CSE + [LICM]  
"Available Expr"

Entry

$x+y$ $x$

$a = x+y$

$5 = x+y$

$x$

Exit
Exit

\[ x = b + c \]

Energy
0. Prepare the graph
   => Add an empty BB at every "merging edge"
1. **Anticipated Expr**

An expression is "Anticipated" at point \( p \) if all of the paths following \( p \) will use that expr.

\[
\begin{align*}
Z &= \text{expr} \\
E &= \text{expr} + b \\
f &= a + b - Z \\
\end{align*}
\]

- \( B_1 \): \text{expr} NOT anticipated
- \( B_2 \): \text{expr}

Exit.
2. “Available” expressions

"Available ANTICIPATED expressions"

Forward
Out[Entry] = Ø

Out[B] =
(In[B] \cup In(anticipated)[B]) -
Meet = ∅

Determine earliest placement points.

Earliest[B] = Anticipated, In[B] -
Available. In[B]

i.e. Anticipated but NOT Available
e.g., \[ a \land b \]

Anticipation
Entry
Available

here is the earliest
(see?)

Note: Available expr
is a little bit off"

It's propagated
one step later
than the anticipation

\[ \text{Out} = (\text{In} \land \text{Anticipate.in}) - \text{kill} \]

This is why it makes it
the earliest.

"Postpone the earliest to the latest points." Forward

\[ \text{Out}[B] = \left( \text{Earliest}[B] \cup \text{In}[B] \right) - \text{Use}[B] \]

All paths following \( p \) have seen the earliest placement of \( \text{atb} \) but not used

Don't want to postpone after use.
e.g.

Entry

Earliest placement

postponable (not including earliest)

at b

latest postponable / latest placement

Exit
Expression for computing the latest : complicated

latest placement $b =$
1. Used in $b$ OR
2. Not ok to place after
4. Clean up

\[
\begin{align*}
t &= a + b \\
c &= t
\end{align*}
\]

Similar to liveness

\[
\text{Kill} = \text{the latest placements} \\
\text{Gen} = \text{the use}
\]

Then we inline those temp variables if not live.
Sum up:

1. Anticipation:
   where can you possibly move the expr

2. Available:
   determine the earliest placement points
   (tricky off-by-one to achieve such an effect)

3. postponable:
   determine latest:
   postponable = have seen the earliest placements but not killed

4. Cleanup temp var (similar: liveness)