UNIVERSITY OF CALIFORNIA
UC RIVERSIDE

CS201 Winter 2017 Project Presentation of Group #1

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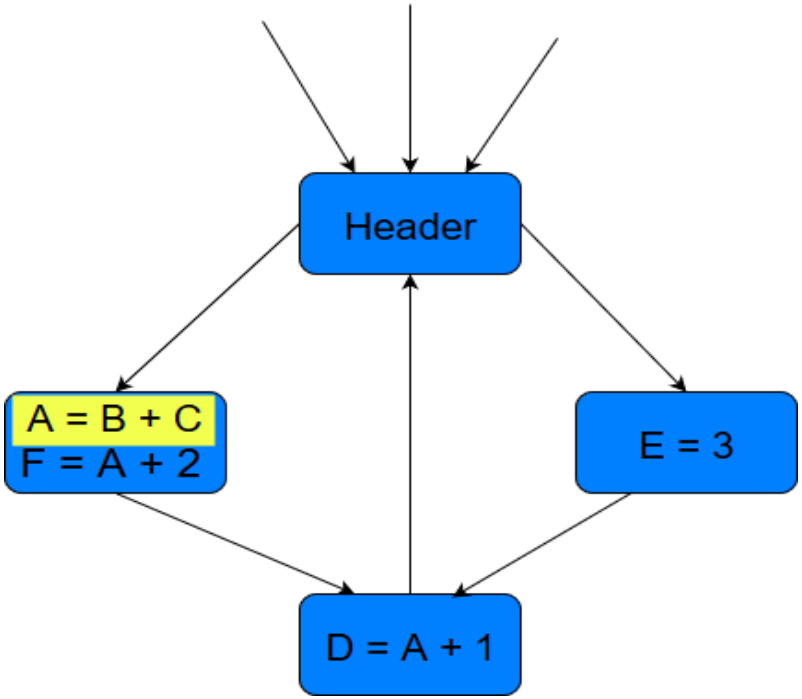
Outline

- Motivation
- Existing Passes
  - Canonicalize Natural Loops
  - Extract Loops Into New Function
- New Passes
  - Call Sequence
  - Function Frequencies
- Performance Evaluation

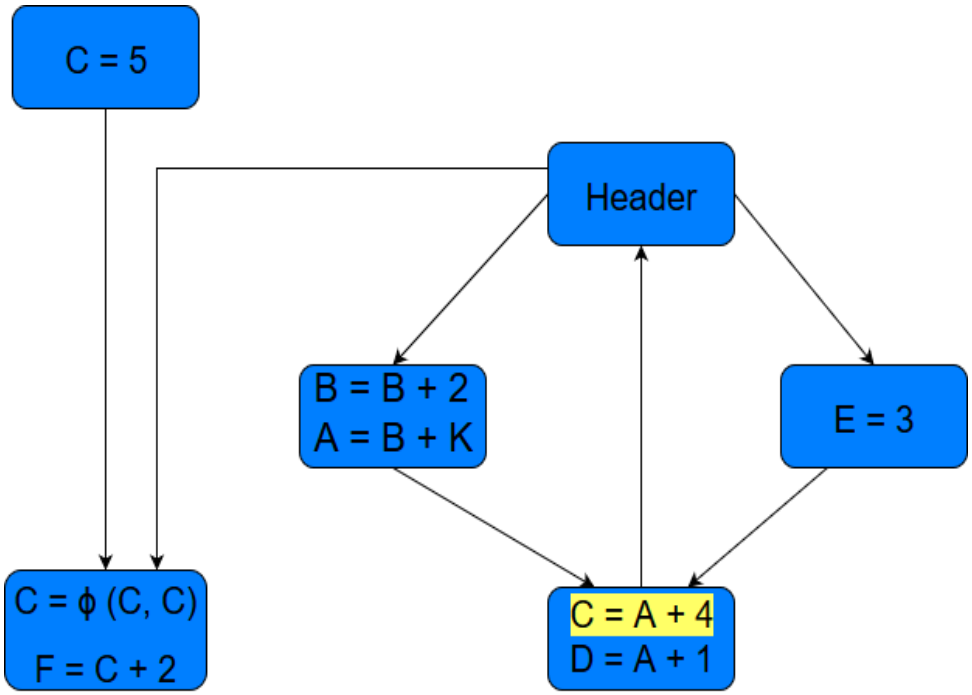
Motivation

- LICM: a computation whose value does not change as long as control stays within the loop



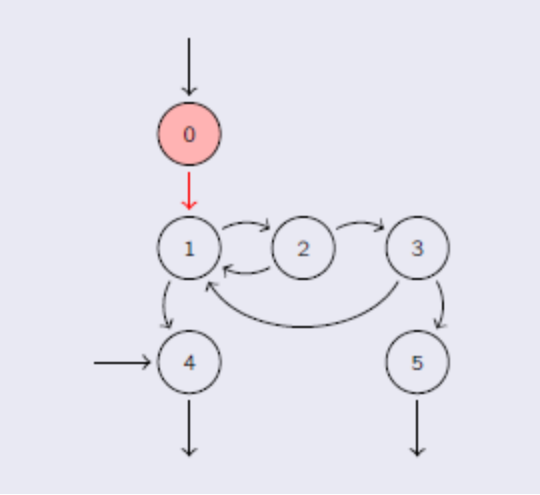
Motivation

- LICM: computations that have been updated but are not used within the loop

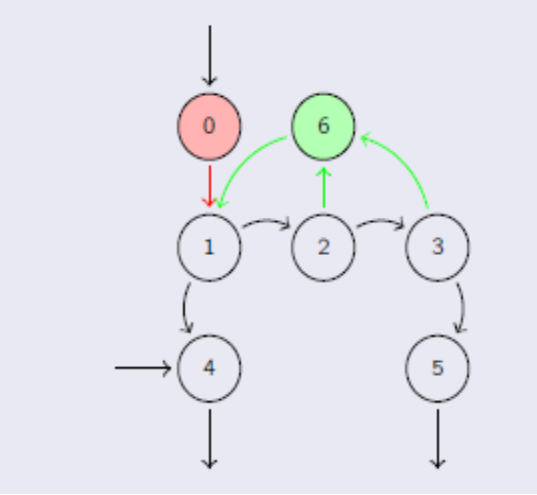


Canonicalize Natural Loops

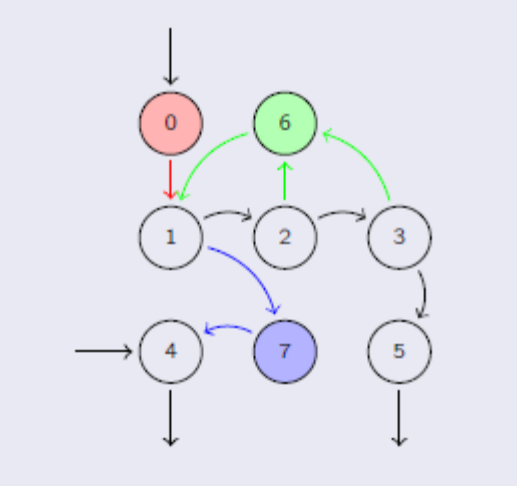
- What it does?
  - Insert a pre-header, latch, and exit block
    - **Pre-header**: the only predecessor of loop header
    - **Latch**: the starting node of only back-edge
    - **Exit-block**: ensure exit dominated by loop header



Pre-header



Latch

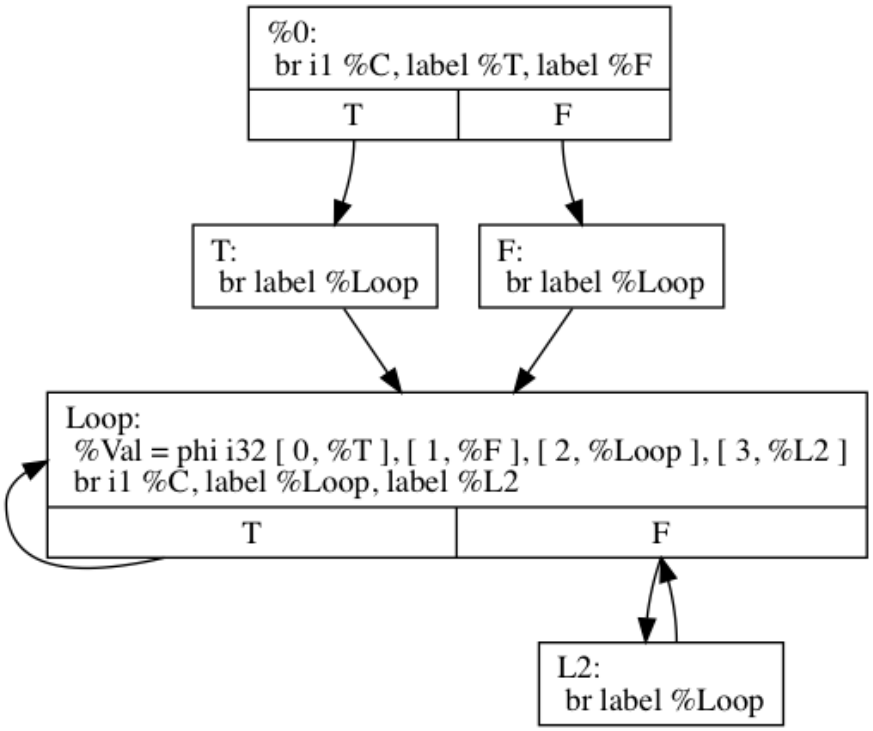


Exit-block

Canonicalize Natural Loops

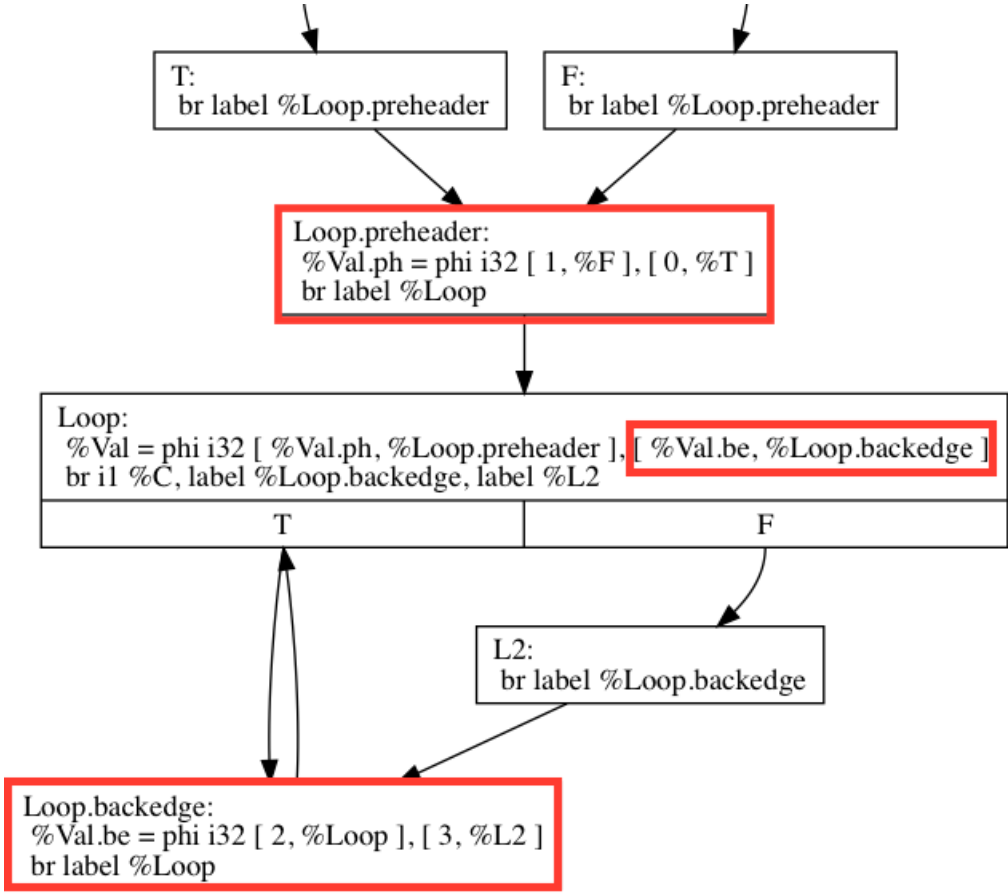
- How it works?

Before



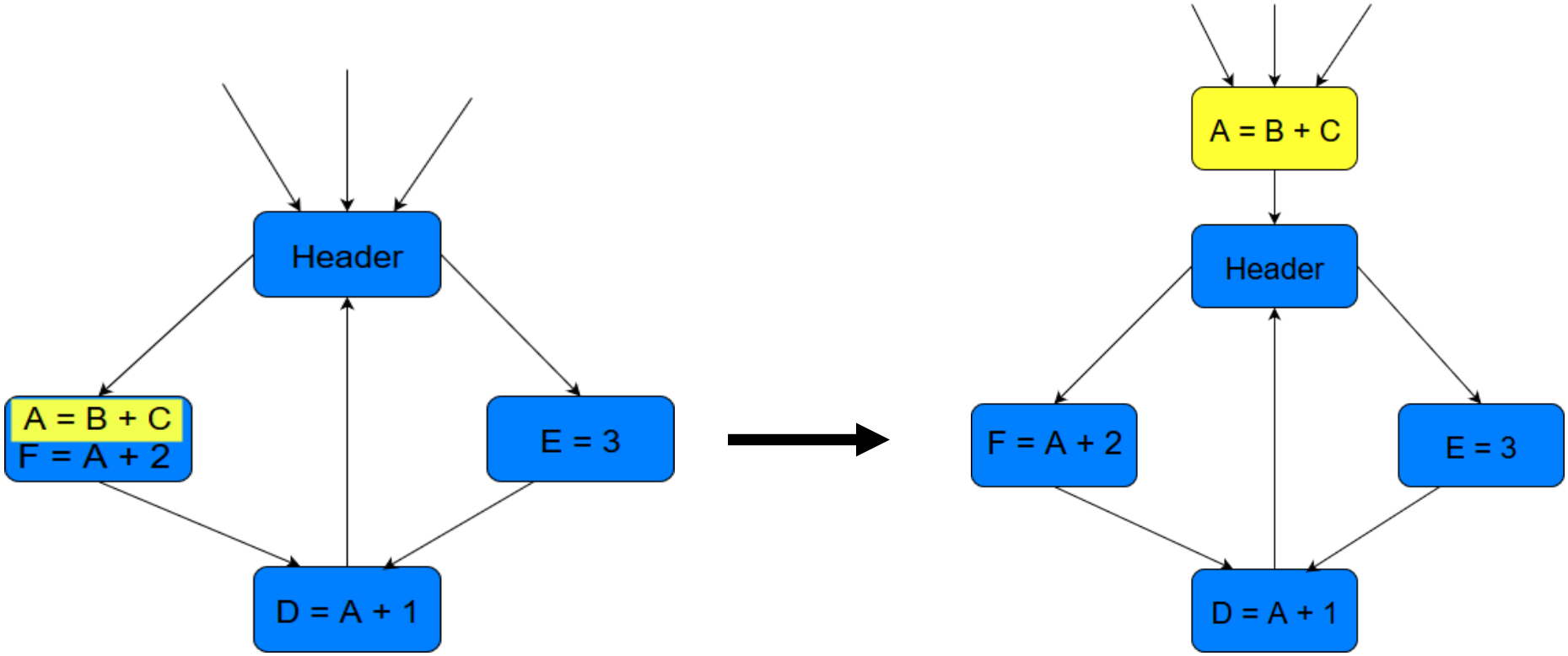
CFG for 'foo' function

After



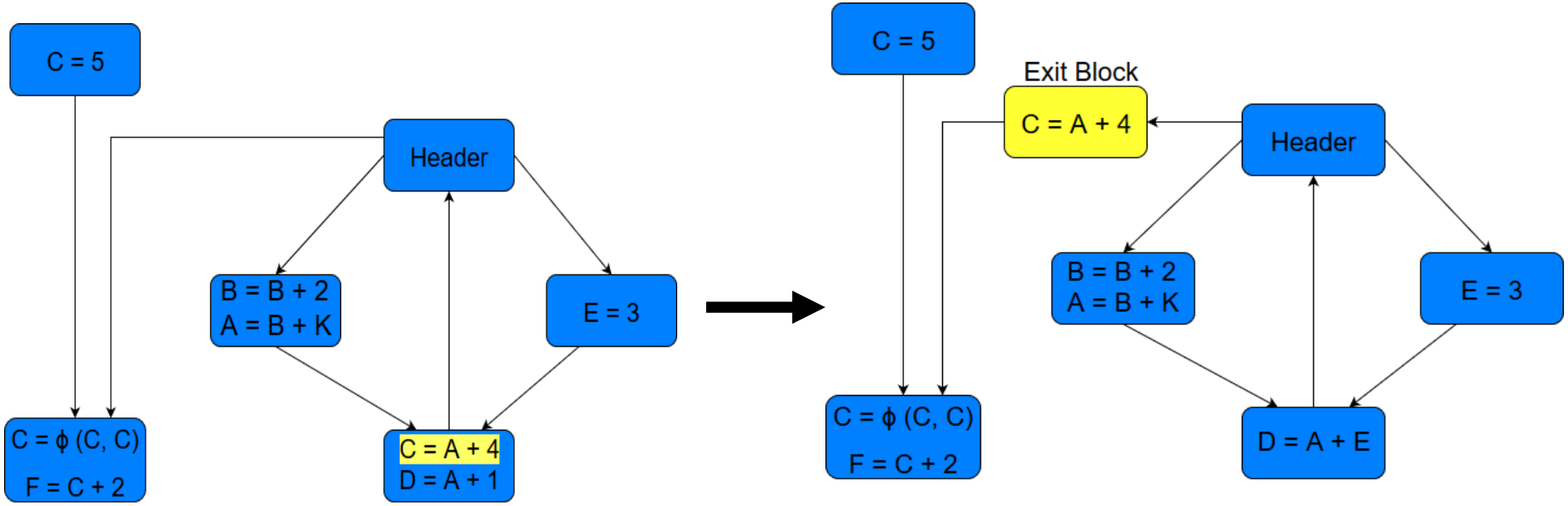
Canonicalize Natural Loops

- Solutions for open problems



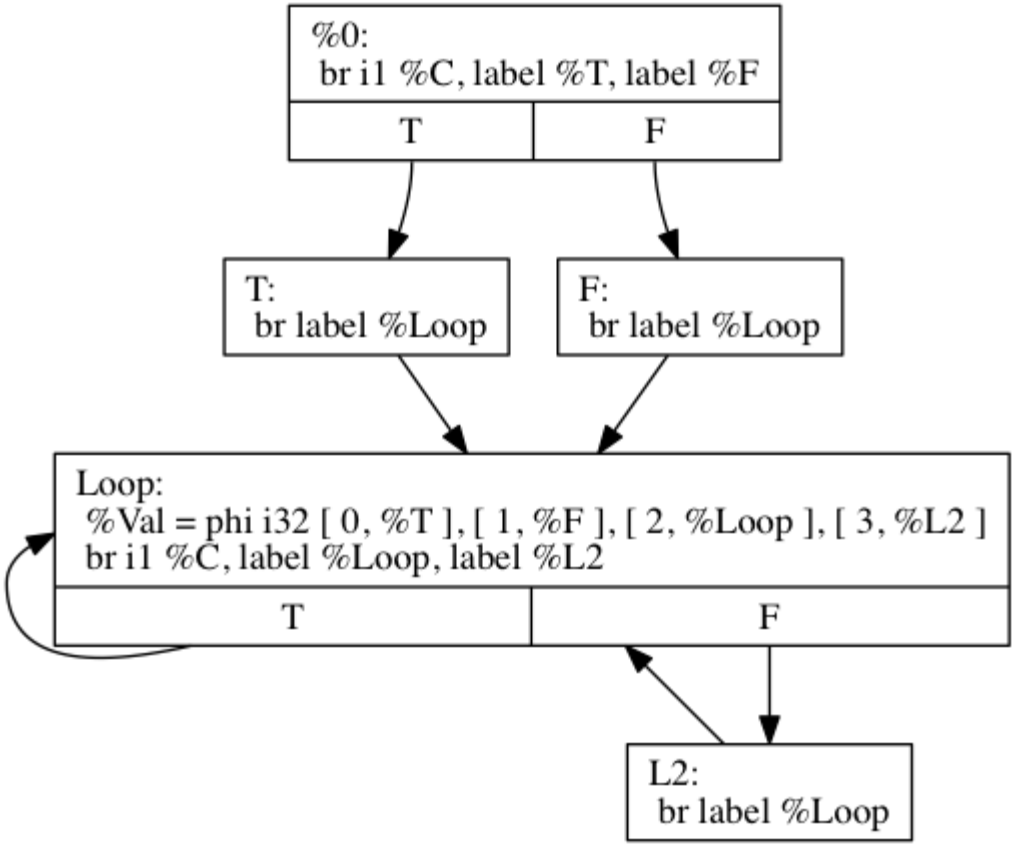
Canonicalize Natural Loops

- Solutions for open problems



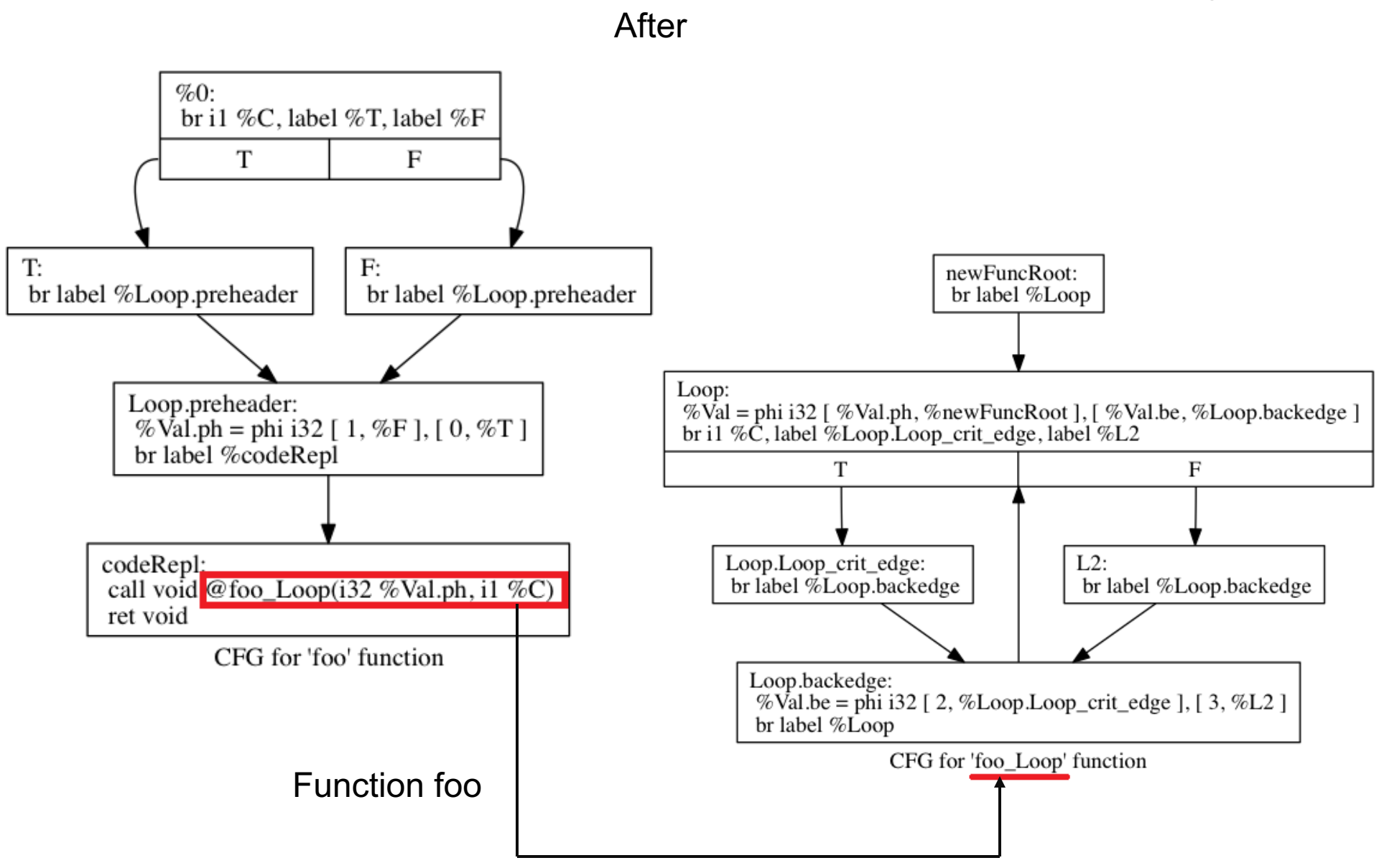
Extract Loops Into New Function

Before



CFG for 'foo' function

Extract Loops Into New Function



New Passes

```
function a()
{
    for (int i=0; i < 5; i++)
        c();
}

function b()
{
}

function c()
{
}

main()
{
    a();
    b();
    c();
}
```

Call sequence:

main, a, c, c, c, c, c, b, c

Function frequencies:

main: 1

a: 1

b: 1

c: 6

Performance Evaluation

- Existing Passes
  - Use benchmarks of LLVM at *llvm/test/Transforms/LoopSimplify*
- New Passes
  - Use benchmarks at *http://www.mrtc.mdh.se/projects/wcet/benchmarks.html*

Questions?

References

- Lattner, Chris, and Vikram Adve. "*LLVM: A compilation framework for lifelong program analysis & transformation*." Proceedings of the international symposium on Code generation and optimization: feedback-directed and runtime optimization. IEEE Computer Society, 2004
- Lattner, Chris, and Vikram Adve. "*LLVM language reference manual*." (2006)
- Writing an LLVM Pass http://laure.gonnord.org/pro/research/ER03_2015/lab3_intro.pdf