



Miking Workshop 2024

digital futures

Digital Futures Hub

Stockholm, December 4, 2024

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WASP
WALLENBERG AI,
AUTONOMOUS SYSTEMS
AND SOFTWARE PROGRAM

TECOSA

**Vetenskapsrådet
(VR)**



Financially supported by the
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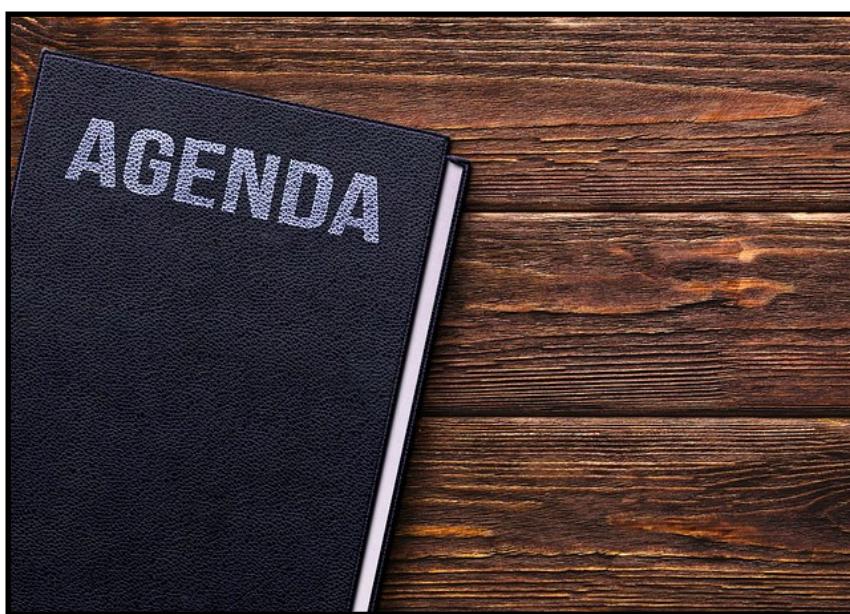
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Part I Workshop Overview

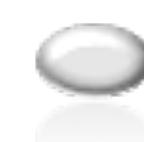


Part II Overview of the Miking Framework





Part I Workshop Overview



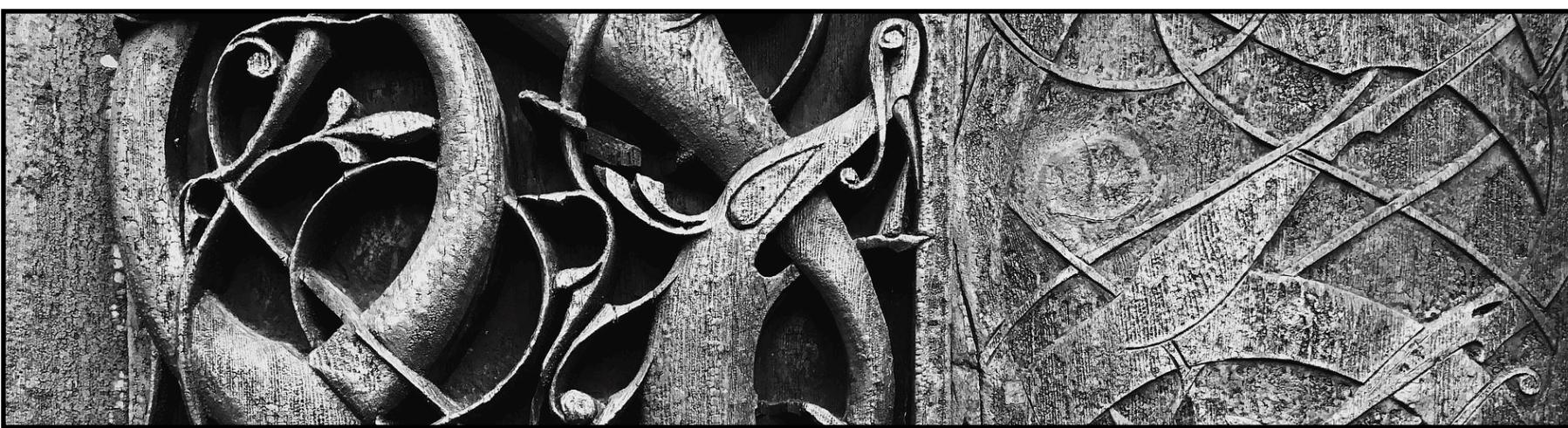
Part I
Workshop Overview

Part II
Overview of the Miking Framework



Agenda

Miking Workshop 2024



10.00 Registration and Coffee

10.30 Welcome and Introduction to Miking.

Speaker: David Broman

11.15 Coffee break

11:30 Tutorial: Parsing with Miking using Resolvable Ambiguity

Speaker: Viktor Palmkvist

12.00 Lunch

13:00 Session 1: Next generation of Miking: Types and Tool Support

- Title: *Language Composition through Product Extension and Its Use Cases for DSL Development*. Speaker: Marten Voorberg
- Title: *Empowering DSLs with Automated Language Server Generation*. Speaker: Didrik Munther

13:30 Hacking session 1: Getting started and playing around

Organizers: The Miking core team

14:15 Session 2: Optimized and Efficient Domain-Specific Languages

- Title: *Partial Evaluation of Automatic Differentiation for Differential-Algebraic Equations Solvers*. Speaker: Oscar Ericsson
- Title: *Trellis: A Domain-Specific Language for Hidden Markov Models with Sparse Transitions*. Speaker: Lars Hummelgren
- Title: *Automated Inference Optimizations in the Probabilistic Programming Language Miking CorePPL*. Speaker: Gizem Caylak

15.00 Coffee break

15:30 Session 3: TreePPL - Phylogenetic Inference using Miking

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16.30 Hacking session 2: Try out your favorite DSL or hack on the compiler

Organizers: The Miking core team

17.00 Conclusions and more happy hacking!



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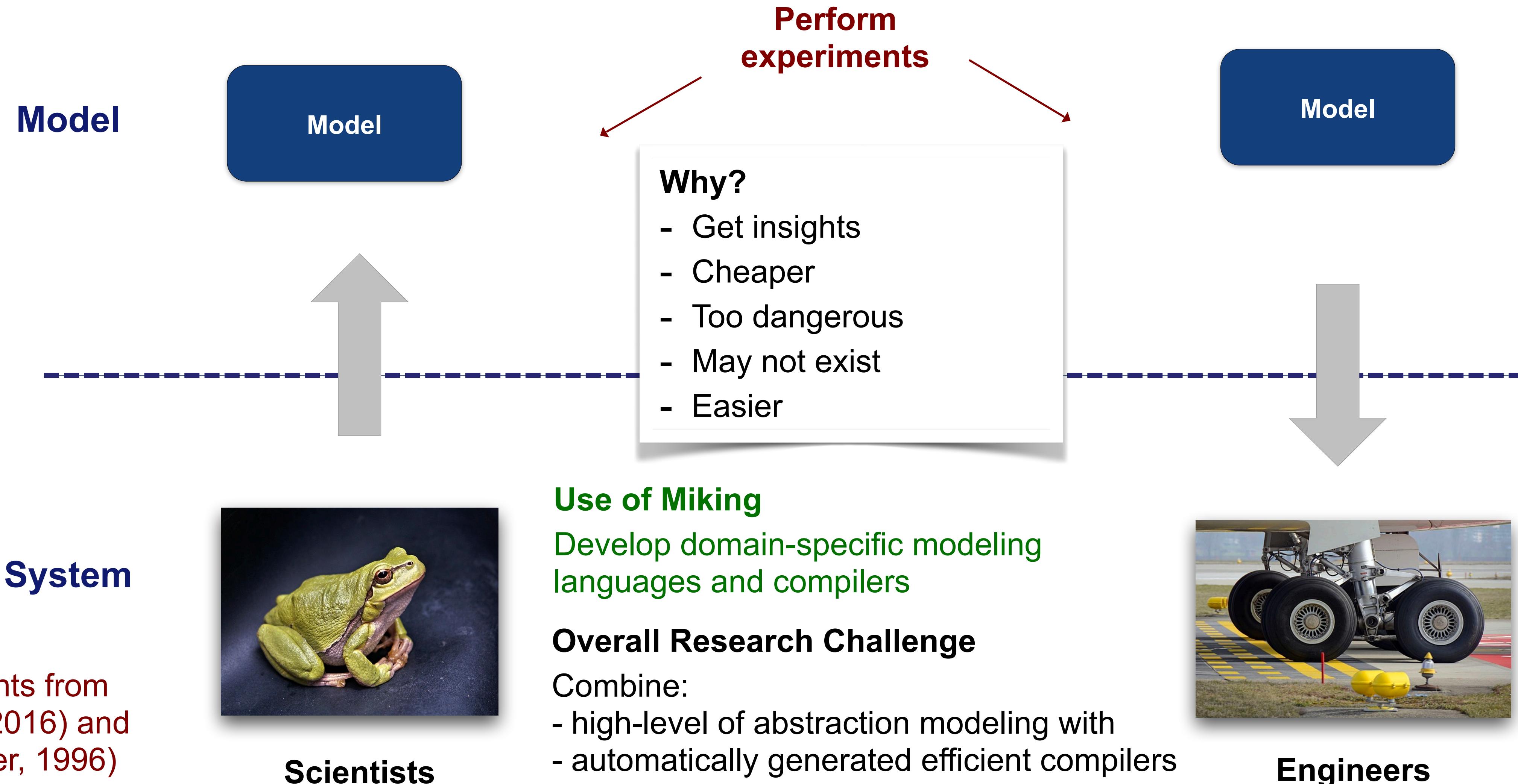
Part II

Overview of the Miking Framework





Why models?





Miking (the Meta vIKING)



Objectives:

- Platform for constructing heterogeneous domain-specific modeling languages
- Polymorphic static type system (based on FreezeML).
- Bootstrapping compiler
- Target constrained real-time systems as well as offline distributed computations
- Efficient compiler - different target platforms
- Research platform
- Open source (MIT license)
- www.miking.org



Related Work

Compiler construction

- Standard Lex, Yacc (external DSL)
- JastAdd (Ekman & Hedin, 2007)

Preprocessing and template metaprogramming

- C++ Templates (Veldhuizen, 1995)
- Template Haskell (Sheard & Peyton Jones, 2002)
- Stratego/XP (Bravenboer et al., 2008)

Embedded DSLs

- Haskell DSELs, e.g., Fran (Elliott & Hudak, 1997), Lava (Bjesse et al. 1998, FHM (Nilsson et al., 2003))
- Scala, e.g. Lightweight modular staging (Rompf and Odersky, 2010)
- Shallow embedding and PE (Leißa et al., 2015)
- Modelize, Equation-based modeling (2019)
- Python (untyped programming)

Language Workbenches and Languages for creating languages

- SugarJ, MPS, Spoofax, RASCAL, MetaEdit+, Enso⁺, Racket etc.





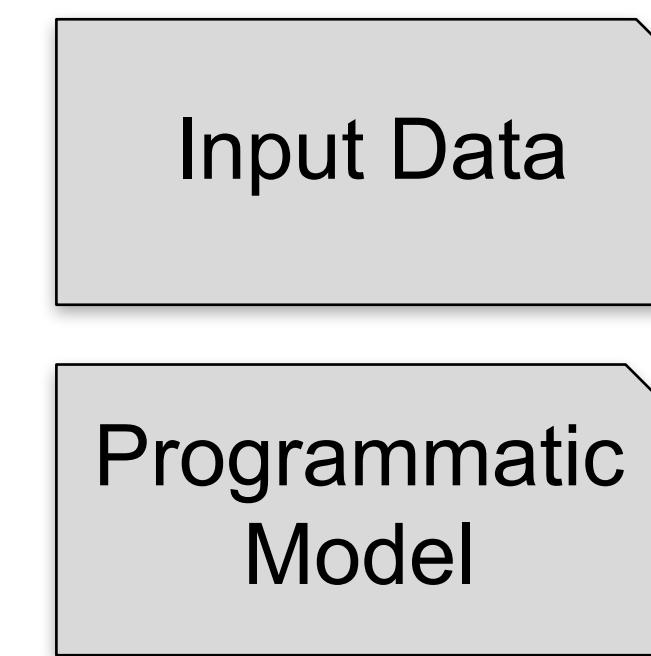
The Vision of Miking



David Broman. **A Vision of Miking: Interactive Programmatic Modeling, Sound Language Composition, and Self-Learning Compilation.** In Proceedings of the 12th ACM SIGPLAN International Conference on Software Language Engineering (SLE 2019), Athens, Greece, ACM, 2019.



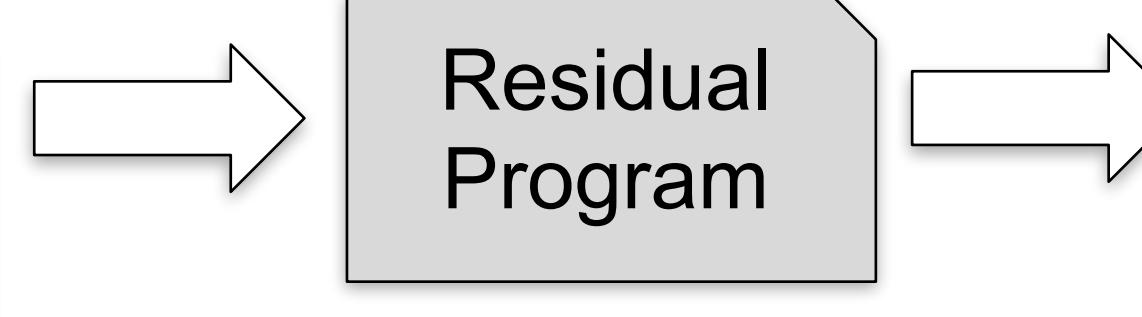
Interactive Programmatic Modeling (Part I)



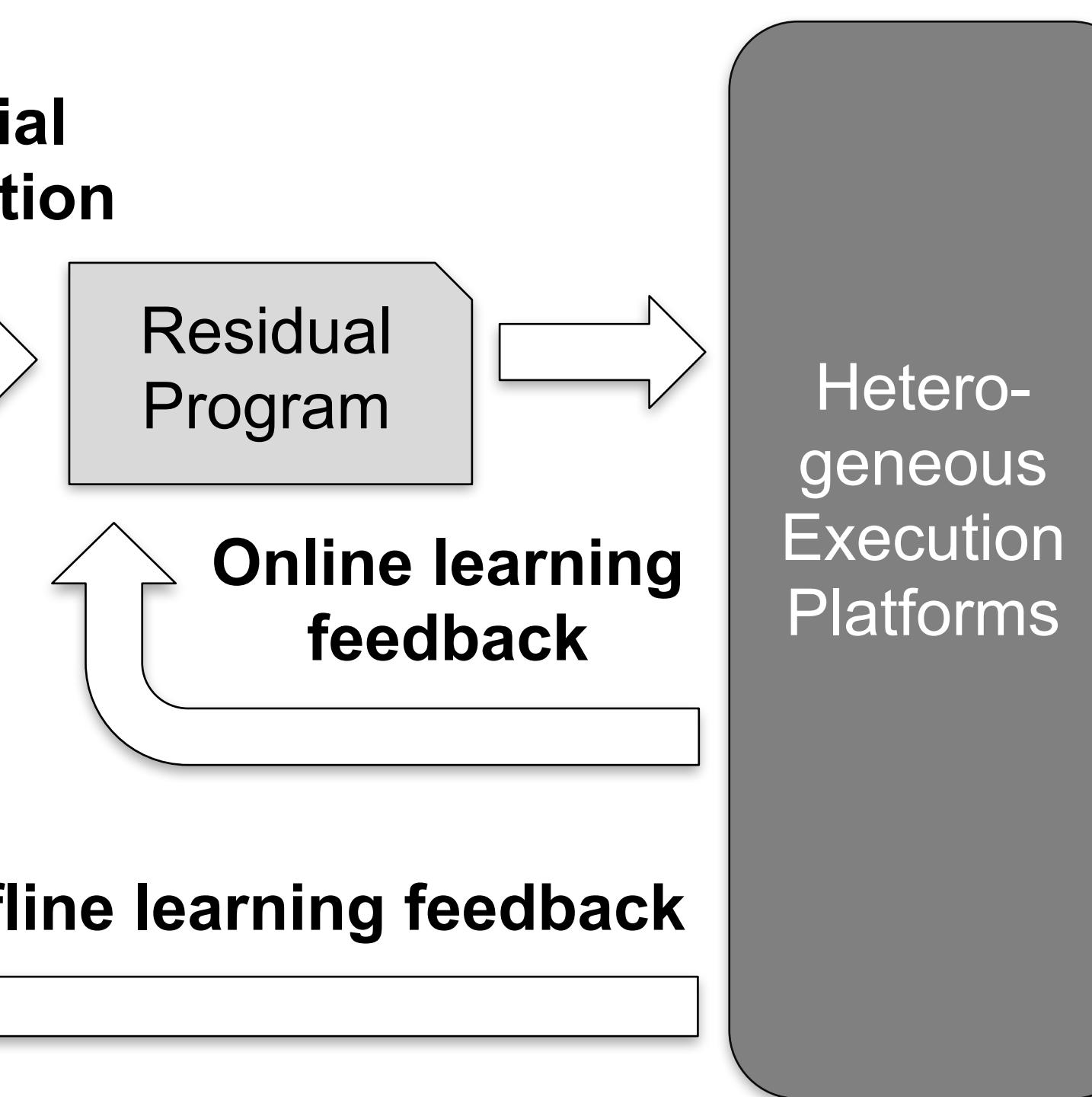
Interactive Views

Efficient Compilation (Part III)

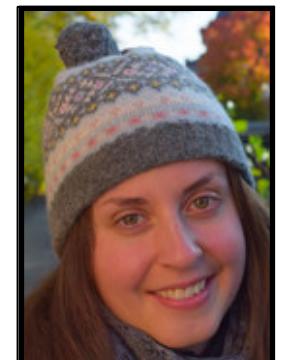
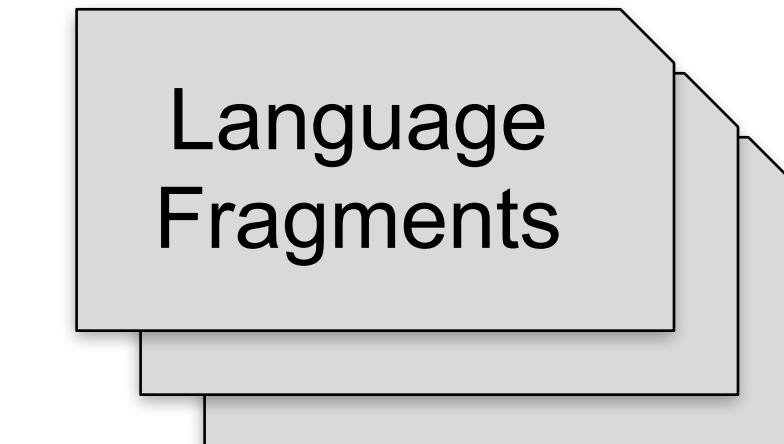
Partial Evaluation



Online learning feedback



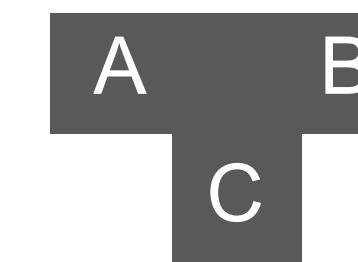
Sound Language Composition (Part II)





Bootstrapping the Miking Compiler

New
 Generated
 Existing



Compiling language A to B, written in language C



Interpreter written in B, interpreting language A

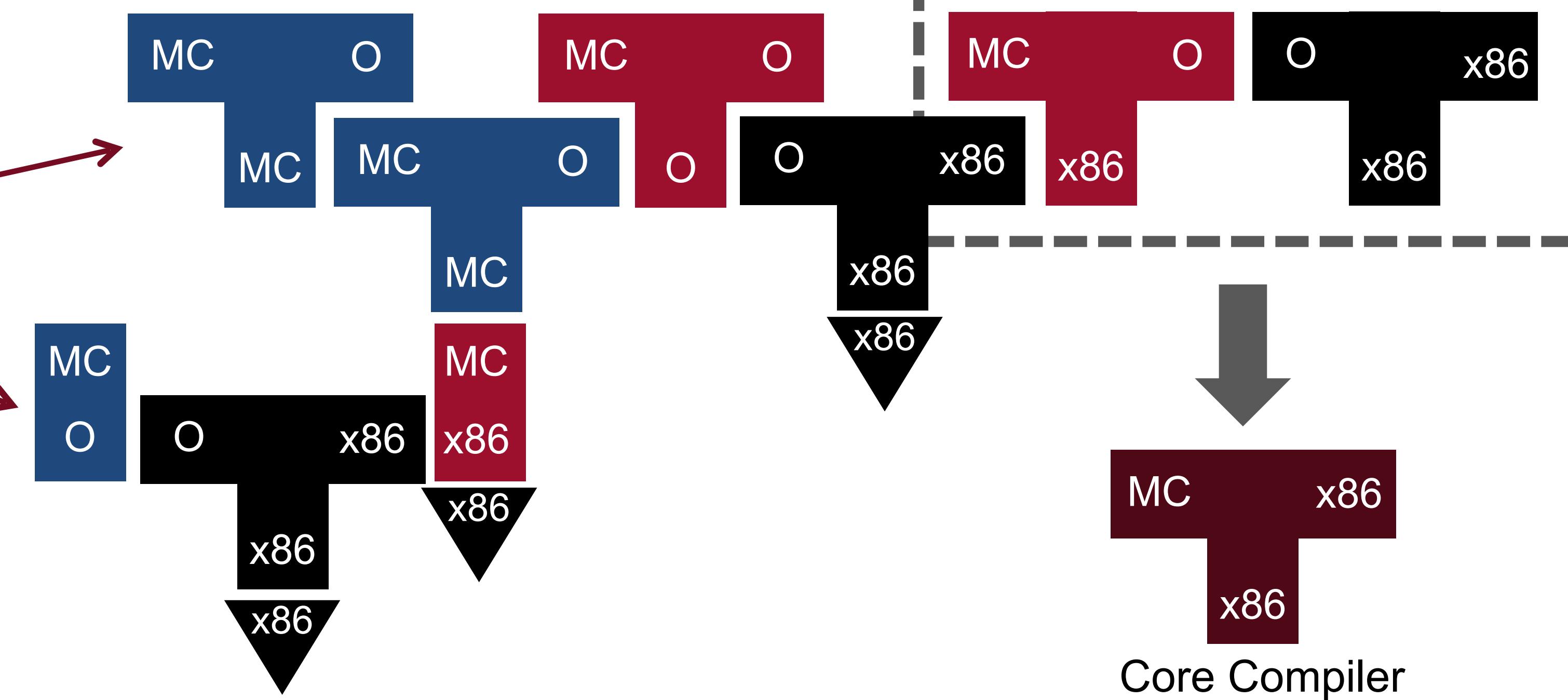


Machine executing language A

$MC = MCore$
 $O = OCaml$

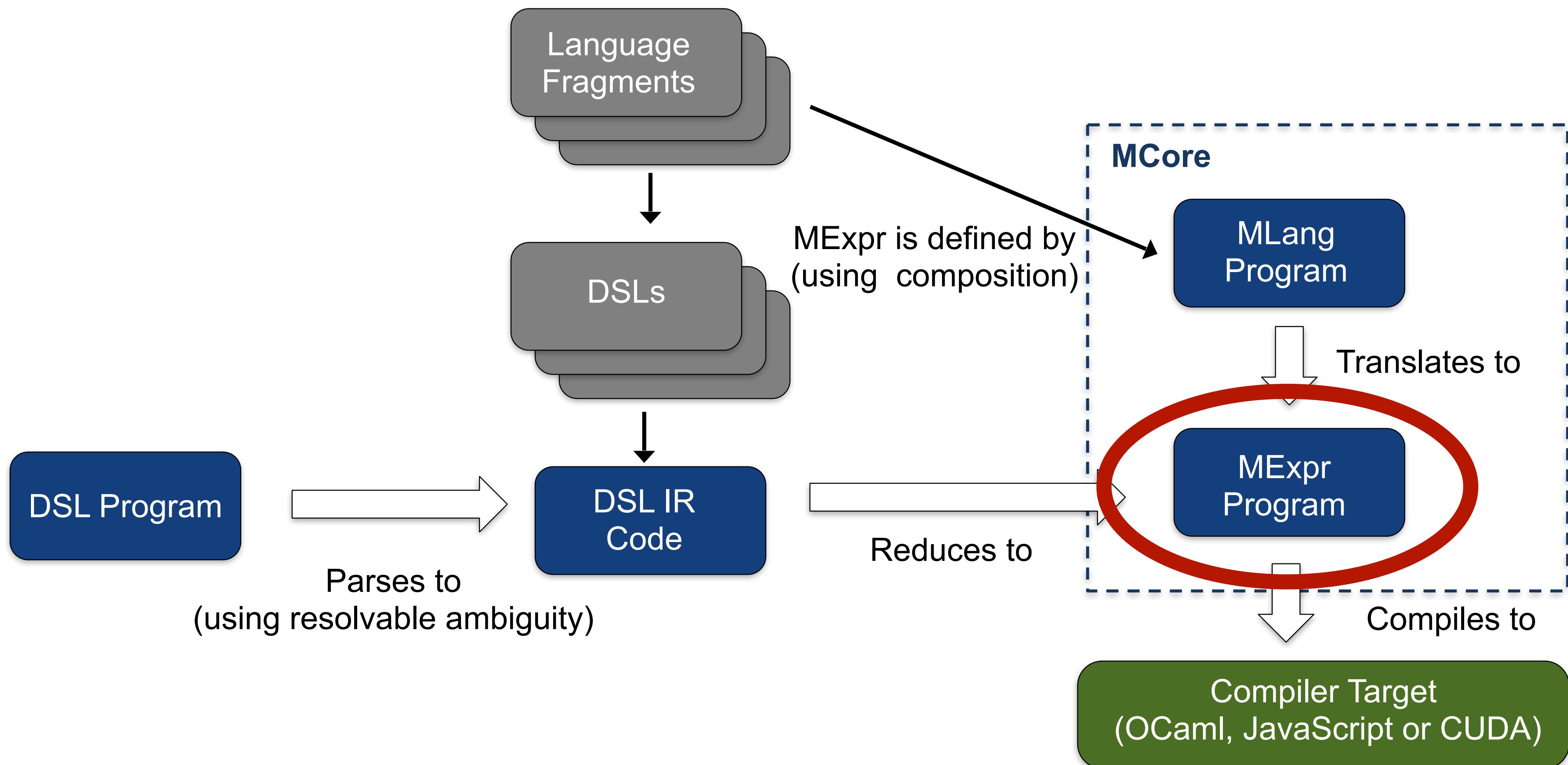
Miking Compiler

Bootstrap interpreter





Overview of the Toolchain





MExpr - the Miking IR

```

type Tree in
con Node : (Tree,Tree) -> Tree in
con Leaf : (Int) -> Tree in

recursive
  let count = lam tree.
    match tree with Node (left,right) then
      addi (count left) (count right)
    else match tree with Leaf v then
      v
    else error "Unknown node"
in
  
```

```

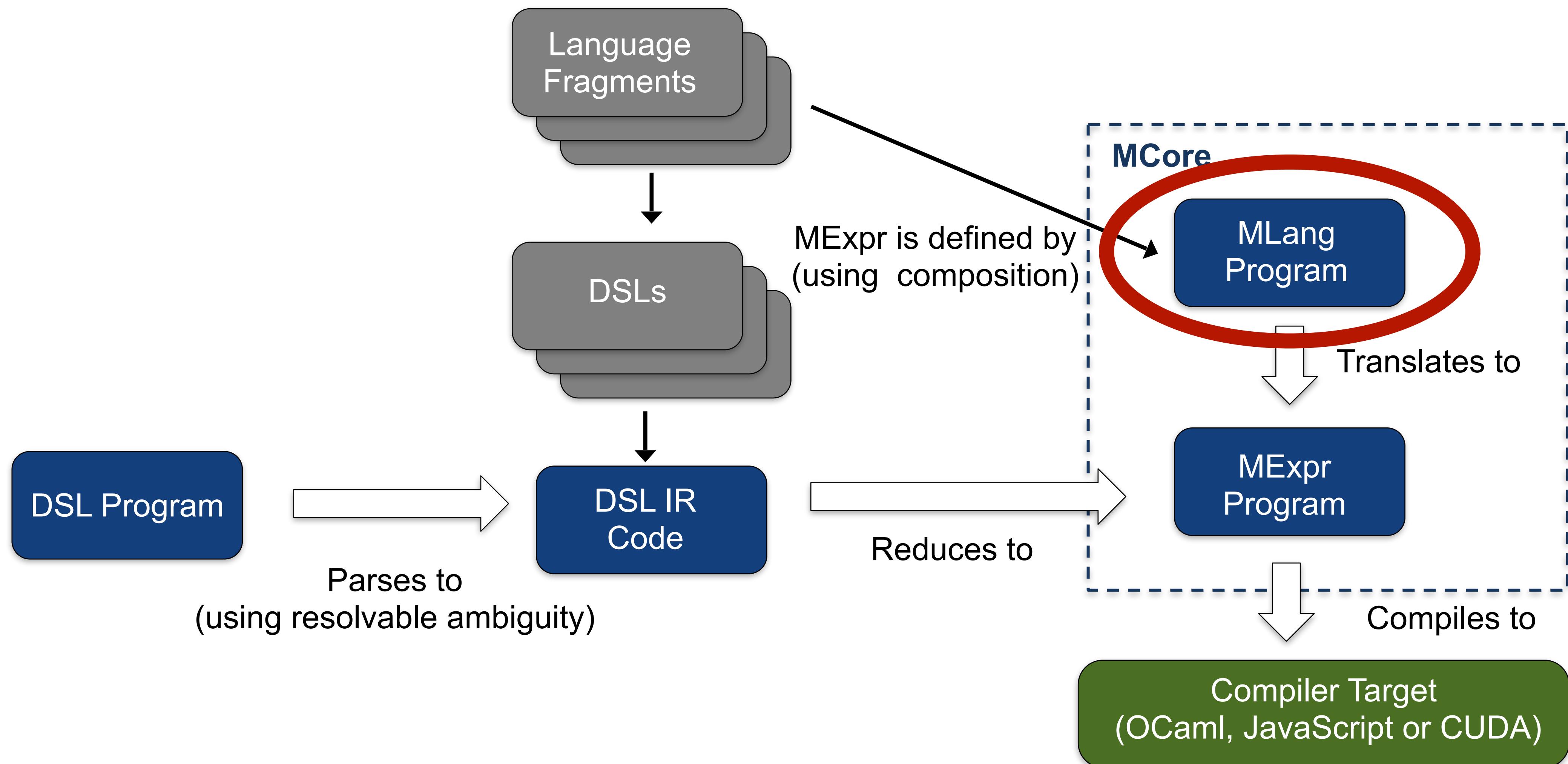
let tree3 = Node(Node(Leaf(3),Node(Leaf(2),Leaf(6))),Leaf(12)) in
utest count tree3 with 23 in
()
  
```

Features

- Functional Intermediate language
- Polymorphic Type System - statically typed with type inference
- Intermediate representation - concrete syntax very close to abstract syntax
- Small but complete. Eager, includes references, arrays, sequences, algebraic data types, pattern matching, etc.



Overview of the Toolchain





MLang: Language Fragments and Composition

syn: defines extensible constructors

```
lang Arith
syn Expr =
| Num Int
| Add (Expr, Expr)
```

sem: define extensible functions

```
sem eval =
| Num n -> Num n
| Add (e1,e2) ->
  match eval e1 with Num n1 then
    match eval e2 with Num n2 then
      Num (addi n1 n2)
    else error "Not a number"
  else error "Not a number"
end
```

use: using a language fragment in an expression

```
mexpr
use Arith in
utest eval (Add (Num 2, Num 3)) with Num 5 in
()
```

Features

- Order-independent pattern matching composition

Independent language fragment, using the same syn and sem names

```
lang MyBool
syn Expr =
| True()
| False()
| If (Expr, Expr, Expr)
```

```
sem eval =
| True() -> True()
| False() -> False()
| If(cnd, thn, els) ->
  let cndVal = eval cnd in
  match cndVal with True() then eval thn
  else match cndVal with False() then eval els
  else error "Not a boolean"
end
```

Composing together language fragments

```
lang ArithBool = Arith + MyBool
```

```
mexpr
use ArithBool in
utest eval (Add (If (False(), Num 0, Num 5), Num 2))
           with Num 7 in
()
```

- Many semantic functions, e.g. ANF transformation, CPS transformation, lambda lifting, symbolizer, etc.



Open Source, building a community

Miking
A framework for constructing efficient domain-specific languages.

Development
The Miking framework is an open-source effort that is currently in Beta status. Please visit the GitHub pages if you would like to contribute to the development.

Vision
Our vision is that Miking will become the leading environment for rapid and efficient development of domain-specific languages. Please see the Miking vision paper for an overview.

Documentation
To learn more, please check out the online documentation for both the Miking core environment, and the domain-specific language for differentiable probabilistic programming, Miking DPPL.

www.miking.org

Miking

Pinned

- miking (Public)
Miking - the meta viking: a meta-language system for creating embedded languages
Monkey C ⭐ 38 🐾 22 ⏲ 39 (1 issue needs help) ⏱ 4 Updated 7 hours ago
- miking-dppl (Public)
miking-dppl - The general Miking benchmark suite
C++ ⭐ 5 🐾 6 ⏲ 2 ⏱ 1 Updated 15 hours ago

Repositories

Find a repository... Type Language Sort New

- miking (Public)
- miking-benchmarks (Public)
- miking-dppl (Public)

<https://github.com/miking-lang>

Miking Workshop 2022
December 14, 2022, KTH Campus, Digital Futures Hub, Stockholm, Sweden

Welcome to the first Miking workshop! Miking is an open-source project developed at KTH Royal Institute of Technology and is now released officially for the first time. The framework is a meta-language system for creating domain-specific languages and tools. Please see the vision paper, the Miking webpage, or the GitHub pages for more information. In this first workshop, you will learn how to code with the Miking core language and how to create your own domain-specific language using the framework. There will be many interesting hands-on tutorials, technical talks, and research talks. Please bring your laptop!

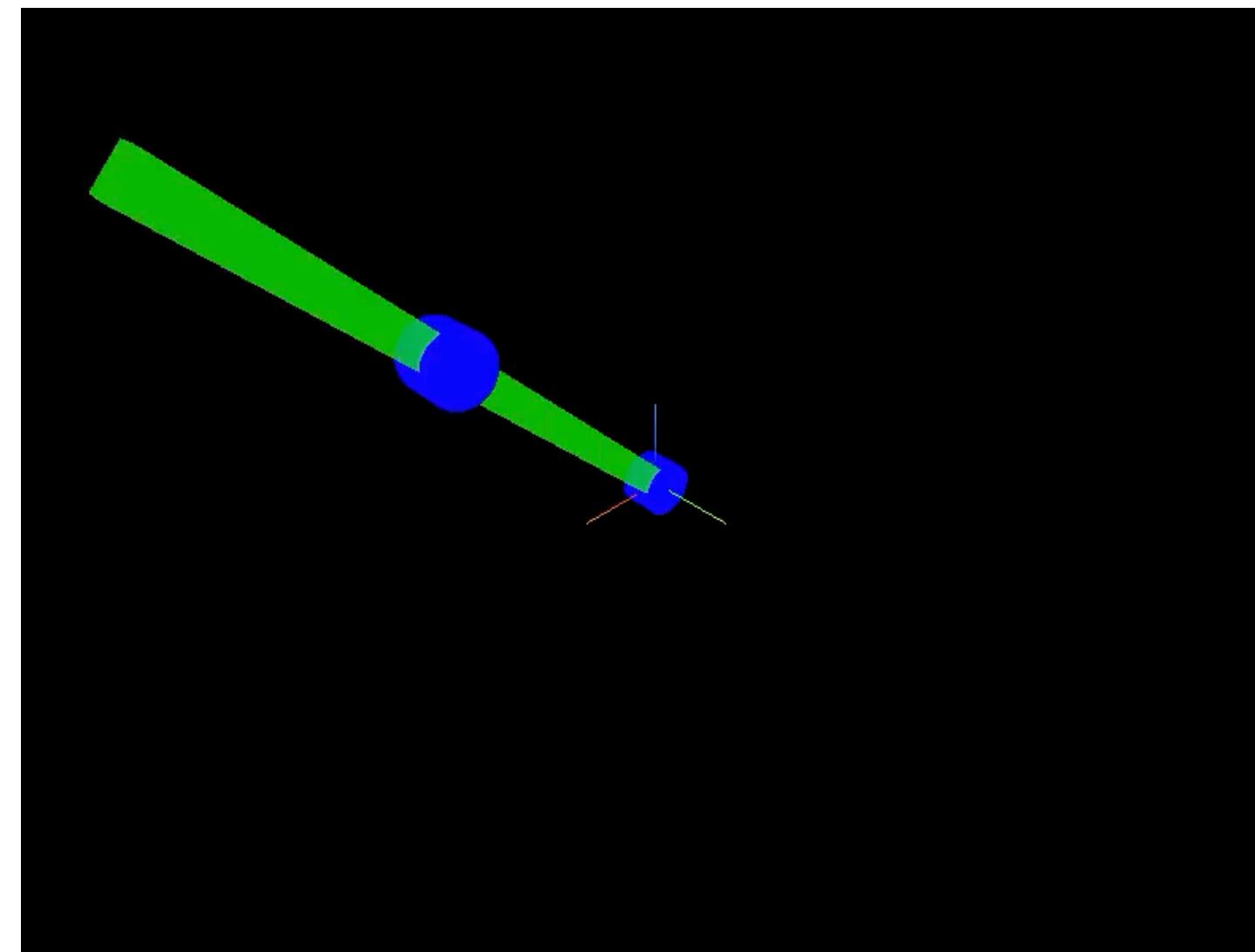
The workshop is free of charge and includes lunch, coffee, and dinner. The format is hybrid. That is, it is possible to attend both in person, and online using Zoom. In both cases, you need to register (first come, first served). The workshop is organized together with Digital Futures. Several organizations have been funding research projects related to the Miking framework, including the Swedish Research Council (VR), the Swedish Foundation for Strategic Research (SSF), Vinnova, and

The first Miking Workshop
(December, 2022, Stockholm)

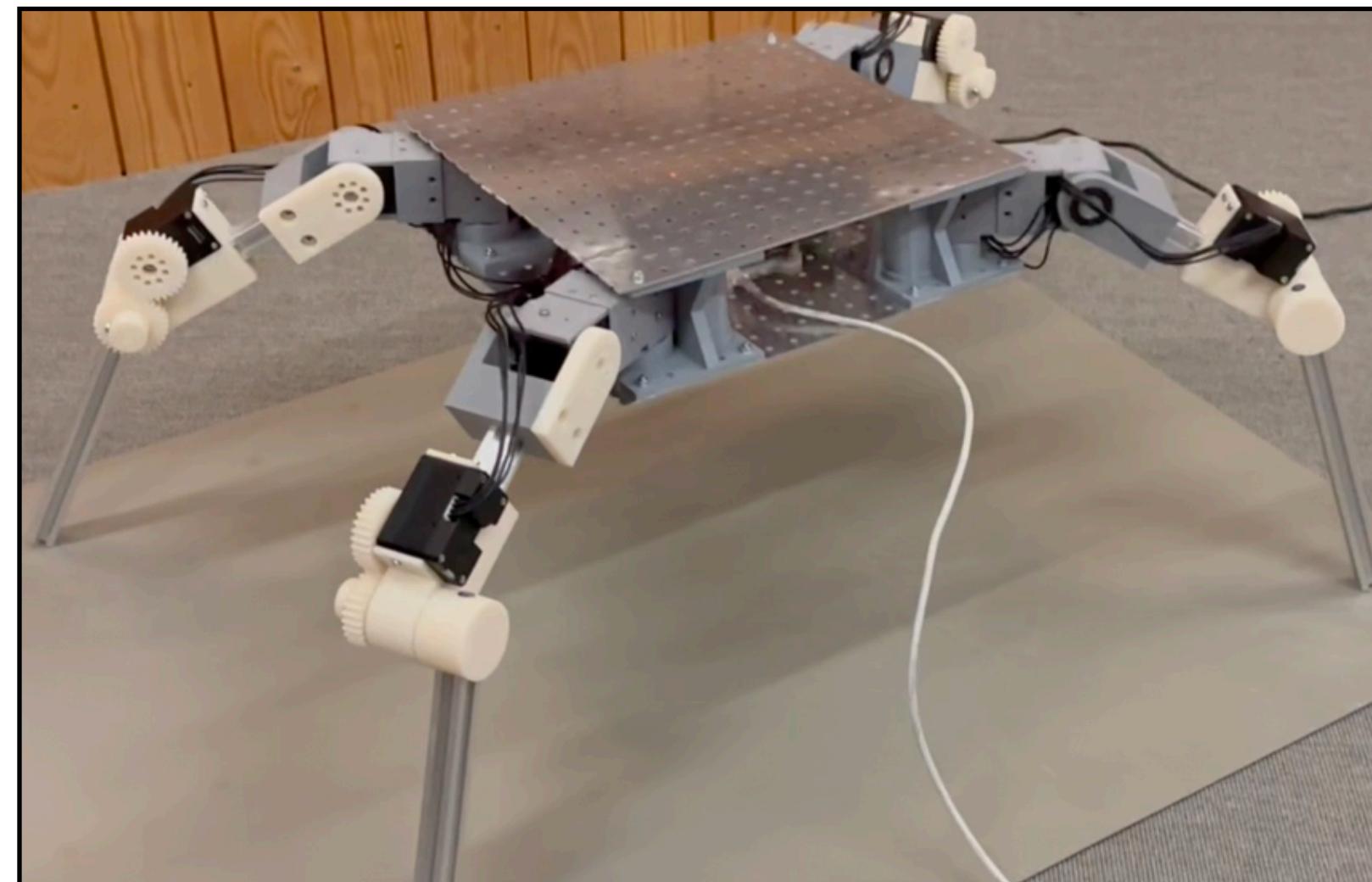


Ongoing Application Areas

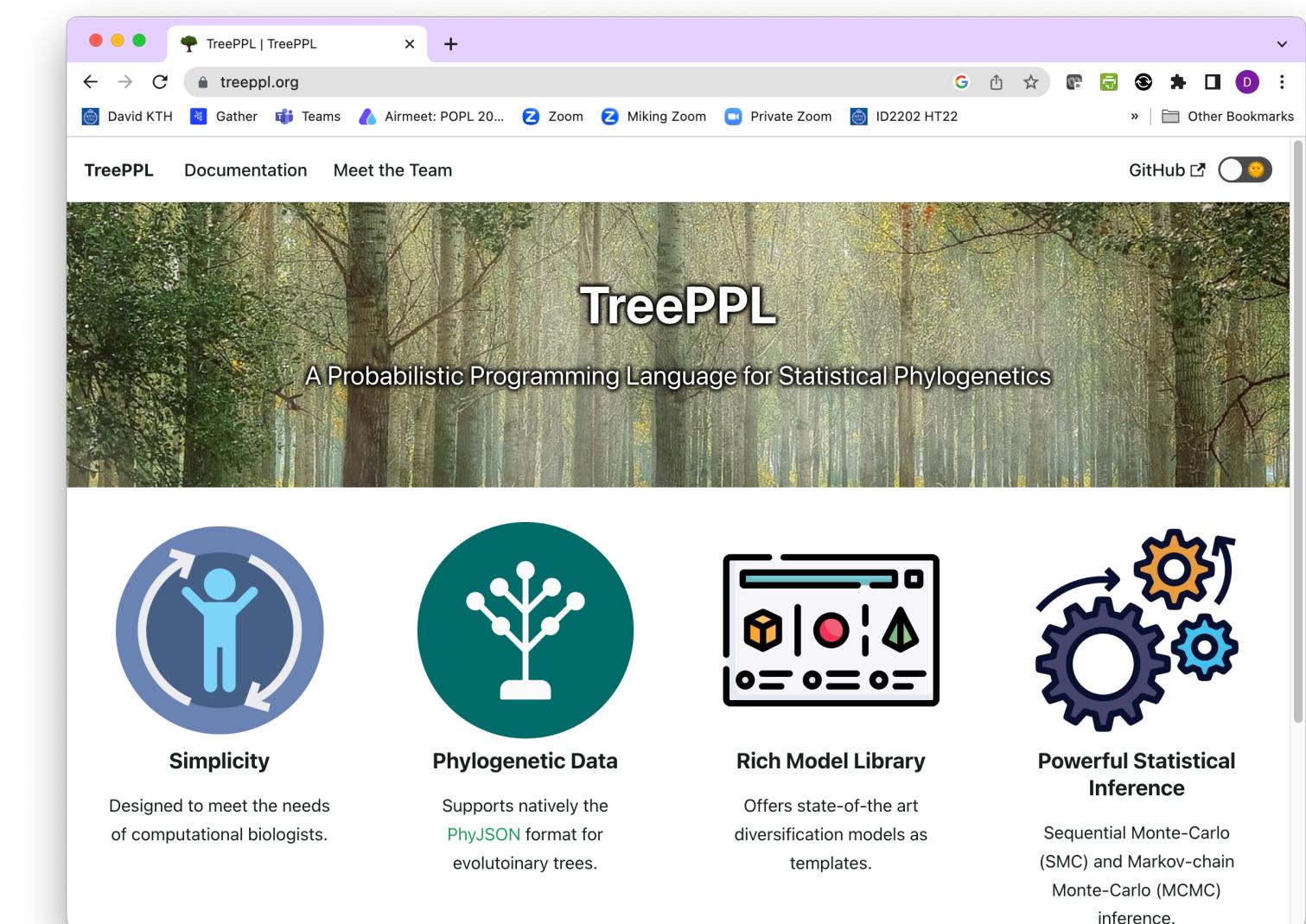
Equation-Based Modeling and Physical Simulation



Robotics and CPS



TreePPL - a DSL for phylogenetics



```
def model2 =
    world -- RevoluteJoint(yhat, q0_1) --
    Bar(1.5 * 1, q0_1) --
    RevoluteJoint(yhat, q0_1) -- Bar(1, q0_2) -- f1
```

Fredrik Ronquist, Jan Kudlicka, Viktor Senderov, Johannes Borgström, Nicolas Lartillot, Daniel Lundén, Lawrence Murray, Thomas B. Schön, and David Broman. **Universal probabilistic programming offers a powerful approach to statistical phylogenetics.** In Communications Biology volume 4, Article number 244, Nature Publishing Group, 2021.



Open Source - MIT license

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Miking - the meta viking: a meta-language system for creating embedded languages

Monkey C ⭐ 38 🏷 22
- miking-dppl (Public)

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- miking-benchmarks (Public)

The general Miking benchmark suite

C++ ⭐ 5 🏷 MIT 🏷 6 ⚡ 2 ⚡ 1 Updated 15 hours ago
- miking-dppl (Public)

People

Invite someone

Top languages

OCaml JavaScript

<https://github.com/miking-lang>

Part II
Overview of the Miking Framework



Getting involved

- Thesis research project
- Extending standard library
- Examples and documentation
- Fixing issues

Thanks for listening!

