

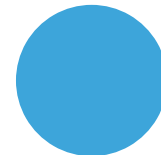
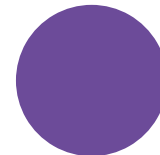
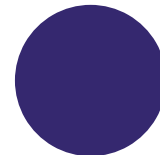
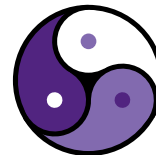
# The Fuzion Intermediate Representation

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An IR for static analysis for safety-critical systems

Fridtjof Siebert, Michael Lill  
Tokiwa Software GmbH

VMIL'24, October 20, 2024, Pasadena, CA, USA



# Overview

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- Fuzion quick intro
- Safety-Critical Aspects
- Toolchain and Static Analysis
- The Fuzion IR
- Status



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# Fuzion Intro

- One concept: a **feature**
  - generalization of class / method / function / etc.
  - may be nested
- statically typed
- polymorphic: union types, parametric types, inheritance
- pure using effects

```
hello_world ! io.out =>  
io.out.println "hello!"
```

```
hello_world
```



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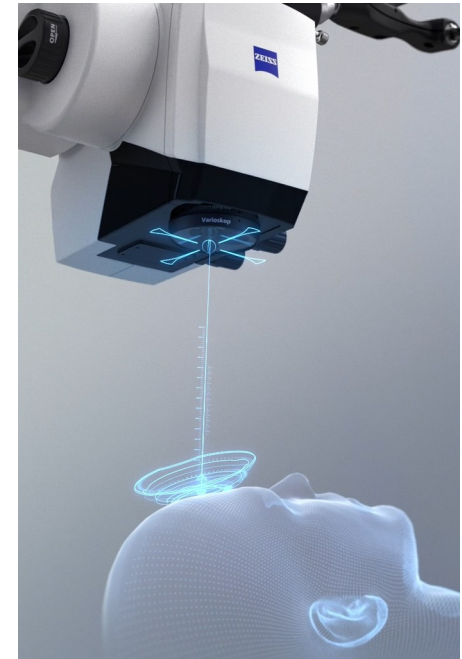
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# Safety-Critical Aspects

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- Formal Guidelines (DO178C, IEC61508, ISO26262, etc.)
- Rigorous Verification and Validation
- Determinism
  - bounded worst-case execution time
  - real-time GC or static memory management
  - no probabilistic algorithms
- Fuzion: simple IR enables tool support



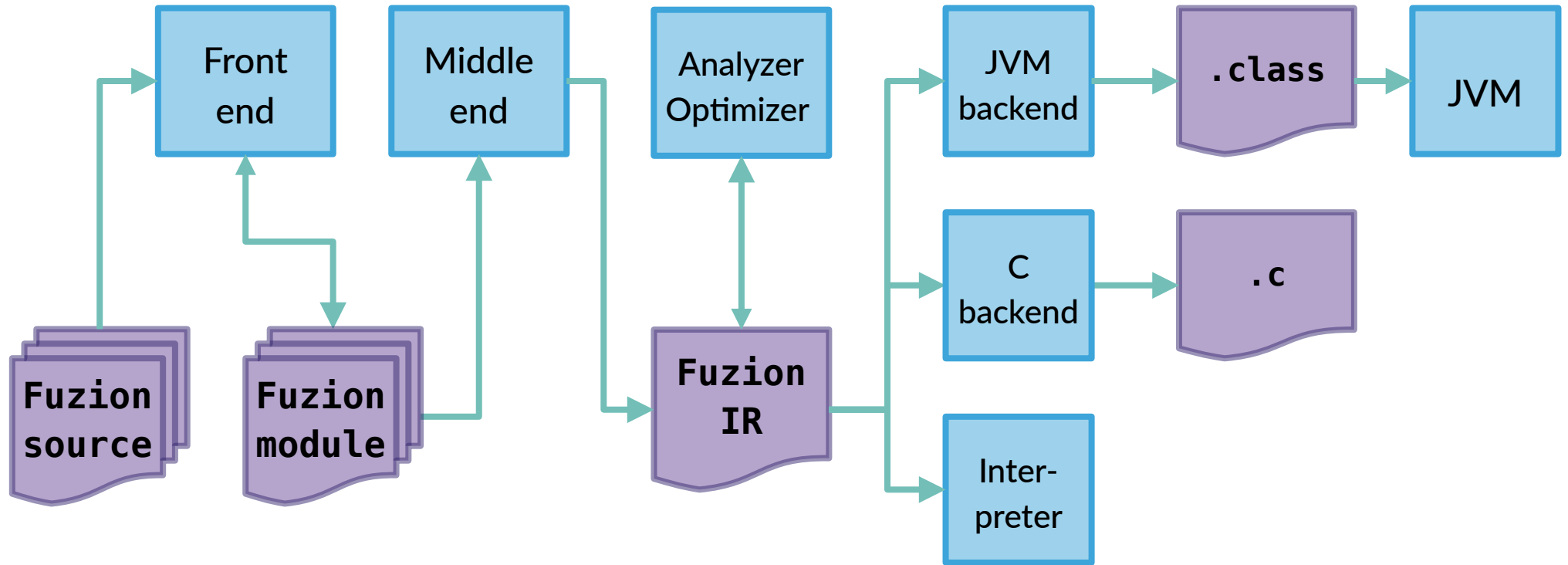
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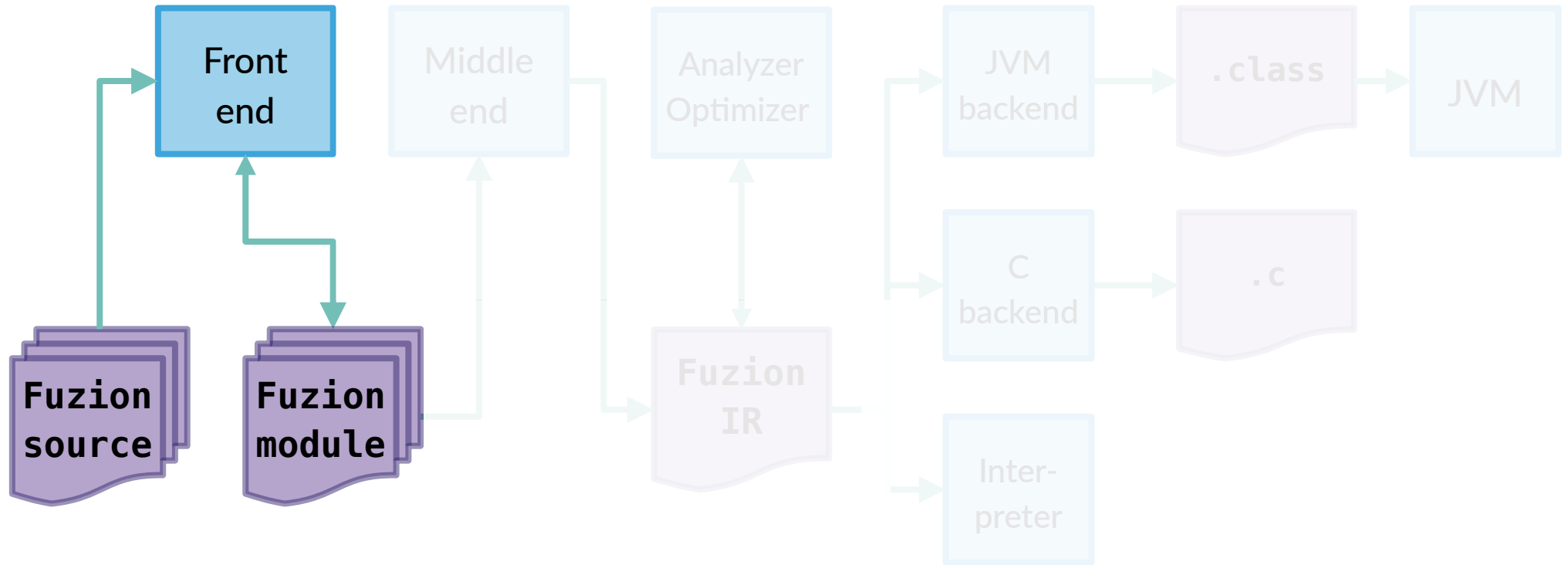


# Fuzion Toolchain and Static Analysis

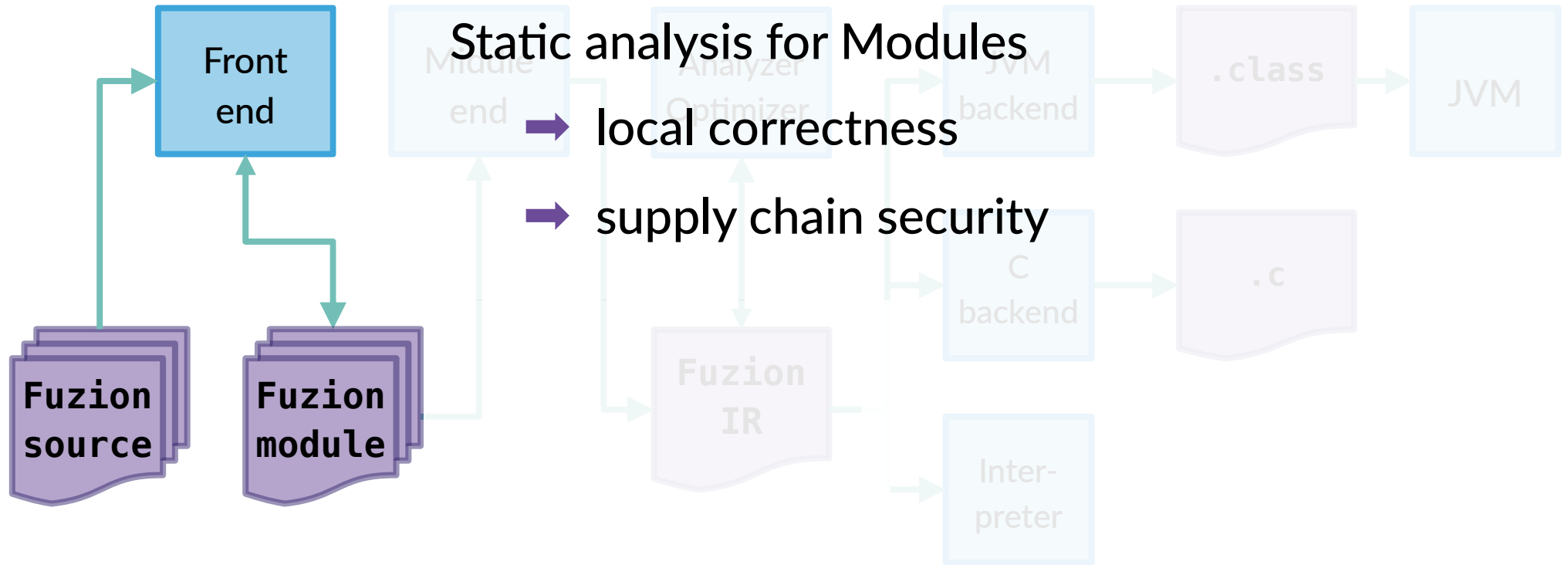




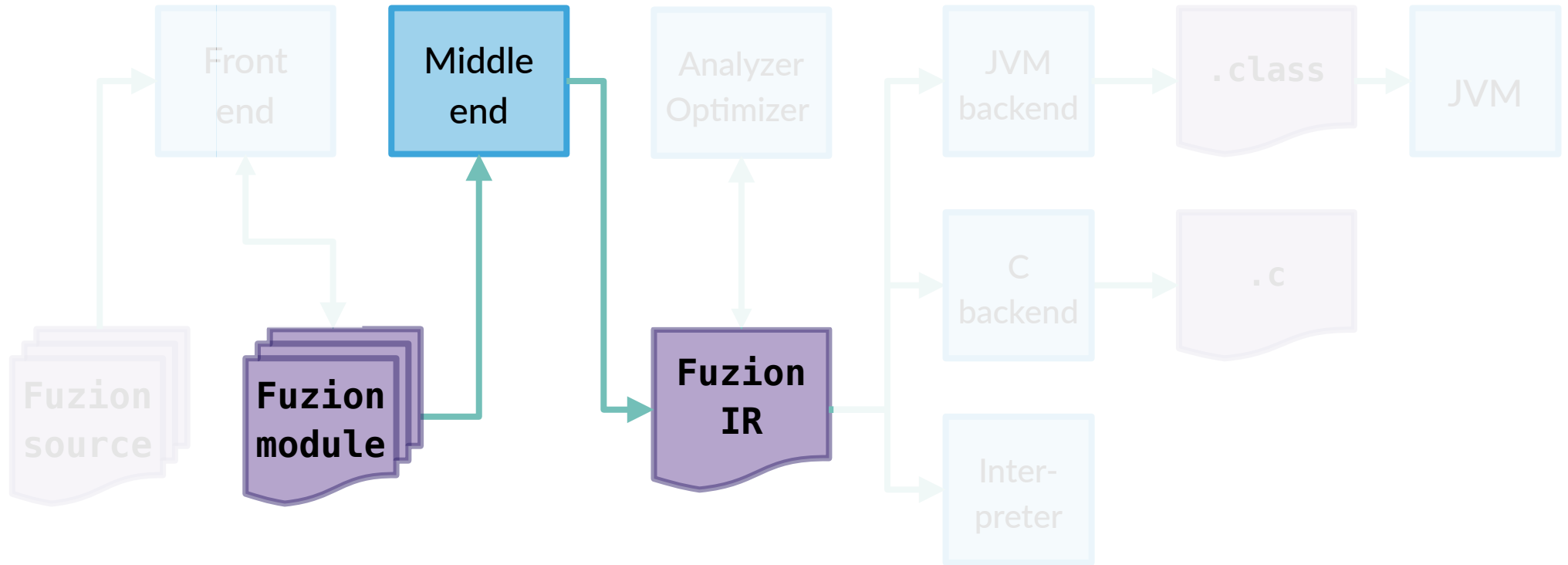
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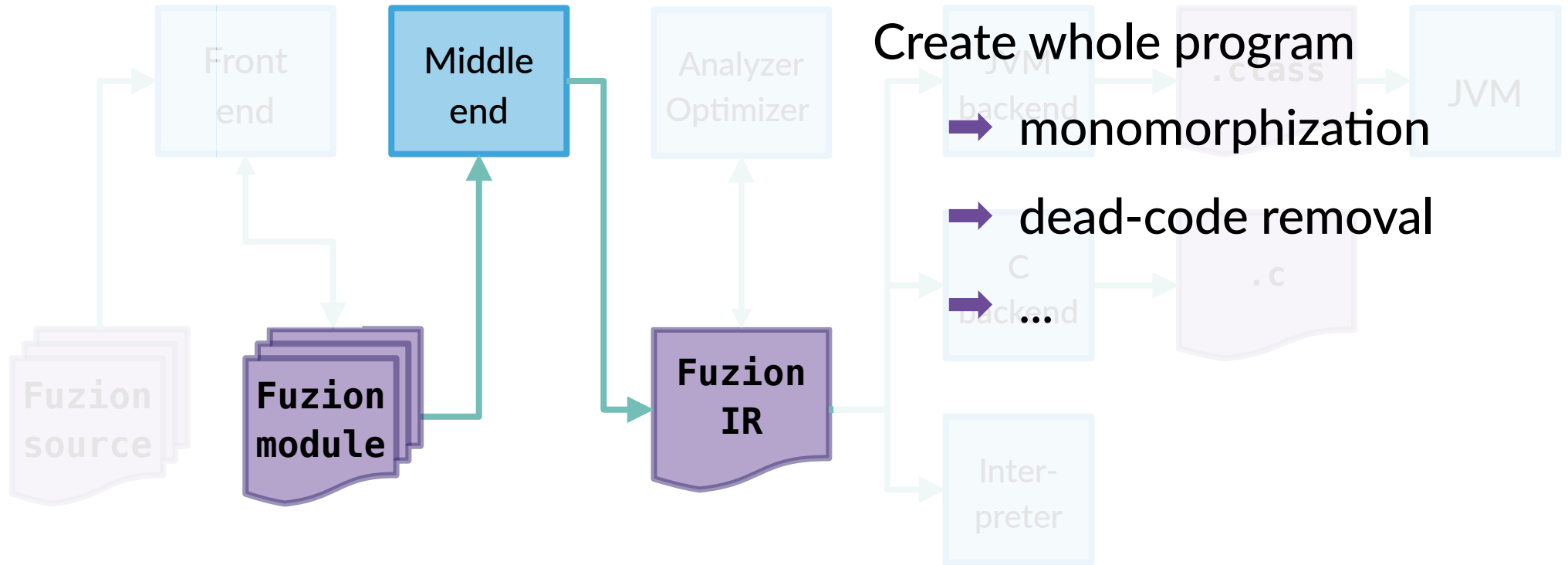
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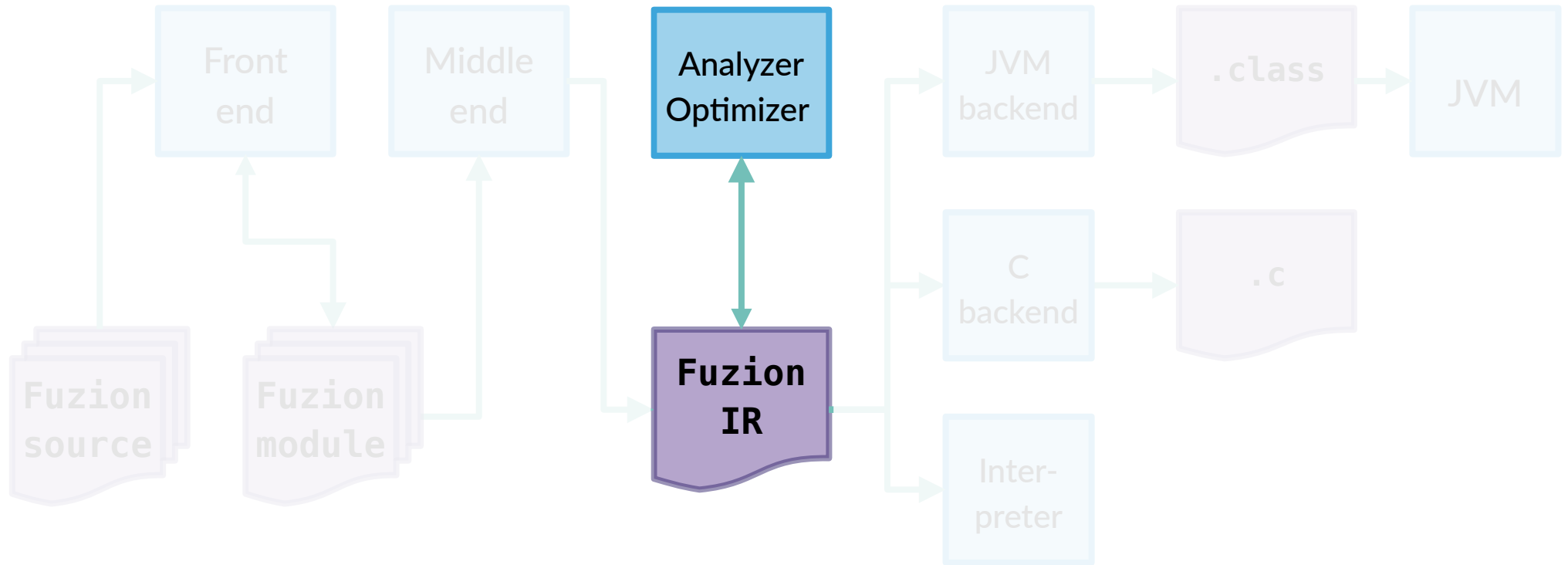
# Fuzion Toolchain and Static Analysis



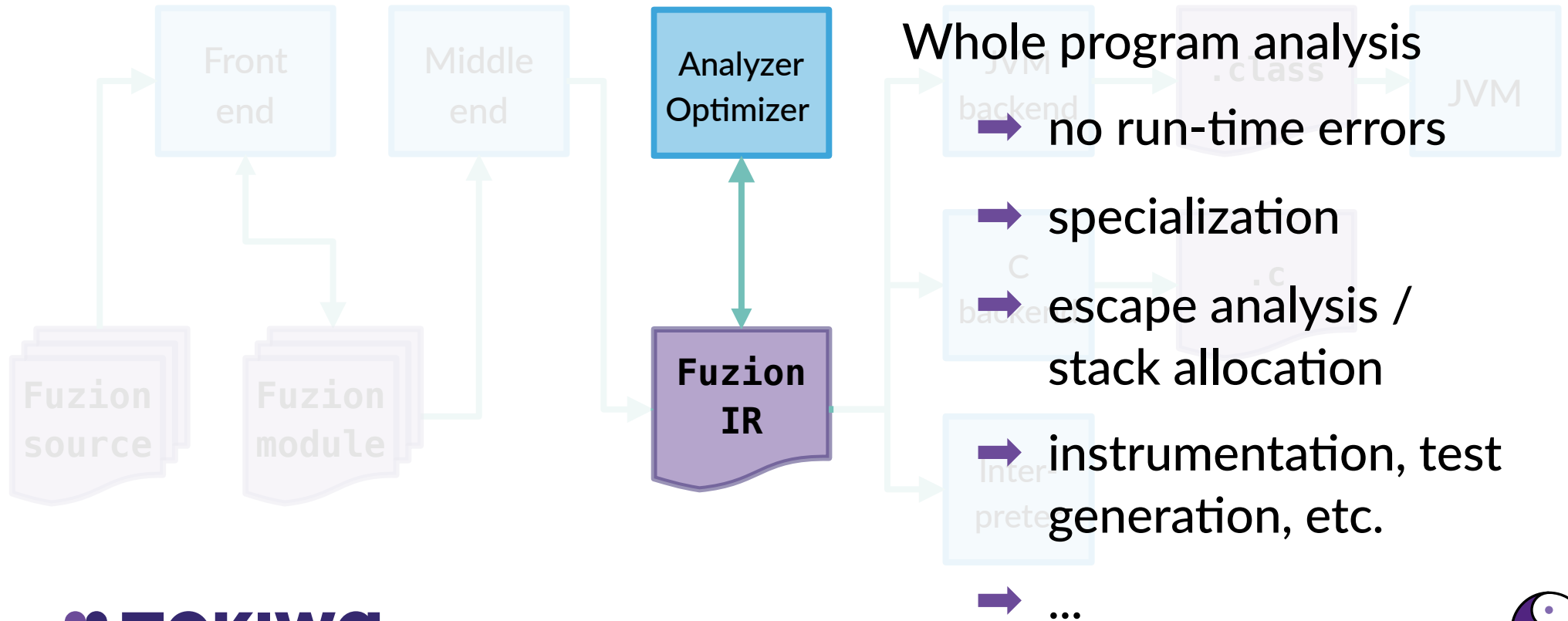
# Fuzion Toolchain and Static Analysis



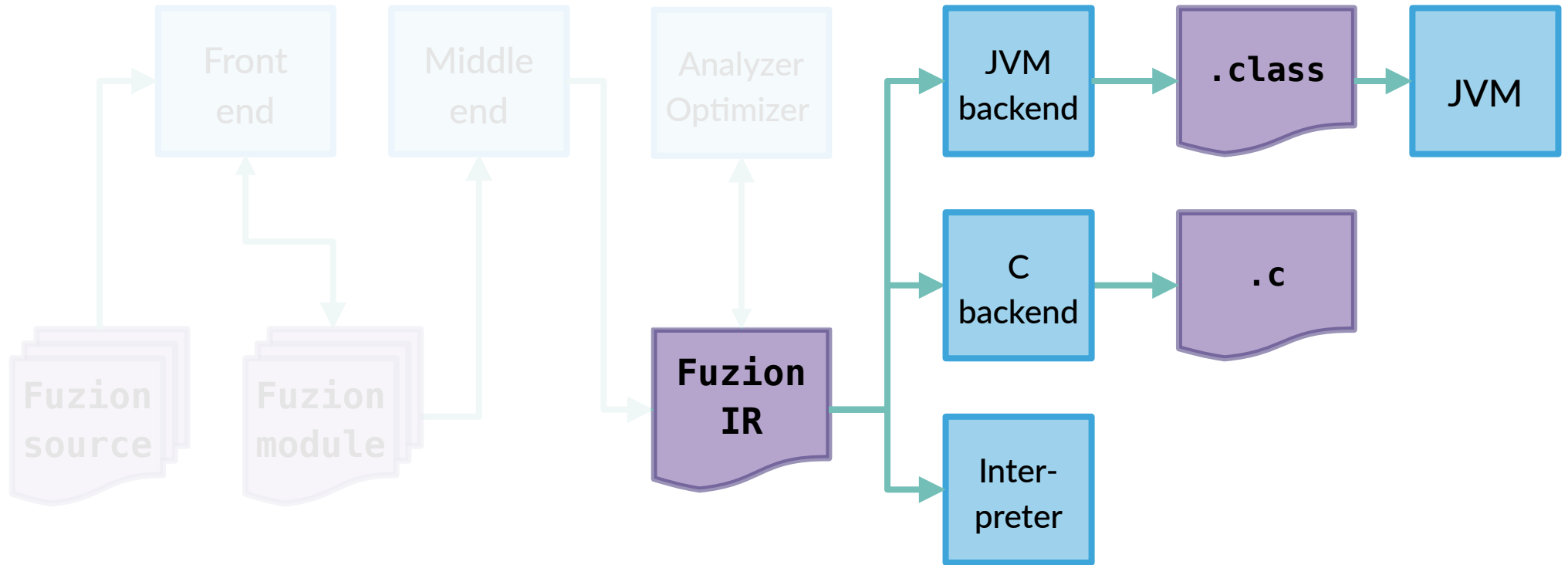
# Fuzion Toolchain and Static Analysis



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# Fuzion Toolchain and Static Analysis



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# The Fuzion IR

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# The Fuzion IR: Runtime Features

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→ Set of runtime features



# The Fuzion IR: Runtime Features

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- Set of **runtime features** of the kinds
  - routine
  - abstract
  - field
  - choice
  - intrinsic
  - native



# The Fuzion IR: Runtime Features

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→ Set of **runtime features** of the kinds

- routine **type**
- abstract
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- choice **type**
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# The Fuzion IR: Runtime Features

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→ Set of **runtime features** of the kinds

- routine      **type**      **callable**
- abstract                      **callable**
- field                              **callable**
- choice              **type**
- intrinsic                      **callable**
- native                              **callable**



# The Fuzion IR: Runtime Features

---

→ Set of **runtime features** of the kinds

- routine      **type**    **callable**    **has code**
- abstract            **callable**
- field                **callable**
- choice            **type**
- intrinsic            **callable**
- native               **callable**



# The Fuzion IR: Code

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→ Stack machine





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→ Stack machine

→ Only 10 commands

- Call

- Assign

- Tag / Match

- Box, Env, Current, Const, Pop, Comment



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# The Fuzion IR: Code

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- Stack machine
- Only 10 commands
  - Call
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  - Box, Env, Current, Const, Pop, Comment
- Intrinsic for arithmetic, runtime system, etc.



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# Fuzion: Status

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Fuzion still under development

- language definition stabilizing
- base library work in progress
- current implementation providing JVM and C backends
- basic analysis tools available
- greencode.ai project starting now





# Thank you. Any questions?

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Please follow and stay informed

- ➔ <https://github.com/tokiwa-software/fuzion>
- ➔ <https://fuzion-lang.dev>
- ➔ @FuzionLang
- ➔ @Fuzion@types.pl

