# FUNAR Technologien





- statisches Typsystem, Typklassen
- effektvolle Berechnungen über explizite Monaden
- viele Erweiterungen
- nicht-strikte Auswertung
- viele Optionen für Parallelisierung und Nebenläufigkeit
- eigene Runtime
- hochoptimierender Compiler (Native Code)
- weltweite Community entwickelt Compiler





- statisches Typsystem
- mächtiges Modulsystem
- imperative Features
- eigene Runtime
   (Bytecode, Native Code)
- optimierender Compiler
- Entwicklung koordiniert von INRIA, OCamlLabs



end

#### https://github.com/janestreet/async\_smtp

```
module Spoolable = struct
module type S = sig
 (** [Spoolable.Metadata.t] should be smallish since it is read and written more
   frequently than [Spoolable.Data.t]. *)
 module Metadata: sig
   type t
   (** [of_string] and [to_string] are used to persist and read [t] on disk. *)
   include
    Stringable.S with type t := t
  end
 (** [Spoolable.Data.t] is where the "real" data lives and it allows for data-specific
   [load] and [save] functionality. *)
  module Data: sig
   type t
   val load: string -> t Deferred.Or error.t
   val save : ?temp_file:string -> t -> string -> unit Deferred.Or_error.t
  end
 (** [Queue.t] is an enumerable type that represents the available queues and the
    mapping to directory names on-disk. *)
  module Queue: sig
  type t [@@deriving sexp, enumerate, compare]
  val to_dirname : t -> string
  end
  module Name generator: Name generator.S
 (** All operations that touch disk are passed through [Throttle.enqueue] *)
  module Throttle: sig
  val enqueue: (unit -> 'a Deferred.t) -> 'a Deferred.t
```



```
module Make base (S: Multispool intf.Spoolable.S) = struct
 include Shared
type t = spool [@@deriving sexp]
 let dir t = t
 let load_metadata path =
  S.Throttle.enqueue (fun () ->
   Deferred.Or_error.try_with (fun () ->
    let%bind contents = Reader.file_contents path in
    return (S.Metadata.of_string contents)))
 let save_metadata ?temp_file ~contents path =
  S.Throttle.enqueue (fun () ->
   Deferred.Or error.try with (fun () ->
    Writer.save path ?temp file ~contents ~fsync:true))
module Data file = struct
  type t =
  { spool : spool
  ; name: string
  let create spool name = { spool; name }
  let path t = data_dir_of t.spool ^/ t.name
  let load t = S.Throttle.enqueue (fun () -> S.Data.load (path t))
  let save t ~contents = S.Throttle.enqueue (fun () -> S.Data.save contents (path t))
  let stat t =
   Deferred.Or error.try with (fun () ->
    S.Throttle.enqueue (fun () -> Unix.stat (data dir of t.spool ^/ t.name)))
end
```

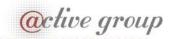




- dynamisch getypt
- Actor-Modell
- inhärent verteilt
- spezialisiert auf fehlertolerante Systeme
- umfangreiches Ökosystem für Deployment und Betrieb
- eigene Runtime (Bytecode, auch Native Code)
- Entwicklung koordiniert von Ericsson



```
-module(mod tkvstore).
-author("Marc Worrell <marc@worrell.nl>").
-behaviour(gen server).
-include lib("zotonic core/include/zotonic.hrl").
%% @doc Fetch the persistent data of a type/key
pid observe tkvstore get(Pid, #tkvstore get{} = Message, Context) ->
  gen server:call(Pid, Message).
%% @doc Fetch persistent data, first check the data dict that is still being written
handle call(#tkvstore_get{type=Type, key=Key}, _From, State) ->
  case dict:find({Type, Key}, State#state.data) of
    {ok, Data} ->
      % Data is being written, return the data that is not yet in the store
      {reply, Data, State};
    error ->
      {reply, m tkvstore:get(Type, Key, State#state.context), State}
  end:
```



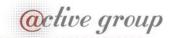


### elixir

- alternative Sprache f
  ür die Erlang-Plattform
- inspiriert durch Ruby
- interoperabel mit Erlang
- eigenes Build-/Package-Tooling



```
defmodule Ecto.Repo.Registry do
use GenServer
def associate(pid, value) when is_pid(pid) do
  GenServer.call( MODULE , {:associate, pid, value})
end
 @impl true
def handle_call({:associate, pid, value}, _from, table) do
  ref = Process.monitor(pid)
 true = :ets.insert(table, {pid, ref, value})
 {:reply, :ok, table}
end
 @impl true
 def handle_info({:DOWN, ref, _type, pid, _reason}, table) do
  [{^pid, ^ref, _}] = :ets.lookup(table, pid)
  :ets.delete(table, pid)
 {:noreply, table}
end
end
```





- hybride OO-/FP-Sprache
- statisches Typsystem
- entwickelt von Apple
- eng mit Objective-C / Cocoa integriert
- eigene Runtime / Reference Counting
- Native Code



```
indirect enum Diagram {
  case primitive (CGSize, Primitive)
  case beside(Diagram, Diagram)
  case below(Diagram, Diagram)
  case attributed(Attribute, Diagram)
  case align(CGPoint, Diagram)
extension Diagram {
 var size: CGSize {
    switch self {
      case .primitive(let size, ): return size
      case .attributed( , let x): return x.size
      case let .beside(l, r):
        let sizeL = l.size
        let sizeR = r.size
        return CGSize (width: sizeL.width + sizeR.width,
          height: max(sizeL.height, sizeR.height))
      case let .below(l, r):
        return CGSize (width: max(l.size.width, r.size.width),
          height: l.size.height + r.size.height)
      case .align( , let r): return r.size
```

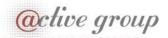
### Kotlin

- primär OO-Sprache
- Funktionstypen (keine "Higher-Kinded Types")
- statisches Typsystem
- entwickelt von JetBrains
- JVM





```
fun <A> Stream<A>.exists(p: (A) -> Boolean): Boolean =
    when (this) {
        is Cons -> p(this.h()) || this.t().exists(p)
        else -> false
    }
fun <A, B> Stream<A>.foldRight(
    z: () \rightarrow B
    f: (A, () -> B) -> B
): B = // <1>
    when (this) {
        is Cons \rightarrow f(this.h()) { t().foldRight(z, f) } // <2>
        else \rightarrow z()
fun <A> Stream<A>.exists2(p: (A) -> Boolean): Boolean =
    foldRight({false}, {a, b \rightarrow p(a) || b()})
```





- Baukasten für Sprachen
- enthält mehrere spezielle Lehrsprachen
- Abkömmling von Scheme/Lisp
- ungetypte und getypte Varianten
- eigene Runtime
   (Byte-Code, Native Code, JIT)



#### #lang racket

```
(require 2htdp/image) ; draw a picture
(let sierpinski ([n 8])
  (cond
      [(zero? n) (triangle 2 'solid 'red)]
      [else (define t (sierpinski (- n 1)))
```

#### #lang typed/racket

```
;; Using higher-order occurrence typing
(define-type SrN (U String Number))
(: tog ((Listof SrN) -> String))
(define (tog l)
    (apply string-append (filter string? l)))
```

#### #lang racket/gui

```
(define f (new frame% [label "Guess"]))
(define n (random 5)) (send f show #t)
(define ((check i) btn evt)
   (message-box "." (if (= i n) "Yes" "No")))
(for ([i (in-range 5)])
```

#### #lang scribble/base

```
a; Generate a PDF or HTML document
atitle{Bottles: aitalic{Abridged}}
a(apply
   itemlist
   (for/list ([n (in-range 100 0 -1)])
```

#### #lang datalog

```
ancestor(A, B) :- parent(A, B).
ancestor(A, B) :-
parent(A, C), ancestor(C, B).
parent(john, douglas).
parent(bob, john).
```

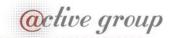
#### #lang web-server/insta

```
;; A "hello world" web server
(define (start request)
   (response/xexpr
   '(html
        (head (title "Racket"))
```





- .NET-Abkömmling von OCaml
- allerdings ohne dessen Modulsystem
- statisches Typsystem
- ... mit Maßeinheiten
- integriert in Visual Studio
- type providers
- Entwicklung bei Microsoft koordiniert



```
"FSharp.Data.dll"
open FSharp Data
let wb = WorldBankData.GetDataContext()
let uk = wb.Countries.``United Kingdom``
uk Indicators
                 Average grace period on new external debt commitments, official (years)
                 Average grace period on new external debt commitments, private (years)
                    Average grant element on new external debt commitments (%)
                    Average grant element on new external debt commitments, official (%)
                    Average grant element on new external debt commitments, private (%)
                    Average interest on new external debt commitments (%)
                    Average interest on new external debt commitments, official (%)
                    Average interest on new external debt commitments, private (%)
                     Average maturity on new external debt commitments (years)
```





- hybride OO-/FP-Sprache
- statisches Typsystem
- Java-Plattform
- Entwicklung koordiniert bei Lightbend (Scala 2)
   EPFL (Scala 3)
- Fokus auf Weiterentwicklung



```
package de.active.funar
import cats.effect.{ExitCode, IO, IOApp, Resource}
import cats.implicits.
import fs2.{io, text, Stream}
import java.nio.file.Paths
import java.util.concurrent.Executors
import scala.concurrent.ExecutionContext
object Converter extends IOApp {
 private val blockingExecutionContext =
   Resource.make(IO(ExecutionContext.fromExecutorService(Executors.newFixedThreadPool(2))))(ec => IO(ec.shutdown()))
 val converter: Stream[IO, Unit] = Stream.resource(blockingExecutionContext).flatMap { blockingEC =>
   def fahrenheitToCelsius(f: Double): Double =
     (f - 32.0) * (5.0/9.0)
   io.file.readAll[IO](Paths.get("testdata/fahrenheit.txt"), blockingEC, 4096)
      .through(text.utf8Decode)
     .through(text.lines)
      .filter(s => !s.trim.isEmpty && !s.startsWith("//"))
      .map(line => fahrenheitToCelsius(line.toDouble).toString)
      .intersperse("\n")
      .through(text.utf8Encode)
      .through(io.file.writeAll(Paths.get("testdata/celsius.txt"), blockingEC))
 def run(args: List[String]): IO[ExitCode] =
   converter.compile.drain.as(ExitCode.Success)
```





- modernes Lisp
- dynamisch getypt
- Java-Plattform
- Entwicklung koordiniert bei Cognitect
- Fokus auf Stabilität



```
; value is a map
(define-record-type ListFormat
 (^{:doc "Make a list format for a VFEI data item."}
 make-list-format size)
 list-format?
 [size list-format-size])
(define-record-type ArrayFormat
(^{:doc "Make an array format for a VFEI data item."}
 make-array-format element-format size)
 array-format?
 [element-format array-format-element-format
 size array-format-size])
(define-record-type DataItem
(^{:doc "Make a VFEI data item."}
 really-make-data-item name format value)
 data-item?
 Iname data-item-name
 format data-item-format
 value data-item-value])
(defn make-data-item
 "Assert that list length matches format."
 [name format value]
 (cond
  (list-format? format)
  (when (not= (list-format-size format) (count value))
  (c/error `make-data-item "list length does not match number of parsed values" name format (count value) value))
  (array-format? format)
  (when (not= (array-format-size format) (count value))
   (c/error `make-data-item "array size does not match number of parsed values" name format (count value) value)))
 (really-make-data-item name format value))
```



### Nach Plattform

Plattform	Sprache
Java	Clojure
Java	Scala
.NET	F#
Apple, Linux	Swift
Android	Kotlin
Erlang (Unix, Windows)	Elixir
Erlang	Erlang
Haskell (Unix, Windows)	Haskell
OCaml (Unix)	OCaml
Racket (Unix, Windows, Mac)	Racket



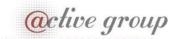
# Statisch/dynamisch getypt

Typsystem	Sprache
dynamisch	Clojure
dynamisch	Elixir
dynamisch	Erlang
dynamisch (auch statisch)	Racket
statisch	F#
statisch, Typklassen	Haskell
statisch, Module	OCaml
statisch, OO-Integration	Scala
statisch, OO-Integration	Swift
statisch, OO-Integration	Kotlin



# Merkmal pro Sprache

Merkmal	Sprache
Lisp	Clojure, Racket
Erlang, andere Syntax	Elixir
verteilte, fehlertolerante Systeme	Erlang
Sprache der Wahl auf .NET	F#
Sprache der Wahl auf Android	Kotlin
"fancy types"	Haskell
Modulsystem	OCaml
Sprach-Baukasten	Racket
hybrid OO/FP auf Java-Plattform	Scala
hybrid OO/FP auf Apple-Plattform	Swift



# Grund pro Sprache

Grund	
Performance, große Projekte	OCaml
Performance, Parallelismus, fancy types	Haskell
Verteilung, Fehlertoleranz	Erlang, Elixir
.NET	F#
Java	Clojure, Scala
DSL	Racket
Apple	Swift
Android	Kotlin



### Tail Calls vs. Plattform

Plattform	"Proper Tail Calls"
JavaScript	Standard: , Implementierungen:
Java (Scala, Clojure)	
.NET (F#)	
Racket, OCaml, Haskell, Erlang	
Swift	

# Eingebettete DSLs

Sprache	DSL-Mechanismus
Racket	Makros
Clojure	Makros
Elixir	Makros
Haskell	Monaden + Typklassen
Scala	Monaden + Implicits
Kotlin	Monaden + Receiver Objects



# Varianten

Sprache	Varianten
Haskell	Frege (JVM)
	ghc -> JavaScript (ab 9.6)
Haskell/Web	Purescript, Elm
OCaml	Reason (OCaml, JS),
	Js_of_ocaml (JS)
Scala	Scalajs (JS)
Clojure	ClojureScript (JS)
F#	Fable (JS)
Kotlin	Kotlin for JavaScript

