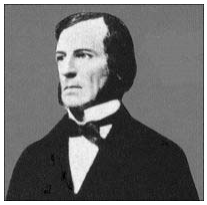
- 1815-1864
- English Mathematician
- His *The Mathematical Analysis of Logic*, 1848 is the first contribution to symbolic logic
- In this book he introduced what is today called Boolean Logic (or Algebra)
  - JT: Boolean (True, False outcome)



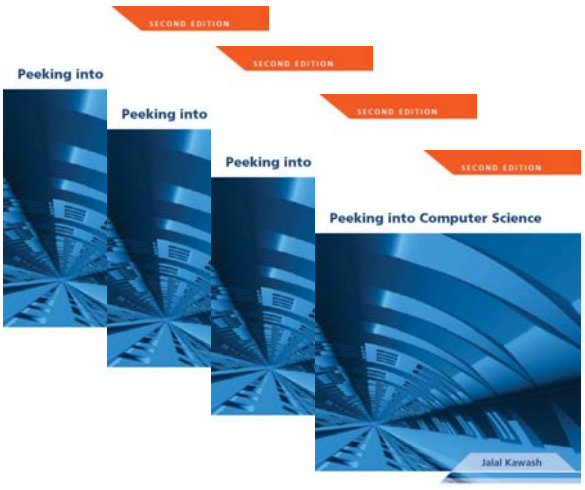
George Boole

Logic

Peeking into Computer Science

- Mandatory: Chapter 2 – Section 2.2

Reading Assignment



Predicate Logic

By the end of this section, you will be able to:

1. Define a predicate
2. Understand universal and existential quantifiers
3. Use quantification to convert a predicate to a proposition
4. Work with quantifier equivalence rules

Objectives

- Proposition: a declarative sentence that is either true or false, but not both.[1]
  - Example propositions
    - 3 > 4
    - 4 > 3

JT: True/False clear cut

1) "Peeking into Computer Science" (2nd Ed) Kawash J.

JT's Extra: Review

- Predicate: a proposition where the value of a variable is unknown.
  - Example predicate
    - P(X): X > 0

JT: True/False "it depends"

JT's Extra: New Material

- X > 3
  - Is not a proposition
- X is taller than Y
  - Is not a proposition
- These are predicates
- P(X): X > 3
- Q(X,Y): X is taller than Y

Predicate Logic

- Predicates can be made propositions by
  1. Substituting values for the variables
     - P(X): X > 3, P(4) is true, P(-1) is false
     - Q(X,Y): X is taller than Y, Q(Debra, Doug)

  OR
  2. Binding the variable with a quantifier
     - Universal Quantifier ∀x P(x)
       - P(x) is true for all x in the universe of discourse
     - Existential Quantifier ∃x P(x)
       - P(x) is true for at least one x in the universe of discourse

Quantification

- Universe of discourse: this 203 class
- P(x): x is female

- ∀x P(x) :
  - All students in this class are female
- ∃x P(x)
  - There is at least one student in this class who is female

Quantification Examples

Quantification Examples

- Universe of discourse: all earth creatures
- M(x): x is a monkey
- F(x): x lives in a forest

- Express: some monkeys live in forests
- $\exists x\ (M(x) \wedge F(x))$:
  - At least some monkey lives in a forest

Quantification Examples

- Universe of discourse: all earth creatures
- M(x): x is a monkey
- F(x): x lives in a forest

- Express: all monkeys live in forests
- $\forall x\ (M(x) \wedge F(x))$: X
  - All earth creatures are monkeys and live in forests
- $\forall x\ (M(x) \rightarrow F(x))$:
  - From all creatures if x is a monkey, then x lives in a forest

- $\forall x\ P(x)$ is equivalent to $\neg\ [\exists x\ \ \neg\ P(x)]$
  - All monkeys are black
  - There is no one monkey which is not black
- $\exists x\ P(x)$ is equivalent to $\neg\ [\forall x\ \ \neg\ P(x)]$
  - There is at least one student who likes the course
  - It is not the case that all students do not like the course

Quantifier Equivalence