Effectively Effecting Effects

Examples of Effects
- I/O
- Variables
- Deterministic
- Random
- Exception
- Information flow

What is an effect?

A program snapshot can yield:
- Classification of programs beside input and output
- Cause and effect
- \( p \rightarrow p + \Delta \)
- Effect e

Effect System

A set of classifications of programs (i.e., a set of effects) and a description of interaction behavior of those classifications

Semantics for Effects: Heads (starting point)

Head is a factor \( M \) with:
- Unit: \( \pi \rightarrow M \)
- \( M \rightarrow M \)

Producer Effects

\( n \rightarrow \Delta \Rightarrow n \rightarrow n \rightarrow \Delta \)
Fusion propagates an effect

\[ 20 \div 2 + 5 \]

1 → 2 → 201 → 201 → 201

Jump propagates an effect

\[ 20 \div 2 + 5 \]

1 → 201 → 201 → 201

Overall effect is partial but doubly partial so we join

Unit causes pure progress into effective progress

\[ 20 + 5 \]

1 → 201 → 201

Associativity prevents this from being ambiguous

\[ 201 \rightarrow 201 \rightarrow 201 \rightarrow 201 \rightarrow 201 \]

\[ 2 \rightarrow 201 \rightarrow 2 \rightarrow 201 \rightarrow 201 \]

Need laws enable mixing

\[ f(0) = [2, 3, 3, 3] \]

\[ f(c), h(c) \]

\[ g(c) = [3] \]

\[ h(c) = [4, 5] \]

What about things such?

Only produces effects

Cannot express effects c for which
- pre-conditions should not have effect c
- w.c. condition killed by c should not have that c