Partial Redundancy Elimination

CS243 Review Session

(With many thanks to Chinmayee Shah, TA in Winter 2017)
Full Redundancy

\[ x = b + c \]
\[ y = b + c \]
\[ z = b + c \]
Partial Redundancy

\[ x = b + c \]

\[ z = b + c \]
Partial Redundancy
Walk-through Example
\[ u = a + b \]
\[ v = a + b \]
\[ w = a + b \]
\[ b = \text{read()} \]
Add empty blocks on edges that lead to blocks with multiple predecessors.
\[ u = a + b \]

\[ v = a + b \]

\[ w = a + b \]

\[ b = \text{read()} \]
Anticipated expressions:
places where it is safe to place \( a + b \)
Can delete added blocks where \( a + b \) is not anticipated
Available expressions: points where \( a + b \) could be made available.
Earliest: when can we earliest compute $a + b$
u = a + b

v = a + b

w = a + b

b = read()

Earliest: when can we earliest compute \( a + b \)
How much can we postpone evaluating $a + b$?
u = a + b

v = a + b

w = a + b

b = read()

Latest: need to compute a + b here
\( u = a + b \)

\( v = a + b \)

\( w = a + b \)

\( b = \text{read()} \)

Latest: need to compute \( a + b \) here
Remove added blocks where we are not going to compute anything
\[ u = t \]
\[ t = a + b \]
\[ v = t \]
\[ w = t \]

Use a temporary variable to store the result
\[ u = t \]
\[ v = t \]
\[ w = t \]
\[ t = a + b \]
\[ b = \text{read()} \]
\[ t = a + b \]
\[ u = t \]

\[ t = a + b \]

\[ v = t \]

\[ t = a + b \]

\[ w = t \]

\[ b = \text{read()} \]

\[ t = a + b \]

Result not used beyond the block in which the variable is defined
Clean up unrequired temporaries

\[ u = t \]

\[ v = a + b \]

\[ t = a + b \]

\[ w = t \]

\[ b = \text{read()} \]
\[ u = t \]
\[ v = a + b \]
\[ t = a + b \]
\[ w = t \]
\[ b = \text{read()} \]

Diagram:

- B1
- B2: \[ t = a + b \]
- B3
- B4
- B5: \[ v = a + b \]
- B6
- B7
- B8: \[ t = a + b \]
- B9
- B10: \[ b = \text{read()} \]
- B11
More Examples
i = 0

B1

a = b + c
... = a
i = i + 1
i < 1000

B2

B3

z = b + c
\[ i = 0 \]
\[ a = b + c \]
\[ z = b + c \]

\[ i = i + 1 \]
\[ i < 1000 \]

\[ t = b + c \]
\[ a = t \]
\[ z = t \]

\[ i = i + 1 \]
\[ i < 1000 \]
\[ c = 2 \]

\[ d = b + c \]

\[ e = b + c \]

\[ a = b + c \]
\[ c = 2 \]
\[ d = b + c \]
\[ e = b + c \]
\[ a = b + c \]