SE 2F03 Fall 2005

06 Epilogue

Instructor: W. M. Farmer

Revised: 5 December 2005

What is Logic?

- Study of the principles underlying sound reasoning.
  - Central idea: **logical consequence**.
- Branch of mathematics.
- Makes explicit several fundamental distinctions:
  - **Syntax** vs. **semantics**.
  - **Language** vs. **metalanguage**.
  - **Theory** vs. **model**.
  - **Truth** vs. **proof**.
- Principal tools: formal systems called **logics**.

The Different Kinds of Logics

- **General purpose** vs. **special purpose**.
  - FOL and STT are general purpose.
  - PROP, LTL, and Hoare logic are special purpose.
- **Theory oriented** vs. **practice oriented**.
  - FOL is theory oriented.
  - STT and the IMPS logic are practice oriented.
- **Two-valued** vs. **multi-valued**.
  - PROP, FOL, LTL, and STT are two-valued.
- **Classical** vs. **constructive**.
  - PROP, FOL, LTL, and STT are classical.

Mathematical Problems: Fundamental Form

- Most mathematical problems can be expressed as statements of the form

  $$T \models A$$

  where T is a theory and A is a formula.

- There are three basic ways of deciding whether or not $T \models A$:

  1. **Model checking**: Show that $M \models A$ for each model M of T.
  2. **Proof**: Show $T \vdash_{\mathbf{P}} A$ for some sound proof system **P**.
  3. **Counterexample**: Show $M \models \neg A$ for some model M of T.

Conclusion

- Logic is to Software Engineering what calculus is to other areas of Engineering.

- Logic is the intellectual technology that Software Engineers use to create, analyze, interconnect, and implement precise specifications and descriptions of software systems.

- Software Engineers need logic to:
  - Communicate their ideas precisely.
  - Show that software they develop is correct.