

Verification requires familiarity with logic

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• Verification: Analytical way of establishing correctness (code meets spec.)
⇒ Need to analytically reason about properties of code

• Logic: Precisely the science of reasoning.
(We use logical arguments to reason about our environment on a day-to-day basis)

• Reasoning involves deduction (and induction) from known facts (knowledge)

⇒ Need to represent knowledge / facts, and
Need techniques for deduction (reasoning) (and induction) (learning)

• Logic provides framework for reasoning

Knowledge represented as axioms
deduction performed through rules of inference

• Using deductions new facts can be established (called theorems)

• Examples: All pirates are thieves. No thieves are reliable. (Axioms)
No pirates are reliable. (Theorem)

$$(P \Rightarrow T) \wedge \neg (T \wedge R) \equiv (P \Rightarrow T) \wedge \underbrace{(\neg T \vee \neg R)}_{T \Rightarrow \neg R} \equiv (P \Rightarrow \neg R) \equiv \neg(P \wedge R)$$

• Example: Arithmetic logic can be used to prove $\sum_{k=1}^n k = \frac{n(n+1)}{2}$.

$$\left. \begin{array}{l} x > y \Rightarrow z := x - y \\ y > x \Rightarrow z := y - x \\ y = x \Rightarrow z := x \end{array} \right\} \Rightarrow z = \text{gcd}(x, y)$$

This can be proved using logical reasoning called thm. proving.