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# Monotone Data Flow Analysis Frameworks

Fengyun Liu, Ólafur Páll Geirsson

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# Today's agenda

Background

Monotone Data Flow Analysis Frameworks

Approaches to solving MDFAF

A Variant of Kildall's Algorithm

Undecidability of MOP Problem for MDFAF

# Overview

## Background

Flow graph

Semilattice

Semilattice: ordering

Semilattice: 0 and 1

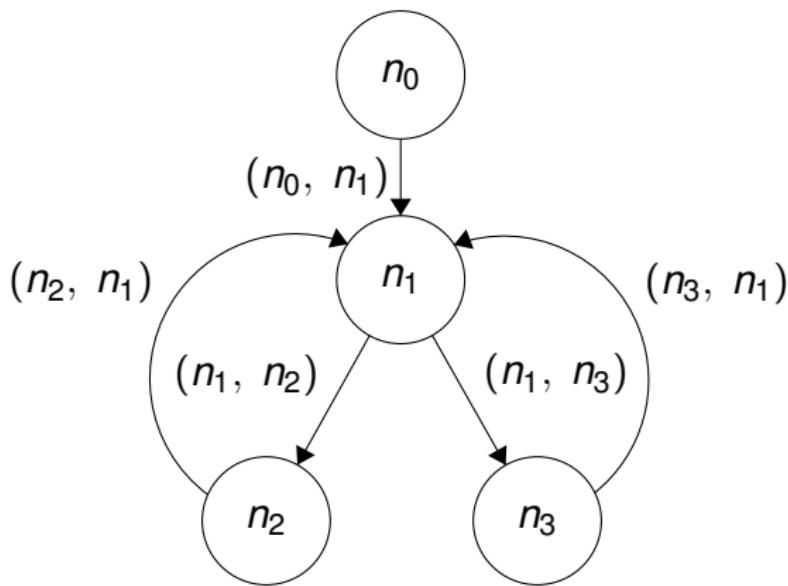
## Monotone Data Flow Analysis Frameworks

## Approaches to solving MDFAF

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## Triple $G = (N, E, n_0)$



## Set $L$ with *meet* operation $\wedge$

$$a \wedge a = a \quad (\text{idempotent})$$

$$a \wedge b = b \wedge a \quad (\text{commutative})$$

$$a \wedge (b \wedge c) = (a \wedge b) \wedge c \quad (\text{associative})$$

## $\wedge$ defines an order on $L$

$$a \leqq b$$

iff  $a \wedge b = b$

$$a < b = b \wedge a$$

iff  $a \wedge b = b$  and  $a \neq b$

## Zero element: 0

Element  $e \in L$  is called zero, labeled 0, if

$$e \wedge x = e \quad \forall x \in L$$

## One element: 1

Element  $e \in L$  is called one, labeled 1, if

$$e \wedge x = x \quad \forall x \in L$$

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## Example usage of blocks and columns

### Block 1

- ▶ 1
- ▶ 2
- ▶ 3

### Block 2

- ▶ b
- ▶ b
- ▶ b

## Example usage of blocks and columns

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