TLDR

The Language Described in this Report

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Agenda

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Concurrency
The Actor Model
Message Passing

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Konkret Sprog Design
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Introduction

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Introduction

1. Simulations
   - 1.1 Created by natural and social scientists
   - 1.2 Run on HPC systems
2. Real World Systems
   - 2.1 Massive scale
   - 2.2 Inherently concurrent
3. Languages
   - 3.1 C
   - 3.2 Fortran

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Concurrency

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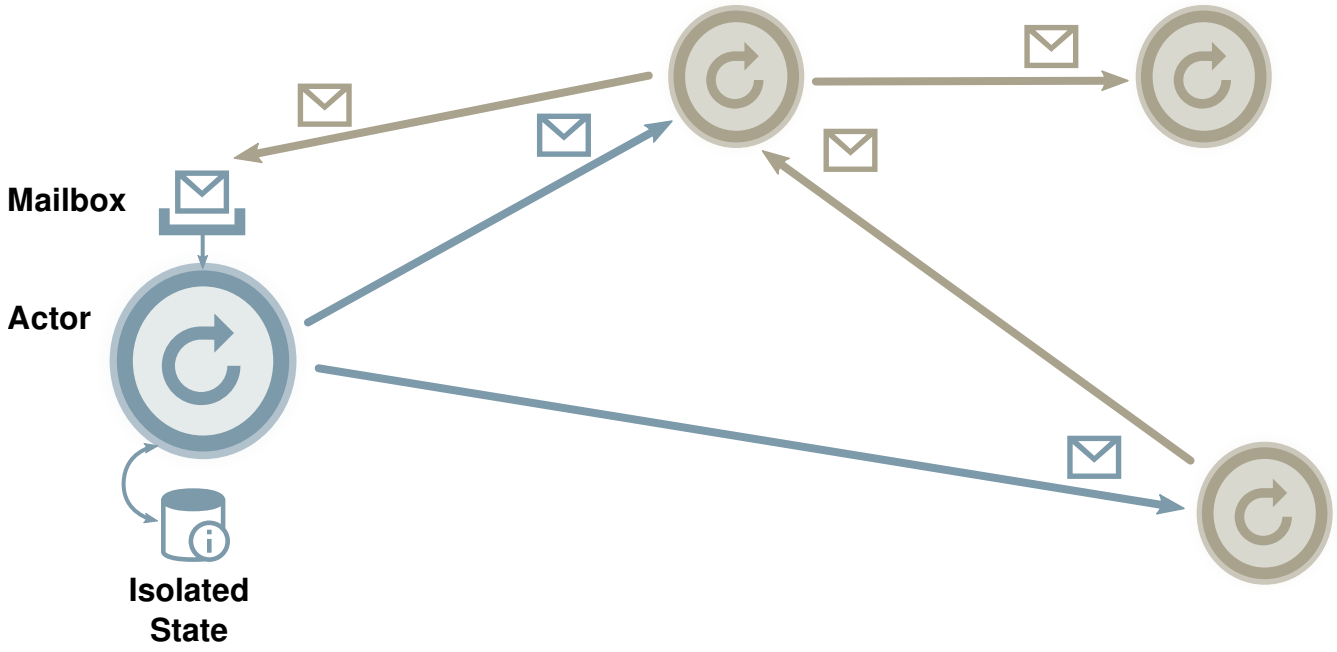
The Actor Model

1. Inherently concurrent
2. State
   - 2.1 Isolated
3. Communication
   - 3.1 Message passing
   - 3.2 Asynchronous
   - 3.3 Reactive



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Message Passing

1. Sending
   1.1 Blocking
   1.2 Non-blocking
2. Receiving
3. MPI

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Filosifier i sprog

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Sprog filosofi

1. Hvorfor har sprog en filosofi?
2. Parallele mentale modeller er svære.

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Filosofier bag TLDR

1. Gennemførte Principper
2. Fail Fast, Fail Hard
3. Matematisk modellering
4. First Class Citizen Functions

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Gennemførte Principper

1. Mentale Modeller er svære (nok).
2. Actors data er isoleret.
3. Ingen implicit casts
4. Tal kan skelnes i signaturen

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Fail Fast, Fail Hard

1. Fejl så tidligt som muligt
2. Store systemer
3. Falske positive med race conditions
4. Ingen implicit casts

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Matematisk Modellering

1. Simuleringer og matematisk beskrivelser
2. Data typer som reflektere matematik
3. Præcision
   - 3.1 Designet
   - 3.2 Implementation

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First Class Citizen Functions

1. Sende functioner mellem actors
2. Generisk opbygning
3. Purity er vigtigt

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Compiler

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F# evaluering

Godt

- Ny vinkel til programmering
- Kort og præcis kode
- Exhaustive checks ved pattern matching

Dårligt

- Nyt sprog at lære
- Ikke så meget compiler-læremateriale

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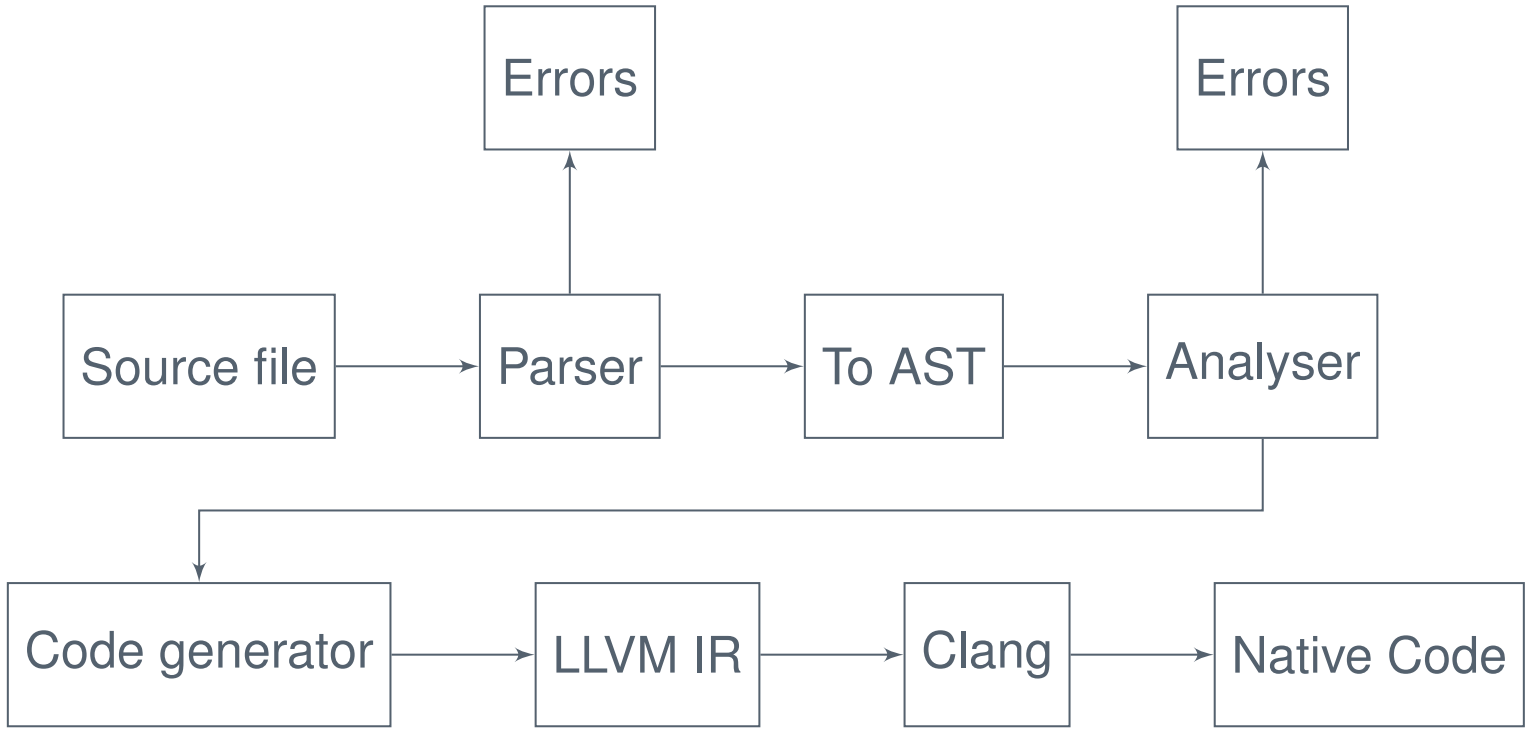
Struktur



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Overgang Mellem Faser


```
type Result<'a> =
     | Success of 'a
     | Failure of string list


let (>>=) (res:Result<'a>) (f:'a -> Result<'b>) : Result<'b> =
    match res with
    | Success r -> f r
    | Failure errs -> Failure errs


let parse (srcInput:string) (grammarPath:string) : Result<
    ASTNode> = ...


let rec toAST (root:ASTNode) : AST = ...


parse input grammarPath
>>= fun tree -> Success (toAST tree)
>>= analyse
>>= (fun ast -> Success (codeGen ast))
```

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Alternativ Compiler Struktur

- Dekorere AST igennem faser => undgå symbol tabel
- Mere uafhængig struktur => alting er transformationer

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Konkret Sprog Design

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Grammatik - Expressions

...

⟨*OP2*⟩ ::= <OP2> <Poneoperator> <OP1>
| <OP1>

⟨*OP1*⟩ ::= <Pzerooperator> <OP1>
| <OP0>

⟨*OP0*⟩ ::= <Operand>
| ’(’ <Expression> ’)’

...

⟨*PTWOOPERATOR*⟩ ::= ’*’ | ’/’ | ’%’

⟨*PTHREEOPERATOR*⟩ ::= ’+’ | ’-’

⟨*PFOUROPERATOR*⟩ ::= ’=’ | ’!=’ | ’<’ | ’<=’ | ’>’ | ’>=’

...

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Grammatik - Expressions

⟨*Operand*⟩ ::= <Block>
| <Integer>
| <Real>
| <Boolean>
| <Literals>
| <Invocation>

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Semantik - Transitions System

$$at = \text{ActorTypes} \rightharpoonup \text{Stm}$$
$$aEnv = \text{Anames} \cup next \rightharpoonup sEnv$$
$$sEnv = \text{Symbols} \rightharpoonup \text{Stm} \times \text{Symbols}$$

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Semantik - Eksempel

$$\text{INVOKE}_{A1}\ \frac{}{\langle x, sEnv\rangle \Rightarrow_A v}\ , sEnv(x) = \langle n, \epsilon\rangle\ , \mathcal{N}(n) = v$$

$$\text{INVOKE}_{A1}\ \frac{}{\langle x, sEnv\rangle \Rightarrow_A \top}\ , sEnv(x) = \langle true, \epsilon\rangle$$

$$\text{INVOKE}_{A1}\ \frac{}{\langle x, sEnv\rangle \Rightarrow_A \bot}\ , sEnv(x) = \langle false, \epsilon\rangle$$

$$\text{INVOKE}_{A1}\ \frac{}{\langle x, sEnv\rangle \Rightarrow_A \langle \{S\}, \epsilon\rangle}\ , sEnv(x) = \langle \{S\}, \epsilon\rangle$$

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Semantik - Eksempel

$$\text{INVOKE}_{A1}\ \frac{}{\langle x(y), sEnv\rangle \Rightarrow_A \langle S_1, sEnv[z \mapsto \langle S_2, s\rangle]\rangle}$$
$$, sEnv(x) = \langle \{S_1\}, z\rangle \, , sEnv(y) = \langle S_2, s\rangle$$

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Compiler Status

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Compiler Status

1. Item1
2. Item2

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Reflection

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Reflection

Reasons for bad decisition:

1. Inexperience with the subject
2. Disagrements in subjective matters

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Creative realisation

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A creative realisation

Actor as substitudes of functions

```
1  actor main := {
2    receive arguments:args := {
3      let adder:addActor := spawn addActor;
4      printint(adder (1,2));
5      die;
6    };
7
8    let adder(x, y):int -> int -> int := {
9      x+y;
10   }
11 };
```

```
1  actor main := {
2    receive arguments:args := {
3      let adder:addActor := spawn addActor;
4      send adder (1,2);
5      die;
6    };
7  };
8
9  actor addActor := {
10   receive msg:(int, int) := {
11     let res:int := msg.[0] + msg.[1];
12     let printer:printActor := spawn printActor res;
13     die;
14   };
15 };
16
17 actor printActor := {
18   receive intMsg:int := {
19     printint(intMsg);
20     die;
21   };
22 };
```

But

less consise

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Conclusion

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Conclusion

Actors as an solution Induces actor modeling as aproaches for modeling the problem

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Future workings

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Future workings

Ideas and constructs not included:

1. Inheritance(OOP)
2. New construct reply, not having to know the sender locally
3. Envoriments and iterationSteps

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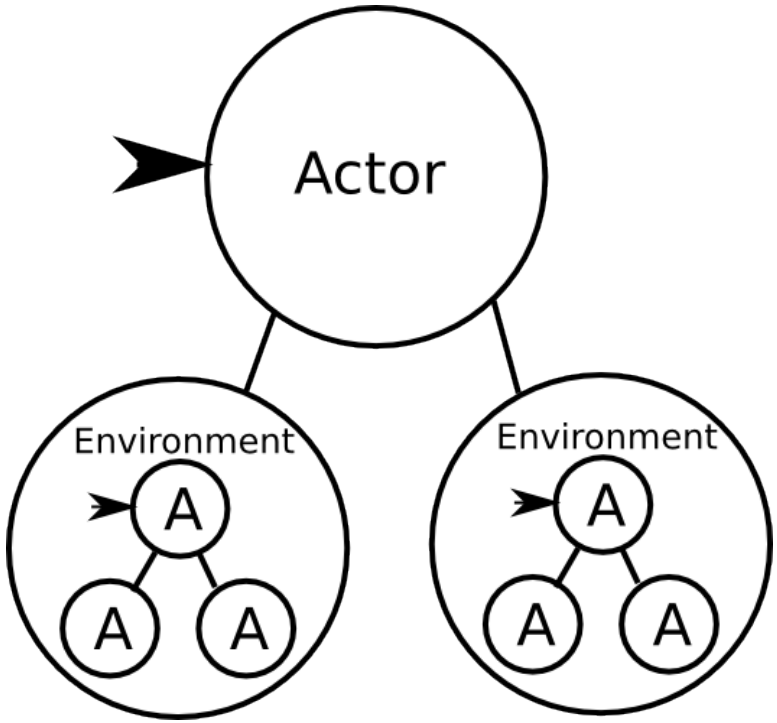
Envoriments



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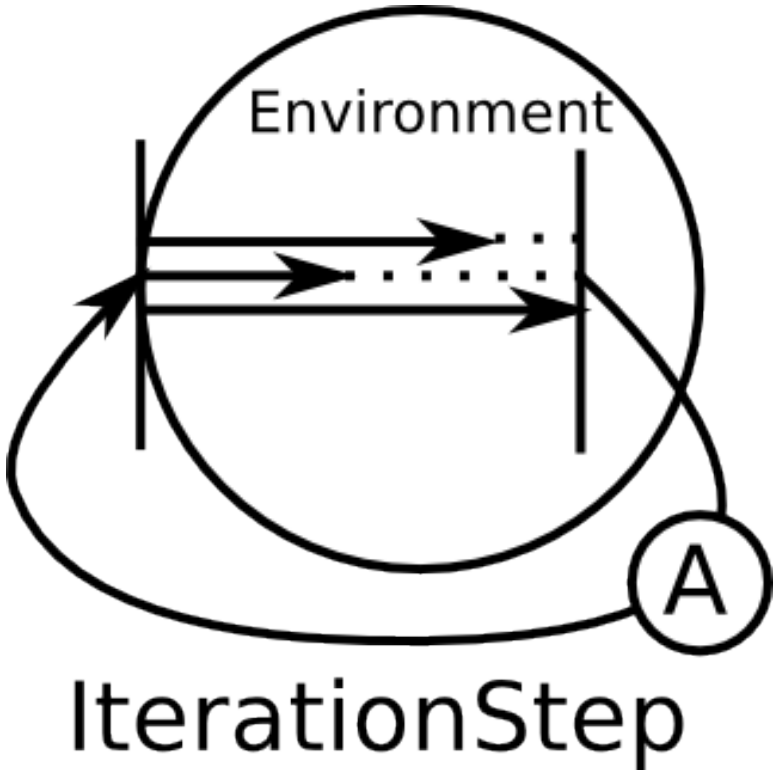
IterationSteps



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