

# Formalization of the IEEE 1800

## Determine phase

$$\begin{aligned} \text{determine}(o) &= \Gamma(o) \quad (\text{where } o \in \mathcal{O}) \\ \text{determine}(\text{BinaryOp}(e_1, e_2)) &= \max(\text{determine}(e_1), \text{determine}(e_2)) \\ \text{determine}(\text{UnaryOp}(e)) &= \text{determine}(e) \\ \text{determine}(\text{ComparisonOp}(e_1, e_2)) &= 1 \\ \text{determine}(\text{LogicOp}(e_1, e_2)) &= 1 \\ \text{determine}(\text{ReductionOp}(e)) &= 1 \\ \text{determine}(\text{ShiftOp}(e_1, e_2)) &= \text{determine}(e_1) \\ \text{determine}(\text{AssignmentOp}(l, e)) &= \phi(l) \\ \text{determine}(\text{ConditionalOp}(e_1, e_2, e_3)) &= \max(\text{determine}(e_2), \text{determine}(e_3)) \\ \text{determine}(\text{Replication}(n, e)) &= n \times \text{determine}(e) \\ \text{determine}(\text{Concatenation}(e_1, \dots, e_k)) &= \sum_{i=1}^k \text{determine}(e_i) \end{aligned}$$

## Propagate phase

$$\begin{aligned} \text{propagate}_e(\square) &= \text{determine}(e) \\ \text{For } e|_p = \text{ReductionOp}(e') : \\ \text{propagate}_e(p \cdot 0) &= \text{determine}(e') \\ \text{For } e|_p = \text{LogicOp}(e_1, e_2) : \\ \text{propagate}_e(p \cdot 0) &= \text{determine}(e_1) \\ \text{propagate}_e(p \cdot 1) &= \text{determine}(e_2) \\ \text{For } e|_p = \text{Concatenation}(e_0, \dots, e_k), \text{ with } i \in \{0, \dots, k\} : \\ \text{propagate}_e(p \cdot i) &= \text{determine}(e_i) \\ \text{For } e|_p = \text{Replication}(n, e') : \\ \text{propagate}_e(p \cdot 0) &= \text{determine}(e') \\ \text{For } e|_p = \text{ComparisonOp}(e_1, e_2) : \\ \text{propagate}_e(p \cdot 0) &= \max(\text{determine}(e_1), \text{determine}(e_2)) \\ \text{propagate}_e(p \cdot 1) &= \max(\text{determine}(e_1), \text{determine}(e_2)) \\ \text{For } e|_p = \text{BinaryOp}(e_1, e_2) : \\ \text{propagate}_e(p \cdot 0) &= \text{propagate}_e(p) \\ \text{propagate}_e(p \cdot 1) &= \text{propagate}_e(p) \\ \text{For } e|_p = \text{UnaryOp}(e') : \\ \text{propagate}_e(p \cdot 0) &= \text{propagate}_e(p) \\ \text{For } e|_p = \text{ShiftOp}(e_1, e_2) : \\ \text{propagate}_e(p \cdot 0) &= \text{propagate}_e(p) \\ \text{propagate}_e(p \cdot 1) &= \text{determine}(e_2) \end{aligned}$$

For  $e|_p = \text{ConditionalOp}(e_1, e_2, e_3)$ :

$\text{propagate}_e(p \cdot 0) = \text{determine}(e_1)$

$\text{propagate}_e(p \cdot 1) = \text{propagate}_e(p)$

$\text{propagate}_e(p \cdot 2) = \text{propagate}_e(p)$

For  $e|_p = \text{AssignmentOp}(l, e')$ :

$\text{propagate}_e(p \cdot 0) = \max(\text{determine}(e'), \phi(l))$