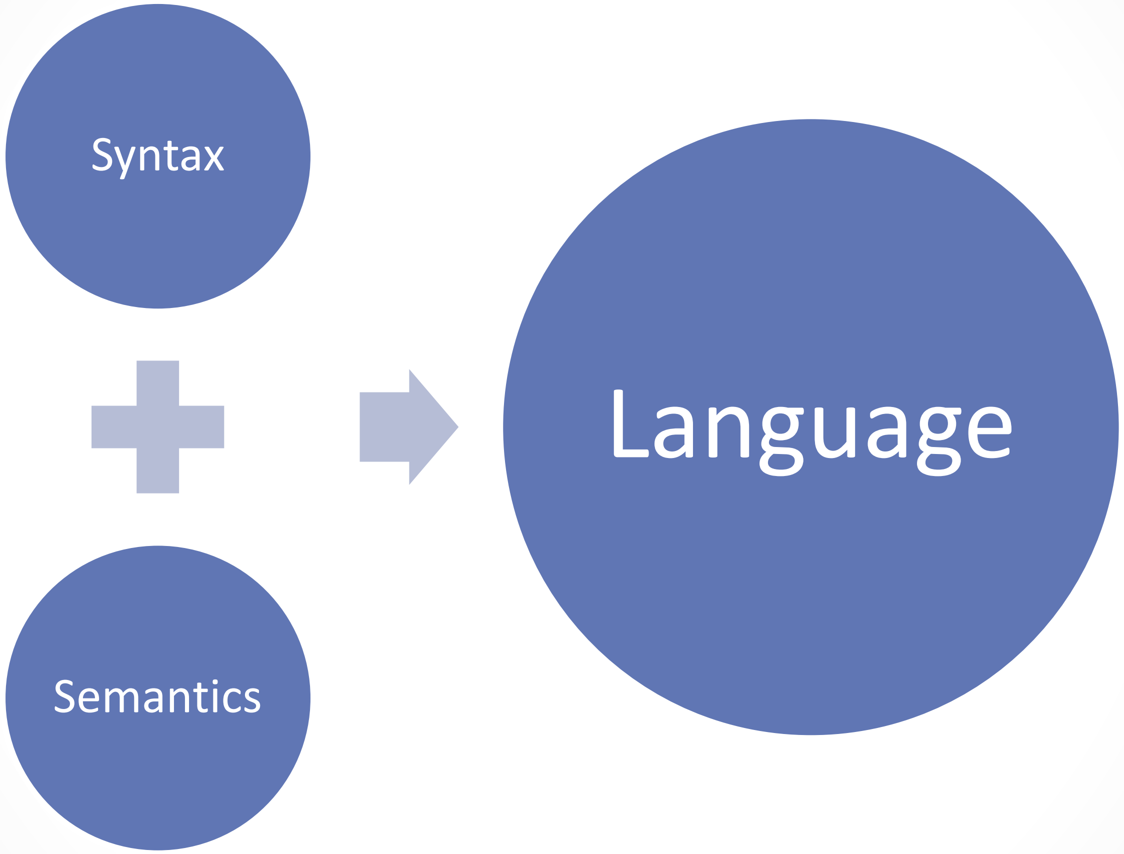
Implementing translations

Analysis

- Parser modified to accept Erlang’
- Same, or similar, abstract syntax
- Already present semantic analysis

Transformation

- Translation implemented like a refactoring
- Using the available query libraries
- Using the present transformation framework


Syntax
Semantics
Language

User-defined operators

User-defined operators

Syntax

Allow a list of special chars to be an operator of an infix expression.
Precedence and associativity is specified in Erlang module attributes.

- New token:
```
    operator        [<>+-*/=?!#:|@&.]+
```
- Infix expressions are allowed to be built by a custom operator

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Semantics

Infix expressions in the code are parsed according to the precedence and associativity rules of the built-in and the user-defined operators.

User-defined operators

Syntax

Allow a list of special chars to be an operator of an infix expression.
Precedence and associativity is specified in Erlang module attributes.

Is this compatible with the AST format?

- New token:

  `oper`

- Infix expressions are allowed to be built by a custom operator

Semantics

Infix expressions in the code are parsed according to the precedence and associativity rules of the built-in and the user-defined operators.

```
-infixl(!!  / 2).
-infixl(>-< / 3).

f(N) -> [1,2,3] >-< [3,4,5] !! N.

!! (L,  I ) -> lists:nth(I, L).
>-<(L1, L2) -> lists:merge(L1, L2).
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„Almost attributes”
(function/arity)

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Portable funs

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Allow construction of special fun expressions (marked with a bang) that can be sent through message passing and can be stored in database.

- Fun expressions are allowed to be also of form
  `'fun' '!' FunExpClause {';' FunExpClause} 'end'`
- Applications of such funs should start with a bang

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- Fun expressions are allowed to be also of form
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Semantics

These funs should be able to be sent and received via message passing. Dependencies of the funs should be handled by the compiler/runtime.

Portable funs: what to send?

```
f(X) ->
      Y = g(X, X - 2),
      F = fun!(A, B) -> h(A, B) + X * Y end,
      self() ! F,
      receive
            Fun -> io:format("~p", [!Fun(2,3)])
      end.
```

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How to represent the fun?
And the dependencies?

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What if portable funs are nested?

How do we invoke a ported fun?

Funs as bytecodes

- No need for compilation on the receiving side
- Easily packed into a binary
- Kind of obfuscation

- VMs need to be compatible (opcodes)
- Not as lazy as could be
- Unused funs remain in the runtime system

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```

```
f(X) ->
        Y = g(X,X-2),
        F = {'86431211'(), [X, Y], '86431211'},
        self() ! F,
        receive
                Fun -> io:format("~p", [apply_ported(Fun, [2, 3])])
        end.

'86431211'() ->
    binary:encode_unsigned(
        203175963351894316433811063389938421147976187795094109591…).
```

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```

```
apply_ported({B, A, N}, Args) ->
    case code:is_loaded(N) of
        false -> code:load_binary(N, N, B);
        _     -> ok
    end,
    erlang:apply((erlang:apply(N, portedfun, A)), Args).
```

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```
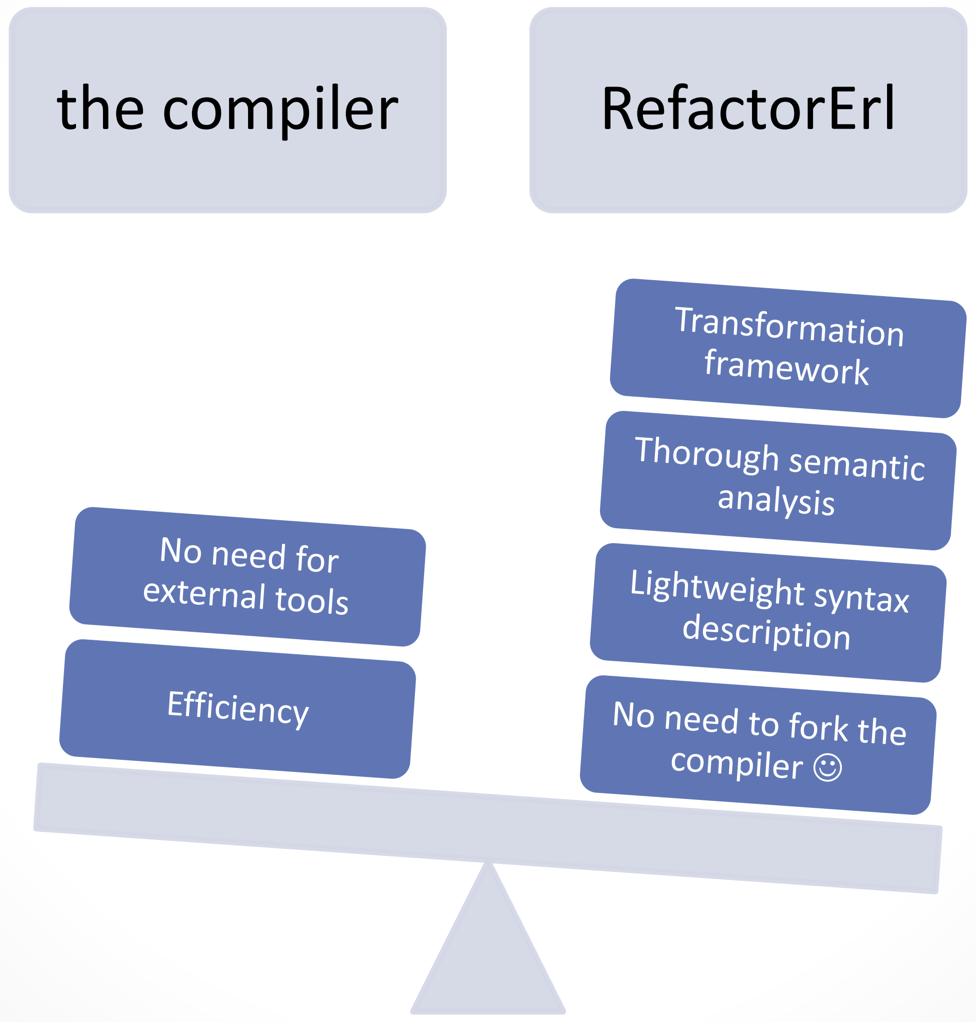

```
-module('86431211').
-export([portedfun/2]).

portedfun(X,Y) ->
    fun(A,B) -> h(A,B)+X*Y end.

h(X,Y) -> X/Y.
```

Language extensions made with


the compiler
RefactorErl
Transformation framework
Thorough semantic analysis
Lightweight syntax description
No need to fork the compiler ☺
No need for external tools
Efficiency

Thank you!

refactorerl.com

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