

How FP Deals With Effects

* PoolC 양제성

Source:  2024/01/24 (Wed)

목차

1st Session

1. 함수형 프로그래밍 Intro
 - Overall Structure
 - Historical Review (CS + Math)
2. SW 엔지니어링의 목표
 - SW Maintainability
 - FP vs OOP vs PP
3. FP는 정말 순수한가?
 - Purity of Functions
 - File I/O Scenario

Basic Haskell Knowledge

2nd Session

1. 함수 합성을 위한 도구들
 - Partial Application
 - Kleisli Composition
2. ...중 하나인 모나드
 - Functor to Monad
 - IO Monad
3. 부수 효과의 관리
 - Action / Calculation / Data
 - Preventing Action Propagation

FP is all about **composing pure functions**.

```
int main(void) {  
    f(); g(); h(); ..  
}
```

[Procedural Programming]

VS

$f(g(h(\dots)))$

[Functional Programming]

FP is all about **composing pure functions**.  How?

```
int main(void) {  
    f(); g(); h(); ..  
}
```

[Procedural Programming]

VS

$f(g(h(\dots)))$

[Functional Programming]

Overall Structure

Sum all. [stdin <- "5\n1 2 3 4 5"]

```
1 int main() { C++ (imperative)
2   int n, result;
3   std::cin >> n;
4   for (size_t i = 0; i < n; ++i) {
5     int a;
6     std::cin >> a;
7     result += a;
8   }
9   std::cout << result << '\n';
10  return 0;
11 }
```

[Procedural Programming]

```
1 main = Haskell (declarative)
2   interact
3     (show . sum .
4      map read . drop 1 . words)
```

```
1 Python3 (declarative)
2 from sys import stdin
3
4 print(sum(map(
5   int, stdin.read().split()[1:]
6 )))
```

[Functional Programming]

1. Purity

- Side Effect
- Referential Transparency
- Significance of ...

2. Immutability

- Recursion (feat. Tail Call Optimization)
- C vs Haskell in file IO

3. First Class Function

- Currying
- Linked List

<Let's
code!>

Historical Review (CS + Math)

함수형 프로그래밍 Intro

Lambda Calculus

1. Very Basics
2. Boolean in Action

Category Theory

1. Very Basics
2. Functor in Action

Function Encoding

1. Variables (Immutable)
2. Functions (Curried)
3. Application



Turing Machine

Function Encoding

1. Variables (Immutable)
2. Functions (Curried)
3. Application

\Leftrightarrow

Turing Machine

$$\lambda x. f x$$

Function Encoding

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Turing Machine

$\lambda x. f x$

Lambda Abstraction

Function Encoding

1. Variables (Immutable)
2. Functions (Curried)
3. Application

\Leftrightarrow

Turing Machine

$$\underline{\lambda x. f x}$$

Lambda Abstraction

JS ver. $(x) \Rightarrow f(x)$

Function Encoding

1. Variables (Immutable)
2. Functions (Curried)
3. Application

\Leftrightarrow

Turing Machine

Function Signifier \leftarrow $\lambda x. f x$
Lambda Abstraction
JS ver. $(x) \Rightarrow f(x)$

Lambda Calculus

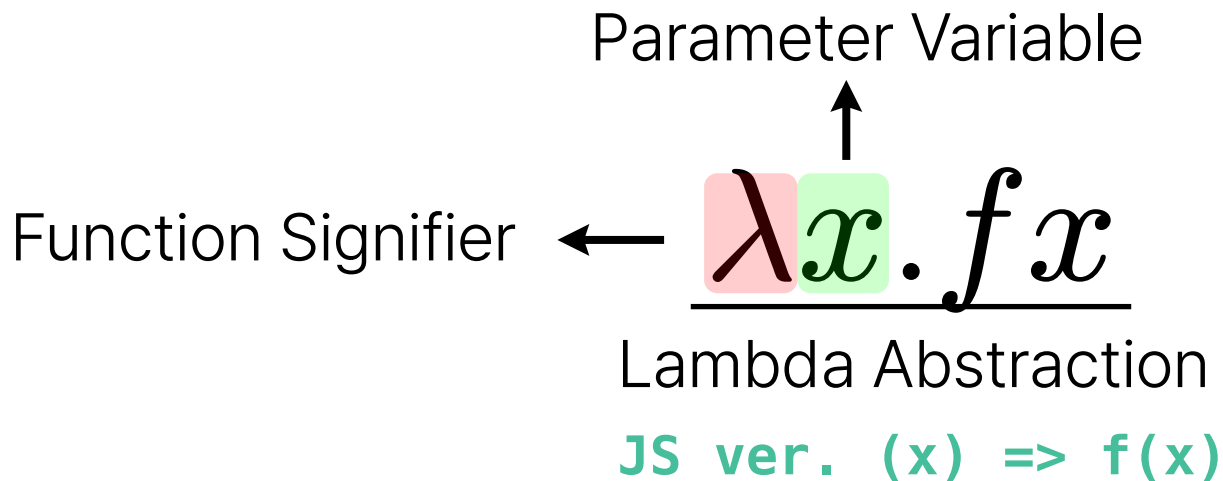
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Function Encoding

1. Variables (Immutable)
2. Functions (Curried)
3. Application

\Leftrightarrow

Turing Machine



Lambda Calculus

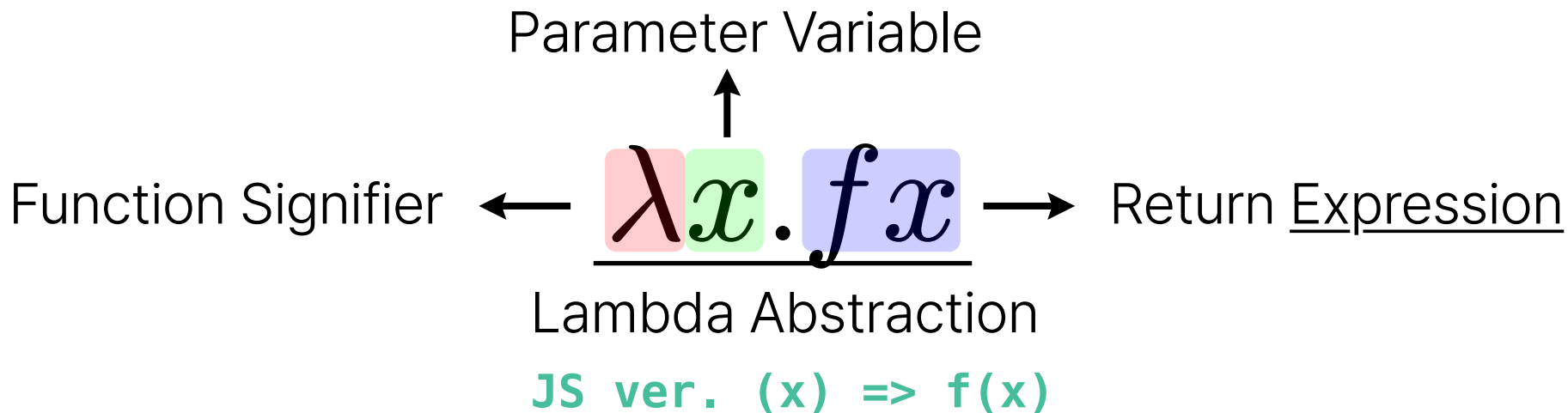
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Function Encoding

1. Variables (Immutable)
2. Functions (Curried)
3. Application

\Leftrightarrow

Turing Machine



Function Encoding

1. Variables (Immutable)
2. Functions (Curried)
3. Application

\Leftrightarrow

Turing Machine

expression ::= variable

identifier

| expression expression

application

| $\lambda v_1 v_2 \cdots .$ expression

abstraction

| (expression)

grouping

Function Encoding

1. Variables (Immutable)
2. Functions (Curried)
3. Application



Turing Machine

ex) Church Encoding: Boolean 