Lecture 32

Code Optimizations

Awanish Pandey

Department of Computer Science and Engineering
Indian Institute of Technology
Roorkee

April 23, 2025

Code Optimization

- Criteria for code improving transformation

Code Optimization

- Criteria for code improving transformation
  - Preserve the meaning

Code Optimization

- Criteria for code improving transformation
  - Preserve the meaning
  - Must speed up the program

Code Optimization

- Criteria for code improving transformation
  - Preserve the meaning
  - Must speed up the program
  - Must be worth the effort

Code Optimization

- Criteria for code improving transformation
  - Preserve the meaning
  - Must speed up the program
  - Must be worth the effort
  - The analysis must be fast

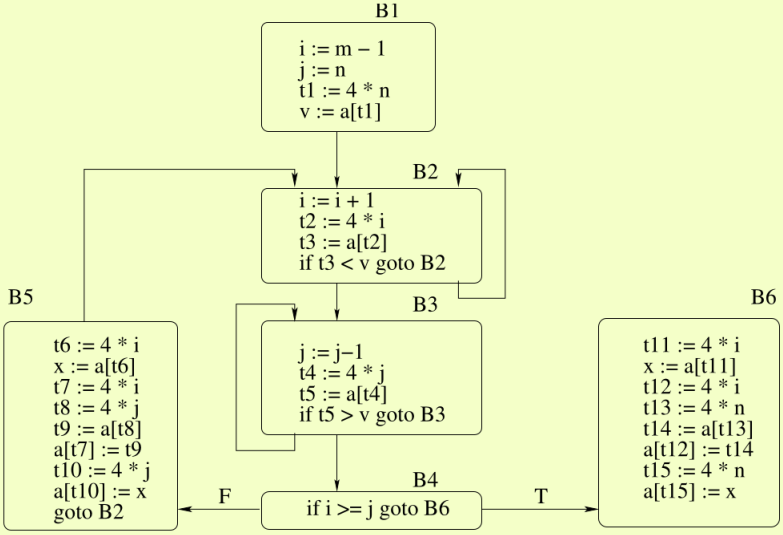
Code Optimization

- Criteria for code improving transformation
  - Preserve the meaning
  - Must speed up the program
  - Must be worth the effort
  - The analysis must be fast
- Local transformation: within basic blocks

Code Optimization

- Criteria for code improving transformation
  - Preserve the meaning
  - Must speed up the program
  - Must be worth the effort
  - The analysis must be fast
- Local transformation: within basic blocks
- Global transformation: across basic blocks

Impact of Code Optimization



Common SubExpression Elimination

Optimized code: block B5

$t_6 = 4 * i$
$X = a[t_6]$

$t_8 = 4 * j$
$t_9 = a[t_8]$
$a[t_6] = t_9$

$a[t_8] = X$
goto L

Global CSE

$t_6 = 4 * i$
$X = a[t_6]$

$t_9 = a[t_4]$
$a[t_6] = t_9$
$a[t_4] = X$
goto L

Global CSE

$t_6 = 4 * i$
$X = a[t_6]$

$t_9 = a[t_4]$
$a[t_6] = t_9$
$a[t_4] = X$
goto L

$t_6 = 4 * i$
$X = a[t_6]$

$a[t_6] = t_5$
$a[t_4] = X$
goto L

Global CSE

$t_6 = 4 * i$
$X = a[t_6]$

$t_9 = a[t_4]$
$a[t_6] = t_9$
$a[t_4] = X$
goto L

$t_6 = 4 * i$
$X = a[t_6]$

$a[t_6] = t_5$
$a[t_4] = X$
goto L

$X = t_3$
$a[t_2] = t_5$
$a[t_4] = X$
goto L

Example of Optimizations

- Common Sub Expression Elimination

Example of Optimizations

- Common Sub Expression Elimination
- Copy Propagation

Example of Optimizations

- Common Sub Expression Elimination
- Copy Propagation
- Constant Folding
- Dead Code elimination

Example of Optimizations

- Common Sub Expression Elimination
- Copy Propagation
- Constant Folding
- Dead Code elimination
  - Code unreachable from any path

Example of Optimizations

- Common Sub Expression Elimination
- Copy Propagation
- Constant Folding
- Dead Code elimination
  - Code unreachable from any path
  - Code producing a value not used

Example of Optimizations

- Common Sub Expression Elimination
- Copy Propagation
- Constant Folding
- Dead Code elimination
  - Code unreachable from any path
  - Code producing a value not used
  - Decision statement whose true and false targets are same

Example of Optimizations

- Common Sub Expression Elimination
- Copy Propagation
- Constant Folding
- Dead Code elimination
  - Code unreachable from any path
  - Code producing a value not used
  - Decision statement whose true and false targets are same
  - Decision statement whose boolean expression can be computed at compile time

Example of Optimizations

- Common Sub Expression Elimination
- Copy Propagation
- Constant Folding
- Dead Code elimination
  - Code unreachable from any path
  - Code producing a value not used
  - Decision statement whose true and false targets are same
  - Decision statement whose boolean expression can be computed at compile time
- Code Motion

Example of Optimizations

- Common Sub Expression Elimination
- Copy Propagation
- Constant Folding
- Dead Code elimination
  - Code unreachable from any path
  - Code producing a value not used
  - Decision statement whose true and false targets are same
  - Decision statement whose boolean expression can be computed at compile time
- Code Motion
- Loop Unrolling

Example of Optimizations

- Common Sub Expression Elimination
- Copy Propagation
- Constant Folding
- Dead Code elimination
  - Code unreachable from any path
  - Code producing a value not used
  - Decision statement whose true and false targets are same
  - Decision statement whose boolean expression can be computed at compile time
- Code Motion
- Loop Unrolling
- Loop Jamming

Example of Optimizations

- Common Sub Expression Elimination
- Copy Propagation
- Constant Folding
- Dead Code elimination
  - Code unreachable from any path
  - Code producing a value not used
  - Decision statement whose true and false targets are same
  - Decision statement whose boolean expression can be computed at compile time
- Code Motion
- Loop Unrolling
- Loop Jamming
- Loop Unswitching

Example of Optimizations

- Common Sub Expression Elimination
- Copy Propagation
- Constant Folding
- Dead Code elimination
  - Code unreachable from any path
  - Code producing a value not used
  - Decision statement whose true and false targets are same
  - Decision statement whose boolean expression can be computed at compile time
- Code Motion
- Loop Unrolling
- Loop Jamming
- Loop Unswitching
- Induction Variable Simplification