

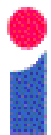
# Explicit vs Implicit Search Guidance



Alan Bundy

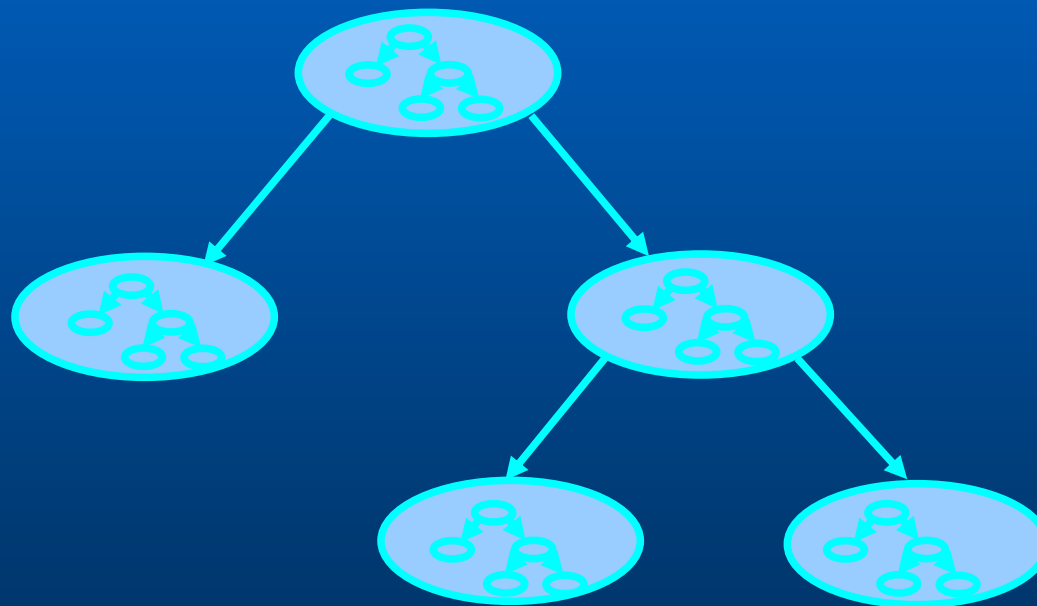
School of  
**informatics**

University of Edinburgh



# Explicit Guidance: Proof Plan

- Outline that guides proof search.



# Implicit Guidance: Provide Lemmas

- Lemma invention is main barrier to automation.
- Modern provers have sophisticated methods for exploiting lemmas,
  - e.g., various rewrite rules sets.
- Trust prover to find appropriate use.
- Generate lemmas in anticipation?
- Or analyse proof failure to suggest them?

# Tradeoffs

- **Explicit strategy provides more control,**
  - But may be too rigid.
- **Implicit strategy more flexible,**
  - But may provide insufficient guidance.
- **Are lemmas enough information to guide proof?**
- **Can we anticipate the missing lemmas?**

# Theory Exploration at Edinburgh

- Forward generation easy – but what is interesting enough to keep?
- MATHsAiD (Roy McCasland):
  - Must not have trivial proof.
- IsaCoSy (Moa Johansson):
  - Generates only normalised terms.
- IsaScheme (Omar Montano Rivas):
  - Instantiates higher-order schemas.

# Yuhui Lin's AI4FM Project

- Translate EventB invariant POs to Isabelle.
- Use IsaScheme to generate lemmas.
  - Currently limited to non-conditional equations.
- Uses standard schemes,
  - e.g., associativity, distributivity.
- Hope to anticipate lemmas needed in PO proof.
  - e.g., as wave-rules in rippling.

# Proof Strategy Transfer

- Consider two theorems with similar proofs.
  - Perhaps first is ‘toy’ version of second.
- Prove source theorem interactively.
- Suppose new lemma is required.
- Abstract this lemma to construct schema.
- Apply IsaScheme to this schema in theory of target theorem.
- Hope to generate lemma required in target proof.

# Conclusion

- Can we provide enough guidance without over-specification?
- Is providing missing lemmas enough?
- Can we find the right lemmas?
  - In advance? After failure analysis?
  - Of sufficient complexity?