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Homework 1

CIS-623 structured programming & formal methods

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Question 1:

Consider the following logic:

Syntax: A wff can be defined using the following BNF rules.

• Φ ::= p | (Φ + Φ) | (¬ Φ)

• p is propositional symbol representing a proposition from the set of propositions {p1, p2, p3, …}

Semantics:

• A proposition can map to “true” or “false”

• “¬” is interpreted as “negation” (¬true = false; ¬false = true)

* 1. • “+” is interpreted as “exclusive or”
  2. o true + true = false
  3. o false + false = false
  4. o true + false = true
  5. o false + true = true

Which strings are well-formed formulas (wff’s) in this logic?

1. is a well-formed formula according to the BNF rules.
2. is a wff.
3. is not a wff because the exclusive or operator is defined as a binary operator in the BNF rules. The proposition on the left-hand side is missing.
4. is a wff.
5. is not a wff because there is a missing set of parentheses.
6. is not a wff. The negation symbol should be inside the parentheses.
7. is not a wff. There is a missing closed parenthesis.
8. is a wff.

Question 2:

Let us assume that unary operator ¬ has higher precedence than + operator, and + is a left associative operator. What are the fully parenthesized versions of the following wffs?

Question 3:

Axioms are the formulas that are regarded to be true in the logic. Can you give three axioms in this logic? (using schemas - generic versions of formulas)

The following three axioms are formulas that are valid (always true).

Question 4:

Can you give some inference rules in this logic? (using schemas generic versions of formulas)

Rule 1:

Rule 2:

Rule 3:

Rule 4:

Rule 5:

Rule 6:

Rule 7:

Question 5:

Can you give a proof p3 from p1, p1+p2, p2+p3 using the inference rules from question 4?

1. (premise)
2. (premise)
3. (premise)

Question 6:

Is a logical consequence of and ?

⊨ ?

|  |  |  |  |
| --- | --- | --- | --- |
| Model Number |  |  |  |
| 1 | F | F | F |
| 2 | F | T | T |
| 3 | T | F | T |
| 4 | T | T | F |

From the above truth table, only Model 3 satisfies the given premises that and are both true. In this model, is false. Therefore, is true.

is a logical consequence of and .

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