UNIFIED SOLVER STRATEGY FOR FLOATING-POINT

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GOAL

To come up with a strategy for solving Floating-Point Arithmetic formulas that takes into account:

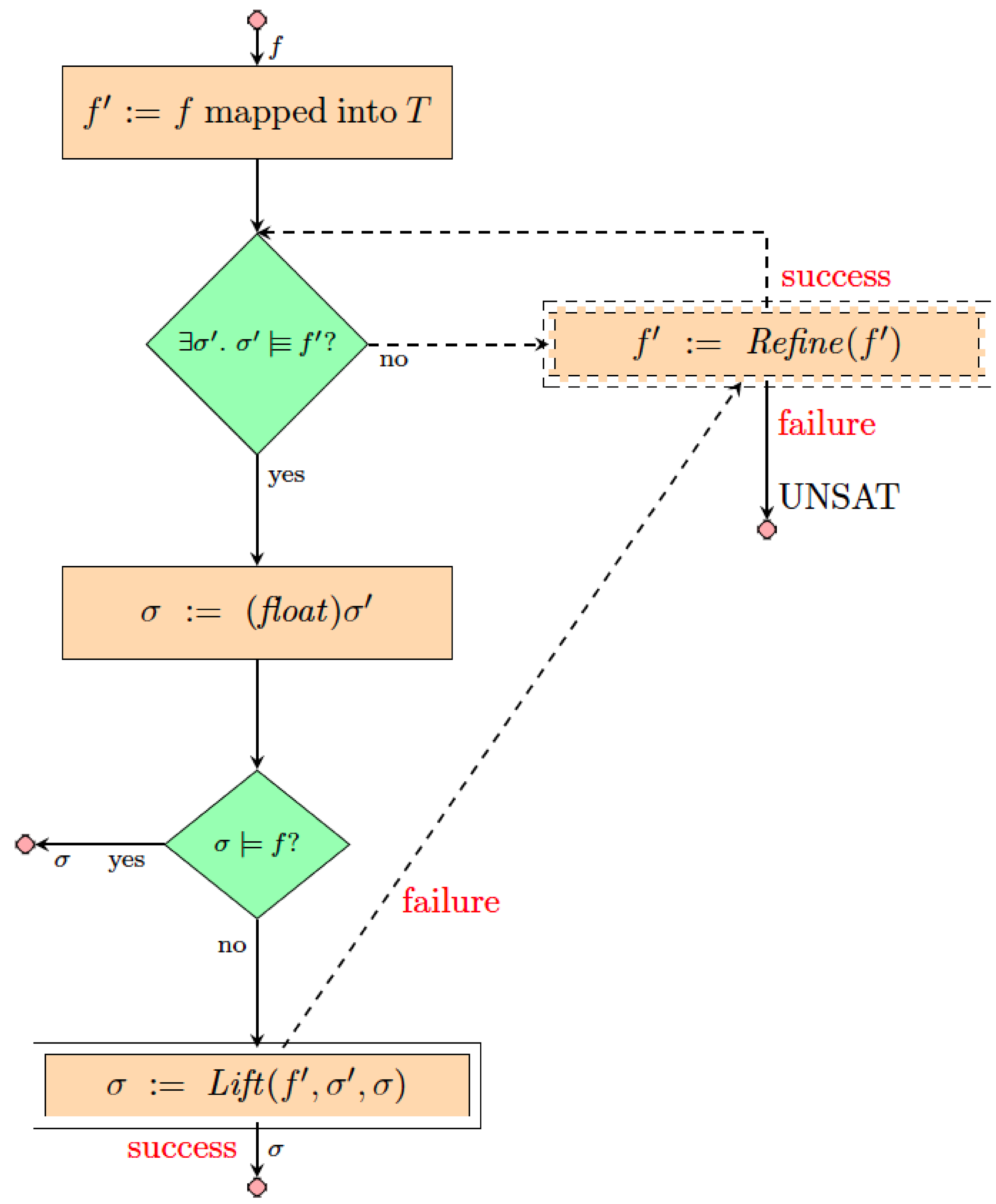
- Nature of input formulas (e.g., complexity)
- Applicability of abstractions
  - ⋆ Performance of "proxy theories"

EXAMPLES

- Linear with arithmetic operations reordered
  $|(x + (y + z)) - ((x + y) + z)| > \epsilon$
- Non-linear
  $10.25 \leq x^2 + y^2 \leq 10.5$
- Non-linear with arithmetic operations reordered
  $|(x + y)^2 - ((x^2 + (2 * x) * y) + y^2)| > \epsilon$

May need different strategies to solve!

MODEL LIFTING ARCHITECTURE



SOLUTION: UNIFIED STRATEGY

Require: f: FPA formula
if $Linear(f)$ **then**
  return MOLLY$^{\text{MRFPA}}$(f) // mixed real-float reasoning
$result$:= MOLLY$^{\text{RA}}$(f) // pure real abstraction
if $result \neq$ `failed` **then**
  return $result$
$result$:= MOLLY$^{\text{dREAL}}$(f) // numerical solving
if $result \neq$ `failed` **then**
  return $result$
return MOLLY$^{\text{RPFPA}}$ // reduced precision

MOLLY CONFIGURATIONS

Spec \ Name	MOLLY$^{\text{RA}}$	Lazy REALIZER	MOLLY$^{\text{MRFPA}}$	MOLLY$^{\text{dREAL}}$	MOLLY$^{\text{RPFPA}}$	APPROX
Proxy theory	RA	RA	RA	Reals + δ-sat	RPFPA	RPFPA
Proxy solver	Z3	REALIZER++	REALIZER++	dREAL	MATHSAT	MATHSAT
Lifting?	✓	×	✓	✓	✓	×
Refinement?	×	✓	✓	×	✓	✓

Experimental evaluation indicates there is no clear winning configuration across all formulas.
Hence the need for a unified strategy.