Type Inference for linear lambda calculus for hardware description

Jeongpyo Lim
Pohang University of Science and Technology

Motivation
Q. Is it possible to use λ-calculus to describe hardware circuits? A. It is Possible but it demands some Modifications!

Because of higher-order functions in λ-calculus

< λ-calculus and hardware circuits>

Linear λ-calculus(Λ)
Q. What is the meaning of "linear"?
A. "Something is linear" means that it can be used only once and it is not sharable!

- Bitstreams are sharable (not linear), but hardware circuits are not sharable(linear)

Problem : Current λ is impractical!
1. λ requires programmers to write all type annotations!

Example : a piece of FFT code

Solution
1. Complete polymorphism

- Conventional let-expression : enables programmers to define polymorphic expressions.
- Polymorphic typing context

2. Type Inference algorithm(\(W\)) : = Revised version of the Hindley/Milner algorithm(\(\bar{W}\))

Conclusions

• Conventional \(W\) algorithm can be transformed to the type inference algorithm for linear λ-calculus(\(\bar{W}\)).

• The type inference algorithm can infer types of untyped expressions, and this allows programmers not to write all type annotations.