Logic Programming

- Logic Variables
- Unification (==)
- Logic operators ('and' and 'or')
- Axioms — ('succ' and 'fail')

E = X | [illegible] | b

P = (== E E) | (∧ P P) | (∨ P P) | S | F | (¬ P)

M : P → (bool) ← wrong model

M(F) = F

M((∧ S (== S S))) = T

M((∨ F (== X 5) (== Y 7))) =

M((∨ (== X 5) (¬ (== X 5)))) = T

⊥
∅
[X ↦ 5]
[Y ↦ 7]

M : P → (X ↦ b) ∪ ⊥

M : P → list (map X b)

C : P → ISWIM + callcc, ⇝ accept a "failure" continuation and return a "next success" continuation

C(fail) = λfk. (fk 'failed)

C(succ) = λfk. fk

C(and P1 P2) = λfk. (P2 (P1 fk))

C(or P1 P2) = λfk. (P1 (λ_. (P2 fk)))

C(== b1 b2) = C(succ) if b1 == b2
C(fail) if b1 ≠ b2

C(== X Y) = λfk. C(== (lookup X) (lookup Y)) fk
if X & Y are bound

C(== X E) = λfk. (bind! X E) (λ_. (unbind! X) (fk 'fail))
if X is unbound

Error-free Programming

Error?

- Syntax errors: "$(\lambda x.)\ 5$"
- Stuck term: $((\lambda x.\ (5\ \ 7))\ 8)$ $\quad E = (E\ E) \mid b \mid \ldots$

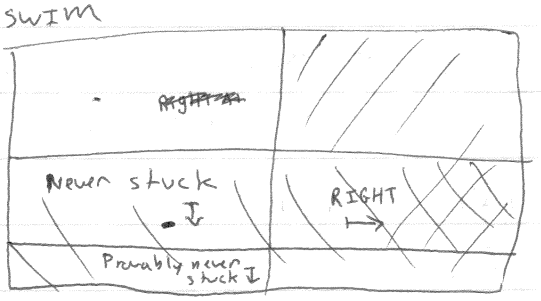
  $((\lambda x.\ (x\ 7))\ 8)$

  $(\lambda x.(x\ 7))((if\ \ P\ \ (\lambda x.x)\ \ 8))$
- Wrong answer: $(\lambda x.\ x + 5)$ (wrong) $\quad (\lambda x.\ x * 5)$ (right)

Does this program have an error?

- wrong answer: support program comparison ($=$, $\simeq$, $\leq$)
  - ↳ need a 2nd program
- stuck term: don't need 2nd
  - build an algorithm to predict

ISWIM



$(\lambda x.$
$\quad (x\ 7))$
$(if\ \ Collatz$
$\quad (\lambda x.x)$
$\quad 8))$