A Hiproof Interface for Viewing and Constructing Proofs

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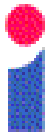
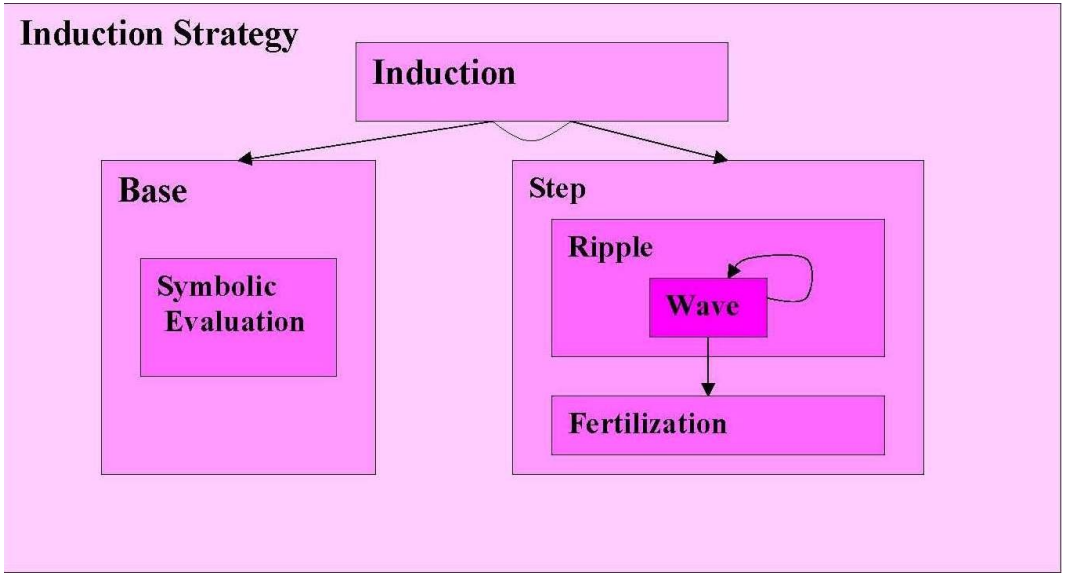


Outline

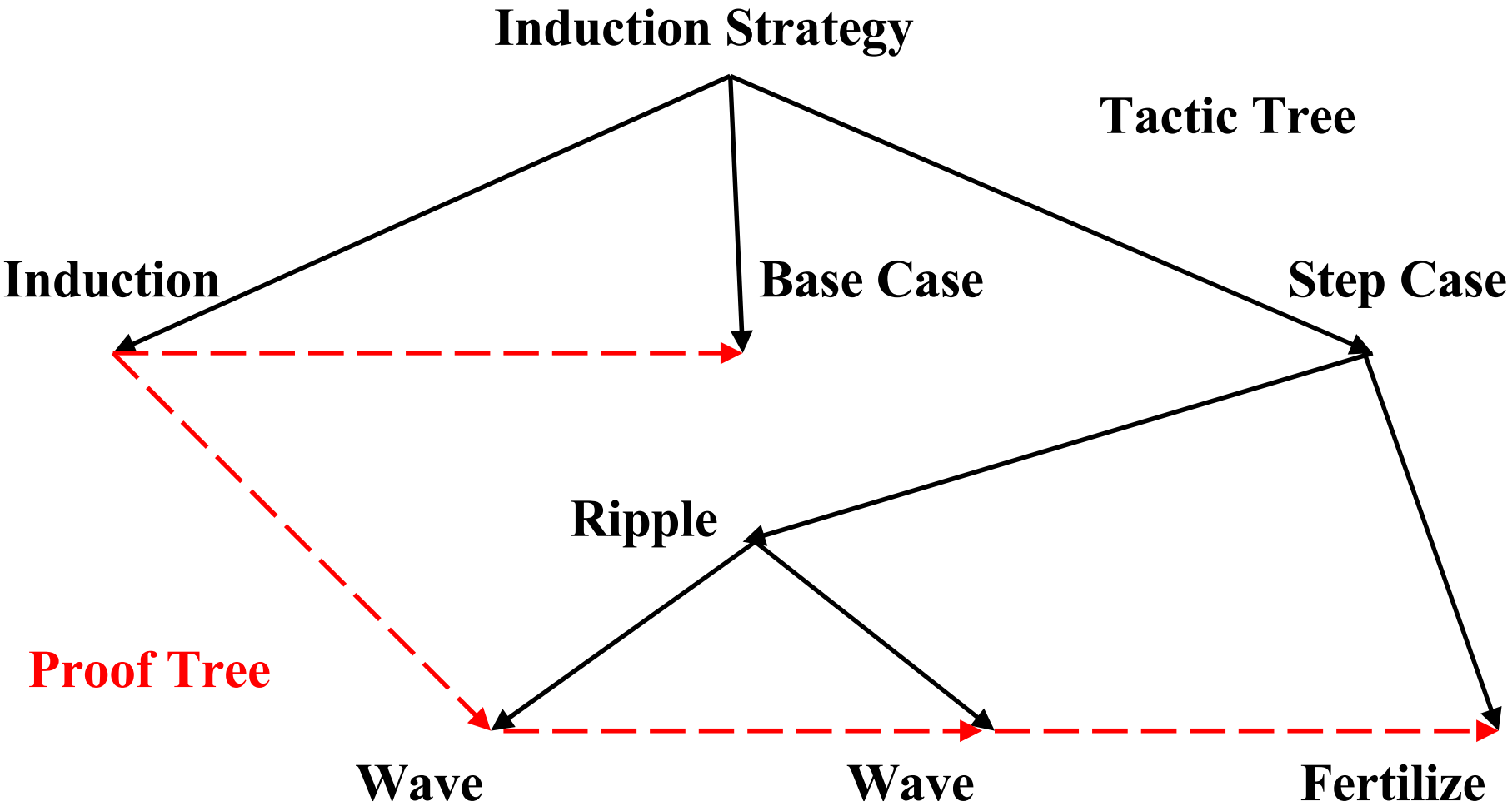
- What are hiproofs?
- Viewing large proofs.
- Top-down proof construction.

•What are Hiproofs?

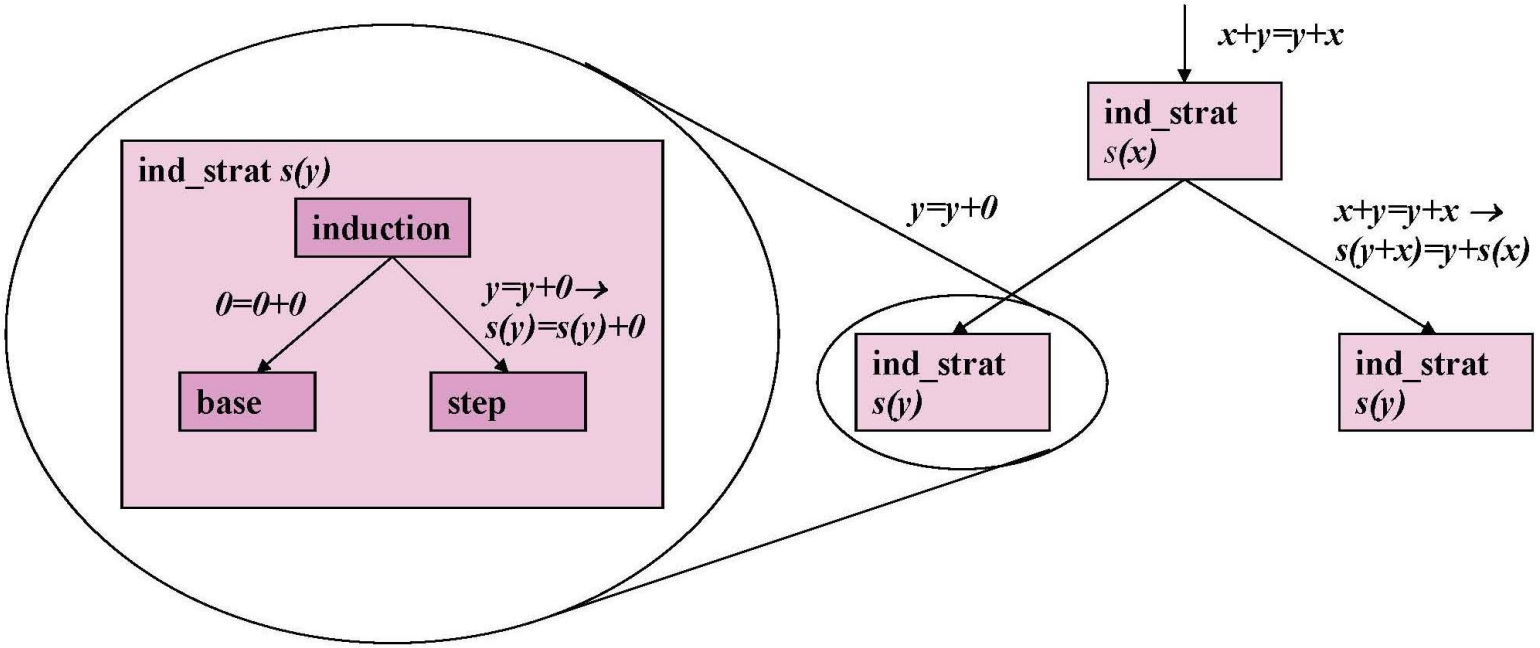


- **Higraphs**: graphs whose nodes are higraphs.
- **Hiproofs**: use of higraphs to represent proofs.
- **Nodes** represent tactics; **arcs** represent proof structure.

Two kinds of hierarchy



Viewing Proof at Different Levels of Detail



Zoom in and out of proof

Motivation

- Need to construct very large proofs:
  - four colour theorem, Kepler conjecture, classification of finite simple groups, Fermat's last theorem.
- Need to view such proofs in varying levels of detail.
- Need to construct such views in modular fashion.
- Graphics is congenial vehicle for understanding.

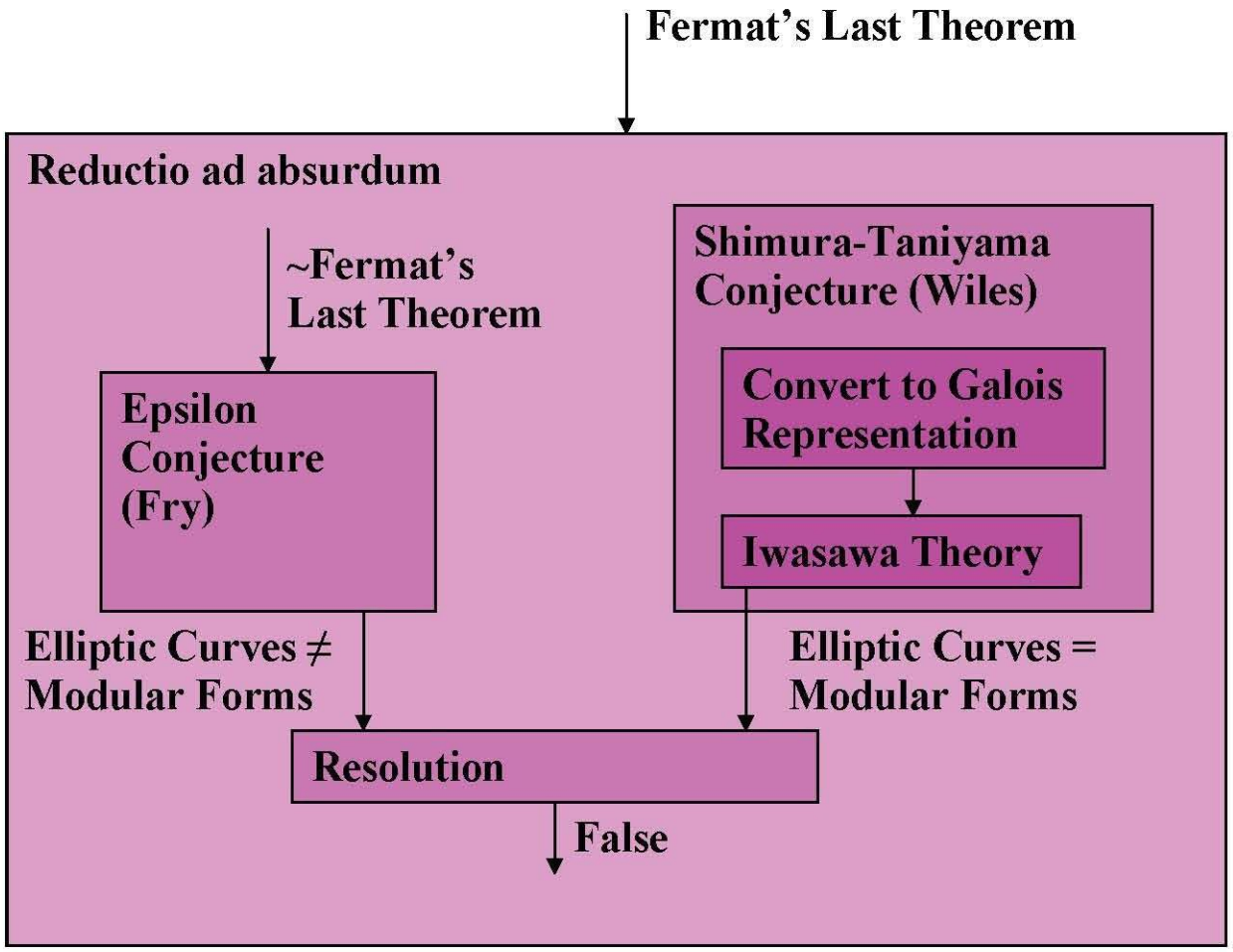
History

- Bundy & Ireland used box diagrams informally to describe proof plans.
- Denney, Power and Tourlas developed hiproof theory.
- Various hiproof viewers developed for Dixon's IsaPlanner.
- Aspinall, Denney & Lüth developed Hitac language and semantics.
- Plan to use hiproof proof constructor.

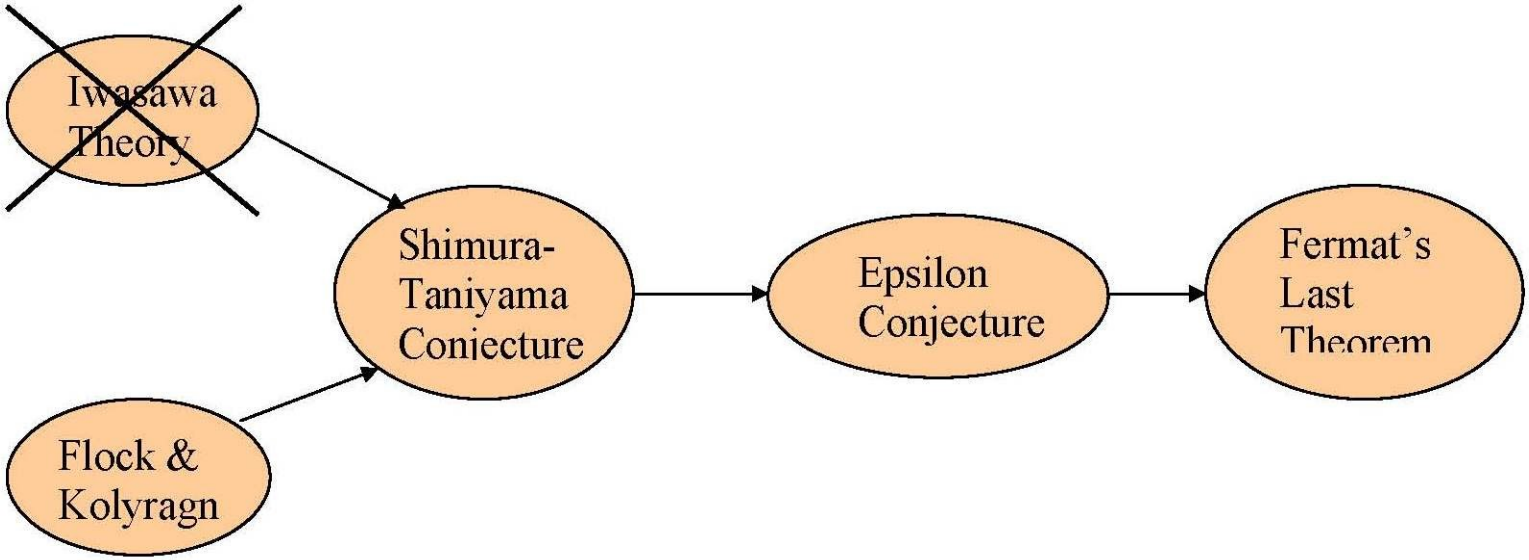
Hiproof Construction

- Sketch out high-level structure of as top-level hiproof.
- Incrementally unpack boxes.
  - Using existing tactics or rules.
  - Postulating new proof-specific tactics.
- Use partial hiproof as record of proof state.
- Prove theorem.
  - Run existing tactics on subgoals.
  - Manual proof of outstanding subgoals.
  - Appeal to 3rd party theorems as ‘axioms’.

Fantasy: Fermat's Last Theorem



Wiles Own Graphic



Note different semantics of arcs:

Containment *vs* implication

Conclusion

- Hiproof graphic can assist with viewing, understanding and constructing proofs.
- Compatible with tactic-based provers.
- Implement hiproof viewer in Proof General.
- Extend to top-down hiproof constructor.
- Evaluate on large proofs.
- Connected to PhD of Iain Whiteside.