Ultimate GemCutter

Dominik Klumpp[1] Daniel Dietsch[1] Matthias Heizmann[2]
Frank Schüssele[1] Azadeh Farzan[3] Andreas Podelski[1]

[1]University of Freiburg, Germany

[2]University of Stuttgart, Germany

[3]University of Toronto, Canada

SV-COMP 2024

Example Program

$$\{\ x = y = i = j = 0\ \}$$

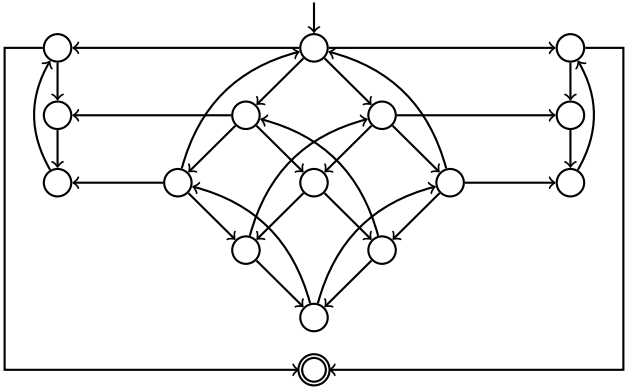
```
while (i < n) {
    x += A[i];
    i++;
}
```

$\|$

```
while (j < n) {
    y += A[j];
    j++;
}
```

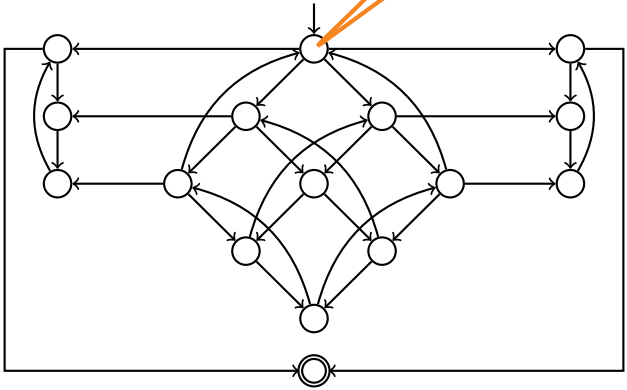
$$\{\ x = y\ \}$$

Key Idea

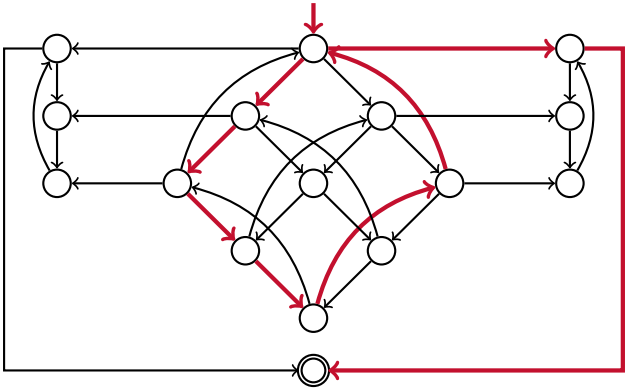


Key Idea

Invariant: $x = \sum_{k=0}^{i} A[k] \wedge y = \sum_{k=0}^{j} A[k] \wedge i \leq n \wedge j \leq n$



Key Idea



Counterexample:

$\tau =$ `i<n` `x+=A[i]` `j<n` `y+=A[j]` `i++` `j++` `i>=n` `j>=n`

Generalization

Generalization

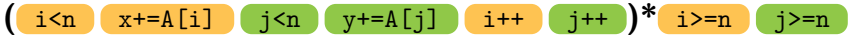
$$\{\ x = y = i = j = 0\ \}$$

$$\{\ x = y\ \}$$

Generalization

$\{\ x = y = i = j = 0\ \}$

generalization
across loop iterations
using interpolation

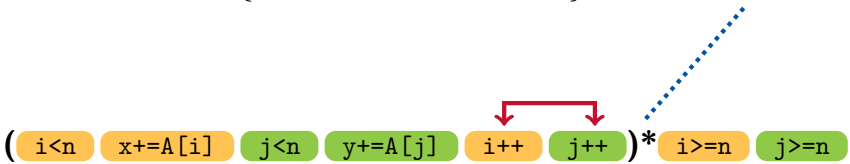


$\{\ x = y\ \}$

Generalization

$\{\ x = y = i = j = 0\ \}$

generalization
across loop iterations
using interpolation

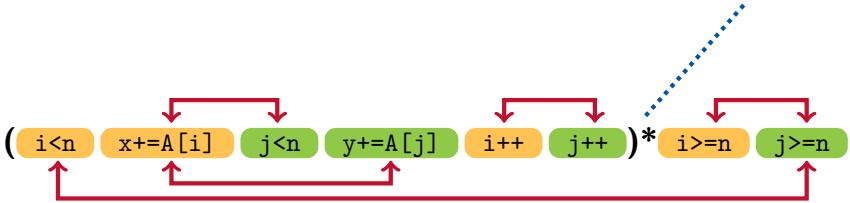


$\{\ x = y\ \}$

Generalization

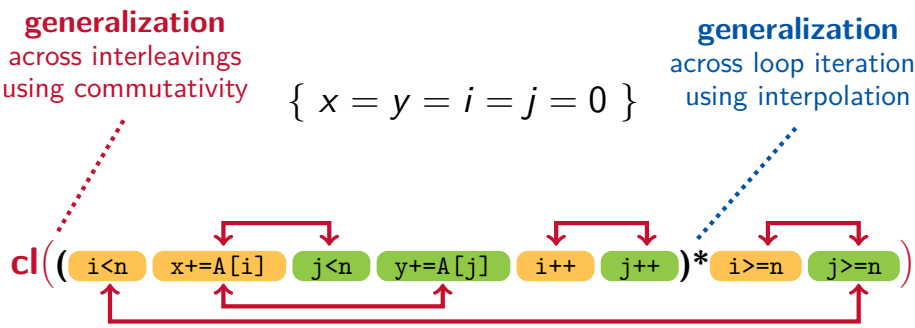
$\{\ x = y = i = j = 0\ \}$

generalization
across loop iterations
using interpolation

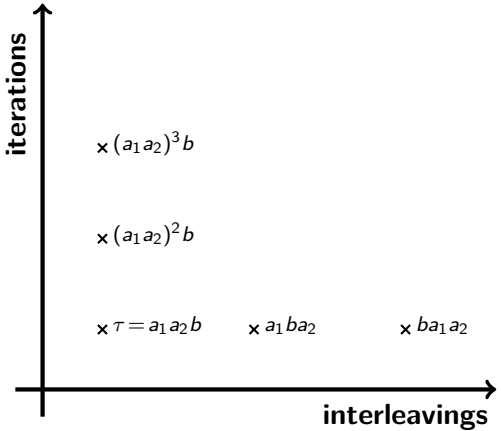


$\{\ x = y\ \}$

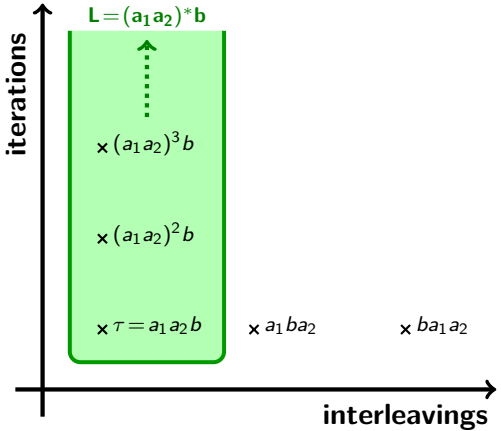
Generalization



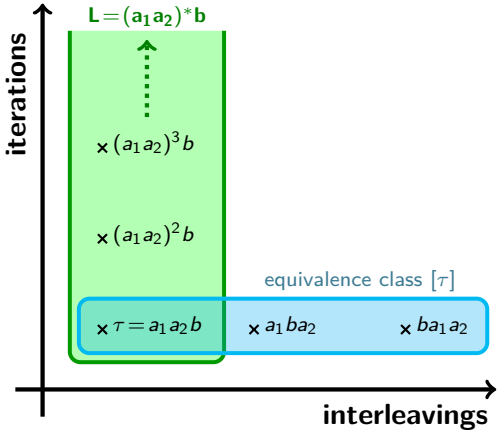
Generalization



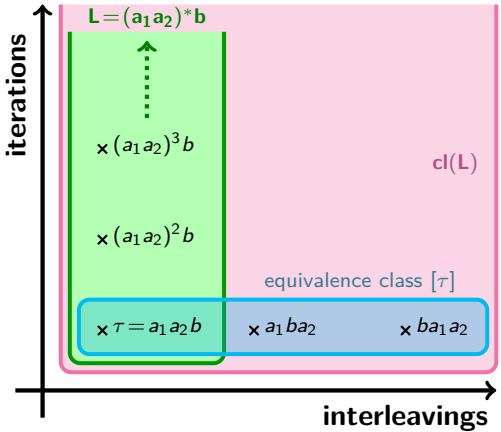
Generalization



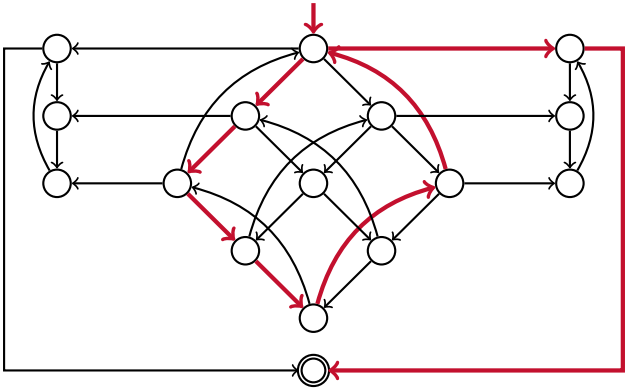
Generalization



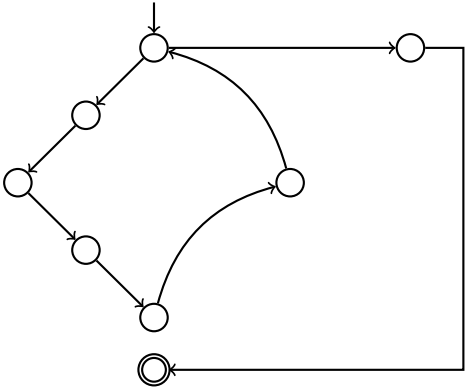
Generalization



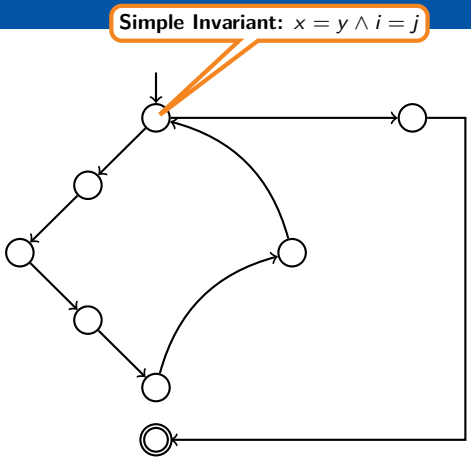
Key Idea



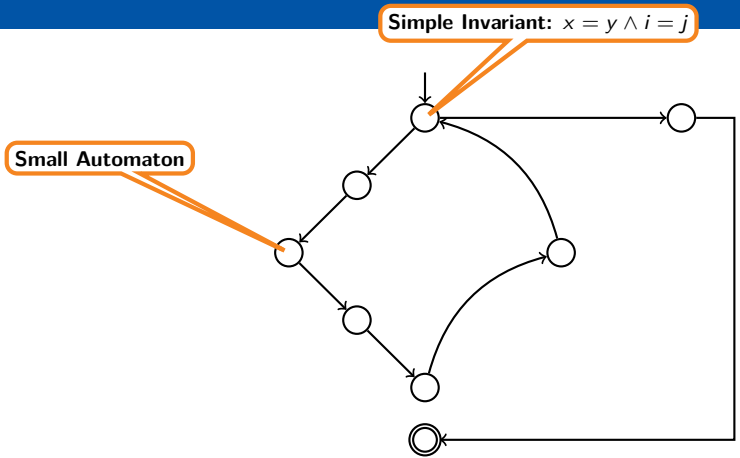
Key Idea



Benefits



Benefits



Ongoing & Future Work

- find more **commutativity**
- select the right **representatives**
- programs with **unbounded threads**

Ongoing & Future Work

- find more **commutativity**
- select the right **representatives**
- programs with **unbounded threads**

Find out more:

`ultimate-pa.org`

GemCutter poster at ETAPS

talk to me