The Fuzion Language

Fridtjof Siebert

Who is this guy?

Fridtjof Siebert

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github: fridis
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‘90-‘94	AmigaOberon, AMOK PD
‘97	FEC Eiffel Compiler Sparc / Solaris
‘98-‘99	OSF: TurboJ Java Compiler
‘00-‘01	PhD on realtime GC
‘02-‘19	JamaicaVM realtime JVM based on CLASSSPATH / OpenJDK, VeriFlux static analysis tool
‘20-…	Fuzion

Motivation

Many languages overloaded with concepts like classes, methods, interfaces, constructors, traits, records, structs, packages, values, …

⇨ Fuzion has one concept: a feature

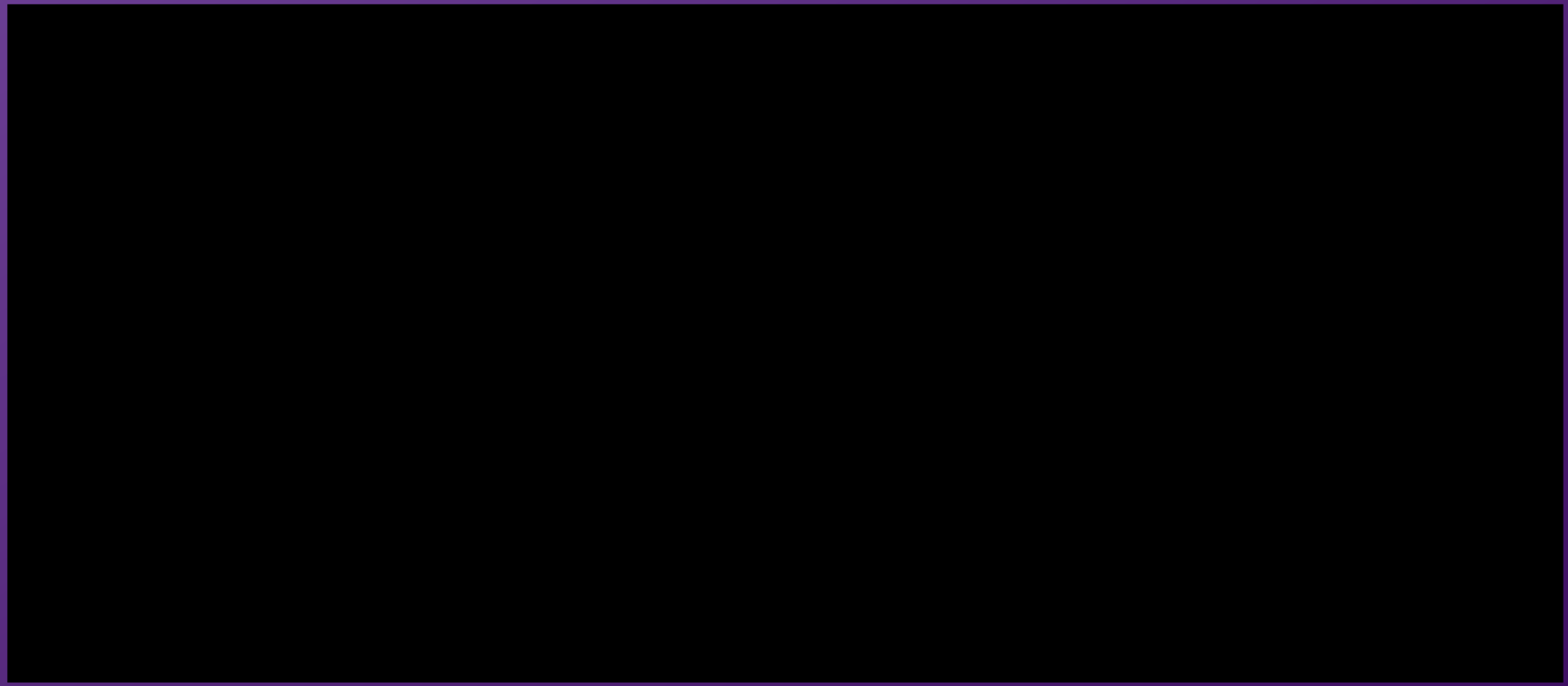
Compilers and tools are more powerful

⇨ Tools make better decisions

Systems are safety-critical

⇨ we need to ensure correctness

Hello World!



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HelloWorld is
  stdout.println("Hello, World!")
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Feature Declaration

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    : lifo<T>, streamable<T>
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    size u64 = 0
    isEmpty => size = 0
    push(x T) myStack<T>
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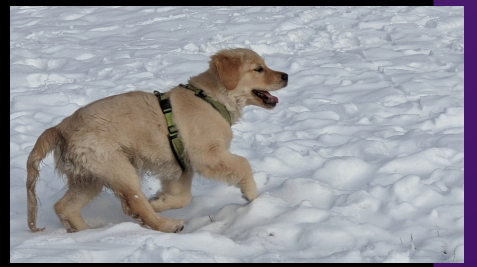

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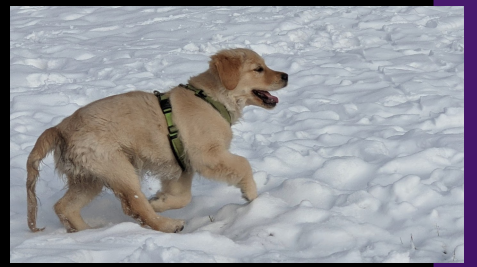

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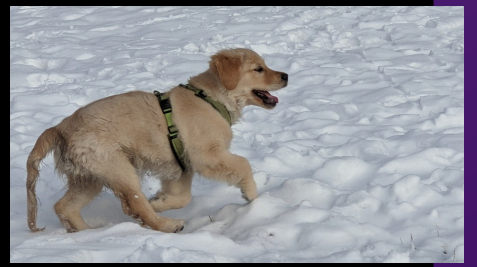

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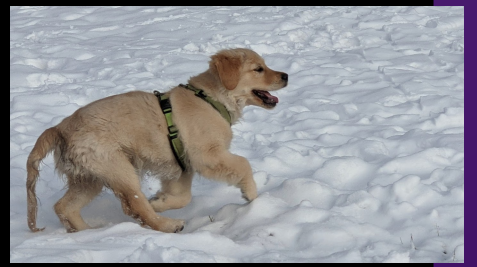

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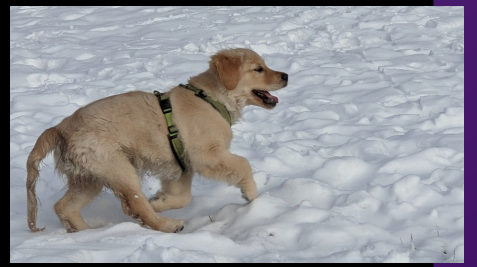

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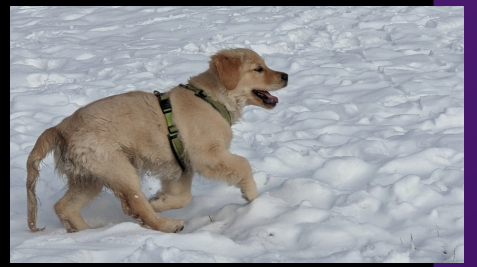

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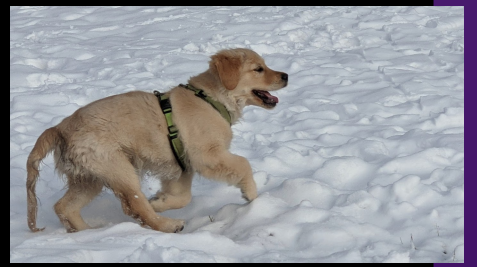

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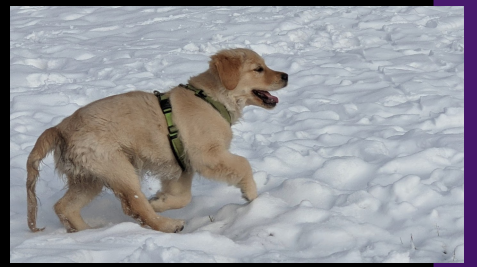

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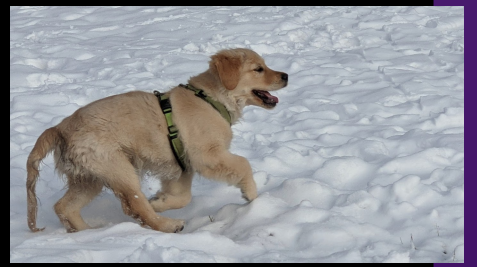

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mapped to feature declarations and calls

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- ⇨ union types — feature **`choice`** with generics
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See Tutorial at https://flang.dev

Immutability

Fields can be assigned a value only once

- ⇨ great for static analysis
- ⇨ great for optimizations
- ⇨ multi-threading becomes race-free without locks
- ⇨ this scares many developers

Immutability in Fuzion

Most fields are immutable

⇨ immutable field declaration syntax simple

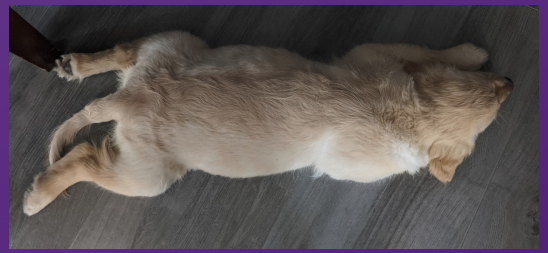
```
x := expr()
```

vs.

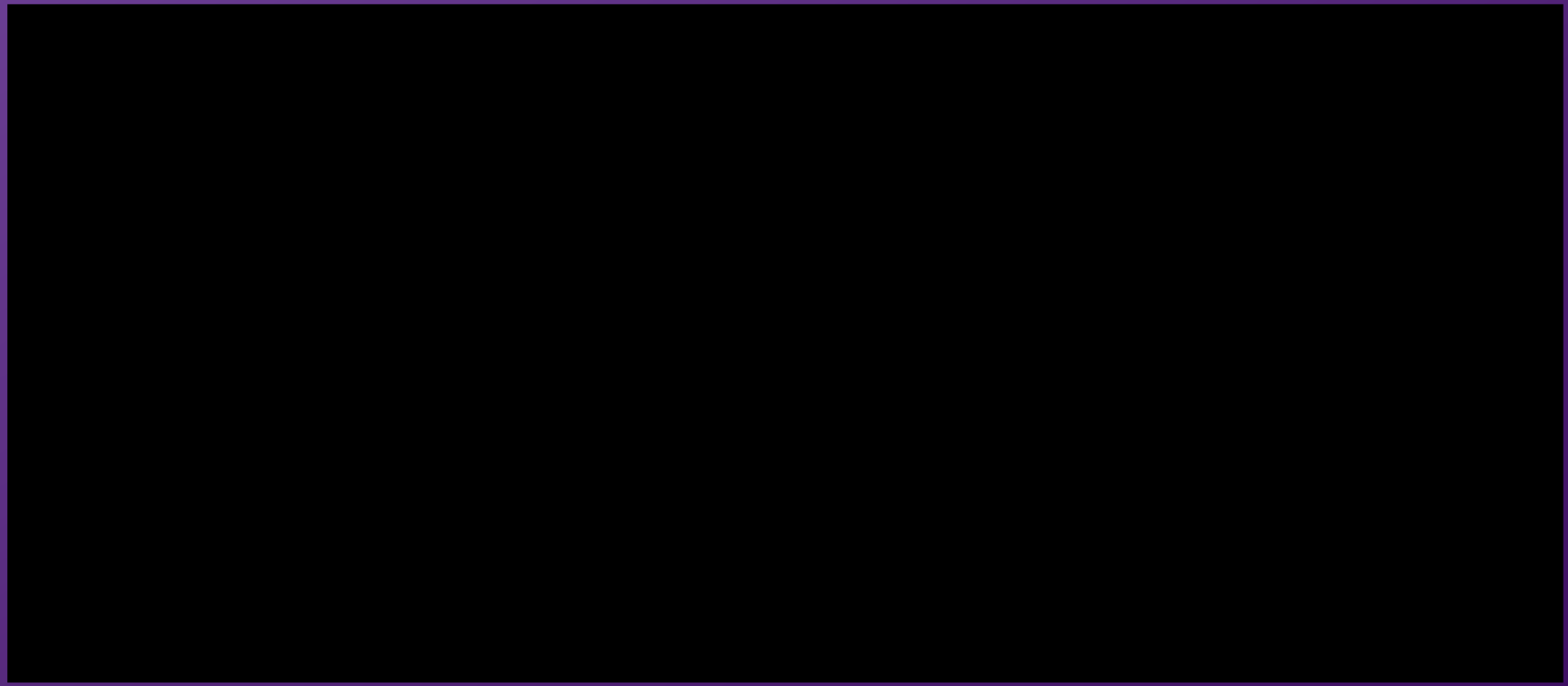
```
x T
set x := expr()
```

⇨ loops converted to tail-recursive functions

⇨ fields shared by threads must be immutable



Memory Management



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⇨ register / stack allocation when possible

⇨ heap allocation otherwise

⇨ realtime GC handles heap deallocation

→ bounded allocation time

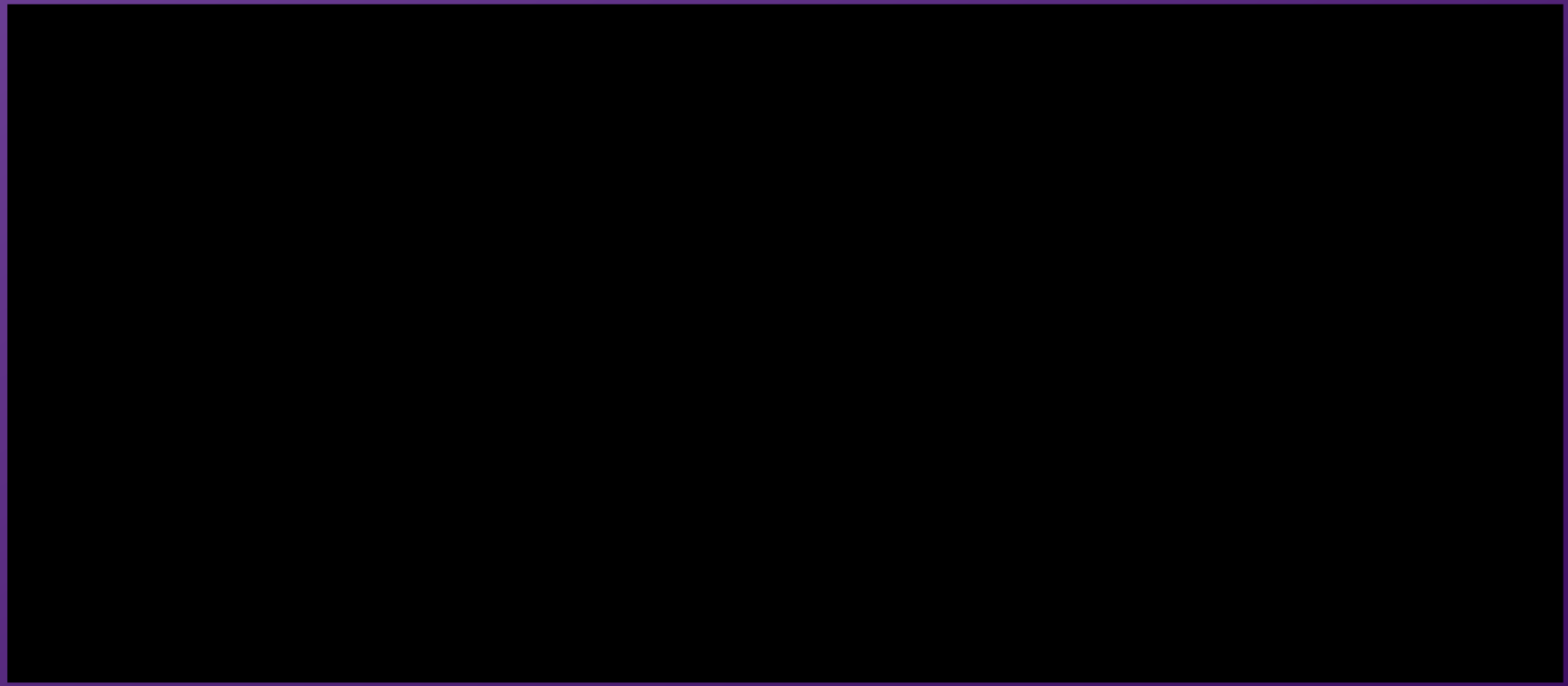
→ fragmentation solved

Memory Management

Realtime GC

- ⇨ parallel mark and sweep standard algorithm
- ⇨ write barrier ensuring strong invariant
- ⇨ segregated size classes to reduce fragmentation
- ⇨ tile-based compaction to fix fragmentation
- ⇨ parallel implementation to avoid pauses
- ⇨ work-based as fallback

Type Inference



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flags := 1 << 24            # default integer type
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Expression to assigned field or function result

⇨ type is expression type

⇨ performed lazily during type inferencing phase

⇨ cycles detected, cause error

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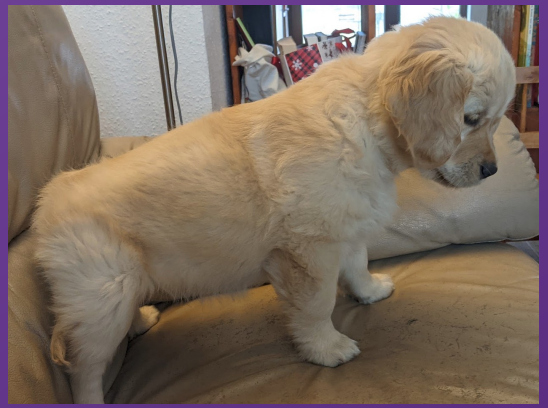
Constant numeric expressions

⇨ type inferred from assignment target

⇨ default type, if not present (i64, f64)

Fuzion Implementation State



Fuzion is still in a proof-of-concept state

- ⇨ Interpreter on top of JVM
- ⇨ C code backend under development
- ⇨ Analysis tools still under development

Help wanted

Resources related to Fuzion

- ⇨ web: https://flang.dev
- ⇨ github: https://github.com/fridis/fuzion
- ⇨ give feedback


The End